REPORT

Mary River Project

2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program

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EXECUTIVE SUMMARY

In 2019, Baffinland Iron Mines Corporation (Baffinland) undertook a fifth consecutive year of environmental effects monitoring (EEM) at Milne Port as part of the Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) monitoring program for the Mary River Project. This report reflects concordance with Project Certificate (PC) No. 005 issued by the Nunavut Impact Review Board to Baffinland for Condition No. 76, which stipulates "*The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment*", No. 87 "*The Proponent shall develop a detailed monitoring program at a number of sites over the long term to evaluate changes to marine habitat and organisms and to monitor for non-native introductions resulting from Project-related shipping*", and No. 126 "*The Proponent shall design monitoring programs to ensure that local users of the marine area in communities along the shipping route have the opportunity to be engaged throughout the life of the Project in assisting with monitoring and evaluating potential Project-induced impacts and changes in marine mammal distributions*". In addition, eight other PC conditions are addressed in this report, and each will be identified within the relevant section.

Marine Environmental Effects Monitoring Program

The MEEMP was developed in 2015 following completion of marine baseline studies in Milne Port during 2013 and 2014. Study components for the 2019 MEEMP included marine water quality; physical oceanography; hydrology and geomorphology; sediment quality; benthic infauna[1]; substrate, macroflora and benthic epifauna[2]; fish; and tissue chemistry. The MEEMP sampling design is based on the Metal Mining Technical Guidance for Environmental Effects Monitoring (Environment Canada 2012) and includes statistical approaches to detecting potential Project-induced impacts on the marine environment. In general, the MEEMP study design and data collection methodology followed the same approach utilized in previous years, in addition to modifications made in 2018, to provide technical continuity and repeatability of the program and to allow for inter-annual comparisons of the multi-year dataset.

Several program modifications were introduced in 2019 in consultation with the Marine Environment Working Group (MEWG) in order to improve ability to detect potential Project-related changes through time. Modifications included (i) increased spatial coverage of vertical physical profiles of water quality parameters, including samples taken north of Ragged Island, in Eclipse Sound; (ii) a background review of potential sea level rise in Nunavut to complement empirical measurements of water levels; (iii) a background review of hydrology and geomorphology in Phillips Creek Estuary to assess the potential for natural sediment redistribution at the head of Milne Inlet; (iv) increasing sampling intensity for benthic infauna and sediment from four transects with 5 stations to five transects with 15 stations each to improve statistical power; (v) adding sculpin (*Myoxocephalus* sp.) to fish tissue sampling; (vi) introduction of fyke nets to the fish sampling program to assess its potential as a replacement for Fukui trapping; and, (vii) submission of *Hiatella arctica* specimens for age analysis in addition to the tissue (body burden) analysis.

Marine Water Quality

To satisfy PC Conditions No. 89 and 99(a), the marine water quality component involved the collection of discrete water quality samples at four sampling stations near the effluent discharge point in Milne Port (distributed in a radial design) to monitor for potential changes in water quality due to site drainage and operational discharges (including iron ore stockpile run-off). **Overall, results indicate that the construction and operation of Milne Port does not**

[1] Infauna – organisms living in the substrate of the seafloor (e.g. polychaete worms, clams).
[2] Epifauna – motile and sessile organisms living on the seafloor substrate (e.g. sea stars, crab).

appear to have negatively affected water quality to date, as measured concentrations were generally consistent with previous years, and within thresholds in the CCME water quality guidelines for the protection of marine aquatic life.

In 2019, reported analytical results for conventional water quality parameters — major ions, nutrients, metals, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs) — were generally within ranges observed during previous MEEMP sampling programs (2015 to 2018) and no exceedances of Canadian Council of Ministers of Environment (CCME) water quality guidelines were noted. Hydrocarbons and PAHs were measured at concentrations less than analytical detection limits in 2019, consistent with results from previous programs. Collectively, measured concentrations of metals and organics were either not detected or were present at low concentrations, such that adverse impacts to the biota inhabiting Milne Inlet are not expected.

Increased iron deposition in the marine environment as a result of the Project is an issue of concern for local Inuit. Since CCME marine water quality guidelines for iron have not been developed, the MEEMP compared 2019 data to those collected during previous MEEMP programs performed between 2015 and 2018 to investigate whether changes in effluent quality have been observed over time. Lab analyses showed that levels of iron in water samples collected in 2019 are within the range of concentrations observed between 2015 and 2018.

The fecal coliform bacteria results in 2019 indicated that fecal coliform concentrations were mostly below detection limits and did not exceed 2 CFU/100 mL, suggesting that the treated effluent discharge collection system is effective at limiting ingress to the marine environment.

Physical Oceanography

The physical oceanography component involved several different field and desktop studies. Sampling was conducted vertically throughout the water column to characterize features and monitor for annual changes, satisfying PC Condition No. 89. Water column parameters, such as conductivity, temperature, dissolved oxygen, turbidity and chlorophyll-a, were measured at sampling stations in Milne Inlet, between Milne Port and Eclipse Sound. Additionally, continuous monitoring of other physical parameters, such as current speed and water levels, was conducted at three locations in Milne Inlet, two near Milne Port and one at Bruce Head, in part to provide additional empirical data for validating the ballast water dispersion model. Lastly, to satisfy PC Conditions No. 1 and 83, multi-year water level data from the Milne Port tide gauge was used in combination with literature review of sea level rise and land uplift/subsidence rates in Nunavut to assess the potential for sea level rise near Milne Port.

An analysis of multi-year tide gauge data indicated no discernible trend (positive or negative) in sea level rise in the three year water level dataset for Milne Port Ore Dock tide gauge. Literature review of land uplift/subsidence rates in Nunavut indicates that the Milne Port area will undergo land uplift (glacial rebound) in the next 100 years, effectively lowering the sea levels by approximately 64 cm to 74 cm.

Measurements of current speed and direction in Milne Inlet, near Bruce Head and Milne Port, indicate flows are weak (i.e., <15 cm/s), primarily wind driven, and oriented along the channel. The relation of current speed to wind events suggest that the upper water column in Milne Inlet is mixed primarily by winds. Vertical profiling of the water column showed seasonal differences in stratification – a feature which refers to the division of the water column into layers with different densities caused by differences in temperature or salinity, or both. Stratification is important because it inhibits vertical transfer of dissolved chemicals and particulates between layers and thus affects how, for example, nutrients are distributed between surface and bottom waters. At the Ore Dock, fluctuations in salinity from near zero to estuarine suggest that Phillips Creek and other sources of freshwater inflows (e.g., melting sea ice) form a freshwater lens at the head of Milne Inlet each summer, which persists until inflows weaken around late August. Freshwater inflow is an important factor in establishing stratification (i.e., little mixing between surface and deeper waters) in Milne Inlet each year, persisting throughout the entire inlet, with the lower bound of the pycnocline (area of greatest temperature and salinity change) approximately 20 m deep. Following the establishment of stratification, oscillations in temperature and salinity measurements at mid-water column near Milne Port suggest that winds play a large role in surface mixing. Below the pycnocline, the temperature and salinity in Milne Inlet is generally constant.

Turbidity is another important aspect of water quality because it can negatively impact aquatic life. For example, high turbidity levels can block light to aquatic plants or smother aquatic organisms. Vertical profiling indicated that overall, the water in Milne inlet was fairly clear throughout the water column; turbidity levels were slightly elevated at the surface, likely due to freshwater input and surface run-off and also towards the bottom, possibly due to the proximity of the instrument to seafloor sediment. Dissolved oxygen (DO) indicates the amount of oxygen in water available to living aquatic organisms. The DO concentrations are constantly fluctuating, influenced by processes such as diffusion and aeration, photosynthesis, respiration and decomposition. In Milne Inlet in 2019, DO concentrations ranged from 6.6 mg/L to 12.2 mg/L, corresponding to saturations ranging from 57% to 104%, indicating that oxygen is generally available within ranges that support ecological productivity.

Chlorophyll-a is a photosynthetic pigment and, in marine systems, measures the amount of algae, specifically phytoplankton, growing in the water. It is an important water quality parameter because too much algae in the water can be a sign of eutrophication, which can negatively affect ecosystems through, for example, hypoxia, toxic algal blooms, and foam events (Perez-Ruzafa et al. 2019). Typically, for the Arctic Ocean, low surface chlorophyll-a is indicated by concentrations of 0 mg/m^3 to 0.7 mg/m^3 and high surface chlorophyll-a is indicated by concentrations 0.7 mg/m^3 to 30 mg/m^3 (Ardyna et al. 2013). In Milne Inlet in 2019, chlorophyll-a concentrations were on the lower side, ranging from 0 mg/m^3 to 0.9 mg/m^3, showing evidence of primary productivity with little risk of eutrophication.

Hydrology and Geomorphology

The hydrology and geomorphology component involved a desktop review of available data for Phillips Creek (i.e., review of literature, historical imagery, and hydrological and sediment data), in order to characterize natural sedimentation patterns and depositional variability in the delta at the head of Milne Inlet. This was done to satisfy PC Condition No. 83(a), which stipulates identification and monitoring the effects of sediment redistribution associated with the construction and operation of Milne Port. **Overall, results indicate that the construction and operation of Milne Port does not appear to have negatively affected hydrology and geomorphology to date, as measured parameters were generally consistent with previous years, or were within the range of natural variability.**

Results indicate that the Phillips Creek delta is a dynamic environment characterized by spatial and temporal variability in sediment deposition. Like typical Arctic streams, most sediment transport on Phillips Creek occurs during the spring freshet, with summer rainstorms triggering additional pulses of transport. The amount and size of sediment routed down the river channel and deposited on the delta every year depends on a variety of factors, including the amount of snowpack, the magnitude and duration of the snowmelt period, and sediment supply from stream banks, slope failures, and other sources. The size of sediment collected along the West Transect from 2014-2017 as part of the MEEMP sampling program has been variable over time; results of this review suggest this is unlikely a result of Milne Port activities but, rather, a trend expected in a naturally dynamic depositional environment. Additionally, movement of Phillips Creek over time is apparent on the historical imagery. Channel migration between 1982 and 2016 was observed on the segment of Phillips Creek stretching from the mouth approximately 2.5 km upstream. A shift of the primary channel from the eastern to the western end of the delta appears to have resulted in the westward progression of a nearby spit.

Marine Sediment Quality

The sediment quality component satisfies PC Conditions No. 83(a) and 99(a) and involved collection of sediment samples along four transects, including three transects (West, East, and Northwest) surveyed in previous years (2014-2018) in addition to the creation of a new Northeast transect to account for potential future changes to Milne Port infrastructure. The radial gradient sampling design enables monitoring effects as a function of distance from the Ore Dock (potential point source), in consideration of potential contaminant issues (e.g., ore dust, hydrocarbon deposition) and/or physical impacts (sediment re-suspension and transportation) in the marine environment. **Overall, results indicate that the construction and operation of Milne Port does not appear to have negatively affected sediment quality to date, as measured parameters were generally consistent with previous years, within thresholds in the interim CCME sediment quality guidelines, or not attributable to Project activities.**

Analysis of the physical and chemical composition of sediments were conducted on samples collected from a total of 44 stations, as well as at two additional non-transect stations added for consistency to previous MEEMP programs. In general, concentrations of metals, volatile organic compounds, hydrocarbons, and polycyclic aromatic hydrocarbons were determined to be less than applicable sediment quality guidelines, with few exceptions. Statistical correlation analysis of spatial trends did not suggest that sediment metal concentrations were accumulating at elevated levels in closer proximity to the Ore Dock relative to other locations sampled within Milne Inlet.

Minor exceedances of sediment quality guidelines were noted for arsenic and nickel but are not considered to be Project-related, as these metals tended to increase with greater distance away from the Ore Dock. Similarly, exceedances were noted for a few organic constituents, but these were rare, small in magnitude (i.e., not considered to be at levels that would represent harm to the aquatic environment), and were not concentrated around the Ore Dock in a way that would suggest a significant point source.

Sediment grain size, particularly the percentage of fines, is an important measure of sediment quality because metals tend to accumulate to a greater degree in finer sediments as a result of both physical and chemical factors (e.g., increased surface area to volume ratio). Comparison of the percentage of fine sediment over time along the transects did not indicate statistically significant changes in fines content between 2014 and 2019.

Importantly, increased iron content in sediments – flagged as of concern to local Inuit due to the potential for increased deposition of iron ore in the form of dust or in runoff from storage stockpiles as a result of the Project – were rarely observed at concentrations greater than those observed during the 2014 baseline characterization program.

Benthic Infauna

To satisfy PC Condition 99a, c, the benthic infauna component involved collection of samples from 32 stations along four transects (East, West, Northeast and Northwest), each co-located with a sediment sampling station. Samples were collected as a composite of three grabs from each station, using a standard Ponar or Van Veen grab, and sent to Biologica Environmental Services for sorting and taxonomic identification (to the lowest practical taxonomic level). **Overall, the results of the benthic infauna survey in 2019 indicated that construction and operation of Milne Port does not appear to have negatively affected benthic infaunal communities, which continue to be diverse and well established.**

Sampling in Milne Inlet revealed a high degree of spatial variability in invertebrate community indices, which is common in marine benthic habitats. Invertebrate density and richness were not significantly lower in 2019 relative to 2018 and, where a statistically significant difference was identified, 2019 values were greater. Furthermore, there were no indications of compromised functional status of the communities located closer to the Ore Dock, as each of the sites generally had strong representation of major taxonomic groups and similar relative proportions of major taxa (i.e., polychaetes, bivalves, malacostracan crustaceans, and ostracods).

Substrate, Macroflora & Benthic Epifauna

The study of substrate, macroflora, and benthic epifauna fulfills PC Condition No. 99a,c and consisted of underwater video monitoring within ten belt transects permanently installed on the sea floor; five transects were established in the Project exposure area and the other five in a nearby reference area. Underwater video was post-processed by a qualified marine biologist and analyzed to record percent (%) cover of substrate type and benthic macroflora, according to the classification system outlined in the 2017 MEEMP report (Golder 2018), as well as taxonomic identification of benthic epifauna down to the lowest practical taxonomic level and their abundance (counts and % cover). **Overall, the results of the substrate, macroflora and benthic epifauna surveys in 2019 indicated that construction and operation of Milne Port does not appear to have negatively affected benthic communities.**

Similar species were found in the belt transect surveys in 2018 and in 2019. More green algae (Chlorophyta) was observed in 2019 compared to 2018, but there were fewer recorded *Laminaria* sp*.* Clams were the dominant taxonomic group among all stations analyzed for relative abundance, while brittle stars (Ophiuridae) and unclassified bivalves (Bivalvia indet.) were present at every station. Observed differences between survey years are considered minor and are likely due to natural variability or within the range of error due to survey methodology. Again, observations reveal no evidence of spatial or temporal trends that might be associated with the construction and operation of Milne Port.

Fish

To satisfy PC Condition No. 99b, c, 113, and 114, sampling was conducted throughout the Milne Port area to assess relative abundance and health condition of Arctic char and other fish species. Multiple sampling methodologies were employed in order to target different species and habitat types, including gill net, Fukui trap, fyke net, angling and beach seine. Collected fish were identified to species and measured for length/weight before being released. Incidental fish mortalities were retained for condition, age, sex, stomach content, and metals in tissue (body burden) analyses. **The similarities in observed species and relative abundance across years suggests the construction and operation of Milne Port has not triggered detectable changes in local fish communities to date; further, similarities in the length to weight relationships across years indicate that site operations have not compromised fish condition.**

Fish captures in 2019, as in 2018, were higher relative to previous years which is attributed to the increased length of the sampling program, and thus higher effort. Relative taxonomic composition of fish captures did not materially change from previous sampling years, with Arctic char (*Salvelinus alpinus*), fourhorn sculpin (*Myoxocephalus quadricornis)* and shorthorn sculpin (*Myoxocephalus scorpius)* still comprising over 99% of the total catch. Two other species were caught, a single sandlance and a single ninespine stickleback, the latter representing the first occurrence of this species in MEEMP surveys.

A total of thirteen fish taxa were captured or observed throughout all MEEMP and AIS surveys in 2019; eight of these taxa were observed incidentally during surveys of other components, indicating that dedicated fish survey methods are not fully characterizing the fish populations in Milne Port and underscoring the importance of employing a range of sampling techniques to fully characterize the species and age groups of fish in Milne Port.

Fyke nets were introduced in 2019 as a possible alternative passive fishing method to Fukui traps to address the low captures observed in that method. Fyke nets captured a total of 12 fish, representing three species, including an Arctic char – representing the first time in MEEMP surveys this species was caught outside of gill net efforts. Catch Per Unit Effort (CPUE) for fyke nets was higher than Fukui traps, indicating this method may be a suitable replacement.

The length to weight relationships were compared between 2017, 2018 and 2019 for Arctic char, fourhorn sculpin and shorthorn sculpin, and no statistically significant differences were found between any of the sample years. Fish of a certain size class are within a consistent weight class in each survey year, indicating there has been no change in fish condition over this time period. The shellfish *H. arctica* was collected as a supplement to fish tissue collection. Shellfish ranged in age from 7 years to 69 years with an average age of 28.1 years – this is consistent with the documented age range published in the literature (Sejr et al. 2002).

Tissue Chemistry

To satisfy PC Conditions No. 113 and 114, a total of 47 tissue samples from Arctic Char were collected in 2019 for analysis of total metals concentrations. **Overall, the results of the tissue chemistry analysis in 2019 indicated that construction and operation of Milne Port do not appear to have negatively affected fish health. Concentrations of iron and other metals in tissue were consistent with concentrations in previous survey and baseline years.**

Arsenic, calcium, sodium, strontium, and titanium concentrations in Arctic Char tissue were statistically significantly greater in 2019 relative to 2018. Mean values were considered to assess consistency over time, but statistical comparisons were not performed for 2019 relative to historical data. Variance in concentrations of arsenic, cadmium, chromium, copper, iron, mercury and zinc have been observed in Arctic Char tissues since baseline years and samples in 2019 were generally consistent with historical data. A total of 80 tissue samples were collected from the clam *H. arctica* in 2019 for analysis of total metals concentrations and, in general, concentrations of most metals were statistically significantly greater in 2019 relative to 2018, with some exceptions. Observed increases in metals concentrations in both species are not considered Project-related and more likely reflect natural geologic sources or atmospheric deposition from further afield.

A total of 35 tissue samples from sculpin were collected in 2019 for analysis of total metals concentrations; however, prior to 2019, incidental sculpin mortalities were not retained for tissue chemistry analysis such that no 2018 sculpin data are available for comparison.

Metals concentrations were consistently and notably greater in *H. arctica* relative to both fish species, occasionally by orders of magnitude. This is attributable to between species differences in habitat preferences, feeding modalities, and ability to metabolize/excrete pollutants. There is no indication that these concentrations of metals are affecting fish health.

As mentioned above, local Inuit have raised concerns regarding the potential for increased iron deposition in the marine environment as a result of the Project and subsequent uptake in the food web. No CCME guidelines exist for iron in fish tissues; instead, this was investigated by comparing iron concentrations in Arctic char tissue samples through time. Iron concentrations in Arctic char tissue measured in 2019 were not statistically significantly different from 2018 and were slightly lower, but consistent, with those reported in previous years (2010-2017); as such, evidence continues to suggest that Project operations are not leading to an accumulation of iron in the marine food web.

No samples (i.e., Arctic Char, sculpin or *H. arctica*) collected in 2018 or 2019 exceeded the Canadian Food Inspection Agency commercial consumption guideline of 0.5 mg/kg wwt mercury.

Aquatic Invasive Species Monitoring Program

The AIS monitoring program was developed in 2015 as part of the MEEMP to establish baseline data and provide early warning of potential AIS and non-indigenous species (NIS) introductions in Milne Port, thereby meeting PC Conditions No. 87, 89, and 91. Components of the AIS monitoring program targeted lower trophic levels, including zooplankton, benthic infauna, macroflora and benthic epifauna, encrusting epifauna, and fish. Sampling methodology for the AIS monitoring program generally followed the approach of previous years (2014-2018) with several modifications made in 2019, including added emphasis on the identification of NIS, considerable expansion of the benthic infauna sampling program and the addition of a fifth transect for underwater towed video to account for potential impacts of the newly constructed Freight Dock.

Zooplankton

The zooplankton component involved collection of samples at Milne Port (6 stations) and at Ragged Island (4 stations) using a combination of vertical and horizontal oblique tows. All zooplankton samples were preserved in 5% formalin and submitted to Biologica for taxonomic identification and enumeration. **No NIS or AIS taxa were identified in zooplankton samples from Milne Port and Ragged Island.**

Of the 43 zooplankton taxa identified in samples collected during the 2019 AIS/NIS monitoring survey, three taxa had not been previously observed during previous monitoring or baseline surveys. At Milne Port, new species identified were *Hybocodon prolifer* - a hydroid cnidarian from the Family Tubulariidae; and *Onisimus glacialis* - a species of amphipod. At Ragged Island, an unidentified zooplankton species from the genus *Obelia* was observed; *Obelia,* or wine glass hydroids, are a globally common taxon and unidentified hydroids have previously been observed on the Ore Dock in Milne Port (Golder 2019b).

Each newly observed taxa was cross-checked against both global and domestic databases of marine invasive species. None of the taxa were identified as a globally recognized invasive species (Molnar et al. 2008) nor were they identified as an invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). Both specimens flagged at Milne Port have wide distributions that include the Canadian Arctic and Baffin Island (WoRMS 2020) while the taxon flagged at Ragged Island contains at least one species with a known occurrence in the Canadian Arctic.

Benthic Infauna

Benthic infauna samples collected as part of the MEEMP were also used for AIS/NIS monitoring, with the same methodologies and analytical approaches used for both programs. Sampling as part of the benthic infauna AIS/NIS program in 2019 represented a considerable increase in sampling locations compared to previous years. Prior to 2018, AIS/NIS samples were collected at 8 locations in Milne Port and the two Ragged Island locations. Fifteen locations were added in 2018, while in 2019, benthic invertebrate samples were collected from thirty-two stations in Milne Port and two stations at Ragged Island. **The majority of identified taxa in benthic infauna samples collected in Milne Port and Ragged Island were not considered NIS or AIS. Potential NIS taxa were identified in 2019, however further review of natural ranges and vectors of introduction are required to confirm NIS or AIS status.**

The benthic infauna species list developed during previous studies was updated and examined for presence of new species identified in 2019. Taxa that had not been previously identified in Milne Inlet were further investigated to determine if their known ranges and distributions included Canadian Arctic, north Atlantic or Arctic waters. In addition, taxa were compared against a global invasive species database (Molnar et al. 2008), as well as a known invasive species list within the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). Any taxa identified as potentially non-indigenous were sent to Philippe Archambault's Benthic Ecology Lab (Université Laval, Quebec) for independent verification.

A total of 58,374 organisms were estimated in 2019 surveys at Milne Inlet, which included 587 organisms at Ragged Island. These were identified to represent at least 319 different taxa, including 41 unique taxa that were not identified in previous surveys at Milne Port and Ragged Island. Of newly identified taxa, 39 were found only at Milne Port and 2 only at Ragged Island.

New taxa observations included a spionid polychaete identified as *Marenzelleria viridis*, confirmed via independent verification by the aforementioned Archambault lab. This species is listed in the Global Database and the National Risk Assessment as a species of concern for Canadian and Arctic waters, with a primary invasion vector through ballast water (Molnar et al. 2008, Casas-Monroy et al. 2014). Specimen collection records for *M. viridis,* and under the superseded name *Scolecolepides viridis* indicate historical occurrences outside the natural range in the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island (Cusson 2018, GBIF 2020, Miller et al. 2014). Further review of collection records around Baffin Island is needed to determine if this species is a recent invader in Milne Port.

Macroflora and Benthic Epifauna

The macroflora and benthic epifauna component involved data collection via underwater video surveys along the length of each of the four previously established AIS/NIS transects, plus an additional transect established in 2019 to the east of the newly constructed Freight Dock. **No NIS or AIS taxa were identified among the macroflora and benthic epifauna species observed in surveys in Milne Port. However, the identification of taxa to the species level was limited by the survey methodology for many taxa observed.**

The addition of high definition (HD) video footage in 2019 helped facilitate the identification of two new taxa of epifaunal invertebrates that have not been previously recorded during AIS underwater video surveys in 2014 through 2018. One of the new taxa, Cephalopoda - which includes squid and octopus - includes three species known to occur in Baffin Bay (Gardiner and Dick 2010), while the second taxa observed was prickleback fish (Family

Stichaeidae) potentially of the genus *Lumpenus*. A total of six distinct macroflora taxa were observed, all of which have been recorded in previous surveys.

Each newly observed taxa was also cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008) or an invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). All taxa that were not identified to the species level had at least one representative species with a native distribution that includes Arctic waters.

Encrusting Epifauna

The encrusting epifauna component involved the deployment of settlement baskets and associated settlement plates deployed on the east side of the Ore Dock (total deployment period of ~12 months); the settlement basket and plates on the west side of the Ore Dock were not recoverable in 2019 as the deployment rope was severed by winter ice break-up, and the settlement plates and basket were lost. **No NIS or AIS taxa were identified in encrusting epifauna samples from Milne Port. Further review of natural ranges and vectors of introduction are required to confirm NIS status.**

As in 2018, colonization appeared to be minimal. However, in 2019, there appeared to be increases in abundance and number of taxa observed, as well as a larger proportion of organisms in adult life stages relative to 2018. A total of 2,317 encrusting epifauna from 22 unique taxa were identified in 2019, the majority of which were bryozoans of the Order Cyclostomatida

Three new encrusting epifauna taxa were identified during the 2019 AIS/NIS surveys, two identifiable to the species level - *Circeis armoricana*, a sabellid worm, and *Patinella verrucaria*, a colonial bryozoan - and one identifiable to the Cnidarian genus *Gonothyraea*. None of the newly observed encrusting epifauna taxa were identified as invasive species, with literature review confirming known Arctic distributions for each (e.g., Casas-Monroy et al. 2014, Sirenko et al. 2020).

Fish

The fish component of the AIS/NIS program involved cross-checking all fish taxa observed in MEEMP and AIS surveys against a global database of marine invasive species (Molnar et al. 2008). **None of the taxa were identified as a globally recognized invasive species. Each fish was also researched independently to confirm their known distributions, and all species had confirmed ranges that included the Arctic Ocean.**

One new taxa was added to the AIS/NIS survey record from ROV surveys, an unidentified eelpout (Zoarcidae indet.), although at least one genus in this Family has been recorded in previous MEEMP surveys. In addition, several species observed in 2019 had been absent from the ROV record for several years, including the common lumpfish (*Cyclopterus lumpus*), seen only in 2014, and a fish doctor (*Gymnelus viridis*), recorded in 2013 and 2015.

Ship Hull Monitoring

To address PC Condition No. 91, ship hull biofouling monitoring was included in the AIS/NIS program for the first time in 2018 and repeated in 2019. **No NIS or AIS taxa were flagged among the biofouling species observed on the ship hulls during surveys.**

The program consisted of conducting underwater video surveys of the hulls of five ore carriers berthed at the Ore Dock using an ROV-based underwater video system. Surveys were conducted along the hulls of the ore carriers covering a representative range of depths of the submerged hulls. Much of the effort was focused on areas of the hull where biofouling was most likely to occur (e.g., chain lockers, bulbous bow and stem, sea-chain grating, stern tube, rope guard, propeller nose cone and blades, rudder side, bottom, leading and trailing edges). The collected video recordings were later examined by qualified biologists to identify potential biofouling species to the lowest practical taxonomic level.

Most of the ships' surfaces below the waterline were found free of biofouling, where observations were made. Exceptions were small areas of the sterns of four ships, where some amounts of colonization by aquatic organisms – predominantly barnacles - were found. The taxonomic resolution of biofouling organisms did not improve in the second year of monitoring, despite the inclusion of a high-resolution camera. Many taxa were not resolved to species level due to the difficulty of identification without a specimen.

Inuit Participant Interviews

To address PC No. 126, upon completion of the MEEMP and AIS/NIS surveys local participants were asked to collectively take part in an end of season interview to provide feedback on the program by answering a series of questions. The questionnaire was used to assess Participant opinions on the methodology, data collection and presentation, and equipment, as well as to receive feedback on any perceived gaps, concerns or recommendations for future programs. No changes in fish populations, abundances or health, as well as no new or unusual fish since the beginning of Operations at Milne Port were reported by Inuit Participants in the 2019 MEEMP and AIS Program during post-season interviews. Responses to questions during the Participant interviews included suggestions and requests for adjustments to the program; for example, requests for increased training in sampling methodology and in the use of sampling equipment, recommendations for sampling locations and methodologies, and a specific request for changes to the fish sampling program to allow for donation of fish tissue to the local community. All suggestions and requests provided by program participants will be considered during program planning for the 2020 MEEMP and AIS program.

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ᓇᐃᓈᖅᓯᒪᔪᖅ

2019-ᒥᑦ, ᐹᕝᕆᓐᓂᓐ ᓴᕝᕙᓂᑦ ᐅᔭᕆᒃᑕᕆᐊᓕᕆᔫᒃᑯᑦ (ᐹᕝᕆᓐᓂᓐᑯᑦ) ᐱᓕᕆᐊᖃᓚᐅᖅᑐᑦ ᑕᒡᓕᒪᙱᓂᑦ ᐅᑭᐅᖑᓕᖅᑐᒥᑦ ᐊᕙᑎᒥᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᕐᓄᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᒃ (EEM) ᕿᙵᐊᓂᑦ ᐃᒃᓴᕐᕕᙵᒥᑦ ᐃᓚᒋᔭᐅᐸᓗᓂ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ (MEEMP) ᐊᒻᒪᓗ ᑕᒫᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐃᒪᕐᒧᐊᖅᑐᑦ ᓂᕐᔪᑏᑦ (AIS) ᖃᐅᔨᓴᐃᓂᕐᒥᒃ ᓄᓘᔭᓂᑦ ᐱᓕᕆᐊᕐᒧᑦ. ᐅᓂᑉᑳᖅ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᖅ ᒪᓕᒃᑯᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓄᓇᐃᒃᑯᑎ ᓈᓴᐅᑎᓕᒃ 005 ᑐᓂᔭᐅᔪᖅ ᐊᕙᑎᓕᕆᔩᒃᑯᓐᓂᑦ ᐹᕝᕆᓐᓂᓐᑯᓐᓄᑦ ᖃᓄᐃᙳᔭᕆᐊᖃᕐᓂᖅ ᓈᓴᐅᑎᒧᑦ 76, ᐅᖃᖅᓯᒪᔪᖅ *"ᐱᓕᕆᐊᓕᒃ ᐋᖅᑭᒃᓯᓂᐊᖅᐳᖅ ᐃᓗᐃᑦᑑᙱᔪᒥᒃ ᐊᕙᑎᒥᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒋᑦ ᐃᓱᒫᓘᑕᐅᔪᑦ ᐊᒻᒪᓗ ᖃᐅᔾᔪᒋᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᑕᕆᐅᕐᒥᐅᑕᓄᑦ"*, ᓈᓴᐅᑎ 87 *"ᐱᓕᕆᐊᓕᒃ ᐋᖅᑭᒃᓯᓂᐊᖅᐳᖅ ᓇᓗᓇᐃᔭᖅᓯᒪᔪᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᐳᐊᕐᔪᓐᓂᑦ ᐃᓂᐅᔪᓂᒃ ᐊᑯᓂᐅᔪᒧᑦ ᕿᒥᕐᕈᓂᐊᕐᓗᒋᑦ ᐊᓯᐊᙳᕐᓂᐅᔪᑦ ᑕᕆᐅᕐᒥᐅᑕᑦ ᐃᓂᖏᑦ ᐊᒻᒪᓗ ᐆᒪᔪᕋᓛᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᐃᓗᑎᒃ ᑕᒫᓂᕐᒥᐅᑕᐅᖏᑦᑐᓂᒃ ᐱᓕᕆᐊᑉ ᐅᒥᐊᕐᔪᐊᖏᓐᓂᑦ ᑎᑭᐅᑎᔭᐅᔪᓂᒃ"*, ᐊᒻᒪᓗ ᓈᓴᐅᑎ 126 *"ᐱᓕᕆᐊᓕᒃ ᐋᖅᑭᒃᓯᐃᓂᐊᖅᐳᖅ ᖃᐅᔨᓴᐃᓂᕐᓄᑦ ᑐᕌᙳᔪᓂᒃ ᓄᓇᓕᖕᒥᐅᑦ ᐊᑐᖃᑦᑕᖅᑐᑦ ᑕᕆᐅᕐᒥᑦ ᓄᓇᓕᖕᓂᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐊᑉᑯᑎᖏᓐᓂᑦ ᐃᓚᐅᖃᑕᐅᔪᓐᓇᕐᓗᑎᒃ ᐊᐅᓚᓐᓂᕐᓗᒃᑖᙱᓂᑦ ᐱᓕᕆᐊᖅ ᐃᑲᔪᕐᓂᐊᕐᓗᑎᒃ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐊᒻᒪᓗ ᕿᒥᕐᕈᓂᕐᓂᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᓄᑦ ᐊᒻᒪᓗ ᐊᓯᐊᙳᕐᓂᐅᔪᓄᑦ ᑕᕆᐅᕐᒥᐅᑕᑦ ᐆᒪᔪᑦ ᓇᒧᙵᐅᓂᖏᓐᓂᒃ"*. ᐃᓚᒋᔭᐅᐸᓗᓂ, 8 ᐊᓯᖏᑦ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒥᑦ ᖃᓄᐃᙳᔭᕆᐊᖃᕐᓂᐅᔪᑦ ᐱᓕᕆᐊᖑᔪᑦ ᑕᑉᐸᓂ ᐅᓂᑉᑲᒥᑦ, ᐊᒻᒪᓗ ᐊᑐᓂ ᓇᓗᓇᐃᖅᑕᐅᓂᐊᖅᑐᑦ ᐱᑦᔪᑕᐅᔪᒧᑦ ᐃᓚᒋᔭᐅᔪᓂᑦ.

ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ

ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ (MEEMP) ᐱᓕᕆᐊᙳᓚᐅᖅᑐᖅ 2015-ᒥᑦ ᐱᐊᓂᙵᑦ ᑕᕆᐅᕐᒥᐅᑕᓄᑦ ᑭᒡᓕᒋᔭᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ ᕿᙵᐊᓂᑦ ᐃᒃᓴᕐᕕᙵᒧᑦ 2013-ᒥᑦ ᐊᒻᒪᓗ 2014-ᒥᑦ. ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐃᓚᒋᔭᐅᔪᑦ 2019 MEEMP-ᒧᑦ ᐃᓚᐅᔪᑦ ᑕᕆᐅᖅ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓ; ᑕᕆᐅᖅ; ᐃᒪᐅᑉ ᖃᓄᐃᓕᐅᕐᓂᖓ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᑐᐊ ᖃᓄᐃᙱᓂᙱᓄᑦ; ᐊᑐᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖓ; ᐊᑐᐊᑕ ᐃᑐᐊᓄᐊᖃᑦᑕᖅᑐᑦ[3]; ᖃᓕᕇᒃᑐᑦ, ᓄᓇᕋᐃᑦ ᐱᕈᖅᑐᑦ ᐊᒻᒪᓗ ᐊᑐᐊᑕ ᗃᙱᓅᖃᑦᑕᖅᑐᑦ ᐆᒪᔪᑦ[4]; ᐃᖃᓗᐃᑦ; ᐊᒻᒪᓗ, ᓂᕿᙱᓐᓂᑦ ᖃᓄᐃᓕᐅᕐᓂᖃᖅᑐᑦ. MEEMP-ᒥᑦ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐋᖅᑭᒃᑕᐅᓯᒪᔪᖅ ᐊᑐᖅᓱᓂ ᓴᕝᕙᒥᑦ ᐅᔭᕆᒃᑕᕆᐊᖅᑕᐅᔪᓄᑦ ᐱᓕᕆᐊᖃᕐᓂᕐᒧᑦ ᒪᓕᒃᑕᐅᔭᕆᐊᓖᑦ ᐊᕙᑎᒥᒃ ᖃᓄᐃᙱᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ (ᑲᓇᑕᒥᑦ ᐊᕙᑎᓕᕆᔩᒃᑯᑦ 2012) ᐃᓚᐅᐸᓗᑎᒡᓗ ᓈᓴᐅᓯᕆᓪᔪᑎᒃᑯᑦ ᐊᑐᖅᑕᐅᔪᑦ ᖃᐅᔨᓂᐊᕐᓗᒋᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᓂᒃ ᑕᕆᐅᕐᒥᐅᑕᓄᑦ. MEEMP ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᓂᙶ ᐊᒻᒪᓗ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᑲᑎᑕᐅᓂᖏᓐᓄᑦ ᐋᖅᑭᐅᒪᔪᑦ ᒪᓕᓚᐅᖅᑐᑦ ᐊᔾᔨᙱᓂᒃ ᐊᑐᖅᑕᐅᕙᒃᑐᓂᒃ ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᓂᒃ, ᐃᓚᒋᔭᐅᐸᓗᓂ ᐋᖅᑭᒋᐊᖅᓯᓂᐅᓚᐅᖅᑐᑦ 2018-ᒥᑦ, ᐱᓕᕆᐊᖅ ᑲᔪᓯᓂᖃᕐᓂᐊᕐᒧᒍ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᓐᓇᕐᓗᓂ ᑐᕌᙳᔪᖅ ᐊᒻᒪᓗ ᐊᕐᕌᒍᑕᒫᒃᑯᑦ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᙱᓈᕐᓂᐊᕐᓗᒋᑦ ᐊᒥᓲᓄᑦ ᐅᑭᐅᓄᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᑲᑎᑕᐅᓯᒪᔪᑦ.

ᖃᐱᐊᕐᔭᐃᑦ ᑐᕌᙳᔪᓂᒃ ᐋᖅᑭᒋᐊᖅᓯᓂᖃᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᐅᖃᖃᑎᒋᐸᓗᒋᑦ ᑕᕆᐅᕐᒥᐅᑕᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔩᑦ (MEWG) ᐱᐅᓯᒋᐊᕐᓂᐊᕐᓗᒍ ᖃᐅᔨᔪᙳᕐᓂᖅ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐊᓯᐊᙳᕐᓂᐅᔪᓄᑦ ᐅᐸᓗᓂᑦ ᐊᓂᒍᖅᐸᓪᓕᐊᔪᓂᑦ. ᐋᖅᑭᒋᐊᖅᓯᓂᕐᓂᑦ ᐃᓚᐅᓚᐅᖅᑐᑦ (i) ᐊᖏᓂᖅᓴᒥᑦ ᐃᓂᐅᔪᓂᑦ ᖁᒻᒧᓪᓗ ᖃᐅᔨᓴᐃᓂᖅ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᙱᓄᑦ ᑭᒡᓕᐅᔪᓂᒃ, ᐃᓚᐅᐸᓗᑎᒃ ᐆᒃᑐᕋᐅᑕᐅᔪᑦ ᐅᐊᙵᙱᓂᑦ ᐃᒥᓖᑦ, ᑕᓯᐅᔭᖅ; (ii) ᑕᒪᐃᓐᓂᑦ ᕿᒥᕐᕈᓂᖃᖅᓱᑎᒃ ᑕᕆᐅᖅ ᐃᒪᐅᑉ ᖁᑦᑎᒃᓯᓂᕆᖃᑦᑕᖅᑕᙱᓂᑦ ᓄᓇᕗᒻᒥᑦ ᐆᒃᑐᕋᐃᓂᖃᖅᓂᐊᕐᓗᑎᒃ ᐃᒪᐅᑉ ᖁᑦᑎᖕᓂᙱᑕ ᓇᓃᓐᓂᕆᖏᓐᓂᑦ; (iii) ᑕᒪᐃᓐᓂᑦ ᕿᒥᕐᕈᓂᖃᖅᓱᑎᒃ ᐃᒪᐅᑉ ᖃᓄᐃᓕᐅᕐᓂᕆᔭᙱᓂᑦ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᑐᐊᓂᑦ ᓄᓇ ᖃᓄᐃᓐᓂᙱᓂᒃ Phillips Creek Estuary-ᒥᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒍ ᐊᑐᐊᓄᐊᖅᑐᑦ ᓇᒨᙱᐅᖃᑦᑕᕐᓂᖏᑦ ᕿᙵᐊᑕ ᐃᓱᐊᓂᑦ; (iv) ᐆᒃᑐᕋᐃᓂᖃᕐᓂᖅᓴᐅᓕᖅᓱᑎᒃ ᐊᑐᐊᑕ ᐃᑐᐊᓄᐊᓲᓂᒃ ᐊᒻᒪᓗ ᐊᑐᐊᓄᐊᖅᑐᓂᒃ ᑎᓴᒪᐅᔪᓂᒃ ᑲᑎᓐᓂᐅᔪᓂᑦ ᑕᒡᓕᒪᓂᑦ ᐆᒃᑐᕋᐃᕚᐅᔪᓂᑦ ᑕᒡᓕᒪᓄᑦ ᐆᒃᑐᕋᐃᕙᙵᓄᑦ 15-ᓂᒃ ᐆᒃᑐᕋᐃᕚᐅᔪᓂᑦ ᐊᑐᓂ ᐱᐅᓯᒋᐊᕐᓂᐊᕐᓗᒋᑦ ᓈᓴᐅᓯᕆᓂᕐᒧᑦ ᓴᙱᓂᐅᔪᖅ (v) ᐃᓚᐸᓗᒋᑦ ᑲᓇᔪᐃᑦ ᐃᖃᓗᐃᑦ ᓂᕿᙱᓐᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ; (vi) ᑐᑭᓯᑎᑦᑎᓂᖅ ᔫᖃᑦᑕᐅᐸᓗᑎᒃ ᒪᑦᑎᑕᐅᑎᓂᒃ (fyke) ᐃᖃᓗᙳᓂᒃ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ (Fukui) ᒪᑦᑎᑕᐅᓂᖗᖅ ᐊᑐᕈᓐᓇᕐᒪᖗᑕ; ᐊᒻᒪᓗ, (vii) ᑐᓂᔭᐅᓂᖏᑦ *Hiatella arctica* ᖃᐅᔨᓭᑕᐅᓂᐊᕐᓗᑎᒃ ᐅᑭᐅᖏᓐᓂᒃ ᐃᓚᒋᔭᐅᐸᓗᓂ ᓂᕿᙱᓐᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ.

[3] ᐊᑐᐊᑕ ᐃᑐᐊᓄᐊᓲᑦ – ᐆᒪᔪᕋᓛᑦ ᖃᓕᕇᒃᑐᓃᖃᑦᑕᖅᑐᑦ ᑕᕆᐅᑉ ᐃᒪᐅᑉ ᐊᑐᐊᓂᑦ (ᓲᕐᓗ ᖁᐱᕈᐃᑦ, ᐊᒻᒨᒪᔪᐃᑦ).
[4] ᐊᑐᐊᑕ ᗃᙱᓅᓲᑦ – ᐆᒪᔪᑦ ᐊᒻᒪᓗ ᐱᕈᖅᑐᑦ ᐆᒪᔪᕋᓛᑦ ᑕᕆᐅᑉ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᗃᙱᓅᖃᑦᑕᖅᑐᑦ (ᓲᕐᓗ, ᐅᐸᓗᕆᐊᙵᐊᑦ ᐊᒥᓱᓂᒃ ᓂᐅᖃᐅᖅᑐᑦ).

ᑕᕆᐅᑉ ᐃᒪᖓᑕ ᖃᓄᐃᓐᓂᖓ

ᖃᐅᔨᓂᐊᕐᓗᓂ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᒥᑦ ᖃᓄᐃᖓᓯᔭᓇᐊᖅᑲᓐᓂᑦ ᓈᓴᐅᑏᑦ 89 ᐊᒻᒪ 99(a), ᑕᕆᐅᑉ ᐃᒪᖓᑕ ᖃᓄᐃᓐᓂᖓᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐃᓚᐅᔪᑦ ᑲᑎᖅᓯᐃᓃᑦ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓂᒃ ᓯᑕᒪᓂᑦ ᐆᒃᑐᕋᐃᕝᕕᐅᔪᓂᑦ ᖃᓂᑕᖓᓂᑦ ᑯᕕᖅᑕᕐᕕᐅᑉ ᕿᙵᐊᓂᑦ ᐃᒃᓯᕙᖓᒥᑦ (ᑐᓂᐅᖅᑲᐅᑕᐅᔪᖅ ᐃᓂᓕᐅᖅᑕᐅᓯᒪᐸᓗᓂ ᐋᖅᑭᐅᒪᔪᒃᑯᑦ) ᖃᐅᔨᓴᕐᓂᐊᕐᓗᑎᑦ ᐊᔾᔨᙳᕐᓂᐅᔪᖕᓇᖅᑐᑦ ᐅᔭᕋᒃᑕᕆᐊᕐᒥᑦ ᑯᕕᔪᓄᑦ ᐊᒻᒪ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᓄᑦ (ᐃᓚᐅᑉᓗᑎᒃ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓂᑦ ᑲᑎᓯᒪᔪᓂᑦ). **ᑕᒪᐃᓐᓅᖓᔪᒃᑯᑦ, ᐅᑉᓗᒥᒨᑦ ᑎᑭᖦᖢᒍ, ᖃᓄᐃᖓᓂᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ ᓴᓇᕚᓕᓕᐊᓂᕐᒥᑦ ᐊᒻᒪ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒥᑦ ᕿᓪᓕᓂᖅ ᐊᒃᑐᐃᓂᖃᕐᓂᖅᑰᔾᔮᙱᑦᑐᖅ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ, ᐆᒃᑐᕋᖅᑕᐅᓂᖏᑦᑎᒍᑦ ᑲᑎᓯᒪᔪᑦ ᐊᔾᔨᒋᔭᖏᓐᓂᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ, ᐊᒻᒪ ᑎᑭᐅᑎᓂᐅᔪᑦ CCME-ᒥᑦ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᒪᓕᒃᑕᐅᔪᒃᓴᓂᑦ ᒥᐊᓂᕆᓂᐊᕐᓗᒋᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ.**

2019-ᒥᑦ, ᐅᖃᐅᓯᐅᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᖃᓄᐃᙵᓂᐅᔪᑦ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᑭᒡᓕᐅᔪᓄᑦ - ᐊᖏᓂᖅᓴᐃᑦ ions, ᓴᕝᕕᑦ, hydrocarbons, ᐊᒻᒪ polycyclic aromatic hydrocarbons (PAHs) — ᓯᕗᓂᐊᒍᑦ ᖃᐅᔨᓴᐅᓚᐅᖅᑐᓂᑦ MEEMP-ᒥᑦ ᐆᒃᑐᕋᐃᓂᕐᓄᑦ ᖃᓂᖓᓃᓚᐅᖅᑐᑦ (2015-ᒥᑦ 2018-ᒧᑦ) ᐆᒃᑐᕋᐃᓂᕐᓂᑦ ᐅᖓᑕᐅᑎᓂᖃᙱᖦᖢᑎᒡᓗ ᑲᓇᑕᒥᑦ ᑲᑎᒪᔩᑦ ᒥᓂᔅᑕᐅᑏᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ (CCME) ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᒪᓕᒃᑕᐅᔭᒃᓴᓂᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ. Hydrocarbons ᐊᒻᒪ PAHs ᐆᒃᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᑲᑎᓯᒪᔫᒃᑯᑦ ᑐᙵᓂᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᐅᔨᔭᐅᔪᓄᑦ ᑭᒡᓕᐅᔪᓂᑦ 2019-ᒥᑦ, ᐊᔾᔨᒋᔭᖏᑦ ᖃᓄᐃᙵᓂᐅᓚᐅᖅᑐᑦ ᓯᕗᓂᐊᒍᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᓂᑦ. ᐊᑕᐅᑦᑎᒃᑯᑦ, ᐆᒃᑐᖅᑕᐅᔪᑦ ᑲᑎᓯᒪᔪᑦ ᓴᕝᕕᑦ ᐊᒻᒪ ᓄᓇᒥᑦ ᐱᔪᑦ ᖃᐅᔨᔭᐅᓚᐅᙱᑦᑐᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐱᑕᖃᓚᐅᙱᑦᑐᑦ ᐊᑦᑎᒃᑐᒥᑦ ᑲᑎᓯᒪᔪᓂᑦ, ᐊᖏᔪᒥᑦ ᐊᒃᑐᖅᓯᓂᖅᑕᖅᑕᐊᖅᓂᐊᕐᓂᖓᓂᑦ ᐃᒪᓂᖅᖢᓂᒃ ᕿᓚᒃᑲᓐᓂᖅᑐᓂᒃ ᓂᕆᐅᒋᔭᐅᙱᑦᑐᑦ.

ᐊᒥᓱᙳᖅᐸᓪᓕᐊᓂᖏᑦ ᓴᕝᕕᑦ ᑕᕆᐅᕐᒧᐊᖅᑐᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐃᓯᖃᑦᑕᐅᔪᖅ ᐃᓄᖕᓄᑦ. ᑕᐃᒪᙵᓂᑦ CCME-ᒥᑦ ᑕᕆᐅᖅ ᐃᒪᕐᒥᒃ ᖃᓂᐃᓐᓂᖓᓄᑦ ᒪᓕᒃᑕᐅᔭᒃᓴᐃᑦ ᓴᕝᕕᖑᓄᑦ ᐋᖅᑭᒃᑕᐅᓯᒪᓚᐅᖅᑐᑦ, MEEMP ᑕᐅᑐᙳᖅᖢᒍ 2019-ᒥᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᑲᑎᑕᐅᓚᐅᖅᑐᖅ ᓯᕗᓂᐊᒍᑦ MEEMP ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᐊᑯᓐᓂᖓᓂᑦ 2015 ᐊᒻᒪ 2018 ᖃᐅᔨᓴᕐᓂᐊᕐᓗᑎᑦ ᐊᔾᔨᙳᕐᓂᐅᔪᑦ ᑯᕕᑎᑕᐅᔪᑦ ᖃᓄᐃᓐᓂᖓᓂ ᖃᐅᔨᓴᐅᖃᑦᑕᖅᓯᒪᔪᓄᑦ. ᖃᐅᔨᓴᐃᕝᕕᖓᓂ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ ᑕᑯᒃᓴᐅᔪᑦ ᓇᓃᓂᐅᔪᑦ ᓴᕝᕕᓂᑦ ᐃᒪᕐᒥᑦ ᐆᒃᑐᖅᑕᐅᔪᓂᑦ 2019-ᒥᑦ ᐊᔾᔨᒋᔭᖏᑦ ᑲᑎᓯᒪᔪᓂᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᓂᑦ ᐊᑯᓐᓂᖓᓂᑦ 2015 ᐊᒻᒪ 2018.

ᐊᓇᖅᑕᔪᖃᕐᓂᑦ ᐱᔪᓂᒃ ᖃᓄᐃᙵᓂᐅᔪᑦ 2019-ᒥᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ ᐊᓇᖃᕐᓂᑦ ᑲᑎᓯᒪᔪᑦ ᐊᑦᑐᓗᒃᑖᓗᐊᖅᑐᑦ ᑭᒡᓕᓯᐅᔫᒥᑦ ᐊᒻᒪ ᐅᖓᑕᐅᑎᓚᐅᙱᑦᑐᑦ 2 CFU/100 mL-ᓂᒃ, ᖃᐅᔨᑎᑦᑎᔪᖅ ᐱᓕᕆᐊᖑᔪᓯᒪᔪᖅ ᑯᕕᑎᑕᐅᔪᖅ ᑲᑎᖅᓱᐃᕝᕕᖕᒥᑦ ᓈᒻᒪᒃᑐᖅ ᑭᒡᓕᒃᓴᓂᐅᔪᒧᑦ ᑕᕆᐅᕐᒧᐊᖅᑕᐅᑉᐸᑦ.

ᑕᕆᐅᖅ

ᑕᕆᐅᑉ ᖃᓂᖓᓐᖓᓃᙶᖓᔪᖅ ᐊᔾᔨᓕᖅᑎᑦᑐᒃ ᐱᓕᕆᐊᖃᕐᓂᖃᓚᐅᖅᑐᖅ ᐊᒻᒪ ᖃᓄᐃᑦᑐᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᖃᖅᑐᓂ. ᐆᒃᑐᕋᐃᓂᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᕿᒥᕐᕈᔪᒃᑯᑦ ᐃᒪᕐᒥᑦ ᖃᐅᔨᓂᐊᕐᓗᓂ ᐃᓚᒋᔭᐅᔪᑦ ᐊᒻᒪ ᖃᓄᐃᓕᕐᓗᓂ ᐊᕐᕋᒍᑖᕐᒥᒃ ᐊᔾᔨᙳᕐᓂᐅᔪᑦ, ᐱᓕᕆᐊᖑᔪᓄᑦ ᓇᓗᓇᐃᒃᑯᑕᕐᒧᑦ ᐱᓕᕆᐊᓕᕆᓂᕐᒧᑦ ᐱᓕᕆᐊᓕᕆᓂᕐᒧᑦ ᖃᓄᐃᖓᓯᔭᓇᐊᖅᑲᓐᓂᑦ ᓈᓴᐅᑎ 89 ᐱᓕᕆᐊᓄᓂᐊᕐᓗᒍ. ᐃᒪᐅᑉ ᐃᓗᐊᓂ ᑭᒡᓕᐅᔪᑦ, ᓂᕿᑦ ᐆᒪᔫᒥᒃᑎᖅᑕᖅ, ᐅᓇᕐᓂᖓ, ᓄᙳᑎᖅᓯᒪᔪᖅ ᐊᒃᓯᔩᓐ, ᐊᑐᐊᓂᑦ ᐱᔪᓂᒃ ᓴᓗᒪᐃᓐᓂᑦ ᐊᒻᒪ ᑐᙳᔪᕐᓂᖅᓯᓂᖅ, ᐆᒃᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᐆᒃᑐᕋᐃᕝᕕᐅᔪᓂᑦ ᕿᓚᒃᑲᓂᑦ ᐃᒃᓯᕙᐅᑉ ᐊᒻᒪ ᑕᓯᐅᔭᐅᑉ. ᐊᒻᒪᓗ, ᖃᐅᔨᓴᐃᓐᖑᕐᓇᐅᔭᕐᓂᖅ ᐊᓯᖓᓂᒃ ᑭᒡᓕᐅᔪᓂᒃ, ᓃᕐᓗ ᐊᐅᓚᓂᐅᑉ ᓇᑭᕐᓂᓪᓗᓂᑦ ᐊᒻᒪ ᐃᒪᐃᑦ ᖁᑎᖕᓂᖓᓂᒃ, ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᐱᖓᓯᐅᓂᑦ ᐃᓂᐅᔪᓂᑦ ᕿᒥᕐᕈᔪᓂᑦ, ᒪᕿᒃ ᖃᓂᑦᑕᕐᓂᑦ ᕿᒥᕐᕈᔪᓂᑦ ᐃᒃᓯᕙᐅᑉ ᐊᒻᒪ ᐊᑕᐅᓯᖅ ᐃᒍᕕᐊᓂᒥᑦ, ᐃᓚᓯᐊᕐᓗᓂ ᓈᓴᐅᑎᖃᓂᕐᓂᑦ/ᑎᑎᖅᑲᐃᑦᑎᖃᓂᕐᓂᑦ ᓇᓗᓇᐃᕐᓂᐊᕐᓗᒋᑦ ᐅᒥᐊᔭᐃᑦ ᐃᒪᖅ ᓯᐊᒻᒪᖕᓂᖓᓄᑦ ᐊᖅᑭᒋᐊᖅ. ᑭᖑᓪᓕᖅᐹᖅ, ᖃᐅᔨᓂᐊᕐᓗᓂ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒥᑦ ᖃᓄᐃᖓᓯᔭᓇᐊᖅᑲᓐᓂᖅᑐᑦ ᓈᓴᐅᑎ 1 ᐊᒻᒪ 83, ᐊᒥᓱᓄᑦ ᐅᑭᐅᓄᑦ ᐃᒪᐅᑉ ᑯᑦᑎᓐᓂᖓᓐᓂᖓᓄᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᕿᒥᕐᕈᔪᓂᑦ ᐅᓕᑦᑕᕐᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᔭᕐᕕᖓ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑕᐅᑦᑎᒃᑯᑦ ᑎᑎᖅᑲᓂᒃ ᕿᒥᕈᓐᓂᖅ ᑕᕆᐅᑉ ᑯᑦᑎᒃᓯᖅᑕᖅᓯᓂᖓᓐᓂᒃ ᐊᒻᒪ ᓄᓇᒧᑦ ᑯᒻᒥᖓᓂᐅᔪᓐ/ᐊᑦᑎᒃᓯᕙᓪᓕᐊᓂᐅᔪᓐ ᓈᓴᐅᑎᓂᒃ ᓄᓇᕗᒻᒥᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒍ ᑕᕆᐅᖅ ᑯᑦᑎᒃᓯᖅᑕᖅᓯᓂᖓᓂᒃ ᕿᒥᕐᕈᔪᓂᑦ ᐃᒃᓯᕙᐅᑉ.

ᖃᐅᔨᓴᐃᓂᖅ ᐊᒥᓱᓄᑦ ᐅᑭᐅᓄᑦ ᐅᓕᑦᑕᕐᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᔭᕐᕕᖓ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᖅ ᖃᐅᔨᓇᖅᑐᖃᖅᑕᕐᓂᐊᕐᓂᖅ ᖃᓄᐃᓕᐅᖅᐸᓪᓕᐊᓂᖏᓐᓂᑦ (ᐱᐅᔪᒥᒃ ᐅᕝᕙᓘᓐᓃᑦ ᐱᐅᙱᑦᑐᒥᒃ) ᑕᕆᐅᖅ ᑯᑦᑎᒃᓯᓂᖓᓂᒃ ᐱᖓᓱᓄᑦ ᐅᓕᑦᑐᓂᖅᑕᐅᓚᐅᖅᑐᖅ ᐃᒪᐅᑉ ᑯᑦᑎᒃᓯᓂᖓᓂᒃ ᓈᓴᐅᑎᓂᑦ/ᑎᑎᖅᑲᓂᑦ ᑯᒻᒥᒃᓯᒪᔪᖅᑕᖅᑕᐅᓂᖓᓂᑦ ᖃᐅᔨᓴᐃᔭᕐᕕᖓᑦ. ᑎᑎᖅᑲᓂᒃ ᕿᒥᕈᓐᓂᖅ ᑯᑦᑎᒃᓯᖅᑕᖅᓯᓂᖓᓂᒃ/ᐊᑦᑎᒃᓯᕙᓪᓕᐊᓂᐅᔪᓂᒃ ᓈᓴᐅᑎᓂᒃ ᓄᓇᕗᒻᒥᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᖃᐅᔨᓴᐃᔭᕐᕕᖓᓂ ᓄᓇᒥᑦ ᑯᑦᑎᒃᓯᖅᑕᖅᓯᓂᖓᓂᑦ ᐊᑦᑐᖅᑐᖅ

(ᖁᐊᖑᐃᓐᓇᐅᔭᖅᑐᒥᑦ ᐱᔪᒥᑦ) 100 ᐅᑭᐅᓂᑦ ᖃᐃᔪᓂᑦ, ᑕᐃᒪᓐᓇᒧᑦ ᐊᑦᑎᕐᓯᑎᑦᑎᓗᓂ ᑕᕆᐅᖅ ᖁᑦᑎᓐᓂᖕᒐᓂᑦ 64 ᓴᓐᑎᒦᑕᓪᓗᐊᓂᑦ 74 ᓴᓐᑎᒦᑕᓪᓗᐊᓄᑦ.

ᐆᒃᑐᕋᐃᓃᑦ ᐊᐅᓚᓂᐅᑉ ᓇᑭᕐᓂᖕᒐᓂᑦ ᐊᒻᒪᓗ ᓇᒧᙵᐅᓂᖕᒐᓂᑦ ᕿᙳᐊᓂᑦ, ᐃᓗᕕᓕᐅᑉ ᖃᓂᑕᖕᒐᓂᑦ ᐊᒻᒪᓗ ᕿᙳᐊᓂᑦ ᐃᒃᓴᕐᕕᐅᑉ, ᓇᓗᓇᐃᖅᓯᔪᑦ ᑯᕕᓃᑦ ᓴᓐᒌᑦᑑᔪᑦ (ᓲᕐᓗ, <15 ᓴᓐᑕᒦᑕᓂᒃ/ᓯᕿᙲᔭᐅᑉ ᑎᓪᓕᖅᑖᖕᒐᓂᑦ), ᐊᓄᕆᒧᑦ ᐱᔭᐅᓗᐊᖅᑐᑦ, ᐊᒻᒪᓗ ᓱᑉᓗᒦᓪᓗᑎᒃ. ᐱᓕᕆᖃᑎᒌᖕᓂᖕᒋᑦ ᐊᐅᓚᓂᐅᑉ ᓇᑭᕐᓂᖕᒐ ᐊᓄᕆᒧᑦ ᕿᙳᐊᓂᑦ ᖁᑦᑎᖕᓂᖅᓴᒦᑦᑐᖅ ᐃᒪᖅ ᐊᑯᓪᓕᖅᑕᐅᓗᐊᖃᑦᑕᖅᑐᖅ ᐊᓂᕆᒧᑦ. ᖁᓪᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ ᐃᒪᕐᒥᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᖅ ᐅᑭᐅᑉ ᐃᓚᖕᒐᒍᑦ ᐊᔾᔨᖏᙱᓐᓂᖕᒋᑦ ᖃᓕᓈᖕᒐᔪᑦ - ᐃᓚᒋᔭᐅᔪᖅ ᐱᔾᔪᑎᖃᖅᐳᓂ ᐊᕕᒃᓯᒪᓂᖕᒋᑦ ᐃᒪᐅᑉ ᖃᓕᓈᓕᖕᒐᑉᓗᑎᒃ ᐊᔾᔨᖏᙱᑦᑑᑉᓗᑎᒃ ᐱᔾᔪᑕᐅᔪᖅ ᐊᔾᔨᖏᙱᓐᓂᖕᒋᑦ ᐆᓇᕐᓂᐅᑉ ᐅᙯᓘᓐᓃᑦ ᑕᕆᐅᖃᕐᓂᐅᑉ, ᑕᒪᐃᓐᓂᓪᓘᓐᓃᑦ. ᖃᓕᕆᓕᖕᒐᓂᖅ ᐱᒪᕆᐅᔪᖅ ᖁᓪᒧᑦ ᔫᑎᑦᑎᖃᑦᑕᕐᒪᑦ ᓄᖑᑎᖅᓯᒪᔪᓂᒃ ᒥᑭᔩᑎᕋᕆᓂᒃ ᐊᑯᓐᓂᖕᒋᓐᓂᑦ ᖃᓕᓈᒃᑐᐃᑦ ᑕᐃᒪᓐᓇᓗ ᐊᒃᑐᖅᓯᓂᖃᖅᑐᖅ, ᐆᒃᑑᑎᒋᓗᒍ, ᓂᕿᑦᑎᐊᕙᐃᑦ ᓯᐊᒻᒪᖃᑦᑕᕐᒪᑕ ᐊᑯᓐᓂᖕᒐᓂᑦ ᖄᖕᒐᓂᑦ ᐊᒻᒪᓗ ᐊᑖᓂᑦ ᐃᒪᐅᑉ. ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓴᕐᕕᖕᒥᑦ, ᑕᕆᐅᕆᓐᓂᐅᓕᖃᑦᑕᖅᑐᖅ ᐊᒻᒪᓗ ᑕᕆᐅᖃᓗᐊᖕᒋᓐᓂᐅᓕᖃᑦᑕᖅᑐᖅ ᐱᑕᖃᙱᑦᑑᑉ ᖃᓂᖕᒐᓂᑦ ᐸᖑᔪᓂᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ Phillips Creek-ᒥᑦ ᐊᓯᖕᒋᓐᓂᓪᓗ ᐃᒪᑦᑎᐊᕙᖅᑐᓂᑦ ᐃᓗᓪᒧᑦ ᑯᕕᔪᓂᒃ (ᓲᕐᓗ ᐊᐅᒃᐸᓪᓕᐊᔪᖅ ᑕᕆᐅᑉ ᓯᑯᖕᒐᓂᑦ) ᐃᒪᑦᑎᐊᕙᓕᐅᖃᑦᑕᖅᑐᑦ ᕿᙳᐊᓂᑦ ᐃᓱᐊᓂᑦ ᐊᐅᔭᑕᒫᒃᑯᑦ, ᑕᐃᒪᓐᓇᐃᖃᑦᑕᖅᐳᓂ ᑭᓯᐊᓂ ᐃᓗᓪᒧᑦ ᑯᕕᔪᑦ ᓴᓐᒋᓕᔭᕌᖕᒐᑕ ᐊᑯᓪᓕᕈᕐᕕᒃ (ᐋᕆᓯ) ᓄᙳᐊᓂᑦ. ᐃᒪᑦᑎᐊᕙᒃ ᐃᓗᓪᒧᑦ ᑯᕕᔪᖅ ᐱᒪᕆᐅᔪᖅ ᖃᓕᓈᖕᒐᔪᓕᐅᕆᓂᕐᒧᑦ (ᓲᕐᓗ, ᐊᑯᓪᓕᖅᑎᕆᓂᖃᓗᐊᖕᒋᑦᑐᖅ ᐊᑯᓐᓂᖕᒐᓂᑦ ᖀᖕᒐᓂᑦ ᐊᒻᒪᓗ ᐃᑎᓂᖅᓴᓂᑦ ᐃᒪᕐᒥᑦ) ᕿᙳᐊᓂᑦ ᐅᑭᐅᑕᒫᖅ, ᑕᐃᒪᐅᖕᒋᓐᓇᖃᑦᑕᖅᐳᓂ ᕿᙳᐊᓂᓗᒃᑖᖅ, ᐊᑦᑎᖕᓂᖅᓴᒥᑦ ᐊᓯᐊᙳᔫᖑᖃᑦᑕᖅᐳᓂ ᐆᓇᕐᓂᕐᒥᒃ ᐊᒻᒪᓗ ᑕᕆᐅᖃᕐᓂᕐᒥᑦ 20 ᒦᑕᓂᑦ ᐃᑎᓂᕐᒥᑦ. ᑭᖑᓂᐊᒍᑦ ᓴᖅᑭᑦᑎᖅᑳᖅᑎᓪᓗᒋᑦ ᖃᓕᓈᓕᖕᒥᑦ, ᐆᓇᕐᓂᐅᔪᖅ ᐊᒻᒪᓗ ᑕᕆᐅᖃᕐᓂᐅᔪᖅ ᐊᓯᐊᙳᖃᑦᑕᕐᓂᖕᒐᓄᑦ ᐆᒃᑐᕋᐃᓃᑦ ᕿᑎᕈᔪᐊᓂᑦ ᐃᒪᐅᑉ ᖃᓂᑕᖕᒐᓂ ᕿᙳᐊᓂᑦ ᓇᓗᓇᐃᖅᑐᖅ ᐊᓄᕆ ᐱᔾᔪᑕᐅᓗᐊᕐᒪᑦ ᐃᒪᐅᑉ ᖀᖕᒐᓂᑦ ᐊᑯᓪᓕᖅᑎᕆᓂᕐᒧᑦ. ᐊᑖᓂᑦ ᐆᓇᕐᓂᐅᑉ ᐊᒻᒪᓗ ᑕᕆᐅᖃᕐᓂᐅᑉ ᐊᓯᐊᖑᓗᐊᖃᑦᑕᕐᓂᐊᓂᑦ ᕿᙳᐊᓂᑦ ᑕᐃᒪᓐᓇᐃᖕᒋᓇᖃᑦᑕᖅᑐᖅ.

ᑕᕆᐅᑉ ᐊᓗᐊᓂᑦ ᓴᓗᒪᐃᓐᓂᖅ ᐱᓪᒪᕆᐅᖕᒥᔪᖅ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖕᒐᓄᑦ ᐱᐅᖕᒋᑦᑐᒥᒃ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᐊᒃᑐᖅᓯᔪᖕᓇᕐᒪᑦ. ᐆᒃᑑᑎᒋᓗᒍ, ᖁᑦᑎᓗᐊᖅᐸᑦ ᓴᓗᒪᐃᓐᓂᖅ ᖃᐅᒪᓂᕐᒥᑦ ᐱᑕᖃᙱᑎᑦᑎᔪᖕᓇᖅᑐᖅ ᑕᕆᐅᕐᒥᑦ ᐱᕈᖅᑐᓄᑦ ᐆᒪᔪᕋᓛᓪᓘᓐᓃᑦ ᐃᐱᑎᓪᓗᒋᑦ. ᖁᓪᒧᑦ ᖃᐃᓐᓴᐃᓂᕐᒥᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᑕᒪᐃᓐᓄᑦ, ᐃᒪᖅ ᕿᙳᐊᓂᑦ ᑕᑯᒃᓴᐅᓐᓇᖅᑐᖅ, ᐃᒪᕐᒥᓗᒃᑖᖅ; ᓴᓗᒪᙱᓐᓂᖅ ᖁᑦᑎᒃᓯᓯᓛᕐᔪᓚᐅᖅᑐᖅ ᐃᒪᐅᑉ ᖀᖕᒐᓂᑦ, ᐱᔾᔪᑕᐅᔫᒃᓴᐅᔪᖅ ᐃᒪᑦᑎᐊᕙᒃᑖᕐᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᖀᖕᒐᓂᑦ ᑯᕕᔪᒧᑦ ᐊᒻᒪᓗ ᐊᓗᐊᓄᙵᐅᔪᒧᑦ, ᐱᔫᒃᓴᐅᔪᖅ ᑕᒃᑯᐊ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓂᓐᓂᖕᒐᓄᑦ. ᓄᖑᑎᖅᓯᒪᔪᑦ ᐋᒃᓯᔾᔨᓐ (DO) ᓇᓗᓇᐃᖅᓯᔪᖅ ᖃᓄᑎᒋ ᐋᒃᓯᔾᔨᓐ ᐃᒪᕐᒥᑦ ᒪᓂᒪᓂᖕᒐᓂᒃ ᐃᑲᔪᖅᐳᓂ ᐆᒪᔪᓂᒃ. ᓄᖑᑎᖅᓯᒪᔪᖅ ᐋᒃᓯᔾᔨᓐ ᑲᑎᓯᒪᔪᑦ ᖁᑦᑎᒃᓯᕙᒃᐳᑎᒃ ᐊᑦᑎᒃᓯᕙᒃᐳᑎᒃ, ᐱᔾᔪᑕᐅᔪᖅ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᒃ ᓲᕐᓗ ᓯᐊᒻᒪᒃᑎᕆᓂᖅ ᐊᒻᒪᓗ ᓯᓚᒥᓪᓚᖅᑐᒥᑦ, ᐊᑯᓪᓕᖅᓯᒪᔪᓂᑦ, ᐊᓂᖅᓵᖅᑐᕐᓂᕐᒥᑦ ᐊᒻᒪᓗ ᓱᕈᖅᐸᓪᓕᐊᔪᓄᑦ. ᕿᙳᐊᓂᑦ 2019-ᒥᑦ, ᓄᖑᑎᖅᓯᒪᔪᑦ ᐋᒃᓯᔾᔨᓐ ᑲᑎᓯᒪᔪᑦ ᐃᒪᓐᓇᐃᓚᐅᖅᑐᑦ 6.6 mg/L to 12.2 mg/L, ᐊᒃᑐᐊᓂᖃᖅᐳᓂ ᑲᑎᓐᓂᐅᔪᓂᒃ 57%-ᒥᑦ 104%-ᒧᑦ, ᓇᓗᓇᐃᖅᓯᔪᖅ ᐋᒃᓯᔾᔨᓐ ᒪᓂᒪᓂᖕᒐᓄᑦ ᑖᑉᑯᓇᓂ ᐃᑲᔪᐃᔪᓂᒃ ᐱᕈᖅᐸᓪᓕᐊᑎᑦᑎᓂᕐᒥᒃ.

ᐱᕈᖅᑐᑦ (Chlorophyll-a) ᐊᑯᓪᓕᖅᓯᒪᔪᒧᑦ ᐃᓚᒋᔭᐅᔪᖅ ᐊᒻᒪᓗ, ᑕᕆᐅᕐᒥᐅᑕᓂᑦ, ᐆᒃᑐᕋᐃᖃᑦᑕᖅᑐᖅ ᖃᓄᑎᒋ ᑐᖑᔪᖅᑐᖃᕐᓂᕐᒥᒃ, ᐱᓗᐊᖅᑐᒥᑦ ᐆᒪᔪᕋᓛᑦ, ᐱᕈᖅᐸᓪᓕᐊᔪᑦ ᐃᒪᕐᒥᑦ. ᐱᓪᒪᕆᐅᔪᖅ ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖕᒐᓄᑦ ᑭᒡᓕᐅᔪᑦ ᑐᖑᔪᖅᑕᓕᒃᑕᖃᓗᐊᖅᐸᑦ ᐃᒪᕐᒥᑦ ᓇᓗᓇᐃᖅᓯᓂᐅᔪᙵᖅᑐᖅ ᖁᕐᕕᖕᒥᙱᖅᑐᕋᓗᙵᓂᑦ ᐱᐅᖕᒋᑦᑐᓕᐅᕆᓂᐅᖕᒪᑦ, ᐱᐅᖕᒋᑦᑐᒃᑯᑦ ᐊᒃᑐᖅᓯᔪᙵᖅᑐᖅ ᐱᕈᖅᐸᓪᓕᐊᓂᖅᑐᓂᒃ, ᐆᒃᑑᑎᒋᓗᒋ, ᐋᒃᓯᔾᔨᓐᖃᓗᐊᖕᒋᓐᓂᖅ ᐳᕙᙵᓄᑦ ᐃᑲᔩᑕᐅᔪᖅ, ᑐᕐᑯᓇᖅᑐᑦ ᑐᖑᔪᖅᑐᐃᑦ, ᐊᒻᒪᓗ ᖃᐳᐊᕿᓂᖃᕐᓂᖅ (Perez-Ruzafa et al. 2019). ᐃᒪᓐᓇᐃᓪᓚᑦ, ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᑕᕆᐅᖅ, ᖄᖕᒐᓂᑦ ᐱᕈᖅᑐᖃᓗᐊᖕᒋᑉᐸᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᑲᑎᓯᒪᔫᒃᑯᑦ 0 mg/m³-ᒥᑦ 0.7 mg/m³-ᒧᑦ ᐊᒻᒪᓗ ᖄᖕᒐᓂᑦ ᐱᕈᖅᑐᖃᑦᑎᐊᖅᐸᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᑲᑎᓯᒪᔪᓂᑦ 0.7 mg/m³-ᒥᑦ 30 mg/m³-ᒧᑦ (Ardyna et al. 2013). ᕿᙳᐊᓂᑦ 2019-ᒥᑦ, ᐱᕈᖅᑐᐃᑦ ᑲᑎᓯᒪᔪᑦ ᐊᑦᑎᖕᓂᖅᓴᐅᓚᐅᖅᑐᑦ, 0 mg/m³-ᒥᑦ 0.9 mg/m³-ᒧᑦ, ᑕᑯᒃᓴᐅᑎᑦᑎᔪᖅ ᖃᐅᔨᒪᓇᐅᑎᒥᒃ ᐱᓕᐅᕆᕙᓪᓕᐊᓂᖅ ᐅᓗᕆᐊᓇᖅᑐᖃᓗᐊᖕᒋᒻᒪᑦ ᐱᐅᖕᒋᑦᑐᖃᕐᓂᕐᒧᑦ ᖁᕐᕕᖕᒥᙱᖅᑐᕋᓗᙵᓂᑦ.

ᐃᒪᐅᑉ ᐊᐅᓚᓂᖕᒐ ᐊᒻᒪᓗ ᔫᓇᓕᕆᓂᖅ

ᐃᒪᐅᑉ ᐊᐅᓚᓂᖕᒐ ᐊᒻᒪᓗ ᔫᓇᓕᕆᓂᖅ ᖃᕆᑕᐅᔭᒃᑯᑦ ᕿᒥᕐᕈᓂᐅᖃᑦᑕᖅᑐᖅ ᒪᓂᒪᔪᓂᒃ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ Phillips Creek-ᒧᑦ (ᓲᕐᓗ, ᕿᒥᕐᕈᐸᓗᓂ ᑎᑎᖅᑲᓂᒃ, ᐊᔾᔨᓂᒃ, ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᐅᓚᓂᖕᒐᓂᒃ ᐊᒻᒪᓗ ᐊᓗᐊᓄᐊᖅᑐᓄᑦ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ), ᖃᓄᐃᖕᒐᔪᓕᕆᓂᐊᕐᓗᓂ ᐊᓗᐊᓄᐊᖅᑐᑦ ᐋᖅᑭᐅᒪᓂᖕᒋᓐᓄᑦ ᐊᒻᒪᓗ ᓇᒧᙵᖃᑦᑕᕐᓂᖕᒋᓐᓂᒃ ᐊᔾᔨᖏᙱᓐᓂᐅᔪᓂᒃ ᐃᒪᕐᒥᑦ ᕿᙳᐊᓂᑦ ᐃᓱᐊᓂᑦ. ᑕᒪᓐᓇ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᖅ ᐱᓕᕆᐊᒃᓴᖅ ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒦᑦᑐᖅ ᓈᓴᐅᑎ 83(a), ᐅᖃᖅᓯᒪᔪᖅ ᓇᓗᓇᐃᒃᑯᑕᕐᒥᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓂᒃ ᐊᓗᐊᓄᐊᖅᑐᑦ ᓇᒧᙵᖃᑦᑕᕐᓂᖕᒋᓐᓄᑦ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᕐᒥᑦ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒥᑦ

ᕿᓐᖑᐊᓂᑦ ᐃᒃᓯᕝᕕᖕᒥᑦ ᐱᔪᓂᒃ. **ᑕᒪᐃᓐᓄᑦ, ᖃᓄᐃᖓᓂᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ ᐅᑉᓗᒥᒧᑦ ᑎᑭᓪᓗᒍ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓚᖅᑎᑕᐅᓂᖓᓄᑦ ᕿᓐᖑᐊᓂᑦ ᐃᒃᓯᕝᕕᒃ ᐱᐅᖏᑦᑐᒥᒃ ᐊᒃᑐᖅᓯᓂᖃᖅᑑᔾᔪᑎᒋᑦᑐᖅ ᐃᒪᐅᑉ ᐊᐅᓚᓂᖓᓄᑦ ᐊᒻᒪᓗ ᓄᓇᓕᕆᓂᕐᒧᑦ, ᐆᒃᑐᕋᖅᑕᐅᔪᑦ ᑭᓪᓕᐅᔪᑦ ᐊᔾᔨᒋᓚᐅᕐᒪᒋᑦ ᐅᑭᐅᓂᑦ ᓯᕗᓂᐊᒍᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᐅᕙᓘᓐᓃᑦ ᐃᖏᓂᒃ ᐊᓯᐊᓐᖑᖃᑦᑕᕐᓂᐅᔫᓪᓗᑎᒃ.**

ᖃᓄᐃᖓᓂᐅᔪᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᑦ Phillips Creek ᖃᓄᑐᐃᓈᕐᒪᑦ ᑕᐃᒪᐃᓇᐃᓪᓗᓂ ᓯᓚᒥᑦ ᐊᒻᒪᓗ ᐱᕚᓪᓕᐊᓂᖓ ᐊᔾᔨᒌᓐᒋᓐᓂᖓᓄᑦ ᑕᕆᐅᑉ ᐊᓗᐊᓄᐊᖅᑐᓄᑦ. ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᑰᓚᕈᑎᑐᑦ, ᑕᒪᒃᑖᕐᓚᖅ ᐊᓗᐊᓄᐊᖅᑐᑦ Phillips Creek-ᒧᐊᖃᑦᑕᖅᑐᑦ ᐅᐱᕐᖖᑳᒃᑯᑦ ᐊᐅᒃᐸᓪᓕᐊᑎᓪᓗᒍ, ᐊᐅᔭᒃᑯᑦ ᒪᕐᑯᒃᑳᖓᓪᓗ. ᐊᖏᑎᒋᓂᖏᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᑰᒃᑯᑦ ᑕᕆᐅᕐᒧᐊᖃᑦᑕᖅᑐᑦ ᐅᑭᐅᑕᓖᒃᑯᑦ ᐊᔾᔨᒌᓐᒋᑦᑐᑦ ᖃᓄᐃᓕᐅᕐᓃᑦ ᐊᑐᖅᓱᒋᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᖃᓄᑎᒋ ᐊᐳᑎᒥᑦ ᐱᔪᑦ, ᐊᖏᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᑯᓂᐅᑎᒋᓂᖓᓄᑦ ᐊᐅᒃᐸᓪᓕᐊᓂᐅᑉ, ᐊᒻᒪᓗ ᐊᓗᐊᓄᐊᖅᑐᑦ ᑰᓚᐃᓂᑦ, ᐅᕝᕕᖓᓂᕐᓂᑦ, ᐊᓯᖏᓐᓂᓪᓗ. ᐊᖏᑎᒋᓂᖓ ᐊᓗᐊᓄᐊᖅᑐᑦ ᑲᑎᑕᐅᔪᑦ ᐱᖓᓱᖓᓂᑦ ᑲᑎᓐᓂᐅᔪᒥᑦ 2014-2017-ᒥᑦ ᐃᓚᒋᔭᐅᓪᓗᓂ MEEMP ᐆᒃᑐᕋᐃᓂᕐᓄᑦ ᐊᔾᔩᓐᒋᖃᑦᑕᖅᓯᒪᔪᖅ; ᐊᒻᒪᓗ, ᐊᐅᓚᓃᑦ Phillips Creek-ᒥᑦ ᑕᐃᒪᓐᖓᓂᑦ ᐱᕚᓪᓕᐊᔪᓂᑦ ᓇᓗᓇᓐᖏᑦᑐᑦ ᐊᔾᔨᒃᑯᑦ. ᓱᐸᓗᑎᒧᑦ ᐃᖏᕐᕋᔪᑦ ᐊᑯᓐᓂᖓᓂᑦ 1982 ᐊᒻᒪᓗ 2016 ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ Phillips Creek ᐸᓐᖓᓂᑦ 2.5 ᑭᓖᒥᑕᓪᓗᐊᓄᑦ ᑕᒃᐸᐅᖓᖖᖅ. ᐊᓯᐊᓐᖑᕐᓂᖅ ᓱᐸᓗᒥᑦ ᑲᓇᖕᓇᖓᓂᑦ ᐱᖓᖕᓇᖓᓄᑦ ᐃᓱᐊᓂᑦ ᑕᕆᐅᑉ ᐱᖓᖕᓇᒨᓐᖓᐅᔫᔭᖅᑐᖅ.

ᑕᕆᐅᕐᒥᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖓ

ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖓ ᐊᑐᖅᑐᖅ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑦ ᖃᓄᐃᖓᔭᕆᐊᖃᕐᓂᕐᒧᑦ ᓈᓴᐅᑎ 83(a) ᐊᒻᒪᓗ 99(a) ᑲᑎᖅᓱᐃᓂᖃᖅᑐᓂ ᐊᓗᐊᓄᐊᖅᑐᓂᑦ ᐆᒃᑑᑎᓂᒃ ᑎᓴᒪᐅᔪᓂᑦ ᑲᑎᓐᓂᕐᓂᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᐱᖓᓱᑦ ᑲᑎᓐᓃᑦ (ᐱᖓᖕᓇᒥᑦ, ᑲᓇᖕᓇᒥᑦ, ᐊᒻᒪᓗ ᐅᐊᖕᓇᖅᐸᓯᖓᓂᑦ ᐱᖓᖕᓇᖅᐸᓯᖓᓂᑦ) ᖃᐅᔨᓴᐃᕙᐅᓯᒪᔪᑦ (2014-2018) ᐃᓚᒋᔭᐅᓪᓗᓂ ᓴᖅᑭᑎᓂᕐᒧᑦ ᓄᑖᖅ ᐅᐊᖕᓇᖅᐸᓯᖓᓂᑦ ᑲᓇᖕᓇᖅᐸᓯᖓᓂᑦ ᑲᑎᓐᓂᐅᔪᒥᑦ ᓯᕗᓂᒃᓴᒥᑦ ᐊᓯᐊᓐᖑᕐᓂᐅᔪᖕᓇᖅᑐᑦ ᐱᔨᑎᕆᐸᓗᕆᑦ ᕿᓐᖑᐊᓂᑦ ᐃᒃᓯᕝᕕᖕᒥᑦ ᐱᕐᑯᑎᖏᓐᓄᑦ. ᐊᕙᓗᐊᓂᑦ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᑦ ᐃᓚᒋᔭᐅᓪᓗᓂ ᐅᖓᓯᒃᑎᒋᔪᒥᒃ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓂᑦ ᐃᒃᓯᕝᕕᖕᒧᑦ (ᐱᒋᐊᕐᕕᐅᔪᖕᓇᖅᑐᖅ), ᐃᓱᒪᒋᐸᓗᒍ ᐱᐅᖏᑦᑐᖅᑕᖅᑲᐅᖕᓇᕐᓂᖓᓄᑦ ᐱᔾᔪᑕᐅᔪᓄᑦ (ᓲᕐᓗ, ᐅᔭᕋᒃᑕᓇᐊᕐᒥᑦ ᐳᔪᖃᖄᒃ, ᐳᔪᕈᔪᐃᑦ ᐊᓂᐊᔪᑦ) ᐊᒻᒪᓗ/ᐅᕙᓘᓐᓃᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᑦ (ᐊᓗᐊᓄᐊᖅᑐᑦ ᐊᐅᓚᔾᔭᒃᑲᓂᕐᓂᖏᑦ ᐊᒻᒪᓗ ᓇᒨᓐᖓᐅᔾᔭᐅᓂᖏᑦ) ᑕᕆᐅᕐᒥᑦ. **ᑕᒪᐃᓐᓄᑦ, ᐅᑉᓗᒥᒧᑦ ᑎᑭᓪᓗᒍ ᖃᓄᐃᖓᓂᐅᔪᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ ᓴᓇᔭᐅᕙᓪᓕᐊᑎᓪᓗᒍ ᐊᒻᒪᓗ ᐊᐅᓚᖅᑎᑕᐅᑎᓪᓗᒍ ᕿᓐᖑᐊᓂᑦ ᐃᒃᓯᕝᕕᒃ ᐱᐅᖏᑦᑐᒥᒃ ᐊᒃᑐᖅᓯᓂᖃᖅᑑᔾᔪᑎᒋᑦᑐᖅ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖓᓄᑦ, ᐆᒃᑐᕋᖅᑕᐅᓯᒪᓂᖏᑦ ᑭᓪᓕᐅᔪᑦ ᐊᔾᔨᖏᒪᒋᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ, ᑎᑭᐅᑎᓂᕐᓃᓪᓗᑎᒃ CCME-ᒥᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖏᓐᓄᑦ ᒪᓕᒃᑕᐅᔭᒃᓴᓂᑦ, ᐅᕙᓘᓐᓃᑦ ᐱᔾᔪᑕᐅᓐᖏᑦᑐᖅ ᐱᓕᕆᐊᕐᒧᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᑦ.**

ᖃᐅᔨᓴᐃᓂᖅ ᑕᒪᑐᒥᓐᖓᑦ ᐊᒻᒪᓗ ᐱᐅᖏᑦᑐᖅᑕᓕᖕᓂᑦ ᐊᓗᐊᓃᑦᑐᓂᒃ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᐆᒃᑐᕋᐅᑏᑦ ᑲᑎᑕᐅᔪᓂᑦ 44-ᓂᒃ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᓂᑦ, ᐊᒻᒪᓗ ᒪᕿᒃᑲᓐᓃᒃ ᑲᑎᓐᓂᖃᖕᖏᑦᑐᓂᒃ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᓂᑦ ᐊᔾᔨᒃᑎᓐᓂᐊᕐᓗᒋᑦ ᓯᕗᓂᐊᒍᑦ MEEMP ᑐᕌᖓᔪᑦ. ᑲᑎᓯᒪᔪᑦ ᓴᕕᑦ, ᓄᓇᒥᑦ ᐱᔪᑦ, ᐳᔪᕐᒥᑦ ᐱᔪᑦ, ᐊᒻᒪᓗ ᓇᐃᒪᓐᓇᖅᑐᑦ ᐳᔪᕐᒥᑦ ᐱᔪᓂᒃ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᑐᖖᓃᒻᒪᑕ ᐊᑐᖅᑕᐅᔭᓇᐊᓪᓚᖕᓄᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖏᓐᓄᑦ ᒪᓕᒃᑕᐅᔭᒃᓴᓂᑦ, ᖃᑉᓯᐊᕐᔪᐃᑦ ᐊᑐᖅᑎᑕᐅᓐᖏᓐᓗᑎᒃ. ᓈᓴᐅᑎᓂᕐᒧᑦ ᐱᓕᕆᖅᑎᒌᓐᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ ᓯᓚᒥᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓄᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᓴᕕᑦ ᑲᑎᓯᒪᔪᑦ ᑲᑎᑉᐸᓪᓕᐊᓂᖃᓚᐅᖅᑐᑦ ᖁᑦᑎᒃᓯᓯᒪᓪᓗᑎᒃ ᖃᓂᓐᓂᖅᓴᐅᔪᒥᑦ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓯᕝᕕᖕᒥᑦ ᐊᓯᖏᓐᓂᐅᖓᓂᑦ ᐃᓂᐅᔪᓂᑦ ᐆᒃᑐᕋᐃᕝᕕᐅᔪᓂᑦ ᕿᓐᖑᐊᓂᑦ.

ᒥᑭᔪᑦ ᐅᖓᑕᐅᑎᓐᓂᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖏᓐᓄᑦ ᒪᓕᒃᑕᐅᔭᒃᓴᓂᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐋᓯᓂᒃᒧᑦ ᐊᒻᒪᓗ ᓂᑯᓪᒧᑦ ᑭᓯᐊᓂ ᐱᓕᕆᐊᕐᔫᓐᖏᑦᑐᓇᔭᐅᔪᑦ, ᓴᕕᑦ ᐊᒥᓱᓐᖑᖅᐸᓪᓕᐊᖃᑦᑕᓚᑕ ᐅᖓᓯᖕᓂᖅᓴᐅᑉᓗᑎᒃ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓯᕝᕕᖕᒥᑦ. ᐊᔾᔨᐸᓪᓕᖓ, ᐅᖓᑕᐅᑎᓐᓂᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᖃᑉᓯᐊᕐᔪᐊᓂᑦ ᓄᓇᒥᑦ ᐱᔪᓂᒃ ᐃᓚᒋᔭᐅᔪᓂᑦ, ᑭᓯᐊᓂ ᐱᑕᖃᕐᓐᖏᑦᑐᑦ, ᒥᑭᔪᑎᐅᑉᓗᑎᒃ (ᓲᕐᓗ, ᖁᑦᑎᖕᓃᑦ ᓇᓃᓐᓂᖏᓐᓂᖏᑦ ᓈᓐᓂᖅᓯᓇᔭᖅᑐᓇᔭᐅᖏᑦᑐᑦ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ), ᐊᒻᒪᓗ ᑲᑎᒪᐅᖏᑦᑐᑦ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓯᕝᕕᖕᒥᑦ ᐱᕙᐅᕙᓪᓕᐊᕙᐅᓂᖓᓄᑦ.

ᐊᓗᐊᓄᐊᖅᑐᑦ ᐊᖏᑎᒋᓂᖏᑦ, ᐱᓗᐊᖅᑐᒥᑦ ᐳᓴᓐᑎᒃᑯᑦ ᒥᕿᔩᑎᓂᑦ, ᐱᒻᒪᕆᐅᔪᖅ ᐊᓗᐊᓄᐊᖅᑐᑦ ᖃᓄᐃᓐᓂᖓᓄᑦ ᓵᕕᑦ ᑲᑎᑉᐸᓪᓕᐊᖃᑦᑕᕐᓂᖏᓐᓄᑦ ᐊᖏᓂᖅᓴᐅᑉᓗᑎᒃ ᒥᕿᔩᑎᓂᒃ ᐊᓗᐊᓄᐊᖅᑐᓄᑦ ᑕᐃᒪᓐᓂᑦ ᐱᔪᓂᒃ ᑖᒻᒪᓐᖓᑦ ᐊᒻᒪᓗ ᐱᐅᖏᑦᑐᓂᑦ (ᓲᕐᓗ, ᐊᒥᓱᓐᖑᕐᕕᐊᓂᖏᑦ ᖃᓐᖓᓂᑦ ᐊᖏᑎᒋᓂᖏᑦ). ᑕᐅᑐᙵᖅᓱᒍ ᐳᓴᓐᑎᖓ ᒥᕿᔪᑦ ᐊᓗᐊᓄᐊᖅᑐᑦ ᑲᑎᓐᓂᐅᔪᓂᒃ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᖏᔪᒥᒃ ᐊᓯᐊᓐᖑᕐᓂᖏᑦ ᒥᒃᕿᔩᑎᓂᑦᑐᑦ ᐊᑯᓂᖓᓂᑦ 2014 ᐊᒻᒪᓗ 2019.

ᐱᒻᒪᕆᐅᔪᖅ, ᐊᖏᓪᓕᕆᐊᖅᑐᑦ ᓴᕕᒃᑕᓕᒃ ᐊᓗᐊᓄᐊᖅᑐᓂᑦ - ᓇᓗᓇᐃᖅᑕᐅᔪᑦ ᐃᓱᒫᓗᑎᒋᔭᐅᓂᖏᓐᓄᑦ ᓄᓇᓕᖏᐅᓄᑦ ᐃᓄᖕᓄᑦ ᐊᖏᓪᓕᕆᐊᕐᓂᖏᓐᓄᑦ ᐅᔾᕋᒃᑕᖅᑕᐅᔪᑦ ᐳᔪᒃᑖᓕᐅᕐᓂᖏᑦ ᐅᕝᕙᓘᓐᓃᑦ ᑯᕕᓂᕐᓂᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᕝᕕᖏᓐᓂᑦ ᐱᓕᕆᐊᑉ - ᖃᐅᔨᔭᐅᒪᔪᖕᒋᑦᑐᑦ ᑲᑎᓯᒪᔪᑦ ᐊᖏᓂᖅᓴᐅᑉᓗᑎᒃ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᓂᐅᖓᓂᑦ 2014-ᒥᑦ ᑭᓪᓕᒋᔭᐅᔪᓕᕆᓂᕐᒥᑦ.

ᐊᓗᐊᓂᑦ ᐆᒪᔪᑦ ᐳᓚᒃᑦᑕᖅᑐᑦ

ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒧᑦ ᖃᓄᐃᖓᓯᕆᐊᒃᑯᓂᖅ 99a,c, ᐊᓗᐊᓂᑦ ᐆᒪᔪᑦ ᐳᓚᒃᑦᑕᖅᑐᓄᑦ ᑲᑎᖅᓱᐃᓂᒃᑲᓚᐅᖅᑐᑦ ᐆᑐᕋᐅᑎᓂᒃ 32-ᓂᒃ ᐆᑐᕋᐃᕝᕚᐅᔪᓂᒃ ᑎᓴᒪᐅᔪᓂᑦ ᑲᑎᖕᓂᕐᓂᑦ (ᑲᓇᖕᓇᒥᑦ, ᐱᖓᖕᓇᒥᑦ, ᐅᐊᖕᓇᖅᐸᓯᖕᒐᓂᑦ ᑲᓇᖕᓇᖅᐸᓯᖕᒐᓂᑦ ᐊᒻᒪᓗ ᐅᐊᖕᓇᖅᐸᓯᖕᒐᓂᑦ ᐱᖓᖕᓇᖅᐸᓯᖕᒐᓂᑦ), ᐊᑐᓂ ᐃᓂᐅᖃᑕᒋᔭᐅᔪᑦ ᐊᓗᐊᓂᑦ ᐆᒃᑐᕋᐃᕝᕚᐅᔪᓂᑦ. ᐆᒃᑐᕋᐅᑏᑦ ᑲᑎᑕᐅᓚᐅᖅᑐᑦ ᐱᖓᓱᓂᒃ ᐱᕝᕙᐅᑉᓗᑎᒃ ᐊᑐᓂ ᐆᒃᑐᕋᐃᕝᕚᐅᔪᓂᑦ, ᐊᑐᖅᐸᑎᒃ ᑎᒍᓯᕐᔪᑎᓂᒃ, ᐊᐅᓪᓚᖅᑎᑕᐅᑉᓗᑎᓪᓗ Biologica Environmental Services-ᑯᓐᓄᑦ ᐋᖅᑭᒃᓱᖅᑕᐅᓂᐊᕐᓗᑎᒃ ᐊᒻᒪᓗ ᐃᓕᑕᖅᓯᓂᐊᕐᓗᑎᒃ (ᐊᑦᑎᓛᒧᑦ ᐱᐅᖏᑦᑐᖅᑕᓕᖏᑦ). **ᑕᒪᐃᓐᓄᑦ, ᖃᓄᐃᖓᓂᐅᔪᑦ ᐊᓗᐊᓂᑦ ᐆᒪᔪᑦ ᐳᓚᒃᑦᑕᖅᑐᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ 2019-ᒥᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑕᐅᓂᖓᓄᑦ ᕿᒥᒍᐊᓂᑦ ᐃᒃᓴᕕᒃ ᐱᐅᖏᑦᑐᒥᒃ ᐋᒃᑐᖅᓯᓂᖅᖅᑑᔾᔭᖏᑦᑐᖅ ᐊᓗᐊᓂᑦ ᐆᒪᔪᑦ ᐳᓚᒃᖅᑕᖅᑐᓄᑦ, ᐱᑕᖃᐅᖏᓐᓇᖅᑐᑦ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᑦᑎᐊᖅᐳᓂ.**

ᐆᒃᑐᕋᐃᓂᖅ ᕿᒥᒍᐊᓂᑦ ᖃᐅᔾᓇᓚᐅᖅᑐᖅ ᓯᓚᒥᑦ ᐊᔾᔨᒌᖏᓐᓂᐅᔪᓂᒃ ᐆᒪᔪᕋᓛᓄᑦ, ᑕᐃᒪᓐᓇᐃᑦᑐᖅ ᐊᓗᐊᓂᑦ ᐆᒪᔪᑦ ᐳᓚᒃᑦᑕᖅᑐᑦ ᐃᓂᖏᓐᓂᑦ. ᐆᒪᔪᕋᓛᖃᐅᕐᓂᖅ ᐊᑦᑎᖕᓂᖅᓴᐅᓗᐊᓚᐅᖏᑦᑐᑦ 2019-ᒥᑦ 2018-ᒥᐅᖓᓂᑦ ᐊᒻᒪᓗ, ᐊᒻᒪᓗ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᔾᔨᒌᖏᓐᓂᕐᔪᐊᑦ ᖃᐅᔨᔭᐅᖓᑕ, 2019-ᒥᑦ ᓈᓴᐅᑏᑦ ᐊᒥᓲᓂᖅᓴᐅᓚᐅᖅᑐᑦ. ᐊᒻᒪᓗᒃᑲᓂᖅ, ᓇᓗᓇᐃᖅᓯᓂᖅᑕᖃᓚᐅᖏᑦᑐᖅ ᐆᒪᔪᕋᓛᓄᑦ ᐊᔪᖏᓐᓂᖃᕐᓂᖏᓐᓄᑦ ᐱᔾᔪᑕᐅᔪᓂᒃ ᖃᓐᓂᖅᓴᐅᔪᓄᑦ ᐅᔾᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓴᕕᖕᒧᑦ, ᐊᑐᓂ ᐃᓂᐅᔪᑦ ᐱᑕᖃᐅᑦᑎᐊᓚᐅᕐᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᐊᔾᔨᕈᔫᑉᓗᑎᒃ ᐆᒪᔪᑦ (ᓲᕐ, ᐊᔾᔨᒋᖏᑦᑐᑦ ᐆᒪᔪᕋᓛᑦ).

ᖃᓪᓇᒃᑐᑦ, ᐊᖏᔪᑦ ᐱᕈᖅᑐᐃᑦ ᐊᒻᒪᓗ ᐆᒪᔪᑦ ᐊᓗᐊᑕ ᖃᖓᓂᕐᒥᐅᑕᐃᑦ

ᖃᐅᔨᓴᐃᓂᖅ ᖃᓪᓇᒃᑐᓂᑦ, ᐊᖏᔪᑦ ᐱᕈᖅᑐᓂᒃ, ᐊᒻᒪᓗ ᐆᒪᔪᑦ ᐊᓗᐊᑕ ᖃᖓᓂᕐᒥᐅᑕᓂᒃ ᐱᓕᕆᐊᒃᖅᑐᖅ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒧᑦ ᓈᓴᐅᑎ 99a,c ᐊᔾᔨᑉᓗᓂᐅᓪᓗ ᐃᒪᕐᒥᑦ ᐊᔾᔨᓕᐅᕈᑎᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᖅ ᕐᑯᓕᓂᑦ ᑲᑎᖕᓂᐅᔪᓂᒃ ᑕᕆᐅᑉ ᐊᓗᐊᓂᑦ ᐃᓕᔭᐅᓯᒪᔪᓄᑦ; ᑕᓪᓕᒪᐃᑦ ᑲᑎᖕᓂᐅᔪᑦ ᓴᖅᑭᑕᐅᓚᐅᖅᑐᑦ ᐱᓕᕆᐊᕐᒥᑦ ᑕᑯᒃᓴᐅᔪᒥᑦ ᐊᓯᖏᓪᓗ ᑕᓪᓕᒪᐃᑦ ᖃᓂᑕᖓᓂᑦ. ᐃᒪᕐᒥᑦ ᐊᔾᔨᓕᐅᕈᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᖅ ᑕᕆᐅᕐᒥᐅᑕᓕᕆᔩᒧᑦ ᐊᒻᒪᓗ ᐊᔾᔨᓕᐅᕆᓂᐊᕐᓗᑎᒃ ᐳᓴᓐᑎᒃᑯᑦ ᖃᓪᓇᒃᑑᓂᕐᓂᑦ ᐊᒻᒪᓗ ᐆᒪᔫᓂᑦ, ᒪᓕᒃᐳᒍ ᐃᓂᓕᐅᕆᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᔪᖅ ᑎᑎᕋᖅᓯᒪᔪᖅ MEEMP ᐅᓂᖁᒥᑦ (Golder 2018), ᐊᒻᒪᓗ ᐱᐅᖏᑦᑐᓂᒃ ᐃᓕᑕᖅᓯᓂᕐᒧᑦ ᐆᒪᔫᓂᑦ ᐊᑦᑎᓛᒥᒃ ᐱᐅᖏᑦᑐᖅᑕᖃᖅᑐᒥᑦ ᐊᒻᒪᓗ ᐊᒥᓲᑎᕆᓂᖏᓐᓂᒃ (ᓈᓴᖅᑕᐅᔪᑦ ᐊᒻᒪᓗ ᐳᓴᓐᑎᒃᑯᑦ). **ᑕᒪᐃᓐᓄᑦ, ᖃᓄᐃᖓᓂᐅᔪᑦ ᖃᓪᓇᖕᒐᔪᓂᑦ, ᐊᖏᔪᑦ ᐱᕈᖅᑐᓂᒃ ᐊᒻᒪᓗ ᐆᒪᔪᑦ ᐊᓗᐊᑕ ᖃᖓᓂᕐᒥᐅᑕᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ 2019-ᒥᑦ ᓇᓗᓇᐃᖅᓯᔪᖅ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑦᑎᓂᖅ ᕿᒥᒍᐊᓂᑦ ᐃᒃᓴᕕᖕᒥᑦ ᐱᐅᖏᑦᑐᒥᒃ ᐋᒃᑐᖅᓯᓂᖅᖅᑑᔾᔭᖏᑦᑐᖅ ᐆᒪᔪᓂᒃ.**

ᐊᔾᔨᖁᖏᑦ ᐆᒪᔪᑦ ᑕᐃᒪᐅᓚᐅᖅᑐᑦ ᑲᑎᖕᓂᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ 2018-ᒥᑦ ᐊᒻᒪᓗ 2019-ᒥᑦ. ᐊᒥᓲᓂᖅᓴᐃᑦ ᑐᖑᔪᖅᑐᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ 2018-ᒥᐅᖓᓂᑦ, ᑭᓯᐊᓂ ᐊᒥᓲᓂᖅᓴᐃᑦ ᐊᔾᔨᓕᐅᖅᑕᐅᓚᐅᖅᑐᑦ *Laminaria* sp. ᐊᒻᒫᒪᔪᖅᑕᒃᑲᐅᓛᖑᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᕝᕚᐅᔪᓂᑦ ᐱᔾᔪᑎᒋᐸᓗᒍ ᐊᒥᓲᓂᖏᑦ, ᐊᓯᖏᑦ ᐅᐸᓗᓇᐊᖑᐊᑦ ᐊᒻᒪᓗ ᐃᓂᓕᐅᖅᑕᐅᓯᒪᖏᑦᑐᑦ ᑕᐃᒪᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᕝᕚᐅᔪᓗᒃᑖᓂᑦ. ᖃᐅᔨᔭᐅᔪᑦ ᐊᔾᔨᒌᖏᓐᓂᖏᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐅᑭᐅᓂᑦ ᒥᑭᔪᓂᕐᔭᐅᔪᑦ ᐊᒻᒪᓗ ᐱᔾᔪᑕᐅᔪᓐᓴᐅᔪᖅ ᐊᔾᔨᒌᖏᒃᑲᓪᓚᕐᓂᖏᑦ ᐅᕝᕙᓘᓐᓃᑦ ᐃᒪᖅᑳᖅ ᑕᒻᒪᖅᓯᒪᓂᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᔪᖅ. ᓱᓕ, ᖃᐅᔨᓴᐅᔪᓂᒃ ᖃᐅᔨᓇᐅᑎᒃᑲᓚᐅᖅᑐᖅ ᓯᓚᒥᑦ ᑕᒫᓂᓗ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᒃ ᐱᔾᔪᑎᒃᖅᑐᓂᒃ ᓴᓇᔭᐅᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑕᐅᓂᖓᓄᑦ ᕿᒥᒍᐊᓂᑦ ᐃᒃᓴᕕᒃ.

ᐃᖃᓗᐃᑦ

ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒧᑦ ᓈᓴᐅᑏᑦ 99b,c, 113, ᐊᒻᒪᓗ 114, ᐆᒃᑐᕋᐃᓂᒃᑲᓚᐅᖅᑐᑦ ᕿᒥᒍᐊᓂᑦ ᐃᒃᓴᕕᐅᑉ ᖃᓂᑕᖓᓂᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ ᐊᒥᓲᓂᖏᑦ ᐊᒻᒪᓗ ᐋᓐᓂᐊᖃᖅᑕᐃᓕᒪᓂᖏᑦᑕ ᖃᓄᐃᖓᓂᖏᑦ ᐃᖃᓗᒃᐲᑦ ᐊᓯᖏᓪᓗ ᐃᖃᓗᐃᑦ. ᖃᑉᓯᐊᕐᔪᕐᓂᑦ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᔾᔨᒋᖏᑦᑐᓂᒃ ᐃᖃᓗᖕᓂᒃ ᐃᓂᒋᔭᐅᔪᓂᓪᓗ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᒪᑦᑎᑕᐅᑏᑦ ᐊᔾᔨᒋᖏᑦᑑᑏᑦ. ᑲᑎᑕᐅᔪᑦ ᐃᖃᓗᐃᑦ ᐃᓕᑕᕆᔭᐅᒃᑲᓚᐅᖅᑐᑦ ᖃᓄᐃᑦᑑᓂᖏᓐᓄᑦ ᐆᒃᑐᖅᓱᕆᓪᓗ ᑕᑭᓂᖏᑦ/ᐅᖁᒪᐃᓐᓂᖏᑦ ᓴᕿᑕᐅᓂᐊᕐᖓᖅᓱᑎᒃ. ᑐᑭᖅᑐᑦ ᐃᖃᓗᐃᑦ ᐱᔭᐅᓯᒪᒃᑦᑕᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ ᖃᓄᐃᓐᓂᖏᑦ,

ᐅᑭᐅᖕᒋᑦ, ᐊᖑᓭᓘᖕᒪᖕᒑᑕ ᐊᕐᓇᓘᖕᒪᖕᒑᑕ, ᐊᕿᐊᕉᖕᒋᑦᑕ ᐃᓗᓕᖕᒋᑦ, ᐊᒻᒪᓗ ᓴᓇᑦ ᑎᒥᖕᒋᓐᓂᑦ (ᑎᒥᐊᓃᑦᑐᑦ) ᖃᐅᔨᓴᕐᓗᒋᑦ. **ᐊᔾᔨᒌᕐᓚᖕᓂᖕᒋᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐃᖃᓗᐃᑦ ᐊᒻᒪᓗ ᐊᒥᓲᓂᖕᒋᑦᑕ ᐅᑭᐅᓂᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᓇᓗᓇᐃᖅᑐᖅ ᓴᓇᔭᐅᕙᓪᓕᐊᓂᖕᒐ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑕᐅᓂᖕᒐ ᕿᙵᐊᓂᑦ ᐃᒃᓴᕙᒃ ᐊᓯᐊᙳᖅᑎᑦᑎᓂᖃᙱᒻᒪᑦ ᐃᖃᓗᖕᓄᑦ ᐅᐸᓗᒥᒧᑦ ᑎᑭᕝᕙᒍ; ᐊᒻᒪᓗᒃᑲᓂᖅ, ᐊᔾᔨᒌᕐᓚᖕᓂᖕᒋᑦ ᑕᑭᓂᖕᒋᓐᓄᑦ ᐊᒻᒪᓗ ᐅᖁᒪᐃᓐᓂᖕᒋᓐᓄᑦ ᐅᑭᐅᓂᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᖕᒋᓐᓂᒃ ᓇᓗᓇᐃᖅᓯᔪᑦ ᐃᓂᐅᔪᒥᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᐅᔪᑦ ᖃᓄᐃᓕᓂᖃᖅᑎᑦᑎᙱᒻᒪᑦ ᐃᖃᓗᐃᑦ ᖃᓄᐃᓐᓂᖕᒋᓐᓄᑦ.**

ᐃᖃᓗᒃᑕᐅᔪᑦ 2019-ᒥᑦ, 2018-ᒥᑎᑐᑦ, ᖁᑦᑎᖕᓂᖅᓴᐅᓚᐅᖅᑐᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᐅᖕᒐᓂᑦ ᐱᔾᔪᑕᐅᕐᓗᓂ ᐊᑯᓂᐅᓂᖅᓴᖅ ᐆᒃᑐᕋᐃᓂᖃᕐᓂᕐᒧᑦ, ᑕᐃᒪᓐᓇᒧᓪᓗ ᐱᓇᓱᖕᓂᖅᓴᐅᓂᖃᓚᐅᖅᑐᑦ. ᐃᓂᓕᐅᕆᓂᕐᓄᑦ ᐃᖃᓗᖕᓂᑦ ᐱᑕᖅᑕᐅᔪᑦ ᐊᓯᐊᙳᓚᐅᖕᒋᑦᑐᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᐃᖃᓗᒃᐲᑦ ᓂᕿᖕᒋᓐᓄᑦ, ᑲᓇᔦᑦ ᐊᒻᒪᓗ ᓇᐃᓐᓂᖅᓴᒥᒃ ᓇᒡᔦᓖᑦ ᑲᓇᔦᑦ 99%-ᖑᕐᓗᑎᒃ ᓱᓕ ᑲᑎᑕᐅᔪᓗᒃᑖᓂᑦ. ᒪᕐᕉᒃ ᐊᓯᖕᒋᑦ ᐃᖃᓗᐃᑦ ᐱᑕᖅᑕᐅᓚᐅᖅᑐᑦ, ᐊᑕᐅᓯᖅ ᑐᐊᑦᑐᕋᐅᔭᖅ (eel) ᐊᒻᒪᓗ ᐊᑕᐅᓯᖅ ᐃᖃᓗᐊᕈᖅ, ᑭᖑᓪᓕᖅᐸᐅᕐᓗᓂ ᑕᐃᒪᓐᓇᐃᑦᑐᓂᒃ MEEMP-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒦᖃᑕᐅᔪᖅ.

ᑲᑎᕝᕗᒋᑦ 13 ᐃᖃᓗᐃᑦ ᐱᔭᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᓘᓐᓃᑦ MEEMP-ᓗᒃᑖᒥᑦ ᐊᒻᒪᓗ AIS-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ 2019-ᒥᑦ; 8-ᖑᔪᑦ ᐃᖃᓗᖕᓂᑦ ᖃᐅᔨᔭᐅᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐊᓯᖕᒋᓐᓂᑦ ᐃᓚᒋᔭᐅᔪᓂᑦ, ᓇᓗᓇᐃᖅᓯᔪᑦ ᐃᖃᓗᖕᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᑦ ᐋᖅᑭᒃᓯᒪᓗᒃᑖᙱᒻᒪᑕ ᐃᖃᓗᐃᑦ ᐊᒥᓲᓂᖕᒋᓐᓂᒃ ᕿᙵᐊᓂᑦ ᐃᒃᓴᕙᖕᒥᑦ ᐊᒻᒪᓗ ᐱᓪᒪᕆᑦᑎᑦᑎᓗᐊᖕᒋᕝᕙᓂ ᐊᔾᔨᒌᙳᖕᒋᑦᑐᓂᒃ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᓂᒃ ᐱᓕᕆᐊᕆᓗᒃᑖᕐᓂᐊᕐᓗᒋᑦ ᖃᓄᐃᑦᑑᓂᖕᒋᑦ ᐃᖃᓗᐃᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖕᒋᑦ ᕿᙵᐊᓂ ᐃᒃᓴᕙᖕᒥᑦ.

Fyke ᒪᑦᑎᑕᐅᑏᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᐊᓯᐊᒍᖕᒎᖅ ᐃᖃᓗᓕᕆᓂᐊᕐᓗᓂ Fuki ᒪᑦᑎᑕᐅᑎᓄᑦ ᐊᒥᓲᙳᓗᐊᖅᑐᓂᒃ ᐃᖃᓗᒃᑕᐅᖃᑦᑕᕐᓂᖕᒋᓐᓄᑦ ᐊᑐᖅᑐᑎᒃ ᑕᐃᒪᓐᓇᐃᑦᑐᓂᒃ. Fyke ᒪᑦᑎᑕᐅᑏᑦ 12-ᓂᒃ ᐃᖃᓗᓚᐅᖅᑐᑦ, ᐱᖕᒐᓱᑦ ᐊᔾᔨᒌᙳᖕᒋᑦᑐᑦ ᐃᖃᓘᐸᓗᑎᒃ, ᐃᓚᐅᐸᓗᓂ ᐃᖃᓗᒃᐱᒃ - ᓯᕗᓪᓕᖅᐸᐅᔪᖅ MEEMP-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐱᑕᖅᑕᐅᓚᐅᖅᑐᖅ ᒪᑦᑎᑕᐅᑏᑦ ᐊᓯᖕᒋᓐᓂᒃ ᐊᑐᕝᕙᓂᒃ. ᐱᑕᖅᑕᐅᔪᑦ ᐊᑐᓂ ᐱᑕᖅᑕᐅᓇᓱᒃᑎᓪᓗᒋᑦ fyke ᒪᑦᑎᑕᐅᑎᓄᑦ ᖁᑦᑎᖕᓂᖅᓴᐅᓚᐅᖅᑐᖅ Fukui ᒪᑦᑎᑕᐅᑎᓂᐅᖕᒐᓂᑦ, ᓇᓗᓇᐃᖅᓯᐸᓗᓂ ᐱᖃᑖ ᐱᐅᓂᖅᓴᐅᓂᖕᒐᓄᑦ ᐊᑐᖅᑕᐅᖕᒎᖅᐸᑦ.

ᑕᑭᓂᖕᒋᑦ ᐊᒻᒪᓗ ᐅᖁᒪᐃᓐᓂᖕᒋᑦ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᖕᒋᓐᓅᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑯᓐᓂᖕᒋᓐᓂᑦ 2017, 2018 ᐊᒻᒪᓗ 2019 ᐃᖃᓗᒃᐱᖕᓄᑦ, ᑲᓇᔪᕐᓄᑦ ᐊᒻᒪᓗ ᓇᐃᓐᓂᖅᓴᒥᒃ ᓇᒡᔦᖕᓄᑦ ᑲᓇᔪᕐᓄᑦ, ᐊᒻᒪᓗ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᔾᔨᒌᙱᖕᒋᓐᓂᖃᓗᐊᓚᐅᖕᒋᑦᑐᑦ ᐊᑯᓐᓂᖕᒋᑦ ᓇᓕᑐᐃᓐᓇᖕᒋᓐᓂᑦ ᐅᑭᐅᓂᑦ ᐆᒃᑐᕋᐃᖤᐅᔪᓂᑦ. ᐃᖃᓗᐃᑦ ᐃᓚᖕᒋᓐᓄᑦ ᐊᖕᒋᓂᖕᒋᑦ ᐊᔾᔨᒋᔭᖕᒋᑦ ᐅᖁᒪᐃᓐᓂᖕᒋᓐᓄᑦ ᐊᑐᓂ ᐅᑭᐅᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᓇᓗᓇᐃᖅᓯᔪᖅ ᐊᓯᐊᙳᕐᓂᖃᙱᒻᒪᑦ ᐃᖃᓗᐃᑦ ᖃᓄᐃᓐᓂᕆᔭᖕᒋᓐᓂᒃ ᑖᕐᑯᓇᓂ ᐅᑭᐅᕐᓂᑦ. ᐊᒻᒥᓯᔪᖃᕐᓗᐃᑦ ᑲᑎᑕᐅᓚᐅᖅᑐᑦ ᐃᓚᒋᔭᐅᓗᑎᒃ ᐃᖃᓗᐃᑦ ᓂᕿᖕᒋᓐᓂᒃ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ. ᐊᒻᒥᓯᔪᐃᑦ ᐅᑭᐅᖕᒋᑦ 7-ᓂᑦ 69-ᓄᑦ ᐅᑭᐅᖃᓚᐅᖅᑐᑦ ᐊᒥᓱᑦ ᐊᑕᐅᓯᙳᖅᑯ 28.1-ᓂᒃ ᐅᑭᐅᖃᖅᑐᑦ - ᐊᔾᔨᒋᔭᖕᒐ ᑎᑎᕋᐅᓯᐅᓯᒪᔪᑦ ᐅᑭᐅᖕᒋᓐᓄᑦ ᐅᖃᓕᒫᒐᕐᒥᑦ (Sejr et al. 2002).

ᓂᕿᖕᒋᑦᑕ ᖃᓄᐃᓕᐅᕐᓂᖕᒋᑦ

ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑎᒧᑦ ᖃᓄᐃᖕᒐᔭᕆᐊᖃᕐᓃᑦ ᓈᓴᐅᑎᓄᑦ 113 ᐊᒻᒪᓗ 114, ᑲᑎᕝᕗᒋᑦ 47 ᐃᖃᓗᒃᐲᑦ ᓂᕿᖕᒋᓐᓂᒃ ᐆᒃᑐᕋᖅᑕᐅᓂᐊᖅᑐᓂᒃ ᑲᑎᑕᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ ᑲᑎᕝᕗᒋᑦ ᓴᓇᑦ ᑲᑎᓯᒪᔪᓂᑦ. **ᑕᒪᐃᓐᓄᑦ, ᖃᓄᐃᖕᒐᓂᐅᔪᑦ ᓂᕿᖕᒋᑦᑕ ᖃᓄᐃᓕᐅᕐᓂᖕᒋᓐᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ 2019-ᒥᑦ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᓴᓇᔭᐅᓂᖕᒐᓄᑦ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑕᐅᓂᖕᒐ ᕿᙵᐊᓂᑦ ᐃᒃᓴᕙᒃ ᐱᐅᖕᒋᑦᑐᒥᒃ ᐊᒃᑐᖅᓯᓂᖃᖅᑑᔭᙱᖕᒋᑦᑐᖅ ᐃᖃᓗᐃᑦ ᐋᓂᐊᖅᑕᐃᓕᒪᓂᖕᒋᓐᓄᑦ. ᑲᑎᓯᒪᔪᑦ ᓴᓇᑦ ᐊᓯᖕᒋᓪᓗ ᓴᓇᑦ ᓂᕿᖕᒋᓐᓂᑦ ᐊᔾᔨᒋᓚᐅᖅᑕᖕᒋᑦ ᑲᑎᓯᒪᔪᐃᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ ᖃᐅᔨᓴᐃᓂᕐᓄᑦ ᐊᒻᒪᓗ ᑭᒡᒥᒋᔭᐅᔪᓄᑦ.**

ᐋᓯᓂᒃ (Arsenic), ᑭᐅᓯᐊᓪ (calcium), ᓲᑎᐊᓪ (sodium), ᓯᑐᕈᓂᒥᒪ (strontium), ᐊᒻᒪᓗ ᑕᐃᑏᓂᐊᓪ (titanium) ᑲᑎᓯᒪᔪᑦ ᐃᖃᓗᒃᐲᑦ ᓂᕿᖕᒋᓐᓂᑦ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᖕᒋᓂᖅᓴᑲᓪᓚᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ 2018-ᒥᐅᖕᒐᓂᑦ. ᒥᑭᔫᕐᓗᑎᒃ ᓈᓴᐅᑏᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᑦ ᖃᐃᔨᓴᐃᓂᐊᕐᓗᓂ ᐊᔾᔨᒌᖕᓂᖕᒋᓐᓂᑦ ᐅᐸᓗᓂᑦ ᐊᓂᒍᖅᐸᓪᓕᐊᔪᓂᑦ, ᑭᓯᐊᓂ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᖕᒋᓐᓅᕐᓂᖃᓚᐅᖕᒋᑦᑐᑦ 2019-ᒧᑦ ᓈᓴᐅᑎᓄᑦ/ᑎᑎᖅᑲᓄᑦ ᐱᔭᐅᓚᐅᖅᓯᒪᔪᓂᑦ. ᐊᔾᔨᒌᙱᖕᒋᓐᓂᕐᒧᑦ ᑲᑎᓯᒪᔪᓂᒃ ᐅᑯᓇᖕᒐ ᐋᓯᓂᒃ (Arsenic), ᑳᑦᒥᐊᓪ (cadmium), ᑰᕈᒥᐊᓪ (chromium), ᓴᕕᒃ, ᓄᖑᓯᐃᑦᑐᖅ ᐊᒻᒪᓗ ᓵᖅ (zinc) ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ ᐃᖃᓗᒃᐲᑦ ᓂᕿᖕᒋᓐᓂᑦ ᑕᐃᒪᙶᓂ ᑭᓪᓕᐅᔪᓕᕆᓂᕐᒧᑦ ᐅᑭᐅᕐᓄᑦ ᐊᒻᒪᓗ ᐆᒃᑐᕋᐃᓐᓄᑦ 2019-ᒥᑦ ᐊᔾᔨᕐᓚᒋᔭᖕᒋᑦ ᓈᓴᐅᑎᓄᑦ/ᑎᑎᖅᑲᓄᑦ ᐱᔭᐅᓚᐅᖅᓯᒪᔪᓄᑦ. ᑲᑎᕝᕗᒋᑦ 80-ᓂᒃ ᓂᕿᖕᒋᓐᓂᒃ ᐆᒃᑐᕋᐅᑕᐅᓂᐊᖅᑐᓂᒃ ᑲᑎᖅᓱᐃᓚᐅᖅᑐᑦ ᐊᒻᒨᒪᔪᓂᒃ 2019-ᒥᑦ ᖃᐅᔨᓂᐊᕐᓗᒋᑦ ᑲᑎᕝᕗᒋᑦ ᓴᓇᑦ ᑲᑎᓯᒪᔪᑦ ᐊᒻᒪᓗ, ᑲᑎᓯᒪᔪᓂᑦ ᑕᒪᐃᓐᓂᓗᒃᑖᖅᑲᔭᖅ ᓴᓇᑦ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᖕᒋᓂᖅᓴᑲᓪᓚᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ 2018-ᒥᐅᖕᒐᓂᑦ, ᐃᓚᖕᒋᑦ ᐃᓚᐅᖕᒋᕝᕙᓂᒃ. ᖃᐅᔨᔭᐅᔪᑦ

ᐊᒥᓲᙱᕐᓂᖏᑦ ᓴᐋᑦ ᑲᑎᓯᒪᔪᑦ ᑕᒪᐃᓐᓂᑦ ᐃᖃᓗᓐᓂᑦ ᐃᓱᒪᒋᔭᐅᖏᑦᑐᑦ ᐱᓕᕆᐊᕐᒨᖓᒪᑕ ᐊᒻᒪᓗ ᐱᔾᔪᑕᐅᔪᕐᓴᐅᔪᖅ ᐃᖏᓂᒃ ᐱᔪᓂᒃ ᐅᔾᙵᓂᒃ ᓯᓚᖃᙱᑦᑐᒥᓪᓗᓐᓃᑦ ᐱᔪᓂᒃ.

ᑲᑎᙵᕐᒥᑦ 35-ᓂᒃ ᓂᕿᓂᒃ ᐆᒃᑐᕋᐅᑕᐅᓂᐊᖅᑐᓂᒃ ᑲᓇᔪᕐᓂᑦ ᑲᑎᑦᑎᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᖃᐅᔨᓂᐊᕐᓗᒋᑦ ᑲᑎᙵᕐᒥᑦ ᓴᐋᑦ ᑲᑎᓯᒪᔪᑦ; ᑭᓱᐊᓂ, ᓯᕗᓂᐊᒎᑦ 2019, ᑲᓇᔪᐃᑦ ᑐᕐᑯᕋᖅᑐᑦ ᐸᐸᑕᐅᓚᐅᖏᑦᑐᑦ ᓂᕿᖏᓐᓂᒃ ᖃᓄᐃᓕᐅᕐᓂᖏᓐᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᐊᕐᓗᑎᒃ ᑕᒪᐃᓐᓇᒎᑦ 2018-ᒥᑦ ᑲᓇᔪᕐᓄᑦ ᓈᓴᐅᑏᑦ/ᑎᑎᖅᑲᐃᑦ ᒪᓂᒪᓚᐅᖏᑦᑐᑦ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᖏᓐᓅᕐᓂᐊᕐᓗᒋᑦ.

ᓴᐋᑦ ᑲᑎᓯᒪᔪᑦ ᐊᔾᔨᒋᓚᐅᖅᑕᖏᑦ ᐊᒻᒪᓗ ᓇᓗᓇᙱᖕᒍᑎᒃ ᐊᒥᓱᓂᖅᓴᐅᔪᑦ ᑕᒪᐃᓐᓂᑦ ᐊᖃᓗᓐᓂᐅᙱᓂᑦ, ᖃᑯᑎᒃᑯᑦ ᐊᖏᓂᖅᓴᐅᓂᒃᑯᑦ. ᐱᔾᔪᑕᐅᔪᖅ ᐊᑯᓐᓂᖏᓐᓂᑦ ᐃᖃᓗᐃᑦ ᐊᔾᔨᙱᖏᑦᑐᑦ ᐊᔾᔨᙱᖏᓐᓂᖏᑦ ᐃᓂᒋᔨᒪᔭᖏᓐᓂᒃ, ᓂᕆᕝᕕᒋᖃᑦᑕᖅᑕᖏᓐᓄᑦ, ᐊᒻᒪᓗ ᑎᒥᖏᑦ ᐊᔪᙱᓐᓂᖃᕐᓂᖏᓐᓄᑦ ᐱᑦᑕᐅᖏᑦᑐᓄᑦ. ᓇᓗᓇᐃᖅᓯᓂᖅᑕᖃᙱᑦᑐᖅ ᑲᑎᓯᒪᔪᓂᑦ ᓴᕙᓐᓂᑦ ᐊᒃᑐᖅᓯᓂᖃᕐᒪᑕ ᐃᖃᓗᐃᑦ ᐋᓐᓂᐊᖃᖅᑕᐃᓕᒪᓂᖏᓐᓂᑦ.

ᐅᖃᖅᓯᒪᓂᖓᑐᑦ ᕐᑯᓛᓂᑦ, ᓄᓇᓕᖏᒥᑦ ᐃᓄᐃᑦ ᐃᓱᒫᓗᑎᖏᓐᓂᒃ ᖃᐅᔨᑎᑦᑎᓚᐅᖅᑐᑦ ᐊᖏᓪᓕᒋᐊᖅᓯᒪᓂᖏᑦ ᓴᕕᒃ ᐊᕙᑎᒥᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐊᒻᒪᓗ ᓂᕆᔭᐅᒃᑕᑦᑕᐅᓂᐊᖅᓱᑎᒃ. CCME-ᒧᑦ ᒪᓕᒃᑕᐅᔪᖅᓴᖅᑕᖅᑲᙱᑦᑐᖅ ᓴᕙᓐᓂᑦ ᐃᖃᓗᐃᑦ ᓂᕿᖏᓐᓂᑦ; ᑭᓱᐊᓂ, ᑕᒪᓐᓇ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᖅ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᖓᓅᖅᑕᐅᑉᓗᓂ ᓴᐋᑦ ᑲᑎᓯᒪᔪᑦ ᐃᖃᓗᒃᐲᑦ ᓂᕿᖏᓐᓂᑦ. ᓴᐋᑦ ᑲᑎᓯᒪᔪᑦ ᐃᖃᓗᒃᐲᑦ ᓂᕿᖏᓐᓂᑦ ᐆᒃᑐᕋᖅᑕᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᓈᓴᐅᓯᕆᓂᒃᑯᑦ ᐊᔾᔨᙱᖏᓐᓂᖃᓗᐊᓚᐅᖏᑦᑐᑦ 2018-ᒥᐅᙱᓂᑦ ᐊᒻᒪᓗ ᐊᑦᑎᓐᓂᖅᓴᐅᕌᔪᓚᐅᖅᑐᑦ, ᑭᓱᐊᓂ ᐊᔾᔨᒋᐸᓗᓂᐅᒃ, ᐅᓂᒃᑳᓯᐅᓚᐅᖅᑐᓂᑦ ᐅᑭᐅᓂᑦ ᐊᓂᒍᖅᑐᓂᑦ (2010-2017); ᑕᒪᐃᓐᓇᒎᑦ, ᖃᐅᔨᒪᓇᖅᑐᖅ ᓱᓕ ᐱᓕᕆᐊᕐᒥᑦ ᐊᐅᓛᖅᑎᑦᑎᓃᑦ ᐱᔾᔪᑕᐅᖏᓐᓂᖓᓄᑦ ᑲᑎᑉᐸᓕᐊᔪᓄᑦ ᓴᕙᖏᑦ ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᓂᕆᖃᑦᑕᖏᓐᓄᑦ.

ᐆᒃᑐᕋᐅᑕᐅᔪᓂᑦ (ᔩᕐᓗ, ᐃᖃᓗᒃᐱᖕᓂᑦ, ᑲᓇᔪᕐᓂᑦ ᐅᕝᕙᓘᓐᓃᑦ ᑲᑎᑕᐅᔪᖃᓚᐅᖏᑦᑐᖅ 2018-ᒥᑦ 2019-ᒥᓗᓐᓃᑦ ᐅᖓᑕᐅᑦᑎᓂᖅᑐᓂᑦ ᑲᓇᑕᒥᑦ ᓂᕿᓂᒃ ᖃᐅᔨᓴᐃᔨᒃᑯᑦ ᓂᐅᕕᐊᒃᓴᐅᔪᓂᒃ ᓂᕆᔭᐅᓂᐊᖅᑐᓄᑦ ᒪᓕᒃᑕᐅᔪᒃᓴᖏᓐᓂᒃ 0.5 mg/kg wwt ᓄᖑᓯᐃᑦᑐᒥᑦ.

ᑖᒥᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐆᒪᔪᓂᒃ ᑎᑭᑎᑕᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᖅ

ᑖᒥᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐆᒪᔪᓂᒃ ᑎᑭᑎᑕᐅᔪᓂᒃ (AISH ᖃᐅᔨᓴᐃᓂᖅ ᓴᖅᑭᑕᐅᓚᐅᖅᑐᖅ 2015-ᒥᑦ ᐃᓚᒋᔭᐅᑉᓗᓂ MEEMP-ᒧᑦ ᓴᖅᑭᑦᑎᓂᐊᕐᓗᒋᑦ ᑭᒡᓕᒋᔭᐅᔪᓄᑦ ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ ᐊᒻᒪᓗ ᖃᐅᔨᑎᑦᑎᕙᓐᓂᕐᓂᐊᕐᓗᑎᒃ AIS-ᖃᑐᐃᓐᓇᕆᐊᓕᖕᓂᑦ ᐊᒻᒪᓗ ᑖᒥᓂᕐᒥᐅᑕᐅᖏᑦᑐᓂᒃ ᐆᒪᔪᓂᒃ (NIS) ᕿᙱᐊᓂᑦ ᐃᒃᓯᕙᖕᒧᐊᖅᑐᓂᒃ, ᑕᒪᐃᓐᓇᒎᑦ ᑎᑭᐅᑎᓯᒪᔪᑦ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᕐᒧᑦ ᖃᓄᐃᙵᓯᕆᐊᖃᕐᓂᐅᔪᓄᑦ ᓈᓴᐅᑎᓖᑦ 87, 89, ᐊᒻᒪᓗ 91. ᐃᓚᒋᔭᐅᔪᑦ AIS-ᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᓄᑦ ᑐᕌᖃᖅᑐᑦ ᐊᑦᑎᖕᓂᖅᓴᐅᔪᓂᒃ ᓂᕿᑦᑎᐊᕙᖅᓂᐅᔪᓂᒃ, ᐃᓚᐅᑉᓗᑎᒃ ᐆᒪᔪᕋᓛ ᐊᓗᐊᑕ ᐃᓗᐊᓄᐊᖃᑦᑕᖅᑐᑦ, ᐊᒻᒪᓗ ᐊᓗᐊᑕ ᖁᖓᓂᖃᑦᑕᖅᑐᑦ, ᐱᕈᖅᑐᑦ, ᐊᒻᒪᓗ ᐃᖃᓗᐃᑦ. ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᔪᖅ AIS ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᒪᓕᖃᑦᑕᖅᑐᖅ ᐅᑭᐅᑦ ᐊᓂᒍᖅᑐᓂᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᒥ (2014-2018) ᖃᐸᐊᕐᔪᖕᓂᑦ ᐋᖅᑭᒋᐊᖅᑕᐅᓯᒪᐸᓗᓂ 2019-ᒥᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᐃᓚᓯᐸᓗᑎᒃ ᓇᓗᓇᐃᖅᓯᓂᖅ NIS-ᒥᑦ, ᐊᖏᓪᓕᒋᐊᕐᔪᐊᖅᓱᒋᑦ ᐆᒪᔪᓂᒃ ᐊᓗᐊᓃᑦᑐᓂᒃ ᐆᒃᑐᕋᐃᓂᕐᓂᑦ ᐊᒻᒪᓗ ᐃᓚᓯᐸᓗᑎᒃ ᑖᓕᒪᖓᓂᒃ ᑲᑎᖓᓂᐅᔪᓂᒃ ᐃᒪᐅᑉ ᐃᓗᐊᓂᑦ ᓄᑦᑐᖅᑕᐅᔪᒥᒃ ᐊᔾᔨᓕᐅᕈᑎᒥᒃ ᐊᒃᑐᖅᓯᓂᐅᑐᐃᓐᓇᕆᐊᓕᒃᓯᐅᖅᓱᑎᒃ ᓄᑖᖅ ᓴᓇᔭᐅᔪᖅ ᐅᓯᔭᐅᔪᓄᑦ ᐃᒃᓯᕙᖕᒥᑦ.

ᒥᑭᔫᑎᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᑦ

ᒥᑭᔫᑎᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᓂᒃ ᑲᑎᖅᓯᐃᓚᐅᖅᑐᑦ ᐆᒃᑐᕋᖅᑕᐅᓂᐊᖅᑐᓂᒃ ᕿᙱᐊᓂᑦ ᐃᒃᓯᕙᖕᒥᑦ (ᐊᕐᕕᓂᓖᑦ ᖃᐅᔨᓴᐃᕝᕖᑦ) ᐃᒥᓕᖕᒥᑦ (ᓯᑕᒪᑦ ᖃᐅᔨᓴᐃᕝᕕᐅᔪᑦ) ᐊᑐᖅᓱᑎᒃ ᑕᒪᐃᓐᓂᒃ ᕐᑯᒧᑦ ᐊᒻᒪᓗ ᓴᓂᒧᑦ ᓄᑦᑐᐃᔪᓂᒃ. ᑕᒪᓗᒃᑖᖅ ᒥᑭᔫᑎᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᓄᑦ ᐆᒃᑐᕋᐃᓃᑦ ᐱᓯᒪᓕᐅᖅᑐᑦ 5% ᑲᓕᖅᑲᙱᑦᑐᖅ ᐅᖅᓱᓕᖏᒥᑦ (formalin) ᑐᓂᐅᑕᐅᑉᓗᓂᓗ Biologica-ᑯᓐᓄᑦ ᐃᓂᓕᐅᖅᑕᐅᓂᖓᓄᑦ ᖃᐅᔨᓂᐊᕐᓗᒋᑦ ᑎᑎᕋᐅᓯᐅᑉᓗᓂᓗ. **NIS-ᒥᒃ AIS-ᒥᓪᓗᓐᓃᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᓚᐅᖅᑐᑦ ᒥᑭᔪᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᓂᒃ ᐆᒃᑐᕋᖅᑕᐅᔪᓂᑦ ᕿᙱᐊᓂᑦ ᐃᒃᑲᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᐃᒥᓕᖕᓂᑦ.**

43 ᒥᑭᔫᑎᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᑦ ᐃᓕᑕᕆᔭᐅᓚᐅᖅᑐᑦ ᐆᒃᑐᕋᐅᑎᓂᒃ ᑲᑎᑕᔪᑦ 2019 AIS/NIS ᖃᐅᔨᓴᐃᓂᕐᒥᑦ, ᑖᒃᑯᓇᙵᑦ ᐱᖓᓱᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᓯᒪᙱᑦᑐᑦ ᓯᕗᓂᐊᒎᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐅᕝᕙᓘᓐᓃᑦ ᑭᒡᓕᐅᔪᓄᑦ ᖃᐅᔨᓴᐃᑎᓪᓗᒋᑦ. ᕿᙱᐊᓂᑦ ᐃᒃᓯᕙᖕᒥᑦ, ᓄᑖᑦ ᐆᒪᔪᖅ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ *Hybocodon prolifer* - ᐱᕈᖅᑐᓐᙵᖅᑐᖅ Tubulariidae; ᐊᒻᒪᓗ, *Onisimus glacialis* - ᓵᑦᑐᓂᑦ ᐆᒪᔪᕋᓛᑦ. ᐃᒥᓕᖕᓂᑦ, ᐃᓕᓴᕆᔭᐅᓯᒪᙱᑦᑐᖅ ᒥᑭᔫᑎᑦ ᐃᒪᐅᑉ ᐃᓗᐊᓃᑦᑐᓂᒃ ᐊᔾᔨᙱᖏᑦᑐᑦ ᐆᒪᔪᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᖅ *Obelia*; *Obelia*, ᑕᒪᒃᑯᐊ,

ᓄᓇᕐᔪᐊᕐᒥᑦ ᑕᐃᒪᐅᔪᑦ ᐊᒻᒪᓗ ᐃᓕᑕᕆᔭᐅᓯᒪᙱᑦᑐᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᓯᒪᔪᑦ ᐅᔾᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᑲᕐᕕᖕᒥᑦ in ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ (Golder 2019b).

ᐊᑐᓂ ᓄᑖᑦ ᖃᐅᔨᔭᐅᔪᑦ ᐆᒪᔪᕋᓛᑦ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓂᖃᑦᑕᓚᐅᖅᑐᑦ ᓄᓇᕐᔪᐊᕐᒥᑦ ᖃᓂᑦᑐᒥᓪᓗ ᖃᓇᑕᐅᔾᒦᑦᑐᓂᒃ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᑎᑭᐅᑎᔭᐅᔪᓂᒃ ᐆᒪᔪᓄᑦ. ᓇᓕᑐᐃᓐᓇᖏᑦ ᓇᓄᓇᐃᖅᑕᐅᓚᐅᖏᑦᑐᑦ ᓄᓇᕐᔪᐊᕐᒥᑦ ᐃᓕᑕᕆᔭᐅᓯᒪᔪᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᑎᑭᑎᑕᐅᔪᑦ ᐆᒪᔪᓄᑦ (Molnar et al. 2008) ᑲᓇᑕᒧᓪᓘᓐᓃᑦ ᑲᓇᑕᒥᑦ ᐅᓄᕆᐊᓇᕐᓂᕐᒥᒃ ᖃᐅᔨᓴᐃᓂᖅ ᑎᑭᐅᑎᔭᐅᔪᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᓂᕐᔪᑎᓄᑦ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒪᖓᓂᑦ ᐱᔪᓂᒃ (Casas-Monroy et al. 2014). ᑕᒪᕐᒥᒃ ᐆᒪᔪᑦ ᓇᓄᓇᐃᒃᑯᑎᖅᑕᐅᓚᐅᖅᑐᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ ᓇᒧᒥᐊᖅᓯᒪᔪᑦ ᐃᓚᐅᑉᐳᑎᒃ ᑲᓇᑕᐅᑉ ᐅᑭᐅᖅᑕᖅᑐᖓᓂᑦ ᐊᒻᒪᓗ ᕿᑭᖅᑖᓗᖕᒥᑦ (WoRMS 2020) ᐆᒪᔪᐃᑦ ᓇᓄᓇᐃᒃᑯᑎᖅᑕᐅᓯᒪᔪᑦ ᐃᒥᓕᖕᒥᑦ ᐊᑕᐅᓯᐅᒐᓗᐊᕐᒥᑦ ᖃᐅᔨᒪᔭᐅᖏᑦᑐᒥᒃ ᐱᑕᖃᖅᑕᖅ ᑲᓇᑕᒥᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ.

ᐆᒪᔪᑦ ᐃᒪᐅᑉ ᐊᓗᐊᓄᑦ ᐳᓚᒃᑕᖅᑐᑦ

ᐆᒪᔪᓂᒃ ᐃᒪᐅᑉ ᐊᓗᐊᓄᑦ ᐳᓚᒃᑕᖅᑐᓂᒃ ᐆᒃᑐᕋᐅᑏᑦ ᑲᑎᑕᐅᓚᐅᖅᑐᑦ ᐃᓚᒋᔭᐅᑉᓗᓂ MEEMP ᐊᑐᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ AIS/NIS-ᓂᒃ, ᐊᔾᔨᙱᓐᓂᒃ ᐊᑐᖅᑕᐅᔪᓂᒃ ᐊᒻᒪᓗ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᓂᒃ ᑕᒪᐃᓐᓄᑦ ᖃᐅᔨᓴᐃᓂᕐᓄᑦ ᐊᑐᓚᐅᖅᑐᑦ. ᐆᒃᑐᕋᐃᓃᑦ ᐃᓚᒋᔭᐅᑉᓗᓂ ᐆᒪᔪᑦ ᐃᒪᐅᑉ ᐊᓗᐊᓄᑦ ᐳᓚᒃᑕᖅᑐᓄᑦ AIS/NIS-ᒧᑦ 2019-ᒥᑦ ᐊᒥᓲᓂᖅᓴᒃᓚᐅᔪᑦ ᐆᒃᑐᕋᐃᕝᕙᐅᔪᓂᑦ ᐅᑭᐅᓂᑦ ᐊᓂᖅᓯᒪᔪᓂᐅᖕᓂᑦ. ᓯᕗᓂᐊᒍᑦ 2018, AIS/NIS ᐆᒃᑐᕋᐅᑎᓂᒃ ᑲᑎᖅᓱᐃᓚᐅᖅᑐᑦ 8-ᓂᑦ ᐃᓂᐅᔪᓂᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᒪᕐᕉᖕᓂᑦ ᐃᒥᖕᒥᑦ ᐃᓂᐅᔪᓂᑦ. 15 ᐃᓂᐅᔪᑦ ᐃᓚᔭᐅᓚᐅᖅᑐᑦ 2018-ᒥᑦ, 2019-ᒥᑦ, ᐆᒪᔪᑦ ᐃᒪᐅᑉ ᐊᓗᐊᓄᑦ ᐳᓚᒃᑕᖅᑐᓄᑦ ᐆᒃᑐᕋᐅᑏᑦ ᑲᑎᐅᓚᐅᖅᑐᑦ 32-ᓂᒃ ᖃᐅᔨᓴᐃᕝᕕᖕᓂᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᒪᕐᕉᖕᓂᑦ ᖃᐅᔨᓴᐃᕝᕕᖕᓂᑦ ᐃᒥᖕᒥᑦ. **ᑕᒪᓗᒃᑖᖅᑲᔭᖅ ᖃᐅᔨᔭᐅᔪᑦ ᐆᒪᔪᐃᑦ ᐆᒃᑐᕋᖅᑕᐅᔪᓂᑦ ᑲᑎᑕᐅᔪᓂᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᐃᒥᖕᓂᑦ NIS ᐅᕝᕙᓘᓐᓃᑦ AIS-ᖑᙱᑦᑐᓇᔭᐅᔪᑦ. NIS ᐆᒪᔫᑐᐃᓐᓇᓇᐊᓖᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ, ᑭᓯᐊᓂ ᕿᒥᕈᓂᒃᑳᑦ ᐃᖕᒥᓂᑦ ᐱᔪᓂᒃ ᓇᓄᓇᐃᖅᓯᕐᑯᔭᐅᔪᑦ NIS ᐅᕝᕙᓘᓐᓃᑦ AIS ᖃᓄᐃᖕᒐᓂᙱᓐᓂᑦ.**

ᐆᒪᔪᑦ ᐃᒪᐅᑉ ᐊᓗᐊᓄᑦ ᐳᓚᒃᑕᖅᑐᓄᑦ ᑎᑎᕋᖅᓯᒪᓪᓗ ᓯᕗᓂᐊᒍᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐱᔭᐅᓚᐅᖅᑐᑦ ᐅᐸᓗᒥᒨᓕᖅᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᑕᐅᐸᓗᑎᒃ ᓄᑖᓂᒃ ᐆᒪᔪᓂᒃ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᓄᑦ 2019-ᒥᑦ. ᐆᒪᔪᑦ ᖃᐅᔨᔭᐅᓚᐅᙱᑦᑐᑦ ᕿᙵᐊᓂᑦ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓂᓚᐅᖅᑐᑦ ᖃᐅᔨᓂᐊᕐᓗᑎᒃ ᖃᐅᔨᒪᔭᐅᓂᙱᑦ ᓇᒧᑦ ᑎᑭᐅᑎᓯᒪᓂᙱᑦ ᐃᓚᐅᑉᐳᑎᒃ ᑲᓇᑕᒥᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ, ᐅᐊᖕᓇᖕᒐᓂᑦ ᐊᑦᑏᓐᑎᒃ ᐅᕝᕙᓘᓐᓃᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᐃᒪᖏᓐᓂᑦ. ᐃᓚᒋᔭᐅᔪᖅ, ᐆᒪᔪᑦ ᖃᓄᐃᓐᓂᖅᓴᐅᓂᖏᓐᓅᖅᑕᐅᓚᐅᖅᑐᑦ ᓄᓇᕐᔪᐊᕐᒥᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᑎᑭᑦᑐᓄᑦ ᖃᓇᑕᐅᔾᒦᑦᑐᓂᒃ (Molnar et al. 2008), ᐊᒻᒪᓗ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐆᒪᔪᑦ ᑎᑭᑦᑐᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᑦ ᑲᓇᑕᒥᑦ ᐅᓄᕆᐊᓇᕐᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᑎᑭᑎᑕᐅᔪᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒪᖓᓂᑦ ᐱᔪᓂᒃ (Casas-Monroy et al. 2014). ᐆᒪᔪᑦ ᖃᐅᔨᔭᐅᔪᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᓐᓂᖏᓐᓄᑦ ᐊᐅᓪᓚᖅᑎᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᕝᕙᖕᒧᑦ (Philippe Archambault's Benthic Ecology Lab) (ᓯᓚᑦᑐᖅᓴᕐᕕᒃᔪᐊᖅ, ᑯᐸᐃᒃ) ᓇᓄᓇᐃᖅᑕᐅᓂᐊᕐᓗᑎᒃ.

ᑲᑎᖦᖢᕆᑦ 58,374 ᐆᒪᔪᕋᓛᖅᑕᖃᕐᓂᖕᒐᓂᒃ ᓇᓚᐅᑦᑖᖅᑕᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᖃᐅᔨᓴᐃᖕᒪᑕ ᕿᙵᐊᓂᑦ, ᐃᓚᐅᑉᓗᑎᒃ 587 ᐆᒪᔪᕋᓛᑦ ᐃᒥᖕᒥᑦ. ᑖᒃᑯᐊ 319-ᖑᔪᓂᒃ ᐆᒪᔪᕋᓛᑦ ᐊᔾᔨᒌᙱᓐᓂᖃᓚᐅᖅᑐᑦ ᐆᒪᔪᓂᒃ, ᐃᓚᐅᑉᓗᑎᒃ 41 ᐊᔾᔨᐅᙱᑦᑐᑦ ᐆᒪᔪᑦ ᐃᓕᑕᕆᔭᐅᓚᐅᙱᑦᑐᑦ ᓯᕗᓂᐊᒍᑦ ᐅᑭᐅᕐᓂᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ ᒥᓕᖕᒥᓗ. ᓄᑖᖅ ᐃᓕᑕᕆᔭᐅᔪᖅ ᐆᒪᔪᓂᑦ, 39 ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑐᐃᓐᓇᐅᓚᐅᖅᑐᑦ ᐊᒻᒪᓗ ᒪᕐᕉᒃ ᐃᒥᖕᓂᑐᐃᓐᓇᖅ.

ᓄᑖᓂᑦ ᐆᒪᔪᓂᑦ ᖃᐅᔨᔭᐅᔪᓂᑦ ᐃᓚᐅᔪᑦ (spionid polychaete) *Marenzelleria viridis*-ᖑᐸᓗᑎᒃ, ᖃᐅᔨᔭᐅᔪᑦ ᐃᖕᒥᒃᑯᑦ ᓇᓄᓇᐃᔭᐃᓂᒃᑯᑦ ᓯᕗᓂᐊᓂᑦ ᐅᖃᐅᓯᐅᖃᐅᔫᒃᑯᑦ Archambault ᖃᐅᔨᓴᐃᕝᕙᖕᒥᑦ. ᑖᓐᓇ ᐆᒪᔪᖅ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᖅ ᓄᓇᕐᔪᐊᕐᒥᑦ ᖃᓇᑕᐅᔾᒥᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕙᖕᒥᑦ ᐊᒻᒪᓗ ᑲᓇᑕᒥᑦ ᐅᓄᕆᐊᓇᖅᑐᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐆᒪᔪᖅ ᐃᓯᒫᓘᑕᐅᓂᖓᓄᑦ ᑲᓇᑕᒥᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᐃᒪᖏᓐᓂᑦ, ᑎᑭᐅᑎᔭᐅᓇᔭᖅᐳᓂ ᐅᒥᐊᕐᔪᐊᑦ ᐃᒪᖓᑦᑎᒍᑦ (Molnar et al. 2008, Casas-Monroy et al. 2014). ᐆᒃᑐᕋᖅᑕᐅᓂᐊᖅᑐᓂᒃ ᑲᑎᖅᓱᐃᓂᕐᒥᑦ ᑎᑎᖅᑲᐅᑏᑦ *viridis*-ᒧᑦ, ᐊᒻᒪᓗ ᐊᑎᖅᑕᐅᓯᒪᓂᖓᒍᑦ *Scolecolepides viridis*-ᒥᑦ ᓇᓄᓇᐃᖅᓯᔪᖅ ᑕᐃᒪᐅᒃᑕᖅᓯᒪᖕᒪᑦ ᓯᓚᑖᓂᑦ ᐃᖕᒥᓂᒃ ᐱᖃᖅᑐᑦ ᑎᑭᐅᑎᓂᕐᓂᑦ ᐅᐊᖕᓇᖕᒐᓂᑦ ᐊᑦᑏᓐᑎᒃ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᐃᒪᖏᓐᓂᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᐅᑭᐅᖅᑕᖅᑐᖅ ᐃᒪᖓ ᐊᒻᒪᓗ ᕿᑭᖅᑖᓗᒃ (Cusson 2018, GBIF 2020, Miller et al. 2014). ᕿᒥᕐᕈᔭᐅᒃᑲᓂᕐᓂᖓ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ ᑎᑎᖅᑲᐅᑏᑦ ᕿᑭᖅᑖᓗᐸ ᖃᓂᑕᕆᓂᑦ ᖃᐅᔨᔭᐅᔭᕆᐊᖃᖅᑐᖅ ᐆᒪᔪᖅ ᑎᑭᓵᕐᒪᖔᑦ ᕿᙵᐊᓂᑦ ᐃᑲᕐᕕᖕᒥᑦ.

ᐊᖏᔪᑦ ᐱᕈᖅᑐᐃᑦ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᐃᑦ

ᐊᖏᔪᑦ ᐱᕈᖅᑐᐃᑦ ᐊᒻᒪᓗ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐃᓚᐅᔪᑦ ᑲᑎᖅᓯᐃᐸᓗᑎᒃ ᐃᒪᐅᑉ ᐃᑐᐊᓂᑦ ᐊᔾᔨᓕᐅᕈᑎᒃᑯᑦ ᑕᑯᓂᖏᑦᑎᒍᑦ ᐊᑐᓂ ᓯᑕᒪᐃᑦ ᐋᖅᑭᒃᑕᐅᓚᐅᖅᑐᑦ AIS/NIS-ᓄᑦ ᑲᑎᓐᓂᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᑲᑎᓐᓂᒃᑲᓐᓂᑦ ᓴᖅᑭᑕᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᑲᓇᖕᓇᖓᓄᑦ ᓄᑖᖅ ᓴᓇᔭᐅᔪᑦ ᐅᓯᔭᐅᔪᓄᑦ ᐃᒃᓴᕐᕕᒃ. **NIS-ᒧᑦ AIS-ᒧᓪᓗᓐᓂᑦ ᐆᒪᔪᑦ ᐃᓕᑕᕆᔭᐅᓚᐅᖏᑦᑐᑦ ᐊᖏᔪᓂᑦ ᐱᕈᖅᑐᓂᑦ ᐊᒻᒪᓗ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᕿᓐᖑᐊᓂᑦ ᐃᒃᓴᕐᕕᖕᒥᑦ. ᑭᓯᐊᓂ, ᐃᓕᑕᕆᔭᐅᓂᖏᑦ ᐆᒪᔪᐃᑦ ᓇᓐᓂᕐᓄᑦ ᑭᓪᓕᖃᓚᐅᖅᑐᖅ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐋᖅᑭᐅᒪᔪᒧᑦ ᐊᒥᓱᓄᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᓴᐅᔪᓄᑦ.**

ᐃᓚᓯᓂᖅ ᐊᐅᓚᔪᓕᐅᕆᑦᑎᐊᔪᔪᒃᑯᑦ ᐊᔾᔨᓕᐅᖅᑕᐅᔪᒥᒃ 2019-ᒥᑦ ᐃᓕᑕᖅᓯᓚᐅᖅᑐᑦ ᒪᕿᕘᖕᓂᒃ ᓄᑖᓂᒃ ᐆᒪᔪᓂᑦ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᓂᒃ ᑎᑎᕋᐅᔨᐅᓚᐅᖅᓯᒪᓐᖏᑦᑐᑦ AIS ᐃᒪᐅᑉ ᐃᑐᐊᓂᑦ ᐊᔾᔨᓕᐅᕆᓂᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓪᓗᒋᑦ 2014-ᒥᑦ 2018-ᒧᑦ. ᐃᓚᖓᑦ ᓄᑖᖅ ᐆᒪᔪᖅ, Cephalopoda - ᐊᒥᓱᓂᒃ ᓂᐅᖃᖅᑐᑦ ᐃᓚᐅᑉᓗᑎᒃ - ᐃᓚᐅᔪᑦ ᐱᖓᓱᑦ ᐆᒪᔪᑦ ᑕᐃᒪᐅᖃᑦᑕᖅᑐᑦ ᕿᑭᖅᑖᓘᑉ ᐃᒪᖓᓂᑦ (Gardiner and Dick 2010), ᑐᓪᓕᐊ ᐆᒪᔪᖅ ᖃᐅᔨᓴᐅᓚᐅᖅᑐᖅ ᓵᑦᑐᑦ ᐃᖃᓗᒃ (Stichaeidae-ᓂᑦ) ᐊᑕᐅᓯᐅᖏᑦᑑᓗᑎᒃ ᐆᒪᔪᕋᓛᖑᔫᒃᓴᐅᔪᖅ (genus *Lumpenus*). ᑲᑎᓪᓗᒋᑦ ᐊᕐᕕᓂᓛᑦ ᐊᔾᔨᐅᖏᑦᑐᑦ ᐊᖏᔪᑦ ᐱᕈᖅᑐᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ, ᑕᒪᕐᒥᒃ ᑎᑎᕋᐅᔨᐅᓯᒪᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᐅᖃᑦᑕᓚᐅᖅᑐᓂᑦ.

ᐊᑐᓂ ᖃᐅᔨᔭᐅᔫᖅᑐᑦ ᐆᒪᔪᐃᑦ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᓚᐅᖅᑐᑦ ᓄᓇᕐᔪᐊᕐᒥᑦ ᖃᓇᑕᐅᔭᒃᑯᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕕᖕᓂᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᓄᑦ ᐊᒻᒪᓗ ᓇᓕᑐᐃᓐᓇᖏᑦ ᐆᒪᔪᐃᑦ ᐃᓕᑕᕆᔭᐅᖏᑦᑐᑦ ᑕᒪᐅᖓᕐᓂᖏᓐᓄᑦ (Molnar et al. 2008) ᐅᕝᕙᓘᓐᓃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᑦ ᐆᒪᔪᐃᑦ ᑲᓇᑕᒥᑦ ᒪᓕᒃᑯᒍ ᑲᓇᑕᒥᑦ ᐅᓗᕆᐊᓇᖅᑐᒦᑦᑐᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᑎᑭᑦᑐᓄᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᓄᑦ ᑲᓇᑕᒧᑦ ᐅᒥᐊᕐᔪᐊᕐᒥᑦ ᐃᒪᖓᓐᓂᙶᖅᑐᒥᑦ (Casas-Monroy et al. 2014). ᐆᒪᔪᓗᒃᑖᑦ ᐃᓕᑕᕆᔭᐅᖏᑦᑐᑦ ᐊᑕᐅᓯᐅᒐᓗᐊᒥᓪᓗᓐᓂᑦ ᐃᓚᖃᖃᑦᑕᐅᔪᑦ ᐆᒪᔪᓂᒃ ᑖᓐᓂᕐᒥᐅᑕᖅᖢᓂ ᐃᓚᐅᑉᓗᓂ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᐃᒪᕐᓂᑦ.

ᖃᓖᑦ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᐃᑦ

ᖃᓖᑦ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐃᓂᓯᖃᑦᑕᓚᐅᖅᑐᑦ ᐆᕐᓂᒃ ᐊᒻᒪᓗ ᐊᑐᐊᓄᐊᖅᑐᓄᑦ ᑲᓇᖕᓇᖓᓂᑦ ᐅᔭᖁᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓴᕐᕕᐅᑉ (ᑲᑎᓪᓗᒋᑦ ᐃᓕᔭᐅᓯᒪᓂᖏᑦ ~12 ᑕᖅᑭᓄᑦ); ᐆᑦ ᐊᒻᒪᓗ ᑐᙱᕚᑦ ᐱᖓᖕᓇᖓᓂᑦ ᐅᔭᖁᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓴᕐᕕᐅᑉ ᐅᑎᖅᑎᑕᐅᓂᖅ ᐊᔪᓚᐅᖅᑐᑦ 2019-ᒥᑦ ᐊᒃᓱᓈᖅ ᓯᖁᒃᑕᐅᓚᐅᕐᒥᑦ ᓯᑯᐃᑦ ᓯᖁᑉᑎᖅᑎᓪᓗᒋᑦ, ᑕᐃᒪᓐᓇᒧᑦ ᐊᓯᐅᔨᔭᐅᓚᐅᖅᑐᑦ. **NIS ᐅᕝᕙᓘᓐᓃᑦ AIS ᐆᒪᔪᐃᑦ ᐃᓕᑕᕆᔭᐅᓚᐅᖏᑦᑐᑦ ᖃᓖᑦ ᐃᒪᐅᑉ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ ᐆᒪᔪᓂᑦ ᐆᒃᑐᕋᖅᑕᐅᔪᓂᑦ ᕿᓐᖑᐊᓂᑦ ᐃᒃᓴᕐᕕᖕᒥᑦ. ᕿᒥᕐᕈᔭᐅᒃᑲᓐᓂᓚᐅᖅᑐᑦ ᐃᖕᒥᓂᑦ ᐱᔪᓂᒃ ᐊᒻᒪᓗ ᑕᐃᑯᙵᕐᓂᐅᔪᑦ ᐱᔭᐅᔭᕆᐊᖃᕐᓂᐊᖅᑐᑦ ᓇᓗᓇᐃᕐᓂᐊᕐᓗᒋᑦ NIS-ᒥᑦ ᖃᓄᐃᖓᓂᐅᔪᖅ.**

2018-ᒥᑐᑦ, ᐆᒪᔪᓄᑦ ᐃᓂᓕᐅᕆᓂᖅᑕᖃᓗᐊᖅᑑᔭᙱᑦᑐᖅ. ᑭᓯᐊᓂ, 2019-ᒥᑦ, ᐊᒥᓲᙳᓇᐊᖅᓯᒪᔩᔭᓚᐅᖅᑐᑦ ᐱᑕᖃᐅᕐᓂᖏᓐᓂᒃ ᐆᒪᔪᐃᑦ ᖃᐅᔨᔭᐅᔪᓂᑦ, ᐊᒻᒪᓗ ᐊᒥᓲᓂᖅᓴᐃᑦ ᐆᒪᔪᕋᓛᑦ ᐃᓐᓇᐅᓕᖅᑐᑦ 2018-ᑎᑑᑉᓗᑎᒃ. ᑲᑎᓪᓗᒋᑦ 2,317 ᖃᓖᑦ ᐊᑐᐊᑕ ᖄᖓᓃᖅᑲᑦᑕᖅᑐᑦ 22-ᓂᒃ ᐊᔾᔨᐅᖏᑦᑐᓂᒃ ᐆᒪᔪᑦ ᖃᐅᔨᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ, ᐊᒥᓲᓂᖅᓴᐃᑦ ᑭᖑᕐᓚᐅᑉᓗᑎᒃ

ᐱᖓᓱᑦ ᖃᓖᑦ ᐆᒪᔪᐃᑦ ᐃᓕᑕᕆᔭᐅᓚᐅᖅᑐᑦ 2019-ᒥᑦ AIS/NIS-ᓄᑦ ᖃᐅᔨᓴᐃᑎᓪᓗᒋᑦ, ᒪᕐᕉᒃ ᐃᓕᑕᕐᓇᖅᑐᑦ ᐆᒪᔪᕐᓂᑦ - *Circeis armoricana*, ᖁᐱᕐᕈᖅ, ᐊᒻᒪᓗ *Patinella verrucaria*, ᑭᖑᕐᓚᒃ - ᐊᒻᒪᓗ ᐊᑕᐅᓯᖅ ᐃᓕᑕᕐᓇᖅᑐᖅ Cnidarian genus *Gonothyraea*. ᓇᓕᑐᐃᓐᓇᖏᑦ ᓄᑖᑦ ᖃᐅᔨᔭᐅᔪᓂᑦ ᖃᓕᖕᓂᑦ ᐆᒪᔪᓂᑦ ᐃᓕᑕᕆᔭᐅᖏᑦᑐᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᓐᓂᖏᓐᓄᑦ ᐅᖃᓖᒐᕐᓂᒃ ᕿᒥᕐᕈᓂᒃᑯᑦ ᓇᓗᓇᐃᖅᑕᐅᑉᓗᓂ ᐅᑭᐅᖅᑕᖅᑐᒧᐊᖃᑦᑕᕐᓂᖏᓐᓂᑦ (ᓱᕐᓗ, Casas-Monroy et al. 2014, Sirenko et al. 2020).

ᐃᖃᓗᒃ

ᐃᖃᓗᖕᓂᒃ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ AIS/NIS ᖃᐅᔨᕆᐊᖃᑦᑕᓚᐅᖅᑐᑦ ᐃᖃᓗᓗᒃᑖᓂᒃ ᖃᐅᔨᔭᐅᔪᓂᑦ MEEMP-ᒥᑦ ᐊᒻᒪᓗ AIS ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᓄᓇᕐᔪᐊᕐᒧᑦ ᖃᓇᑕᐅᔭᒃᑯᑦ ᑐᖅᑯᖅᓯᒪᔪᓂᒃ ᐃᒪᕐᒥᐅᑕᐃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᑦᑐᓄᑦ (Molnar et al. 2008). **ᓇᓕᑐᐃᓐᓇᖏᑦ ᐆᒪᔪᐃᑦ ᐃᓕᑕᕆᔭᐅᓂᖃᓚᐅᖏᑦᑐᑦ ᓄᓇᕐᔪᐊᕐᒧᑦ ᖃᓇᑕᐅᔭᒃᑯᑦ ᑐᖅᑯᖅᓯᒪᔪᓂᒃ ᐃᒪᕐᒥᐅᑕᐃᑦ ᑖᓂᕐᒥᐅᑕᐅᖏᓐᓂᖏᓐᓄᑦ. ᐊᑐᓂ ᐃᖃᓗᐃᑦ ᖃᐅᔨᓴᖅᑕᐅᖃᑦᑕᓚᐅᖅᒥᔪᑦ ᐊᑕᐅᓯᐅᖃᑦᑕᖅᓱᒋᑦ ᓇᓗᓇᐃᕐᓂᐊᕐᓗᒋᑦ ᖃᐅᔨᒪᔭᐅᓂᖏᑦ ᓇᒨᖓᐅᖃᑦᑕᕐᓂᖏᑦ, ᐊᒻᒪᓗ ᐃᖃᓗᓗᒃᑖᑦ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᓇᒨᖓᖃᑦᑕᕐᓂᖏᑦ ᐃᓚᐅᑉᓗᓂ ᐅᑭᐅᖅᑕᖅᑐᒥᑦ ᑕᓇᐅᖅ.**

ᐊᑕᐅᓯᖅ ᓄᑖᖅ ᐆᒪᔪᖅ ᐃᓚᔭᐅᔪᖅ AIS/NIS ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᖅ ROV-ᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ, ᐃᓕᑕᕆᔭᐅᓯᒪᙱᓐᑐᖅ ᑐᐊᑦᑐᕋᐃᔭᐃᑦ ᐃᖃᓗᒃ (Zoarcidae indet.), ᐊᑕᐅᓯᓪᓗᐊᖅ ᐆᒪᔪᖅ ᑎᑎᕋᐅᓯᐅᓯᒪᐸᓗᓂ ᓯᕗᓂᐊᒍᑦ MEEMP ᖃᐅᔨᓴᐃᓂᐅᓚᐅᖅᑐᒥᑦ. ᐃᓚᒋᔭᐅᔪᖅ, ᖃᐸᐃᐊᕐᔪᐃᑦ ᐃᖃᓗᐃᑦ ᖃᐅᔨᔭᐅᔪᑦ 2019-ᒥᑦ ᐱᑕᖃᓚᐅᙱᑦᑐᑦ ROV-ᒥᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᑦ ᖃᐸᐃᐊᕐᔪᖕᓄᑦ ᐅᑭᐅᓄᑦ, ᐃᓚᐅᐸᓗᓂ ᖁᐃᓂᔪᖅ ᐃᖃᓗᒃ (*Cyclopterus lumpus*), ᑕᑯᔭᐅᓚᐅᖅᑐᖅ 2014-ᒥᑐᐃᓐᓇᖅ, ᐊᒻᒪᓗ ᐊᓯᐊ ᐃᖃᓗᒃ (*Gymnelus viridis*), ᑎᑎᕋᐅᓯᐅᓚᐅᖅᑐᖅ 2013-ᒥᑦ ᐊᒻᒪᓗ 2015-ᒥᑦ.

ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓂᑦ ᖃᐅᔨᓴᐃᓂᖅ

ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᖅ ᖃᓄᐃᙶᔭᕆᐊᓕᙵᑦ ᓈᓴᐅᑎ 91, ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓂᑦ ᐃᒍᓇᖅᑐᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᓂᑦ ᐃᓚᐅᑎᑕᐅᓚᐅᖅᑐᖅ AIS/NIS-ᒥᑦ ᓯᕗᓪᓕᖅᐹᒥᑦ 2018-ᒧᑦ ᐃᓚᐅᑎᑕᐅᒃᑳᓂᖅᓱᓂᓗ 2019-ᒥᑦ. **NIS ᐅᙱᓘᓐᓃᑦ AIS ᐆᒪᔪᓂᒃ ᓇᓗᓇᐃᖅᓯᓂᖃᓚᐅᙱᑦᑐᖅ ᐃᒍᓇᖅᑐᑦ ᐆᒪᔪᓂᒃ ᖃᐅᔨᔭᐅᔪᑦ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓂᑦ ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓪᓗᒋᑦ.**

ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐃᒪᐅᑉ ᐃᒡᓗᐊᓂᑦ ᐊᔾᔨᓕᐅᕆᐸᓗᑎᒃ ᖃᐅᔨᓴᐃᓚᐅᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓂᑦ ᑖᓕᒪᓂᑦ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓂᒃ ᐅᓯᒃᑦᑕᖅᑐᓂᑦ ᐅᔭᕋᒃᑕᖅᑕᐅᔪᓄᑦ ᐃᒃᓯᕙᙹᑦᑐᓂᑦ ᐊᑐᖅᓱᑎᒃ ROV-ᒥᑦ ᐃᒪᐅᑉ ᐃᒡᓗᐊᓂᑦ ᐊᔾᔨᓕᐅᕈᑎᒃᑯᑦ. ᖃᐅᔨᓴᐃᓂᖃᓚᐅᖅᑐᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐃᒡᓗᙱᓐᓂᑦ ᐃᑎᓂᕐᓂᑦ ᐃᒻᒥᖅᓯᒪᔪᓂᑦ ᐅᒥᐊᕐᔪᐊᑦ ᐃᒡᓗᙱᓐᓂᑦ. ᑕᒪᓗᒃᑖᖅᑲᔭᖅ ᑕᐅᑐᒐᖃᓚᐅᖅᑐᖅ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓂᑦ ᐃᒍᓇᖅᑐᖃᕐᒪᙵᑦ (ᓱᕐᓘ, ᐊᒃᓱᓈᑦ ᐱᓂᐊᕐᕕᖕᓂᑦ, ᐊᓯᙱᓐᓂᓗ, ᓱᐸᓗᒥᑦ, ᐊᒃᓱᓇᐸ ᑑᙵᓂᑦ, ᐸᐱᕈᐊᓂᑦ, ᓴᓂᕚᓂᑦ, ᐊᑖᓂᑦ, ᐃᓱᙱᓐᓂᓪᓗ). ᑲᑎᑕᐅᔪᑦ ᐊᐅᓚᔪᓕᐊᓂᑦ ᑭᖑᓂᐊᒍᑦ ᐆᒪᔪᓕᕆᔨᓄᑦ ᕿᒥᕈᔭᐅᓚᐅᖅᑐᑦ ᐃᒍᓇᖅᑐᖅᑕᖃᕐᒪᙵᑦ.

ᑕᒪᓗᒃᑖᖅᑲᔭᖅ ᐅᒥᐊᕐᔪᐊᑉ ᐃᒡᓗᐊᓃᑦᑐᑦ ᐃᒪᐅᑉ ᑭᒡᓕᐊᑕ ᐊᑖᓂᑦ ᐃᒍᓇᖅᑐᖅᑕᖃᓚᐅᙱᑦᑐᑦ, ᖃᐅᔨᔭᐅᔪᓂᑦ. ᐃᓚᐅᓚᐅᙱᑦᑐᑦ ᒥᑭᔫᑎᑦ ᐃᓂᐅᔪᑦ ᓯᑕᒪᓂᑦ ᐅᒥᐊᕐᔪᐊᕐᓂᑦ, ᐃᓚᙱᑦ ᑲᑎᓯᒪᔪᑦ ᐆᒪᔪᕋᓵᑦ - ᐃᓚᐃᓐᓇᙳᐊᙹᓚᐅᖅᑐᑦ - ᓇᓂᔭᐅᓚᐅᖅᑐᖅ. ᑕᑯᒃᓴᐅᓂᙱᑦᑎᒍᑦ ᓂᕿᙱᓐᓂᑦ ᐃᒍᓇᖅᑐᑦ ᐆᒪᔪᕋᓵᓂᑦ ᐱᐅᓯᕚᓪᓕᓚᐅᙱᑦᑐᑦ ᑐᓪᓕᐊᓂ ᐅᑭᐅᕐᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ, ᑕᑯᒃᓴᐅᑦᑎᐊᖅᑐᒥᑦ ᐊᔾᔨᓕᐅᕈᑎᒥᒃ ᐊᑐᓕᓚᐅᕋᓗᐊᖅᑎᓪᓗᒋᑦ. ᐊᒥᓱᑦ ᓂᕿᙱᓐᓂᒃ ᐆᒪᔪᓂᒃ ᐋᖅᑭᒃᑕᐅᓚᐅᙱᑦᑐᖅ ᐃᓕᑕᕆᔭᐅᔾᔪᓇᓚᐅᕐᓂᙱᓐᓄᑦ ᐆᒃᑐᕋᐅᑎᑕᒃᖏᓪᓗᓂ.

ᐃᓄᐃᑦ ᐃᓚᐅᖃᑕᐅᔪᓂᒃ ᐊᐱᖅᓱᐃᓃᑦ

ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒍ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᕐᒧᑦ ᓈᓴᐅᑎ 126, ᐱᐊᓂᙵᑦ MEEMP ᐊᒻᒪᓗ AIS/NIS ᖃᐅᔨᓴᐃᓃᑦ ᓄᓇᓕᖕᒥᐅᑦ ᐊᑕᐅᑦᑎᒃᑯᑦ ᐃᓚᐅᖃᑕᐅᖁᔭᐅᓚᐅᖅᑐᑦ ᐃᓱᐊᓂᑦ ᐃᓚᙳᓂᑦ ᐅᑭᐅᐸ ᐊᐱᖅᓱᖅᑕᐅᓗᑎᒃ ᑐᓵᕝᕕᒋᓂᐊᕐᓗᒋᑦ ᑐᕌᖓᔫᐸ ᒥᒃᓵᓄᑦ ᑭᐅᒃᑦᑕᕐᓗᑎᒃ ᖃᐸᐃᐊᕐᔪᖕᓂᑦ ᐊᐱᖅᑯᑕᐅᔪᓂᒃ. ᐊᐱᖅᓲᑏᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᐊᕐᓗᒋᑦ ᐃᓚᐅᖃᑕᐅᔪᑦ ᐃᓱᒪᒋᔭᖏᑦ ᐋᖅᑭᐅᒪᓂᖓᑕ ᒥᒃᓵᓄᑦ, ᓈᓴᐅᑎᓂᒃ/ᑎᑎᖅᑲᓂᒃ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ ᐊᒻᒪᓗ ᖃᓄᐃᑦᑑᓂᖓᓄᑦ, ᐱᖁᑏᓪᓗ, ᐊᒻᒪᓗ ᑐᓴᕐᕕᒋᓗᒋᑦ ᐱᑕᖃᙱᑦᑐᕆᔭᐅᔪᑦ ᒥᒃᓵᓄᑦ, ᐃᓱᒫᓘᑕᐅᔪᓂᒃ ᐅᙱᓘᓐᓃᑦ ᐃᒪᓐᓈᖅᑑᑎᒋᔭᙱᑦ ᓯᕗᓂᒃᓴᒥᑦ ᐱᓕᕆᐊᖑᓂᐊᖅᑐᓄᑦ. ᐊᓯᐊᙳᕐᓂᖃᓚᐅᙱᑦᑐᖅ ᐃᖃᓗᐃᑦ ᐊᒥᓲᓂᙱᓐᓂᒃ, ᐱᑕᖃᐅᕐᓂᙱᓐᓂᒃ ᐋᓂᐊᖃᖅᑕᐃᓕᒪᓂᙱᓐᓂᓪᓘᓐᓃᑦ, ᐊᒻᒪᓗ ᓄᑖᓂᒃ ᐊᔾᔨᐅᙱᑦᑐᓂᓪᓘᓐᓃᑦ ᐃᖃᓗᒃᑕᖃᓚᐅᙱᑦᑐᖅ ᑕᐃᒪᙵᓂᑦ ᐊᐅᓖᖅᑎᑦᑎᓃᑦ ᐱᕆᐊᕐᒪᑕ ᕿᙳᐊᓂᑦ ᐃᒃᓯᕙᕐᒥᑦ ᐅᖃᐅᓯᐅᓚᙱᑦᑐᑦ ᐃᓄᙵᓄᑦ ᐃᓚᐅᖃᑕᐅᔪᓄᑦ 2019 MEEMP ᐊᒻᒪᓗ AIS-ᒧᑦ ᑭᙵᓂᐊᒍᑦ ᐊᐱᖅᓱᖅᑕᐅᖅᑳᖅᑎᓪᓗᒋᑦ. ᑭᐅᔾᔪᑕᐅᔪᑦ ᐊᐱᖅᑯᑎᓄᑦ ᐃᓚᐅᔪᑦ ᖃᓄᐃᓕᐅᕐᑯᔨᓃᑦ ᐊᒻᒪᓗ ᐋᖅᑭᕆᐊᖅᓯᕐᑯᔨᓃᑦ ᑐᕋᙵᔪᒧᑦ; ᐆᒃᑑᑎᒋᓗᒍ, ᐊᔪᕈᓐᓃᖅᓴᐃᓂᖃᒃᑲᓂᕐᓂᖅᓴᐅᓗᑎᒃ ᐆᒃᑐᕋᐃᓂᕐᓄᑦ ᐊᑐᖅᑕᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᓂᙱᓐᓄᑦ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐱᖁᑏᑦ, ᐃᒪᓐᓈᖅᑑᑏᑦ ᐆᒃᑐᕋᐃᕝᕙᐅᔪᓄᑦ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᔪᓄᑦ, ᐊᒻᒪᓗ ᐊᓯᐊᙳᕐᑯᔨᓃᑦ ᐃᖃᓗᐃᑦ ᓂᕿᙱᓐᓂᒃ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ ᐱᔭᐅᓚᐅᖅᑐᓂᒃ ᑐᓂᔭᐅᒃᑦᑕᕐᓗᑎᒃ ᓄᓇᓕᖕᒥᐅᓄᑦ. ᖃᓄᐃᓕᐅᕐᑯᔭᐅᓂᓗᒃᑖᑦ ᐊᒻᒪᓗ ᑐᒃᓯᕋᐅᑕᐅᔪᑦ ᐃᓚᐅᖃᑕᐅᔪᓂᒃ ᐱᔭᐅᔪᑦ ᐃᓱᒪᒋᔭᐅᓂᐊᖅᑐᑦ ᐸᕐᓇᐃᓂᖃᖅᑎᓪᓗᒋᑦ 2020 MEEMP-ᒧᑦ ᐊᒻᒪᓗ AIS-ᒧᑦ.

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
°C	Degree Celsius
µm	Micrometre
ADCP	Acoustic Doppler Current Profiler
AIS	Aquatic Invasive Species
ALS	ALS Environmental
ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
ArcOD	Arctic Ocean Diversity
ARMS	Arctic Register of Marine Species
Baffinland	Baffinland Iron Mines Corporation
BACI	Before-After-Control-Impact
Biologica	Biologica Environmental Services
BV Labs	Bureau Veritas Laboratory
CCME	Canadian Council of Ministers of Environment
cm	Centimetres
CPUE	Catch Per Unit Effort
CTD	Conductivity, Temperature, Depth
DFO	Fisheries and Oceans Canada
DL	Detection Limit
DO	Dissolved oxygen
DQO	Data Quality Objectives
EEM	Environmental Effects Monitoring
EOL	Encyclopedia of Life
EPH	Extractable Petroleum Hydrocarbons
ERL	Effects Range Low
ERP	Early Revenue Phase
ETI	ETI Bioinformatics
FCSAP	Federal Contaminated Sites Action Plan
FEIS	Final Environmental Impact Statement
g	Grams
GBIF	Global Biodiversity Information System
GPS	Global Positioning System
HD	High Definition
HDPE	High Density Polyethylene
HSD	Honest Significant Difference

Acronym or Abbreviation	Definition
Indet.	Indeterminate
ISQG	Interim Sediment Quality Guideline
LSA	Local Study Area
MEEMP	Marine Environmental Effects Monitoring Program
MEWG	Marine Environment Working Group
m	Metre(s)
M^2	Square Metres
m/s	Metre per Second
MDL	Method Detection Limit
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mg	Milligram
mm	Millimetre
MSL	Mean sea level
Mtpa	Million Tonnes per Annum
NCCOS	National Centers for Coastal Ocean Science
NEMESIS	National Exotic Marine and Estuarine Species Information System
NIRB	Nunavut Impact Review Board
NIS	Non-Indigenous Species
NTU	Nephelometric Turbidity Unit
No.	Number
OBIS	Ocean Biogeographic Information System
PAH	Polycyclic Aromatic Hydrocarbons
PC	Project Certificate
PCA	Principal Component Analysis
PEL	Probable Effect Level
PSU	Practical Salinity Unit
QA/QC	Quality Assurance/Quality Control
RM	Repeated Measures
ROV	Remotely Operated Vehicle
RPD	Relative Percent Differences
SD	Standard Deviation
SEM	Sikumiut Environmental Management Ltd.
sp.	Species
sp. nr.	Species Near to
SWI	Standard Working Instructions

Acronym or Abbreviation	Definition
TEL	Threshold Effect Level
The Project	Mary River Project
TIC	Total Inorganic Carbon
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds
WQG	Water Quality Guidelines
wwt	Wet Weight
WoRMS	World Register of Marine Species

1.0 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) completed the fifth consecutive year of environmental effects monitoring (EEM) for the Mary River Project (hereafter, “the Project”). This report presents the results for the 2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) monitoring programs conducted in Milne Inlet during the open-water season. Both programs were originally developed in 2015 following completion of marine baseline studies in Milne Port (the Port) during 2010, 2013 and 2014. The MEEMP and AIS monitoring programs are intended to provide a primary means to identify and quantify Project-related changes in the marine environment. Where such change occurs, the programs assist in identifying appropriate modifications to, or mitigation of, Project operational activities to avoid and/or minimize adverse effects on the marine environment. Results from the MEEMP and AIS monitoring programs also provide information to the Nunavut Impact Review Board (NIRB) to support its yearly review of the Mary River Project.

1.1 Project Context

The Mary River Project is an operating iron ore mine located in the Qikiqtaaluk Region of North Baffin Island, Nunavut (Figure 1-1). Baffinland is the owner and operator of the Project. The operating Mine Site is connected to a port at Milne Inlet (Milne Port) via the 100-km long Milne Inlet Tote Road. Undeveloped components of the Project include a South Railway connecting the Mine Station to a future port at Steensby Inlet (Steensby Port).

Project Certificate (PC) No. 005, amended by the Nunavut Impact Review Board (NIRB) on 27 May 2014, authorizes Baffinland to mine up to 22.2 million tonnes per annum (Mtpa) of iron ore from Deposit No. 1. Of this 22.2 Mtpa of ore, the Company is currently authorized to transport 18 Mtpa by rail to Steensby Port for year-round shipping through the Southern Shipping Route (via Foxe Basin and Hudson Strait), and 4.2 Mtpa by truck to Milne Port for open water shipping through the Northern Shipping Route using chartered ore carrier vessels. A Production Increase to ship 6.0 Mtpa from Milne Port was approved for 2018 and 2019. Shipping of ore from Milne Inlet during the early revenue phase (ERP) began in 2015 and is expected to continue for the life of the Project (20+ years). During the first year of ERP Operations in 2015, Baffinland shipped approximately 900,000 tonnes via 13 ore carrier voyages. The amount of ore shipped during the 2019 open-water season reached approximately 5.86 million tonnes via 81 return ore carrier voyages.

LEGEND

- MINE SITE
- PROJECT LOCATION
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- SHIPPING ROUTE
- WATERCOURSE
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- INAC FORESHORE LEASE
- LOCAL STUDY AREA
- NUNAVUT SETTLEMENT AREA
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- WATERBODY

0 5 10
1:250,000 KILOMETRES

REFERENCE(S)

LOCAL STUDY AREA BOUNDARY DIGITIZED FROM THE MARY RIVER PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT (FEBRUARY 2012). FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE PROVIDED BY CLIENT, MAY 28, 2018 AND PROVIDED BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
PROJECT LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	CB
PREPARED	AA
REVIEWED	MW
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000-04	0	1-1

1.2 Background

As a part of regulatory commitments, Baffinland has developed and implemented a multi-parameter Environmental Effects Monitoring (EEM) program for the marine environment, collectively referred to as the MEEMP. The MEEMP was designed to evaluate potential Project-related effects on the marine environment as predicted in the Final Environmental Impact Statement (FEIS; Baffinland 2013) and FEIS Addendum (Baffinland 2013). Potential effects on the marine environment may include:

- Changes in water and sediment quality (e.g., ore dust, hydrocarbon leaks, wastewater, and site runoff)
- Changes in marine habitat and biota from contaminant sources (e.g., ore dust, hydrocarbon leaks, wastewater, and site runoff)
- Physical perturbations caused by shipping (sediment re-suspension and transportation)

The MEEMP includes monitoring of marine water and sediment quality, marine invertebrates, marine vegetation, and fish and fish habitat. The MEEMP sampling design is based on the Metal Mining Environmental Effects Monitoring (EEM) guidelines (Environment Canada 2012) and includes statistical approaches for detecting potential Project-induced impacts on the marine environment. Aquatic Invasive Species (AIS) and Non-Indigenous Species (NIS) monitoring is an integral component of the MEEMP. It is designed to address the potential risks of invasive species introductions to the marine environment from ship ballast water and hull biofouling in accordance with existing Terms and Conditions of the Project Certificate (as applicable).

Sikumiut Environmental Management Ltd. (SEM) was originally retained by Baffinland to design and implement the MEEMP. The MEEMP program was first implemented in 2014. Monitoring efforts in 2014 focused primarily on further characterization of baseline conditions in Milne Port. Environmental effects monitoring was completed by SEM in 2015 and 2016. Golder completed environmental effects monitoring in 2017 and 2018, which included modifications to 2014-2016 MEEMP and AIS sampling design to better address the objectives of the programs. Following the 2018 program, further modifications to the 2017-2018 MEEMP and AIS sample design were made to address recommendations from the 2018 MEEMP report based on input from the Marine Environment Working Group (Golder 2019a).

1.3 Objectives

This report presents the results of the MEEMP and AIS monitoring programs conducted at Milne Port and in Milne Inlet during the 2019 open-water season. The physical oceanography component of the program is presented in a separate report, included as Appendix L. The background review of hydrology and geomorphology in Phillips Creek Estuary is also presented in a separate report, included as Appendix M.

In accordance with existing Terms and Conditions of Project Certificate No. 005, Baffinland is responsible for the establishment and implementation of the MEEMP, which comprises EEM studies that are conducted over a defined time period with the following objectives:

- Assess the accuracy of effects predictions in the FEIS (Baffinland 2012) and Addendum 1 (Baffinland 2013).
- Assess the effectiveness of Project mitigation measures.
- Verify compliance of the Project with regulatory requirements, Project permits, standards and policies.
- Identify unforeseen adverse effects and provide early warnings of undesirable changes in the environment.

- Improve understanding of local environmental processes and potential Project-related cause-and-effect relationships.
- Provide feedback to the applicable regulators (e.g. NIRB) and advisory bodies (e.g. Marine Environment Working Group or MEWG) with respect to:
  - Potential adjustments to existing monitoring protocols or monitoring framework to allow for the most scientifically defensible synthesis, analysis and interpretation of data.
  - Project management decisions requiring modification of operational practices where and when necessary.

The MEEMP was developed in consideration of the anticipated and potential Project-related impacts to the marine environment as identified in the 2012 FEIS and 2014 ERP Addendum, as well as monitoring requirements outlined in the following PC Conditions:

- Condition No. 76 – 'The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment.'
- Condition No. 1 and 83 – 'GPS/tidal gauge monitoring of sea levels and storm surges. Install tidal gauges at Steensby and Milne Port to monitor seas levels and storm surges.'
- Condition No. 83 (a) – 'To identify potential for and conduct monitoring to identify effects of sediment redistribution associated with construction and operation of the Milne Port.'
- Condition No. 84 – 'The Proponent shall update its sediment redistribution modeling once ship design has been completed and sampling should be undertaken to validate the model and to inform sampling sites and the monitoring plan.'
- Condition No. 85 – 'The Proponent shall develop a monitoring plan to verify its impact predictions associated with sediment redistribution resulting from propeller wash in shallow water locations along the shipping route. If monitoring detects negative impacts from sediment redistribution, additional mitigation measures will need to be developed and implemented.'
- Condition No. 86 – 'Prior to commercial shipping or iron ore, use more detailed bathymetry collected from Steensby and Milne Inlets to model anticipated ballast water discharges from ore carriers. This information should be used to update ballast water discharge impact predictions and sampling should be conducted to validate the model.'
- Condition No. 87 – 'The Proponent shall develop a detailed monitoring program at a number of sites over the long term to evaluate changes to marine habitat and organisms and to monitor for non-native introductions resulting from Project-related shipping. This program needs to be able to detect changes that may have biological consequences and should be initiated several years prior to any ballast water discharge into Steensby Inlet and Milne Inlet to collect sufficient baseline data and should continue over the life of the Project.'
- Condition No. 89 – 'The Proponent shall develop and implement an effective ballast water management program that may include the treatment and monitoring of ballast water discharges in a manner consistent with applicable regulations and/or exceed those regulations if they are determined to be ineffective for providing the desired and predicted results. The ballast water management program shall include, without limitation, a provision that requires ship owners to test their ballast water to confirm that it meets the salinity requirements of the applicable regulations prior to discharge at the Milne Port, and a requirement noting that the Proponent, in choosing shipping contractors will, whenever feasible, give preference to contractors that use ballast water treatment in addition to ballast water exchange.'

- Condition No. 91 – 'The Proponent shall develop a detailed monitoring plan for Steensby Inlet and Milne Inlet for fouling that complies with all applicable regulatory requirements and guidelines as issued by Transport Canada, and includes sampling areas on ships where antifouling treatment is not applied such as the areas where non-native species are most likely to occur.'
- Condition No. 99 (a) – 'Establish shipping season, inter-annual baseline in Steensby Inlet and Milne Inlet that enables effective monitoring of physical and chemical effects of ballast water releases, sewage outfall, and bottom scour by ship props, particularly downslope and downstream from the docks. This shall include the selection and identification of physical, chemical, and biological community/indicator components. The biological indicators shall include both pelagic and benthic species but with emphasis on relatively sedentary benthic species (e.g., sculpins).'
- Condition No. 99 (b) (ii) – 'The collection of additional baseline data in Milne Inlet on narwhal, bowhead and anadromous Arctic char abundance, distribution ecology and habitat use.'
- Condition No. 113 – 'The Proponent shall conduct monitoring of marine fish and fish habitat, which includes but is not limited to, monitoring for Arctic char stock size and health condition in Steensby Inlet and Milne Inlet, as recommended by the Marine Environment Working Group.'
- Condition No. 114 – 'In the event of the development of a commercial fishery in the Steensby Inlet area or Milne Inlet‐Eclipse Sound areas, the Proponent, in conjunction with the Marine Environment Working Group, shall update its monitoring program for marine fish and fish habitat to ensure that the ability to identify Arctic char stock(s) potentially affected by Project activities and monitor for changes in stock size and structure of affected stocks and fish health (condition, taste) is maintained to address any additional monitoring issues identified by the MEWG relating to the commercial fishery.'
- Condition No. 126 – 'The Proponent shall design monitoring programs to ensure that local users of the marine area in communities along the shipping route have opportunity to be engaged throughout the life of the Project in assisting with monitoring and evaluating potential Project-induced impacts and changes in marine mammal distributions.

1.4 Valued Ecosystem Components and Thresholds

The Valued Ecosystem Components (VECs) on which effects were assessed in the FEIS and monitored during the MEEMP studies were Marine Water and Sediment Quality, Marine Fish Habitat and Arctic Char Health. The assessment predicted that Project activities may result in localized changes above threshold values (Level-II-magnitude) for Water and Sediment Quality and Arctic Char Health VECs, confined within the LSA. It was predicted that changes would not exceed thresholds (Level-I-magnitude) for the Marine Fish Habitat VEC. All predicted residual environmental effects were rated as "Not Significant" since they were confined to the LSA (Baffinland 2012 and 2013).

Criteria used to determine effect magnitude thresholds for the Water and Sediment Quality VECs were Canadian Council of Ministers of Environment (CCME) Guidelines for the Protection of Aquatic Life (Table 1-1) or baseline concentrations if they exceeded guidelines prior to start of Project activities. CCME guidelines for water quality were also used to determine effect magnitude thresholds for the Arctic Char Health VEC (Table 1-2). Thresholds for effect magnitude on the Fish Habitat VEC were established as a reduction in productive capacity measured as a proportion of lost or altered habitat to the total area of the LSA (Table 1-3) (Baffinland 2012 and 2013). For certain parameters where no guidelines or quality criteria exist (e.g., sediment percent fines, sediment iron concentrations and benthic community abundance), the MEEMP uses a significance criterion of two standard deviations of the baseline year as a threshold (Baffinland 2016).

Table 1-1: Criteria for Determination of the Magnitude of Effect on Water and Sediment Quality (Baffinland 2012)

Level	Descriptor	Criteria
Not Assessed (Level 0)	Negligible	Water/sediment quality change not expected to be detectable
Level I	Low	Water/sediment quality change may be detectable but would remain within CCME guidelines
Level II	Moderate	Water/sediment quality change within an order of magnitude of the CCME guidelines
Level III	High	Water/sediment quality change greater than an order of magnitude above the CCME guidelines

Table 1-2: Criteria for Determination of the Magnitude of Effect on Arctic Char Health Due to Changes in Water Quality (from Baffinland 2012)

Level	Descriptor	Criteria
Not Assessed (Level 0)	Negligible	Water quality change within CCME guidelines
Level I	Low	Water quality change is from 1 to 10 times the CCME guidelines
Level II	Moderate	Water quality change is from 10 to 100 times the CCME guidelines
Level III	High	Water quality change is more than 100 times the CCME guidelines

Table 1-3: Criteria for Determination of the Magnitude of Effect on Marine Fish Habitat (from Baffinland 2012)

Level	Descriptor	Criteria
Not Assessed (Level 0)	Negligible	Less than 1% reduction in productive capacity
Level I	Low	Between 1% and 10 % reduction in productive capacity
Level II	Moderate	Between 10% and 20% reduction in productive capacity
Level III	High	More than 20% reduction in productive capacity

1.5 Study Area

The 2019 MEEMP and AIS field surveys were conducted primarily within the Local Study Area (LSA) for the Marine Environment as defined[5] in the FEIS and Addendum (Baffinland 2012; 2013). The LSA includes all of Milne Port (Assomption Harbour) and extends north up to 4 km from the existing terminal (spanning the full width of Milne Inlet at the northern boundary) (Figure 1-1). The southeast boundary of the LSA ends at the confluence of Milne Inlet with Phillips Creek.

[5] The LSA includes all marine waters where there exists a reasonable potential for direct measurable effects from Project activities on the marine environment.

Following feedback provided from MEWG members and local Inuit during the 2016 community workshops, additional AIS/NIS and physical oceanographic monitoring was conducted north of the LSA boundary extending to Ragged Island and Eclipse Sound in 2019. This represented the third consecutive year of sampling at Ragged Island which aimed at detecting potential Project effects from ore carriers when anchored in this area.

2.0 STUDY DESIGN

2.1 MEEMP (2014-2018)

The MEEMP was designed to evaluate potential Project-related impacts on the marine environment as predicted in the FEIS and FEIS Addendum (Baffinland 2012; 2013). The MEEMP design has continually evolved since its inception, based on refinements to the program that have been identified through consultation with regulatory agencies and Inuit organizations and recommendations made in previous survey years. The original sampling design for the MEEMP (Baffinland 2016; SEM 2015) was based on a radial gradient transect design extending out from the Ore Dock (Figure 2-1), which represents a potential point source for contaminants (e.g., ore dust, hydrocarbon release, wastewater, and site runoff) and physical perturbations (e.g., sediment re-suspension and transportation). The radial pattern was designed to detect potential Project-related effects based on a gradient of key components with numerical indicators (e.g., metal concentrations in sediment) along a series of transects with increasing distance from the point source.

The initial MEEMP design (excluding AIS monitoring) included the following study components:

- Marine sediment quality
- Benthic epifauna and epiflora dive surveys
- Fish

Water quality was added to the MEEMP in 2015 to monitor for potential changes in water quality associated with site drainage and treated effluent discharges to the marine environment (including iron ore stockpile run-off). Four water quality stations were established near the site discharge point for compliance monitoring; one station next to the site discharge point, and three stations located slightly offshore to the northeast, north and northwest of the source.

In 2017, monitoring of sea levels (using a tidal gauge) and vertical physical profiles of physical oceanographic parameters at Milne Port were added to the MEEMP. In 2018, this was expanded to include physical oceanographic monitoring throughout Milne Inlet including two sites at Milne Port and one at Bruce Head, and additional vertical physical profiles at select times and locations throughout Milne Inlet.

In 2018, the number of sediment samples analyzed for hydrocarbon concentrations was reduced from three samples to one sample at each station, as hydrocarbon concentrations had been below detection limits (DL) in all samples to date. Additionally, in 2018 two new sediment sampling stations were added along the East Transect to account for future expansion (e.g., the Freight Dock completed in 2019; Golder 2019a, Golder 2020).

The 2014 to 2017 MEEMP study design did not include a benthic infauna sampling program. Changes to the benthic community were instead evaluated using epifauna[6] and epiflora[7] as indicators using towed underwater video transect surveys. The use of epifauna and epiflora as effect indicators deviated from the standard EEM methodology (Environment Canada 2010; 2012) and presented a number of disadvantages, including 1) high temporal and spatial variability due to the transient nature of most epifaunal species, 2) typical low resolution of video survey data compared to laboratory analysis for species identification, enumeration and substrate classification, and 3) difficulty in distinguishing between live epiflora (e.g. kelp) and dead vegetation debris using video survey methods, which can result in inaccurate data reporting. As such, with input from the MEWG, benthic infaunal sampling was added to the MEEMP in 2018.

Additionally, in 2018, towed video surveys for benthic epifauna and epiflora were not conducted along the full transect lengths; instead, the study design was changed to follow a Before-After-Control-Impact (BACI) approach with five belt transects (1 m x 5 m plots) permanently installed on the seabed in each of the Exposure (Impact) and Reference (Control) areas; monitoring was conducted using a remotely operated vehicle (ROV) underwater video system. Taxonomic data was also used to inform the AIS/NIS program.

Prior to 2018, fish tissue sampling was limited to incidental Arctic char mortalities, which fluctuated from year to year and did not always yield enough samples for a meaningful statistical analysis. In 2018, a local shellfish species, *Hiatella arctica,* was added to the MEEMP as an additional effects indicator for the fish health sampling program in case finfish species (Arctic char or sculpins) were sampled in insufficient numbers to adequately support statistical analyses. *H. arctica* are a resident species in the Project area, easily identifiable and measurable in the field, and are fairly abundant in the study area (Golder 2018). Measurement endpoints included tissue (body burden) analysis. No additional licensing or permit was required for shellfish sample collection.

In 2017, fish sampling was limited to a two-week period in August, which may not have been representative of the entire open-water shipping season (late July to mid-October). In 2018, fish sampling was conducted throughout the duration of the MEEMP program (over four weeks, from the end of July to the end of August) for better representation of the shipping season. Fishing methods included gill netting and Fukui traps, with angling added in 2017, and beach seines added in 2018.

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[6] benthic invertebrates living on the substrate
[7] marine vegetation attached to the substrate (e.g. kelp)

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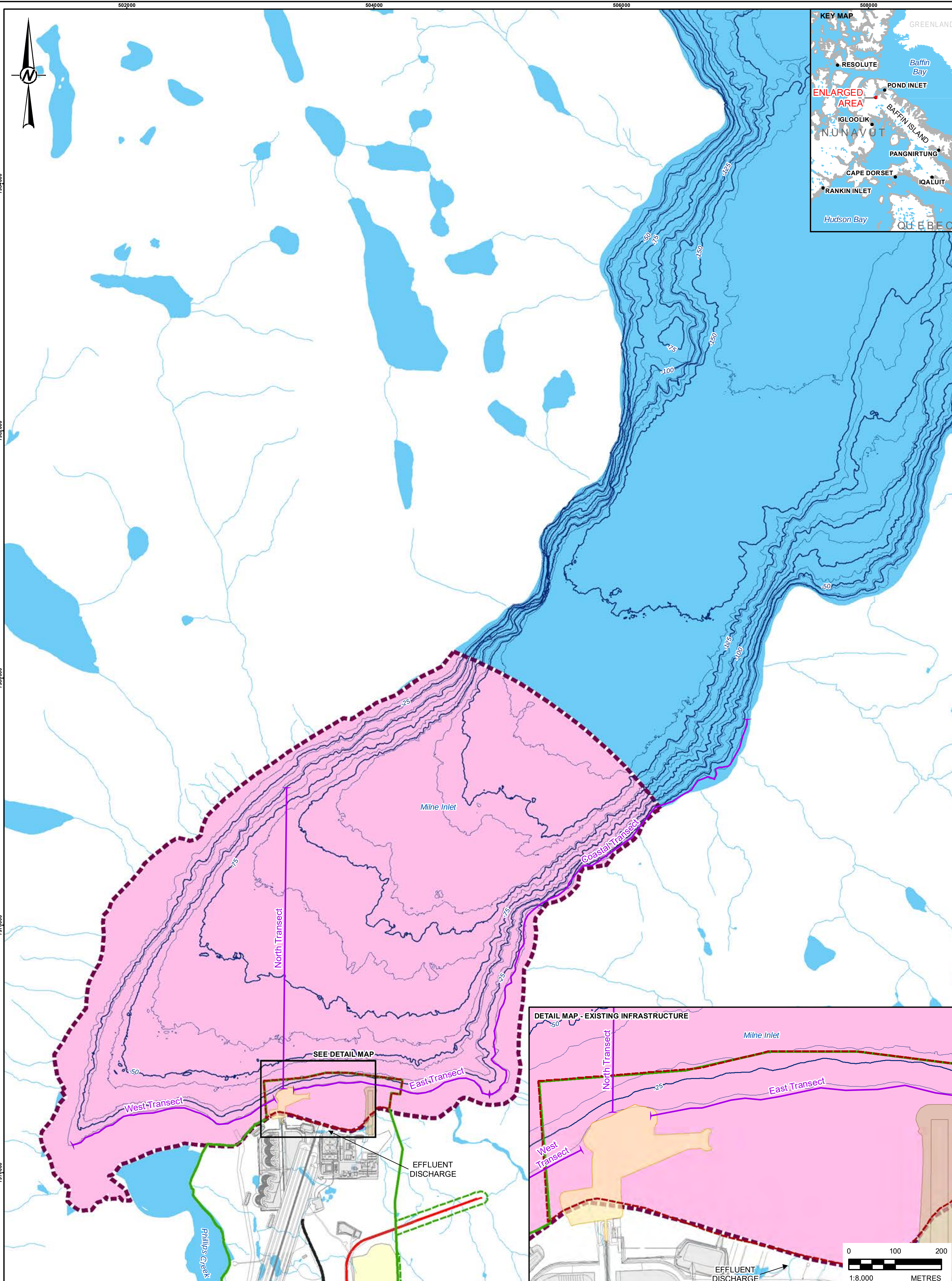

LEGEND

- BATHYMETRIC CONTOUR (15 m INTERVAL)
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- TRANSECT
- WATERCOURSE
- AGGREGATE SOURCE (BORROW PIT OR QUARRY)
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- LOCAL STUDY AREA
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- WATERBODY

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REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE PROVIDED BY CLIENT, MAY 28, 2018 AND PROVIDED BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
RADIAL GRADIENT STUDY DESIGN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	CB
PREPARED	AA
REVIEWED	MW
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
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2.1.1 Modifications to the MEEMP (2019)

The 2019 MEEMP study design considered the following:

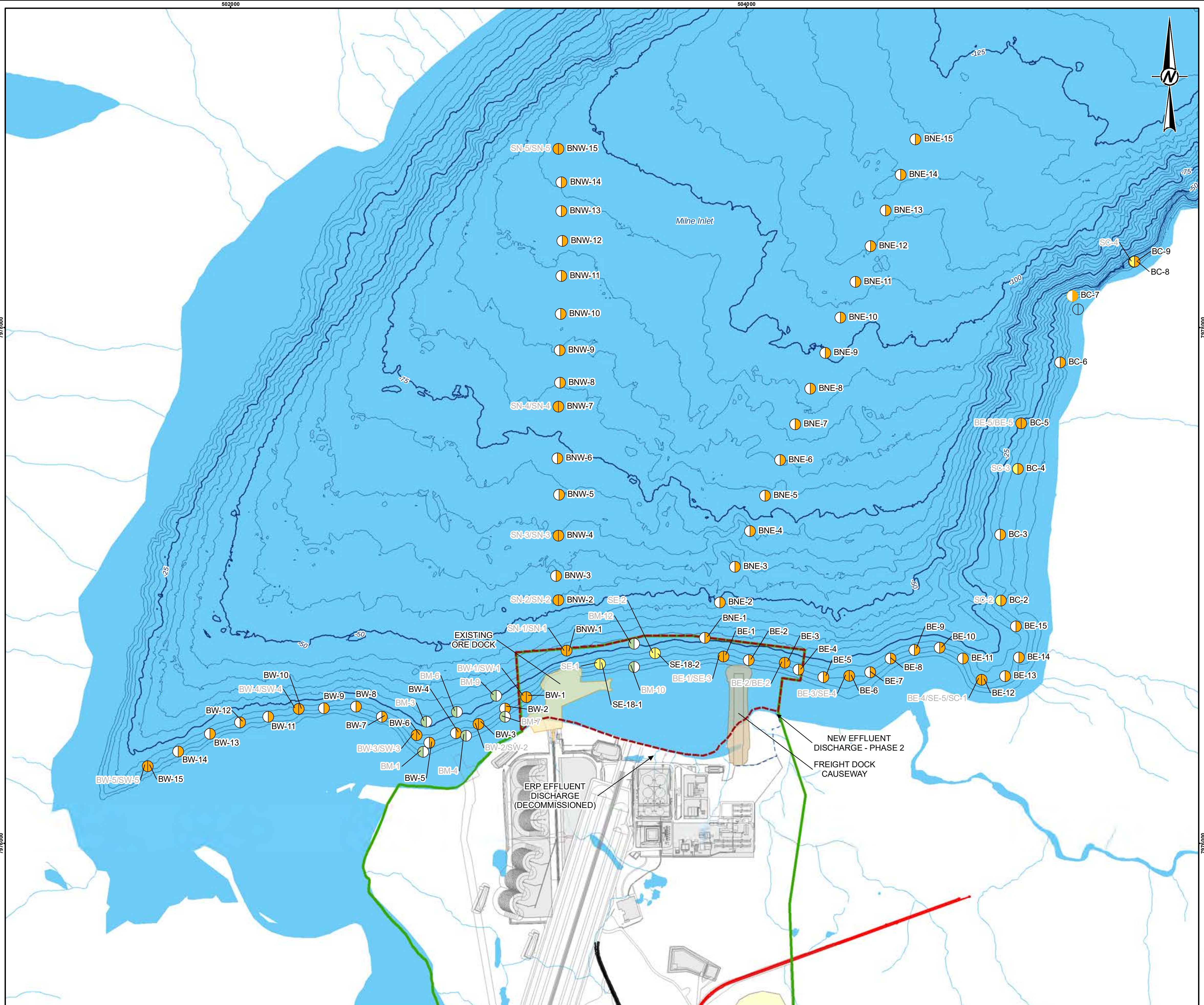
- MEEMP 2014 to 2018 results
- Feedback from MEWG and Regulators on the 2018 MEEMP report and the MEEMP program to-date
- EEM guidance from Environment and Climate Change Canada (Environment Canada 2012)
- Sampling requirements for any future expansions of Port infrastructure or any increase in Milne Port operations and shipping activities

Based on the above, the following changes to the MEEMP study design occurred in 2019:

- Vertical physical profiles of water quality parameters including temperature, salinity, conductivity, turbidity, pH, chlorophyll-a, and dissolved oxygen were taken north of Ragged Island in Eclipse Sound in August and September 2019.
- Increased spatial coverage of vertical physical profiles of conductivity/salinity, temperature and depth (i.e. CTD profiles) near Milne Port following deployment and recovery of Physical Oceanographic moorings in 2019.
- Background review of potential sea level rise in Nunavut to provide context to ongoing continuous monitoring of water levels at Milne Port Ore Dock in the open-water season.
- Background review of hydrology and geomorphology in Phillips Creek Estuary to assess the potential for natural sediment redistribution at the head of Milne Inlet.
- Following the results of a power analysis (Golder 2019c) requested by the MEWG, benthic infauna and sediment sampling stations were changed to a larger radial gradient design increasing from four transects with 5 stations to five transects with 15 stations each to improve statistical power and the ability to detect Project-related effects. Unlike in previous years, separate AIS stations were not sampled due to the expansion of the benthic sampling program (Figure 2-2).
- A fifth transect (Northeast Transect) was added to the 2019 MEEMP. The new transect extended offshore from between the existing Ore Dock and the Freight Dock at an angle to the Northeast to a distance of approximately 2,100 m, corresponding to a water depth of approximately 120 m. Consistent with the other transect locations, targeted sediment and benthic sampling stations were proposed at 15 stations along the northeast transect.
- The North Transect was renamed the “Northwest Transect” to clearly differentiate it from the Northeast transect. Both the Northwest and Northeast transects included a distance and depth gradient for consideration in the EEM analyses, whereas the East, West and Coastal transects only include a distance gradient due to their positioning along the 15 m depth contour.
- In previous years, 3 subsamples were taken at each benthic infauna sampling station. In 2019, the three subsamples were composited into a single sample for each station.
- Benthic infauna and sediment samples were collected using a standard Ponar grab and a Van Veen grab, increasing the sample volumes and surface areas. Due to the large volume of the Van Veen grab, each of the triplicate grabs was split in the field and half of the sample retained.

- Fish tissue sampling included sculpin (*Myoxocephalus* sp.), due to the number of incidental mortalities being sufficient to support analyses. Sculpin were identified as a potential target species for body burden analysis during the early stages of the MEEMP; however, low catch rates and limited recaptures suggested that their population size in the LSA was too low to support lethal fish collection for subsequent tissue analysis.
- Instead of collecting length and weight measurements of *Hiatella arctica* samples in the field, *H. arctica* specimens were submitted for age analysis in addition to the tissue (body burden) analysis.
- Fyke nets were introduced to the fish sampling program to determine the capture efficiency of the method in Milne Port and assess its potential as a replacement for Fukui trapping.

Other components of the 2019 MEEMP program remained unchanged from previous years (2014-2018).



LEGEND

BENTHIC INFAUNA AND SEDIMENT SAMPLING STATIONS

2018 AIS BENTHICS	NO 2019 SAMPLE
2018 BENTHICS AND SEDIMENTS	2019 BENTHICS AND SEDIMENTS
2018 SEDIMENTS	2019 BENTHICS AND SEDIMENTS
2018 SEDIMENTS	2019 SEDIMENTS
NO 2018 SAMPLE	2019 BENTHICS AND SEDIMENTS

- BATHYMETRIC CONTOUR (5 m INTERVAL)
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- NEW EFFLUENT PIPELINE
- PDA / QIA COMMERCIAL LEASE
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- INAC FORESHORE LEASE
- AGGREGATE SOURCE (BORROW PIT OR QUARRY)
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- WATERBODY

0 500 1,000

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REFERENCE(S)

REIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE PROVIDED BY CLIENT, MAY 28, 2018 AND PROVIDED BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
COMPARISON OF 2018 MEEMP BENTHIC AND SEDIMENT SAMPLING DESIGN TO 2019 PROPOSED SAMPLING LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	CB
PREPARED	AA
REVIEWED	MW
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000	0	2-2

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2.2 AIS Monitoring (2014-2018)

The AIS monitoring program was designed to detect for the potential introduction of non-indigenous species from ballast water discharges and/or hull biofouling. The AIS monitoring program is largely based on a Before-After experimental design that focuses on areas with the highest likelihood of marine invasion. The AIS Monitoring Program is conducted at a surveillance level for AIS and NIS, where detection of a single invasive species is the threshold for the triggering of adaptive management measures (e.g., species rapid response plans) and/or potential corrective actions (e.g., measures to eradicate the AIS), if deemed feasible. The AIS/NIS monitoring program consists of data collected across multiple trophic levels (marine vegetation, zooplankton, benthic invertebrates and fish) to establish a comprehensive inventory of existing marine biota in the Project area that is intended to serve as a point of reference for any new species (i.e. NIS) identified over time, and to evaluate potential changes in community structure that may be linked to NIS introductions. Marine organisms identified during baseline studies in 2008, 2010 and 2013 also contributed to the AIS/NIS inventory. AIS/NIS monitoring is recommended to be conducted annually until results of ballast water sampling are deemed satisfactory to recommend reducing the frequency of monitoring in the receiving environment.

Since ballast water releases occur at the anchorages and the Ore Dock in Milne Port, AIS/NIS sampling conducted to date has largely focused in southern Milne Inlet. Baseline AIS surveys were conducted in 2014 to enhance marine flora and fauna inventories collected during baseline sampling in 2008 and 2013. AIS monitoring undertaken in 2015 and 2016 focused on identification of organisms not previously detected during the baseline program (as primary indicators of invasion). Equivalent AIS monitoring was conducted in Milne Port area during 2017, although the program was expanded to include AIS sampling at Ragged Island in response to public concern over ships potentially discharging ballast water while occupying anchorage sites in this area. It is noted that no ballast water is to be discharged at Ragged Island by any Project-related vessel.

In 2018, in accordance with monitoring requirements outlined in PC Condition No. 91., ROV-based underwater video surveys were conducted of several ore carrier ship hulls to assess for potential biofouling and transport of non-native species by Project vessels originating from outside Canadian waters.

Several of the benthic infaunal sampling stations (15-25 m strata) that were part of the 2014-2017 AIS monitoring program were relocated in 2018 to new locations along the three MEEMP transects (Figure 2-2). The benthic infauna samples collected along the North, West and East transects were used as an effects indicator for the EEM program as well as monitoring for the AIS program.

2.2.1 Modifications to the AIS program (2019)

The following modifications were made to the AIS program in 2019:

- Following recommendations from the 2018 MEEMP and AIS Program Report (Golder 2019a), a new high definition (HD) camera was attached to the ROV to improve taxonomic identification capability.
- Following the results of a power analysis (Golder 2019c), benthic infauna sampling stations as part of the MEEMP were changed to a larger radial gradient design increasing from four transects with five stations to five transects with fifteen stations each. As in previous years, three subsamples were taken at each station, although in 2019, the subsamples were composited.
- Following recommendations from MEWG, emphasis was added to reporting to highlight the AIS monitoring program included monitoring for all NIS, not just AIS.
- In 2019, no sampling occurred at the AIS specific stations, due to the significant expansion of the benthic sampling program. A greater number of stations were sampled for identification of benthic infauna. AIS/NIS status was determined for all infauna identified in benthic sampling.
- A new AIS towed video survey transect was added east of the new Freight Dock at Milne Port to account for potential changes in shipping rates in Milne Port.

3.0 MATERIALS AND METHODS

The 2019 MEEMP and AIS field monitoring programs were conducted over nine weeks between 24 July and 6 October by a five-person field team composed of Golder biologists, local Inuit researchers, and a local Inuit vessel operator from Pond Inlet, NU. Sampling was conducted from a 28-foot aluminum vessel (field vessel) and an 11-foot zodiac tender vessel based at the Milne Port facility. Physical oceanography monitoring was conducted from Ocean Group tugboats and the icebreaker *MSV Botnica*.

3.1 MEEMP

3.1.1 Water Quality

Water quality samples were collected during six sampling events between 26 August and 1 October 2019 to monitor for potential changes in water quality associated with site drainage and treated effluent discharges to the marine environment. Samples were typically collected weekly over this period; however, an unexpected health and safety incident disrupted the 2019 sampling schedule, such that on-water sampling was not possible for approximately a week of the program resulting in a slight change in the sampling program from previous years. Consequently, two sampling events were completed during the last week of August (i.e., on 26 August and 29 August 2019) and no sampling was conducted the week of 16 September 2019.

Water quality samples were collected at four sampling stations that were previously monitored from 2015–2018 (SEM 2016; SEM 2017a; Golder 2018, Golder 2019a): one station was situated directly offshore of the marine discharge point for treated effluent and collected site drainage (i.e., Source) while the remaining three stations were located approximately 250 m offshore of the outfall location to the northwest (WNE), north (North), and northeast (ENE), respectively (Figure 3-1; Table 3-1). The treated effluent and site drainage discharge system consists of an upland pipe that terminates in a collection ditch on the upper foreshore. The ditch runs downslope to a marine discharge point located on the beach east of the existing Ore Dock. During sampling, discharge water was observed flowing from the pipe into the collection ditch, where it permeated the ground prior to reaching the shoreline (i.e., water was not observed to be flowing directly into the marine receiving environment during the sampling events).

Table 3-1: Marine Water Quality Sampling Locations

Station Name	UTM Zone	Easting (m)	Northing (m)
ENE	17W	503874	7976517
North	17W	503725	7976612
WNW	17W	503540	7976599
Source	17W	503662	7976403

Notes: UTM = Universal Transverse Mercator; m = meter.

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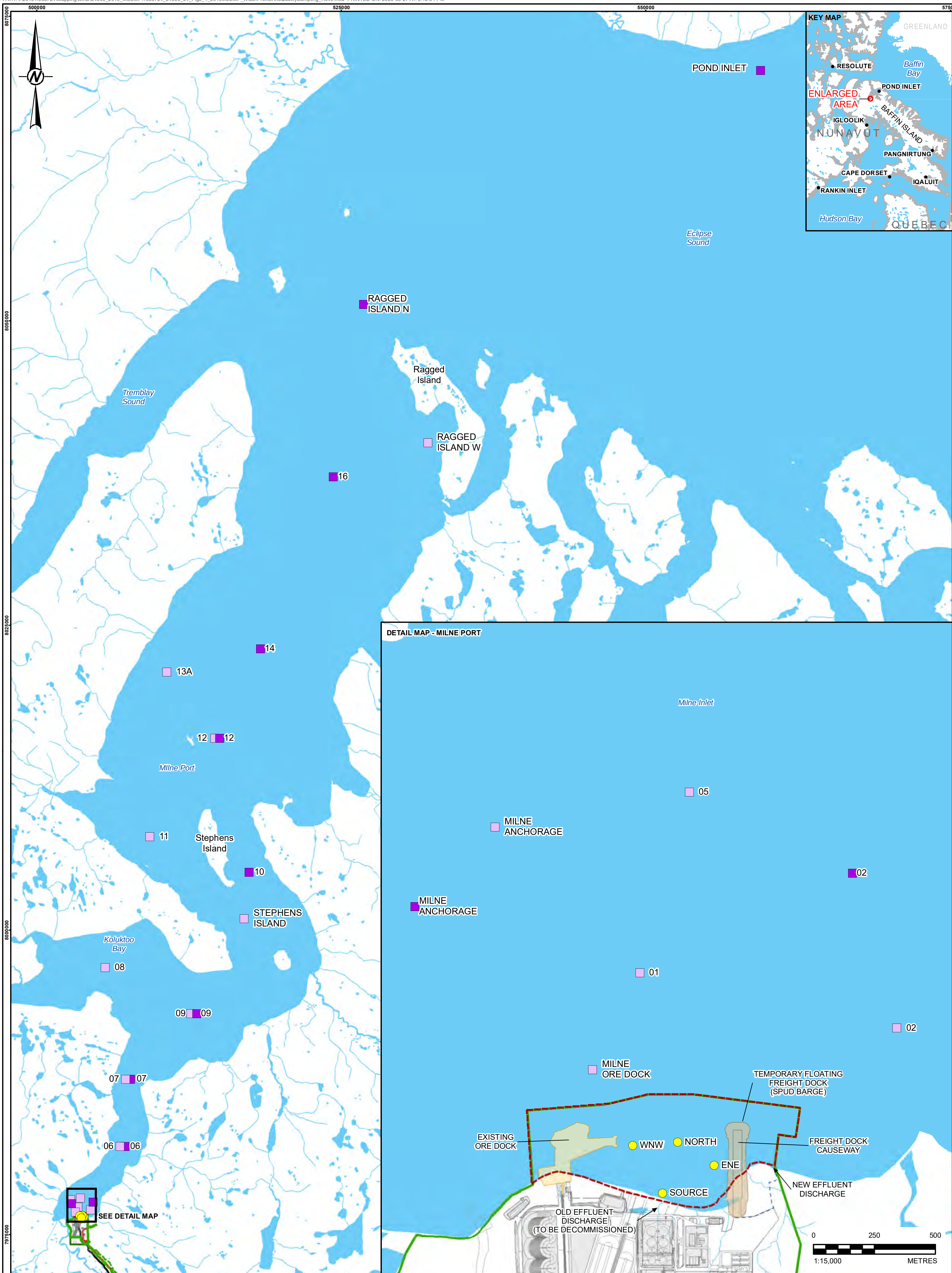

LEGEND

- AUGUST BIOLOGICAL CONDUCTIVITY TEMPERATURE DEPTH (CTD) VERTICAL PROFILE
- SEPTEMBER BIOLOGICAL CONDUCTIVITY TEMPERATURE DEPTH (CTD) VERTICAL PROFILE
- DISCRETE WATER QUALITY SAMPLE
- MILNE INLET TOTE ROAD
- NEW EFFLUENT PIPELINE
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- INAC FORESHORE LEASE
- WATERBODY

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)

FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

TITLE
SUMMARY OF PROJECT AND DATA COLLECTION LOCATIONS BETWEEN MILNE PORT AND ECLIPSE SOUND

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	EE
PREPARED	AA
REVIEWED	MW
APPROVED	PR

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Water sampling at each station was conducted from the field vessel using a 5.0 L Niskin sampling bottle. Samples were collected from approximately 0.5 to 1 m below the surface due to the relatively shallow depth and lack of stratification at the sampling stations. Samples were preserved in the field according to laboratory instructions and kept refrigerated until they were shipped (within 48 h of sample collection) on ice in coolers to ALS Environmental Laboratories (ALS), an accredited analytical laboratory. Samples for dissolved metals analyses were field-filtered using laboratory supplied 0.45 micrometer filters prior to preservation. Laboratory analyses of water samples were conducted by ALS and included general chemistry, nutrients, major ions, total and dissolved metals, coliforms, and hydrocarbons. Laboratory analytical results are presented in Appendix B-1.

3.1.1.1 Data Analysis

Water quality results were screened against the Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life for marine environments (CCME 2014). For parameters without an applicable CCME water quality guideline (e.g. iron), concentrations were compared to the range of water concentrations reported in previous years (i.e., 2015-2018). Mean, minimum and maximum concentrations were calculated for each sampling station over the six sampling events. For statistical calculations, the value of the reported detection limit (DL) was conservatively used for measurements that were reported to be below the analytical DL.

3.1.2 Physical Oceanography

In-field measurements of physical oceanographic parameters were supported through three subsurface tautline moorings deployed in Milne Inlet, one at Bruce Head and two near Milne Port, and a tide gauge deployed at Milne Port (Figure 3-1). Vertical physical profiles of conductivity, temperature and depth (CTD) were taken adjacent to the moorings at select times to characterize through water column conditions. Additionally, CTD profiles were taken around an ore carrier vessel while berthed at Milne Port Ore Dock and along a transect from Milne Port to Ragged Island. Along the Milne Port to Ragged Island transect, additional parameters including turbidity, fluorescence (chlorophyll-a), and dissolved oxygen were measured to better characterize the physiochemical properties of the marine environment important for biological productivity (profiles are shown in Figure 3-1).

All measurements were taken within the open-water season, early August to late September. The moorings were designed to provide a time series of instrument depth, current speed and direction through the water column, and conductivity, salinity and temperature at select depths.

A tide gauge was deployed at Milne Port Ore Dock in 2019 for the third consecutive year. Following previous years protocol, a survey of the deployed location to reference the water levels to a common datum was completed. The gauge was designed to provide a time series of water surface elevations and conductivity, salinity and temperature near surface. Multi-year data from the Milne Port tide gauge, in combination with a literature review of sea level rise and land uplift/subsidence rates in Nunavut, was conducted to assess the potential for sea level rise near Milne Port.

More detailed methodology of the Physical Oceanography Program are presented in Appendix L.

3.1.3 Background Hydrology and Geomorphology

A review of Phillips Creek hydrology and geomorphology was undertaken to characterize natural patterns of sedimentation in the vicinity of the Phillips Creek delta. The purpose of the review was to contextualize changes to sediment size observed in the 2014-2017 MEEMP sediment samples over the West Transect and to assess any potential natural variability in the depositional environment near the Phillips Creek delta. The review included:

- A literature review of arctic hydrology and geomorphology.
- An analysis of geomorphic change along Phillips Creek from approximately 17.5 km upstream of its mouth to the delta using air photos and satellite imagery collected between 1982 and 2016.
- A high-level analysis of available Phillips Creek discharge data.
- A high-level analysis of sediment size data along the West Transect collected during the MEEMP sediment sampling program between 2014 and 2017.
- A discussion of the findings of the literature review, historical imagery analysis, and data review and implications for sediment quality sampling.

More detailed methodology of the Background Review of Hydrology and Geomorphology in Phillips Creek Estuary is presented in Appendix M.

3.1.4 Sediment Quality

As described in Section 2.0, the EEM sampling design for sediment quality and benthic infauna (specific methods provided in Section 2.1.1) was based on a radial gradient transect design extending from the Ore Dock. Fifteen sediment and benthic stations were targeted along each of the five proposed transects, as shown previously in Figure 3-2 . Sampling stations were positioned at increasing distances from the point source (i.e., the Ore Dock) along each of the five transects. Three transects (East, West, and Coastal) were arranged along the 15 metre (m) water depth contour to reduce the confounding influence of depth on sediment and associated biota. The 15 m depth contour is unaffected by winter ice scour and was previously associated with relatively higher species counts and increased species diversity for both marine flora and fauna (SEM 2015; Baffinland 2016). The fourth transect (Northwest Transect) extended directly offshore of the existing Ore Dock to a distance of 2,000 m, corresponding with a water depth of approximately 100 m. A fifth transect (Northeast Transect) was added in 2019. The Northeast transect extended offshore from a point between the existing Ore Dock and the Freight Dock, and extended at a Northeast angle to a maximum distance of 2,100 m, corresponding to a water depth of approximately 120 m. The Northwest and Northeast transects included both a distance and depth gradient for consideration in the EEM analysis.

An unexpected health and safety incident disrupted the 2019 sampling schedule, such that only a subset of the targeted sediment and benthic infauna stations were sampled, and no samples were collected along the Coastal Transect. Sediment quality samples collected along the four remaining transects are depicted in Figure 3-2. Along each of these four transects, between 10 and 12 stations were sampled for sediment chemistry analyses. The coordinates, depths and approximate distance from Ore Dock of each station sampled are shown in Table 3-2.

In addition to the 44 transect stations sampled as part of the 2019 MEEMP, samples from two additional stations (SE18-1 and SE18-2) were also collected and submitted for chemical analyses. These two stations were added for consistency with previous MEEMP programs but were not part of the updated radial gradient sampling design. They were sampled to allow direct comparison of 2019 results to those sampled from the same locations in 2018.

Table 3-2: Sediment Sampling Locations Sampled in 2019

Station Name	UTM Coordinates (Zone 17W)		Approximate Lateral Distance Along Transect (m)	Water Depth (m)
	Easting	Northing		
East Transect				
SE-1	503907	7976716	11	12
SE-2	504046	7976688	144	10
SE-3	504106	7976701	201	19
SE-4	504192	7976679	289	14
SE-5	504301	7976637	404	15
SE-6	504396	7976654	494	19
SE-7	504487	7976680	582	17
SE-8	504558	7976731	651	16
SE-9	504651	7976767	745	18
SE-10	504754	7976769	848	19
SE-11	504840	7976731	933	20
Northeast Transect				
SNE-1	503834	7976806	8	29
SNE-2	503908	7976942	158	52
SNE-3	503946	7977081	301	57
SNE-4	504018	7977219	456	67
SNE-5	504071	7977356	603	82
SNE-6	504136	7977487	749	90
SNE-7	504187	7977629	900	98
SNE-8	504249	7977761	1045	102
SNE-9	504302	7977890	1190	104
SNE-10	504377	7978053	1364	105
SNE-11	504430	7978181	1503	121
Northwest Transect				
SNW-1	503305	7976766	15	37
SNW-2	503268	7976895	148	50
SNW-3	503269	7977038	289	62
SNW-4	503264	7977196	447	67
SNW-5	503272	7977363	613	72
SNW-6	503254	7977502	753	75
SNW-7	503270	7977662	912	80
SNW-8	503282	7977780	1029	85
SNW-9	503288	7977911	1160	88
SNW-10	503283	7978046	1295	91
West Transect				
SW-1	503148	7976588	17	17
SW-2	503055	7976532	100	21
SW-3	502961	7976473	210	22
SW-4	502878	7976439	300	16
SW-5	502768	7976398	417	17
SW-6	502677	7976449	486	15
SW-7	502593	7976480	561	18
SW-8	502486	7976524	663	18
SW-9	502372	7976525	786	14
SW-10	502264	7976521	884	21
SW-11	502154	7976496	996	19
SW-12	502040	7976484	1110	20

Station Name	UTM Coordinates (Zone 17W)		Approximate Lateral Distance Along Transect (m)	Water Depth (m)
	Easting	Northing		
Additional Non-transect Stations				
SE18-1	503425	7976692	Not on transect	17
SE18-2	503647	7976729	Not on transect	26

Notes: UTM = Universal Transverse Mercator; m = meter.

Sediment samples were collected using either a standard Ponar grab sampler (area of 0.05 m^2) or a Van Veen grab sampler (area of 0.1 m^2). At each station, multiple grab samples were collected by lowering the sediment sampler in adjacent deployment positions to obtain a sufficient volume of surficial sediments for the selected analyses. Each grab sample was examined for acceptability based on the following criteria:

- The sampler was fully closed
- There was adequate penetration depth (i.e., sediment volume greater than 25% full)
- the sample did not appear overfilled or disturbed, and the sample did not appear to have been collected on an angle
- the sampler did not appear to be leaking sediment at a substantial rate (i.e., the top of the sediment profile did not appear to be sloping inwards)

Upon acceptance, the top 5 cm of sediment from each grab sample was removed from the center of the grab (i.e., sediment from the side and bottom of the grab was not collected) using a stainless-steel spoon and transferred to a stainless-steel bowl. Sediment samples from composite grabs were homogenized using the stainless-steel spoon until the colour and texture were consistent throughout the sample. Aliquots of homogenized sediments from each station were then transferred to clean, laboratory supplied sampling containers. Terra Core® samples[8] were also taken from the homogenized sediments and placed into laboratory-supplied vials containing methanol to preserve samples destined for analysis of volatile organic compounds (VOCs).

Additional information, including the number of unsuccessful grabs, sediment appearance and odour (if any), presence of debris in sample, presence of live organisms in sample, and deviations from the planned sampling program, were recorded on field data sheets (Appendix C-1). The date, time, transect name, station number, and global positioning system (GPS) coordinates of each sample were recorded. All sampling gear was cleaned with brushes and biodegradable laboratory-grade detergent between sample collections. Sediment sub-samples were stored on ice in coolers prior to shipment to the analytical laboratory (within 48 h of sample collection) for the following analyses:

- moisture and pH
- grain size
- extractable metals
- total organic carbon (TOC) and total inorganic carbon (TIC)
- hydrocarbons (extractable petroleum hydrocarbons [EPHs], volatile organic compounds [VOCs] and polycyclic aromatic hydrocarbons [PAHs]).

[8] The Terra Core sampler is a single-use transfer tool, designed to extract sediment samples and transfer them to the appropriate containers for in-field chemical preservation.

3.1.4.1 Data Analysis

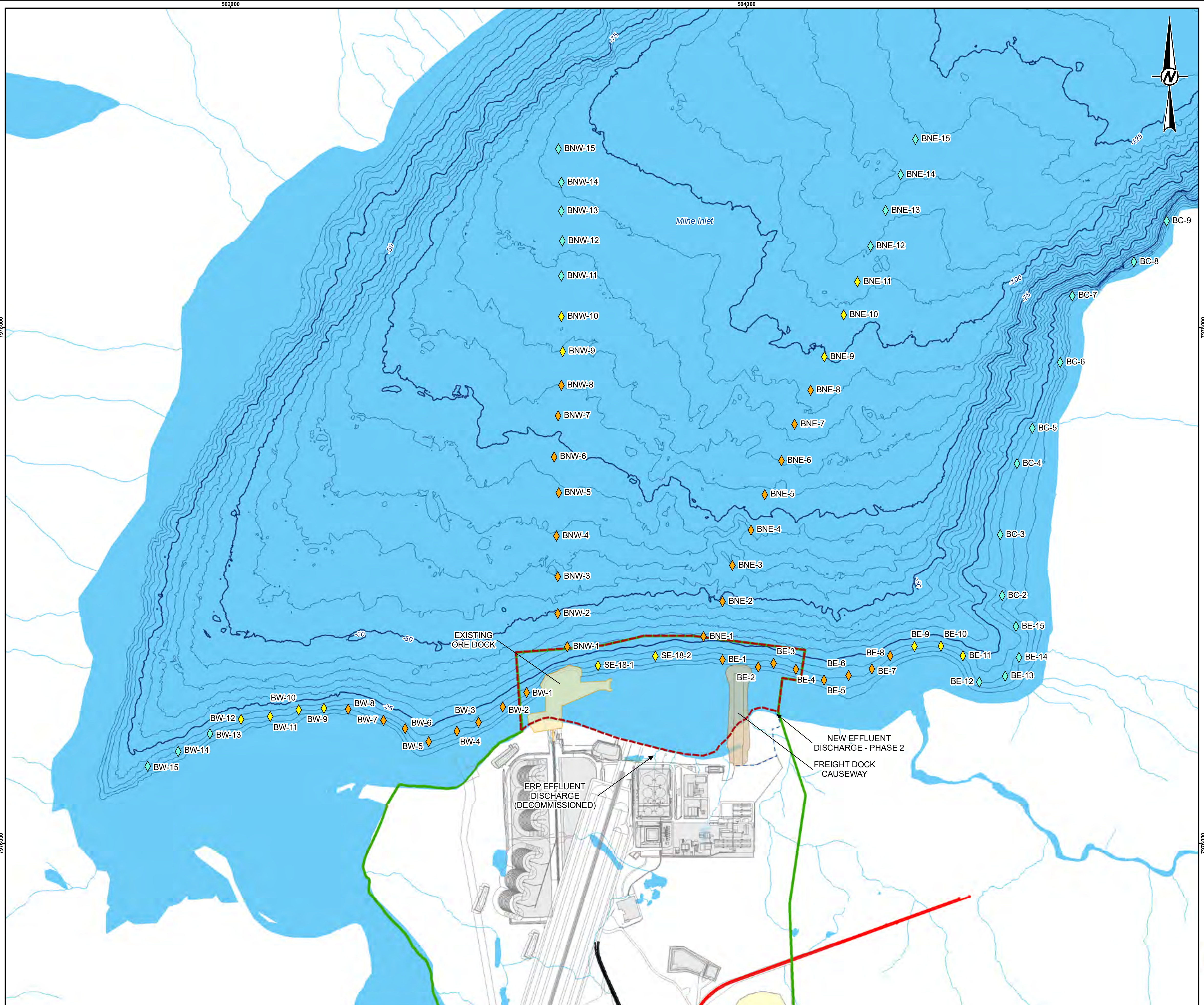
Analytical results were compiled, and descriptive statistics (e.g., mean and standard deviation [SD]), were performed for each station. Concentrations of metals and hydrocarbons were compared to CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Level (PELs) for the protection of aquatic life in the marine environment (CCME 2014). In addition, metals and hydrocarbons were compared to British Columbia Working Quality Guidelines for sediment (BC MOE 2017), and the National Oceanic and Atmospheric Administration (NOAA) sediment benchmarks (Buchman 2008), following feedback received from MEWG.

A Spearman Rank Correlation analysis was conducted to determine if there were statistically significant relationships ($P < 0.05$) between sediment metal concentrations and the sampled distance from the Ore Dock along each Transect. For the analysis, concentrations below the laboratory DLs were substituted with half the DL.

Principal Component Analysis (PCA) was conducted on sediment physical and chemical variables of samples. PCA is an ordination technique that examines ecological distances (differences or similarities) between samples and allows plotting of high dimensional data in two or three-dimensional graphs, with the distances between the samples in the graphs representing the degree of similarity or difference in chemistry. For the analysis, concentrations below the laboratory DLs were substituted with half the DL; all concentrations were transformed into their square roots. Variables for which all concentrations were below DLs (e.g., hydrocarbons, volatile organic compounds) were excluded from the PCA. The PCA was conducted in the statistical environment R v. 3.6.1 (R 2019), using the package FactoMiner (Le et al. 2008).

Fines content (i.e., sum of clay and silt fractions) was analyzed separately for the 2019 data and the combined 2014–2019 data to assess spatial and temporal gradients, respectively. Both analyses were conducted using general linear modelling. The model for the 2019 data included main effects of distance from transect origin, transect, and the possible interaction between the two variables. The model for the 2014–2019 data included main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions among the three variables. The effect of distance was modeled as a second-degree orthogonal polynomial to account for the non-linearity in percent fines relative to distance from transect origin. Model residuals were examined to identify departures from linear regression assumptions—normality, homoscedasticity (equal variances), and linearity in predictors. No outliers were identified in the analyses; therefore, all applicable data were used in the models. Following the 2019 linear regression, multiple comparisons were performed to assess differences in fines content at consecutive distances along each transect individually. Following the multi-year linear regression, multiple comparisons were performed at the following covariate values: distances of 0 m, 500 m, 1,000 m, and 1,500 m. The model results were compared between years within each distance-transect combination. Tukey's honest significant difference (HSD) procedure was used in pairwise comparisons to correct for Family-wise error rate, and in 2019, Holm-Sidak method was used for *P*-value adjustments.

The analysis of iron concentrations in sediments was performed in a similar manner to the analysis of fines content. However, the model also included a main effect of percent fines. Fines and iron concentrations were transformed using natural logarithms, and the effect of distance was modeled as a second-degree orthogonal polynomial. One outlier value was removed during the 2019 analysis based on examination of residuals—the value was from the SE Transect (at 144 m). Three outlier values were removed during the multi-year analysis based on examination of residuals—all values were from the East Transect, one in 2016 (120 m) and two in 2019 (144 m and 289 m). All outliers were shown on the plots depicting raw values and model predictions. Multiple comparisons were performed for observed fines content at each transect-distance combination (or combination of transect-distance-year for the multi-year comparison) for each of the models. The comparisons for 2019 assessed differences between consecutive distances along each individual transect based on the observed iron and fines values, whereas comparisons for the multi-year analysis assessed differences among years based on the observed fines values at each distance-transect combination. In the calculation of multiple comparisons based on observed fines content, all estimates were adjusted to mean natural log-transformed fines for each transect-distance combination. The analysis of both fines and iron concentration were performed in the statistical environment R v.3.6.1 (R 2019), using the packages “car” (Fox and Weisberg 2019), “emmeans” (Length 2020), and “multcomp” (Hothorn et al. 2008).



LEGEND

BENTHIC INFAUNA AND SEDIMENT SAMPLING STATIONS

- PROPOSED, NOT SAMPLED IN 2019
- SEDIMENTS ONLY
- SEDIMENTS AND BENTHICS
- BATHYMETRIC CONTOUR (5 m INTERVAL)
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- NEW EFFLUENT PIPELINE
- PDA / QIA COMMERCIAL LEASE
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- INAC FORESHORE LEASE
- AGGREGATE SOURCE (BORROW PIT OR QUARRY)
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- WATERBODY

0 500 1,000
1:15,000 METRES

REFERENCE(S)

REIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE PROVIDED BY CLIENT, MAY 28, 2018 AND PROVIDED BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
MEEMP SEDIMENT AND BENTHIC INFAUNA SAMPLING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
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PREPARED	AA
REVIEWED	MW
APPROVED	PR

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3.1.5 Benthic Infauna

As described in Section 2.0, the EEM sampling design for benthic infauna was based on a radial gradient transect design extending from the Ore Dock. Fifteen sediment stations were targeted along each of the five proposed transects, as shown previously in Figure 3-2.

An unexpected health and safety incident disrupted the 2019 sampling schedule, such that only a subset of the targeted benthic infauna stations were sampled, and no samples were collected along the Coastal Transect. Benthic infauna samples were collected from 32 stations along four transects (East, West, Northeast and Northwest) and were each co-located with a sediment sampling station (Figure 3-2; Table 3-3).

Benthic infauna samples were collected as a composite of three grabs from each station using a standard Ponar grab or Van Veen sampler with an area of 0.05 m² or 0.1 m², respectively. Due to the large volume of the Van Veen sampler, each grab was split using a field splitter constructed specifically for the purpose of this program. One half of each Van Veen grab was retained and composited for each grab sample to standardize the area of grab samples obtained using different devices (i.e., ½ of Van Veen [0.1 m^2] = full Ponar grab [0.05 m^2]). Each benthic grab sample was examined for acceptability using the criteria outlined in Section 3.1.4.

Upon acceptance, each of the three replicate grab samples from each station (once standardized for consistent grab area) were combined and transferred to an aluminum sieving table. The composite material from each station (i.e., made up of 3 replicates/station) was gently rinsed through a 0.5 mm mesh sieve with filtered seawater and preserved in pre-labeled 1 L wide-mouth high-density polyethylene (HDPE) sample jars containing 10% buffered formalin solution. Larger organisms were removed during the rinsing process using forceps and preserved in separate jars to avoid crushing the organisms with hard substrate material. The containers were then sealed and inverted several times to promote homogenization with the formalin. Containers were labeled internally (water-resistant labels) and externally. Samples were sent to Biologica Environmental Services (Biologica) for sorting and taxonomic identifications (to the lowest practical taxonomic levels).

Table 3-3: Benthic Infauna Sampling Station Locations.

Station Name	UTM Coordinates (Zone 17W)		Approximate Distance along Transect (m)	Depth (m)
	Easting	Northing		
East Transect				
BE-1	503907	7976716	11	12
BE-2	504046	7976688	144	10
BE-3	504106	7976701	201	19
BE-4	504192	7976679	289	14
BE-5	504301	7976637	404	15
BE-6	504396	7976654	494	19
BE-7	504487	7976680	582	17
BE-8	504558	7976731	651	16
Northeast Transect				
BNE-1	503834	7976806	8	29
BNE-2	503908	7976942	158	52
BNE-3	503946	7977081	301	57
BNE-4	504018	7977219	456	67
BNE-5	504071	7977356	603	82
BNE-6	504136	7977487	749	90
BNE-7	504187	7977629	900	98
BNE-8	504249	7977761	1045	102

Station Name	UTM Coordinates (Zone 17W)		Approximate Distance along Transect (m)	Depth (m)
	Easting	Northing		
Northwest Transect				
BNW-1	503305	7976766	15	37
BNW-2	503268	7976895	148	50
BNW-3	503269	7977038	289	62
BNW-4	503264	7977196	447	67
BNW-5	503272	7977363	613	72
BNW-6	503254	7977502	753	75
BNW-7	503270	7977662	912	80
BNW-8	503282	7977780	1029	85
West Transect				
BW-1	503148	7976588	17	17
BW-2	503055	7976532	100	21
BW-3	502961	7976473	210	22
BW-4	502878	7976439	300	16
BW-5	502768	7976398	417	17
BW-6	502677	7976449	486	15
BW-7	502593	7976480	561	18
BW-8	502486	7976524	663	18

Notes: UTM = Universal Transverse Mercator; m = meter.

3.1.5.1 Data Analysis

Taxonomic identifications provided by Biologica (Appendix E-1) were used to calculate community indices to assess the benthic community at the various sampling stations. Community indices that were calculated included: density, species richness, Simpson's Diversity Index, Evenness, and the relative abundance of dominant taxa. Prior to calculating indices, the taxonomy data provided by Biologica were first pre-screened and adjustments made:

- Species from several major taxa groups were excluded from the dataset before data analysis because these are meiofauna and not reliably retained on 500 µm mesh, or not strictly benthic invertebrates.
- Eliminated groups, not expected to have significant direct exposure to sediments, included invertebrates from Calanoida, Copepoda, Hyperiidae, Nematoda, and the fish Zoarcidae and Cottidae.

Organism Density

Total invertebrate density was calculated as the number of organisms per square metre (org/m^2) for each station. This calculation was based on the bottom area of the grab sampler used. Because grab samples collected with the Van Veen grab sampler (area of 0.1 m^2) were split in half, and due to the fact that the area of the standard Ponar grab sampler represents half the volume of the Van Veen grab sampler, the surface area used in this calculation was 0.05 m^2, regardless of which sampler was used. This area was multiplied by 3 to account for the three replicate grab samples that were combined at each station. As a result, organism density was calculated using the following equation:

$$\frac{\textit{number of organisms per station}}{(\textit{sampler area} \times 3 \textit{ replicates})}$$

Species Richness

Richness is the total number of unique taxa per station. Richness provides an indication of the diversity of benthic invertebrates in an area; a higher richness value typically indicates a more healthy and balanced community. Because the three replicate grab samples from each station were combined prior to taxonomy, the richness metric indicated the variety of taxa on a station-wide basis (i.e., station richness) rather than the average number of taxa per individual grab (i.e., replicate richness).

Simpson's Diversity Index

Simpson's Diversity Index (SDI) measures the proportional distribution of organisms in the community. The SDI takes into account the variety of taxonomic groups and also how evenly the total density is distributed among these groups. Certain conditions may favour one organism over another, resulting in the community being dominated by a few taxa, which is reflected in decreased diversity (Simpson 1949). The SDI values range between zero and one, where lower values indicate a less diverse community and higher values indicate a more diverse community. The SDI was calculated using the formula provided by Krebs (Krebs 1999):

$$SDI = 1 - \sum_{i=1}^{S} (p_i)^2$$

Where:

- SDI = Simpson's diversity index
- S = the total number of taxa
- p_i = the proportion of the i^{th} taxon

Simpson's Evenness Index

Simpson's Evenness Index (SEI) is a measure of how evenly the total invertebrate density is distributed among the taxa present at the station. The SEI is included along with the SDI to provide context as to whether taxonomic richness or the distribution of total density among taxa is driving the SDI values. The SEI is also expressed as a value between one and zero, with one representing high evenness (i.e., equal numbers of all taxa present in a sample) and zero representing low evenness (i.e., a high degree of dominance by one or a few organisms). The SEI values were calculated using the following formula (Smith and Wilson 1996):

$$SEI = 1 \,/ \sum_{i=1}^{S} (p_i)^2 / S$$

Where:

- SEI = Simpson's evenness index
- S = the total number of taxa
- p_i = the proportion of the i^{th} taxon

Statistical Evaluation

Benthic infauna total density was analyzed separately for the 2019 data and the combined 2018–2019 data to assess spatial and temporal gradients, respectively. Both analyses were conducted using general linear modelling. The model for the 2019 data included main effects of distance from transect origin, transect, and the possible interaction between the two variables, and percent fines. The model for the 2018–2019 data included main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions among the three variables. Total density and percent fines were transformed using natural logarithms to meet statistical assumptions in both models. Model residuals were examined to identify departures from linear regression assumptions – normality, homoscedasticity (equal variances), and linearity in predictors (lack of structure in residuals). Three outlier values were removed during the 2019 analysis based on examination of residuals—two values were from the BNE Transect (900 m and 1,045 m) and one value was from the BE Transect (144 m). No outliers were identified in the 2018–2019 analysis, therefore all applicable data were used in the model. All outliers were shown on the plots depicting raw values and model predictions. Multiple comparisons were performed for fines content at each transect-distance combination (transect-distance-year for the multi-year comparison) for each of the models.

Following the 2019 linear regression, multiple comparisons were performed to assess differences in benthic infauna total density at consecutive distances along each transect individually, based on observed fines values. Following the multi-year linear regression, multiple comparisons were performed to assess differences among years based on the observed fines values at each distance-transect combination; comparisons were made at the following standardized covariate values: distances of 50 m, 300 m, 500 m, 800 m, and 1,000 m. In the multiple comparison tests based on observed fines content, all estimates were adjusted to mean natural log-transformed fines for each distance-transect combination. The model results were compared between years within each distance-transect combination. Tukey’s honest significant difference (HSD) procedure was used to adjust multiple comparisons test results for Family-wise error rate, and in 2019, Holm-Sidak method was used for *P*-value adjustments.

The analysis for benthic infauna richness was performed in a similar manner to the analysis of benthic infauna total density. Fines were transformed using natural logarithms in both models, and the effect of distance was modeled as a second-degree orthogonal polynomial for the 2019 model. Two outlier values were removed during the 2019 analysis based on examination of residuals—one value was from the BE Transect (144 m) and one was from the BNE Transect (900 m). One outlier value was removed during the 2018–2019 analysis based on examination of residuals—the value was from the BE Transect (144 m).

The analyses for benthic infauna Shannon Diversity Index (SDI) and Shannon Evenness Index (SEI) were performed in a similar manner to the analysis of benthic infauna total density and richness, except they were only examined for the 2019 data. For both models, fines and distance were transformed using natural logarithms. For the model examining SDI, four outlier values were removed based on examination of residuals—two values were from the BE Transect (11 m and 144 m) and two values from the BW Transect (561 m and 663 m). For the model examining SEI, one outlier value was removed based on examination of residuals—the value was from the BNE Transect (900 m). Multiple comparisons were not performed for either SDI or SEI as neither distance nor the interactions that included distance significantly explained variation in SDI, and none of the explanatory variables or their interaction significantly explained variation in SEI. The analyses of benthic fauna total density, richness, SDI, and SEI were performed in the statistical environment R v.3.6.1 (R 2019).

3.1.6 Substrate, Macroflora, and Benthic Epifauna

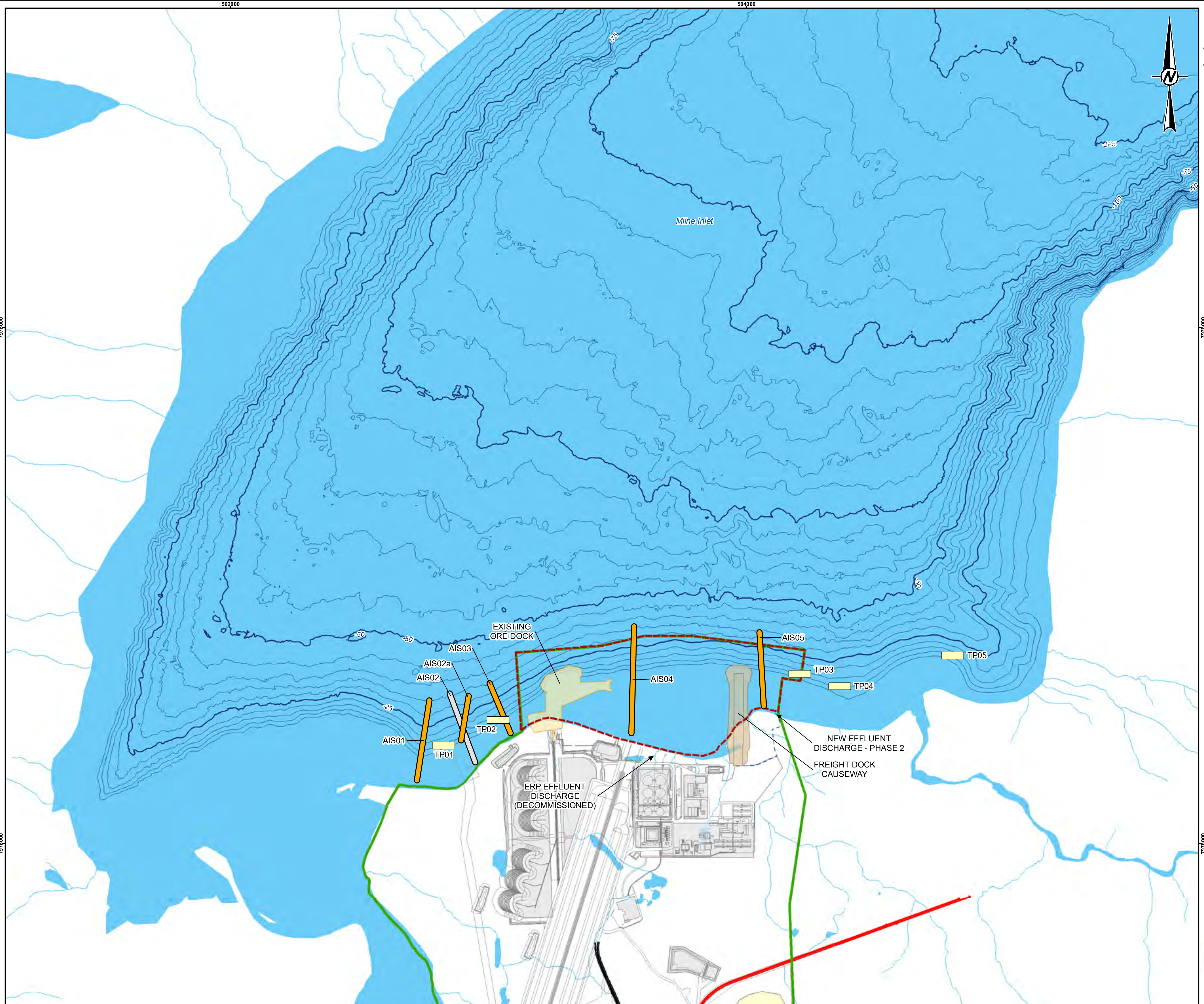
Epibenthic studies within the 2019 program consisted of underwater video monitoring of benthic epifauna and macroflora communities within permanent belt transects installed on the sea floor. Ten belt transects (1 m x 5 m rectangular plots with clearly demarcated boundaries to allow for study repeatability and count accuracy) were permanently installed on the sea floor, five in the Project exposure area and five in a reference area (Table 3-4; Figure 3-3). Each belt transect was made of two 1-m-long, 5-cm-diameter aluminum pipes filled with concrete connected by two 5-m-long steel chains attached to the both ends of the pipes. The chains were marked at 1-m intervals to allow for accurate area measurements and species scaling. The belt transects were deployed from the field vessel in water depths of approximately 5 to 15 m. An underwater video camera mounted on an ROV was used to verify that the belt transects were positioned properly.

Substrate, benthic macrofloral and epifaunal communities were surveyed within each belt transect using the underwater video system consisting of one high resolution video camera (1080p, added to the MEEMP program in 2019) and one standard resolution camera (NTSC standard definition with 3x optical zoom) mounted on a lightweight Seamor Chinook 300F industrial-grade inspection ROV equipped with spotlights, integrated pressure/depth sensor and magnetic compass. The video camera on the ROV was connected via umbilical to a video monitor set-up on the deck of the field vessel, where video data was recorded on an external hard drive. The ROV was operated by a trained, subcontracted ROV technician (Andy Clark - Ocean Dynamics Inc.) using manual and automatic thruster, tilt, pitch and heading controls built into a top-side deck-mounted control box.

Underwater video was post-processed by a qualified marine biologist. The recorded underwater video footage was analyzed frame by frame to record percent (%) cover of substrate type and benthic macroflora, according to the classification system outlined in the 2017 MEEMP report (Golder 2018). The analysis included taxonomic identification of benthic epifauna down to the lowest practical taxonomic level and their abundance (counts and % cover).

Table 3-4: Belt Transect Locations

Area	Station	UTM Coordinates (17W)		Average Depth (m)	Condition
		Easting (m)	Northing (m)		
Milne Port	TP-1	502828	7976382	9.8	Belt moved; chains pushed together in the middle
	TP-2	503039	7976480	9.8	Belt moved; pipes too close together
	TP-3	504208	7976659	12.4	Belt obscured
	TP-4	504363	7976611	12	Good condition
	TP-5	504802	7976731	12.1	Good condition
Reference Area	TP-6	506562	7979114	10	Redeployed in 2019, belt twisted and moved, unable to use
	TP-7	506774	7979170	10.9	First deployment failed. Second deployment successful
	TP-8	506957	7979457	11	Good condition
	TP-9	506997	7979599	10.9	Belt moved minimal amount
	TP-10	506584	7979115	8	Belt moved minimal amount



LEGEND

- BELT TRANSECT
- AIS TRANSECT - SAMPLED
- AIS TRANSECT - NOT SAMPLED
- BATHYMETRIC CONTOUR (5 m INTERVAL)
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- NEW EFFLUENT PIPELINE
- PDA / QIA COMMERCIAL LEASE
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- INAC FORESHORE LEASE
- AGGREGATE SOURCE (BORROW PIT OR QUARRY)
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- WATERBODY

0 500 1,000

1:15,000 METRES

REFERENCE(S)

FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE PROVIDED BY CLIENT, MAY 28, 2018 AND PROVIDED BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
MEEMP BELT TRANSECT AND AIS TRANSECT SAMPLING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	BP
PREPARED	AA
REVIEWED	MW
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000	0	3-3

3.1.7 Fish

3.1.7.1 Permitting

The following scientific data collection permits were obtained prior to the start of the 2019 fish sampling program:

- Fisheries and Oceans Canada (DFO) Licence to Fish for Scientific Purposes Permit # S-19/20-1033-NU
- DFO Animal Use Protocol Permit # FWI-ACC-2019-42
- Nunavut Research Institute Scientific Research Licence # 02 020 19R-M

Copies of the permits are provided in Appendix G-1.

3.1.7.2 Fish Surveys

Fish sampling was conducted in the Milne Port area from 26 July 2019 to 3 September 2019 using both active (angling, gill netting, beach seine) and passive (Fukui traps, fyke nets) capture methods (Figure 3-4). Fish sampling locations and methods were consistent with those in previous years, with the addition of fyke net sampling in 2019. The effort was spread over five weeks to capture as much of the open-water season conditions as possible (between late July and mid-October). All incidental mortalities were retained and processed as described in Section 3.1.7.3.

3.1.7.2.1 Angling

Angling (jigging and trolling) was conducted over a total of six days between 26 July and 27 August to characterize bottom and demersal fish communities in the LSA (Table 3-5) with a total effort of 3 hours and 42 minutes. The duration of sampling was activity-dependent; with a single trolling event occurring for 36 minutes, and jigging occurring between 10 and 46 minutes (n=6). Sampling start and end positions were recorded using a Garmin GPS and logged in a field notebook. Jigging occurred from a stationary position with one or two rods and lines deployed from the field vessel. Baited hooks or spoon lures (flashers) were allowed to hit the bottom, then flicked upward to attract bottom fish. Trolling occurred along a pre-determined depth contour where lines with flashers were cast over the side of the field vessel and spooled in towards the field vessel at a known depth to attract pelagic fish.

Table 3-5: Summary of 2019 Fish Sampling - Angling (Jigging and Trolling)

Fishing Type	Station Name	Date	UTM Coordinates (Zone 17W)		Duration (hour:min)
			Easting	Northing	
Jigging	AN01	26 July 2019	501695	7976247	0:46
Jigging	AN02	24 August 2019	506745	7979140	0:33
Jigging	AN03	24 August 2019	503367	7976675	0:40
Trolling	AN04	25 August 2019	503119	7976509	0:36
Jigging	AN05	26 August 2019	503066	7976481	0:15
Jigging	AN06	27 August 2019	505005	7976607	0:42
Jigging	AN07	27 August 2019	504973	7976603	0:10
Total effort					**3:42**

3.1.7.2.2 Gill Netting

Standardized monofilament floating gill nets were used to sample shallow (i.e., up to 15 m deep) subtidal areas for characterization of pelagic fish communities present in the Milne Port area. A total of 20 gill net sets occurred from 27 July to 29 August 2019 (Table 3-6). Each gill net consisted of six panels with each panel measuring 15.2 m in length and 2.4 m in width, with mesh sizes of each panel consisting of 2.5 cm, 3.8 cm, 5.1 cm, 6.4 cm, 7.6 cm and 10.2 cm. The gill nets were deployed in a shore-perpendicular orientation (smallest mesh size closest to shore) and suspended just below the water surface and were checked every two hours for fish presence over the duration of deployment. Sampling locations were recorded using a Garmin GPS and logged in a field notebook. Total soak durations ranged from 2 hours to 9 hours and 59 minutes with an average soak duration of 5 hours and 27 minutes. Exceptions included gill net sets GN05 and GN07, which were deployed for 28 hours and 58 minutes and 24 hours and 40 minutes, respectively. Total sampling effort for gill net sampling was 151 hours and 54 minutes.

Table 3-6: Summary of 2019 Fish Sampling - Gill Net

Station Name	Date	UTM Coordinates (Zone 17W)				Total Duration (hour:min)	Number of Checks[1]
		Start		End			
		Easting	Northing	Easting	Northing		
GN01	27 July 2019	502737	7976240	502769	7976314	9:59	5
GN02	27 July 2019	502586	7976253	502616	7976325	8:52	5
GN03	27 July 2019	502809	7976339	502809	7976385	7:03	3
GN04	27 July 2019	503183	7976557	503110	7976560	6:06	3
GN05	28 July 2019	504481	7976499	504423	7976561	28:58[2]	2
GN06	28 July 2019	504573	7976633	504519	7976684	3:51	1
GN07	28 July 2019	504574	7976663	504505	7976612	24:40[2]	0
GN08	22 August 2019	503055	7976431	503061	7976522	6:00	2
GN09	22 August 2019	502968	7976342	502963	7976417	6:05	2
GN10	26 August 2019	502913	7976294	502888	7976364	2:00	0
GN11	27 August 2019	504749	7976618	504786	7976690	5:55	2
GN12	27 August 2019	505122	7976649	505053	7976679	6:00	2
GN13	27 August 2019	504376	7976458	504424	7976523	6:00	2
GN14	28 August 2019	503150	7976492	503112	7976565	5:45	2
GN15	28 August 2019	502524	7976253	502566	7976316	4:55	2
GN16	28 August 2019	502917	7976275	502882	7976359	4:50	2
GN17	28 August 2019	503027	7976386	502973	7976445	4:45	2

Station Name	Date	UTM Coordinates (Zone 17W)				Total Duration (hour:min)	Number of Checks[1]
		Start		End			
		Easting	Northing	Easting	Northing		
GN18	29 August 2019	505205	7977616	505107	7977584	3:25	1
GN19	29 August 2019	505171	7977204	505074	7977200	3:25	1
GN20	29 August 2019	505158	7976961	505069	7976971	3:20	1
Total Effort						**98:16**	

Notes: [1] Number of checks represents the number of times the field team checked the net and sampled fish with the net remaining in the same location. [2] A H&S incident occurred that interfered with the field team's ability to check gill nets 28 July 2019. Nets were pulled as early as possible after the incident.

3.1.7.2.3 Seine Netting

Seine nets were used to sample fish in near shore habitat in Milne Port on 30 August 2019 in three sampling events (Table 3-7). Sampling was conducted using a 1.5 m by 9 m seine net with a 5 mm mesh. Sampling effort took a total of 16 minutes to sample areas ranging from 315 m^2 to 630 m^2 at an approximate average depth of 1 m. Sampling locations were recorded using a Garmin GPS and logged in a field notebook.

Table 3-7: Summary of 2019 Fish Sampling - Seine Net

Station	Date	Total Duration (hour:min)	Area Sampled (m^2)	UTM Coordinates (Zone 17W)				Total Duration (hour:min)
				Start		End		
				Easting	Northing	Easting	Northing	
SN01	30 August 2019	0:04	315	503151	7976474	503129	7976445	0:04
SN02	30 August 2019	0:07	612	503123	7976452	503059	7976428	0:07
SN03	30 August 2019	0:05	630	5030194	7976374	502968	7976324	0:05
Total Effort								**0:16**

3.1.7.2.4 Fukui Traps

Fukui traps were used to sample demersal fish in the Milne Port area from 22 August 2019 to 3 September 2019 (Table 3-8). Sampling was conducted with sets consisting of three traps connected with a line, each trap measuring 61 cm x 46 cm x 20 cm, with 1.25 cm stretch mesh, and equipped with a bait container. Fukui traps were modified in 2019 using the 'sinker' method described in Bergshoeff et al. (2019). raps were baited with Arctic char and deployed for several days at each station. Deployment time ranged from 46 hours and 27 minutes to 164 hours and 20 minutes, with a mean deployment time of 94 hours and 6 minutes. Traps were periodically checked (normally every day) and, upon retrieval, bait containers were refilled if necessary, prior to redeployment. There were 18 Fukui trap stations in total. Fishing locations were recorded using a Garmin GPS and logged in a field notebook.

Table 3-8: Summary of 2019 Fish Sampling - Fukui Traps

Station	Date		UTM Coordinates (Zone 17W)		Duration (hour:min)
	Set	Pull	Easting	Northing	
FT01	22 August 2019	24 August 2019	503133	7976517	52:40
FT02	22 August 2019	24 August 2019	503002	7976443	49:59
FT03	22 August 2019	24 August 2019	503173	7976526	51:58
FT04	22 August 2019	24 August 2019	503041	7976441	51:14
FT05	22 August 2019	24 August 2019	502937	7976416	46:27
FT06	22 August 2019	24 August 2019	503080	7976475	48:18
FT07	24 August 2019	27 August 2019	503039	7976490	69:15
FT08	24 August 2019	27 August 2019	503073	7976542	68:54
FT09	24 August 2019	27 August 2019	502961	7976470	67:40
FT10	24 August 2019	27 August 2019	503105	7976498	67:15
FT11	24 August 2019	27 August 2019	503197	7976541	67:29
FT12	24 August 2019	27 August 2019	503037	7976475	67:05
FT13	27 August 2019	3 September 2019	505111	7976711	164:15
FT14	27 August 2019	3 September 2019	504841	7976646	164:20
FT15	27 August 2019	3 September 2019	504656	7976710	164:20
FT16	27 August 2019	3 September 2019	504599	7976690	164:17
FT17	27 August 2019	3 September 2019	504506	7976601	164:15
FT18	27 August 2019	3 September 2019	504369	7976534	164:10
Total Effort					**1,693:51**

3.1.7.2.5 Fyke Nets

In 2019, fyke net sampling was added to the fish sampling program to test the effectiveness of this method compared to Fukui traps, as the latter sampling technique obtained consistently low catch rates during previous survey years. Fyke nets were used to sample fish in near shore habitat in Milne Port from 28 August to 2 September 2019 (two sampling events in total). Total sampling effort was 233 hours and 15 minutes (Table 3-9). Sampling was conducted using a 4 m two-chamber fyke net consisting of 40 mm mesh. The net was placed so the 0.9 m diameter mouth was perpendicular to the shore and the 9 m length wing panels were oriented in a wide V-shape extending outwards from the net opening. Fyke nets were set in nearshore habitat in the subtidal area west of the Ore Dock during low tide with the wing panels running from a minimum water depth of 0.2 m to a maximum of 1.5 m. Nets were checked daily during low tide.

Table 3-9: Summary of 2019 Fish Sampling – Fyke Nets

Station	Date		UTM Coordinates (Zone 17W)		Duration (hour:min)
	Set	Pull	Easting	Northing	
FN01	28 August 2019	2 September 2019	503049	7976434	117:10
FN02	28 August 2019	2 September 2019	503012	7976394	116:05
Total Effort					**233:20**

3.1.7.2.6 Incidental Fish Observations

During surveys for other components of the MEEMP, fish species were incidentally captured (i.e., in benthic infauna samples, zooplankton tows) or observed (i.e., during ROV surveys). All incidental captures and observations were recorded and presented in this report. Additionally, as part of the monitoring of offsetting habitat in Milne Port, additional ROV surveys were performed to assess fish usage of the coarse rock habitat; fish observed in this footage were also included in the incidental fish observations and the AIS/NIS analysis.

3.1.7.3 Fish Processing

All fish collected were transferred to buckets with seawater prior to processing. Representative photographs were taken for each species. Fish were identified to species, or lowest practical taxonomic level, measured for length and weight, and directly released or returned to buckets to allow for recovery if visibly stressed prior to release to the approximate area of capture. Incidental mortalities were retained for tissue (body burden), stomach content, condition, and age analysis. Mortalities were individually wrapped in aluminum foil, labelled and frozen. Frozen fish were shipped to Biologica for further analysis.

Prior to tissue collection for analysis (Section 3.1.8.1), fish were sexed and examined for lesions and tumors. Internal organs were removed and stored in formalin for stomach content analysis, heads were removed for removal of otoliths, and the body set aside for tissue collection.

During stomach content analysis the stomach was separated from the intestines anterior of the pyloric caecae and the intestines discarded. A longitudinal incision was made with a scalpel, avoiding damage to the contents, revealing the food bolus. Prior to dissection of the bolus, percent fullness and percent digestion were assessed. At this time, stomach fullness was estimated by considering two factors: the degree of distention of the stomach, and the weight of the bolus relative to the size of the fish. The bolus was dissected, working anterior-posterior, and its identifiable components weighed to the nearest 0.0001g. Prey items were identified to the lowest practicable taxonomic level (species when possible). Digested and unidentifiable material were categorized (e.g., unidentified parts, digested tissue, non-food, etc.). Each identifiable unit (taxon or category) was placed in small drops of water on a petri dish to prevent desiccation during the identification process. All prey categories (taxa and unidentifiable categories) were blotted and weighed to the nearest 0.01 mg of wet weight (wwt).

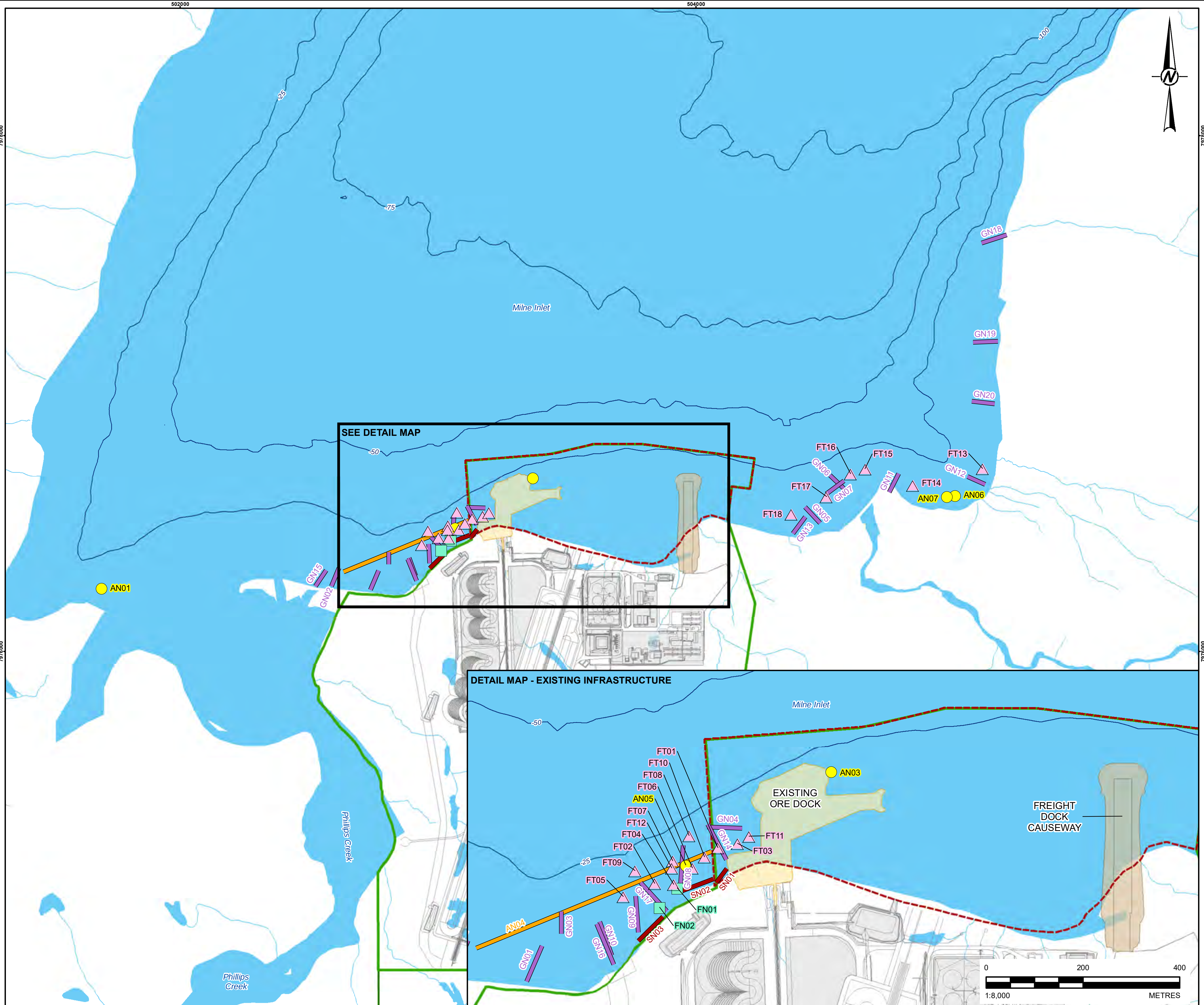
For fish aging, the sagittal otoliths were removed from each fish head, cleaned and stored in water. Whole otoliths were mounted and polished, if necessary. Aging was performed by counting the number of annuli on each otolith visible under compound microscope. Detailed methodologies for stomach content analysis and aging are available in Appendix G-3.

3.1.7.3.1 Shellfish aging

Hiatella arctica (wrinkled rock borer) were collected as a supplement to fish health monitoring (Section 3.1.7.3). Data for shellfish condition was collected from the same stations as sediment and benthic invertebrate samples. The first five to ten shellfish specimens found in benthic infauna sample grabs were collected for analysis. Specimens were wrapped in damp cloth and aluminum foil, frozen, and sent to Biologica where they were shucked, and shells were retained for age analysis. For aging analysis, shells were sectioned through the umbo rim and polished using progressively finer grit sandpaper. Polished shells were etched in a 1% hydrochloric acid for 1 min, rinsed and dried. An acetate peel was made of the polished umbo surface. Peels were examined using a dissecting microscope to count continuous growth lines to determine the age of the shell. Detailed shellfish aging methods are described in Appendix F-4.

3.1.7.4 Data Analysis

Summary statistics and regressions for each species were calculated using Microsoft Excel. Relative abundance, length frequency distributions, Length-age relationship (von Bertalanffy growth model, Ricker 1975), weight-length relationships, and major taxa composition in stomach contents were plotted using SigmaPlot version 14.0. Weight-length relationships were only calculated for fish species captured in large enough numbers (≥8) to make the regression statistically significant and meaningful. SYSTAT version 13 and R 3.6.3 were used to compare the relationship interaction between sample years by multiplicative ANCOVA. If a significant interaction between sample years and the log-transformed length covariate was found ($P < 0.05$), the EEM guidance on potential removal of the interaction was followed (Section 8.3.3.2.5, Environment Canada 2012). That is, simplification of the multiplicative model to an additive ANCOVA was based on the R^2 values of the multiplicative and the additive ANCOVAs and removal of influential points.



LEGEND

- ANGLING (JIGGING) SAMPLE LOCATION
- FUKUI TRAP SAMPLE LOCATION
- FYKE NET SAMPLE LOCATION
- ANGLING (TROLLING) SAMPLE LOCATION
- GILL NET SAMPLE LOCATION
- SEINE NET SAMPLE LOCATION
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- PDA / QIA COMMERCIAL LEASE
- WATERCOURSE
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- INAC FORESHORE LEASE
- WATERBODY

0 500 1,000

1:15,000 METRES

REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

TITLE
FISH SAMPLING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	CB
PREPARED	AA
REVIEWED	MW
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000-04	0	3-4

3.1.8 Tissue Chemistry

3.1.8.1 Fish

A total of 47 Arctic char and 35 sculpin (i.e., *Myoxocephalus* sp.) incidental mortalities were collected from six different gill nets and one fyke net (Table 3-10), and processed according to the steps described in Section 3.1.7.3 above. Due to fish condition upon arrival at the lab, species were not able to be determined for sculpin, therefore, all sculpin incidental mortalities were grouped as *Myoxocephalus* sp. Tissue samples for Arctic char were collected by removing a portion of muscle and skin with a clean knife (which was rinsed between samples) and wrapping the samples in new food-grade aluminum foil to be placed in clean labeled bags. Muscle tissue samples for sculpin were collected using a tissue punch to collect a muscle tissue plug. Muscle tissue samples from both Arctic char and sculpin were wrapped in aluminum foil and frozen as soon as possible and delivered in a cooler with ice packs to Bureau Veritas Labs (BV Labs) in Burnaby, BC for metals in tissue (body burden) analysis. BV Labs then removed the skin from the samples and analyzed the muscle tissue samples for moisture content and metals concentrations (wet weight) by atomic spectroscopy by ICP-MS. The certificates of analysis and chain of custody documents between Biologica and BV Labs are provided in Appendix G-4-1 and Appendix G-4-2. Laboratory methods are described in Section 3.1.7.3 and Appendix G-4-1.

Table 3-10: Fish Survey Stations in Milne Port Area where Arctic Char and Sculpin Species were Retained for Metals Analysis in 2019

Station Name	Sample Date (2019)	UTM Coordinates (Zone 17W)				Number of Arctic Char Collected	Number of Sculpin Collected
		Start		End			
		Easting	Northing	Easting	Northing		
GN01	27 July	502737	7976240	502769	7976314	3	0
GN03	27 July	502809	7976339	502809	7976385	4	0
GN04	27 July	503183	7976557	503110	7976560	0	1
GN05	29 July	504481	7976499	504423	7976561	22	24
GN07	29 July	504574	7976663	504505	7976612	15	10
GN09	22 August	502968	7976342	502963	7976417	2	0
FN02	2 September	503012	7976394	-	-	1	0
TOTAL						**47**	**35**

3.1.8.2 Shellfish

A total of 80 *H. arctica* were collected from 19 sediment and benthic invertebrate sampling stations (Table 3-11), and processed according to the steps outlined in Section 3.1.7.3.1 above. Tissue samples, comprised of whole body tissues were then sent to BV Labs for metals analysis. Similar to the process outlined for finfish, BV Labs analyzed the tissue samples for moisture content and metals concentrations (wet weight) by atomic spectroscopy. The certificate of analysis and chain of custody between Biologica and BV Labs and the raw data, are provided in Appendix F-1 and Appendix F-2. Achieved DLs for fish species and *H. arctica* are presented in Table 3-12.

Table 3-11: Sediment and Benthic Invertebrate Sampling Stations in Milne Port Area where *Hiatella arctica* were Retained for Metal Analysis in 2019

Station	Sample Date (2019)	UTM Coordinates (Zone 17W)		Station Depth (m)	Number of *H. arctica* Collected
		Easting	Northing		
BW-1	27 September	503148	7976588	17	5
BW-2	27 September	503055	7976532	21	5
BW-3	27 September	502961	7976473	22	5
BW-4	27 September	502878	7976439	16	5
BW-5	28 September	502768	7976398	17	5
BW-6	28 September	502677	7976449	15	5
BW-7	28 September	502593	7976480	18	5
BW-8	28 September	502456	7976524	18	5
BNW-1	29 September	503305	7976766	37	2
BNE-1	2 October	503834	7976806	29	1
BNE-4	4 October	504018	7977219	67	1
BNE-5	4 October	504071	7977356	82	1
BE-1	22 September	503907	7976716	12	5
BE-3	23 September	504106	7976701	19	5
BE-4	23 September	504192	7976679	14	5
BE-5	24 September	504301	7976637	15	5
BE-6	24 September	504396	7976654	19	5
BE-7	24 September	504487	7976680	17	5
BE-8	25 September	504558	7976731	16	5
TOTAL					**80**

Note*:* *H. arctica* stations correspond to sediment and benthic sampling stations.
UTM = Universal Transverse Mercator.

Table 3-12: Detection Limits for Metal Concentration in Arctic Char, Sculpin, and *Hiatella arctica* Tissue Samples from the Milne Port Area, 2018 and 2019.

Arctic Char			Sculpin		*Hiatella arctica*		
Parameter	2018	2019	Parameter	2019	Parameter	2018	2019
mg/kg wwt	DL	DL	mg/kg wwt	DL	mg/kg wwt	DL	DL
Aluminum	0.2	0.2	Aluminum	0.5	Aluminum	0.4-1	0.5
-	-	-	Antimony	0.002	Antimony	0.002	0.002
Arsenic	0.004	0.004	Arsenic	0.005	Arsenic	0.004-0.006	0.005
Barium	0.01	0.01	Barium	0.01	Barium	0.01	0.01
-	-	-	-	-	Beryllium	0.002	0.002
-	-	-	Bismuth	0.0013	Bismuth	0.002	0.0013
Boron	0.2	0.2	Boron	0.2	Boron	0.2	0.2
Cadmium	0.001	0.001	Cadmium	0.0013	Cadmium	0.001-0.002	0.0013

Arctic Char			Sculpin		*Hiatella arctica*		
Parameter	2018	2019	Parameter	2019	Parameter	2018	2019
mg/kg wwt	DL	DL	mg/kg wwt	DL	mg/kg wwt	DL	DL
Calcium	2	2	Calcium	4	Calcium	4	4
Chromium	0.01	0.01	Chromium	0.025	Chromium	0.01-0.04	0.025
Cobalt	0.0013	0.0013	Cobalt	0.0013	Cobalt	0.004	0.0013
Copper	0.01	0.01	Copper	0.013	Copper	0.02-0.01	0.013
Iron	0.25	0.25	Iron	0.25	Iron	0.6	0.25
Lead	0.001	0.001	Lead	0.0013	Lead	0.004-0.01	0.0013
Magnesium	0.4	0.4	Magnesium	0.4	Magnesium	0.4	0.4
Manganese	0.01	0.01	Manganese	0.01	Manganese	0.01	0.01
Mercury	0.002	0.002	Mercury	0.013	Mercury	0.001	0.013
-	-	-	Molybdenum	0.008	Molybdenum	0.004-0.008	0.008
Nickel	0.01	0.01	Nickel	0.01	Nickel	0.04	0.01
Phosphorus	2	2	Phosphorus	2	Phosphorus	2	2
Potassium	2	2	Potassium	2.5	Potassium	4	2.5
Selenium	0.01	0.01	Selenium	0.01	Selenium	0.01-0.02	0.01
Silver	0.001	0.001	Silver	0.0013	Silver[(a)]	-	0.0013
Sodium	2	2	Sodium	2.5	Sodium	4	2.5
Strontium	0.01	0.01	Strontium	0.013	Strontium	0.01-0.02	0.013
Thallium	0.0004	0.0004	Thallium	0.0004	Thallium	0.0004	0.0004
Tin	0.02	0.02	Tin	0.02	Tin	0.02	0.02
Titanium	0.02	0.02	Titanium	0.13	Titanium[(a)]	-	0.13
Uranium	0.0004	0.0004	Uranium	0.0004	Uranium	0.0004	0.0004
-	-	-	-	-	Vanadium	0.02	0.02
Zinc	0.04	0.04	Zinc	0.2	Zinc	0.1-0.2	0.2

Notes: (a) Metals not analyzed in 2018.
n= all fish processed for tissue metals, mg/kg wwt = milligrams per kilogram wet weight, DL = reportable detection limit; SD = standard deviation of the sample; < = less than.

3.1.8.3 Data Analysis

Descriptive Statistics

Descriptive statistics (i.e., sample size, mean, median, standard deviation [SD], standard error [SE], minimum, and maximum values) were calculated for 2019 metals concentrations in Arctic Char, sculpin, and *H. arctica*. Any concentrations reported below the DL were substituted with half the value of the DL for qualitative (i.e. boxplots) and quantitative (i.e., statistical) assessments. Descriptive statistics were also calculated for historical samples of Arctic Char from 2010, 2013 and 2015 to 2018 (Appendix G-4 Table 1), and from *H. arctica* from 2018.

Comparisons were made between Arctic Char and *H. arctica* data collected in 2019 relative to 2018. The lack of data from sculpin in 2018 prevented a similar comparison for sculpin.

Tissue chemistry data were presented visually using boxplots, where the median value is indicated within each box and the first and third quartiles are represented by the lower and upper bounds of each box, respectively. Lower and upper fences were calculated as 1.5 times the interquartile range beyond the first and third quartile. Observations outside the fences were plotted as individual points. Whiskers were extended to the minimum and maximum values within the data set that fell within the fences. Any metals that were below DL were plotted at half the value of the DL, with a horizontal line plotted to indicate the DL value and an open circle to represent the sample below the DL (with the number of samples below DL indicated beside open circle). The best visual representation of the data, either raw/non-transformed data or log10-transformed data, are presented. Outliers were removed from datasets and were not included in boxplots and were recorded as outliers (Appendix G-4 Table 2 for fish and Appendix F Table 1 for *H. arctica*).

Statistical Comparisons

For Arctic Char and *H. arctica*, differences in mean metals concentrations between 2018 and 2019 were assessed using analysis of variance (ANOVA). When the assumptions of ANOVA were not met (i.e., the residuals of the data after being fit to the model were not normally distributed nor had equal variance between groups), the data were log-transformed, and the ANOVA was re-run. If, after being log-transformed, the assumptions of ANOVA were still not met, a non-parametric Kruskal-Wallis (K-W) test was used.

Statistical comparisons (i.e., ANOVA or K-W) were not completed for metals that had at least 50% of the samples below DL. This was the case for 13 metals for Arctic Char tissues (i.e., aluminum, antimony, barium, beryllium, bismuth, boron, lead, chromium, molybdenum, silver, tin, uranium, vanadium) and one metal for *H. arctica* (i.e., silver). No statistical comparison was completed for *H. arctica* for titanium because this parameter was not reported in 2018.

The magnitude of differences between 2019 and 2018 metals concentrations were calculated by expressing the difference as a percentage of the 2018 concentrations as follows:

$$Magnitude = \frac{\bar{x}_{2019} - \bar{x}_{2018}}{\bar{x}_{2018}} * 100$$

Where:

$\bar{x}2019$ is the mean of the 2019 concentrations, and

$\bar{x}2018$ is the mean of the 2018 concentrations

If the statistical comparison was conducted on log-transformed data, then the percent difference was calculated using geometric means. If the statistical comparison between years was conducted using the K-W test, the data were not considered to be normally distributed and the percent difference was calculated using medians. As the Kruskal-Wallis test is a non-parametric method for testing whether samples originate from the same distribution (i.e., it is not a comparison of sample medians), there were instances where the K-W test was significant, but no differences in magnitude of difference were observed.

Metals concentrations with a difference of magnitude less than 40% were considered practically similar and within the laboratory margin of error. Therefore, only significant differences with magnitudes of difference greater than 40% were considered notable.

Comparison to Guidelines

Mercury concentrations in fish and *H. arctica* muscle tissue were compared to the Canadian Food Inspection Agency (CFIA) commercial guideline of 0.5 milligrams per kilogram wet weight (mg/kg wwt) (CFIA 2014).

3.2 AIS/NIS

Zooplankton, benthic infauna and encrusting epifauna samples were sent to Biologica for taxonomic identification and enumeration, where specimens were identified to the lowest possible taxonomic level. For all trophic levels, the list of identified taxa was compared to the taxa inventory from previous survey years and any taxa that had not been identified during previous AIS/NIS and MEEMP surveys in Milne Inlet were assessed further through literature review to determine if their known distributions and ranges included north Atlantic, Arctic and/or Canadian Arctic waters.

Sources for the literature review included the World Register of Marine Species (WoRMS 2020), the Global Biodiversity Information Facility (GBIF 2020), Encyclopedia of Life (EOL 2020), SeaLifeBase (Palomares and Pauly 2019), Marine Species Identification Portal (ETI 2020), National Centers for Coastal Ocean Science (NCCOS 2020), the Arctic Register of Marine Species (ARMS) compiled by the Arctic Ocean Diversity (ArcOD, Sirenko et al. 2020) and Arctic species inventories published or accessed through the Ocean Biogeographic Information System (OBIS 2020). These taxa were also compared against a global invasive species database (Molnar et al. 2008), the National Exotic Marine and Estuarine Species Information System (NEMESIS; Fofonoff et al. 2020), as well as a known invasive species list within the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014).

Species were not always identified to the species level due to a variety of limitations. Species descriptions are often based on adult samples, and immature specimens may lack the features present in the adult that are required for specific identification (Steinerstauch 2019, pers. comm.). Fragmented samples, or samples damaged during collection, may also be missing identifying features that would be used to determine species. Incomplete species records and descriptions also lead to limitations in specific identification (Steinerstauch 2019, pers. comm.).

3.2.1 Zooplankton

Zooplankton samples were collected at Milne Port and at Ragged Island using a combination of vertical and horizontal oblique tows (Table 3-13; Figure 3-5). Vertical hauls were conducted at six sampling stations in the Milne Port area, and four stations at Ragged Island. Vertical hauls were conducted by lowering a 0.3 m diameter (64 µm mesh size) or 0.5 m (250 µm mesh size) plankton net to 1 to 3 m above the bottom and then raising the net by hand to the surface at a rate of approximately 1 m/s (visually estimated). Three replicate hauls were conducted at each station and combined into a single composite sample following methodology from previous years (SEM 2017a; Golder 2018, 2019a). Unlike previous surveys, a zooplankton sample was not collected alongside an anchored ore carrier during ballast exchange due to loss of the plankton net while sampling.

Horizontal oblique tows were conducted along six transects in Milne Port consistent with the studies conducted in 2018, plus at two new locations at Ragged Island. Horizontal oblique tows were conducted by towing a 0.3 m diameter (64 µm mesh size) or 0.5 m diameter net (250 µm mesh size) at a speed of approximately 8-10 km/h for a period of at least ten minutes per tow. Tows were conducted near the surface in a sinusoidal fashion by means of regular transitions in tow speed (1-minute towing, 1-minute idling), which allowed the weighted net to periodically sink and rise during active sampling. This helped to avoid sampling only in the upper few metres of the water column. The sinusoidal oblique tow approach was used to help catch a more representative sample of zooplankton in the water column and to catch faster moving larvae (e.g., fish larvae, larger crustaceans). Transects were towed in sections to allow for clearing of the plankton net, samples were collected as a single composite sample for each transect. Between each tow, the nets and bottles were flushed down with sea water on the outside of the net to rinse the entire sample down into the dolphin bottle, or by using a spray bottle. The spray bottle was filled with sea water through the net mesh to exclude organisms. Once the sample was transferred to the sample bottle, water was splashed or sprayed on the outside of the net to rinse any remaining sample out the bottom. All zooplankton samples were preserved in 5% formalin and submitted to Biologica for taxonomic identification and enumeration.

Table 3-13: Zooplankton sampling locations in 2019

Station Name	Sampling Date	UTM Zone	UTM Coordinates			
			Start		End	
			Easting	Northing	Easting	Northing
Milne Port **Horizontal tows**						
ZH-01	31 August 2019	17W	502484	7976593	502278	7977327
ZH-02	31 August 2019	17W	502888	7976532	502527	7977169
ZH-03	31 August 2019	17W	502999	7976642	502425	7977013
ZH-04	31 August 2019	17W	503604	7976846	502995	7977281
ZH-05a*	31 August 2019	17W	504360	7978026	503850	7977723
ZH-05b*	31 August 2019	17W	503850	7977723	502767	7977657
ZH-06	31 August 2019	17W	502247	7976849	503673	7977153
Vertical tows						
ZV-01	30 August 2019	17W	502768	7976524	n/a	n/a
ZV-02	30 August 2019	17W	502866	7976548	n/a	n/a
ZV-03	30 August 2019	17W	503028	7976580	n/a	n/a
ZV-04	30 August 2019	17W	503570	7976801	n/a	n/a
ZV-05	30 August 2019	17W	503793	7976782	n/a	n/a
ZV-06	30 August 2019	17W	502576	7976603	n/a	n/a
Ragged Island **Horizontal tows**						
ZH-07	1 September 2019	17X	533913	8042529	533300	8041988
ZH-08	1 September 2019	17X	534073	8041851	533466	8041329
Vertical tows						
BR1	1 September 2019	17X	533494	8043032	n/a	n/a
BR2	1 September 2019	17X	533668	8042953	n/a	n/a
BR3	1 September 2019	17X	532428	8042298	n/a	n/a
BR4	1 September 2019	17X	532336	8042130	n/a	n/a

* Plankton net was lost during transect ZH-05, following the first interval. The sample from the first interval was retained as ZH-05a and the tow was completed with a different net (collected as ZH05b)

3.2.2 Benthic Infauna

Benthic infauna collected from sediment grabs were analyzed for taxonomic composition (identified to the lowest practical taxonomic levels) and abundance by Biologica (Section 3.1.5). Two additional samples were collected at Ragged Island, near the anchorages (Table 3-14). After completing the literature review and inventory/database comparisons, any taxa identified as potentially non-indigenous were sent to Philippe Archambault's Benthic Ecology Lab (Université Laval, Quebec) for independent verification.

Table 3-14: Benthic Infauna Sampling Stations at Ragged Island

Station	Sample Date	UTM Coordinates (Zone 17X)		Depth (m)
		Easting	Northing	
BR-1	1 September 2019	533494	8043032	5
BR-4	1 September 2019	532336	8042130	20

3.2.2.1 Data Analysis

A taxa accumulation curve was calculated for samples collected in Milne Inlet and Ragged Island to compare sampling effort with previous AIS/NIS monitoring surveys and to provide an estimate of the effort required to fully characterize the benthic infauna community. The non-parametric species estimator Chao 2 was calculated for 2019 following the methods used in SEM 2017a). Chao 2 provides an estimate of species diversity in a population based on presence/absence in a sample set. The difference between the estimated number of species and the observed provides an indication of how many species are needed to fully characterize the community, or how effectively the community is represented in the samples. During taxonomic identification, some specimens were not identifiable, but were identified to the lowest possible taxonomic level (e.g. *Macoma* sp.). These specimens may have been non-unique, a species that had already been identified (e.g. *Macoma balthica*) or a unique species within the same genus. In the accumulation curve and Chao 2 analyses, it was assumed that all taxonomic designations were representative of unique taxa and were included in the analysis, which may have resulted in an over-estimate of the expected number of taxa within an infinite number of samples.

3.2.3 Macroflora and Benthic Epifauna

Macroflora and benthic epifauna data were collected using underwater video surveys conducted along the length of each of the four previously established AIS transects, plus an additional transect established in 2019 to the east of the Freight Dock (Table 3-15) using the ROV. The collected underwater video footage was examined to identify macrofloral and epifaunal species to the lowest practical taxonomic level and to determine AIS/NIS status. Data recorded included presence only, rather than enumeration, since relative abundance of species was not of interest for the AIS/NIS monitoring program (Appendix J). Macroflora and benthic epifauna observed using ROV of the belt transects described in Section 3.1.6 were also examined.

Underwater video was post-processed by a qualified marine biologist. The recorded underwater video footage was analyzed frame by frame to record benthic macroflora and epifauna. Taxonomic identification was made for all observed flora and fauna down to the lowest practical taxonomic level.

Table 3-15: AIS Transect Locations

Station ID	Date	UTM Coordinates (17W)				Depth Range (m)
		Start		End		
		Easting	Northing	Easting	Northing	
AIS01	26 August 2019	502723	7976246	502771	7976555	0.2-33
AIS02	-	502948	7976316	502849	7976582	Not sampled
AIS02a*	24 August 2019	502923	7976572	502894	7976401	3-31
AIS03	22 August 2019	503086	7976429	503005	7976622	2-34
AIS04	24 August 2019	503554	7976429	503565	7976843	0.8-35
AIS05**	24 August 2019	504068	7976533	504051	7976819	1-35

*AIS02a was sampled in 2019 instead of the established AIS02 transect to avoid an iceberg present in the transect path
**New transect in 2019

3.2.4 Encrusting Epifauna

During the 2019 field season, Golder recovered settlement baskets initially deployed by SEM in August 2016 on the west and east sides of the Ore Dock, adjacent to the caisson (Figure 3-5). The baskets were originally retrieved by Golder in September 2017 then immediately redeployed due to the limited amount of colonization present. In addition, five settlement plates were attached to the baskets to provide additional surface area for colonization. The settlement baskets and plates were subsequently recovered in August 2018 and processed for taxonomic analysis prior to being redeployed for the winter. On 29 August 2019, Golder recovered the settlement baskets and plates deployed on the east side of the Ore Dock (total deployment period of ~12 months) and these were processed for subsequent taxonomic analysis. The settlement basket and plates on the west side of the Ore Dock were not recoverable in 2019 as the deployment rope was severed by winter ice break-up and the settlement plates and basket were lost.

In 2018, the recovered settlement baskets and plates exhibited low levels of colonization. Following consultation, the taxonomist recommended submission of the unprocessed settlement baskets (whole rocks) and settlement plates directly to the laboratory rather than the scraped epifaunal samples in order to improve the taxonomic identification. In line with the recommendation, the sediment plates and all rocks in the settlement baskets were preserved in 10% formalin as a single composite sample to preserve sample integrity. The composite sample was submitted to Biologica for taxonomic identification and enumeration. Laboratory methodology for sample analysis is presented in Appendix K-1.

Table 3-16: Settlement Basket Recovery Locations

Location	Sample Name	UTM Coordinates (Zone 17W)		Deployment Date	Retrieval Date	Deployment Period
		Easting	Northing			
East Ore Dock	SBEO-1	503229	7976590	13 August 2018	29 August 2019	12 months
West Ore Dock	SBWO-1	503346	7976648	13 August 2018	29 August 2019*	Settlement baskets and plates lost over winter

* Attempted retrieval date of SBWO-1

3.2.5 Fish

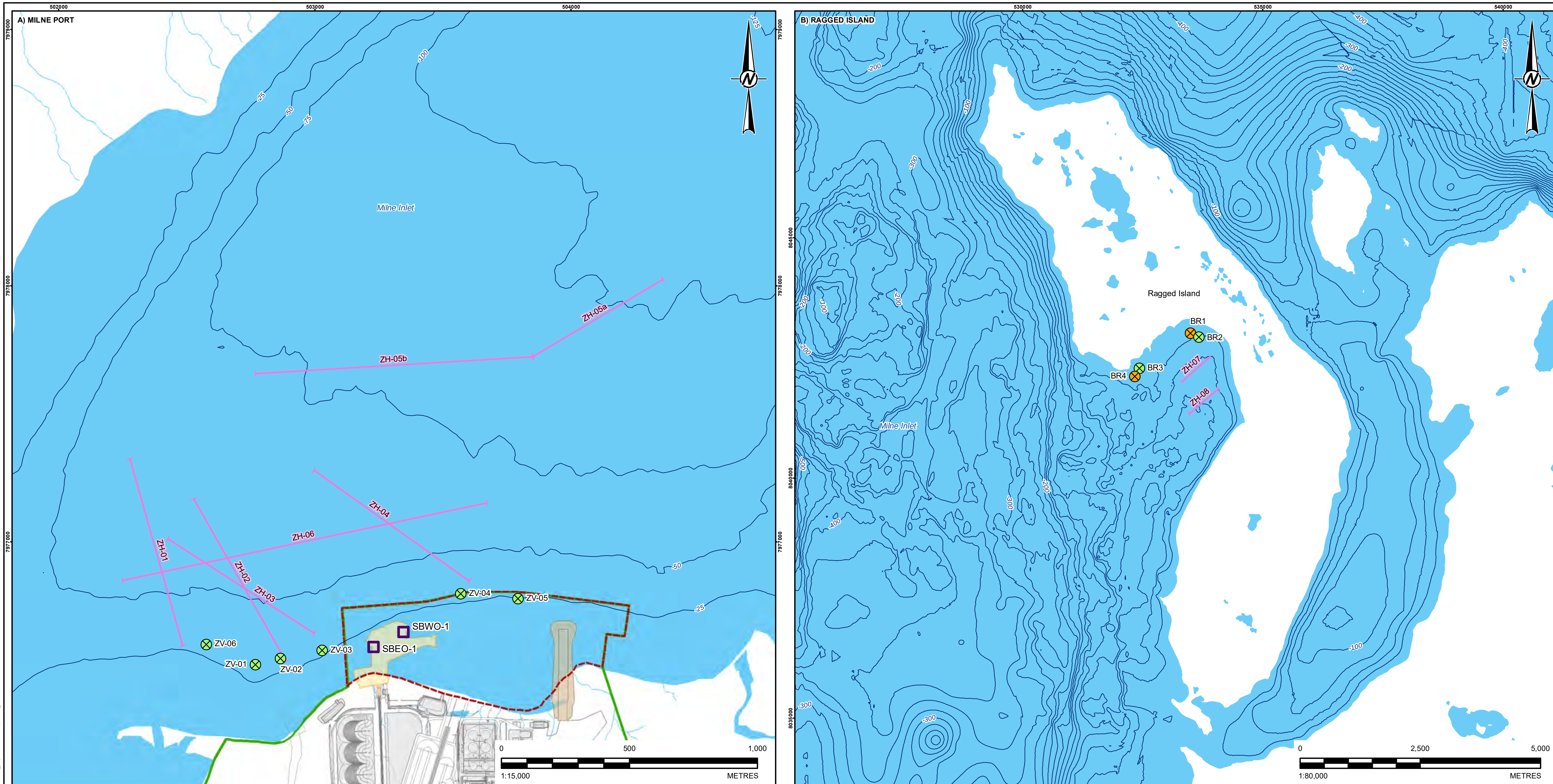
Fish collected as part of the MEEMP and AIS program during fish surveys (Section 3.1.7), observed in underwater video surveys (Section 3.1.6), or captured incidentally as part of other survey methods were identified to the lowest practical taxonomic level and used to update the AIS/NIS fish database.

3.2.6 Ship Hull Monitoring

A ship hull biofouling monitoring was included in the AIS/NIS program for the first time in 2018 and repeated in 2019. The program consisted of conducting underwater video surveys of the hulls of five ore carriers berthed at the Ore Dock using an ROV-based underwater video system. Surveys were conducted along the hulls of the ore carriers covering a representative range of depths of the submerged hulls (Table 3-17). Much of the effort was focused on areas of the hull where biofouling was most likely to occur (e.g., chain lockers, bulbous bow and stem, sea-chain grating, stern tube, rope guard, propeller nose cone and blades, rudder side, bottom, leading and trailing edges). The collected video recordings were later examined by qualified biologists to identify potential biofouling species to the lowest practical taxonomic level.

Table 3-17: Ship Hull Monitoring Surveys

Date	Vessel	Maximum depth (m)
22 August 2019	*Nordic Oasis*	13.6
22 August 2019	*Golden Enterprise*	6.5
24 August 2019	*NS Yakutia*	5.6
25 August 2019	*Golden Bull*	10.1
26 August 2019	*Sagar Samrat*	2.7



LEGEND

- BENTHIC INFAUNA AND ZOOPLANKTON VERTICAL HAUL SAMPLE LOCATION
- SETTLEMENT BASKET SAMPLE LOCATION
- ZOOPLANKTON VERTICAL HAUL SAMPLE LOCATION
- ZOOPLANKTON OBLIQUE TOW SAMPLE LOCATION
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- PDA / QIA COMMERCIAL LEASE
- WATERCOURSE
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- INAC FORESHORE LEASE
- WATERBODY

REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES. FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-08-27
DESIGNED	CB
PREPARED	AA
REVIEWED	MW
APPROVED	PR

TITLE
AQUATIC INVASIVE (AIS) MONITORING PROGRAM SAMPLING LOCATIONS

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000-04	0	3-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

3.3 Quality Management

3.3.1 Field QA/QC

The overall goal of the program was to collect quality data, which was achieved through consistent application of quality assurance/quality control (QA/QC) measures, including diligent and thorough data collection, regular communication amongst data recorders, and attention to detail during data entry.

Field staff were trained to be proficient in standardized sampling procedures, data recording using standardized forms, and equipment operations applicable to the monitoring program. All field work was completed according to specified instructions and established technical procedures for standard sample collection, preservation, handling, storage, and shipping protocols. Preliminary interpretation of the records and data QA/QC was carried out in the field to ensure the data collected met client specifications for quality and documentation of liability controls. At the end of the field survey, data were entered and organized in a database for subsequent analysis and interpretation. Field data recorded in notebooks was transferred to an electronic database.

A thorough QA/QC check of the data during the data analysis stage was conducted. The QA/QC measures in place included a multi-tiered technical review team that reviewed all data for consistency of methods and results and independently tested random data samples for quality.

General QA/QC tasks completed during the survey included, but were not limited to, the following:

- Preparing geo-referenced field maps for use during the surveys to accurately document the location of any observations.
- Preparing Project-specific data collection forms to ensure a comprehensive and accurate field data collection process.
- Collecting geo-referenced coordinates in the field for comparison with field maps to confirm the location of documented observations.
- Maintaining adequate photo documentation to illustrate the various features and species observed during field surveys, and to be kept for subsequent review and reporting.
- Collating and reviewing field data collected among observers to ensure consistent methods and calibrate observer estimates (e.g., estimation of substrate and vegetation cover in quadrat sampling).
- Reviewing all data and reports for accuracy (e.g., species identification) and consistency (e.g., measurement units).
- Allowing regular communications between the Project Manager and field staff.
- Quality Control (duplicate) samples were collected in the field.
- Accredited laboratories were selected for sample analysis. Performance quality of selected laboratories were verified through Golder’s internal vendor approval and assessment procedures.
- Field data sheets were reviewed by the field supervisor at the end of each day for completeness and accuracy.
- Chain-of-custody documentation were used to track sample shipments to the individual subcontractor laboratories.
- Samples were packaged and shipped to the laboratory in accordance with required holding times and storage conditions.

Laboratory QA/QC included verification of recommended sample holding times and the analysis of laboratory control samples, laboratory duplicates, and spiked samples to assess precision and accuracy of analytical methods. Laboratory QA/QC reports were reviewed upon receipt to confirm that the laboratory data quality objectives (DQOs) had been met and that the appropriate QA/QC information had been reported.

3.3.2 MEEMP

3.3.2.1 Water Quality

Quality assurance/quality control measures were implemented to reduce possible contamination of the collected water samples. Industry standard sampling protocols were followed including collection, handling and shipping procedures. Samples were collected in laboratory-sterilized water bottles including collection and analysis of travel and field blanks. For field blanks, sample containers were filled with de-ionized water in the laboratory and then processed in the field in the same manner as the collected samples (i.e., uncapped, treated with preservative, re-capped). Field blanks were analyzed to identify potential sources of contamination during field sampling. For travel blanks, sample containers were filled with de-ionized water in the laboratory and then remained sealed in the field, allowing for an assessment of contamination during transport and storage periods.

Laboratory QA/QC for water samples included the analysis of laboratory control samples, method blanks, laboratory duplicates, and spiked samples to assess precision and accuracy of analytical methods. Laboratory QA/QC reports were reviewed upon receipt to confirm that the laboratory data quality objectives (DQOs) had been met and that the appropriate QA/QC information had been reported.

3.3.2.2 Physical Oceanography

Where applicable, instruments were factory calibrated prior to deployment and pre-deployment checks and on-site calibrations were done as necessary. Quality assurance/quality control checks of the data following recovery were performed on- and off-site and included:

- Checking the instrument for physical damage and/or biofouling;
- Reviewing time series measured by the instruments, including various diagnostic parameters;
- Checking the instrument clock for drift during the deployment;
- Checking internal recorder and file status; and
- Plotting and viewing the time series data.

During the 2018 physical oceanographic monitoring program (Golder, 2018b), the combination of reduced horizontal component in earth's magnetic field coupled with the presence of iron ore at Milne Port introduced significant errors to the calibration parameters computed for the Acoustic Doppler Current Profiler (ADCP) compass in the Milne Port area. As a result, several corrective measures were taken in attempt to better reconcile current direction in 2019:

- In conjunction with manufacturer recommendations, it was determined that the factory compass calibration settings, computed at a more southern latitude, would be used in place of locally determined calibration parameters.

- All frames on the subsurface moorings were equipped with a Plexiglas fin and a swivel so that the frame could freely rotate and align with current direction, even during weak current speeds. Additionally, all ADCPs were positioned such that the northward beam was in line with the fin.
- A up-looking Nortek Signature 500 kHz ADCP was installed on the Bruce Head mooring. The Nortek Signature series has a much greater tilt sensor accuracy than other ADCPs which leads to greater overall heading accuracy. Additionally, the Nortek Signature series are built, and factory calibrated in Oslo Norway (60 degrees North).

The present techniques used to measure currents in Milne Inlet follow industry standards for measuring currents at high Northern latitudes. Additionally, Golder has followed the same approach to successfully measure currents in the Beaufort Sea (69-74 degrees North). In future deployments, ADCP instruments will undergo a post-calibration spin using a compass calibration table and satellite GPS at a location off-site. The location will be chosen to best reduce the interference of local magnetic effects (i.e. ore). Additionally, Nortek Signature series instruments will be added to the Milne Port moorings. It should be noted that while these practices will help reduce compass errors, they will not eliminate them. As discussed, the far northern latitude combined with a fluctuating geomagnetic field around Baffin Island and scarcity of overhead satellites makes the use of magnetic and satellite compasses challenging.

More detail around instrument calibration and data processing procedures is presented in Appendix L.

3.3.2.3 Sediment Quality

To confirm sample integrity, the following QA/QC measures were undertaken:

- Samples were collected and processed by qualified experienced personnel.
- Samples were collected in such a way that no foreign material was introduced to the sample.
- Sample handling or contact with contaminated materials/surfaces was minimized.
- Samples were placed in appropriate clean containers in such a way that no material of interest was lost due to adsorption, degradation, or volatilization.
- Sufficient sediment volumes were collected so that required detection limits could be met, and quality control samples analyzed.
- Equipment including the grab sampler, stainless steel bowls and spoons were washed with laboratory-grade biodegradable detergent between each station to prevent cross-contamination. Equipment was rinsed with seawater at the sample site between grab samples.
- Field duplicates were sampled from four randomly selected replicate samples (approximately 10% of total number of stations). Field duplicates were blind sample (identified as Duplicate A to D) collected from the same discrete homogenized grab sample (a split sample) as the “original” sample. To assess variability between field duplicates, the Relative Percent Difference (RPD) was calculated as follows:

$$RPD = \left(\frac{sample - duplicate}{(sample + duplicate)/2}\right) \times 100$$

  In accordance with the BC Field Sampling Manual (BC MOE 2013) and CCME (2016), an RPD value of >50% was used to identify differences between original and duplicate samples. Values less than five times the Method Detection Limit (MDL) were not included in the RPD calculations because analytical variability near the MDL is higher and does not provide a good measure of variability associated with the collection of field samples.

- Field data sheets were reviewed by the field supervisor at the end of each day for completeness and accuracy.
- Chain-of-custody documentation were used to track sample shipments to the individual subcontractor laboratories.
- Samples were packaged and shipped to the laboratory in accordance with holding times and storage conditions in an effort for analysis targets to be met.

Laboratory QA/QC for sediment samples included recommended sample holding times and the analysis of laboratory control samples, method blanks, laboratory duplicates, and spiked samples to assess precision and accuracy of analytical methods. Laboratory QA/QC reports were reviewed upon receipt to confirm that the laboratory data quality objectives (DQOs) had been met and that the appropriate QA/QC information had been reported.

3.3.2.4 Benthic Infauna

Field QA/QC procedures are discussed in Section 3.3.1. Biologica laboratory QA/QC measures included an assessment of sorting recovery, identification error, and precision/accuracy of sub-sampling. The taxonomic laboratory identified organisms to the lowest practical taxonomic level. Laboratory procedures included sample sorting measures, spot-checks, preliminary counting of major groups, and collaborative identification to accurately identify species to their lowest taxonomic level. Results of QA/QC measures implemented by the taxonomic laboratory are reported in Appendix E-1.

Benthic data were checked and no obvious signs of error in sample analyses were found. Incidental organisms, such as meiofauna, including copepod and nematode species, were removed from benthic analysis because these species often fall through the 500 µm mesh sieve used to separate benthic infauna from sediments in the field. Numbers of these species collected within samples would not be representative of the true population numbers at each station and would otherwise bias station comparisons of total abundance, relative abundance, and species diversity.

Biologica developed a subsampling strategy that maximized the detection of large and rare individuals while also enumerating smaller organisms. Large organisms (>1 cm) were first sorted, enumerated, and removed from the whole sample. The remaining debris was then spread evenly on a Caton grid and subsampled via sequential quadrat sorting. The subsample was sorted until a minimum of 400 organisms were counted.

3.3.2.5 Substrate, Macroflora and Epifauna

Underwater video was viewed in real-time to ensure appropriate depth and visual representation of the sea bottom features. Video footage from each survey was post-processed by a marine biologist with local Arctic experience. Epibenthic organisms were identified to the lowest practical taxonomic level using a variety of species identification keys and databases. A subset of images used to identify organisms was checked by a second observer and local Arctic biology specialists to confirm species identifications.

3.3.2.6 Fish

The following QA/QC measures were implemented by field staff during the fish sampling activities.

- Specific Working Instructions (SWIs) were reviewed and followed by all field members.
- Prior to fishing activities, all field members were briefed on sampling protocol/methods and made aware of their role in data collection. Each activity was performed at each station/location in the same manner to maintain consistency throughout the field program.
- Data were collected in Project-specific notebooks and were reviewed by the team lead at the end of each day to ensure quality and completeness. The notebook pages were scanned and saved on an external hard drive at the field office as a backup.
- Fish identification was recorded to species. Any identification that was questionable in the field was verified using fish field guides.
- Field instruments such as digital weigh scales were appropriately cleaned and calibrated prior to use.
- All data recorded in field notebooks were entered into Microsoft Excel and verified accurate and complete by a second team member. These documents were saved to the desktop then saved to an external hard drive as a backup.
- All samples were kept on ice, in a fridge or freezer, where appropriate, and labeled (station, date, time, samplers, and contents). All samples were shipped appropriately wrapped and kept on ice in coolers with appropriate documentation for receivers and sent with chain of custody forms.

Quality control methodologies by Biologica and BV Labs are described in Appendix F and Appendix G.

3.3.2.7 Tissue Chemistry

Quality assurance and quality control (QA/QC) procedures were applied during field sampling, data entry and sample shipping, laboratory analyses, data analyses, and report preparation.

Standard laboratory protocols were followed at Biologica during sample processing prior to sample analyses, to support accurate measurements and avoid cross-contamination among samples.

Laboratory QA/QC at BV labs included analysis of a series of method blanks, certified reference materials, and duplicate samples run in parallel. The chemistry dataset was visually assessed for outliers using scatterplots and erroneous values were corrected, if possible (i.e., values were identified as data entry errors). Statistical analyses and tables containing data summaries and statistical results were independently reviewed and verified by a second individual with appropriate technical qualifications.

3.3.3 AIS/NIS

3.3.3.1 Zooplankton

Zooplankton collection was standardized to minimize the introduction of sampling error during sample collection. Nets were rinsed using the same rinsing techniques and samples were subject to the same preservation methods to ensure consistency. Zooplankton analysis was conducted by Biologica Environmental Services Ltd., which identified organisms down to the lowest practical taxonomic level. Results of QA/QC measures implemented by the taxonomic laboratory are reported in Appendix H.

Data were checked thoroughly, and no errors or omissions were found. Species distributions within each collected sample are believed to be representative of the zooplankton community at each sampling location.

3.3.3.2 Benthic Infauna

The same field and laboratory QA/QC procedures were used during collection and analysis of benthic invertebrate communities for AIS Program as those used for the MEEMP. These methods are discussed in sections 3.3.2.1, 3.3.2.3, and 3.3.2.4.

3.3.3.3 Macroflora and Benthic Epifauna

The same QA/QC measures described in Section 3.3.2.4 were used during underwater video surveys along the AIS transects. Epibenthic organisms were identified to the lowest practical taxonomic level using a variety of species identification books in coordination with the benthic infauna data; a subset of images used to identify organisms was checked by a second observer to confirm species identifications.

3.3.3.4 Encrusting Epifauna

QA/QC procedures for the encrusting epifauna sample collection are discussed in Section 3.2.4.

3.3.3.5 Fish

QA/QC measures for fish data collection are described in Section 3.3.2.6.

3.3.3.6 Ship Hull Monitoring

Video documented during the ship hull monitoring surveys was viewed in real-time to verify that all representative areas of the ship were surveyed and ensure appropriate visual representation of the recorded locations. Field notes were taken during the survey. Video footage from each survey was post-processed by a qualified marine biologist with local Arctic experience. Biofouling or encrusting organisms were identified to the lowest practical taxonomic level where possible using a variety of species identification keys and databases. A subset of images was checked by a second qualified observer (marine biologist) to confirm quality of observations.

3.4 Inuit Participant Interviews

Upon completion of the MEEMP and AIS/NIS surveys, Participants in the program were asked to collectively take part in an end of season interview to provide feedback on the program by answering a series of questions. The questionnaire was used to assess Participant opinions on the methodology, data collection and presentation, and equipment, as well as to receive feedback on any perceived gaps, concerns or recommendations for future programs. Questions were broad and open-ended, related to topics including program design, reporting and future participation. A summary of the interview is provided in Appendix N.

4.0 RESULTS

4.1 MEEMP

4.1.1 Water Quality

Water quality laboratory results are presented in Appendix B-2. Summary statistics (mean, maximum, and minimum) for key parameters included during the 2019 water quality program are presented in Table 4-1. Measured concentrations were determined to be less than applicable CCME water quality guidelines (WQGs) in each of the 2019 samples collected from the four water quality stations. Summary statistics for the five monitoring years between 2015 and 2019 are provided in Appendix B, Table B-3, with annual summaries for key parameters presented in Table 4-2. Measured concentrations were within similar ranges to those measured during the previous 2015 to 2018 MEEMP sampling programs, with the exception of total aluminum and copper, as discussed further below for conventional parameters, nutrients, and trace metals.

4.1.1.1 QA/QC Results

Most chemical analyses on surface water samples were completed within the sample hold time requirements. Hold time exceedances were limited to:

- pH during each of the six sampling events
- measurements of fecal coliform by membrane filtration in five out of the six sampling events
- nitrate and nitrite for samples taken on 29 August 2019, 2 September 2019 and 9 September 2019
- Turbidity for samples taken on 29 August 2019 and 1 October 2019.
- Total suspended solids for samples taken on 23 September 2019

Although exceedances of sample hold time requirements have been documented, the hold times for the parameters in question are relatively short. Given the remote location of the site, such exceedances were unavoidable. The data should still be comparable to previous yearly measurements as similar issues with hold time exceedances have been encountered.

ALS is certified by the Canadian Association for Laboratory Accreditation (CALA) for the analyses conducted. The analytical laboratory also incorporated and reported the results of internal QA/QC checks. These were used to assess the reliability, accuracy, and reproducibility of the data. Reports from the laboratory are provided in Appendix B-1 and were reviewed by Golder.

The data reported by the laboratory were considered reliable based on the following QA/QC results:

- Analytical blanks were generally measured at concentrations less than the analytical detection limit, with the following exceptions[9]:
  - Conductivity (samples dated 1 October 2019). The result reported was 52.3 µS/cm, while the detection limit reported is 2 µS/cm. This was not considered a data quality issue as measured conductivity in field samples were substantially greater than this value and, as a result, interpretation of conductivity results

[9] These parameters with method blank exceedances were not key parameters and, thus, these exceedances were not considered to have had a considerable impact on the interpretation of the report results.

would not have been significantly impacted based on this small amount of background conductivity identified in the blanks.

- Vanadium (samples dated 23 September 2019). The result reported was 0.0084 mg/L, while the detection limit reported is 0.0005 mg/L. This suggests that vanadium samples collected on this date may have been biased high. As vanadium was not identified at elevated concentrations in samples, this was not considered a major data quality issue.
- Sodium (samples dated 9 September 2019). The result reported was 3 mg/L, whereas the detection limit is 2.5 mg/L. As the value is only marginally greater than the detection limit, this was not considered a major data quality issue.
- Aluminum and manganese (samples dated 28 August 2019). The aluminum result reported was 0.415 mg/L, while the detection limit is 0.005 mg/L. This was considered for the interpretation of the results and was not determined to have impacted interpretation of aluminum results. The manganese result reported was 0.00041 mg/L, while the detection limit is 0.0002 mg/L. As the value is only marginally over the detection limit this was not considered a major data quality issue.

- Laboratory duplicate RPDs fell within the DQOs set by the laboratory
- Laboratory spike samples fell within the DQOs set by the laboratory, with the following exceptions[10]:
  - During the 23 September 2019 sampling event, boron marginally exceeded the laboratory DQO (80–120%) in one laboratory control sample, as percent recovery was 128%.
  - During the 2 September and 29 August 2019 sampling event, sulphur did not meet the laboratory DQO (80-120%) in laboratory control samples, as percent recovery was 78%.
- Analytical results for reference materials fell within the target specified by the laboratory, with the following exception:
  - During the 26 August 2019 sampling event, total yttrium measured in the reference material was greater than the DQO (70–130%), with measured percent recovery 134%. As the exceedance was marginal in magnitude, this was not identified as a significant data quality issue.
- Matrix spike results fell within the DQOs set by the laboratory, with the following exceptions:
  - Matrix spike recovery could not be accurately calculated due to high analyte background in the sample for total and dissolved boron, calcium, magnesium, potassium, rubidium, strontium, sulfur, sodium. This was related to the elevated concentrations for these parameters in Site sediments relative to the amount that was spiked into the matrix, rather than a data quality issue.
- From the field blanks collected during the field program, measured concentrations were generally less than the analytical detection limit, with the following exceptions[11]:
  - Turbidity levels were 0.12 NTU
  - Ammonia was measured at 0.0062 mg/L, whereas the detection limit was <0.005 mg/L

[10] The laboratory did not consider these discrepancies to be problematic as they occurred with less than 10% of the analytes tested and percentages were only slightly outside of DQO.

[11] These low-level detects were not considered to represent a significant data quality issue.

4.1.1.2 Conventional Parameters

The pH in surface water samples collected in 2019 ranged from 7.9 to 8.2 (Table 4-1) and so was within the CCME WQG range for marine waters (7.0 to 8.7). The 2019 pH values were also within ranges previously reported in 2015 (7.5 to 7.9; SEM 2016), 2016 (7.7 to 7.9; SEM 2017a), 2017 (7.0 to 8.0; Golder 2018), and 2018 (7.9 to 8.1; Golder 2019a) (Table 4-2). Salinity concentrations ranged from 6400 mg/L to 31,500 mg/L in 2019 reflective of a brackish to fully saline environment (Table 4-1). Total suspended solids (TSS) were low, with most samples <2 mg/L (19 of 24 collected samples) and a maximum concentration of 2.9 mg/L in a sample collected from ENE on 29 August. Turbidity levels were similarly low (<0.1 NTU to 0.67 NTU). Both TSS and turbidity levels in 2019 were below CCME WQGs (Table 4-1) and within previously observed annual MEEMP ranges from 2015 to 2018 (Table 4-2).

4.1.1.3 Nutrients

As reported in 2017 and 2018, nitrate concentrations in 2019 were below detection (<0.5 mg/L) (Table 4-1). In 2015 and 2016, nitrate concentrations were detected, but were orders of magnitude below the long term CCME WQG of 200 mg/L (SEM 2016, 2017a). Ammonia concentrations were also mostly below detection in 2019 (<0.0005 mg/L) and where detected, were within the concentration range measured between 2015 and 2018 (Appendix B-3). Nitrite concentrations measured in 2019 were also below detection (<0.1 mg/L) except for the sample collected from the Source station on 9 September 2019 that measured 0.12 mg/L.

Fecal coliform bacteria in 2019 were generally less than the analytical detection limit, with the exception of nine samples with fecal coliform bacteria concentrations that ranged from 1 CFU/100mL to 2 CFU/100 mL (Table 4-1). Fecal coliform levels were below detection in 2018 (Golder 2019a), and were low in 2017, ranging from between 1 and 2 CFU/100 mL (Table 4-2; Golder 2018). Fecal coliform bacteria were not tested for in 2015 or 2016 (SEM 2016; SEM 2017a).

4.1.1.4 Metals

Measured total and dissolved metal concentrations were less than applicable CCME WQGs at each of the four sampling stations over the six sampling events conducted in 2019. Several metals (total concentrations) were below detection limits[12] in each of the 2019 samples (Appendix B-2). Additionally, dissolved concentrations of aluminum, chromium, iron, lead, mercury, nickel, thallium, and zirconium were below detection limits in each of the 2019 samples, indicating that measured total concentrations were primarily associated with the particulate phase.

In 2017 and 2018, total arsenic and cadmium concentrations were less than analytical detection limits. In 2019, the laboratory was able to improve its limit of detection for total arsenic from 2 µg/L to 0.4 µg/L and total cadmium from 0.05 µg/L to 0.01 µg/L. These analytical improvements resulted in detectable concentrations for these two metals in 2019, but at concentrations lower than previously reported detection limits and applicable CCME WQGs.

Total mercury concentrations previously exceeded the CCME long-term WQG (0.016 µg/L) at each of the stations sampled on 30 August 2015 (concentrations ranged from 0.023 µg/L to 0.025 µg/L; Table 4-1). Concentrations were less than the analytical detection limits and CCME WQG during each of the other sampling events performed in 2015 (SEM 2016), as well as during each of the sampling events performed in 2016, 2017, and 2018. In 2019, a similar trend was observed, as measured concentrations of mercury were less than the detection limit, with the

[12] Total antimony, beryllium, bismuth, cesium, chromium, cobalt, gallium, phosphorus, rhenium, selenium, silicon, silver, tellurium, thorium, tin, titanium, tungsten, and yttrium.

exception of a single sample collected at the Source station on 26 August 2019 (0.005 µg/L), which had measured concentrations that were less than the CCME long-term WQG.

The 2019 mean (1.74 µg/L) and maximum (11.0 µg/L) total copper concentrations were greater than those observed in 2017 (0.61 µg/L and 0.97 µg/L, respectively) and 2018 (0.56 µg/L and 0.88 µg/L, respectively). In 2015 and 2016, detection limits for total copper were elevated and all measurements were reported as <20 µg/L, so temporal comparisons cannot be conducted to those years. Although CCME WQGs are not available for copper in marine waters, the province of British Columbia (BC) recommends a long-term guideline of 2 µg/L and a short-term guideline of 3 µg/L in marine waters. During the 2019 sampling event, measured total copper concentrations were greater than 2 µg/L during two of the six sampling events (i.e., 3 of 4 samples collected on 23 September; 1 of 4 samples collected on 1 October). For these samples, between 22% and 53% of the total concentration was present in the dissolved phase, suggesting that at least half of the reported total concentration was likely present in particulate form, which may not be as bioavailable for uptake by aquatic biota. The mean total copper concentration was below the BC long-term WQG of 2 µg/L, although 4 of the 24 collected samples did exceed the recommended short-term guideline of 3 µg/L.

Total aluminum and iron concentrations in samples collected in 2019 ranged from <5 µg/L to 334 µg/L and from <10 µg/L to 20 µg/L, respectively (Table 4-1). Although there are no CCME WQGs for aluminum and iron in marine waters, 2019 aluminum concentrations were within annual ranges previously reported for the MEEMP for all but one sample, i.e., WNW on 2 September. Comparison of total (334 µg/L) and dissolved (<5 µg/L) aluminum concentrations in the sample taken from the WNW station on 2 September suggested that elevated particulates in the sample may have resulted in higher aluminum concentrations, despite this sample having low turbidity (0.65 NTU) and TSS concentrations (<2.0 mg/L).

The detection limits for iron during MEEMP studies in 2015 and 2016 (<500 µg/L) were considerably higher than detection limits achieved during the 2017, 2018, and 2019 sampling programs (<10 µg/L), thereby precluding comparison of the 2019 data to pre-2017 data. The maximum total iron concentration in 2019 (20 µg/L) was substantially lower than the highest iron concentration of 290 µg/L measured during a 2017 September storm event when TSS was elevated. Dissolved iron concentrations were less than the analytical detection limit of 10 µg/L in each of the samples collected in 2019, indicating that for most samples, a substantial portion of the reported total concentration was likely present in particulate form, and likely less bioavailable for uptake by aquatic biota.

4.1.1.5 Hydrocarbons

Hydrocarbons and PAHs were less than the analytical detection limits in each of the samples collected during the 2019 MEEMP. Hydrocarbons have consistently been less than detection limits throughout the MEEMP during sampling in 2019, 2018, 2017, 2016 and 2015 (SEM 2016; SEM 2017a; Golder 2018, Golder 2019a).

Table 4-1: Water Quality Summary Statistics for Each Sampling Location over Six Sampling Events in 2019.

Parameter	CCME Marine WQG for Protection of Aquatic Life		Source			WNW			North			ENE		
	Short Term	Long Term	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Physical														
pH	—	7.0-8.7	8.03	7.96	8.14	8.02	7.96	8.13	8.04	7.93	8.20	8.03	7.96	8.13
Salinity (PSU)	—	—	20.4	10.4	31.5	21.4	12.8	30.7	19.9	6.4	31.3	21.2	12.4	31.3
TSS (mg/L)	<25 mg/L above background	<5 mg/L above background	1.2	<2	2	<2	<2	<2	1.2	<2	2.2	1.8	<2	2.9
Turbidity (NTU)	<8 NTU above background	<2 NTU above background	0.28	0.15	0.49	0.31	<0.10	0.65	0.28	0.13	0.46	0.41	<0.10	0.67
Nutrients (mg/L)														
Nitrate (as N)	1500	200	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bacteria (CFU/100 mL)														
Fecal Coliform	—	—	1.58	0	<10	1.42	0	<10	1.25	0	<10	1.67	0	<10
Total Metals (µg/L)														
Aluminum	—	—	10	<5	14	62	5	334	16	6	48	13	<5	26
Arsenic	—	12.5	1	0.5	1.6	1	0.6	1.5	1	<0.4	1.6	1	0.6	1.5
Cadmium	—	0.12	0.026	0.013	0.041	0.029	0.013	0.040	0.026	<0.010	0.046	0.026	0.012	0.041
Chromium	—	1.5 (Cr(VI))	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.30	<0.50	0.54	<0.50	<0.50	0.50
Copper	—	—	3.14	<0.50	11.00	0.88	<0.50	1.74	1.43	<0.50	4.60	1.51	<0.50	5.33
Iron	—	—	14	<10	19	10	<10	20	11	<10	16	15	<10	20
Mercury	—	0.016	0.003	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	7.5	—	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PAHs (µg/L)														
Naphthalene	—	1.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Notes: (a) = Guidelines taken from CMME Marine WQG for the protection of Aquatic Life (http://ceqg-rcqe.ccme.ca/download/en/221); **Bold Font = indicates an exceedance from the guideline**; CCME = Canadian council of ministers of the environment; WQG = water quality guidelines; Min = minimum; Max = maximum; — = no guideline available; NR = not recorded; PSU = practical salinity unit; TSS = Total suspended solid; mg/L = milligrams per liter; < = less than; N = Nitrogen; CFU = colony forming unit; Cr(VI) = hexavalent chromium; PAH = polycyclic aromatic hydrocarbon; µg/L = micrograms per liter; mL = milliliter.

Table 4-2: Water Quality Summary Statistics for 2015, 2016, 2017, 2018, and 2019 at all Sampling Locations.

Parameter	CCME Marine WQG for Protection of Aquatic Life		2015			2016			2017			2018			2019		
	Short Term	Long Term	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Physical																	
Salinity (ppt)	—	Within 10% of background ppt	NR	NR	NR	NR	NR	NR	13.9	4.1	24.4	8.8	5.4	19.3	20.7	6.4	31.5
pH	—	7.0–8.7	7.83	7.52	7.91	7.85	7.67	7.94	7.77	7.01	8.00	8.00	7.90	8.10	8.03	7.93	8.20
TSS (mg/L)	<25 mg/L above background	**<5 mg/L above background**	1.2	0.5	2.2	1.6	1.0	3.0	4.2	<2.0	**25.5**	1.4	1.0	4.3	1.3	<2.0	2.9
Turbidity (NTU)	<8 NTU above background	**<2 NTU above background**	0.23	0.05	0.92	0.43	0.10	0.99	1.06	0.27	**9.60**	0.73	0.19	**2.52**	0.32	<0.10	0.67
Nutrients (mg/L)																	
Nitrate	1500	200	0.04	0.03	0.16	0.16	0.05	0.58	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bacteria (CFU/100 mL)																	
Fecal Coliform	—	—	NR	NR	NR	NR	NR	NR	1.25	1.00	2.00	<1.00	<1.00	<1.00	1.48	0.00	<10.00
Total Metals (µg/L)																	
Aluminum	—	—	NR	<50	50	16	9	25	25	8	142	18	8	48	25	<5	334
Arsenic	—	12.5	<10	<10	<10	<10	<10	<10	<2	<2	<2	<2	<2	<2	1	<0.4	1.6
Cadmium	—	0.12	<0.01	<0.01	<0.01	0.016	0.013	0.018	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.027	<0.010	0.046
Chromium	—	1.5 (Cr[VI])	<10	<10	<10	<10	<10	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.26	<0.50	0.54
Copper	—	—	<20	<20	<20	<20	<20	<20	0.61	0.50	0.97	0.56	<0.25	0.88	1.73	<0.50	11.00
Iron	—	—	<500	<500	<500	<500	<500	<500	40	10	290	20	<10	90	13	<10	20
Mercury	—	**0.016**	0.01	0.01	**0.03**	<0.013	<0.013	<0.013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.003	<0.005	0.005
Silver	7.5	—	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAHs (µg/L)																	
Naphthalene	—	**1.4**	NR	NR	NR	NR	NR	NR	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Notes: (a) = Guidelines taken from CMME Marine WQG for the protection of Aquatic Life (http://ceqg-rcqe.ccme.ca/download/en/221); **Bold Font = indicates an exceedance from the guideline**; CCME = Canadian council of ministers of the environment; WQG = water quality guidelines; Min = minimum; Max = maximum; ppt = parts per trillion; % = percentage; — = no guideline available; NR = not recorded; NTU = nephelometric turbidity unit; TSS = Total suspended solid; mg/L = milligrams per liter; < = less than; N = Nitrogen; CFU = colony forming unit; Cr(VI) = hexavalent chromium; PAH = polycyclic aromatic hydrocarbon; µg/L = micrograms per liter; mL = milliliter.

4.1.2 Physical Oceanography

A summary of measured currents and physical water column properties including conductivity (i.e. salinity), temperature, turbidity, chlorophyll-a, pH, and dissolved oxygen in Milne Inlet are presented below. More detailed results of the Physical Oceanography Program are presented in Appendix L.

4.1.2.1 Currents

Analysis of current speed and direction measured continuously at Bruce Head and near Mine Port between early August and late September indicate that flows in Milne Inlet are generally oriented along channel and primarily wind driven. The strongest depth average current speeds coincide with sustained northerly wind events. Overall, currents in Milne Inlet are weak, with current speeds generally less than 15 cm/s. More detailed site-specific results are summarized below:

- **Bruce Head:** The mid-water column flows are dominantly from southerly directions and take on a bimodal direction near the seabed, coming from the northeast and southwest near the bed. Overall, the currents at Bruce Head are oriented along channel. In general, the depth average currents at Bruce Head are between 5-10 cm/s but peak as high as 15 cm/s.
- **Milne Port 01:** The surface currents show a dominant north-south direction (i.e. tidal ebb/flood). At depth the Milne Port 01 currents become unimodal and are dominantly from the south direction with a slight turning to from the southwest near bed. In general, the depth average currents at Milne Port 01 are between 5-10 cm/s but peak as high as 15 cm/s during wind events.

4.1.2.2 Salinity and Temperature

Analysis of salinity and temperature measured (i) continuously at the moorings and (ii) on select days with vertical profiles in Milne Inlet, between Milne Port to Eclipse Sound collectively indicate that Milne Inlet is stratified (i.e. temperature and salinity gradient) with the pycnocline depth from surface to -20 m in early August and -15 m to -40 m in later September. During September, as the air temperature cools and wind events increase in intensity, the upper layer of water above the pycnocline becomes well mixed. Below the pycnocline, temperature and salinity are relatively constant. However, during strong and/or sustained northerly and southerly wind events the surface and mid-water column can mix below the depth of the pycnocline, particularly at the head of Milne Inlet near Milne Port. More detailed site-specific results are summarized below:

- **Bruce Head:** Sensor depth was approximately -44 m mean sea level (MSL). During the beginning of the deployment, temperature was relatively constant between -1.3°C and -0.5˚C and salinity was relatively constant between 31 practical salinity unit (PSU) and 32 PSU. From the end of August onwards, temperature showed fluctuations between -0.5°C and 2˚C and salinity showed fluctuations between 30 PSU and 32 PSU. The increase in temperature and salinity fluctuations is due to a deepening of the pycnocline towards the instrument depth and is driven by increased wind mixing near the surface in late August and early September and dropping air temperatures. Both factors act to de-stratify the upper water column.
- **Milne Port 01:** Sensor depth was approximately -45 m MSL. During the beginning of the deployment, temperature was relatively constant between -1.2°C and 0˚C and salinity was relatively constant between 31 PSU and 32 PSU. From the end of August onwards, temperature showed fluctuations between -0.5°C and 3.5˚C and salinity showed fluctuations between 30 PSU and 32 PSU. Again, the increased temperature and salinity fluctuations are due to increased wind mixing and changing atmospheric conditions, as noted for Bruce Head.

- **Milne Port 02:** Sensors were at approximate depths of -33 m MSL and -18 m MSL.
  - **-33 m MSL:** During the beginning of the deployment, temperature was relatively constant between -1°C and 0.5˚C and salinity was relatively constant between 31 PSU and 32 PSU. From the end of August onwards, temperature showed fluctuations between -0.5°C and 2˚C and salinity showed fluctuations between 28 PSU and 31 PSU. Again, the increased temperature and salinity fluctuations are due to increased wind mixing and changing atmospheric conditions, as noted for Bruce Head.
  - **-18 m MSL:** During the beginning of the deployment, temperature was relatively constant between -0.5°C and 1.3 ˚C and salinity was relatively constant between 30 PSU and 31.5 PSU. From the end of August onwards, temperature showed fluctuations between -1°C and 4˚C and salinity showed fluctuations between 26.5 PSU and 30.5 PSU. The large spikes in temperature and salinity from the end of August onwards are likely a result of intense wind mixing above the pycnocline.
- **Milne Port Ore Dock Tide Gauge:** Sensor depth was approximately -1.5 m MSL. During the beginning of deployment there were large fluctuations in temperature and salinity, between 1°C and 10°C and 0 PSU and 32 PSU, respectively. The increased variation in temperature and salinity in late June and early August is due to increased freshwater inflows from sources such as Phillips Creek and melting of sea ice. From mid-July to approximately August 24, daily and hourly fluctuations in temperature and salinity, between 2°C and 8°C and 10 PSU and 30 PSU, respectively, were observed. These fluctuations were due to wind and tidal driven mixing near the surface. On August 24, a large wind event caused the upper water column to become well mixed, this is seen as a large decrease in surface temperature and increase in salinity. From this point onwards, the fluctuations in temperature and salinity at the gauge were decreased.
- **CTD Profiles:**
  - In early August, the temperature at the surface was approximately 8˚C and decreased rapidly to approximately -1˚C at depths of approximately -15 m to -40 m MSL. Salinity increased rapidly from 15 PSU to 25 PSU at the surface to approximately 31 PSU at depths of approximately -20 m MSL. Below the depth of the pycnocline, temperature and salinity were relatively constant to the seabed.
  - In late September, temperature was relatively uniform at approximately 2-3˚C from the surface to depths of approximately -15 m MSL. Salinity was relatively constant at 26 PSU to 30 PSU from the surface to depths of approximately -15 m MSL. The uniform salinity and temperature in the upper 20 m suggest a well-mixed layer. At the depth of the pycnocline (-15 m to -40 m MSL), temperature and salinity decreased and increased rapidly to approximately -1˚C and 31-32 PSU, respectively. Below the depth of the pycnocline temperature and salinity were generally constant but temperature increased at depths greater than -100 m MSL (temperature of maximum density of seawater is approximately 3-4˚C).

4.1.2.3 Physiochemical Properties

Analysis of turbidity, dissolved oxygen, and chlorophyll-a measured with vertical physical profiles on select days indicate that concentrations are determined in large part by the location of the pycnocline. In general, the concentrations of turbidity, dissolved oxygen, and chlorophyll-a are increased above the pycnocline, where wind mixing is intensified, and decrease below. More detailed site-specific results are summarized below:

- **Chlorophyll-a**: In early August, Chlorophyll-a concentration increased from the surface and peaked at or just below the pycnocline, between -17 m and -40 m MSL depending on the station. A maximum concentration of 1.3 mg/m^3 was recorded at Station 12, at -30 m MSL. Concentrations reached near zero for all stations by depths of -60 m MSL (i.e. below the photic depth). In late September, Chlorophyll-a concentrations ranged from 0 mg/m^3 to 0.9 mg/m^3 and reached maximum between -8 m and -30 m MSL depending on the station.

The maximum concentration was recorded at Ragged Island N at -8.5 m MSL. Concentrations reached near zero for all stations by depths of -45 m MSL (i.e. below the photic depth).

- **Turbidity**: Water in Milne Inlet was clear throughout the water column with elevated turbidity near the surface (between 0 m and -10 m MSL) and the bottom of each cast. Surface turbidity values ranged between 0.3 nephelometric turbidity units (NTU) and 1.2 NTU.
- **Dissolved Oxygen**: In early August, a pump turn-on delay occurred and prevented the collection of useable dissolved oxygen data. In late September, dissolved oxygen concentrations ranged from 6.6 mg/L to 12.2 mg/L corresponding to saturations ranging from 57% to 104%. The peak for each station occurred between depths of -25 m and -46 m MSL, with peaks generally being higher and deeper towards the head of the inlet. Below these depths, dissolved oxygen decreased with depth.

4.1.3 Background Hydrology and Geomorphology

The literature review, historical imagery analysis, and analysis of Phillips Creek hydrological and sediment data indicate that the Phillips Creek delta is a dynamic environment characterized by spatial and temporal variability in sediment deposition. Like typical arctic streams, most sediment transport on Phillips Creek occurs during the spring freshet. Summer rainstorms trigger additional pulses of transport. The amount and size of sediment routed down the river channel and deposited on the delta every year depends on a variety of factors, including the amount of snowpack, the magnitude and duration of the snowmelt period, and sediment supply from stream banks, slope failures, and other natural sources. Sediment derived from Project-related sources, such as fugitive dust from the tote road, ore dust, and erosion at road crossings may also contribute to the supply to Phillips Creek, although Knight Piesold (2018) concluded that inputs of dust resulting from the project are expected to be under levels outlined in the Canadian Council of Ministers of the Environment (CCME) water quality guidelines. Once on the delta, coastal transport due to wave action and ice drift contribute to additional sediment reworking. The size of sediment on the delta can be expected to change from year to year due to natural variability in hydrology, sediment supply, and coastal depositional processes.

Sediment deposition on Phillips Creek delta is also influenced by dynamic fluvial and coastal landform evolution. Movement of Phillips Creek over time is apparent on the historical imagery. Channel migration between 1982 and 2016 was observed on the segment of Phillips Creek stretching from the mouth to approximately 2.5 km upstream. A shift of the primary channel from the eastern to the western end of the delta appears to have resulted in the westward progression of a nearby spit.

The size of sediment collected along the West Transect from 2014-2017 as part of the MEEMP sampling program has been variable over time, as can be expected in a naturally dynamic depositional environment.

More detailed results of the Background Review of Hydrology and Geomorphology in Phillips Creek Estuary are presented in Appendix M.

4.1.4 Sediment Quality

Analysis of the physical and chemical composition of sediments was conducted on samples collected from a total of 44 stations along four transects, as well as at two additional non-transect stations (18SED-01 and 18SED-02). Results of these analyses are presented in Appendix C, where sediment parameter concentrations are compared to sediment quality guidelines (Appendix C-3), including CCME ISQGs and PELs, BC Working sediment guidelines (BC MOE 2017), and NOAA sediment quality benchmarks (Buchman 2008).

Similar to previous years, the physical composition of sediments in samples collected in 2019 varied among stations and transects (Figure 4-1). Sediment in the West (SW) and East (SE) Transects predominantly consisted of sand and silt, while the Northern Transects (SNW and SNE) had higher proportions of fines (i.e., silt and clay), which appeared to increase with greater distance from the Ore Dock.

4.1.4.1 QA/QC Results

Chemical analyses on sediment samples were completed within the sample hold time requirements. ALS is certificate by CALA for the analyses conducted. The analytical laboratory also incorporated and reported the results of internal QA/QC checks. These were used to assess the reliability, accuracy and reproducibility of the data. Reports from the laboratory are provided in Appendix B-1 and were reviewed by Golder.

The data reported by the laboratory were considered reliable based on the following QA/QC results:

- Analytical blanks were measured at concentrations less than the analytical detection limit.
- Laboratory duplicates fell within the DQOs set by the laboratory
- Surrogate recoveries were within the DQOs set by the laboratory, except for 1,4-difluorobenzene at station SNW-9, where percent recovery (55.7%) was marginally lower than the DQO. This was not considered a significant data quality issue, as report hydrocarbon concentrations were less than detection in this sample.
- Analytical results for reference materials or spiked standards fell within the DQOs specified by the laboratory.

Four field duplicate samples (DUP-A, DUP-B, DUP-C and DUP-D) were collected for the purposes of this investigation, consistent with the quality control objective (i.e., ~10% of samples). Where applicable (i.e., where concentrations above the RDLs were reported for both the original field sample and the duplicate sample), RPDs were calculated (see Appendix B-2). The reported RPDs were generally within the DQOs, with the following exception:

- Cadmium, with an RPD of 74%, exceeded the 50% recommended RPD allowance.

This is not considered a significant data quality issue, as cadmium concentrations were less than applicable sediment quality guidelines in each of the samples evaluated at the Site.

A power analysis was also conducted to assess level of effect required for the ANCOVA to identify a significant in effect during each of the spatial and temporal comparisons described in Sections 4.1.4.1 and 4.1.4.2. The results of the power analysis are provided in Appendix O.

4.1.4.2 Correlation Analyses

Strong correlations between sediment metal concentrations and the proportion of fine-grained sediments (i.e., clay and silt sediment fractions) have previously been identified in Milne Inlet during baseline characterization programs (Baffinland 2013; SEM 2014; 2015), and during previous MEEMP years (2004–2018). In these studies, an observation was made that the proportion of fine-grained sediments tended to increase with greater distance offshore. Direct impacts to sediment quality, if any, resulting from Port operations (i.e., prop wash scouring, ore dust, hydrocarbon leaks, wastewater, and site runoff) would be greatest in closer proximity to the Ore Dock, with direct effects progressively decreasing with distance away from the Ore Dock. To evaluate whether this was the case during the 2019 sediment program, a Spearman Rank Correlation analysis was undertaken to investigate whether there was a relationship between metal concentrations measured in the sediments and distance from the Ore Dock.

Metal concentrations along the northern transects (i.e., Northeast and Northwest Transects) were positively correlated with distance from the Ore Dock (Appendix C-4), suggesting that metal concentrations increased with distance offshore. These relationships were statistically significant ($P < 0.05$) for each of the metals analyzed except for arsenic, cadmium, magnesium, and phosphorus. These results do not suggest that Milne Port represents a substantial point source of metals to sediments along the northern transects. However, the influence of particle size gradient complicates the interpretation of spatial trends, as the concentrations of many metals are known to correlate with the fines content of sediment.

Statistically significant relationships between metal concentrations and distance from the Ore Dock were generally not identified during the Spearman Rank Correlations along the East and West Transects, although the direction of the relationships were typically positive (i.e., increasing metal concentrations with increasing distance from the Ore Dock).

Overall, the results of the Spearman Rank Correlation analyses suggested that:

- Metal concentrations increase with increasing distance offshore along the northeast and northwest transects. This may represent a physical condition whereby sediments contain increasing percentages of fine-grained sediments in deeper offshore waters. This is consistent with results reported in previous MEEMP programs that identified a strong relationship between metal concentrations and sediment fines.
- Significant correlations were not identified between sediment metal concentrations and distance from Ore Dock along the West and East Transects. The West and East Transects are positioned along the 15 m depth contour. There is less variability in sediment percent fines content along these shallower transects compared to the northern transects because sediment samples were taken at a consistent water depth within similar depositional environments.
- The correlation analysis did not suggest that sediment metal concentrations were accumulating at elevated levels close to the Ore Dock relative to other locations sampled within Milne Port.

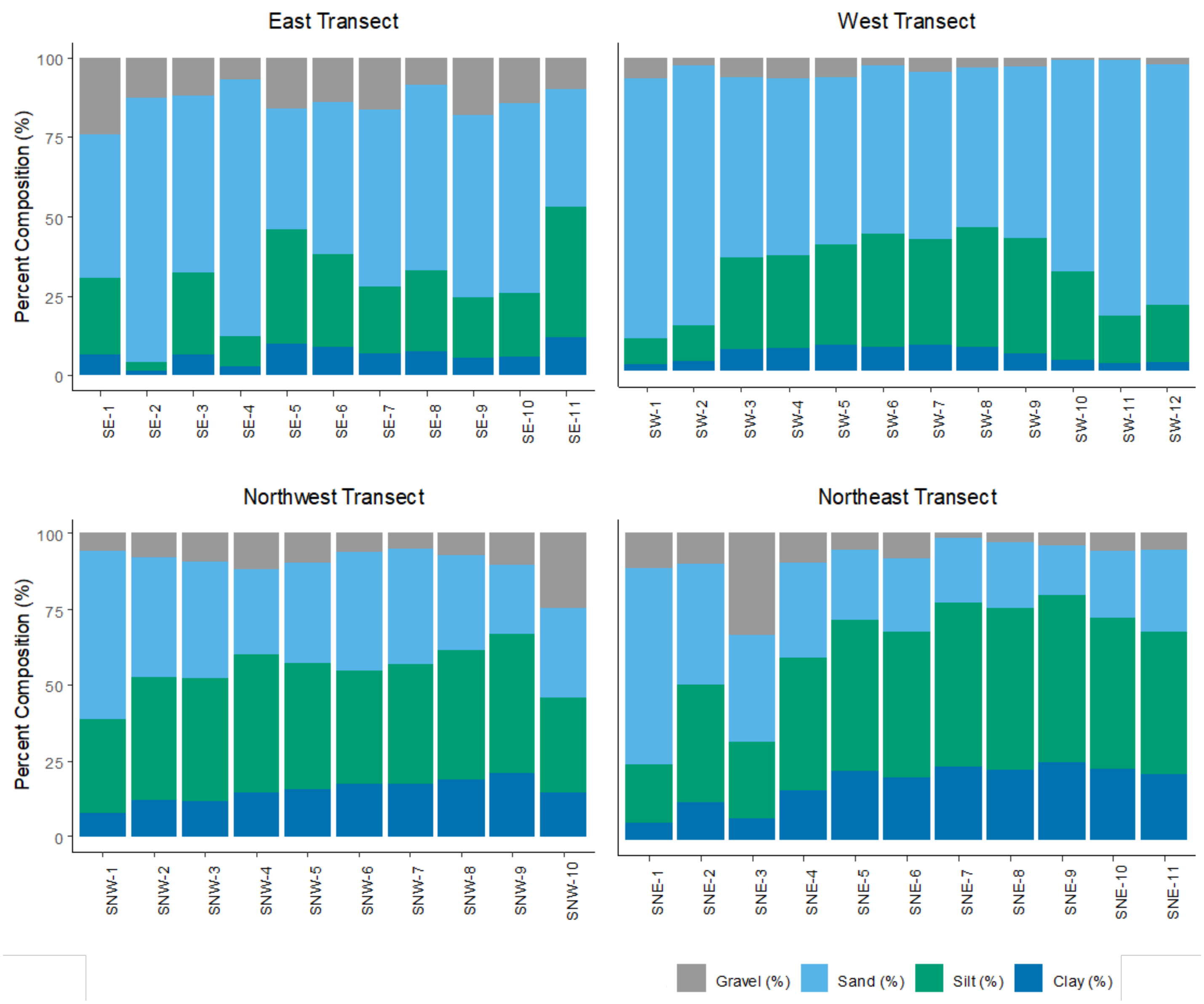


Figure 4-1: Mean Sediment Particle Size Distribution for Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

4.1.4.3 Principal Component Analysis

Metals, in general, tend to accumulate to a greater degree in finer sediments due to a combination of physical (e.g. increased surface area to volume ratio) and chemical (e.g. geochemical substrate) factors (Jones and Bowser 1978; Horowitz 1991). As a result, a PCA was conducted to investigate the relationship between sediment physical and chemical data collected during the 2019 field program. PCA takes a large data set (in this case, sediment chemistry data) and reduces it to a small number of variables (i.e., principal components) that characterize the variability inherent in the data set. The magnitude of concentration is less important than variability in the analysis, which makes it useful to evaluate spatial patterns that could otherwise be missed because of the influence of stations with highly variable sediment parameters.

The PCA showed three components with eigenvalues >1 that accounted for 92% of the total variance. The first component explained the highest percentage of the variance in the original data (84%). The other two principal components accounted for the remaining 8% of the explained variance and will not be discussed further. Details of the PCA, including the eigenvalues, loadings, scores, correlations, and quality of representation are presented in Appendix C-5.

As depicted in Figure 4-2, PC1 positively correlated strongly with fine fractions of sediments (silt and clay), moisture, inorganic carbon, concentrations of metals (loading coefficient ≥0.9) and, to a lesser extent with molybdenum (loading coefficient = 0.73). PC1 strongly negatively correlated with sand (loading coefficient = -0.96), pH (loading coefficient = -0.52), and, to a lesser extent with gravel (loading coefficient = -0.06).

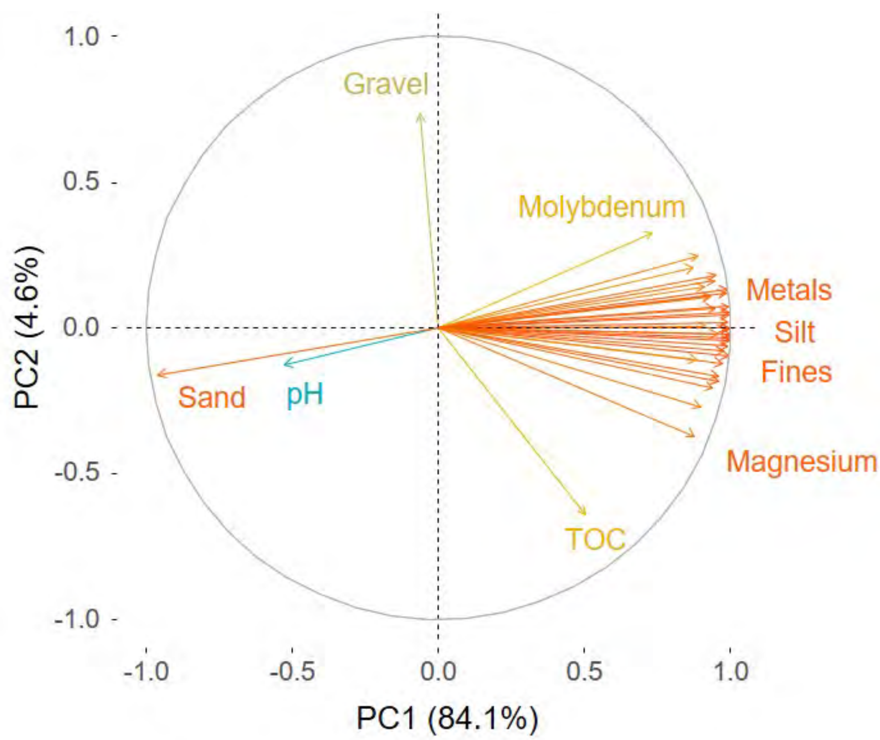


Figure 4-2: Principal Component Analysis (PCA) of Sediment Quality at Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

PC1 and PC2 were plotted to identify where samples lie in two-dimensional ordinal space, allowing for further interpretation of the data (Figure 4-3). The right half of Figure 4-3 represents higher silt and clay content, inorganic carbon, and concentrations of metals, with lower pH and sand content; the left half of the figure represents higher sand content, higher pH, and lower metal concentrations. The upper half of Figure 4-3 represents higher gravel content; the lower half of the figure represents higher magnesium and TOC concentrations. Most stations on the two northern transects that extend out into the inlet (SNE and SNW) are oriented on the right side of the graph, reflective of the finer sediments and higher carbon and metal concentrations. Stations along the SE and SW transects closer to the shore position in the left half of the graph, reflective of shallower environments with coarser sediments, and subsequently lower metal concentrations.

More specifically, stations along the SE Transect are located in the upper-left part of the graph indicative of higher gravel content, whereas stations along the SW Transect are located in the lower-left part of the graph, indicative of higher magnesium and TOC concentrations. Stations from the northern transects (SNE and SNW) position in the right half of the graph, with higher concentrations of silt, clay, and other metals, and lower pH and sand content. Stations along the SNE Transect are located in the upper-right part of the graph, with higher gravel content, but also dominated by fines with lower sand, while SNW was located in the right-central part of the graph, with relatively moderate TOC concentrations.

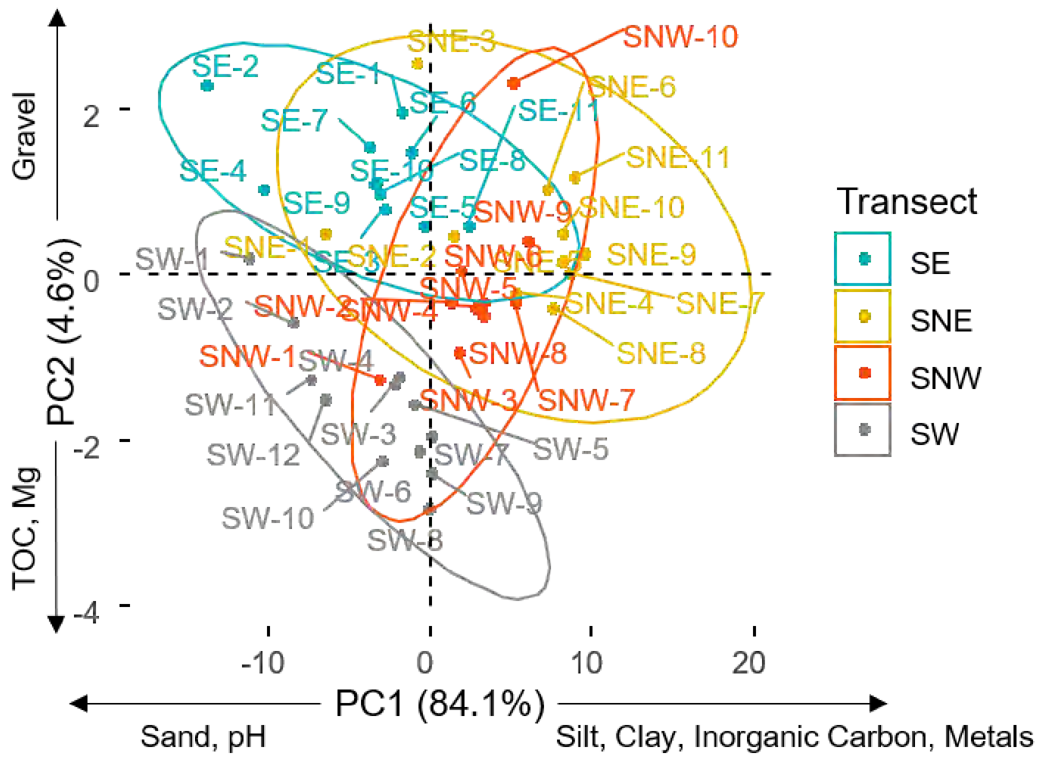


Figure 4-3: Principal Component Scores for Sediment Quality Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

Overall, the results of the PCA suggested that:

- There appears to be a relationship between sediment metal concentrations and the proportion of fine-grained sediments (i.e., silt and clay). This is consistent with results reported in previous MEEMP programs that identified a similar relationship.
- The chemical profile of sediments along the transects appear to be driven by substrate type rather than Port activities. Similarly, the type of substrate along each transect seems to differ based on depositional forces (i.e., coastal transects tend to have greater amounts of coarse material than deeper offshore sediments along the northern transects), rather than Port activities.
- The PCA did not suggest that sediment metal concentrations or fine-grained sediments were accumulating at elevated levels close to the Ore Dock relative to other locations sampled within Milne Port.

4.1.4.4 Comparison to Sediment Quality Guidelines

Concentrations of bismuth, silver, tin, and tungsten were measured below their respective detection limits in each of the 2019 samples, with antimony and selenium detected in less than 50% of the samples. Where detected, metal concentrations tended to be present at greater concentrations in areas with a higher proportion of fines and were not determined to be concentrated close to the Ore Dock (Figure 4-2 and Figure 4-3). For instance, aluminum and iron concentrations increased with greater distance from the Ore Dock along the Northwest and Northeast Transects (i.e., the Northern Transects), consistent with an increase in fine grained sediments with greater depth offshore (Figure 4-4 and Figure 4-5). Concentrations for these metals were less variable along the West and East Transects, which are situated parallel to the coast (i.e., the Coastal Transects), as these samples were collected along a similar depth profile and were less variable in sediment grain size.

Sediment metal concentrations at stations sampled in 2019 were generally less than applicable sediment quality guidelines, with the exceptions of arsenic and nickel (discussed below).

Measured arsenic concentrations during the 2019 MEEMP were less than applicable guidelines along the East and West transects, but exceeded the CCME ISQG (7.24 mg/kg) at eleven stations sampled along the two Northern Transects (Figure 4-6), specifically:

- three stations along the Northwest Transect (i.e., SNW-3, -7 and -9)
- eight stations along the Northeast Transect (i.e., SNE-4, -5, -6, -7, -8, -9, -10, and -11)

Concentrations in 10 of these samples (i.e., all except the SN-7 sample) also exceeded the NOAA T_{20} benchmark (7.4 mg/kg; Buchman 2008) and 9 of these samples exceeded the NOAA Effects Range-Low (ERL) of 8.2 mg/kg (Buchman 2008). Arsenic was also measured at elevated concentrations in Milne Inlet during baseline characterization work in 2007, 2008 and 2011 (Baffinland 2012), and in 2013 and 2014 (SEM 2014; 2015). Concentrations up to 9.0 mg/kg were measured in sediment during these baseline sampling programs. The highest arsenic concentration (12.4 mg/kg) measured in 2019 was found at station SNE-5. As depicted in Figure 4-6, arsenic concentrations tended to increase with greater distance from the Ore Dock along the two northern transects, which is the opposite of what would be expected if the Ore Dock were the cause of the elevated arsenic concentrations. The 2019 results are consistent with those reported during previous MEEMP programs (2014–2018), which documented sporadic and marginal exceedances of arsenic ISQGs in sediments. As described above, variability in measured concentrations of arsenic in Milne Port were well explained by the variability in percent fines (Figure 4-2), which was shown to increase with greater distance from the Ore Dock. Overall, arsenic concentrations in 2019 were similar to those reported in previous surveys and did not approach the CCME PEL of 41.6 mg/kg in any sample. As a result, the low magnitude exceedances of CCME ISQGs in some samples are likely reflective of background conditions and related to physical sediment properties (i.e., percent fines), rather than contamination caused by Port activities.

Nickel concentrations in 2019 exceeded the T_{20} benchmark (15 mg/kg) at eight stations located along the Northern Transects (Figure 4-7): 1 Northwest Transect stations (SNW-9) and seven Northeast Transect stations (SNE-5, -6, -7, -8, -9, -10, and -11). The same seven stations from the Northeast Transect also exceeded the NOAA Threshold Effect Level (TEL) of 15.9 mg/kg. The highest nickel concentration of 19 mg/kg was measured at station SNE-9 located in deeper waters in the inlet. CCME sediment quality guidelines are not currently available for nickel; however, measured concentrations were less than the lower (30 mg/kg) and upper (50 mg/kg) BC Working sediment guidelines. Concentrations of nickel in sediments have previously been measured up to 25 mg/kg during baseline studies performed in Milne Inlet (SEM 2015), suggesting that nickel concentrations measured in 2019 were within the range of background concentrations for this area. Furthermore, as depicted in Figure 4-7, nickel concentrations tended to increase with greater distance from the Ore Dock along the two northern transects, which is the opposite of what would be expected if the Port were the cause of the elevated nickel concentrations. This is further supported by the results of the Spearman Rank Correlation analysis and PCA, which suggest that reported nickel concentrations were related to sediment grain size (fines), rather than Port activities.

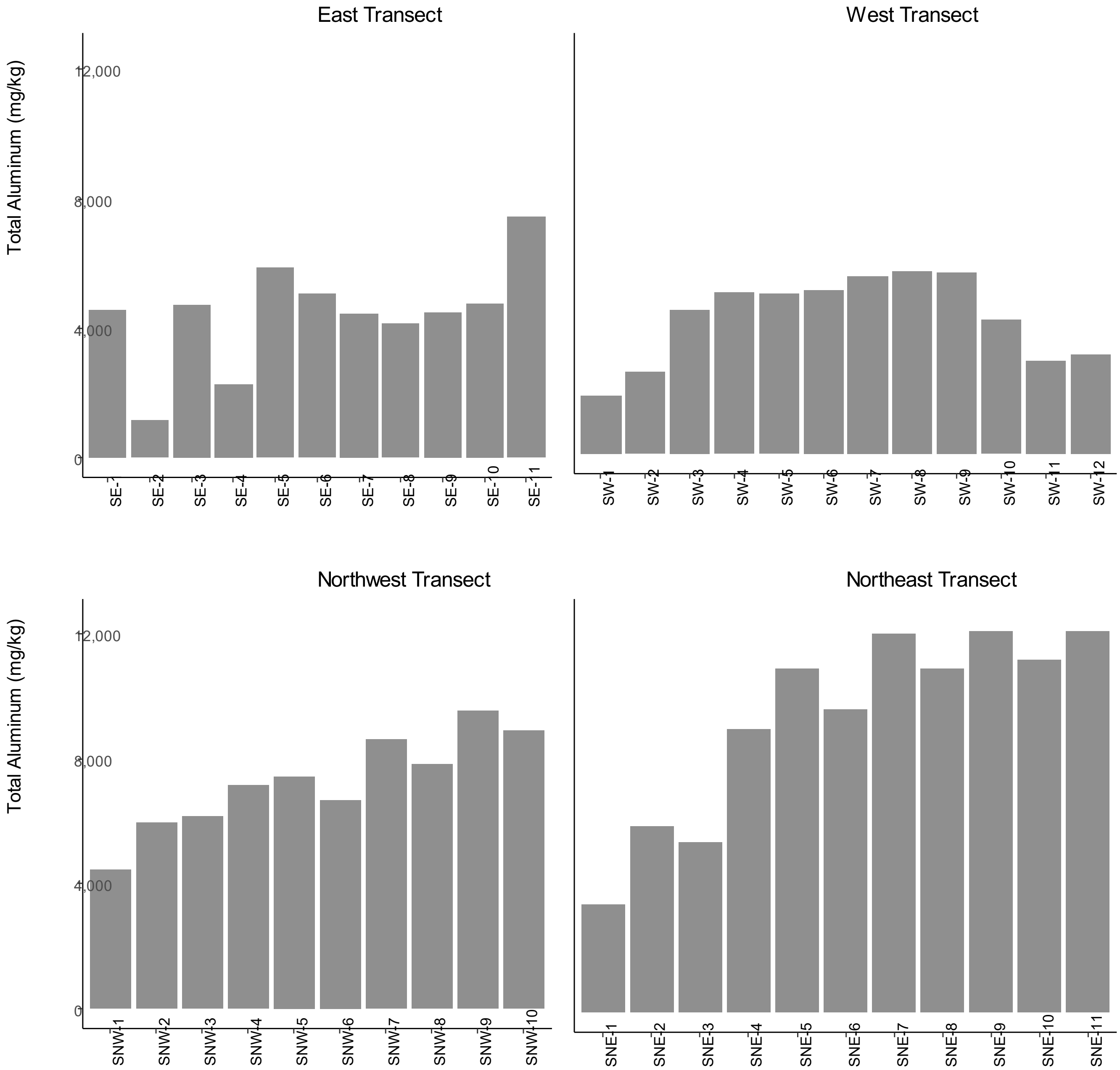


Figure 4-4: Sediment Aluminum Concentrations at Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

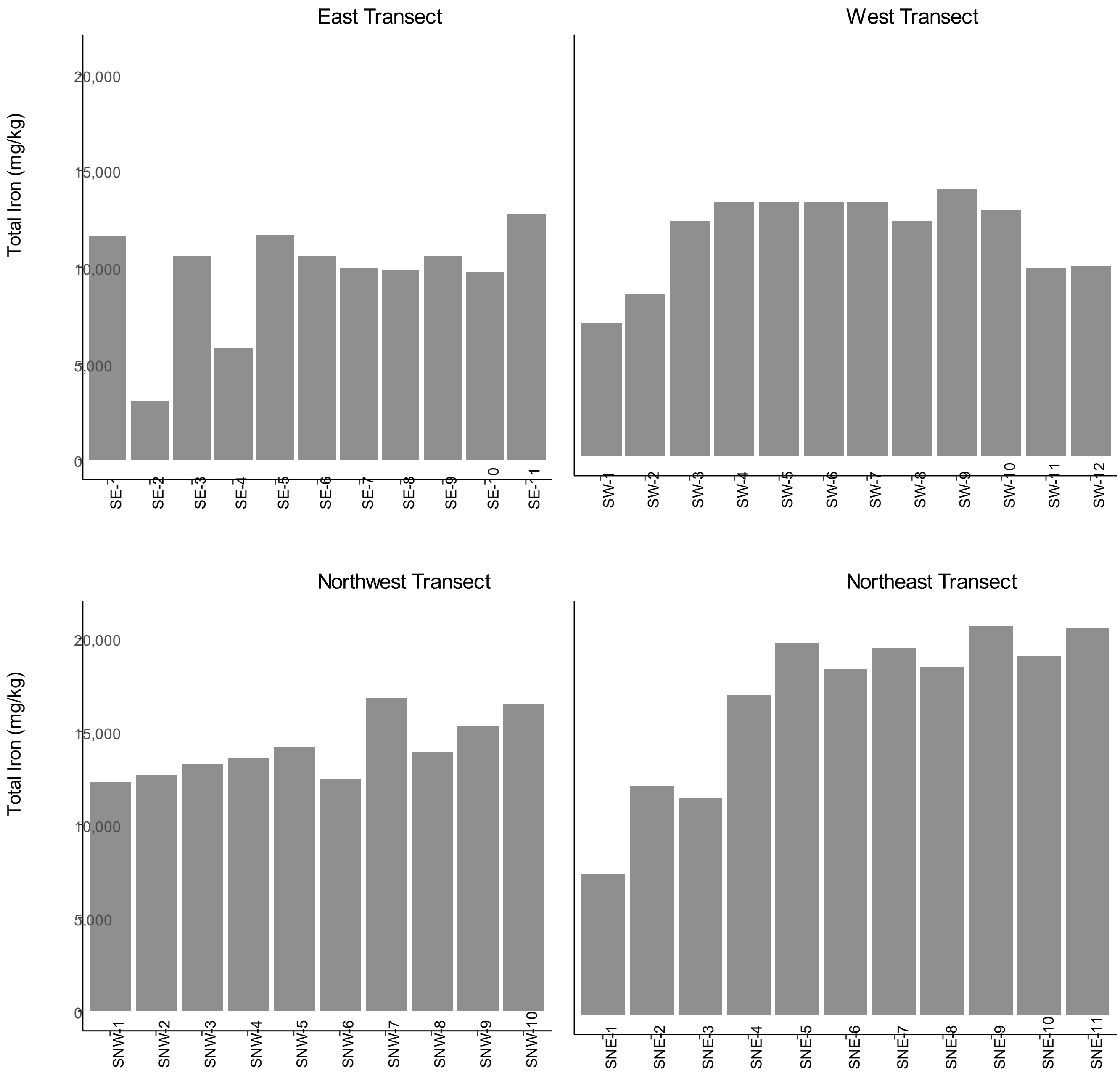


Figure 4-5: Sediment Iron Concentrations at Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

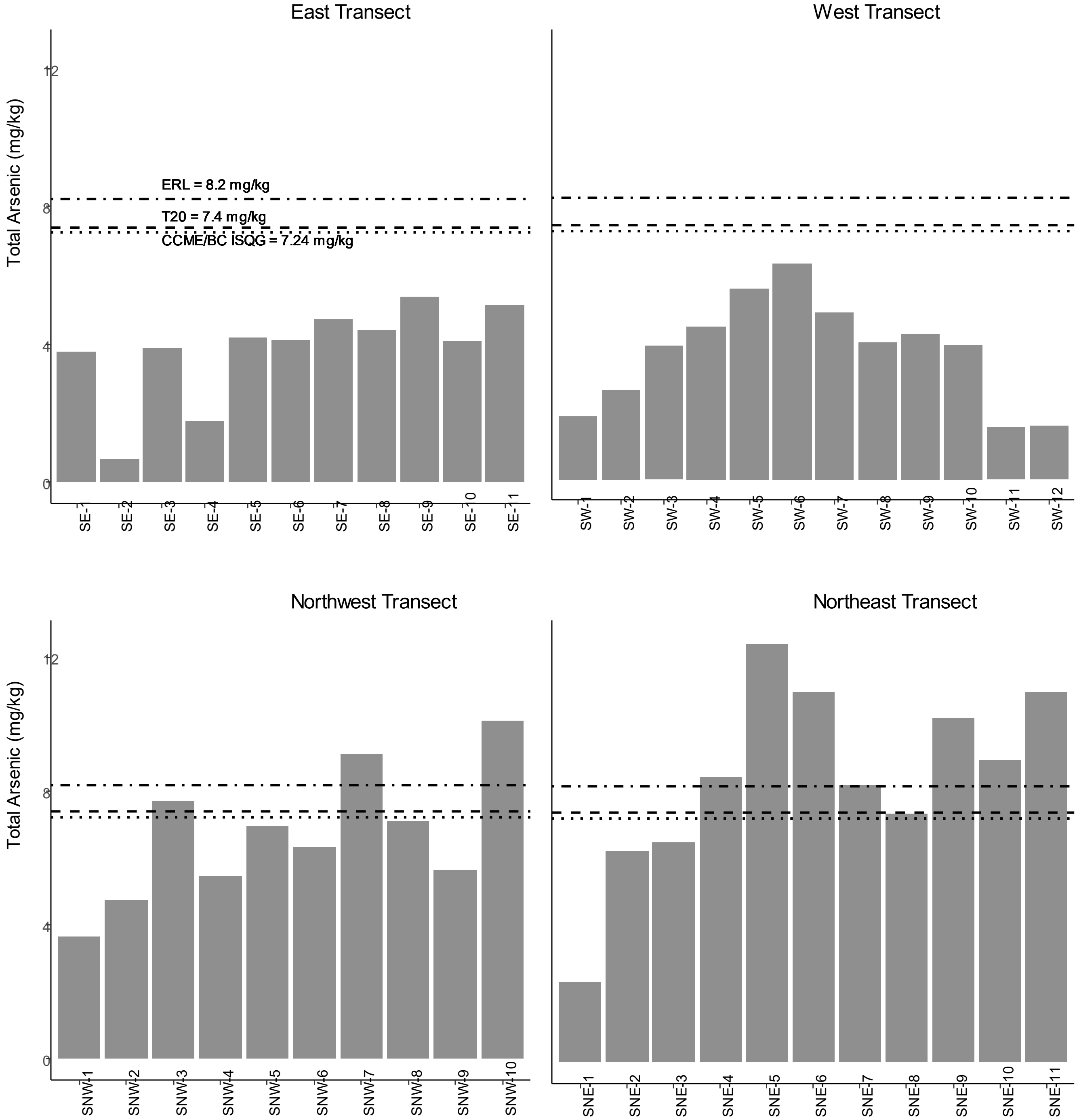


Figure 4-6: Sediment Arsenic Concentrations at Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

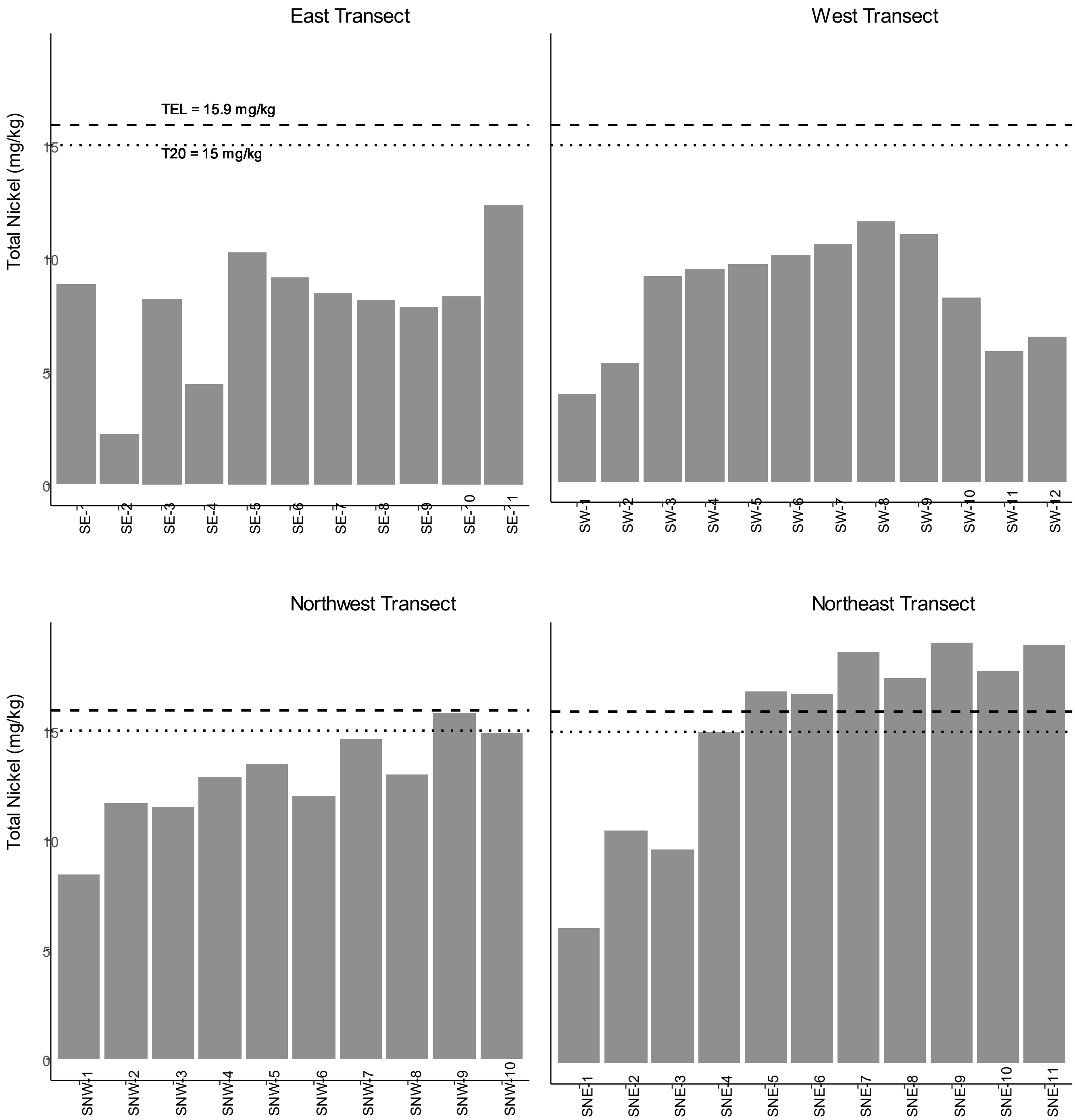


Figure 4-7: Sediment Nickel Concentrations at Stations Located Along Transects Radiating out from the Ore Dock in Milne Port, 2019

Volatile organic compounds, extractable petroleum hydrocarbons and PAHs were, with few exceptions, determined to be less than their respective analytical detection limits in sediment samples collected in 2019 (Appendix C-3). Stations with detectable sediment concentrations for these parameters included:

- Several PAHs were detected in sediments collected at stations SNE-1, SNW-6, SE-3, SNE-7 and SNE-8
- VOCs**:** benzene was detected at stations SE-6 (0.0170 mg/kg), SE-10 (0.0063 mg/kg), SE-11 (0.0079 mg/kg), SNE-10 (0.0059 mg/kg) and SNE-11 (0.0057 mg/kg), while toluene was found in SE-6 (0.103 mg/kg), SE-11 (0.091 mg/kg), SNE-10 (0.078 mg/kg) and SNE-11 (0.09 mg/kg)
- Petroleum hydrocarbons were measured to be less than the detection limit in each of the samples analyzed.

Concentrations of acenaphthene (0.013 mg/kg) and dibenz(a,h)anthracene (0.0177 mg/kg) in SNE-1 exceeded CCME ISQGs of 0.00671 and 0.00622 mg/kg, respectively. Concentrations of dibenz(a,h)anthracene at stations SNW-6 (0.0098 mg/kg), SNE-7 (0.0088 mg/kg) and SNE-8 (0.0076 mg/kg) also marginally exceeded the CCME ISQG and the BC Working lower guideline of 0.00622 mg/kg. Other organic compounds measured in sediments sampled during the 2019 sediment program did not exceed sediment quality guidelines and benchmarks.

Interpretation of the few ISQG exceedances for organics must acknowledge the high degree of conservatism in the individual ISQGs for PAHs. These guidelines are among the most conservative sediment quality guidelines in the world, have high uncertainty, and are suitable only for use as conservative screening values (i.e., the ISQG is intended to represent a concentration below which adverse biological effects are rarely expected to occur). CCME PELs are intended to represent concentrations above which adverse effects are predicted to occur frequently, based on a concurrence data set with sediment chemical concentration and benthic invertebrate effects data from other sites. Notably, the Federal Contaminated Sites Action Plan (FCSAP) guidance for working harbours (FCSAP 2018) recommends use of PEL over ISQG for screening primary contaminants of potential concern, as screening with ISQGs is considered overly conservative and does not always correlate well with observed effects under field conditions (FCSAP 2018). Both sediment organic and inorganic parameters measured in 2019 were less than CCME PEL guidelines in each of the collected sediment samples.

4.1.4.5 EEM – Content of Fines

2019: Spatial Comparison

Based on the observed relationship between total sediment metals and percent fines, the percentage of fines at stations sampled in 2019 were analyzed using a general linear model, with main effects of distance from transect origin, transect, and their interaction. The effect of distance was modeled as a second-degree polynomial to account for the non-linearity in percent fines relative to distance from transect origin. The model explained 79% of the data variability, and the two-way interaction was statistically significant (P=0.001), indicating differences in the relationship between fines and distance at different transects (Table 4-3).

Overall, the Northeast and Northwest Transects had slightly higher fines content at each distance, compared to the East and West Transects. The spatial relationships determined from the linear regression analysis were:

- Along the East Transect, percent fines were generally lower than observed along the northern transects and did not increase significantly between distances extending from the Ore Dock (Figure 4-8; Table 4-4).
- Along the Northeast Transect, percent fines were consistently higher at each distance compared to the transects running along the coast (Figure 4-8; Table 4-4). Estimates of fines along the Northeast Transect increased significantly between distances from 0 m to 900 m from the Ore Dock (Table 4-4).
- Along the Northwest Transect, percent fines were slightly higher at each distance compared to the coastal transects, but the increasing relationship between fines content and distance from the Ore Dock was less pronounced compared to the Northeast Transect and was not statistically significant (Figure 4-8; Table 4-4).
- Along the West Transect, percent fines were generally lower and more similar to the East Transect than to the Northwest and Northeast transects. There was high variability in fines content along the West transect, and fines increased significantly between distances ranging from 0 m to 400 m from the Ore Dock, followed by a significant decrease in fines at distances between 900 m and 1,200 m from the Ore Dock (Table 4-4), which could be related to sedimentation patterns resulting from the outflow of Phillips Creek (i.e., deposition of fine-grained riverine sediments).

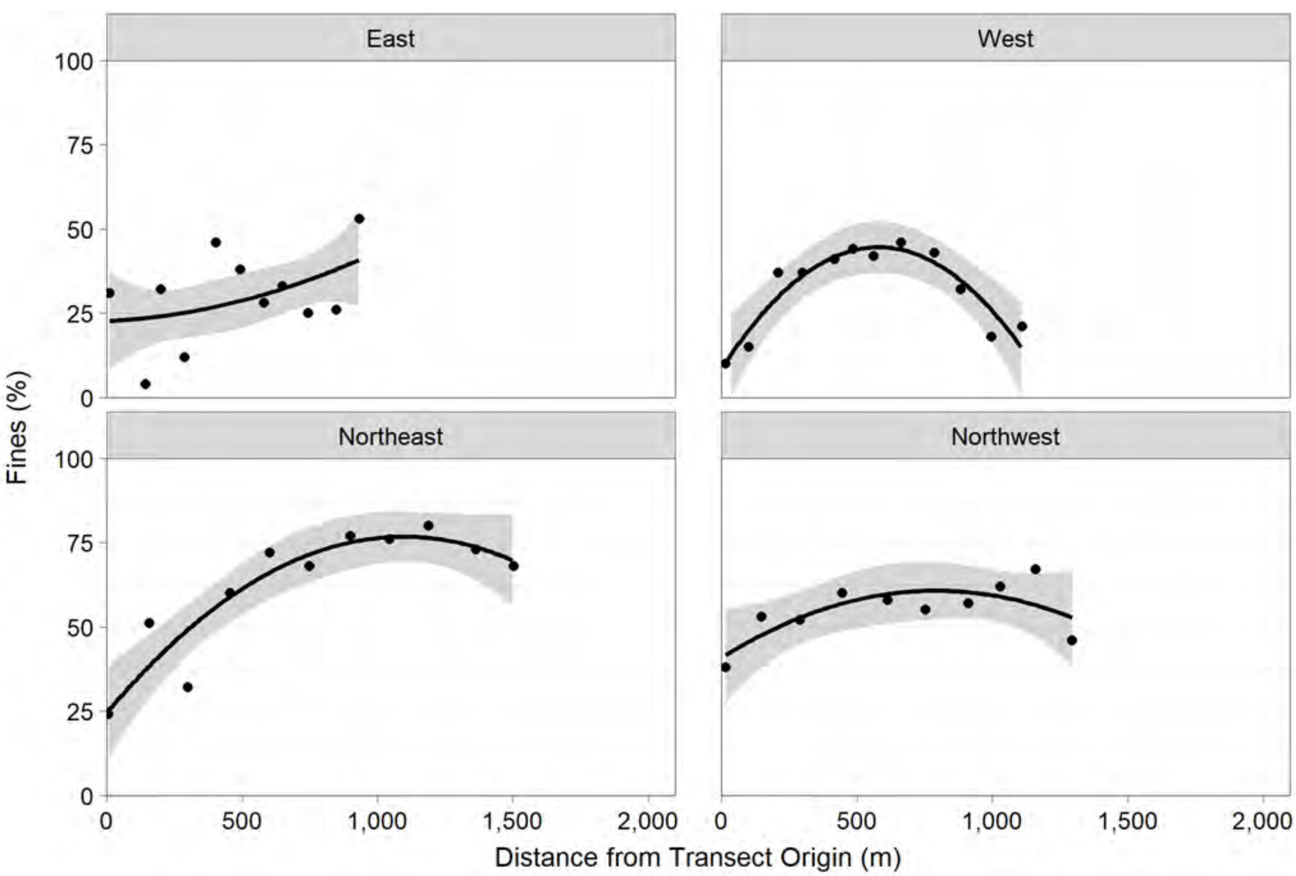


Figure 4-8: Observed (Points) and Estimated (Lines) Percent Fines in Sediment Relative to Sampling Distance along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-3: ANOVA Summary of Percent Fines in Sediments by Transect in 2019

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.793	Distance from transect origin	2	17.60	**<0.001**
	Transect	3	28.99	**<0.001**
	Distance × Transect	6	5.26	**0.001**

Notes: Adj. R^2= Adjusted *R* squared value; Df= degrees of freedom. Distance was modeled as a second-degree orthogonal polynomial.

Table 4-4: Comparison of Percent Fines between Consecutive Distances along each Transect in 2019

Distance from Origin (m)	Transect *P*-Value			
	East	West	Northeast	Northwest
100 – 0	1.000	**0.001**	**0.001**	0.526
200 – 100	1.000	**0.002**	**0.001**	0.497
300 – 200	1.000	**0.002**	**<0.001**	0.463
400 – 300	0.965	**0.006**	**<0.001**	0.428
500 – 400	0.499	0.057	**<0.001**	0.414
600 – 500	0.426	0.998	**<0.001**	0.516
700 – 600	0.747	0.709	**<0.001**	0.923
800 – 700	0.921	0.055	**<0.001**	1.000
900 – 800	0.974	**0.012**	**0.018**	1.000
1,000 – 900	0.990	**0.006**	0.743	0.999
1,100 – 1,000	0.995	**0.004**	1.000	0.993
1,200 – 1,100	0.998	**0.003**	1.000	0.978

Notes: Significant *P*-values (<0.05) are indicated in bold

2014–2019: Temporal Comparison

The percentages of fines at sediment stations sampled during the 2014-2018 and 2019 MEEMP programs were also evaluated using a general linear model, with main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions. The effect of distance was modeled as a second-degree polynomial to account for the non-linearity in percent fines relative to distance from transect origin. The model explained 70% of the data variability. The only statistically significant interaction indicated that there were differences in the relationship between fines and distance along different transects (*P* <0.001), but not among years (Table 4-5). There were comparable relationships between fines and distance across years within each transect (Figure 4-9). Overall, the results of the linear regression suggest that sediment fines content has not changed significantly between 2014 and 2019 for the sediment transect locations investigated (Table 4-6).

For three of the four transects the following distance-based trends were noted. Comparison of trends between years was not possible for the Northeast Transect because 2019 was the first year that this transect was sampled.

- **East Transect**—fines generally increased with distance from the Ore Dock during each of the MEEMP years, with small interannual differences in the relationship (Figure 4-9). Estimates of fines content did not vary significantly between years at any distance from the Ore Dock and, while variability between years was recorded, there did not appear to be any statistically significant interannual differences between distances within this transect (Table 4-6). Overall, no consistent interannual trend was detected at the East Transect origin or anywhere along the transect.
- **Northwest Transect (North Transect in pre-2019 MEEMP years)**—all six years had a similar pattern of increasing fines with distance from the transect origin up to approximately 1,000–1,500 m, followed by a slight decrease or stabilization in fines content (Figure 4-9). There were no statistically significant differences between years at any of the distances evaluated along the Northwest Transect (Table 4-6).
- **West Transect**—fines were generally low at the Ore Dock and 1,500 m from the Ore Dock, but increased from the Ore Dock up to a distance of between 500 m and 1,000 m from the Ore Dock (Figure 4-9), potentially as a result of the outflow of Phillips Creek, followed by a decreasing trend to 1,500 m from the Ore Dock. There were no statistically significant differences between years at any of the distances along the West Transect (Table 4-6).

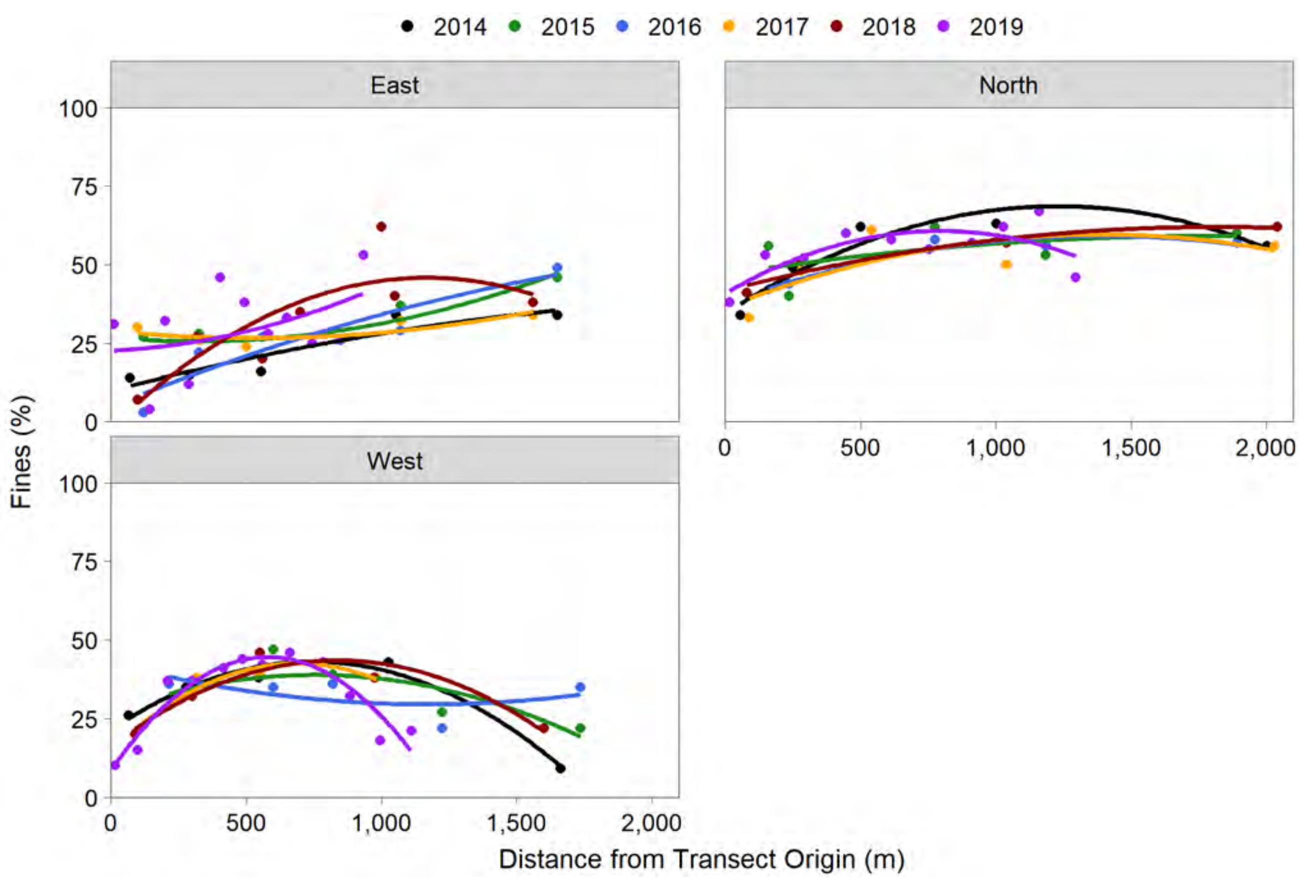


Figure 4-9: Observed (Points) and Estimated (Lines) Percent Fines in Sediment Relative to Sampling Distance along Transects, 2014 to 2019.

Table 4-5: ANOVA Summary of Percent Fines in Sediments by Year and Transect

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.699	Distance from transect origin	2	22.61	**<0.001**
	Year	5	0.48	0.791
	Transect	2	94.2	**<0.001**
	Distance × Year	10	1.76	0.089
	Distance × Transect	4	8.79	**<0.001**
	Year × Transect	10	0.79	0.638
	Distance × Year × Transect	20	1.17	0.311

Notes: Adj. R^2= Adjusted *R* squared value; Df= degrees of freedom. Distance was modeled as a second-degree orthogonal polynomial.

Table 4-6: Multiple Comparisons of Percent Fines between Years, within Distance/Transect Combinations

Transect and Distance from Origin (m)	Sampling Year					
	2014	2015	2016	2017	2018	2019
East Transect						
0	a	a	a	a	a	a
500	a	a	a	a	a	a
1,000	a	a	a	a	a	a
1,500	a	a	a	a	a	a
North Transect						
0	a	a	a	a	a	a
500	a	a	a	a	a	a
1,000	a	a	a	a	a	a
1,500	a	a	a	a	a	a
West Transect						
0	a	a	a	a	a	a
500	a	a	a	a	a	a
1,000	a	a	a	a	a	a
1,500	a	a	a	—	a	—

Notes: Years that do not share letters (within every distance in each transect) are significantly different from each other. Increasing letters represent an increase in values: “a” is the lowest estimated fines value, “b” representing is the second lowest, and so on. Grey shading depicts significant, increasing trends between consecutive years, and underlined letters represent significant, decreasing trends between consecutive years. “—” represents a distance where temporal comparisons could not be made, as samples were at the given distance over the specific sampling period.

4.1.4.6 EEM—Iron Concentrations

Increases in iron content over time could represent a Project-related effect due to the potential for release of iron ore in the form of dust or in runoff from storage stockpiles. Additionally, iron ore could be released to the marine environment during loading of the ore onto vessels at the Port. Given that the iron ore consists primarily of iron (>65%; FEIS; Baffinland 2013), monitoring for changes in the concentration of this element in sediments over time is an important component of the MEEMP. To further evaluate sediment iron concentrations in Milne Inlet, a spatial comparison of the 2019 transect data was undertaken as described below. A comparison of sediment iron data collected by the MEEMP between 2014 and 2019 was also conducted to evaluate temporal trends and is also described below.

Spatial Comparison

To evaluate the potential for iron ore dust and runoff to impact the marine environment, sediment iron concentrations were analyzed using a general linear model, with main effects of distance from transect origin, transect, and the interaction between the two variables. In addition, a main effect of percent fines was also assessed, to account for the strong relationship between these two variables (Figure 4-10). Iron content and percent fines were natural-log transformed to make the relationships linear. Since non-linearity still remained in the relationship between natural-log transformed iron content and distance, the effect of distance was modeled as a second-degree polynomial. The model explained 79% of the data variability, and the two-way interaction was statistically significant (P=0.005), indicating differences in the relationship between iron and distance along different transects (Table 4-7). Percent fines was also a statistically significant explanatory variable of iron content (P <0.001).

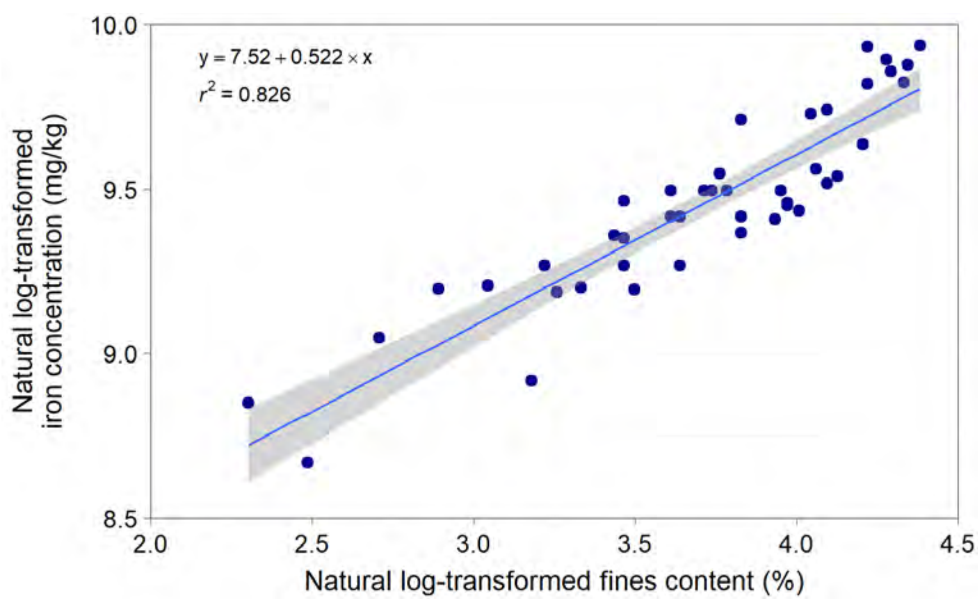


Figure 4-10: Relationship between Iron Concentration and Fines Content in Sediment in 2019. Grey Ribbon is 95% Confidence Interval.

Table 4-7: ANOVA Summary of Iron Content in Sediments by Transect

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.927	Distance from transect origin	2	9.48	**0.001**
	Transect	3	7.32	**0.001**
	Distance × Transect	6	3.99	**0.005**
	Fines	1	64.75	**<0.001**

Notes: Adj. R_2= Adjusted *R* squared value; Df= degrees of freedom. Iron content and fines were log-transformed prior to analysis, and distance was modeled as a second-degree orthogonal polynomial.

There was substantial variability in iron concentrations observed between transects in 2019 (Figure 4-11; Table 4-8). Overall, iron content was similar between transects closer to the Existing Ore Dock (< 300 m from transect origin) and only increased significantly with distance from the Ore Dock along the Northeast Transect (i.e., up to 800 m from the transect origin at the Ore Dock). The spatial relationships determined from the linear regression analysis were:

- **Coastal Transects (East and West)**—iron concentrations did not increase significantly with distance from the Ore Dock.
- **Northern Transects (Northeast and Northwest)**—iron concentrations increased significantly with distance from the Ore Dock along the Northeast transect between 0 m and 800 m from the transect origin, before stabilizing at approximately 900 m from the Ore Dock. Along the Northwest Transect, iron concentrations increased slightly with distance from the Ore Dock; however, the relationship was not determined to be statistically significant (Figure 4-11; Table 4-8).

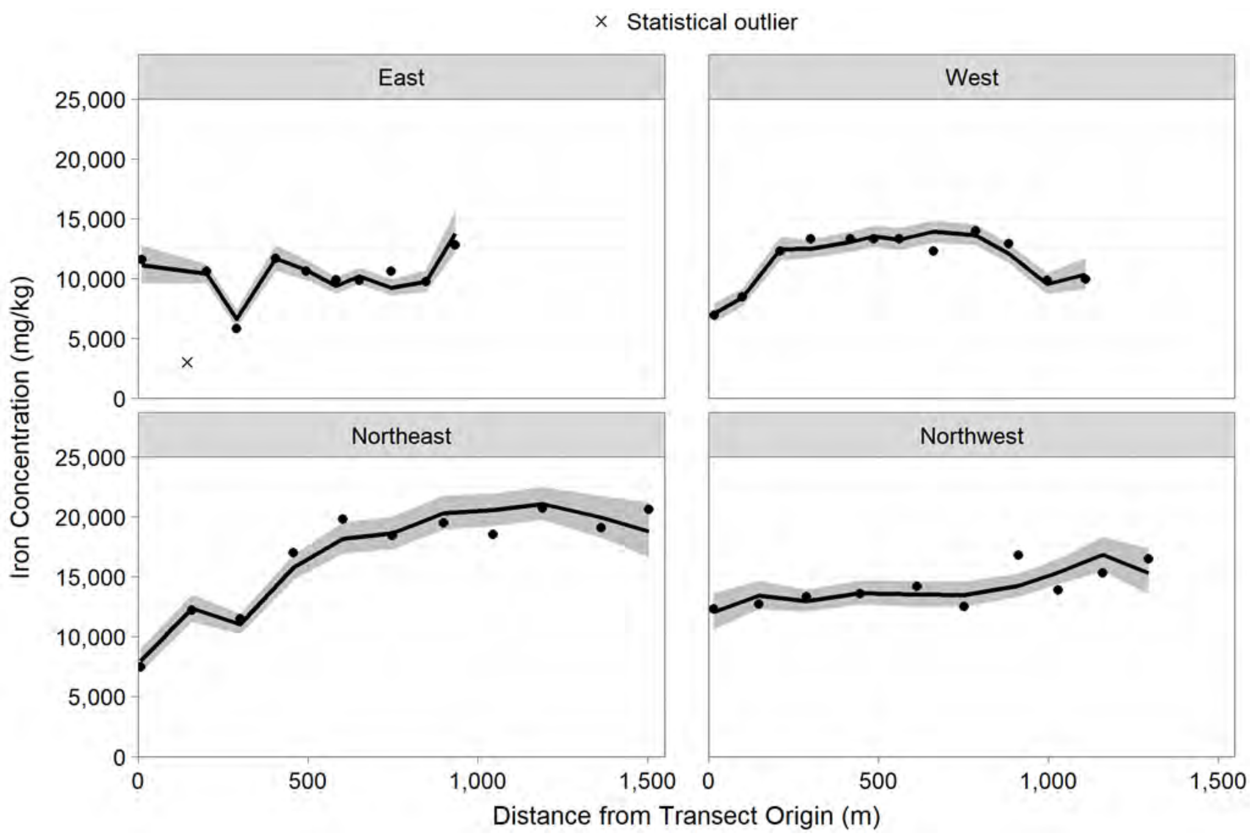


Figure 4-11: Observed (Points) and Estimated (Lines) Iron Content in Sediment Relative to Sampling Distance along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-8: Comparison of Iron Content between Consecutive Distances along each Transect in 2019

Distance from Origin (m)	Transect *P*-Value			
	East	West	Northeast	SNW
100 – 0	0.820	1.000	**0.010**	0.959
200 – 100	0.846	1.000	**0.007**	0.983
300 – 200	0.898	1.000	**0.005**	0.997
400 – 300	0.979	1.000	**0.003**	1.000
500 - 400	1.000	1.000	**0.001**	1.000
600 – 500	1.000	1.000	**0.001**	1.000
700 – 600	0.974	0.999	**<0.001**	0.566
800 – 700	0.912	1.000	**0.001**	0.129
900 – 800	0.870	1.000	**0.022**	0.103
1,000 – 900	0.845	1.000	0.587	0.130
1,100 – 1,000	0.830	1.000	1.000	0.168
1,200 – 1,100	0.820	1.000	1.000	0.206

Notes: Significant *P*-values are indicated in bold

Temporal Comparison

To evaluate temporal trends in sediment iron concentrations collected during the MEEMP between 2014 and 2019, sediment samples were analyzed using a general linear model, with main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions between the three variables, in addition to a main effect of percent fines (Figure 4-12). Iron content and percent fines were natural-log transformed to make the relationships linear. Because non-linearity still remained in the relationship between natural-log transformed iron content and distance, the effect of distance was modeled as a second-degree polynomial.

The model explained 92% of the data variability, and two-way interactions were statistically significant, indicating differences in the relationship between iron and distance along different transects ($P<0.001$) and in the relationship between iron and year along different transects ($P=0.006$; Table 4-9). The three-way interaction was not statistically significant ($P=0.137$). Log-transformed percent fines was a statistically significant explanatory variable of iron content ($P<0.001$).

Interpretation of the regression analysis results presented in Table 4-13 and Table 4-10 are provided below. Overall, statistically significant increases in iron content in sediments at concentrations greater than those observed during the 2014 baseline characterization program were only observed along the East Transect at 500 m and 1,000 m from the Ore Dock. Similar to the West Transect, iron concentrations year-over-year along these coastal transects (15 m depth profile) were determined to be more variable than the Northwest offshore transect. It is unclear whether elevated concentrations observed along the East Transect suggest an upward trend, or whether it is simply reflective of this high natural variability. Further monitoring is likely required to differentiate between these two possibilities.

Coastal Transects

Along the East Transect, significant changes in iron concentrations were observed between 2014 and 2019. These changes are described below at 0 m, 500 m, 1,000 m, and 1,500 m distances from the Ore Dock.

- **East Transect (0 m):** Measured sediment iron concentrations in 2017 and 2018 were significantly greater than concentrations measured by the MEEMP between 2014 and 2016. In contrast, results reported in 2019 were not determined to be significantly different than results reported between 2014 and 2016, or relative to the 2017 and 2018 results.
- **East Transect (500 m):** Measured sediment iron concentrations in 2017, 2018 and 2019 were determined to be significantly greater than concentrations measured between 2014 and 2016.
- **East Transect (1,000 m):** Measured sediment iron concentrations in 2017 and 2018 were not determined to be significantly greater than baseline concentrations measured in 2014 but were significantly greater than concentrations measured in 2015 and 2016. Concentrations measured in 2019 were not determined to be significantly different than 2017 and 2018 but were significantly greater than 2014 results.
- **East Transect (1,500 m):** Measured iron concentrations in 2015, 2016, 2017, and 2018 were not determined to be significantly different from baseline concentrations reported in 2014. Unfortunately, as sampling stations were not collected at this distance from the Ore Dock during the 2019 program, comparisons to 2019 values could not be performed.

These results suggest variability in iron concentrations among years along the East Transect, but do not definitively suggest increased iron concentrations over time resulting from Port activities. Sediments collected close to the Ore Dock did not have significantly greater fines-adjusted iron concentrations than baseline conditions reported in 2014. Concentrations of iron were significantly greater than 2014 results at 500 m and 1,000 m from the Ore Dock in 2019; however, 2019 concentrations were not significantly greater than those over the past two MEEMP sediment programs (2017 and 2018). It is unclear whether the observed differences in iron concentrations at 500 m and 1,000 m from the Ore Dock reflect an upward trend related to Port operations, or whether they are simply reflective of the variable sediment conditions in this area of Milne Inlet. Further monitoring is likely required to differentiate between these two possibilities.

Along the West Transect, similar to the East Transect, sediment iron trends showed higher variability year over year than along the Northwest Transect, and a variety of statistical differences between years were identified, as detailed in Figure 4-13 and Table 4-10. However, measured iron concentrations collected in 2019 were not determined to be statistically different than those measured in 2014, suggesting measured concentrations in 2019 were similar to background.

Northwest Transect

Interannual changes in iron concentrations (at observed fines content values) were not observed at any of the four tested distances between 2014 and 2019 along the Northwest Transect (Table 4-10; Figure 4-13), suggesting that measured concentrations were similar to background conditions measured in 2014.

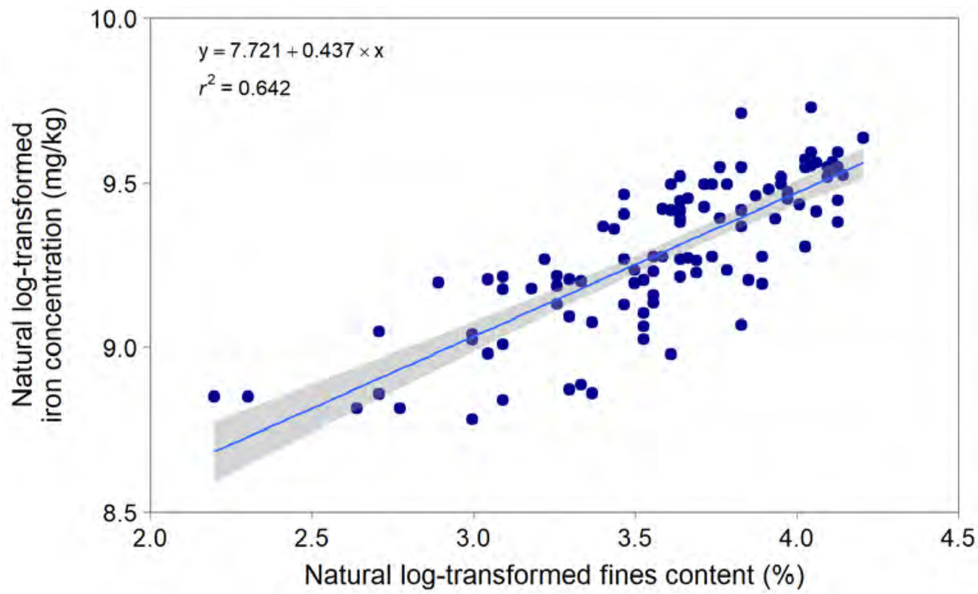


Figure 4-12: Relationship between Iron Concentration and Fines Content in Sediment, 2014-2019. Grey Ribbon is 95% Confidence Interval.

Table 4-9: ANOVA Summary of Iron Content in Sediments by Year and Transect

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.916	Distance from transect origin	2	3.45	**0.039**
	Year	5	35.7	**<0.001**
	Transect	2	45.1	**<0.001**
	Distance × Year	10	1.18	0.327
	Distance × Transect	4	19.1	**<0.001**
	Year × Transect	10	2.88	**0.006**
	Distance × Year × Transect	20	1.46	0.137
	Fines	1	43.95	**<0.001**

Notes: Adj. R^2= Adjusted *R* squared value; Df= degrees of freedom. Distance was modeled as a second-degree orthogonal polynomial; fines and iron content were natural log-transformed prior to analysis.

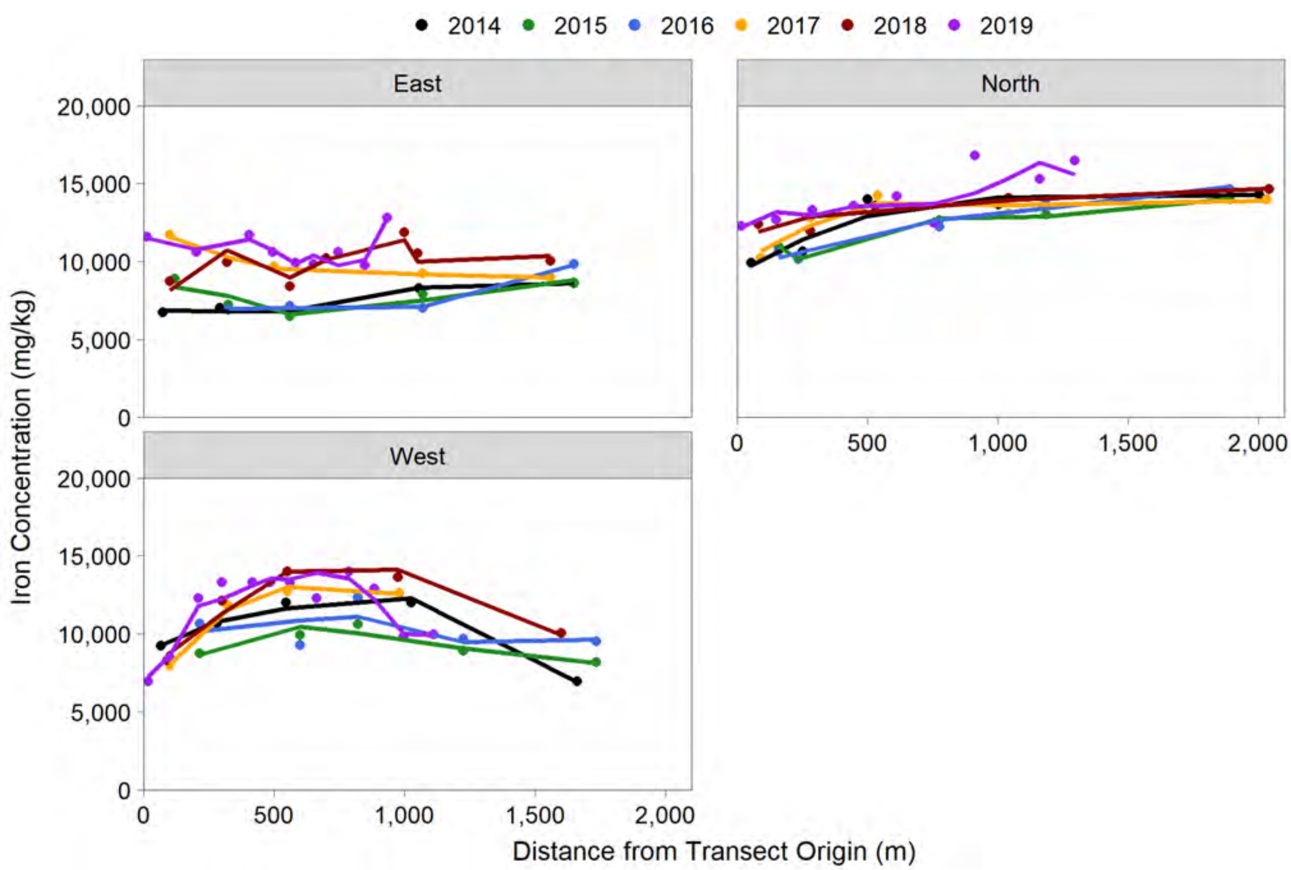


Figure 4-13: Observed (Points) and Estimated (Lines) Iron Content in Sediment Relative to Sampling Distance along Transects, 2014-2019.

Table 4-10: Multiple Comparisons of Iron Content between Years, within Distance/Transect Combinations (Adjusted to Mean Fines)

Transect and Distance from Origin (m)	Sampling Year					
	2014	2015	2016	2017	2018	2019
East Transect						
0	a	ab	ab	b	b	ab
500	a	a	a	b	b	b
1,000	ab	a	a	bc	bc	c
1,500	ab	a	ab	ab	b	—
North Transect						
0	a	a	a	a	a	a
500	a	a	a	a	a	a
1,000	a	a	a	a	a	a
2,000	a	a	a	a	a	a

Transect and Distance from Origin (m)	Sampling Year					
	2014	2015	2016	2017	2018	2019
West Transect						
0	a	a	a	a	a	a
500	<u>bc</u>	<u>a</u>	ab	bc	c	c
1,000	abc	a	ab	abc	c	bc
1,500	ab	a	ab	—	b	—

Notes: Years that do not share letters (within every distance in each transect) are significantly different from each other. Increasing letters represent an increase in values: "a" is the lowest estimated fines value, "b" representing is the second lowest, and so on. Grey shading depicts significant, increasing trends between consecutive years, and underlined letters represent significant, decreasing trends between consecutive years. Multiple comparisons were performed on iron concentrations adjusted to mean log-transformed percent fines within each transect. "—" represents a distance where temporal comparisons could not be made, as samples were at the given distance over the specific sampling period.

4.1.5 Benthic Infauna

4.1.5.1 QA/QC Results

Field sieved and preserved benthic community samples were submitted to the Biologica Environmental Laboratory (Victoria, BC) for enumeration and identifications. Detailed discussion of quality assurance and quality control procedures used in the benthic invertebrate taxonomy program are discussed in the Biologica data report in Appendix E-1. The following laboratory QA/QC procedures were employed by Biologica to validate the results reported:

- Sorting efficiency checks were performed on 50% of samples (n = 16). This involved resorting 25% of the sample debris and comparing the results to the original sort results. The sorting efficiency QC checks were reported to be 98.7% accurate and exceeded the data quality objective of >95% in each of the samples investigated.
- Samples were completely re-sorted when sorting efficiency fell below 95%.

As a result, the quality assurance and quality control program performed by the laboratory did not identify any data quality issues.

A power analysis was also conducted to assess level of effect required for the ANCOVA to identify a significant effect during each of the spatial and temporal comparisons. The results of the power analysis are provided in Appendix O.

4.1.5.2 Community Studies

Benthic invertebrate infauna samples were collected from 32 stations arranged along four transects (East, West, Northeast, and Northwest) extending out from the Ore Dock. Detailed results of the taxonomic analysis of benthic infauna are available in Appendix E-2. The laboratory report provided by Biologica is provided in Appendix E-1.

Benthic Invertebrate Community Indices

Benthic invertebrate community indices used to evaluate the communities along the four transects that extended out from the Existing Ore Dock are depicted in Figure 4-14 to Figure 4-17. An evaluation of total density, species richness, SDI, and SEI for the coastal and northern transects are provided below.

- **Total Density**—Densities were generally greater and more variable along the East and West coastal transects (4,441 to 26,842 org/m^2) compared to the Northwest and Northeast Transects that extended further out into deeper waters within the inlet (871 to 9,612 org/m^2) (Figure 4-14).
- **Species Richness**—Richness (i.e., number of unique taxa) along the coastal transects (East and West Transects) ranged from 17 to 78 taxa, with a mean of 62 taxa between both transects (Figure 4-15; Appendix E-2, Table 3). Richness was lower along the northern transects that extended offshore into Milne Port from the Ore Dock (19 to 67 taxa), with a means of 54 taxa for the Northwest Transect and 51 for the Northeast transect.
- **Simpson's Diversity Index**—SDI was generally higher for the northern transects compared to the coastal transects (Figure 4-16). SDI was greater than 0.90 at each of the stations investigated along the Northwest and Northeast Transects. Along the East and West Transects, SDI values averaged 0.88 and 0.89, respectively. The lowest SDI values were observed at stations BE-2 (0.69) and BW-7 (0.77).
- **Simpson's Evenness Index**—SEI values indicated that evenness was somewhat variable along the four transects, but was generally lower along the East and West transects (0.07 to 0.25) when compared to the Northeast and Northwest transects (0.21 to 0.58) (Figure 4-17). The lowest evenness was observed at stations BE-1 (0.09) and BE-7 (0.07) along the East Transect.

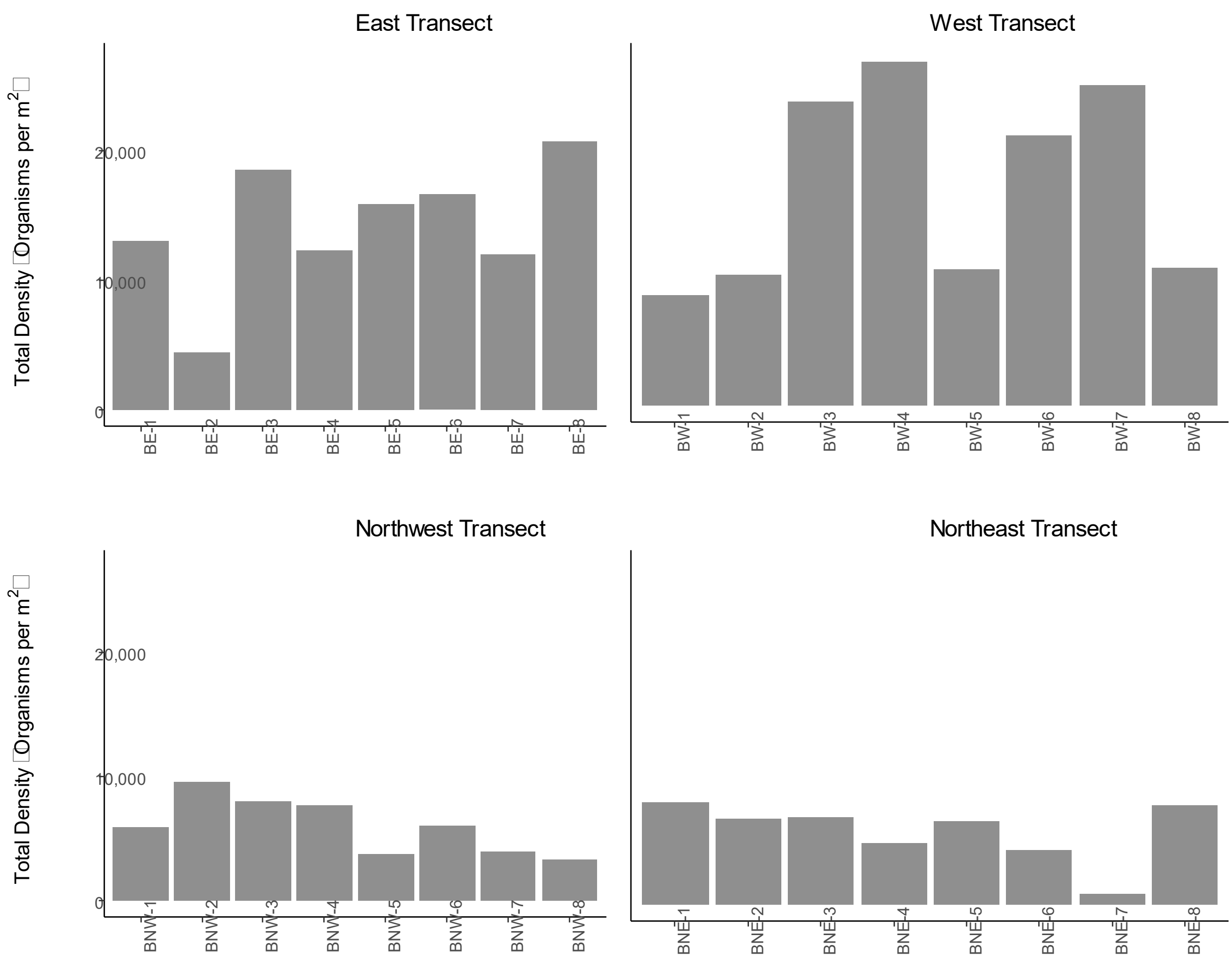


Figure 4-14: Total Density of Benthic Infauna for Sampling Stations along Coastal and Northern Transects Extending from the Ore Dock, Milne Port, 2019.

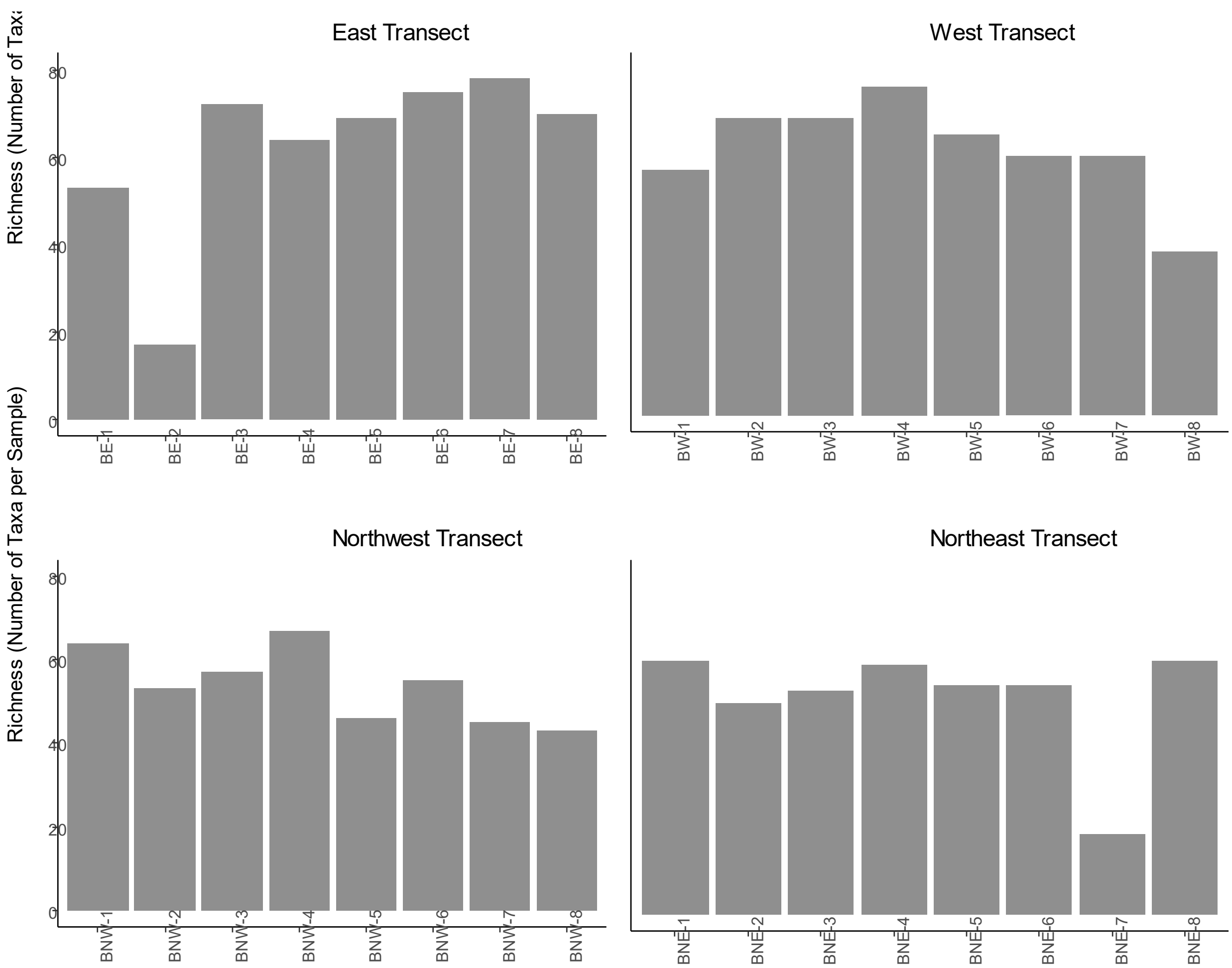


Figure 4-15: Total Richness of Benthic Infauna for Sampling Stations along Coastal and Northern Transects Extending from the Ore Dock, Milne Port, 2019.

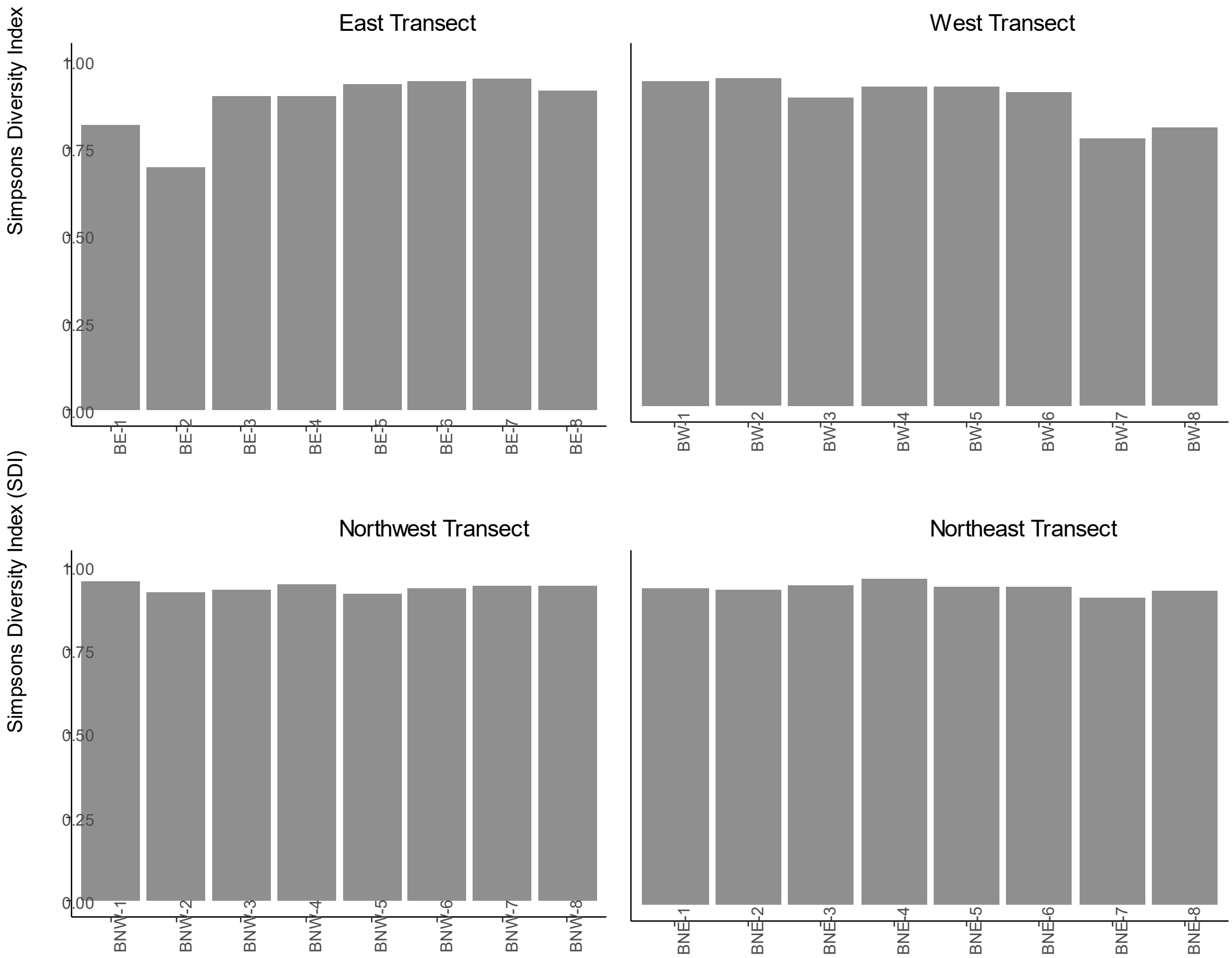


Figure 4-16: Diversity of Benthic Infaunal Communities from Sampling Stations along Coastal and Northern Transects Extending from the Ore Dock, Milne Port, 2019.

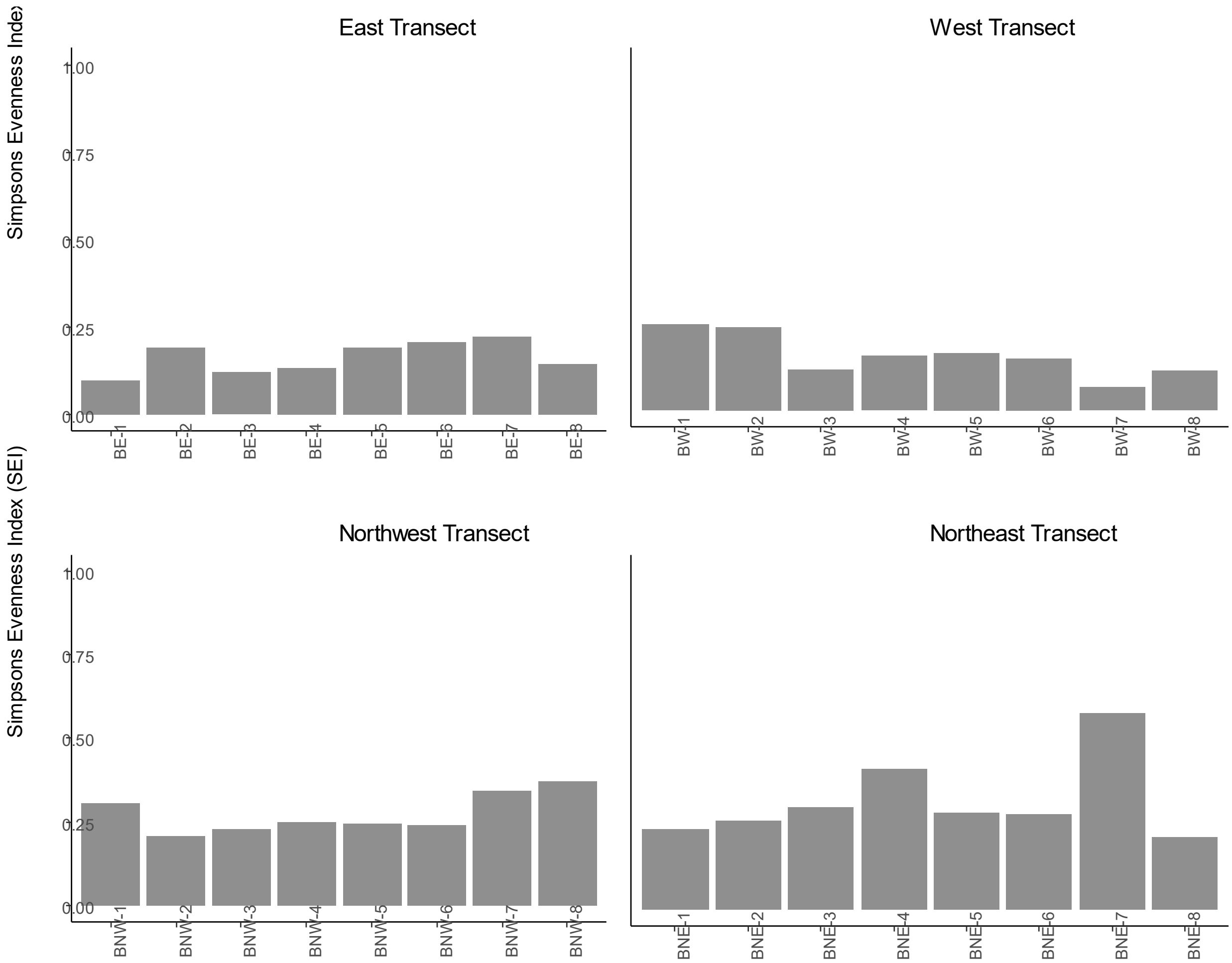


Figure 4-17: Evenness of Benthic Infaunal Communities from Sampling Stations along Coastal and Northern Transects Extending from the Ore Dock, Milne Port, 2019.

Relative Densities of Benthic Invertebrate Taxa

Benthic communities sampled at stations along the four transects were dominated by four major taxonomic groups in descending order: Polychaeta, Malacostraca, Bivalvia, and Ostracoda (Figure 4-18). Similar to 2018, benthic communities identified in 2019 were dominated by polychaetes, with percent relative abundance values ranging between 17% and 88%. The polychaete genus *Pholoe* spp., accounted for 26.7% of total density across the transects. Other dominant taxa included malacostracans (1%–58%), bivalves (1%–23%), and ostracods (0%–21%).

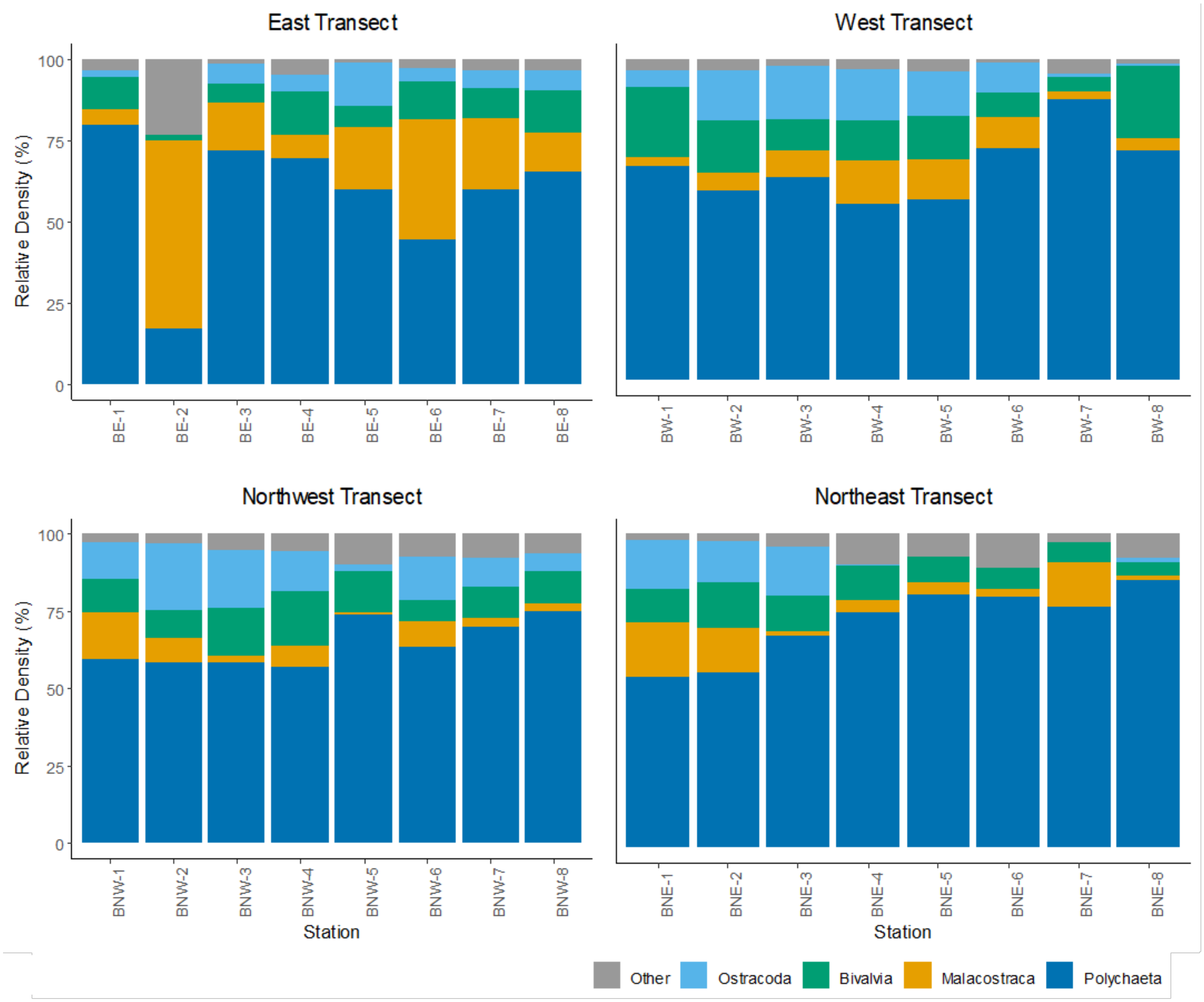


Figure 4-18: Relative Density of Major Benthic Infaunal Taxa from Sampling Stations Extending from the Ore Dock, Milne Port, 2019

Total Density

2019: Spatial Comparison

The total density of benthic infauna was analyzed using a linear regression model, with main effects of distance from transect origin, transect, and the interaction between the two variables. Additionally, a main effect of percent fines was also used to account for the ecological relationship between these two variables. Total density and percent fines were natural-log transformed to meet data assumptions and make the relationship linear. The model explained 75% of the data variability. Distance and transect, but not their interaction, were statistically significant (P=0.006 and P <0.001, respectively), indicating a significant effect of distance and transect, but no differences in the relationship between total density and distance among transects (Table 4-11). Log-transformed percent fines was also a statistically significant explanatory variable of benthic infauna total density (P=0.029).

Table 4-11: ANOVA Summary of Benthic Infauna Total Density by Transect (2019)

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.753	Distance from transect origin	1	9.57	**0.006**
	Transect	3	23.96	**<0.001**
	Distance x Transect	3	1.64	0.211
	Fines	1	5.54	**0.029**

Notes: Adj. R_2= Adjusted R squared value; Df= degrees of freedom. Total density and percent fines were natural-log transformed prior to analysis.

Along the East and West coastal transects, benthic invertebrates were present in higher densities compared to the Northeast and Northwest Transects (Figure 4-19). Although the coastal transects had no significant relationship between total density and distance from transect origin (Figure 4-19), both the Northwest and Northeast Transects had slopes that significantly decreased with increasing distance along each transect (P=0.025 and P=0.006, respectively). Along the Northeast Transect, the estimated decrease in density was 0.134 organisms/m² for every 100 m increment in distance from the Ore Dock. Along the Northwest transect, the estimated decrease was 0.098 organisms/m² for every 100 m increment in distance from the Ore Dock.

Of the four transects, only the East Transect had a positive slope, indicating that total density increased with distance from transect origin, although this trend was not statistically significant and the magnitude of the increase was low (i.e., an increase of 0.01 organisms/m² for every 100 m increment from transect origin; Table 4-12; Figure 4-19).

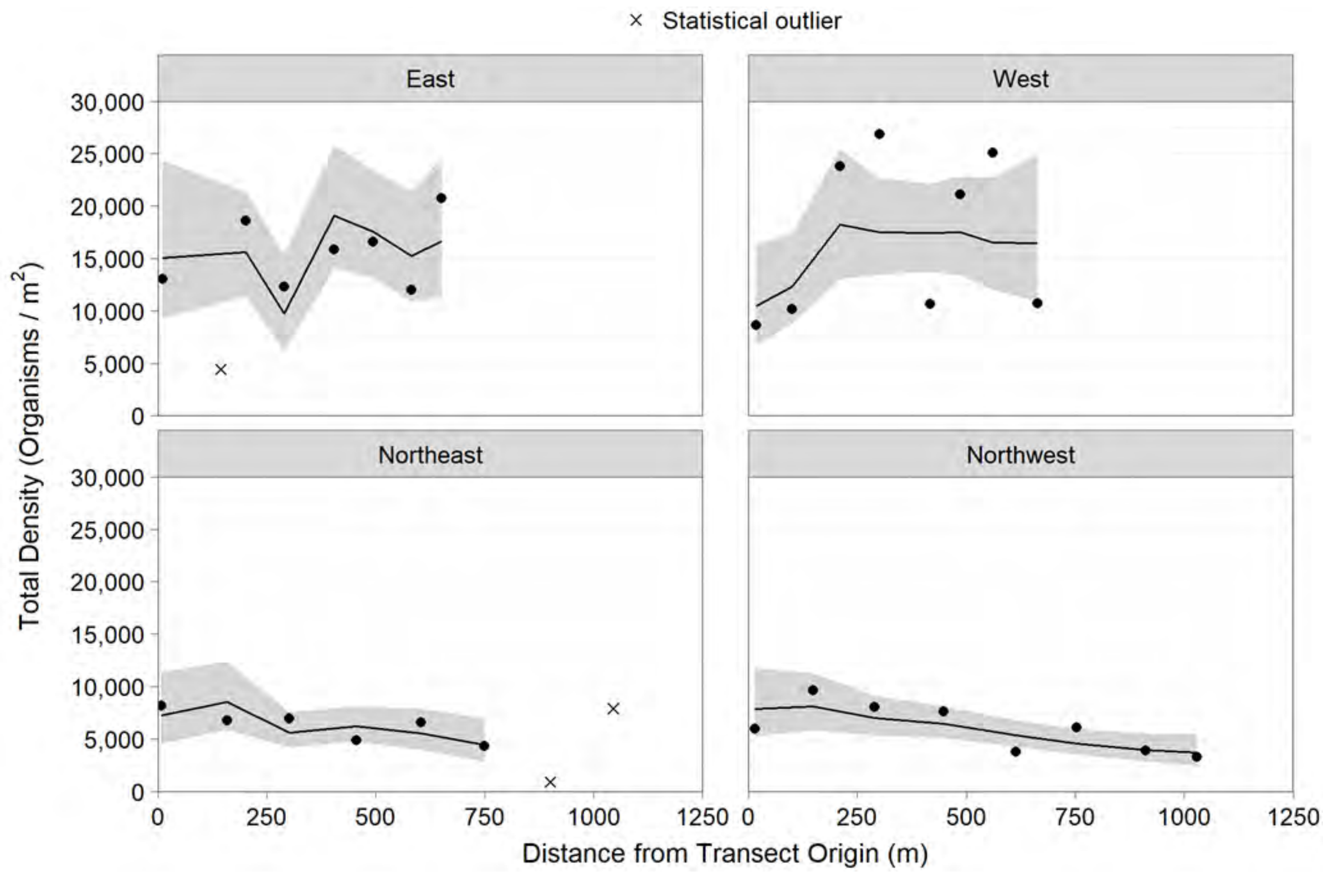


Figure 4-19: Observed (Points) and Estimated (Lines) Benthic Infauna Total Density Relative to Sampling Distance along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-12: Significance of Slopes of Effect of Distance on Benthic Infauna Total Density along each Transect in 2019

Transect	Estimate (on Natural Log Scale)	SE	*P*-Value
East	0.0001	0.0005	0.842
West	0.0001	0.0005	0.842
Northeast	-0.0013	0.0006	**0.025**
Northwest	-0.0010	0.0003	**0.006**

Notes: Significant *P*-values are indicated in bold

2018–2019: Temporal Comparison

The total density of benthic infauna was analyzed using a general linear model, with main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions between the three variables. Additionally, a main effect of percent fines was included to account for the ecological relationship between these two variables. Total density and percent fines were natural-log transformed to make the relationship linear and meet the assumptions of residual normality and homoscedasticity. The model explained 75% of the data variability, and the three-way interaction was statistically significant, indicating differences in the relationship between total density and distance along different transects between years (*P*=0.045; Table 4-13). Log-transformed percent fines was a statistically significant explanatory variable of benthic infauna total density (*P*=0.005).

Table 4-13: ANOVA Summary of Benthic Infauna Total Density by Year and Transect

Adj. R^2	Parameter	Df	*F* value	*P*-Value
0.753	Distance from transect origin	1	41.60	**<0.001**
	Year	1	2.44	0.124
	Transect	2	72.67	**<0.001**
	Distance x Year	1	0.00	0.996
	Distance x Transect	2	11.92	**<0.001**
	Year x Transect	2	0.73	0.485
	Distance x Year x Transect	2	3.28	**0.045**
	Fines	1	8.62	**0.005**

Notes: Adj. R_2= Adjusted *R* squared value; Df= degrees of freedom. Total density and fines were natural-log transformed prior to analysis.

Significant interannual differences in benthic infauna total density were not observed between 2018 and 2019 (when adjusted to mean percent fines) along any of the four transects (Figure 4-20; Table 4-14). Samples were not collected beyond 800 m along the East or West Transect, or beyond 1,000 m along the North Transect in 2019 and, therefore, evaluation of annual differences beyond these distances were not possible.

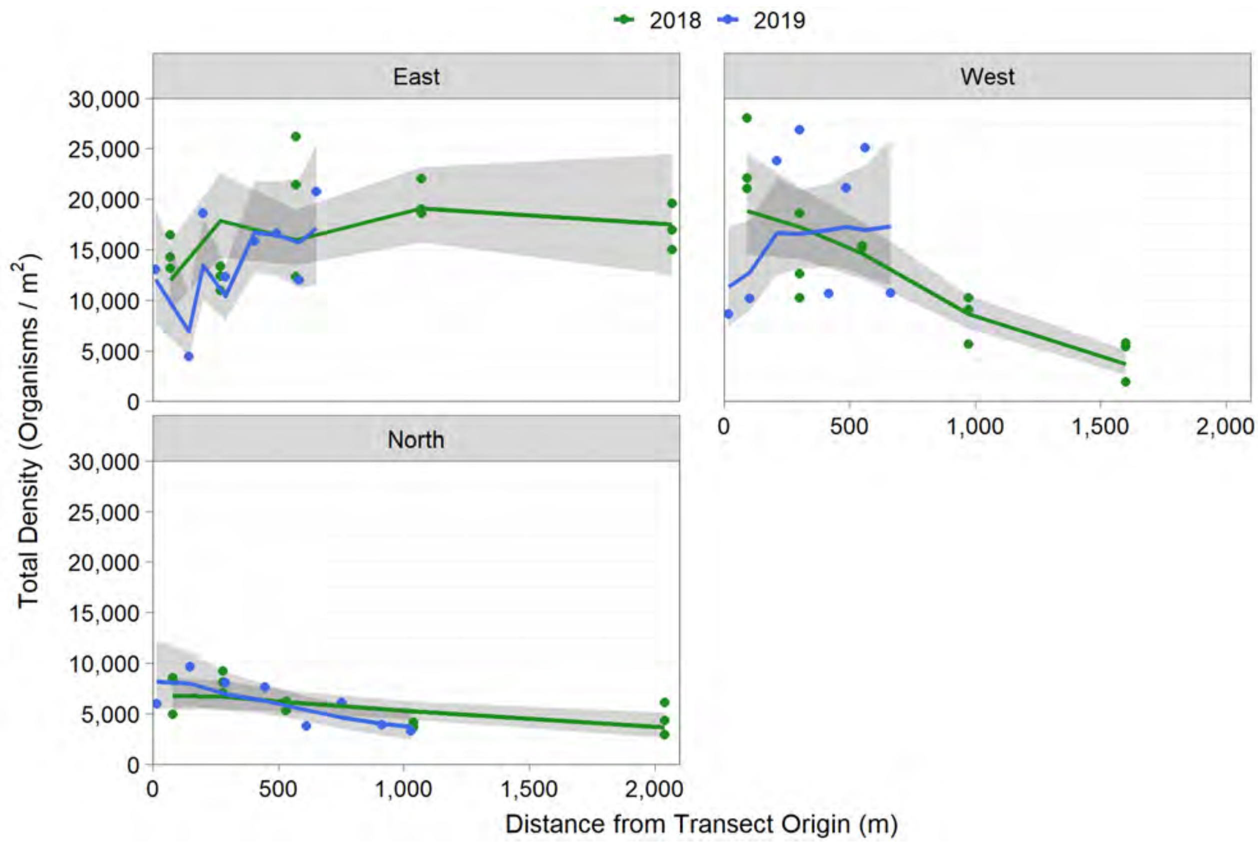


Figure 4-20: Observed (Points) and Estimated (Lines) Benthic Infauna Total Density Relative to Sampling Distance along Transects in 2018 and 2019.

Table 4-14: Comparison of Benthic Infauna Total Density between Years at Distances along each Transect in 2018 and 2019.

Transect and Distance from Origin (m)	Sampling Year	
	2018	2019
East Transect		
50	a	a
300	a	a
500	a	a
800	a	a
West Transect		
50	a	a
300	a	a
500	a	a
800	a	a
North Transect		
50	a	a
300	a	a
500	a	a
1,000	a	a

Notes: Years that do not share letters (within every distance in each transect) are significantly different from each other. Increasing letters represent an increase in values: "a" is the lowest estimated total density value, "b" representing is the second lowest, and so on.

Species Richness

2019: Spatial Comparison

The richness of benthic infauna was analyzed using a linear regression model, with main effects of distance from transect origin, transect, and the interaction between the two variables. Additionally, a main effect of percent fines was included to account for the ecological relationship between these two variables. Percent fines was natural-log transformed to make the relationships linear, and the effect of distance was modeled as a second-degree polynomial to account for the non-linearity remaining in the relationship between richness and distance. The model explained 71% of the data variability, and the two-way interaction was statistically significant (*P*=0.001), indicating differences in the relationship between richness and distance between transects (Table 4-15). Log-transformed percent fines was not a statistically significant explanatory variable of benthic infauna richness (*P*=0.971).

Table 4-15: ANOVA Summary of Benthic Infauna Richness by Transect

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.708	Distance from transect origin	2	2.89	0.083
	Transect	3	4.98	**0.012**
	Distance × Transect	6	7.12	**0.001**
	Fines	1	0.001	0.971

Notes: Adj. R_2= Adjusted *R* squared value; Df= degrees of freedom. Fines were natural-log transformed and distance was modeled as a second-degree orthogonal polynomial prior to analysis.

Along the East Transect, richness increased slightly with greater distance from the Ore Dock (Figure 4-21), but a significant difference between consecutive distances was only estimated for the comparison between 200 m and 300 m from the Ore Dock (Table 4-16). Along the Northeast Transect, richness was comparable across sampling stations, except for a low value recorded 900 m from the Existing Ore Dock, which was identified as an outlier. As a result, richness did not change significantly between consecutive distances along the Northeast Transect (Figure 4-21,Table 4-16). Along the coastal West Transect, observed richness increased slightly, but not significantly, between 0 m and 300 m (Figure 4-21), before decreasing significantly between 300 m and 500 m, 500 m and 600 m, and between 600 m and 700 m from the Ore Dock (Table 4-16). On the Northwest Transect, richness showed a slight decreasing trend with distance from the Ore Dock (Figure 4-21), but there were no significant changes between consecutive distances extending from the Existing Ore Dock (Table 4-16). Overall, benthic infauna richness was similar between distances, and only decreased significantly with greater distance from the Ore Dock along the West Transect.

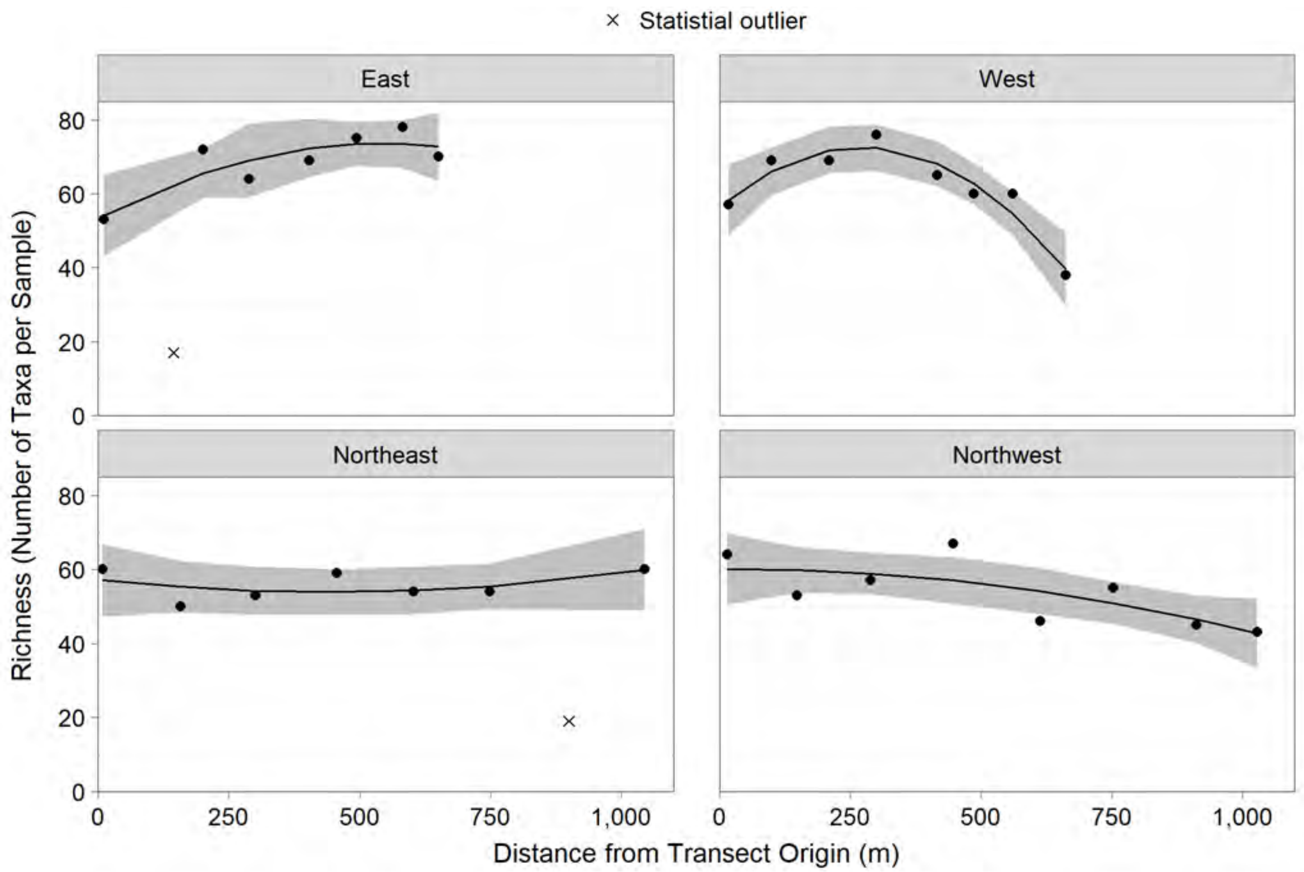


Figure 4-21: Observed (Points) and Estimated (Lines) Benthic Infauna Richness Relative to Sampling Distance along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-16: Comparison of Benthic Infauna Richness between Consecutive Distances along each transect in 2019

Distance from Origin (m)	Transect			
	East	West	Northeast	Northwest
220–0	0.154	0.200	0.982	1.000
300–200	**0.038**	0.992	0.994	0.980
500–300	0.485	**0.002**	1.000	0.457
600–500	1.000	**<0.001**	0.996	**0.034**
700–600	0.996	**0.001**	0.946	0.058

Notes: Significant *P*-values are indicated in bold.

2018–2019: Temporal Comparison

The richness of benthic infauna was analyzed using a linear regression model, with main effects of distance from transect origin, year (as a categorical variable), transect, and all possible interactions between the three variables. Additionally, a main effect of percent fines was used to account for the ecological relationship between these two variables. Percent fines was natural-log transformed to make the relationship linear. The model explained 51% of the data variability, and the three-way interaction was statistically significant, indicating interannual differences in the relationship between richness and distance along different transects (*P*=0.011; Table 4-17). Log-transformed percent fines was a statistically significant explanatory variable of benthic infauna richness (*P*=0.014).

Table 4-17: ANOVA Summary of Benthic Infauna Richness by Year and Transect

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.512	Distance from transect origin	1	14.04	**<0.001**
	Year	1	8.33	**0.006**
	Transect	2	10.65	**<0.001**
	Distance × Year	1	1.56	0.218
	Distance × Transect	2	5.24	**0.008**
	Year × Transect	2	0.93	0.399
	Distance × Year × Transect	2	4.90	**0.011**
	Fines	1	6.46	**0.014**

Notes: Adj. R_2= Adjusted *R* squared value; Df= degrees of freedom. Fines was natural log-transformed prior to analysis.

Along the East Transect, significant differences were observed between 2018 and 2019, with significant increases in observed richness (at observed fines content values) at 500 m and 800 m from the dock (Figure 4-22, Table 4-18). Stations were not sampled for benthic invertebrates beyond 800 m from the dock in 2019, and thus, multiple comparisons could not be calculated at a farther distance. Along the West Transect, changes in species richness were observed between 2018 and 2019, with significant increases in observed richness (adjusted to mean percent fines fines) at 50 m and 300 m from the Ore Dock (Figure 4-22, Table 4-18). Stations were not sampled for benthic invertebrates beyond 800 m from the Ore Dock in 2019, and thus, multiple comparisons could not be calculated at a farther distance. Along the Northwest Transect, significant interannual changes in richness (adjusted to mean percent fines) were not identified at any of the four tested distances between 2018 and 2019 (Figure 4-22, Table 4-18). Overall, these results indicate that interannual increases in benthic infauna richness were observed on the East Transect at 500 m and 800 m, and on the West Transect at 50 m and 300 m, between 2018 and 2019, but there were no observed changes in benthic fauna richness along the Northwest Transect during this time period.

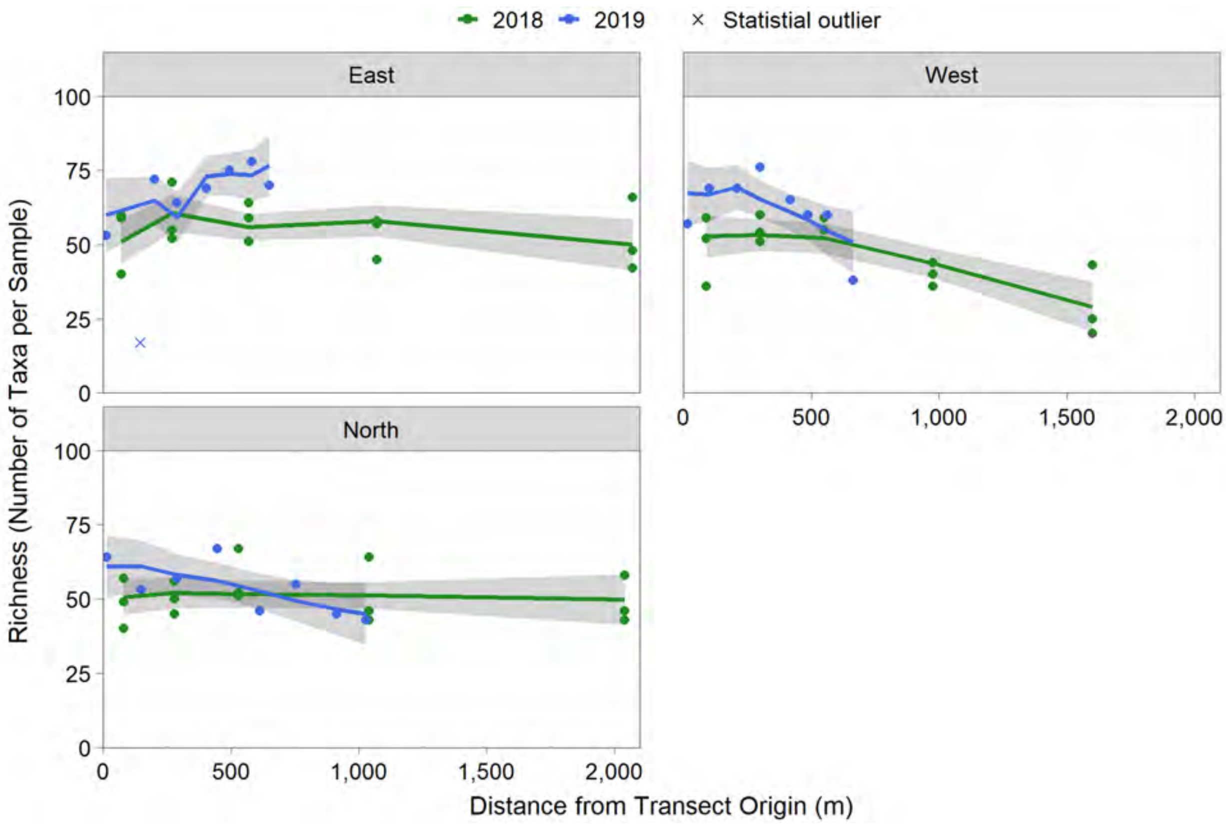


Figure 4-22: Observed (Points) and Estimated (Lines) Benthic Infauna Richness Relative to Sampling Distances along transects in 2018 and 2019.

Table 4-18: Comparison of Benthic Infauna Richness between Years and Distances along each Transect in 2018 and 2019.

Transect and Distance from Origin (m)	Sampling Year	
	2018	2019
East Transect		
50	a	a
300	a	a
500	**a**	**b**
800	**a**	**b**
West Transect		
50	**a**	**b**
300	**a**	**b**
500	a	a
800	a	a
North Transect		
50	a	a
300	a	a
500	a	a
1,000	a	a

Notes: Years that do not share letters (within every distance in each transect) are significantly different from each other. Increasing letters represent an increase in values: “a” is the lowest estimated richness value, “b” representing is the second lowest, and so on. Bold depicts significantly higher levels of benthic infauna richness at a specific distance, among transects.

Simpson's Diversity Index

2019: Spatial Comparison

The 2019 benthic infauna Simpson's Diversity Index (SDI) was analyzed using a general linear model, with main effects of distance from transect origin, transect, and the interaction between the two variables. Additionally, a main effect of percent fines was used to account for the ecological relationship between these two variables. Percent fines were natural-log transformed to make the relationships linear. The model explained 56% of the data variability, and the interaction between distance and transect was statistically significant (P=0.001; Table 4-19). That is, the model found a significant difference in the relationships between SDI and distance among transects. The effect of log-transformed percent fines was not significant (P=0.5).

Table 4-19: ANOVA Summary of Benthic Infauna Simpson's Diversity Index by Transect in 2019

Adj. R^2	Parameter	Df	*F* value	*P*-value
0.562	Distance from transect origin	1	0.22	0.642
	Transect	3	6.85	**0.002**
	Distance × Transect	3	8.61	**0.001**
	Fines	1	0.38	0.545

Notes: Adj. R_2= Adjusted R squared value; Df= degrees of freedom. Distance and percent fines were natural-log transformed prior to analysis.

Variability in SDI values were relatively low along the northern transects, with SDI values ranging between 0.91 and 0.96 along the Northeast Transect, and between 0.92 and 0.95 along the Northwest Transect (Figure 4-23). Along the West Transect, SDI decreased slightly with distance from the Ore Dock, while at the East Transect, SDI increased with distance from the Ore Dock (Figure 4-23, Table 4-19). Although the Northeast and Northwest transects did not have significant relationship between total densities and distance from transect origin (Table 4-20; Figure 4-23), both the East and West Transects exhibited significant slopes. These included an increasing slope along the East Transect (P=0.009, an increase of 0.015 in SDI value per each 100 m increment in distance) and a decreasing slope along the West Transect (P=0.001, a decrease of 0.025 in SDI value per each 100 m increment in distance).

Overall, benthic infauna SDI was generally similar between the Northwest and Northeast transects, where distance from the Ore Dock did not affect SDI values. The East and West transects had opposite trends with distance – an increase of SDI with distance along the East Transect and a decrease of SDI along the West transect.

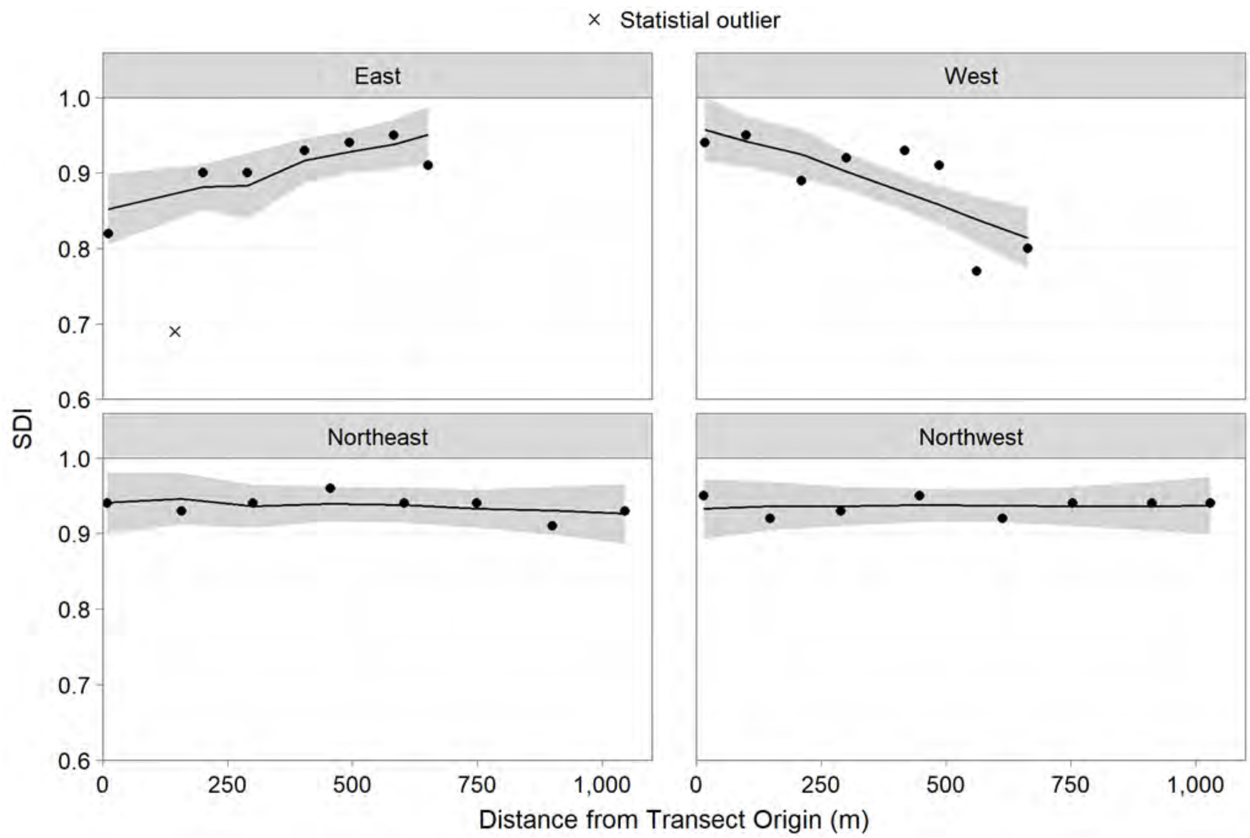


Figure 4-23: Observed (Points) and Estimated (Lines) Benthic Infauna Simpson's Diversity Index Relative to Sampling Distance along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-20: Significance of Slopes of Effect of Distance on Benthic Infauna SDI along each Transect in 2019

Transect	Estimate	SE	*P*-Value
East	1.528×10^{-4}	5.323×10^{-5}	**0.009**
West	-2.517×10^{-4}	6.466×10^{-5}	**0.001**
Northeast	-2.758×10^{-5}	3.633×10^{-5}	0.456
Northwest	-1.326×10^{-6}	3.084×10^{-5}	0.966

Notes: Significant *P*-values are indicated in bold

Simpson's Evenness Index

2019: Spatial Comparison

The 2019 benthic infauna SEI was analyzed using a general linear model, with main effects of distance from transect origin, transect, and the interaction between the two variables. Additionally, a main effect of percent fines was used to account for the ecological relationship between these two variables. Percent fines were natural-log transformed to make the relationships linear. The model explained 86% of the data variability, and the two-way interaction was statistically significant (P=0.002), indicating differences in the relationship between SEI and distance between transect (Table 4-21). Log-transformed percent fines was not a statistically significant explanatory variable of benthic infauna richness (P=0.257).

Table 4-21: ANOVA Summary of Benthic Infauna Shannon Evenness Index by Transect in 2019

Adj. R^2	Parameter	Df	*F* value	*P*-Value
0.858	Distance from transect origin	2	1.48	0.253
	Transect	3	18.79	**<0.001**
	Distance × Transect	6	5.41	**0.002**
	Fines	1	0.37	0.257

Notes: Adj. R_2= Adjusted *R* squared value; Df= degrees of freedom. Fines were natural-log transformed and distance was modeled as a second-degree orthogonal polynomial.

Along the East Transect, SEI values increased slightly with distance from the Ore Dock between 0 m and 100 m, then remained stable for the remaining distances assessed. Significant differences among consecutive distances were not identified for this transect (Figure 4-24; Table 4-22). Along the Northeast Transect, SEI increased slightly to a distance of ~500 m from the Ore Dock, then decreased slightly to a value similar to the that observed closer to the Ore Dock. Along the Northwest Transect, SEI remained stable up to approximately 500 m from the Port, then increased significantly (Table 4-22). Along the West Transect, SEI decreased with distance from the Ore Dock (Figure 4-24). Overall, benthic infauna SEI along the four transects followed varying spatial patterns—increasing with distance (East Transect), parabolic (Northeast and Northwest Transects), and decreasing with distance (West Transect). Differences in evenness between distance increments were not significantly different from each other along the four transects, with the exception of the station located furthest from the Existing Ore Dock along the Northwest Transect (Table 4-22). These results do not suggest that benthic infaunal evenness was impacted by Port operations.

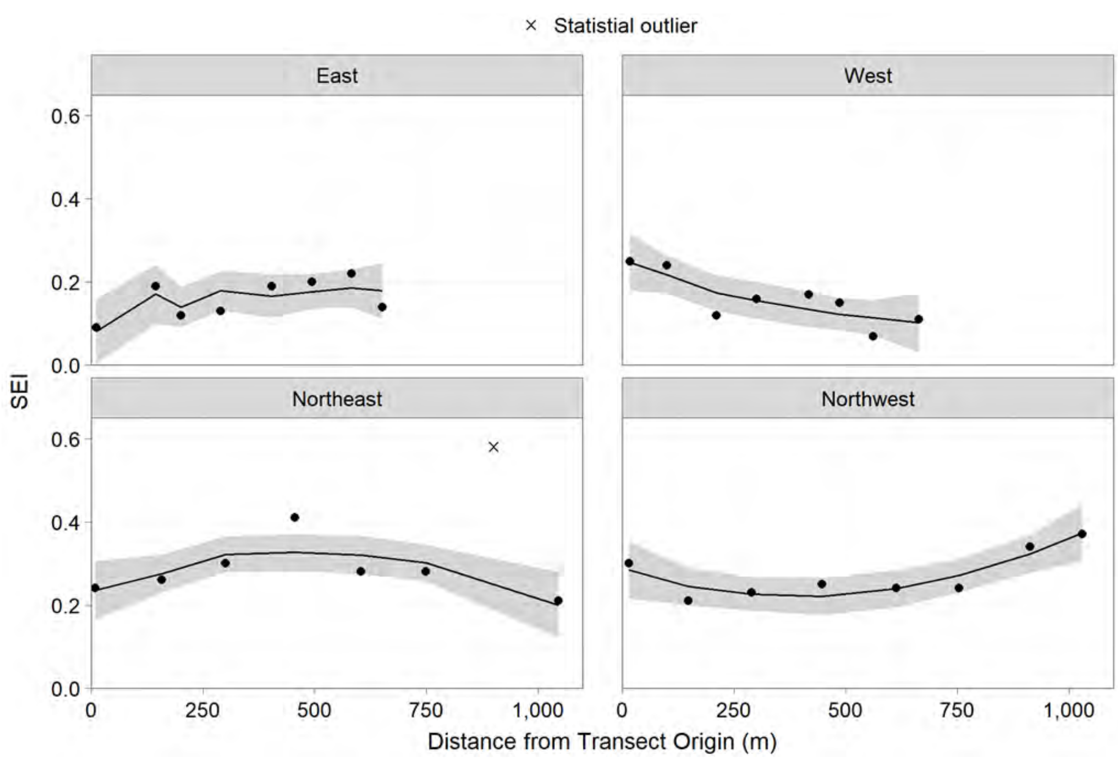


Figure 4-24: Observed (Points) and Estimated (Lines) Benthic Infauna Shannon Evenness Index Relative to Sampling Distances along Transects in 2019. Grey Ribbons are 95% Confidence Intervals.

Table 4-22: Comparison of Benthic Infauna SEI Values between Consecutive Distances along each transect in 2019

Distance from Origin (m)	Transect			
	East	West	Northeast	Northwest
200 – 0	0.465	0.799	0.060	0.435
300 – 200	0.194	0.385	0.107	0.761
500 – 300	0.734	0.348	0.461	1.000
600 – 500	1.000	0.968	0.981	0.052
700 - 600	1.000	0.998	0.276	**0.011**

Notes: Significant *P*-values are indicated in bold.

4.1.6 Substrate, Macroflora, and Benthic Epifauna

Detailed information on video observation of each belt is presented in Appendix D and summarized below. Ice movement in 2019 following spring breakout in Milne Port was notably greater compared to previous years. Icebergs and large pieces of ice were present throughout the summer, the ice frequently grounding with the tides in the area of the belt transects. Five of the belt transects, TP01, TP02, TP03, and TP06, were either not fully spread, moved or obscured by the substrate, likely due to ice scour, which substantially altered their perceivable area; these belts were included in the analysis, but only presence data, rather than enumeration, were collected for benthic epifauna. Belt transects TP09 and TP10, although moved, retained enough shape to extrapolate reasonable benthic epifauna counts.

Observed substrate in the belt transects consisted of predominantly fines and covered from 65% (TP09) to 100% (TP02, TP06) of the total transect area. The other observed substrate types were shell debris (from 1% to 6%), mixed cobbles and boulders (1% to 33%).

Taxonomic resolution of macroflora and benthic epifauna was relatively coarse for stations in Milne Port area in 2019 as a result of poor visibility due to suspended particles in the water column. Despite this, taxonomic identification was improved compared to previous years through the addition of HD ROV videos in tandem with the standard definition versions. Relative abundance of macroflora was largely dominated by unidentified algae (Figure 4-25) and taxonomic resolution of identifiable taxa was limited to Phylum, except for brown bladed kelp (*Laminaria* sp.) and encrusting coralline algae (Family Corallinophycidae). Due to poor visibility, algae in TP06 were exclusively classified as unidentifiable algae. TP02 was dominated by brown algae (Phaeophyceae) and green algae (Chlorophyceae). *Laminaria* sp. was only observed at TP07 and TP10 in small quantities while encrusting coralline algae was present TP03, TP07, and TP09. Brown algae (Phaeophyceae), green algae (Chlorophyceae), and red algae (Rhodophyceae) were present in most belt transects, with the most dominant brown algae found at TP02 and TP03 and the most dominant green algae found at TP01 and TP02.

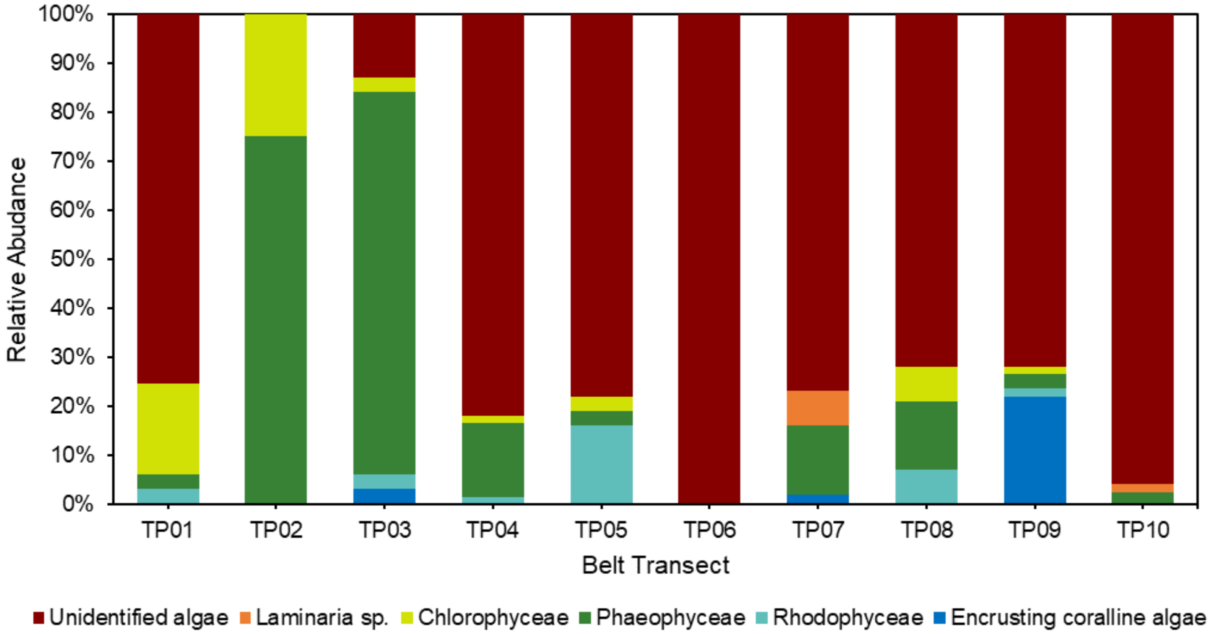


Figure 4-25: Relative abundance (%) of Macroflora observed in belt transects, 2019

Total abundance (taxonomic groups/station) of epifauna are presented in Figure 4-26 (top). TP02, TP03, and TP09 had the highest abundance of taxonomic groups (8), followed by TP01 and TP07 (7), then TP04, TP08, and TP10 (6). The lowest abundance was found at TP06 (2 taxonomic groups).

Clams were the dominant taxonomic group among all stations analyzed for relative abundance (Figure 4-26 (bottom)). Brittle stars (Ophiuridae) and unclassified bivalves (Bivalvia indet.) were present at every station (Appendix J). Sea urchins were most prevalent at TP04 and TP05 but absent from TP10. Organisms only present at one station in the relative abundance analysis included cone worms and a shrimp (TP10), a sea spider (TP04), and a sculpin (TP08).

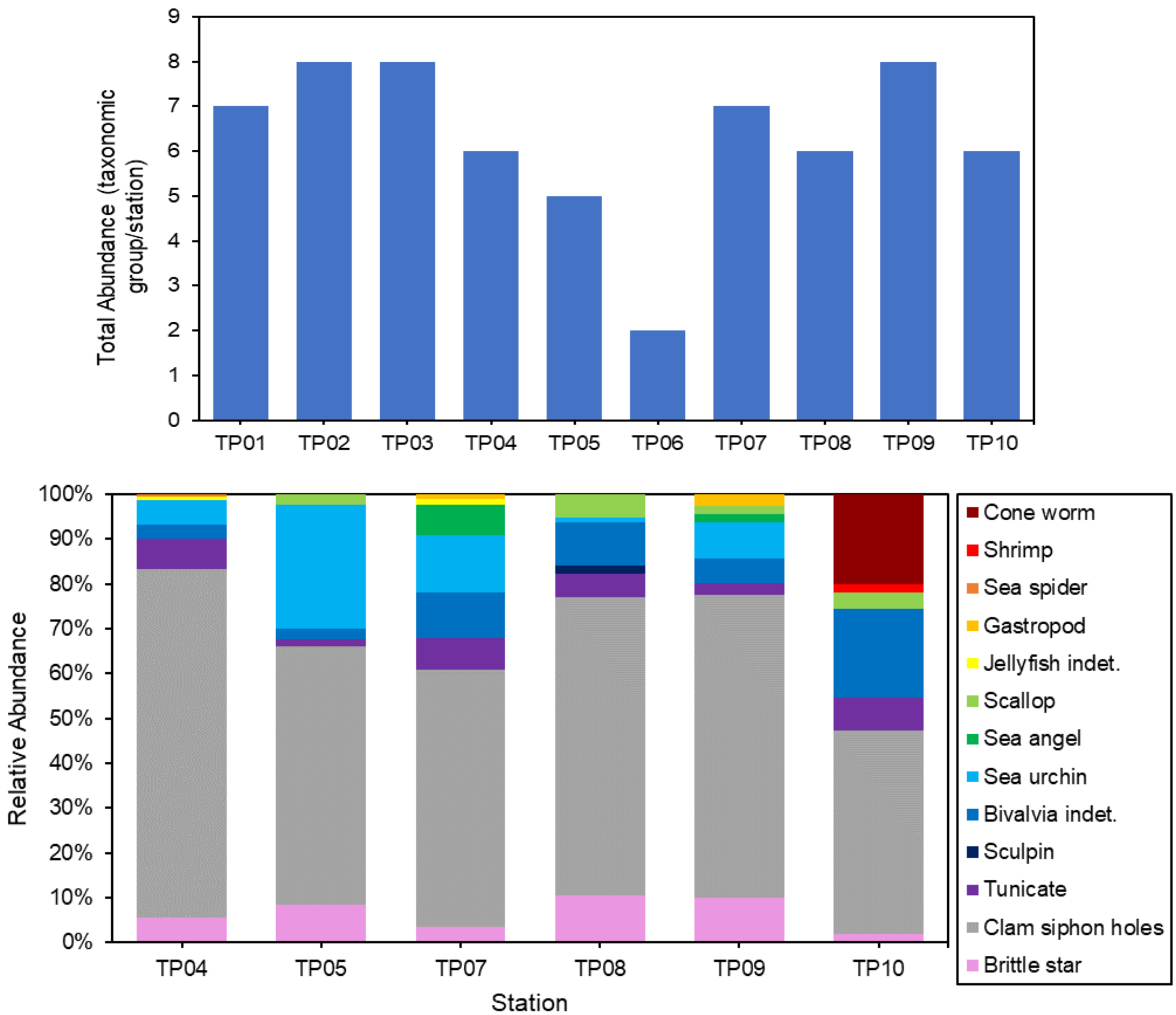


Figure 4-26: Total abundance (taxonomic groups/station) of epifauna (top) and relative abundance (%) of taxonomic groups (bottom) at each belt transect, 2019.

4.1.7 Fish Surveys

4.1.7.1 Catch Data

A total of 279 fish belonging to five Arctic species groups were captured during active fish sampling undertaken in 2019. Fish species captured in the Milne Port area for all fishing methods are shown in Figure 4-27. As in previous survey years (SEM 2016a; SEM 2017a; Golder 2018), Arctic char (*Salvelinus alpinus,* 37.6%), fourhorn sculpin (*Myoxocephalus quadricornis,* 38.0%) and shorthorn sculpin (*M. Scorpius,* 23.7%) were among the most abundant fish species caught, comprising 99.3% of the total catch in 2019. A single northern sandlance (*Ammodytes dubius*) and a single ninespine stickleback (*Pungitius pungitius*) made up the remainder of identified species with each with a relative abundance of 0.36% each (Appendix A, Photos 23-28).

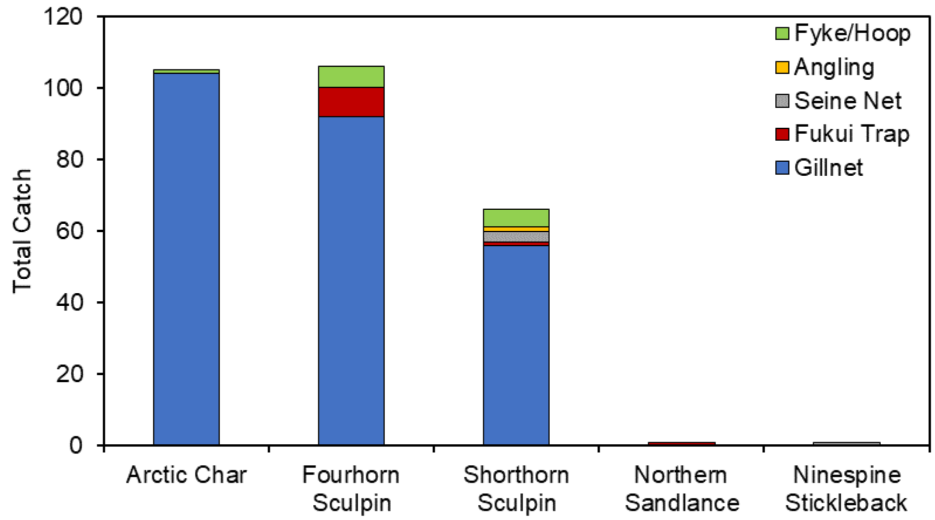


Figure 4-27: Fish Species Captured by Method in Milne Port Area During 2019 Fish Surveys

Species captured in previous sampling years, for all sampling methods combined, is presented in Table 4-23. The most commonly captured species in 2019 is comparable to previous sampling and baseline years.

Table 4-23: Total Fish Catch Data by Species for all Sampling Methods Combined in Milne Inlet. 2010 – 2019

Common Name	Taxonomic ID	2010	2013	2014	2015	2016	2017	2018	2019
Arctic Char	*Salvelinus alpinus*	11	6	3	67	157	23	169	105
Arctic Sculpin	*Myoxocephalus scorpioides*	0	0	4	1	0	9	3	0
Shorthorn Sculpin	*Myoxocephalus scorpius*	50	4	9	8	18	45	78	66
Fourhorn Sculpin	*Myoxocephalus quadricornis*	7	3	39	13	18	40	147	106
Arctic Staghorn Sculpin	*Gymnocanthus tricuspis*	3	0	0	2	0	0	0	0
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	0	2	4	2	2	0	0	0
Arctic Hookear Sculpin	*Artediellus atlanticus*	0	0	5	1	0	0	0	0
Unidentified Sculpin	Cottidae	0	0	0	12	0	0	3	0
Greenland Cod	*Gadus macrocephalus*	4	0	1	0	0	0	0	0
Common Lumpfish	*Cyclopterus lumpus*	0	0	1	0	0	0	0	0
Fishdoctor	*Gymnelis viridis*	0	1	0	3	0	0	0	0
Fourline Snakeblenny	*Eumesogrammus parecisus*	0	0	1	2	2	0	0	0
Sandlance	*Ammodytes spp.*	0	0	0	0	0	1	1	1
Artic Cod	*Arctogadus glacialis*	0	0	0	0	0	0	1	0
Ninespine Stickleback	*Pungitius pungitius*	0	0	0	0	0	0	0	1
Unidentified Species	-	0	0	0	0	0	0	1	0
Total species caught		**5**	**5**	**9**	**10**	**5**	**5**	**8**	**5**
Total fish captures		**75**	**16**	**67**	**111**	**197**	**118**	**403**	**279**

Table 4-24 presents Catch Per Unit Effort (CPUE) for all species of fish captured and all methods used in 2019. Beach seine sampling obtained the highest CPUE (15.86 ± SD 7.75 fish/h) and Fukui traps had the lowest (0.0074 ± SD 0.0147 fish/h). Gill nets were the most successful sampling method in 2019 (N = 252) which was also found in 2018 (N = 376). Gill nets, Fukui traps, and fyke nets sampled the highest number of fish species (N = 3) in 2019. A single ninespine stickleback was captured during beach seine sampling, which had not been observed in past sampling years, although the species is known to occur in brackish Arctic environments.

Table 4-24: Total Fish Catch Records and Catch per Unit Effort (CPUE) Presented by Sampling Method in 2019

Species	N (Fish Counts)			CPUE	
	Range	Mean ± SD	Total	Range (fish/h)	Mean ± SD (fish/h)
Angling					
Shorthorn sculpin/ All species	0 - 1	0.14 ± 0.38	1	0 - 6.00	0.86 ± 2.27
Gill net[1]					
Arctic char	0 - 44	5.20 ± 10.37	104	0 - 2.08	0.48 ± 0.62
Fourhorn sculpin	0 - 31	4.60 ± 7.97	92	0 - 3.67	0.57 ± 0.85
Shorthorn sculpin	0 - 13	2.80 ± 3.96	56	0 - 2.17	0.42 ± 0.66
All species	0 - 77	12.60 ± 18.27	252	0 - 6.33	1.47 ± 1.58
Beach Seine					
Shorthorn sculpin	0 - 2	1.00 ± 1.00	3	0 - 24.00	10.86 ± 12.16
Ninespine stickleback	0 - 1	0.33 ± 0.58	1	0 - 15.00	5.00 ± 8.66
All species	1 - 2	1.33 ± 0.58	4	9.00 - 24.00	15.86 ± 7.75
Fukui traps					
Shorthorn sculpin	0 - 1	0.06 ± 0.24	1	0 - 0.006	0.0003 ± 0.0014
Fourhorn sculpin	0 - 4	0.44 ± 0.98	8	0 - 0.059	0.0067 ± 0.0149
Northern sandlance	0 - 1	0.06 ± 0.24	1	0 - 0.006	0.0003 ± 0.0014
All species	0 - 4	0.56 ± 0.98	10	0 - 0.059	0.0074 ± 0.0147
Fyke Nets					
Arctic char	0 - 1	0.5 ± 0.71	1	0 - 0.009	0.0043 ± 0.0061
Fourhorn sculpin	2 - 4	3.00 ± 1.41	6	0.017 - 0.034	0.0258 ± 0.0123
Shorthorn sculpin	2 - 3	2.50 ± 0.71	5	0.017 - 0.026	0.0215 ± 0.0062
All species	4 - 8	6.00 ± 2.83	12	0.034 - 0.069	0.0515 ± 0.0246

[1] Extended deployments occurred for two gill netting efforts.

4.1.7.1.1 Angling

A single shorthorn sculpin was the only fish collected during angling surveys in 2019 (Table 4-24). This species was the most abundant fish caught in angling surveys in 2017 and 2018 (Figure 4-28). The mean Catch Per Unit Effort (CPUE) for shorthorn sculpin in 2019 angling (0.86 fish/h ± 2.27 SD) was comparable to the CPUE for shorthorn sculpin in 2018 (0.69 fish/h ± 1.25 SD). Due to a single fish being caught across all angling efforts, overall mean CPUE for all species was lower in 2019 than in previous survey years. Effort in 2019 (3 h 42 min) was less than 2018 (9 h 47 min) where three species and 13 individuals were captured. In all years, the most abundant species captured by angling has consistently been shorthorn sculpin.

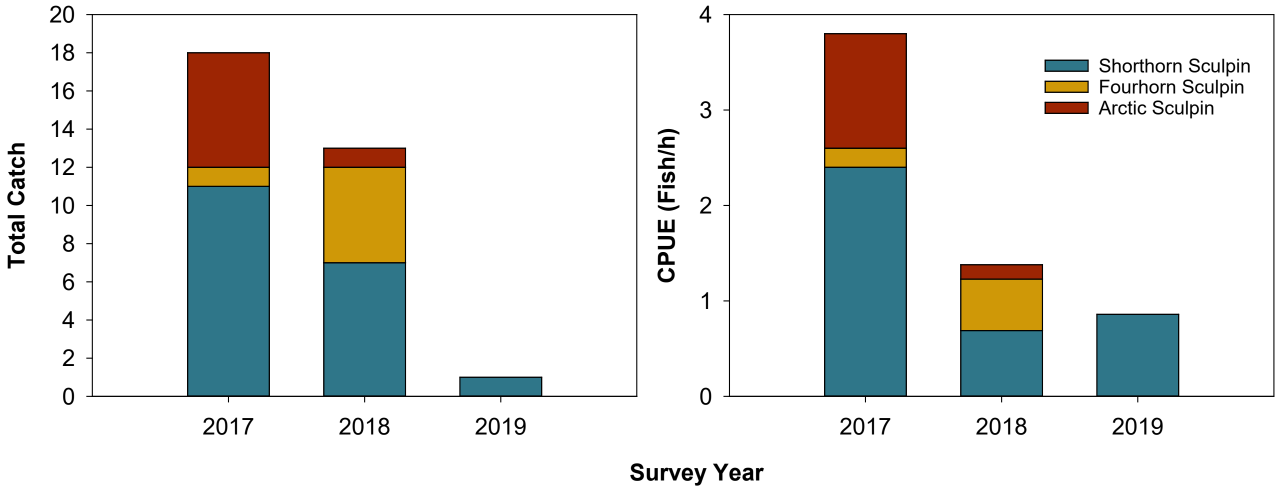


Figure 4-28: Total Catch and Catch Per Unit Effort (CPUE) for Angling in the Milne Port Area (2017 to 2019).

4.1.7.1.2 Gill Netting

As in previous years, gill nets proved to be the most effective method for fish collection and yielded the highest number of fish caught (N = 252), although CPUE remains variable between sample years (Table 4-24, Figure 4-29). Fish species caught using gill nets consisted primarily of Arctic char (n = 104), fourhorn sculpin and shorthorn sculpin, with Arctic char the most commonly captured species, similar to previous years (Figure 4-28). In all survey years prior to 2019, gill nets were the only sampling method capable of capturing Arctic char. Fourhorn sculpin were the second most captured species recorded in gillnet sampling (n = 92), followed by shorthorn sculpin (n = 56). No other species were recorded in gill net sampling in 2019. Mean CPUE in 2019 was greatest for fourhorn sculpin at (0.57 fish/h ± 0.85 SD), followed by Arctic char (0.48 fish/h ± 0.62 SD) and shorthorn sculpin at (0.42 fish/h ± 0.66 SD) (Table 4-24, Figure 4-29). Individuals captured in 2019 (N = 252) were the second highest amount after 2018 (N = 376).

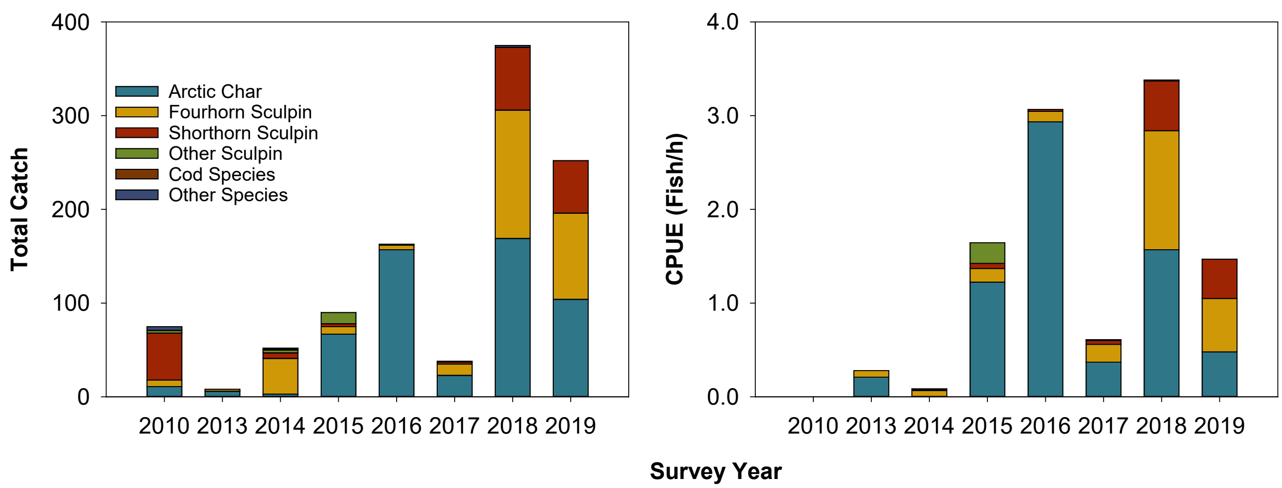


Figure 4-29: Total Catch and Catch Per Unit Effort (CPUE) for Gill Net Sampling in the Milne Port Area (2010[13] to 2019)

[13] CPUE for 2010 sampling not presented due to missing effort data.

4.1.7.1.3 Beach Seines

In terms of CPUE, beach seines were the most effective fish sampling method with a mean CPUE of 15.86 ± 7.75 fish/h. Despite the relatively high CPUE, beach seine netting is limited to sampling of nearshore subtidal habitats with small substrate (i.e. sand and gravel) and captured fish are generally small and occasionally not identifiable to species (Appendix G-2). In 2019, a total of four fish were captured during beach seine sampling, including three shorthorn sculpin and a single ninespine stickleback (Table 4-24). CPUE for beach seine sampling was 10.86 fish/h (± 12.16) for shorthorn sculpin and 5.00 fish/h (± 8.66) for ninespine stickleback (Figure 4-30).

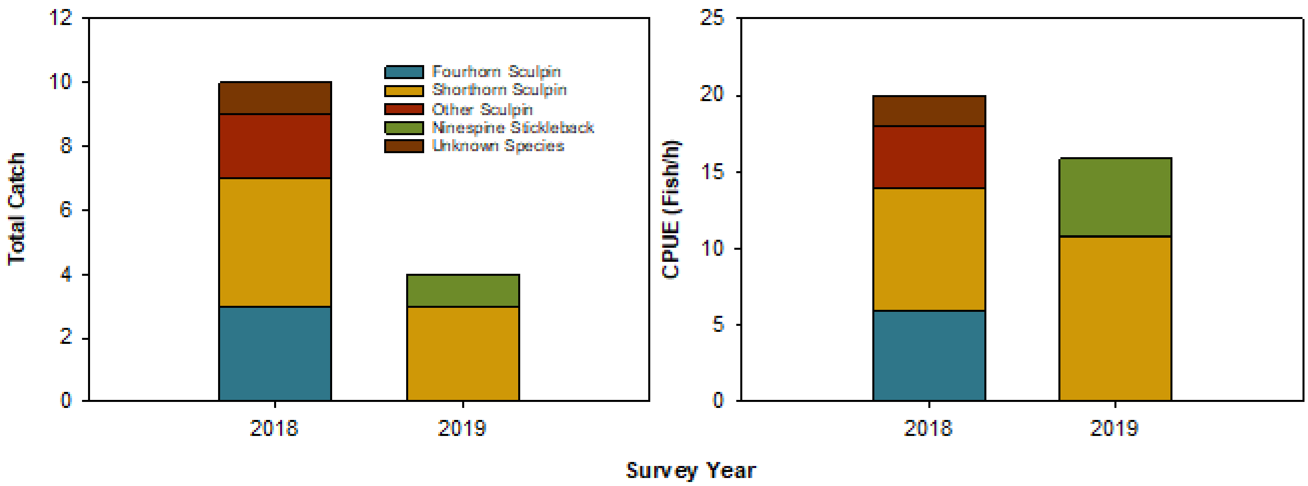


Figure 4-30: Total Catch and Catch Per Unit Effort (CPUE) for Beach Seine Sampling in the Milne Port Area (2018 to 2019)

4.1.7.1.4 Fukui Traps

Total catch and mean CPUE for Fukui trap sampling were low in 2019, although both were greater than that recorded in 2018 (Figure 4-31). A total of 10 fish representing three species were collected in the Fukui traps. Similar to 2017, this included shorthorn sculpin, fourhorn sculpin and sandlance. Given the increased sampling effort due to extended deployment times, relative abundance, indicated by mean CPUE, was low for all species (Table 4-24). The highest CPUE was for fourhorn sculpin (N = 8), with 0.0067 fish/h (± 0.0149 SD). CPUE for shorthorn sculpin (N = 1) and northern sandlance (N = 1) was 0.0003 fish/h (± 0.0014 SD). CPUE for Fukui trap sampling remained low compared to other survey methods in the Milne Port area with the greatest CPUE occurring in 2014 and 2015 (0.030 fish/h).

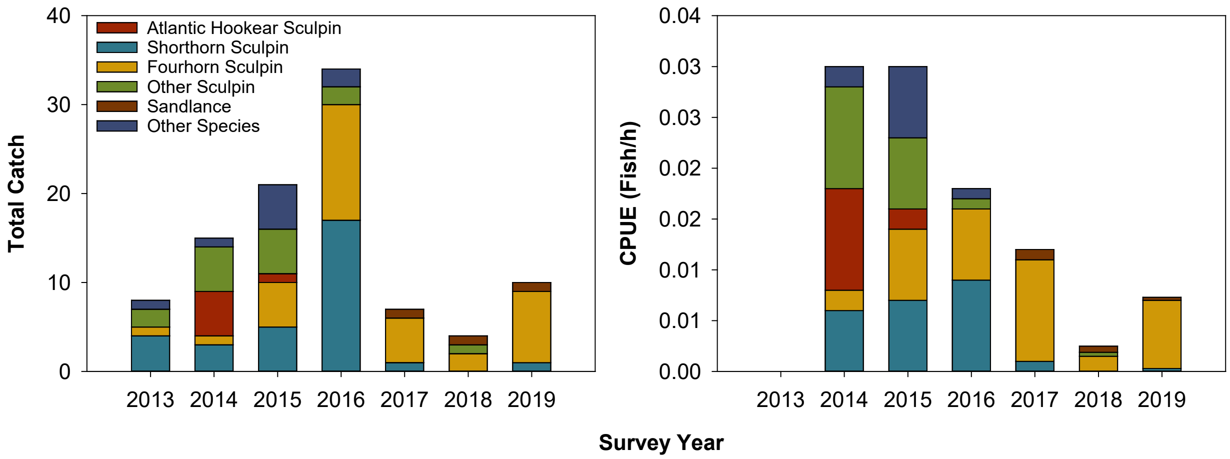


Figure 4-31: Total Catch and Catch Per Unit Effort (CPUE) for Fukui Trap Sampling in the Milne Port Area (2013[14] to 2019).

4.1.7.1.5 Fyke Nets

Fyke net surveys were introduced to the sampling program in 2019 to test as a possible replacement for Fukui trap surveys. Fyke nets were shown to be more effective than Fukui traps at capturing fish, with a mean CPUE of 0.051 ± 0.025 fish/h (Figure 4-32). A total of 12 fish from three species groups were captured during fyke net efforts, with fourhorn and shorthorn sculpin the most abundant species recorded (Table 4-24). A single juvenile Arctic char was also captured during fyke net sampling, the only instance where char were captured outside of gill net efforts.

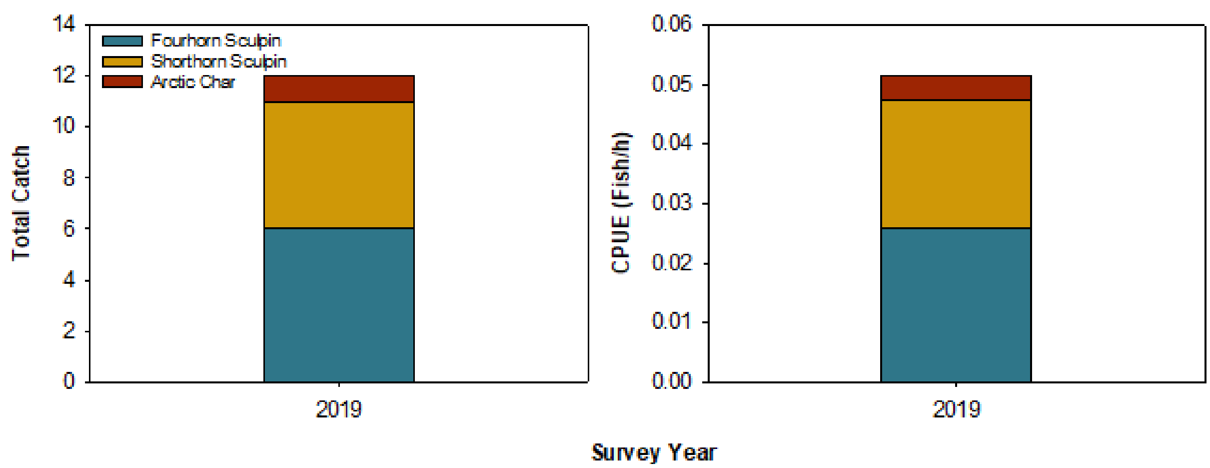


Figure 4-32: Total Catch and Catch Per Unit Effort (CPUE) for Fyke Net Sampling in the Milne Port Area (2019).

[14] CPUE for 2013 not presented due to a lack of effort data.

The majority of fishing efforts in 2019 were concentrated in the shallow (i.e., up to 15 m deep) subtidal areas adjacent to sandy beaches largely within 1 km of the west side of the Ore Dock and within 1.5 km of the east side of the Existing Ore Dock (Figure 3-4). Observed fish species and their relative abundance levels were generally consistent with that observed during previous years. There was no apparent correlation between a CPUE and sample location in Milne Port, which may indicate that fish presence in the vicinity of the Existing Ore Dock and the offset habitat is consistent with fish presence throughout the rest of Milne Port (Assomption Harbour).

4.1.7.1.6 Incidental Fish Observations

In addition to the fish captured in the active fish sampling described above, incidental observations of fish occurred in other sampling as part of the MEEMP and AIS programs. A summary of fish collections and observations is presented in Table 4-25. At least one fish was captured or observed in benthic infauna samples (Section 4.1.5), zooplankton samples (Section 4.2.1), fish stomachs (Section 4.1.7.3) and in ROV surveys (Sections 4.1.6, 4.2.3 and 4.2.6).

A total of thirteen fish taxa were captured or observed throughout all MEEMP and AIS/NIS surveys, eight of which were not seen in the fish collection component. Arctic char and ninespine stickleback were captured in fish surveys but were not captured or observed in any other method. Benthic infauna samples included two juvenile fish, one an indeterminate species in the Family Zoarcidae (eelpouts) and the other an indeterminate sculpin species (Cottidae). A single larval fish in zooplankton samples was identified as an indeterminate cod (Gadidae). Stomachs of incidental mortalities of Arctic char and sculpin species contained whole body and parts of indeterminate sculpin as well as unidentifiable fish tissue. The greatest number observed fish taxa occurred in review of ROV footage. Many fish in ROV surveys were not resolved to species level due to poor camera angle, camera motion, visibility in the water column and fish behaviour limiting the ability to observe the fish in detail. Four taxa observed in ROV surveys were not observed in any of the other survey methods.

Table 4-25: Summary of Fish Observations by Method During 2019 MEEMP and AIS/NIS Surveys at Milne Port

Order Family	Subfamily	Taxa	Common Name	Survey Method				
				Fishing Efforts[1]	Benthic Infauna	Zooplankton	Fish Stomachs	ROV[2]
Gadiformes								
Gadidae	-	Gadidae indet.	Unknown Cod			X		X
Gasterosteiformes								
Gasterosteidae	-	*Pungitius pungitius*	Ninespine Stickleback	X				
Perciformes								
Zoarcidae		*Gymnelus viridis*	Fish Doctor					X
Zoarcidae	-	Zoarcidae indet.	Unidentified Eelpout		X			X
Ammodytidae	-	*Ammodytes* sp.	Unidentified Sandlance	X				X
Stichaeidae	-	Stichaeidae indet. sp. 1	Eelblenny					X
Stichaeidae	-	Stichaeidae indet.	Unknown Prickleback					X
Salmoniformes								
Salmonidae	Salmoninae	*Salvelinus alpinus*	Arctic Char	X				
Scorpaeniformes								
Cottidae	-	*Cyclopterus lumpus*	Common lumpfish					X

Order Family	Subfamily	Taxa	Common Name	Survey Method				
				Fishing Efforts[1]	Benthic Infauna	Zooplankton	Fish Stomachs	ROV[2]
Cottidae	-	*Myoxocephalus quadricornis*	Fourhorn Sculpin	X				X
Cottidae	-	*Myoxocephalus scorpius*	Shorthorn Sculpin	X				X
Cottidae	-	Cottidae indet.	Unknown Sculpin		X		X	X
-	-	-	Unknown Species				X	X

Notes: [1]Fishing efforts include angling, gill nets, Fukui traps, fyke nets and seine nets. [2]ROV includes underwater video surveys of offset habitat, ship hulls, AIS transects, and belt transects

4.1.7.2 Fish Length and Weight

A total of five species of fish were captured in 2019. Summary statistics for fish lengths and weights were calculated for Arctic char, fourhorn sculpin, and shorthorn sculpin caught at Milne Port in 2019, excluding species with sample sizes too small (N = 1; ninespine stickleback, northern sandlance) for comparison (Table 4-26). Arctic Char lengths ranged from 126 mm to 840 mm (mean length = 439 mm, SD = 127.9 mm) while weights ranged from 19 g to 6809 g (mean weight = 1200 g, SD = 1034.3 g).

Table 4-26: Length and Weight Summary Statistics for All Fish Captured in Milne Port Area, 2019

Species	N	Statistic			
		Min	Max	Mean	SD
Length (mm)					
Arctic Char	105	126	840	439	127.9
Fourhorn sculpin	106	142	310	217	41.7
Ninespine stickleback[1]	1	38	-	-	-
Northern sandlance[1]	1	168	-	-	-
Shorthorn sculpin	66	56	405	180	63.3
Weight (g)					
Arctic Char	105	19	6,809	1,200	1,034.3
Fourhorn sculpin	106	25	310	116	72.9
Ninespine stickleback[1]	1	1	-	-	-
Northern sandlance[1]	1	20	-	-	-
Shorthorn sculpin	66	2	832	98	140.6

Notes: [1] Statistics not calculated for sample size of one.

Fourhorn sculpin length ranged from 142 mm to 310 mm (N = 106) showing a small distribution for a large sample size. In contrast, shorthorn sculpin had a larger distribution of length, ranging from 56 mm to 405 mm with a smaller sample size (N = 66). Of the two sculpin species identified in 2019, shorthorn sculpin were found to have both the smallest (2 g) and highest (832 g) weight of all sculpin sampled representing the largest range. Conversely, the largest mean weight (116 g) of the two species was found within fourhorn sculpin sampled in 2019.

In addition to Arctic char and the two species of sculpin, a single ninespine stickleback with a length of 38 mm and weight of 1 g and a single northern sandlance with a length of 168 mm and 20 g were captured.

The length frequency distribution of Arctic char captured in 2019 is similar to 2018 with a unimodal center of distribution between 400 mm to 500 mm. Including Arctic char, three species of fish captured have sample sizes larger than three and are presented in Figure 4-33. Fourhorn and shorthorn sculpin both have a center of distribution between 150 mm and 250 mm and are unimodal, with shorthorn sculpin having a wider distribution.

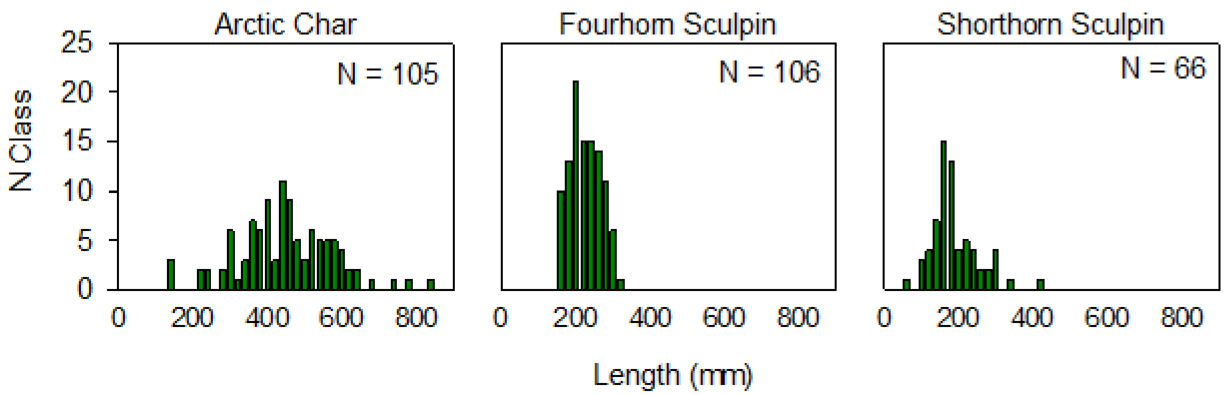


Figure 4-33: Length Frequency Distribution for Fish Species (where N>3) captured in Milne Port Area, 2019

Weight-length regression was performed on all species with three or more weight and length data points (i.e., Arctic char, fourhorn sculpin, and shorthorn sculpin). The 2017 and 2018 regression curves were superimposed on the plots of 2019 data to visualize changes in length-weight relationships between the most recent three years (Figure 4-34). The regression for Arctic char had a high R^2 value (0.960), indicating a good fit for the Arctic char data. The 2017 and 2018 regressions were both similar to 2019, despite a much smaller sample size in 2017 (N = 23) and larger size in 2018 (N = 156) compared to 2019 (N=106). Data did not meet the assumption of normality for ANCOVA; however, many data sets with non-normal residuals are still suitable for analysis, particularly if the assumption of heteroscedasticity is met (Sokal and Rohlf 2012). As the assumption of heteroscedasticity was met, and the magnitudes of difference between years were small, the test results were considered reliable. For Arctic char, the weigh-length relationship was not significantly different between 2018 and 2019 (*P*-value of the ANCOVA interaction = 0.321[15], year effect = 0.059).

The sample size for fourhorn sculpin was smaller in 2019 compared to 2018 (N = 106 and 146, respectively) but significantly larger than 2017 (N = 28, Figure 4-34). The 2019 regression was found to be very similar to 2018 but predicted lower weights for lengths of 200 mm or higher compared to 2017. However, the 2019 relationship had a higher R^2 (0.895) compared to the 2018 (0.874) and 2017 (0.658) regression. A significant interaction was observed between years 2018 and 2019; however, the regression slopes of the full and reduced models were considered practically similar and it was appropriate to proceed with the ANCOVA (Barrett et al. 2010) (*P*-value of the ANCOVA interaction = 0.049[16], year effect = 0.848).

The weight-length regressions for shorthorn sculpin did not differ significantly between 2018 and 2019. The 2017 regression predicted lower weights for fish approximately 300 mm and above compared to both 2019 and 2018. Sample sizes were comparable between 2019 (N = 66) and 2018 (N = 77) but lower in 2017 (N = 20). The visual difference between 2018 and 2019 compared to 2017 may be explained by the absence of sufficient numbers of individuals less than 200 mm and no shorthorn sculpin sampled that were greater than 350 mm during 2017 sampling. Therefore, it is likely that the visual difference in the length-weight regressions between these years were due to sampling limitations. The length-weight relationship was not significantly different between 2018 and 2019 (*P*-value of the ANCOVA interaction = 0.749[17], year effect = 0.133).

[15] Seven outliers identified (studentized residual values >|3.5|) and removed from ANCOVA analysis.
[16] Three outliers identified (studentized residual values >|3.5|) and removed from ANCOVA analysis.
[17] Three outliers identified (studentized residual values >|3.5|) and removed from ANCOVA analysis.

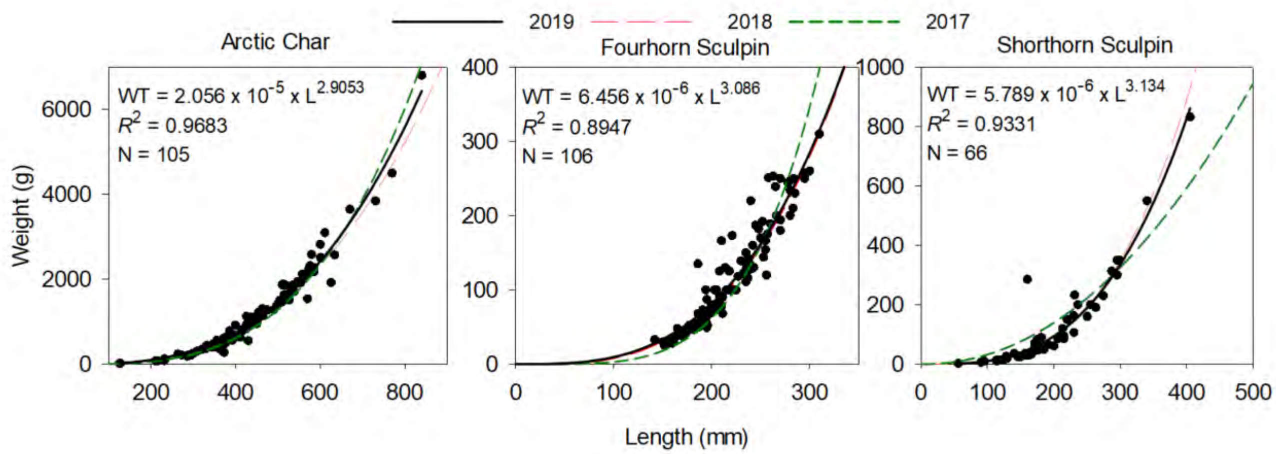


Figure 4-34: Weight-Length Plots and Regression for Fish Species Captured (N>3) in Milne Port Area in 2019 With Previous Regression Curves for Comparison.

A total of 76 incidental fish mortalities were collected in 2019 including 46 Arctic char and 30 sculpin[18]. Estimated ages of 46 Arctic char incidental mortalities were determined in lab and compared to the body length of each fish in order to determine the relationship between size and age in Arctic char at Milne Port. Visually, a slight relationship is observed in plotted data but the variation is not described through regression analysis of body length and age for Arctic char incidental mortalities (R^2 = 0.271, Figure 4-35), indicating body size is not a good predictor for Arctic char age in the Milne Port area.

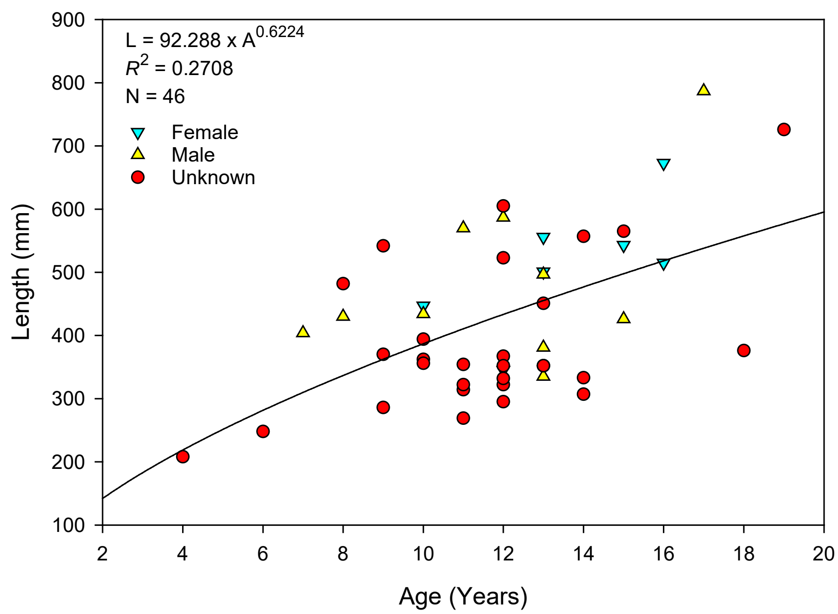


Figure 4-35: Age-Length Relationship of Arctic Char Incidental Mortalities from the Milne Port Area, 2019

[18] Sculpin mortalities include both fourhorn and shorthorn species.

Conversely, estimated ages of 30 sculpin incidental mortalities, including both fourhorn and shorthorn species, were determined in lab and compared to the body length of each fish in order to assess the relationship between size and age in sculpin collected at Milne Port. Visually, a stronger relationship is observed for sculpin, compared to Arctic char, where the data is more accurately described through regression analysis of body length and age for sculpin incidental mortalities (R^2 = 0.759; Figure 4-36). This indicates that body size is a fairly accurate predictor for sculpin age in the Milne Port area.

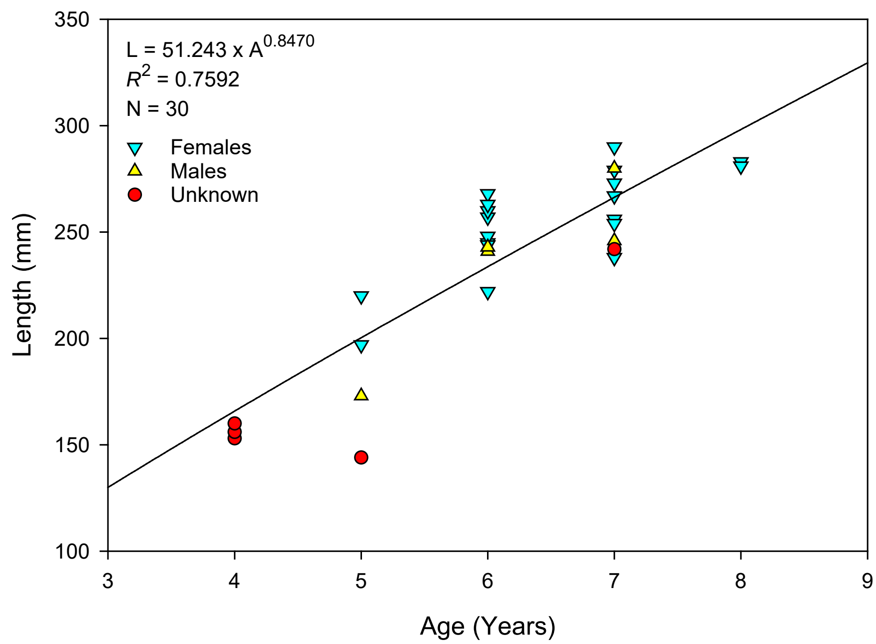


Figure 4-36: Age-Length Relationship of Sculpin Species Incidental Mortalities from the Milne Port Area, 2019

4.1.7.3 Sex, Age and Stomach Content

4.1.7.3.1 Arctic Char

Forty-seven incidental mortalities of Arctic char were retained for aging and stomach content analysis. Mortalities were composed of fish damaged during gillnet retrievals at GN-01, GN-03, GN-04, GN-05, GN-06, GN-07, GN-09 and during fyke net effort FN-02. Ages of incidental mortalities ranged from 4 to 19 years, with a mean of 12 years (±3.0 SD; Table 4-27). Age range and mean were comparable to those of incidental mortalities in 2018 (5 to 17 years, mean of 11, Golder 2019a) and to previous survey years. Due to degradation and damage to some fish during transportation, sex was not determinable for all fish, therefore summary of characteristics based on age are not reflective of the full sample set. Mean age in fish identifiable as female (n=7) was 13.6 compared to 11.9 in males (n=10). A higher average age in females was also observed in 2018 (Golder 2019a). As in 2018, females were on average longer than males; however, in 2019 males were heavier on average, largely due to a single male weighing over 6 kg. Detailed results of analysis of Arctic char incidental mortalities in 2018 are in Appendix G-3.

Table 4-27: Summary of Characteristics of Arctic Char Incidental Mortalities, 2019

	N*	Min	Max	Mean	SD
Age (years)					
All	47	4	19	12.0	3.0
Female	7	10	16	13.6	2.2
Male	10	7	17	11.9	3.0
Length (mm)					
All	47	208	787	425.9	128.8
Female	7	345	673	511.4	100.9
Male	10	335	787	485.1	132.5
Weight (g)					
All	47	110	6,480	1,147.7	1,112.7
Female	7	490	2320	1,579.0	649.1
Male	10	617.3	6,480	1,876.7	1750.7

*Note: Sex was not determinable for all fish, therefore male and female totals are not equal to total incidental mortalities

In the analysis of stomach contents of Arctic char incidental mortalities, approximately 35% of the total stomach contents, by weight, was indeterminate or unidentifiable material. A summary of the relative composition of the major taxa groups identifiable in stomach contents, by total weight is presented in Figure 4-37. The most abundant of the classifiable tissue was indeterminate crustacean tissue. This tissue, at 41% of the total weight of stomach contents, was composed of various parts lacking features that would resolve identification further. Of the identifiable taxa, amphipods were the most abundant taxa by weight at 15% of the total stomach contents and the second most abundant by individual with 1,612 specimens. Calanoids were the most abundant by individuals (1,773), but only accounted for 2.6% of the total weight. In contrast, fish species accounted for 4% of the weight, with an abundance of only 9 individuals. The Order Mysida was the third largest recognizable taxa with 121 individuals, accounting for 1.6% of the total weight. A single juvenile decapod and parts of an unidentifiable gastropod together accounted for less than 1% of the total weight and were excluded from Figure 4-37. As in previous years, the majority (93%) of the identifiable tissue were of the Subfamily Crustacea, indicating the importance of this taxa group to Arctic char in Milne Port. Additionally, a high number (97) of the identifiable taxa were planktonic compared to nine epibenthic taxa and one benthic taxon, reflecting the preferred feeding mode of the pelagic Arctic char.

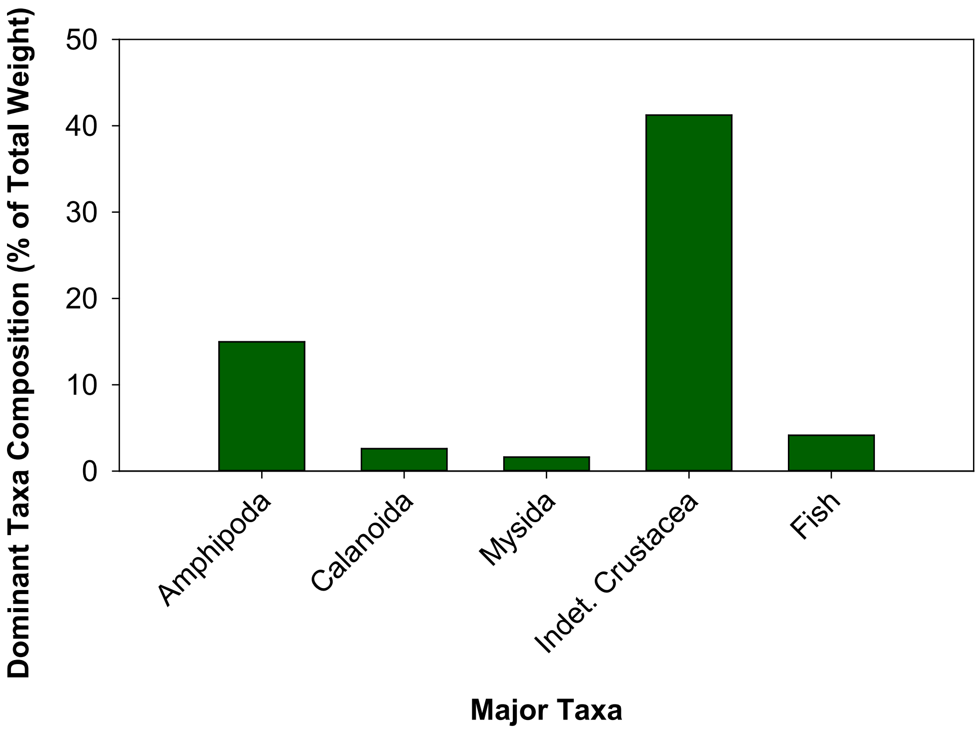


Figure 4-37: Composition of Major Taxa in the Stomach Contents of Arctic Char Incidental Mortalities, 2019. Indet. Crustacea = Indeterminate Crustaceans

Stomach fullness in incidental mortalities ranged from 10% to 100% (Table 4-28). Arctic char mortalities from GN-01 had stomachs ranging from 75% to 100% (full stomachs). The dominant identifiable stomach contents in the fish were indeterminate *Themisto* species and other indeterminate crustaceans. Mortalities from the third gillnet set (GN-03) had stomachs that ranged from 25% to 75% full, with the dominant taxa being indeterminate crustaceans and fish species. Other dominant taxa included *Themisto* sp. and *Calanus* sp. Stomach fullness in fish from GN-05 ranged from 10% to 100%, with identifiable taxa dominated by indeterminate crustaceans, as well as indeterminate Lysianassoidea, Calanoida, Amphipoda and Hyperiidea. Stomach contents in fish from GN-07 ranged between 10% and 75%, and were dominated by indeterminate crustaceans, aside from one specimen, where Mysida were dominant. Mortalities from GN-09 had stomachs that were 50% and 75% full, and stomach contents were primarily composed of unidentifiable crustaceans, *Themisto* sp., and indeterminate Mysida.

A single Arctic char incidental mortality occurred in one of the fyke net sets. The stomach of this fish was primarily unidentifiable tissue and indeterminate crustaceans. Stomach fullness was 25%.

Table 4-28: Summary of Arctic Char Incidental Mortality Stomach Characteristics, 2019

Sample ID	Catch Effort	Date Sampled	Stomach Weight (g)	Stomach Fullness (%)	Material Digested (%)	Dominant Identifiable Taxa in Stomach (by Weight)
19-072-133	GN-01	27-Jul-19	34.6	100	75	Arthropoda (Crustacea indet.)
19-072-134	GN-01	27-Jul-19	27.6	75	75	Arthropoda (*Themisto* sp.)
19-072-135	GN-01	27-Jul-19	53.3	75	75	Arthropoda (*Themisto* sp.)
19-072-136	GN-03	27-Jul-19	40.3	50	100	Arthropoda (Crustacea indet.)

Sample ID	Catch Effort	Date Sampled	Stomach Weight (g)	Stomach Fullness (%)	Material Digested (%)	Dominant Identifiable Taxa in Stomach (by Weight)
19-072-137	GN-03	27-Jul-19	71.2	75	75	Arthropoda (Crustacea indet.)
19-072-138	GN-03	27-Jul-19	113	25	100	Chordata (Pisces indet.)
19-072-139	GN-03	27-Jul-19	36.5	25	75	Arthropoda (Crustacea indet.)
19-072-140	GN-05	29-Jul-19	14.4	50	100	Arthropoda (Calanoida indet.)
19-072-141	GN-05	29-Jul-19	7.83	75	75	Arthropoda (Crustacea indet.)
19-072-142	GN-05	29-Jul-19	12.1	25	75	Arthropoda (Lysianassoidea indet.)
19-072-143	GN-05	29-Jul-19	7.04	75	100	Arthropoda (Amphipoda indet.)
19-072-144	GN-05	29-Jul-19	4.88	50	100	Arthropoda (Crustacea indet.)
19-072-145	GN-05	29-Jul-19	12.3	100	75	Arthropoda (Crustacea indet.)
19-072-146	GN-05	29-Jul-19	42.4	75	75	Arthropoda (Crustacea indet.)
19-072-147	GN-05	29-Jul-19	13.3	25	100	Unidentifiable tissue
19-072-148	GN-05	29-Jul-19	36.0	50	100	Arthropoda (Crustacea indet.)
19-072-149	GN-05	29-Jul-19	7.17	25	100	Arthropoda (Crustacea indet.)
19-072-150	GN-05	29-Jul-19	35.9	25	100	Arthropoda (Crustacea indet.)
19-072-151	GN-05	29-Jul-19	10.4	50	75	Arthropoda (Crustacea indet.)
19-072-152	GN-05	29-Jul-19	13.8	75	75	Arthropoda (Crustacea indet.)
19-072-153	GN-05	29-Jul-19	15.5	75	75	Arthropoda (Crustacea indet.)
19-072-154	GN-05	29-Jul-19	16.0	75	75	Arthropoda (Crustacea indet.)
19-072-155	GN-05	29-Jul-19	12.8	50	75	Arthropoda (Hyperiidea indet.)
19-072-156	GN-07	29-Jul-19	5.74	25	100	Arthropoda (Mysida indet.)
19-072-157	GN-07	29-Jul-19	6.51	50	100	Arthropoda (Crustacea indet.)
19-072-158	GN-07	29-Jul-19	12.2	75	75	Arthropoda (Crustacea indet.)
19-072-159	GN-07	29-Jul-19	18.9	10	100	Arthropoda (Crustacea indet.)
19-072-160	GN-07	29-Jul-19	24.4	10	100	Arthropoda (Crustacea indet.)
19-072-161	GN-07	29-Jul-19	15.0	50	100	Arthropoda (Crustacea indet.)
19-072-162	GN-07	29-Jul-19	11.8	75	75	Arthropoda (Crustacea indet.)
19-072-163	GN-05	29-Jul-19	12.6	25	100	Arthropoda (Crustacea indet.)
19-072-164	GN-05	29-Jul-19	19.9	25	100	Arthropoda (Calanoida indet.)
19-072-165	GN-05	29-Jul-19	17.0	50	100	Arthropoda (Crustacea indet.)
19-072-166	GN-05	29-Jul-19	10.6	25	100	Unidentified tissue
19-072-167	GN-05	29-Jul-19	27.2	10	100	Arthropoda (Crustacea indet.)
19-072-168	GN-05	29-Jul-19	21.8	75	100	Arthropoda (Hyperiidea indet.)
19-072-169	GN-07	29-Jul-19	15.1	50	100	Arthropoda (Crustacea indet.)
19-072-170	GN-07	29-Jul-19	8.27	10	100	Unidentified tissue
19-072-171	GN-07	29-Jul-19	38.4	25	100	Unidentified tissue
19-072-172	GN-07	29-Jul-19	85.5	75	100	Arthropoda (Crustacea indet.)

Sample ID	Catch Effort	Date Sampled	Stomach Weight (g)	Stomach Fullness (%)	Material Digested (%)	Dominant Identifiable Taxa in Stomach (by Weight)
19-072-173	GN-07	29-Jul-19	10.9	50	75	Arthropoda (Crustacea indet.)
19-072-174	GN-07	29-Jul-19	12.8	50	75	Arthropoda (Crustacea indet.)
19-072-175	GN-07	29-Jul-19	15.4	75	75	Arthropoda (Crustacea indet.)
19-072-176	GN-07	29-Jul-19	22.2	25	75	Arthropoda (Crustacea indet.)
19-072-177	GN-09	22-Aug-19	18.7	50	50	Arthropoda (*Mysis* sp.)
19-072-178	GN-09	22-Aug-19	8.79	25	75	Arthropoda (Crustacea indet.)
19-072-179	FN-02	02-Sep-19	1.22	25	100	Arthropoda (Crustacea indet.)

4.1.7.3.2 Sculpin

Thirty incidental mortalities of sculpin (unidentified *Myoxocephalus* sp.) were retained for aging and stomach content analysis. Mortalities were composed of fish damaged during gillnet retrievals at GN-04, GN-05, GN-06, and GN-07. Ages of incidental mortalities ranged from 4 to 8 years, with a mean of 6.1 years (±1.1 SD; Table 4-29). Sculpin were not retained for age analysis in 2018. Due to degradation and damage to some fish during transportation, sex was not determinable for all fish, therefore summary of characteristics based on age are not reflective of the full sample set. Of the identifiable sculpin, 19 were female and 6 were male. Mean ages in fish identifiable as female was 6.5 compared to 6.2 in males. Females were on average slightly longer than males. Weights of sculpin incidental mortalities are not presented due to a perceived error in the data where the majority of sculpin appeared to have unrealistically small weights (<10 g). Detailed results of analysis of sculpin incidental mortalities in 2018 are in Appendix G-3-4.

Table 4-29: Summary of Characteristics of Sculpin (*Myoxocephalus* sp.) Incidental Mortalities, 2019

	N*	Min	Max	Mean	SD
Age					
All	30	4	8	6.1	1.1
Female	19	5	8	6.5	0.8
Male	6	5	7	6.2	0.8
Length (mm)					
All	30	144	290	237.5	41.8
Female	19	197	290	255.0	23.8
Male	6	173	280	237.7	35.0

*Note: Sex was not determinable for all fish, therefore male and female totals are not equal to total incidental mortalities;
Summary statistics are not presented for sculpin weights due to an error in the results indicating unrealistic weights

In the analysis of stomach contents of sculpin incidental mortalities, approximately 51% of the total stomach contents by weight was indeterminate or unidentifiable material. This included the presence of 200 eggs that were not able to be taxonomically resolved. Other non-food material was found in stomach contents but not included in the weight measurements. Non-food material included a mix of sand, leaves, filamentous algae, other plant material, wood fragments and polychaete tubes. A summary of the relative abundances of the major taxa groups identifiable in stomach contents by total weight is presented in Figure 4-38.

The most abundant of the classifiable tissue was fish tissue. This tissue, at 27% of the total weight of stomach contents, was composed of various parts lacking features that would resolve identification further and three individuals whose taxonomic description could not be resolved further than indeterminate Cottidae. Amphipods were the second most abundant taxa by weight at 12% of the total stomach contents, and the most abundant by individuals, with 81 intact individuals counted in the stomach contents, although only two were identifiable to genus, the remaining amphipod tissue was unidentifiable parts. Indeterminate pectanariid polychaetes of the Subclass Sedentaria were the next most abundant by weight at 7.5% of the total weight, with six intact individuals. Indeterminate crustacean parts represented only about 1% of the total weight. Parts from an unidentifiable Errantian polychaete, an individual and parts of a *Philomedes* sp. of ostracod, an individual and parts of the bivalve *Musculus discors*, and a single indeterminate individual from the Phylum Acanthocephala were together less than 1% of the total weight of stomach contents. Identifiable taxa were all benthic species aside from a single parasitic species, reflecting the preferred feeding mode of sculpin.

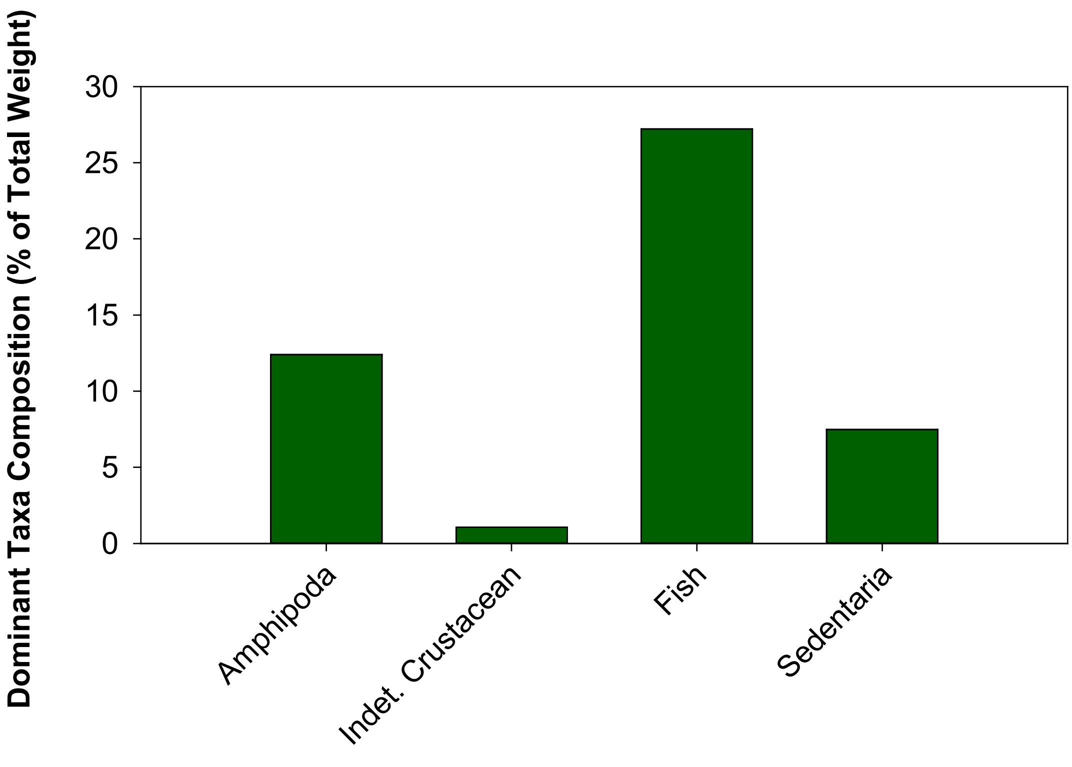


Figure 4-38: Abundance of Major Taxa in the Stomach Contents of Sculpin (Myoxocephalus sp.) Incidental Mortalities, 2019. Indet. Crustacea = Indeterminate Crustaceans

Stomach fullness in incidental mortalities ranged from 10% to 100% (Table 4-30). The single sculpin mortality from GN-04 all had a full stomach (100%). The dominant identifiable stomach contents in the sculpin in GN-04 were parts and intact specimens of indeterminate Cottidae and other indeterminate fish. Also in the stomach were indeterminate Errantian polychaetes of the Family Nereididae and Lysianassoidean amphipods. Stomach fullness in sculpin from GN-05 ranged from 10% to 100%, with identifiable taxa dominated by indeterminate crustaceans, as well as indeterminate Amphipoda (including indeterminate Lysianassoidea, Oedicerotidae, and *Atylus* sp.), indeterminate Polychaeta (including indeterminate Pectinariidae) and indeterminate fish species. Two incidental mortalities from GN-07 had stomachs that were 25% and 50% full. The specimen with a 25% full stomach had no identifiable tissue in the stomach contents. The specimen with the half full stomach ingested indeterminate crustaceans and amphipods.

Table 4-30: Summary of Sculpin (*Myoxocephalus* sp.) Incidental Mortality Stomach Characteristics, 2019

Sample ID	Catch Effort	Date Sampled	Stomach Weight (g)	Stomach Fullness (%)	Material Digested (%)	Dominant Identifiable Taxa in Stomach (by Weight)
19-072-180	GN-04	27-Jul-19	31.0	100	100	Chordata (Cottidae indet.)
19-072-181	GN-05	29-Jul-19	1.07	10	100	Unidentified tissue
19-072-182	GN-05	29-Jul-19	1.24	50	100	Arthropoda (Amphipoda: Lysianassoidea indet.)
19-072-183	GN-05	29-Jul-19	0.99	25	100	Arthropoda (Amphipoda indet.)
19-072-184	GN-05	29-Jul-19	1.81	10	100	Unidentified tissue
19-072-185	GN-05	29-Jul-19	0.62	25	100	Arthropoda (Crustacea indet.)
19-072-186	GN-05	29-Jul-19	1.08	10	100	Arthropoda (Crustacea indet.)
19-072-187	GN-05	29-Jul-19	4.73	50	100	Unidentified tissue
19-072-188	GN-05	29-Jul-19	6.05	50	100	Arthropoda (Amphipoda indet.)
19-072-189	GN-05	29-Jul-19	5.15	50	100	Unidentified tissue
19-072-190	GN-05	29-Jul-19	4.64	50	100	Unidentified tissue
19-072-191	GN-05	29-Jul-19	4.39	25	100	Annelida (Polychaeta: Pectinariidae indet.)
19-072-192	GN-05	29-Jul-19	9.22	25	100	Annelida (Polychaeta: Pectinariidae indet.)
19-072-193	GN-05	29-Jul-19	4.03	75	100	Arthropoda (Crustacea indet.)
19-072-194	GN-05	29-Jul-19	5.07	25	100	Arthropoda (Crustacea indet.)
19-072-195	GN-05	29-Jul-19	7.20	50	100	Arthropoda (Amphipoda: *Atylus* sp..)
19-072-196	GN-05	29-Jul-19	10.9	75	100	Arthropoda (Amphipoda: Oedicerotidae indet.)
19-072-197	GN-07	29-Jul-19	2.05	25	100	Unidentified tissue
19-072-198	GN-07	29-Jul-19	2.86	50	100	Arthropoda (Crustacea indet.)
19-072-199	GN-05	29-Jul-19	8.49	50	100	Arthropoda (Crustacea indet.)
19-072-200	GN-05	29-Jul-19	5.28	75	100	Annelida (Polychaeta: Pectinariidae indet.)
19-072-201	GN-05	29-Jul-19	8.30	50	100	Annelida (Polychaeta indet.)
19-072-202	GN-05	29-Jul-19	16.3	100	75	Arthropoda (Amphipoda: Oedicerotidae indet.)
19-072-203	GN-05	29-Jul-19	17.2	100	75	Arthropoda (Amphipoda indet.)
19-072-204	GN-05	29-Jul-19	13.0	100	75	Arthropoda (Amphipoda indet.)
19-072-205	GN-05	29-Jul-19	5.65	75	50	Annelida (Polychaeta: Pectinariidae indet.)

Sample ID	Catch Effort	Date Sampled	Stomach Weight (g)	Stomach Fullness (%)	Material Digested (%)	Dominant Identifiable Taxa in Stomach (by Weight)
19-072-206	GN-05	29-Jul-19	8.97	25	100	Unidentified tissue
19-072-207	GN-05	29-Jul-19	19.3	100	100	Chordata (Pisces indet.)
19-072-208	GN-05	29-Jul-19	3.90	25	100	Arthropoda (Crustacea indet.)
19-072-209	GN-05	29-Jul-19	7.56	25	100	Unidentified tissue

4.1.7.4 Shellfish Aging

Specimens of the bivalve *Hiatella arctica* (wrinkled rock borer) were collected as a supplement to fish condition monitoring. Analysis included specimen aging and tissue chemistry (Section 4.1.8.4). Shellfish were collected from the same stations as the sediment and benthic invertebrate samples, where *H. arctica* were present. A maximum of five intact specimens were found at sampled stations, with the majority of collections occurring at stations along the eastern and western transects at depths less than 25 m (Table 3-11). A summary of the ages of collected shellfish ages, by station and transect is presented in Table 4-31.

Table 4-31: Summary of Shellfish Age Based on Transect Location, Milne Port, 2019

Station	Station Depth (m)	Collected (Analyzed)*	Min	Max	Mean	SD
Eastern Transect						
BE-1	12	5	13	29	19	6.8
BE-3	19	5	10	58	38.6	20.7
BE-4	14	5	16	51	31.2	14.8
BE-5	15	5	8	31	23.4	9.7
BE-6	19	5	14	52	29	15.2
BE-7	17	5	9	40	23.2	15.0
BE-8	16	5	13	56	33.6	20.0
Total		**35**	**8**	**58**	**28.3**	**15.3**
Western Transect						
BW-1	17	5	14	55	27.8	16.0
BW-2	21	5	7	30	20.4	8.8
BW-3	22	5(4)	9	45	19.3	17.2
BW-4	16	5	26	69	42.8	16.9
BW-5	17	5	38	51	44	6.1
BW-6	15	5	21	35	27.4	6.2

Station	Station Depth (m)	Collected (Analyzed)*	Min	Max	Mean	SD
BW-7	18	5	16	27	21.2	4.7
BW-8	18	5(4)	10	18	12.5	3.7
Total:		**40(38)**	**7**	**69**	**27.5**	**14.7**
Northeastern Transect						
BNE-1	29	1	-	-	59	-
BNE-4	67	1	-	-	11	-
BNE-5	82	1	-	-	34	-
Total		**3**	**11**	**59**	**34.7**	**24.0**
Northwestern Transect						
BNW-1	37	2(0)	nd	nd	nd	nd
Total		**2(0)**	**nd**	**nd**	**nd**	**nd**
Totals		**80(76)**	**7**	**69**	**28.1**	**15.2**

* Four shells were not able to be aged due to shells being broken at the hinge or the shell being too small to cut (<1.5 cm, <100 mg). nd = no data

Thirty-five *H. arctica* were collected from the Eastern Transect. The ages of these bivalves ranged from 8 years to 58 years, with a mean age of 28.3 years (SD 15.3 years, Table 4-31). Mean age on the Western transect was similar at 27.5 years (SD 14.7 years), however the age range was greater, between 7 and 69 years. A total of forty *H. arctica* were collected from the western transect, but only 38 were analyzed for age due to shell damage along the hinge structure.

H. arctica have been found at depths of up to 175 m. However, the prominent depth range for this species is estimated to be between 15 and 25 m (Sejr et al. 2002). This was apparent in the collections from the northeastern and northwestern transects that were along a deeper gradient (29 m to 102 m) than the western and eastern transects (between 10 m and 22 m). Only five specimens were collected from these two transects, and all were collected at the shallower depths along the transect range (Table 4-31). Two of the collected specimens were unable to be aged due to the small size of the bivalve (less than 1.5 cm). The three remaining specimens, all from the northeastern transect were aged to 11, 34 and 59 years.

4.1.8 Tissue Chemistry

All parameters are plotted as box plots in Appendix G-4, Figure G-4.1 to Figure G-4.32 for fish species and Appendix F-5, Figure F-5.1 to Figure F-5.32 for *Hiatella arctica.*

4.1.8.1 Laboratory QA/QC Results

In general, analytical QC data from BV Labs were within acceptable limits, with some sample heterogeneity issues identified in two fish samples and two *H. arctica* samples. Relative percent difference (RPD) exceeded QC limits due to sample heterogeneity in: Arctic Char sample GN-01-1 19-072-133 (calcium, manganese and strontium had RPDs between duplicates of 91%, 50%, and 84%, respectively); Arctic Char sample GN7-P6 19-072-085 (calcium, manganese and strontium had RPDs between duplicates of 112%, 58%, and 114%, respectively); *H. arctica* sample BE-8 SA19-072-085 (cobalt and manganese had RPDs between duplicates of 67%, and 97%); *H. arctica* sample BW-5 SA19-072-111 (antimony, barium, cobalt and manganese had RPDs between duplicates of 75%, 53%, 41% and 46%, respectively). Sample heterogeneity issues are not unusual with biological samples due to inherent variability of biological tissues (i.e., they are not a uniform matrix); therefore, the data were considered acceptable.

Recovery for matrix spikes were outside of QC limits for two Arctic char samples and one *H. arctica* sample: Arctic Char sample GN-01-1 19-072-133 (silver recovery of 44%); Arctic Char sample GN7-P6 19-072-085 (silver recover of 48%); *H. arctica* sample BW-7 SA19-072-121 was outside recovery QC limits for vanadium, however it was suspected to be a result of lab interference and no recovery was reported. With the exception of the vanadium matrix spike issue, all QC were deemed to meet acceptability criteria. Overall, analytical data reported by BV Labs were considered reliable. Quality control results from BV Labs are provided in Appendix F for shellfish data and Appendix G-4 for fish tissue.

4.1.8.2 Arctic Char

Descriptive Statistics

A total of 47 tissue samples from Arctic Char were collected in 2019 for analysis of total metals concentrations (Table 4-32). The 2019 data were compared to Arctic Char metals concentrations from 2018 (n=26). Means and standard deviations were calculated for all metals above DLs. The following metals were below DL in Arctic Char tissue samples collected in both 2018 and 2019, preventing between year comparisons: antimony, beryllium, bismuth, molybdenum, and vanadium (Appendix G-4, Table 3). Only one sample was above DL for barium, boron, tin and uranium in 2018; therefore, between year comparisons were also not completed for these parameters. Detailed results of metal analysis for each Arctic Char tissue sample are presented in Appendix G-4-3.

Table 4-32: Descriptive Statistics for Detected Metal Concentration in Arctic Char Muscle Tissue Samples from the Milne Port Area, 2018 and 2019.

Parameter	2018 (n=26)				2019 (n=47)			
mg/kg wwt	n>DL(a)	DL	Mean	SD	n>DL(a)	DL	Mean	SD
Aluminum	8	0.2	0.4	0.2	45	0.2	0.7	1.4
Arsenic	26	0.004	0.527	0.218	47	0.004	0.799	0.374
Barium	1	0.01	0.01	N/A	16	0.01	0.02	0.01
Boron	1	0.2	0.2	N/A	0	0.2	N/A	N/A
Cadmium	25	0.001	0.006	0.006	45	0.001	0.006	0.005
Calcium	26	2	87	45	47	2	164	118
Chromium	13	0.01	0.02	0.01	35	0.01	0.02	0.01

Parameter	2018 (n=26)				2019 (n=47)			
mg/kg wwt	n>DL(a)	DL	Mean	SD	n>DL(a)	DL	Mean	SD
Cobalt	26	0.0013	0.0049	0.0015	47	0.0013	0.0049	0.0022
Copper	26	0.01	0.51	0.09	47	0.01	0.41	0.09
Iron	26	0.25	4.36	0.74	47	0.25	4.49	2.74
Lead	10	0.001	0.002	0.001	40	0.001	0.002	0.001
Magnesium	26	0.4	282	12	47	0.4	303	22
Manganese	26	0.01	0.09	0.02	47	0.01	0.10	0.04
Mercury	26	0.002	0.043	0.016	47	0.002	0.052	0.025
Nickel	21	0.01	0.02	0.01	37	0.01	0.01	0.004
Phosphorus	26	2	2992	105	47	2	2877	187
Potassium	26	2	4411	159	47	2	3978	438
Selenium	26	0.01	0.34	0.04	47	0.01	0.40	0.08
Silver	2	0.001	0.001	0.001	0	0.001	N/A	N/A
Sodium	26	2	501	96	47	2	711	233
Strontium	26	0.01	0.20	0.11	47	0.01	0.48	0.26
Thallium	26	0.0004	0.0031	0.0008	47	0.0004	0.0025	0.0010
Tin	1	0.02	0.04	N/A	4	0.02	0.026	0.005
Titanium	26	0.02	0.12	0.02	47	0.02	0.49	0.03
Uranium	1	0.0004	0.0006	N/A	6	0.0004	0.0006	0.0002
Zinc	26	0.04	5.66	0.91	47	0.04	7.63	2.84

Notes: (a) Indicates the number of samples with concentrations above the detection limit. n= all fish processed for tissue metals, mg/kg wwt = milligrams per kilogram wet weight, DL = reportable detection limit; SD = standard deviation of the sample; < = less than.

Statistical Comparisons

Differences in mean metals concentrations in Arctic Char between 2019 and 2018 were assessed using ANOVA or K-W tests for 18 metals (i.e. those metals with >50% of samples >DL in 2018 and 2019; Table 4-33).

Significant differences were identified for concentrations of arsenic, calcium, copper, magnesium, potassium, selenium, sodium, strontium, thallium, and titanium between years in Arctic Char tissue between 2018 and 2019 (Table 4-33). Of these, only arsenic (43%), calcium (72%), sodium (43%), strontium (146%), and titanium (290%) were notable (i.e., magnitude >40%) with 2019 metals concentrations being significantly greater than the concentrations measured in 2018.

Raw data were not compiled for years prior to 2018, nor were data available for all metals. In some instances, sample sizes were small (e.g. less than 5 samples available). Mean values have been considered herein to assess consistency over time, but statistical comparisons were not performed for 2019 relative to historical data (Table 4-34). Relatively large variance in arsenic concentrations has been observed in Arctic Char tissues since baseline years (range of 0.51 mg/kg wwt to 1.38 mg/kg wwt) and samples in 2019 were consistent with historical data (i.e concentrations generally fell within the measured range of values reported since 2010), despite a statistically significant increase in arsenic concentrations in 2019 versus 2018. Cadmium, chromium, mercury and zinc concentrations in 2019 also were generally consistent with the ranges of concentrations reported since baseline surveys in 2010. Copper concentrations, which showed a significant but small magnitude decrease since 2018, were generally consistent with historical data, but there might be a slight downward trend in mean concentrations in recent years. Similarly, iron concentrations did not change significantly between 2018 and 2019, but a slight downward trend in mean concentrations has been noted in recent years.

Comparison to Guidelines

No Arctic Char tissue samples exceeded the CFIA commercial consumption guideline of 0.5 mg/kg wwt for mercury (CFIA 2014) in 2018 or 2019.

Table 4-33: Statistical Comparisons of Detected Metal Concentrations in Arctic Char Sampled in the Milne Port Area, 2018 and 2019.

Parameter	Test	Outlier removed?[(a)]	Shapiro-Wilk Test	Levene's Test	Test *P*-Value	n		LSM[(b)]		MSE	Magnitude (% difference)
						2019	2018	2019	2018		
Arsenic	ANOVA	Y	0.159	0.481	**<0.001**	46	26	0.754	0.527	0.0473	43
Cadmium	$ANOVA_{log}$	N	0.164	0.108	0.501	47	26	-2.3551	-2.4227	<0.0001	17
Calcium	$ANOVA_{log}$	Y	0.414	0.686	**<0.001**	46	26	2.1353	1.8991	0.0366	72
Cobalt	K-W	N	-	-	0.519	47	26	0.00430	0.00465	-	-8
Copper	ANOVA	Y	0.052	0.549	**<0.001**	46	26	0.407	0.508	0.0065	-20
Iron	K-W	N	-	-	0.178	47	26	3.95	4.36	-	-9
Magnesium	K-W	N	-	-	**<0.001**	47	26	301	285	-	6
Manganese	$ANOVA_{log}$	Y	0.059	0.484	0.660	46	26	-1.026	-1.035	0.0064	2
Mercury	K-W	N	-	-	0.203	47	26	0.0423	0.0379	-	12
Nickel	K-W	N	-	-	0.427	47	26	0.013	0.014	-	-7
Phosphorus	K-W	N	-	-	**0.004**	47	26	2900	3000	-	-3
Potassium	K-W	N	-	-	**<0.001**	47	26	4060	4390	-	-8
Selenium	K-W	N	-	-	**<0.001**	47	26	0.375	0.330	-	14
Sodium	K-W	N	-	-	**<0.001**	47	26	700	489	-	43
Strontium	K-W	N	-	-	**<0.001**	47	26	0.433	0.176	-	146
Thallium	K-W	N	-	-	**<0.001**	47	26	0.00216	0.00294	-	-26
Titanium	K-W	N	-	-	**<0.001**	47	26	0.486	0.125	-	290
Zinc	K-W	N	-	-	**0.002**	47	26	6.95	5.475	-	27

Notes: n = sample size; LSM = least squared mean; MSE = mean squared error; K-W = Kruskal Wallis test; ANOVA = Analysis of Variance; log=data log10 transformed prior to analysis; Y = yes; N = no; - = not applicable. Values in bold indicate significant differences.

(a) Outliers are presented in Appendix G-4-6 Table 2.

(b) Substituted for median when data were analyzed using the K-W test

Table 4-34: Summary of Detected Metal Concentrations (mg/kg wwt) in Arctic Char Incidental Mortality Tissue Samples in the Milne Port Area (2010 to 2018).

Metals	Health Canada Guidelines	2010 (n=11)		2013 (n=6)		2015 (n=5)		2016 (n=13)		2017 (n=2)		2018 (n=26)		2019 (n=47)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Arsenic	-	0.82	0.17	0.61	0.12	1.38	0.91	0.97	0.21	0.81	0.40	0.51	0.24	0.799	0.374
Cadmium	-	0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.05	<0.01	0.01	<0.01	0.01	0.01	0.006	0.005
Chromium	-	0.59	0.90	<0.5	<0.01	<0.5	<0.01	<0.5	<0.01	<0.01	<0.01	0.02	0.01	0.02	0.01
Copper	-	0.85	0.27	1.06	0.26	0.55	0.20	1.63	1.18	0.56	0.12	0.48	0.13	0.41	0.09
Iron	-	9.90	5.03	<15	<0.01	<15	<0.01	8.38	3.19	6.00	0.14	4.20	1.07	4.49	2.74
Mercury	0.50	0.05	0.03	0.03	0.01	0.04	0.01	0.04	0.02	0.06	0.04	0.04	0.02	0.052	0.025
Zinc	-	6.20	0.80	9.20	1.96	6.92	1.71	7.18	1.27	5.84	0.54	5.45	1.40	7.63	2.84

4.1.8.3 Sculpin

Descriptive Statistics

A total of 35 tissue samples from sculpin were collected in 2019[19] for analysis of total metals concentrations (Table 4-27). Means and standard deviations were calculated for all metals with results above DLs (Table 4-35). Beryllium and vanadium were below DLs in all sculpin samples collected in 2019 (Appendix G-4 -Table 4). Detailed results of metal analysis for all sculpin samples collected in 2019 are presented in Appendix G-4-4. No sculpin were sent for analysis of metal concentrations in tissues in historical surveys.

Table 4-35: Descriptive Statistics for Metal Concentrations in Sculpin Muscle Tissue Samples in the Milne Port Area, 2019

Parameter	2019 (n=35)			
	n>DL[(a)]	DL	Mean	SD
Aluminum	30	0.5	2.9	2.4
Antimony	15	0.002	0.0024	0.0003
Arsenic	30	0.005	1.796	1.076
Barium	30	0.01	0.15	0.09
Bismuth	26	0.0013	0.003	0.001
Boron	23	0.2	0.3	0.1
Cadmium	30	0.0013	0.0367	0.0338
Calcium	30	4	2234	1205
Chromium	21	0.025	0.052	0.035
Cobalt	30	0.0013	0.0122	0.0041
Copper	30	0.013	0.590	0.207
Iron	30	0.25	9.91	4.63
Lead	30	0.0013	0.0185	0.0115
Magnesium	30	0.4	281	45
Manganese	30	0.01	0.36	0.16
Mercury	30	0.013	0.143	0.053
Molybdenum	4	0.008	0.010	0.002
Nickel	30	0.01	0.03	0.01
Phosphorus	30	2	2784	698
Potassium	30	2.5	2860	344
Selenium	30	0.01	0.51	0.08
Silver	3	0.0013	0.0017	0.0006
Sodium	30	2.5	1262	197
Strontium	30	0.013	13.99	8.213
Thallium	29	0.0004	0.0010	0.0004
Tin	19	0.02	0.15	0.31
Titanium	30	0.13	0.48	0.16
Uranium	30	0.0004	0.0045	0.0041
Zinc	30	0.2	18	3.9

Notes: a) Indicates the number of specimens with concentrations above detection limit;
n= all fish processed for tissue metals, mg/kg wwt = milligrams per kilogram wet weight, DL = reportable detection limit; SD = standard deviation of the sample; < = less than.

[19] Prior to 2019, incidental sculpin mortalities were not retained for tissue chemistry analysis; no 2018 sculpin data are available.

Comparison to Guideline

No sculpin tissue samples exceeded the CFIA commercial consumption guideline of 0.5 mg/kg wwt for mercury (CFIA 2014).

4.1.8.4 Hiatella arctica

Descriptive Statistics

A total of 80 tissue samples were collected from *H. arctica* in 2019 for analysis of total metals concentrations (Table 4-28). The 2019 data were compared to *H. arctica* metals concentrations from 2018 (n=24). Means and standard deviations were calculated for all metals above DLs. Silver and titanium were not analyzed in 2018 and tellurium was not analyzed in 2019; therefore, only 2019 data are presented for these metals silver and titanium, and tellurium data is not included. Antimony and tin concentrations were above DL in most samples analyzed in 2019 (n=79; Table 4-36). In general, concentrations of most metals in *H. arctica* appeared greater in 2019 relative to 2018, with some exceptions (e.g., cadmium, potassium and strontium; Appendix F-5, Figures F-5.1 to F-5.37). Detailed results of metal analysis for each *H. arctica* tissue sample are presented in Appendix F-6.

Table 4-36: Descriptive Statistics for Detected Metals in *Hiatella arctica* Tissue Samples in the Milne Port Area, 2018 and 2019.

Parameter	2018 (n=24)				2019 (n=80)			
	n>DL [(a)]	DL	Mean	SD	n>DL [(a)]	DL	Mean	SD
Aluminum	24	0.4-1	516	196	80	0.5	909	355
Antimony	24	0.002	0.006	0.002	79	0.002	0.018	0.006
Arsenic	24	0.004-0.006	2.440	0.684	80	0.005	2.930	1.032
Barium	24	0.01	9.20	5.23	80	0.01	10.7	6.33
Beryllium	24	0.002	0.033	0.011	80	0.002	0.051	0.020
Bismuth	24	0.002	0.007	0.002	80	0.0013	0.012	0.004
Boron	24	0.2	6.0	1.4	80	0.2	8.9	2.7
Cadmium	24	0.001-0.002	0.684	0.474	80	0.0013	0.502	0.217
Calcium	24	4	5570	2544	80	4	7905	4261
Chromium	24	0.01-0.04	1.53	0.55	80	0.025	2.66	1.03
Cobalt	24	0.004	0.785	0.391	80	0.0013	1.222	0.747
Copper	24	0.02-0.01	2.11	0.40	80	0.013	2.32	0.55
Iron	24	0.6	1330	512	80	0.25	2338	1034
Lead	24	0.004-0.01	0.739	0.349	80	0.0013	1.264	0.492
Magnesium	24	0.4	2640	1073	80	0.4	4126	1625
Manganese	24	0.01	90	75	80	0.01	137	136
Mercury	24	0.001	0.027	0.015	80	0.013	0.033	0.014
Molybdenum	24	0.004-0.008	0.263	0.104	80	0.008	0.372	0.191
Nickel	24	0.04	1.54	0.50	80	0.01	2.13	0.65
Phosphorus	24	2	1195	257	80	2	1395	546
Potassium	24	4	1432	268	80	2.5	1247	240
Selenium	24	0.01-0.02	1.17	0.17	80	0.01	1.39	0.27
Silver[(b)]	-	-	-	-	80	0.0013	0.0058	0.0036
Sodium	24	4	4110	1246	80	2.5	4159	869
Strontium	24	0.01-0.02	21.5	9.23	80	0.013	19.9	13.4

Parameter	2018 (n=24)				2019 (n=80)			
	n>DL [(a)]	DL	Mean	SD	n>DL [(a)]	DL	Mean	SD
Thallium	24	0.0004	0.0136	0.0075	80	0.0004	0.0228	0.0107
Tin	20	0.02	0.05	0.07	79	0.02	0.07	0.06
Titanium[(b)]	-	-	-	-	80	0.13	34.4	14.8
Uranium	24	0.0004	0.1254	0.0303	80	0.0004	0.2034	0.0724
Vanadium	24	0.02	2.41	0.90	80	0.02	3.91	1.32
Zinc	24	0.1-0.2	11	1.8	80	0.2	14	2.3

Notes: (a) Indicates the number of specimens with concentrations above detection limit;
(b) Metals not analyzed in 2018.
n = total number of Hiatella arctica processed for tissue metals, mg/kg wwt = milligrams per kilogram wet weight, DL = reportable detection limit; SD = standard deviation of the sample; - = not applicable or not available.

Statistical Comparisons

Differences in mean metals concentrations of *H. arctica* tissue between 2019 and 2018 were assessed using ANOVA or K-W tests for 29 metals (i.e., those metals with >50% of samples >DL in 2018 and 2019; Table 4-37).

Significant differences were identified between years for concentrations of all metals except barium, phosphorus, sodium and strontium in *H. arctica* tissue (Table 4-37). Of these, aluminum (81%), antimony (181%), beryllium (51%), bismuth (71%), boron (47%), calcium (40%), chromium (76%), cobalt (51%), iron (76%), lead (67%), magnesium (58%), manganese (53%), thallium (77%), tin (85%), uranium (57%) and vanadium (62%) were notable (i.e., magnitude >40%) with 2019 metals concentrations being significantly greater than the concentrations measured in 2018.

Comparison to Guideline

No *H. arctica* samples exceeded the CFIA commercial consumption guideline for fish tissue of 0.5 mg/kg wwt for mercury (CFIA 2014).

Table 4-37: Statistical Comparisons of Detected Metal Concentrations in *Hiatella arctica* Sampled in the Milne Port Area, 2018 and 2019.

Parameter	Test	Outlier Values	Shapiro-Wilk Test	Levene's Test	Test *P*-Value	n		LSM[(a)]		MSE	Magnitude (% difference)
						2019	2018	2019	2018		
Moisture (%)	K-W	-	-	-	**<0.001**	80	24	77.5	81.45	-	-5
Metals (mg/kg wwt)											
Aluminum	$ANOVA_{log}$	2370	0.605	0.565	**<0.001**	79	24	2.934	2.678	0.028	81
Antimony	$ANOVA_{log}$	0.0424	0.679	0.469	**<0.001**	79	24	-1.761	-2.210	0.017	181
Arsenic	$ANOVA_{log}$	-	0.076	0.367	**0.024**	80	24	0.444	0.372	0.018	18
Barium	$ANOVA_{log}$	-	0.526	0.585	0.219	80	24	0.962	0.890	0.062	18
Beryllium	ANOVA	0.1460	0.661	0.053	**<0.001**	79	24	0.0497	0.0330	0.0002	51
Bismuth	$ANOVA_{log}$	0.0248	0.930	0.534	**<0.001**	79	24	-1.951	-2.184	0.017	71
Boron	$ANOVA_{log}$	16.70	0.514	0.695	**<0.001**	79	24	0.929	0.762	0.014	47
Cadmium	K-W	-	-	-	**0.004**	80	24	0.448	0.560	-	-20
Calcium	$ANOVA_{log}$	27000	0.576	0.562	**0.001**	79	24	3.847	3.701	0.039	40
Chromium	$ANOVA_{log}$	7.34	0.430	0.652	**<0.001**	79	24	0.402	0.155	0.025	76
Cobalt	$ANOVA_{log}$	-	0.649	0.925	**0.002**	80	24	0.019	-0.160	0.057	51
Copper	K-W	-	-	-	**0.099**	80	24	2.230	2.015	-	11
Iron	$ANOVA_{log}$	7000	0.826	0.585	**<0.001**	79	24	3.336	3.091	0.033	76
Lead	ANOVA	3.420	0.530	0.128	**<0.001**	79	24	1.237	0.739	0.170	67
Magnesium	$ANOVA_{log}$	-	0.775	0.669	**<0.001**	80	24	3.586	3.388	0.027	58
Manganese	$ANOVA_{log}$	-	0.637	0.608	**0.045**	80	24	1.970	1.785	0.153	53

Parameter	Test	Outlier Values	Shapiro-Wilk Test	Levene's Test	Test *P*-Value	n		LSM[(a)]		MSE	Magnitude (% difference)
						2019	2018	2019	2018		
Mercury	K-W	-	-	-	**0.013**	80	24	0.0300	0.0227	-	32
Molybdenum	$ANOVA_{log}$	-	0.091	0.513	**0.002**	80	24	-0.475	-0.611	0.035	37
Nickel	ANOVA	4.26	0.246	0.248	**<0.001**	79	24	2.11	1.54	0.35	37
Phosphorus	K-W	-	-	-	0.275	80	24	1225	1190	-	3
Potassium	$ANOVA_{log}$	-	0.817	0.260	**0.002**	80	24	3.088	3.148	0.007	-13
Selenium	K-W	-	-	-	**<0.001**	80	24	1.40	1.21	-	15
Sodium	K-W	-	-	-	0.832	80	24	4205	3955	-	6
Strontium	$ANOVA_{log}$	80.1, 89.9	0.051	0.159	0.104	78	24	1.230	1.294	0.028	-14
Thallium	$ANOVA_{log}$	0.0636	0.160	0.150	**<0.001**	79	24	-1.674	-1.922	0.035	77
Tin	K-W	-	-	-	**<0.001**	80	24	0.0600	0.0325	-	85
Uranium	$ANOVA_{log}$	-	0.846	0.110	**<0.001**	80	24	-0.717	-0.914	0.020	57
Vanadium	ANOVA	-	0.874	0.087	**<0.001**	80	24	3.91	2.41	1.53	62
Zinc	ANOVA	-	0.060	0.238	**<0.001**	80	24	13.7	11.3	4.86	21

n = sample size; LSM = least squared mean; MSE = mean squared error; K-W = Kruskal Wallis test; ANOVA = Analysis of Variance; log=data log10 transformed prior to analysis; - = not applicable. Values in bold indicate significant differences.
a) Substituted for median when data were analyzed using the K-W test

4.2 AIS/NIS

4.2.1 Zooplankton

Taxonomic data of zooplankton collected from seven stations in Milne Port and four stations at Ragged Island are presented in Appendix H-2. Zooplankton taxa presence in 2019 is presented along with presence/absence of the 2019 taxa from sample years since 2014 in Table 4-38. A complete presence/absence table is presented in Appendix H-3. A list of newly observed taxa in Milne Port, defined as taxa identified during the 2019 survey that had not been observed previously in MEEMP surveys since 2014 or in baseline surveys is provided in Table 4-39, along with a brief description of the known geographic distribution of each taxon or its status as AIS/NIS.

Of the 43 zooplankton taxa identified in samples collected during the 2019 AIS monitoring survey, three taxa had not been previously observed during AIS monitoring or baseline surveys (Table 4-39).

Table 4-38: Zooplankton Taxa Presence in Milne Inlet During AIS Monitoring in 2019 compared to previous survey years (2014-2018)

Taxa	2014	2015	2016	2017	2018	2019
Acartia longiremis	x	x	x	x		x
*Aeginopsis laurentii***				x	x	x
Aglantha digitale	x			x	x	x
Balanomorpha indet.**				x		x
Bivalvia indet.	x	x	x	x	x	x
Calanoida indet.	x	x	x	x	x	x
Calanus finmarchicus	x	x	x	x	x	x
Calanus glacialis	x	x	x	x	x	x
Calanus hyperboreus	x	x	x	x	x	x
Cladocera indet.						x
Clione limacina	x			x	x	x
Cnidaria indet.			x	x	x	x
Echinoidea indet.	x	x	x	x	x	x
Euphysa sp.		x			x	x
Fritillaria sp.		x	x		x	x
Gadidae indet.				x	x	x
Hybocodon prolifer						x
Isopoda indet.**				x	x	x
Limacina helicina		x		x	x	x
Microcalanus sp.				x	x	x
Microsetella norvegica	x	x	x	x	x	x
Obelia sp.						x
Oikopleura sp.		x		x	x	x
Oithona similis	x	x	x	x	x	x
Onisimus glacialis						x
Parasagitta elegans	x			x	x	x
Polychaeta indet.	x	x	x	x	x	x
Pseudocalanus sp.	x	x	x	x	x	x
Themisto libellula				x	x	x

Notes: Taxa identified to the lowest practical taxonomic level; presence/absence for previous years taken from SEM 2015, 2016, 2017a, Golder 2018, Golder 2019a. **=taxa not identified in 2014 through 2017 but identified during baseline studies in 2008 or 2010 (Baffinland 2012; SEM 2017a); indet.= indeterminate (taxa could not be identified beyond the taxonomic level listed); sp.=species. High taxonomic levels presented for taxa not previously identified to a lower taxonomic level (e.g. Crustacea indet. omitted due to large numbers of crustacean taxa identified to species level, Cottidae indet. presented due to lack of sculpins identified to species level).

In 2019, zooplankton samples contained three taxa that were not identified in previous years during MEEMP, AIS and baseline surveys (Table 4-39). Two taxa were identified to species level and one was only identifiable to genus level. New species identified were *Hybocodon prolifer*, a hydroid cnidarian from the Family Tubulariidae and *Onisimus glacialis*, a species of amphipod. Both species were identified in samples from Milne Port. Although 2019 represented the first observation of *O. glacialis* in Milne Port, an identified species from the same genus was observed during baseline surveys in Milne Port. At Ragged Island, an unidentified zooplankton species from the genus *Obelia* was observed in zooplankton samples. *Obelia* or wine glass hydroids, are a globally common taxon. Unidentified hydroids have previously been observed on the Ore Dock in Milne Port (Golder 2019b).

Each newly observed taxa was cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008) or an invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). In addition to these databases, each new taxon was researched independently in the literature for their known habitats and distributions for signs of taxa that may be considered non-native to the Arctic region. None of the newly observed zooplankton taxa in 2019 could be identified as non-native to the Arctic, despite not being previously identified in Milne Port (Table 4-39). Further review of natural ranges and vectors of introduction are required to confirm NIS status. Both taxa identified to the species level have wide distributions that include the Canadian Arctic and Baffin Island (WoRMS 2020). The taxon identifiable to only the genus level (*Obelia*) contains at least one species with a known occurrence in the Canadian Arctic.

Table 4-39: Newly Observed Zooplankton Taxa Identified in Milne Inlet in 2019

Taxa	Common Name	Description
Hybocodon prolifer (medusa stage)	Hydroid cnidarian	Species of hydroid cnidarians within the Family Tubulariidae. Global distribution, including Canadian Arctic and Baffin Island.
Obelia sp.* (medusa stage)	Wine glass hydroid	Genus of cnidarian within the Family Hydrozoa. Globally common and containing species with Canadian Arctic distributions.
Onisimus glacialis	Amphipod	Species of amphipod. Distributed throughout the Arctic and Northwest Atlantic, including the Canadian Arctic Archipelago. Unidentified species from the same genus were observed during baseline surveys.

*indicates taxa identified only at Ragged Island and not at Milne Port

A total of 475,409 organisms were estimated from samples collected at Milne Port and Ragged Island in 2019. Adjusted for the total volume of water sampled during each vertical haul and oblique tow, the mean density[20] of organisms for each area and sampling method was 3,573 ± 1,201 (SD) organisms/m^3 in vertical hauls at Milne Port, 769 ± 1111 (SD) organisms/m^3 in oblique tows at Milne Port, 2,480 ± 1,775 (SD) organisms/m^3 in vertical hauls at Ragged Island, and 39 ± 6 (SD) organisms/m^3 in oblique tows at Ragged Island (Figure 4-39). Higher zooplankton density in vertical hauls compared to the oblique tows was consistent with previous sampling years and likely a result of differences in the depth strata targeted by each sampling method. In general, zooplankton density, taxa richness and overall community composition in 2019 were comparable to previous AIS monitoring years.

[20] Calculated as the average density per sampling method ± one standard deviation of the mean

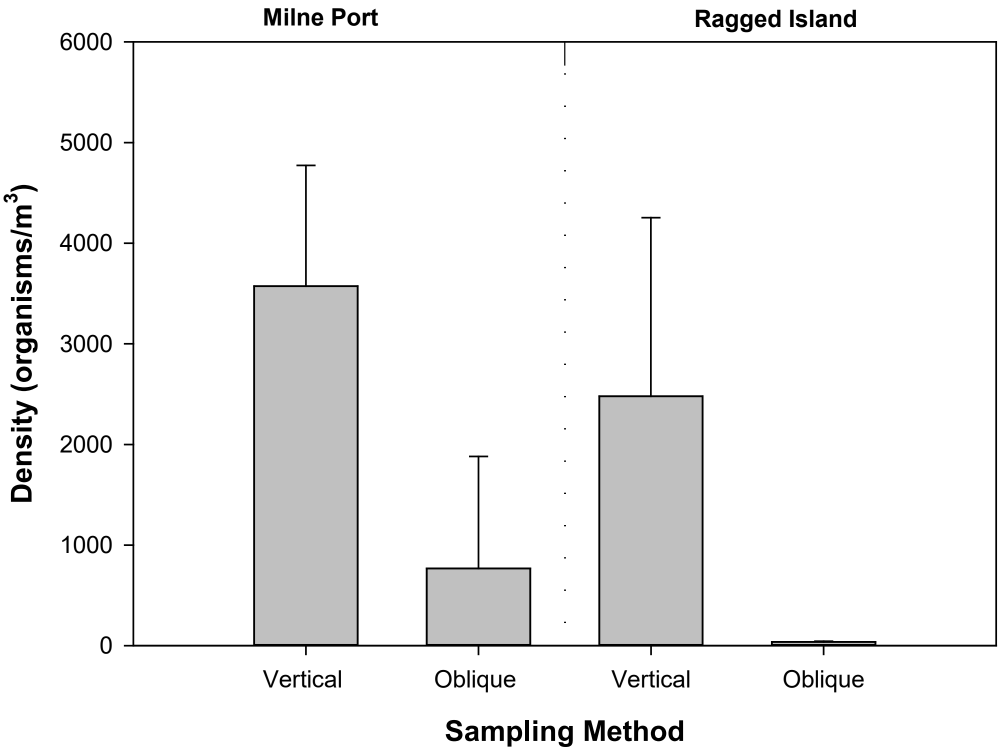


Figure 4-39: Mean Density of Zooplankton Collected in Oblique Tows and Vertical Hauls, Milne Port and Ragged Island, 2019. Error bars represent one standard deviation.

A taxa accumulation curve was calculated for samples collected in 2019 to compare sampling effort with previous AIS monitoring surveys in Milne Port and to provide an estimate of the effort required to fully characterize the zooplankton community (Figure 4-40). The taxa accumulation curve for the 2019 AIS sampling effort reached an asymptote at approximately fifteen samples, after which no new taxa were identified in any additional samples up to a total of twenty-one. The taxa accumulation curve for the 2019 AIS sampling effort is very similar to that observed for the 2017 and 2018 AIS sampling efforts (Golder 2018, 2019a), suggesting that the sampling effort in 2019 captured a proportion of the overall zooplankton community that was sufficient to describe the general zooplankton community structure.

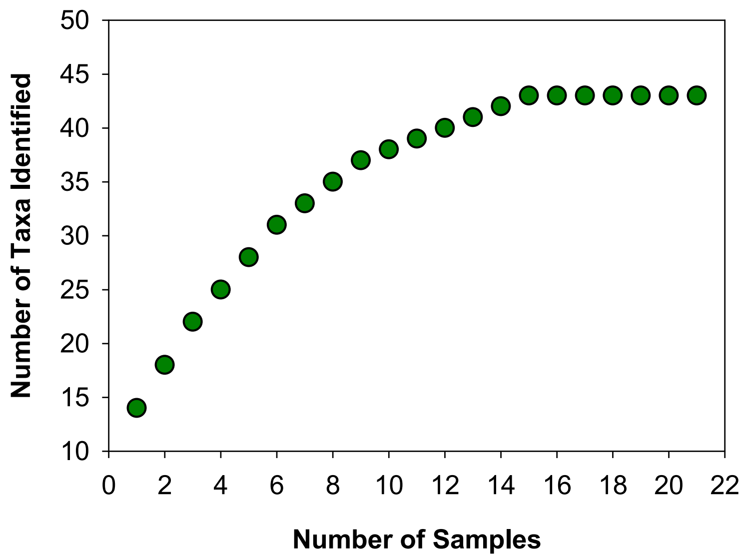


Figure 4-40: Taxa Accumulation Curve for Zooplankton, Milne Inlet, 2019.

The non-parametric species estimator Chao 2[21] was calculated for 2019 following the methods used in SEM 2017a, Golder 2018 and Golder 2019a. For samples collected in 2019, the Chao 2 calculation provided an estimate of 47.5 taxa observed, which exceeded the actual observed number of taxa (43) by 10% (Table 4-40). The discrepancy between the observed and expected number of zooplankton taxa was smaller than in 2018, but similar to the discrepancy observed during previous AIS monitoring in 2017 and 2014. The relatively low discrepancy between the observed and expected number of taxa suggests that the zooplankton sampling effort in 2019 was sufficient to characterize the overall zooplankton community.

Table 4-40: Chao 2 Species Estimates for Zooplankton Samples Collected in Milne Inlet (2014-2019)

Year	S_{obs}	Q_1	Q_2	S_1	% S_1 exceeds S_{obs}
2014	34	7	6	38.1	12
2015	40	10	6	48.3	21
2016	37	8	5	43.4	17
2017	44	8	9	47.6	8
2018	44	10	6	52.3	19
2019	43	9	9	47.5	10

Notes: Values for 2014 through 2018 taken from SEM 2017a, Golder 2018 and Golder 2019a. S_{obs}= # of taxa observed; Q_1= # of species occurring in only one sample; Q_2= # of species occurring in two samples; S_1= # of taxa expected to be observed based on Chao 2 estimate

4.2.2 Benthic Infauna

Sampling as part of the benthic infauna AIS/NIS program in 2019 represented a significant increase in sampling locations compared to previous years. Prior to 2018, AIS/NIS samples were collected at 8 locations in Milne Port

[21] Chao 2 calculation: $S_1=S_{obs}+(Q_1^2/2Q_2)$

and the two Ragged Island locations. Fifteen locations were added in 2018. In 2019, benthic invertebrate samples were collected from thirty-two stations in Milne Port and two stations at Ragged Island (Figure 3-2 and Figure 3-5). Benthic infauna and any incidental epifauna were identified to the lowest possible taxonomic level (Appendix E) and the presence/absence of each taxa compared to taxonomic data from baseline and previous MEEMP and AIS surveys (Appendix I). The program taxa list was also updated to include any new or updated accepted species names for any previously identified species.

A total of 58,374 organisms were estimated in 2019 surveys at Milne Inlet, which included 587 organisms at Ragged Island. These were identified to represent at least 319 different taxa, including 41 unique taxa that were not identified in previous surveys at Milne Port and Ragged Island (Table 4-41). Of newly identified taxa, 39 were found only at Milne Port and 2 only at Ragged Island. Approximately 70% of the new taxa were identified to the species level, 15% only to the genus level and 15% represented the first observations of higher taxonomic levels in Milne Inlet.

Some of the newly observed species represented the first occurrences where a specimen in a previously observed higher taxonomic level was able to be identified to the species level. In previous years, specimens from the genera *Aglaophamus*, *Pionosyllis*, *Aceroides*, *Clymenura*, *Pygospio*, *Nymphon* and *Polycirrus* were identified but were not resolved to the species level. *Eupyrgus scaber* is the first species identified in the Order Molpadiida - in previous surveys, specimens remained as indeterminate in the Order. Similarly, *Siphonodentalium lobatum* represents the first identifiable species in the Family Gadilidae.

Table 4-41: Newly Observed Benthic Infauna Taxa Identified at Milne Port and Ragged Island in 2019

Phylum Class/Order	Family	Taxa	Description
Annelida			
Polychaeta/ Cirratulida	Paraonidae	*Aricidea (Strelzovia) antennata*	Polychaete worm with a type locality in the Arctic Ocean.
Polychaeta/ Not Assigned	Maldanidae	*Clymenura polaris**	Arctic species with a distribution that includes the Canadian Arctic and Baffin Island.
Polychaeta/ Not Assigned	Maldanidae	*Petaloproctus tenuis*	Polychaete species with a distribution that includes the North Atlantic and Canadian Arctic, with observations at Baffin Island.
Polychaeta/ Phyllodocida	Nephtyidae	*Aglaophamus malmgreni**	Polychaete species with a distribution that includes the North Atlantic and Canadian Arctic, with observations at Baffin Island.
Polychaeta/ Phyllodocida	Nephtyidae	*Nephthys paradoxa*	Polychaete species with a distribution throughout the North Atlantic and Arctic Oceans, including the Canadian Arctic.
Polychaeta/ Phyllodocida	Phyllodocidae	*Eumida* sp.	Genus containing at least one representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island.
Polychaeta/ Phyllodocida	Polynoidae	*Harmothoe rarispina*	Species range includes the north western Atlantic, specimens collected in Canadian Arctic, including Baffin Island (under synonymized name *Lagisca rarispina*).
Polychaeta/ Phyllodocida	Sphaerodoridae	*Sphaerodoropsis biserialis*	Canadian Arctic species of polychaete.
Polychaeta/ Phyllodocida	Syllidae	*Exogone naidina*	Widespread distribution, including the Arctic Ocean, the Canadian Arctic and Baffin Island.
Polychaeta/ Phyllodocida	Syllidae	*Pionosyllis compacta**	Polychaete species with a distribution that includes the North Atlantic and Canadian Arctic, with observations at Baffin Island.

Phylum Class/Order	Family	Taxa	Description
Polychaeta/ Sabellida	Fabriciidae	*Pseudofabricia* sp. nr. *aberrans***	Only described species in genus. Very limited description for the species indicates possible endemism to the Mediterranean Sea, but indications of specimens collected in the Black Sea and in the North Sea. Sent for verification.
Polychaeta/ Sabellida	Sabellidae	*Dialychone* sp. 1	Various undescribed species observed previously in Milne Inlet. Specimen has features that do not match any described species in the genus.
Polychaeta/ Sabellida	Sabellidae	*Euchone analis*	North Atlantic and Arctic Oceans including the Canadian Arctic and Baffin Island, with a type locality in the Greenlandic portion of the Arctic Ocean.
Polychaeta/ Sabellida	Sabellidae	Sabellidae sp. 3	Unique sabellid specimen lacking features that match any described species.
Polychaeta/ Sabellida	Sabellidae	Sabellidae sp. 4	Unique sabellid specimen lacking features that match any described species.
Polychaeta/ Spionida	Spionidae	*Marenzelleria viridis**	Records include North Atlantic and Arctic Oceans, including Canadian Arctic and Baffin Island, Listed as invasive to areas outside of East Coast North America. Invasive to the Baltic and North Seas, vector is ballast water and sediments (locally by currents).
Polychaeta/ Spionida	Spionidae	*Pygospio elegans**	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Polychaeta/ Terebellida	Ampharetidae	*Ampharete borealis*	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Polychaeta/ Terebellida	Ampharetidae	*Sosane* sp. nr. *wireni*	Described range does not extend beyond New England, but there are potential specimen collections around Scandinavia and Greenland under a former name. Sent for verification.
Polychaeta/ Terebellida	Terebellidae	*Polycirrus medusa**	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Arthropoda			
Malacostraca/ Amphipoda	Acanthonotozomatidae	*Acanthonotozoma inflatum*	First observation of the Family in AIS/NIS surveys. Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic.
Malacostraca/ Amphipoda	Oedicerotidae	*Aceroides latipes**	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Malacostraca/ Amphipoda	Uristidae	*Anonyx laticoxae*	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Malacostraca/ Cumacea	Leuconidae	*Leucon nasica*	Widespread distribution, including the Arctic Ocean, the Canadian Arctic and Baffin Island.
Ostracoda/ Podocopida	Cytheridae	Cytheridae indet.	Ostracod Family with global distribution, contains representative species with distributions in the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Pycnogonida/ Pantopoda	Nymphonidae	*Nymphon hirtipes**	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Bryozoa			

Phylum Class/Order	Family	Taxa	Description
Gymnolaemata/ Cheilostomatida	Escharellidae	*Escharella* sp.	Genus containing at least one representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island, distribution in the Northwest Atlantic and, Arctic Ocean.
Stenolaemata/ Cyclostomatida	Oncousoeciidae	*Oncousoecia* sp.	Genus with some representation in the North West Atlantic, but specimens collected from New England area only, two species have arctic distributions, but European arctic/Barents Sea/Svalbard area (*O. diastoporides* and *O. canadensis*). Sent for verification.
Stenolaemata/ Cyclostomatida	Tubuliporidae	*Tubulipora* sp.	Genus containing species common to the North West Atlantic, and Arctic Oceans, at least one representative species collected from Baffin Island.
Chordata			
Actinopterygii/ Scorpaeniformes	Cottidae	Cottidae indet.	Sculpin Family new to benthic samples, however representative species of sculpin are regularly captured as part of the fish program of the MEEMP.
Actinopterygii/ Perciformes	Zoarcidae	Zoarcidae indet.	Globally widespread Family of fish, include species with Arctic distributions.
Cnidaria			
Anthozoa/ Actiniaria	Edwardsiidae	Edwardsiidae indet.	Actiniarian (anemone) Family containing at least one representative species with a native distribution within the North Atlantic and Arctic Oceans, including Baffin Bay.
Hydrozoa/ Anthoatheca	Corynidae	Corynidae indet.***	Hydrozoan Family containing at least one representative species with a native distribution within the Canadian Arctic, including collections at Baffin Island.
Hydrozoa/ Leptothecata	Lafoeidae	*Lafoea* sp.	Hydrozoan genus containing at least one representative species with a native distribution within the North Atlantic and Arctic Oceans, including Baffin Island.
Echinodermata			
Holothuroidea/ Molpadiida	Eupyrgidae	*Eupyrgus scaber*	First observation of a species within the Order in AIS/NIS surveys. Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Ophiuroidea/ Ophiurida	Ophiopyrgidae	*Ophiopleura borealis*	First observation of the Family in AIS/NIS surveys. Canadian Arctic species, observations include at Baffin Island.
Mollusca			
Gastropoda/ Cephalaspidea	Philinidae	Philininae indet.	Subfamily with limited descriptions of ranges. Globally representative taxa.
Gastropoda/ Neogastropoda	Buccinidae	*Buccinum ciliatum*	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Gastropoda/ Not assigned	Lottidae	*Erginus rubellus****	Limpet species with a documented range that includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.
Scaphopoda/ Gadilida	Gadilidae	*Siphonodentalium lobatum*	Documented range includes the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island.

Phylum Class/Order	Family	Taxa	Description
Nemertea			
Pilidiophora/ Heteronemertea	Lineidae	*Lineus* sp.	Globally distributed genus, with at least one representative species with North Atlantic or Arctic Ocean distribution.

Notes: Taxa identified to the lowest practical taxonomic level; *=First species designation of previously observed genus; **=Specimens initially designated as *Pseudofabricia* sp. nr. *fabricia* were identified in 2018 samples as well but assigned a possible alternative identification of *Manayunkia aesturiana*; ***= New species observed only at Ragged Island. sp.=species; Taxa listed as "sp. 1" or "sp. A" indicate provisional taxa identified as unique that do not match a described species. High taxonomic levels presented only for taxa not previously identified to a lower taxonomic level. Taxa information sources: Casas-Monroy et al. 2014, Cusson 2018, Degan and Faulwetter 2019, DFO 2019, EOL 2020, ETI 2020, Fofonoff et al. 2020, GBIF 2020, Golder 2019a, Goldsmit 2016, Miller et al. 2014, Molnar et al. 2008, NCCOS 2020, OBIS 2011, 2016, Palomares and Pauly 2019, Read and Fauchald 2020, Sirenko et al. 2020, Stewart et al. 1985, WoRMS 2020

A taxa accumulation curve was calculated for samples collected in Milne Inlet and Ragged Island to compare sampling effort with previous AIS/NIS monitoring surveys and to provide an estimate of the effort required to fully characterize the benthic infauna community (Figure 4-41). The curve reaching an asymptote would be an indication that sampling was sufficient to fully characterize the benthic infaunal community. In 2018, the asymptote was reached at 58 out of 71 samples, at 351 taxa. In 2019, the accumulation curve did not reach an asymptote, indicating the samples collected were not sufficient to fully characterize biodiversity of the benthic infaunal community in Milne Port and Ragged Island, despite an increase in sample locations and sample volumes.

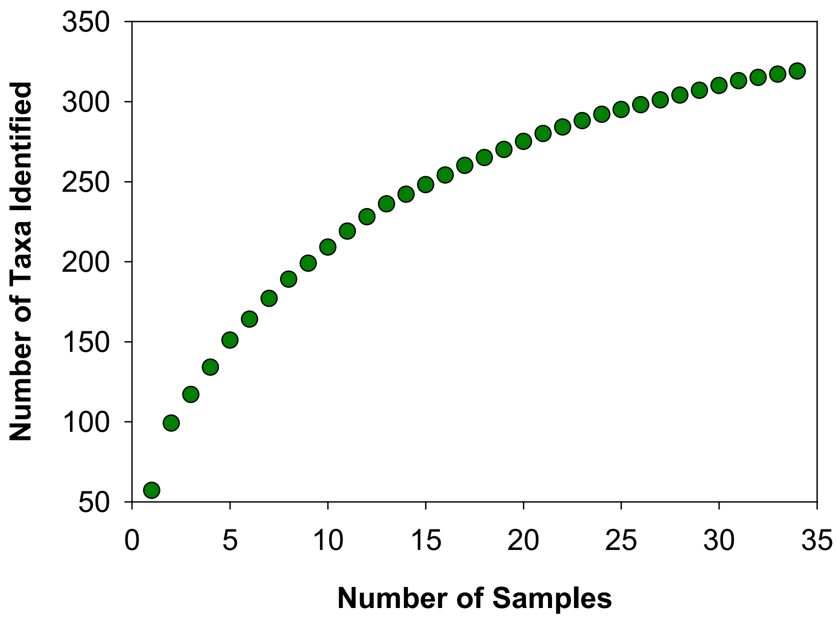


Figure 4-41: Taxa Accumulation Curve for Benthic Infauna Collected at Milne Inlet, 2019

The non-parametric species estimator Chao 2 was calculated for 2019 following the methods in SEM 2017a (Table 4-42). For samples collected in 2019, the Chao 2 calculation provided an estimate of 411.1 taxa to be expected within samples, compared to the observed number of 319. The estimate exceeded the observed by 29%.

Table 4-42: Chao 2 Species Estimates for Benthic Infauna Samples Collected in Milne Inlet (2013, 2015 through 2019)

Year	S_{obs}	Q_1	Q_2	S_2	%S_2 Exceeds S_{obs}
2013	188	70	27	278.7	48
2015	181	56	25	246.3	36
2016	218	59	38	263.8	21
2017	235	92	47	324.0	38
2018	346	81	35	439.7	27
2019	319	89	43	411.1	29

Notes: Values for 2013, 2015 through 2018 taken from SEM 2017a, Golder 2018 and Golder 2019a. S_{obs}= # of taxa observed; Q_1= # of species occurring in only one sample; Q_2= # of species occurring in two samples; S_1= # of taxa expected to be observed based on Chao 2 estimates

4.2.2.1 Taxa Verifications

The majority of newly observed taxa were known in Arctic habitats, or had representative species with Arctic distributions. However, during the 2019 AIS/NIS survey program, a number of species were identified as potentially non-indigenous to the region, or to Arctic waters. Fauna of the Canadian Arctic are not thoroughly described, and marine surveys have not been exhaustive, therefore it is possible that a species not described as from the region may represent a first observation within a native range and not the introduction of a non-native species, or it may represent a record of a new species.

Species that were determined as potentially non-indigenous or invasive were flagged for secondary taxonomic review by Biologica. Additionally, independent verifications of the samples were made by Philippe Archambault's Benthic Ecology Lab at Université Laval (Laval; Quebec), in order to confirm the presence of any non-indigenous species. Additional samples were also sent for verification where new species descriptions existed or there was uncertainty on the identification, whether or not the species were of concern as non-indigenous or invasive species. Specimens identified as *Nereimyra aphroditoides* and *Streptospinigera niuquut* were sent for confirmation due to the taxonomic description for these species being updated. Additionally, specimens of *Rhodine loveni* from samples in 2019, were sent to gain clarity on the identification due to specimens of this species being tentatively identified as *R. gracilior* in 2018.

4.2.2.1.1 *Pseudofabricia* sp. nr. *aberrans*

In 2018, a sabellid polychaete worm was found in benthic infaunal samples and tentatively identified as a *Pseudofabricia* species (Golder 2019a). *P. aberrans* is the only described species in the genus, and it has a defined range limited to the Mediterranean Sea (Giangrande and Cantone 1990, WoRMS 2020). However, specimens identified as *P. aberrans*, as well as unidentified specimens from the *Pseudofabricia* genus, have been identified in waters around the United Kingdom and the Black Sea (OBIS 2020). *P. aberrans* is not listed as an invasive species or a species of concern in Canadian or Arctic waters (Molnar et al. 2008, Casas-Monroy et al. 2014).

Only a limited description exists for *P. aberrans*, and polychaete surveys in the Canadian Arctic are not exhaustive. In 2018, it was determined the specimens were possibly a cryptic species related to *P. aberrans*, or that the range on record was incomplete. As the samples collected from Milne Port matched the species description of *P. aberrans*, a temporary identification of *Pseudofabricia* sp. nr. *aberrans* was assigned to those specimens, indicating an inconclusive identification near to *P. aberrans*. The samples were sent for independent verification and a tentative alternative identification of *Manayunkia aesturiana* was assigned (Golder 2019a), although the identification was uncertain.

Biologica taxonomists again identified *Pseudofabricia* sp. nr. *aberrans* in benthic samples from MEEMP and AIS surveys in 2019. Seven adults and two juveniles were found in samples BNW-4 (corresponding approximately to 2018 sample location SN-3, a location where *P. aberrans* was tentatively identified in 2018), BNE-3, BNE-4, BNE-5 and BNE-8. Specimens from 2019 samples were sent to Laval for independent verification of the identification. Laval identified the specimens as *Fabricia sabella*, however, in the taxonomic record this is considered an unaccepted name for *Fabricia stellaris*. *F. stellaris* (and *F. sabella*) have documented distributions that include the Canadian Arctic, with specimen collections made at Baffin Island.

4.2.2.1.2 *Marenzelleria viridis*

Specimens of a spionid polychaete identified as *Marenzelleria viridis* were found in two benthic samples in 2019. Unidentified species from this genus have been identified previously in benthic samples prior to 2019 (2016, 2017 and 2018). *M. viridis* is described as native to east coast North America from Nova Scotia to Delaware, with a probable native range that includes waters around Newfoundland to Chesapeake Bay (Fofonoff et al. 2020). This species is listed in the Global Database as invasive to areas outside of East Coast North America (Molnar et al. 2008). It is also listed in the National Risk Assessment as a potential invader to Canadian waters, including the Arctic region (Casas-Monroy et al. 2014). The primary invasion vector is considered to be transport through ballast water and sediments and, once established, locally by currents (Molnar et al. 2008). Introduced to California, Scotland, the North Sea, and the Baltic Sea, *M. viridis* reaches high densities, in some locations replacing native infauna and altering sediment characteristics (Molnar et al. 2008, Fofonoff et al. 2020). Once established, management is considered highly difficult, being irreversible or impossible to contain or confine (Molnar et al. 2008).

However, there is uncertainty surrounding the AIS status of this species in Canadian waters. Notably, Casas-Monroy et al. (2014) describes this species as a potential invader to the Atlantic, which is part of this species' described natural range (Fofonoff et al. 2020). Specimen collection records for *M. viridis* also indicate a potentially wider range, or historical occurrences outside the natural range in the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island (Cusson 2018, WoRMS 2020). Additionally, under the former identification for this species, *Scolecolepides viridis,* multiple specimens have been collected in the Canadian Arctic in the 1970s and 1980s (GBIF 2020, Miller et al. 2014).

These specimens were sent to Laval for verification. Laval confirmed the identification of *Marenzelleria viridis*.

4.2.2.1.3 *Sosane* sp. nr. *wireni*

A terebellid polychaete worm was identified in 2019 samples that matched the identification of *Sosane wireni* – a species with a distribution limited to New England. However, specimen collection records indicate this species may have extensively been collected in Scandinavian waters, Western Greenland, and the Laptev Sea, including under the former name *Sosanopsis wireni* (GBIF 2020, WoRMS 2020). Other species within the genus *Sosane* have Arctic or North Atlantic distributions. *S. bathyalis* is distributed within the European Arctic, *S. sulcate* and *S. wahrbergi* have North Atlantic and Scandinavian distributions, and *S. cinctus* is distributed through the North Atlantic. No specimens from any species within the *Sosane* or *Sosanopsis* genera have been recorded in previous MEEMP or AIS surveys at Milne Port.

Due to the similarities to the species description of *S. wireni*, specimens from 2019 samples are being referred to as *Sosane* sp. nr. *wireni,* prior to confirmation of identification. The specimens have been sent for independent verification at Laval. *S. wireni* is not listed on any of the available databases on invasive species or species of concern.

4.2.2.1.4 *Monocorophium* sp.

In baseline surveys and subsequent survey years, an amphipod was identified as *Monocorophium insidiosum* – a tube building gammarid amphipod that is a well-known fouling invasive species with a wide global distribution that is possibly non-indigenous to the Canadian Arctic (Molnar et al. 2008). The northern extent of the range of this species is unknown and it is considered cryptogenic on the North American east coast, although it may be considered native to parts of the northern Atlantic Ocean (Palomares and Pauly 2019, NIMPIS 2018, Molnar et al. 2008). Vectors for introduction and spread include biofouling of ship hulls and hard substrates in harbours and ports and, possibly, also through accidental transplant (Fofonoff et al. 2020, Molnar et al. 2008).

In 2019, specimens tentatively identified as *M. insidiosum* from samples in the 2017 and 2018 AIS/NIS programs at Milne Port were sent for independent taxonomic verification by Philippe Archambault's Benthic Ecology Lab at Université Laval. Review suggested that the *M. insidiosum* identified in those years may have been *Crassicorophium bonelli*, although the identification was considered uncertain by Biologica (Golder 2019a, MacDonald 2020, Pers. Comm.). No record was found of this species in Arctic waters during review, indicating that if this was the accepted identification of the specimens from 2017 and 2018, it would indicate the potential presence of a non-indigenous species.

An unknown species of gammarid amphipod was again identified from the *Monocorophium* genus in 2019 benthic infauna samples. No species within this genus have known distributions that include Arctic waters, and in addition to *M. insidiosum*, two other species in this genus (*M. acherusicum* and *M. sextonae*) are also considered invasive (Molnar et al. 2008). These specimens again were sent to Laval for verification. Additionally, a third-party lab specializing in identification of amphipods is being sought to gain clarity on the identification of these specimens.

4.2.2.1.5 *Oncousoecia* sp.

Among bryozoan species identified in 2019 AIS benthic infauna samples was an unidentified species from the genus *Oncousoecia.* This genus includes species with ranges that extend into the North West Atlantic; however, recent specimen collection records within this region are solely from the New England area (WoRMS 2020). Two species within this genus (*O. diastoporides and O. canadensis*; WoRMS 2020) have distributions that include Arctic waters, but are limited to the European Arctic (i.e., the Barents Sea and Svalbard). A record of collection exists for *O. diastoporides* in Greenland, however, the identification was made from a preserved sample collected in 1875, and no recent records exist (GBIF 2020). No species within the genus *Oncousoecia* are listed on any of the available databases on invasive species or species of concern. These specimens were sent for independent verification at Laval.

4.2.3 Macroflora and Benthic Epifauna

Five transects were surveyed for aquatic invasive macroflora and benthic epifauna. Four transects were re-surveyed from 2018, with one additional transect added to incorporate the area around a new Freight Dock constructed in Milne Port in 2019. Due to the presence of an iceberg on Transect AIS02, the transect location was adjusted for 2019 surveys. The adjusted transect path was referred to as AIS02a.

A total of six distinct macroflora taxa were observed during AIS underwater video surveys in Milne Port in 2019 (Table 4-43, Appendix J). Only one species was recorded in 2019 that was not seen in the 2018 surveys, *Desmarestia* sp., a brown filamentous alga. However, this species was recorded in AIS surveys from 2014-2017.

The thirty-seven distinct epifauna taxa recorded from AIS and belt transect underwater video surveys and Fukui trap samples in Milne Port in 2019 included epifauna, fish, and plankton (Table 4-43, Appendix J). Supported by the inclusion of high definition (HD) video footage in 2019, eleven new taxa, not previously recorded during AIS underwater video surveys in 2014 through 2018, have been identified. These new taxa included two unidentified cephalopods (Cephalopoda indet.) (Appendix A; Photo 46), an unidentified worm of the Phylum Annelida, an unidentified shrimp from the Crangonidae Family (Appendix A; Photo 41), an unidentified crustacean (Crustacean indet.), an unidentified amphipod (Amphipoda indet.), a moon snail of the Naticidae Family, a tunicate (*Polycarpa* sp.) (Appendix A; Photo 39), and mud scallops (*Similipecten greenlandicus*) (Appendix A; Photo 40). Many of the new taxa identifications were based on a review of benthic infauna samples collected in 2019 (Appendix E) and on distributions demonstrated in literature. Members of the Cephalopoda Class have been identified as being in the Arctic, with several possible species identified in Baffin Bay (Gardiner and Dick 2010). *P. pomaria*, *S. greenlandicus*, and at least one Naticidae species have been documented in the Canadian Arctic as well (Golder 2018, WoRMS 2020, E-Fauna BC 2020).

Several species observed in 2019 had been absent from the ROV record for several years, including the blunt gaper (*Mya truncata*), a bivalve seen only in 2013, and two other taxa desribed in Section 1.1.1. The use of HD video footage has also led to a resolved classification of one polychaete worm identified in 2018, Pectinariidae (ice cream cone worm); in 2019, with the higher video resolution and coroboration with benthic infauna data, the Pectinariidae was identified as *Cistenides granulata*.

A literature review was performed for all taxa identified in ROV surveys, including AIS transects, belt transects and ship hull surveys to determine their known habitats and distributions for signs of taxa that may be considered non-native to the Arctic region. Each newly observed taxa was also cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008) or as an invasive species in Canada, according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). All taxa that were not identified to the species level had at least one representative species with a native distribution that includes Arctic waters (Table 4-43).

Table 4-43: AIS/NIS Surveys Macroflora and Benthic Epifauna, 2019

Phylum Class/Order	Family	Taxa Common Name	Description
Annelida			
Polychaeta/ Terebellida	Pectinariidae	*Cistenides granulate** Ice cream cone worm	Small scallop species with verified distribution near Baffin Island and seen in benthic infauna data during MEEMP surveys in Milne Port.
Polychaeta/ Terebellida	Terebellidae	*Pista maculata* Fiber tube worm	Polychaete worm species with verified distribution near Baffin Island and seen in benthic infauna data during MEEMP surveys in Milne Port.
Polychaeta/ Sabellida	Sabellidae	Sabellidae indet.	Unidentified feather duster worm; Family with at least one representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island. Several species seen in benthic infauna data during MEEMP surveys in Milne Port.
---	---	---	Unidentified ring worm*; Phylum with at least one representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island.
Arthropoda			
Malacostraca/ Amphipoda	---	Amphipoda indet.*	Unidentified amphipod; Order with at least one representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island. Several species seen in the benthic infauna data during MEEMP surveys in Milne Port.
Malacostraca/ Decapoda	Crangonidae	Crangonidae indet.*	Unidentified shrimp; Family with at least one known representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island. At least one species seen in the benthic infauna data. During MEEMP surveys in Milne Port.
Pycnogonida/ Pantapoda	Nymphonidae	*Nymphon* sp. Sea spider	Genus with known species in the Canadian Arctic, including Baffin Island. Seen in previous MEEMP surveys in Milne Port.
Crustacea	---	Crustacea indet.*	Unidentified arthropod; Clade with at least one known species in the Canadian Arctic; at least one species seen in the benthic infauna data during MEEMP surveys in Milne Port.
Chlorophyta			
---	---	---	Unidentified green algae; Phylum with known species in the Canadian Arctic. Previously identified in the MEEMP program in Milne Port.
Chordata			
Actinopterygii/ Gadiformes	Gadidae	Gadidae indet.*	Unidentified cod, juvenile; Family with several known species at Baffin Island and several species caught in the fish surveys during MEEMP surveys in Milne Port.
Actinopterygii/ Perciformes	Zoarcidae	*Gymnelus viridis* Fish doctor	Prickleback species with known distribution including Baffin Island; seen in previous MEEMP surveys in Milne Port.
Actinopterygii/ Perciformes	Zoarcidae	Zoarcidae indet.*	Unidentified eelpout; Family with at least one known representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island.

Phylum Class/Order	Family	Taxa Common Name	Description
Actinopterygii/ Perciformes	Stichaeidae	Stichaeidae indet. sp. 1.**	Unidentified eelblenny, potentially of the genus *Lumpenus*, with at least one known native representative species with distribution in the Canadian Arctic.
Actinopterygii/ Perciformes	Stichaeidae	Stichaeidae indet.	Unidentified prickleback; Family with at least one known representative species with a native distribution within the Canadian Arctic Ocean, including Baffin Island.
Actinopterygii/ Scorpaeniformes	Cyclopteridae	*Cyclopterus lumpus* Common lumpfish	Small fish species with known distribution in Baffin Island; seen in previous MEEMP surveys in Milne Port.
Actinopterygii/ Scorpaeniformes	Cottidae	*Myoxocephalus* sp. Sculpin	Unidentified sculpin; Genus with known species in Baffin Island and in the MEEMP fish surveys in Milne Port.
Ascidiacea/ Stolidobranchia	Styelidae	*Polycarpa* sp.* Tunicate	Sea squirt previously noted to be in the Canadian Arctic in the 2018 MEEMP program in Milne Port.
Ascidiacea/ Stolidobranchia	Styelidae	Styelidae indet.	Unidentified tunicate (sea squirt); Family with at least one representative species with a known distribution in the Canadian Arctic.
---	---	---	Unidentified fish.
Cnidaria			
Anthozoa/ Actiniaria	---	Actiniaria indet.	Unidentified sea anemone; Order with at least one known representative species with a native distribution within the Canadian Arctic, including Baffin Island.
Hydrozoa	---	Hydrozoa indet.[t]	Unidentified hydromedusa; Class with at least one known representative species identified in the benthic infauna data during MEEMP surveys in Milne Port.
---	---	---	Unidentified cnidarian; Phylum with several known representative species with a native distribution within the Canadian Arctic, including Baffin Island.
Ctenophora			
---	---	---	Unidentified ctenophore; Phylum with several known representative species with a native distribution within the Canadian Arctic, including Baffin Island. Seen previously in MEEMP ROV surveys in Milne Port .
Echinodermata			
Asteroidea/ Velatida	Solasteridae	*Crossaster pappuosus* Common sun star	Many-armed sea star seen in previous MEEMP surveys in Milne Port.
Asteroidea	---	Asteroidea indet.	Unidentified sea star; Class with at least one known representative species with a native distribution within the Canadian Arctic, including Baffin Island.
Crinoidea/ Comatulida	Bourgueticrinidae	*Bourgueticrininia* sp. Sea lily	Crinoid genus seen in previous MEEMP surveys in Milne Port.

Phylum Class/Order	Family	Taxa Common Name	Description
Echinoidea/ Echinoida	Strongylocentrotidae	*Strongylocentrotus droebachiensis* Green sea urchin	Urchin species seen in previous MEEMP surveys in Milne Port.
Echinoidea	---	Echinoidea indet.	Unidentified sea urchin; Class with at least one known representative species with a native distribution within the Canadian Arctic, including Baffin Island.
Holothuroidea	---	Holothuroidea indet.	Unidentified sea cucumber; seen in previous MEEMP surveys in Milne Port.
Ophiuroidea/ Ophiurida	Ophiuridae	*Ophiura sarsii* Brittle star	Brittle spar species seen in previous MEEMP surveys in Milne Port.
Mollusca			
Bivalvia/ Adepedonta	Hiatellidae	*Hiatella arctica* Wrinkled rock borer	Clam species seen in previous MEEMP surveys in Milne Port.
Bivalvia/ Myidea	Myidae	*Mya truncata* Blunt gaper	Clam species seen in previous MEEMP surveys in Milne Port.
Bivalvia/ Pectinida	Pectinidae	*Chlamys islandica* Iceland scallop	Scallop species seen in previous MEEMP surveys in Milne Port.
Bivalvia/ Pectinida	Pectinidae	Pectinidae indet. Unidentified scallop	Unidentified scallop seen in previous MEEMP surveys in Milne Port.
Bivalvia/ Pectinioida	Propeamussiidae	*Similipecten greenlandicus** Mud scallop	Scallop species with known distribution in the Canadian Arctic. Identified based on benthic infauna data from MEEMP surveys in Milne Port.
Bivalvia/ Venerida	Arcticidae	*Arctica islandica* Ocean quahog	Clam species seen in previous MEEMP surveys in Milne Port.
Bivalvia	---	Bivalvia indet.	Unidentified bivalve; Class with several known representative species with a native distribution within the Canadian Arctic, including Baffin Island.
Cephalopoda	---	Cephalopoda indet.*	Unidentified cephalopod; Phylum with at least ten native representatives in the Canadian Arctic, including three in Baffin Island.
Gastropoda/ Cephalapidea	---	Cephalaspidea indet.[t]	Unidentified bubble snail; Order with at least one native representative in the Canadian Arctic; at least one species identified in benthic infauna data during MEEMP surveys in Milne Port.
Gastropoda/ Littorinimorpha	Naticidae	Naticidae indet.*	Unidentified moon snail; Family with at least one native representative in the Canadian Arctic; at least one species identified in benthic infauna data during MEEMP surveys in Milne Port.
Gastropoda/ Not assigned	Buccinidae	*Buccinum undatum* Common whelk	Whelk species seen in previous MEEMP surveys in Milne Port.
Gastropoda/	Clinonidae	*Clione limacina*	Small sea slug seen in previous MEEMP surveys in Milne Port.

Phylum Class/Order	Family	Taxa Common Name	Description
Not assigned		Sea angel	
Gastropoda/ Not assigned	Limacinidae	*Limacina helicina* Sea butterfly	Small sea snail seen in previous MEEMP surveys in Milne Port.
Gastropoda	---	Gastropoda indet.[t]	Unidentified gastropod; Family with at least one native representative in the Canadian Arctic, including Baffin Island; at least one species identified in benthic infauna data during MEEMP surveys in Milne Port.
Ochrophyta			
Phaeophyceae/ Desmarestiales	Desmarestiaceae	*Desmarestia* sp. Acid weed	Filamentous brown algae seen in previous MEEMP surveys in Milne Port.
Phaeophyceae/ Fucales	Fucaceae	*Fucus sp.* Rockweed	Small brown algae seen in previous MEEMP surveys in Milne Port.
Phaeophyceae/ Laminariales	Costariaceae	*Agarum cribosum* Sieve kelp	Large bladed brown algae seen in previous MEEMP surveys in Milne Port.
Phaeophyceae/ Laminariales	Lamanariaceae	*Laminaria* sp. Kelp	Large bladed brown algae seen in previous MEEMP surveys in Milne Port.
---	---	---	Unidentified brown algae; Phylum with known species in the Canadian Arctic. Previously identified in the MEEMP program in Milne Port.
Rhodophyta			
Florideophyceae	Gigartinales	*Chondrus crispus* Irish moss	Small red algae species seen in previous MEEMP surveys in Milne Port.
Florideophyceae	---	Corallinophycidae indet.	Unidentified encrusting coralline algae; Class seen previously in 2018 MEEMP ROV surveys in Milne Port.
---	---	---	Unidentified red algae; Phylum with known species in the Canadian Arctic. Previously identified in the MEEMP program in Milne Port.

Notes: Taxa identified to the lowest practical taxonomic level; *=First record of specimen in ROV surveys; **=First record of specimen in MEEMP and AIS/NIS program; [t]=specimen only seen in belt transects; sp.=species; High taxonomic levels presented only for taxa not previously identified to a lower taxonomic level. Taxa information sources: Appendix G-2, Appendix E, E-Fauna BC 2020, EOL 2020, Gardiner and Dick 2010, WoRMS 2020

4.2.4 Encrusting Epifauna

Only the settlement basket and settlement plates on the east side of the Ore Dock were analyzed in 2019. The settlement basket and plates on the western side of the Ore Dock were lost when the tether that attached the settlement baskets to the Ore Dock was severed just below the water line, presumably due to interactions with the sea ice during the winter break-up period. The settlement plates were found washed up on shore and were therefore unusable, while the settlement baskets were not recovered.

A total of 2,317 encrusting epifauna from twenty-two unique taxa were identified from settlement baskets and settlement plates recovered from the existing Ore Dock in 2019 (Table 4-44, Appendix K-2). The majority of encrusting epifauna collected were bryozoans of the Order Cyclostomatida, which included a total of 1,570 adults unidentifiable to the species level. An additional 264 adult Cyclostomatidan bryozoans were identified to be the species *Patinella verrucaria*. Other bryozoans identified included unknown species from the genera *Alcyonidium* and *Bowerbankia*, and a single unidentifiable individual from the Suborder Ascophora.

The next most abundant taxa were barnacles of the arthropodan Suborder Balanomorpha (species undetermined), of which a total of 302 juveniles were observed. Other arthropods included copepods of the Order Harpacticoida (n=3) and unidentified amphipods (n=2).

Each epifauna taxa identified to species was cross-checked against global databases of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008, Fofonoff et al. 2020), or as invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). New taxa observations from 2019 were also reviewed to determine their known natural distributions and confirm that these species have ranges that extend into the Arctic or North Atlantic near Baffin Island and are not potentially non-indigenous.

New taxa observations in 2019 included the sabellid worm, *Circeis armoricana.* In 2018 AIS/NIS surveys, unidentified species within this genus were observed. *C. armoricana* has a limited description, but records indicate the species is present in Arctic and North Atlantic waters (WoRMS 2020, GBIF 2020, Sirenko et al. 2020). The most common of the identifiable bryozoans was the colonial species *Patinella verrucaria*. This species has a described range that includes the Canadian Arctic, with specimen records from Baffin Island, Devon Island and Ellesmere Island, as well as Western Greenland (GBIF 2020, WoRMS 2020). Unidentified species from the Cnidarian genus *Gonothyraea* were also observed on settlement substrates. *Gonothyraea* is a genus of hydrozoan cnidarians with a global distribution. At least one species within the genus has a described range and collection records within the Canadian Arctic, including Baffin Bay and Davis Strait (GBIF 2020). Additionally, new observations included unidentifiable individuals from the cnidarian hydrozoan Family Tubulariidae. Tubulariidae includes species with Arctic distributions, including *Hybocodon prolifer*, a species observed for the first time in MEEMP and AIS/NIS zooplankton surveys in 2019 (Section 4.2.1).

Table 4-44: Epifauna Taxa Identified from Settlement Baskets and Plates in Milne Port, 2019

Taxa	Total Abundance				Description
	A	I	J	L	
Annelida					
*Nereimyra aphroditoides**	2	2			Polychaete worm, known to be distributed in the Canadian and Greenlandic part of the Arctic Ocean, including Baffin Island.
*Pholoe minuta**	1	2			Small bristle worm, known to be distributed in the Arctic Ocean, including Baffin Island.
*Harmothoe imbricata**	2	1			Scale worm, widely distributed in the northern hemisphere, including the Canadian Arctic.
Polynoinae indet.			2		Polychaete Subfamily, with representative species in the Arctic Ocean, including Baffin Island.
*Circeis armoricana**[1]	88	8	5		Calcareous tube dwelling sabellid worm, known to be distributed in the Arctic Ocean.
*Leaena ebranchiata**	2	2			Terebellid worm, known to be distributed in the Arctic Ocean, including Baffin Island.
Terebellidae indet.			1		Polychaete Family, with representative species in the Arctic Ocean, including Baffin Island.
Arthropoda					
Harpacticoida indet.*	3				Order of copepods; global distribution.
Balanomorpha indet.*			302		Unidentified barnacles; global distribution.
Amphipoda indet.*	2				Unidentified amphipods; global distribution.
Bryozoa					
Ascophora indet.*	1				Suborder of bryozoan species; global distribution.
*Alcyonidium sp.**	4				Genus of colonial bryozoan species; known to be distributed in the North Atlantic and Arctic Oceans.
*Bowerbankia sp.**	1				Genus of colonial bryozoan species; known to be distributed in the North Atlantic and Arctic Oceans.
*Patinella verrucaria**[1]	264				Colonial bryozoan, known to be distributed in the Arctic Ocean, including Baffin Island.
Cyclostomatida indet.	1,570				Order of colonial bryozoan species; globally distributed.
Mollusca					
*Hiatella arctica**			23		Common name: wrinkled rock-borer; species of saltwater clam native to the Arctic; adult specimens observed in previous surveys.
*Mya truncata**			2		Common name: truncate softshell; species of saltwater clam known to be distributed in the Arctic Ocean.

Taxa	Total Abundance				Description
	A	I	J	L	
*Musculus sp.**			2		Genus of mussels, globally distributed.
Mytilidae indet.			1		Mussel Family; globally distributed.
Propeamussiidae indet.*			1		Scallop Family; globally distributed.
Bivalvia indet.			5		Mollusc Class; globally distributed.
Gastropoda indet.*		1	3		Mollusc Class; globally distributed.
Cnidaria					
Tubulariidae indet. *	1				Hydrozoan Family; globally distributed.
*Gonothyraea sp.**	9				Genus of hydrozoans, globally distributed.
Other					
Stolidobranchia indet.*			1		Unidentified Ascidian tunicate; global distribution.
Ascidiacea indet.*			1		Unidentified Ascidian tunicate; global distribution.
Nemertea indet.*			1		Unidentified Nemertean worm; global distribution.
Invertebrate indet.				1	Unknown immature invertebrate larvae.

A= adult; I= intermediate (has adult features but not of typical reproductive size); J= juvenile, L= Larvae.
*= Unique taxa
[1]New taxa observation for MEEMP and AIS/NIS surveys in 2019
Taxa information sources: WoRMS 2020, ETI 2019, Degan and Faulwetter 2019, Golder 2019a, DFO 2019

4.2.5 Fish

One new taxa was added to the AIS/NIS survey record from ROV surveys, an unidentified eelpout (Zoarcidae indet.), although at least one genus in this Family has been recorded in 2019 and previous MEEMP surveys. Several species observed in 2019 had been absent from the ROV record for several years: common lumpfish (*Cyclopterus lumpus*), seen only in 2014, and a fish doctor (*Gymnelus viridis*), recorded in 2013 and 2015 (Appendix A; Photo 44).

The use of HD video footage has also led to a resolved classification of one fish identified in 2018 as an unidentified prickleback (Stichaeidae indet.). In the 2019 surveys, a fish within the same Family was observed and, through increased video resolution, was identified as potentially belonging to the genus *Lumpenus* sp. (Appendix A; Photo 43). Although this fish is thought to be the slender eelblenny (*Lumpenus fabricii*) due to distribution, there is not enough information at this time to confirm to species level and the identification was kept at Stichaeidae indet. sp. 1, indicating a fish with the Family that was distinct from other indeterminate specimens.

All fish taxa observed in MEEMP and AIS/NIS surveys were cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally-recognized invasive species (Molnar et al. 2008) or an invasive species in Canada according to the National Risk Assessment for Introduction of Aquatic Nonindigenous Species to Canada by Ballast Water (Casas-Monroy et al. 2014). In addition to these databases, each fish was researched independently in the literature for their known habitats and distributions for signs of taxa that may be considered non-native to the Arctic region. Fish that were not identified to the species level were confirmed that the identified higher level taxa had at least one representative species with a distribution that included Arctic waters (Table 4-45).

Table 4-45: Known Distributions of Fish Identified in MEEMP and AIS/NIS Surveys in Milne Port, 2019

Order Family	Subfamily	Taxa	Common Name	Description
Gadiformes				
Gadidae	-	Gadidae indet.	Unknown Cod	Family including at least three species known to be distributed in the Canadian and Greenlandic part of the Arctic Ocean, including Baffin Island.
Gasterosteiformes				
Gasterosteidae	-	*Pungitius pungitius*	Ninespine Stickleback	A ray-finned fish, known to be distributed in Hudson Bay and Hudson Strait. Sporadically, observed around the southern portion of Baffin Island.
Perciformes				
Zoarcidae		*Gymnelus viridis*	Fish Doctor	A ray-finned fish, known to be distributed in the Hudson Strait and around Baffin Island. Recorded in previous MEEMP surveys.
Zoarcidae	-	Zoarcidae indet.	Unidentified Eelpout	Family including species in the Canadian and Greenlandic part of the Arctic Ocean, including Baffin Island.
Ammodytidae	-	*Ammodytes* sp.	Unidentified Sandlance	Family with species records in the Arctic Ocean, including Baffin Island and Greenland. Observed in previous MEEMP surveys.

Order Family	Subfamily	Taxa	Common Name	Description
Stichaeidae	-	Stichaeidae indet. sp. 1.	Eelblenny	A fish in the prickleback Family, species distributed in the Hudson Strait, Hudson Bay, and around Baffin Island. Observed in previous MEEMP and AIS/NIS surveys.
Stichaeidae	-	Stichaeidae indet.	Unknown Prickleback	Prickleback Family includes species with described ranges that include the Canadian Arctic and Baffin Island.
Salmoniformes				
Salmonidae	Salmoninae	*Salvelinus alpinus*	Arctic Char	A ray-finned fish distributed throughout the Hudson Strait, Hudson Bay and Baffin Island. Previously been observed in MEEMP and AIS/NIS surveys.
Scorpaeniformes				
Cottidae	-	*Cyclopterus lumpus*	Common lumpfish	A ray-finned fish known to be distributed in the Hudson Strait and around the southern portion of Baffin Island. Previously observed in MEEMP surveys.
Cottidae	-	*Myoxocephalus quadricornis*	Fourhorn Sculpin	A ray-finned fish in the sculpin Family distributed in the Hudson Bay, Hudson Strait, and around Baffin Island. Previously observed in MEEMP surveys.
Cottidae	-	*Myoxocephalus scorpius*	Shorthorn Sculpin	A ray-finned fish in the sculpin Family distributed in the Hudson Bay, Hudson Strait, and around Baffin Island. Previously observed in MEEMP surveys.
Cottidae	-	Cottidae indet.	Unknown Sculpin	A ray-finned fish in the sculpin Family.
-	-	-	Unknown Species	-

4.2.6 Ship Hull Monitoring

Six video surveys were conducted using ROVs alongside five ore carriers docked in Milne Port between 22 and 26 August 2019 (Table 4-46). A total of 113 minutes of video footage of the ship hulls was collected, which was analyzed to assess the presence or absence of aquatic invasive species. *Nordic Oasis* had an apparently small amount of biofouling barnacles on the stern hull at 4.9 m depth. The encrusting barnacles could only be identified to the Suborder Balanomorpha (Steinerstauch 2020, pers. Comm.). *Golden Bull* also had small traces of encrusting barnacles on its rudder at 8.3 m. *Golden Enterprise* and *Sagar Samrat* had a larger presence of biofouling organisms. *Golden Enterprise* had several large patches of encrusting barnacles (Balanomorpha indet.) from 1.2 m to 3.2 m on the rudder and hull. Another biofouling organism was observed at 1.2 m but could not be positively identified (Figure 4-42). *Sagar Samrat* was observed with encrusting barnacles in the water intake port and on the stern of the ship from 0.9 m to 1.2 m. The carrier was also observed to have collected small unidentifiable debris in a hole on the stern of the ship at 1.3 m. *NS Yakutia* had no visible signs of biofouling along the bow and stern sections.

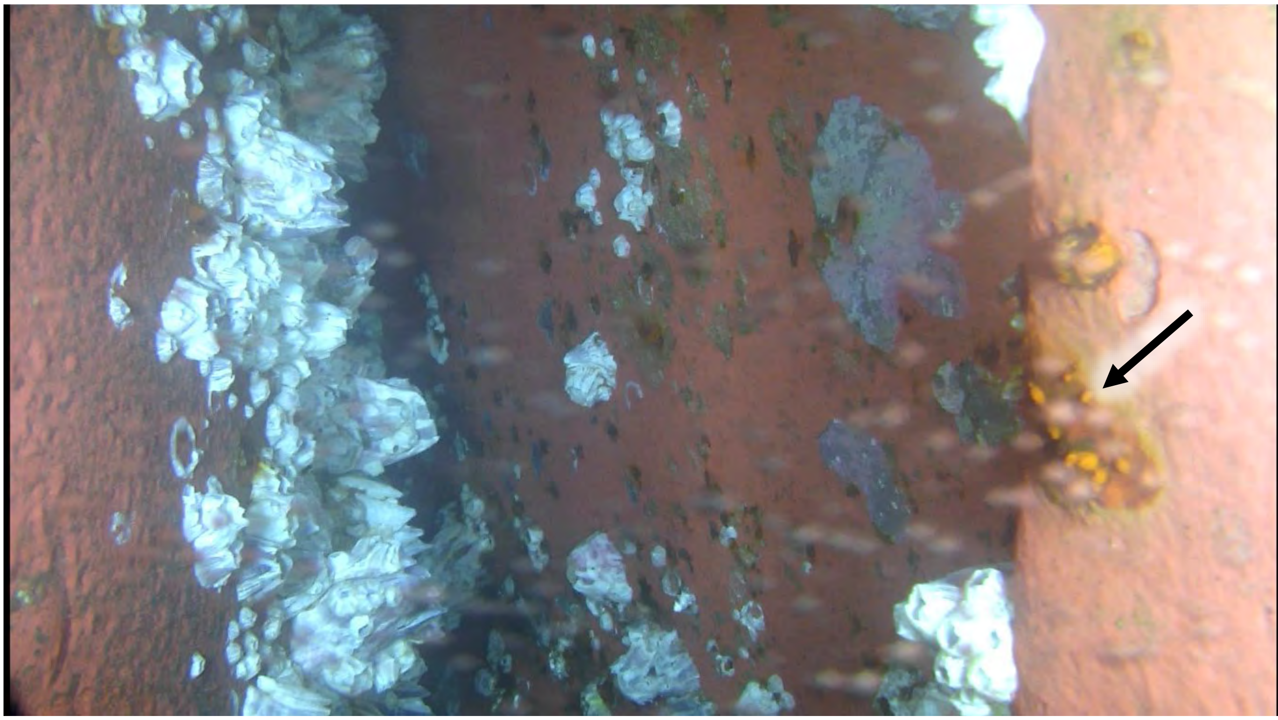


Figure 4-42: ***Golden Enterprise*** **hull with encrusting barnacles and unidentified biofouling organism (black arrow) from ROV footage.**

Table 4-46: Ship hull biofouling monitoring effort in 2019.

Date	Carrier	Location of survey	Maximum depth (m)	Survey effort (min:sec)	Evidence of biofouling
22 August 2019	*Nordic Oasis*	Stern section	13.6	12:09	Barnacles observed on dock side of the hull
22 August 2019	*Golden Enterprise*	Stern section	6.5	24:35	Barnacles observed on the rudder and on hull; Unidentified biofouling organism observed on hull
24 August 2019	*NS Yakutia*	Bow section	5.3	13:24	No signs of biofouling
		Stern section	5.6	22:54	No signs of biofouling
25 August 2019	*Golden Bull*	Stern section	10.1	27:10	Barnacles observed on hull
26 August 2019	*Sagar Samrat*	Stern section	2.7	13:14	Barnacles observed in the water intake port

4.3 Inuit Participant Interviews

A broad summary of responses to questions in the end of season interview is available in Appendix N. Responses included suggestions for improvements to the program, such as increased training in use of program equipment for participants, adjustments to sampling locations to better target fish species, changes to fish handling procedures to reduce fish injury, and suggested locations for increased sampling efforts. Other responses included suggestions of changes to the sampling program, including the recommendation of a modification to the tissue sampling program component. It was noted that fish tissue sampling should not require the submission of the full fish body and it was requested that in future programs, tissue collection be performed in the field and the remaining tissue be donated to the local community for consumption, rather than submission of the full intact fish to the lab. Respondents also noted that they had observed no changes in fish populations, abundances or health, as well as no new or unusual fish since the beginning of Operations at Milne Port.

5.0 DISCUSSION

The 2019 MEEMP and AIS field programs were impacted by ice conditions in Milne Port as icebergs and large pieces of ice persisted throughout the summer. Ice movements limited access to some regular sample locations, impacted fishing efforts, and caused the transect for one of the ROV surveys to be adjusted. Ice movements were also presumably responsible for disturbance of belt transects and the loss of a deployed settlement basket.

5.1 MEEMP

5.1.1 Water Quality

The collection of water samples was added to the MEEMP in 2015 to monitor for potential effects on water quality associated with site drainage and treated effluent discharges to the marine environment. Since 2015, samples have been collected near the discharge location and at three other nearby locations. Sampling has typically involved five discrete sampling events at each of the four stations between August and October. In 2019, water quality results were obtained over six discrete sampling events at each of the four sampling stations.

In 2019, reported analytical results for conventional water quality parameters, major ions, nutrients, metals, hydrocarbons, and PAHs, were generally within concentration ranges observed during previous MEEMP sampling programs (2015 to 2018), and did not exceed applicable CCME water quality guidelines. Hydrocarbons and PAHs were measured at concentrations less than analytical detection limits in 2019, consistent with results from previous programs. An exception to the finding of consistent water quality was identified for total copper, where the 2019 mean and maximum concentrations were higher than those observed in previous years. Although CCME WQGs are not available for copper in marine waters, British Columbia recommends a long-term guideline of 2 µg/L and the mean total copper concentration for the 2019 open water season was below the long-term guideline. There were individual values measured above 2 µg/L; however, between 22% and 53% of the total concentration was present in the dissolved phase suggesting that at least half of the reported total concentration was likely present in particulate form, and thus likely less bioavailable for uptake by aquatic biota. The cause of the elevated copper concentrations are currently a source of uncertainty; monitoring of water quality within the study area will continue in 2020. Monitoring results remain within original FEIS predictions, which forecasted no significant residual effects on water quality but indicated the potential for minor localized increases in TSS, nutrient, metal, and hydrocarbon concentrations.

Increased iron deposition in the marine environment as a result of the Project is an issue of concern for local Inuit. Lab analyses show that levels of iron in water samples collected in 2019 are within the range recorded between 2014 and 2018. These results show no evidence of compromised water quality as a result of iron ore deposition and are aligned with original FEIS predictions.

The fecal coliform bacteria results in 2019 indicated that fecal coliform concentrations were mostly below detection limits and did not exceed 2 CFU/100 ml. Thus, monitoring in 2019 suggested that the treated effluent discharge collection system is effective at limiting ingress to the marine environment.

Hydrocarbons were consistently measured at concentrations less than detection limits during MEEMP sampling in 2019, which suggests that land-based discharge does not represent a point source of hydrocarbon contamination to the marine environment.

5.1.2 Physical Oceanography

Measurements of current speed and direction in Milne Inlet, near Bruce Head and Milne Port, indicate flows are weak (i.e., <15 cm/s), primarily wind driven, and oriented along channel; the relation of current speed to wind events suggests that the upper water column in Milne Inlet is mixed primarily by winds.

Continuous monitoring of near-surface and mid-water column temperature and salinity at Milne Port from mid-July through September indicate that the head of Milne Inlet is strongly influenced by freshwater inflows and winds, and to a lesser extent tide. At the Ore Dock, fluctuations in salinity from near zero to something resembling an estuarine salinity suggest that Phillips Creek and other sources of freshwater inflows (e.g., melting sea ice) form a freshwater lens at the head of Milne Inlet each summer. This lens persists through July and into August until the freshwater inflows weaken. It is likely that this freshwater inflow is an important factor in establishing stratification[22] (i.e., little mixing between surface and deeper waters) in Milne Inlet each year, persisting throughout the entire inlet, with the lower bound of the pycnocline (area of greatest temperature and salinity change) approximately 20 m deep. Following the establishment of stratification, oscillations in temperature and salinity measurements at mid-water column near Milne Port suggest that winds play a large role in surface mixing.

On August 24, a large wind event caused the upper water column to become well mixed, this is seen as a large decrease in surface temperature and increase in salinity. From this point onwards, the fluctuations in temperature and salinity at the gauge were decreased. Further, CTD profiles in September showed the depth of the pycnocline deepened to near 40 m and the upper water column became well-mixed. The deepening of the pycnocline is driven by increased wind mixing near the surface in late August and early September and dropping air temperatures. Below the pycnocline, the temperature and salinity in Milne Inlet is generally uniform. These observations indicate that the upper water column of Milne Inlet undergoes an annual mixing event in the late fall before ice-on and that the freshwater (i.e. lower salinity water) measured near the surface in August becomes homogenously mixed year over year.

A review of multi-year tide gauge data and land uplift/subsidence rates in Nunavut was carried out to better inform the potential for sea-level rise at Milne Port. There was no discernible trend, positive or negative, with respect to sea level rise in the three year water level dataset for the Milne Port Ore Dock tide gauge. However, literature

[22] Stratification refers to the division of the water column into layers with different densities caused by differences in temperature or salinity, or both. Stratification is important because it inhibits vertical transfer of dissolved chemicals and particulates between layers and thus affects how, for example, nutrients are distributed between surface and bottom waters.

indicates Nunavut is expected to undergo land uplift (post-glacial rebound) in the next 100 years, effectively lowering sea levels by approximately 64 cm to 74 cm.

Turbidity is another important aspect of water quality because it can negatively impact aquatic life. For example, high turbidity levels can block light to aquatic plants or smother aquatic organisms. Vertical profiling indicates that overall, the water in Milne inlet was fairly clear throughout the water column; turbidity levels are slightly elevated at the surface, likely due to freshwater input and surface run-off and also towards the bottom, possibly due to the proximity of the instrument to seafloor sediment. Monitoring results remain within original FEIS predictions, which forecasted no significant residual effects on water quality but indicated the potential for minor localized changes.

Dissolved oxygen (DO) indicates the amount of oxygen available to living aquatic organisms. Dissolved oxygen concentrations are constantly in flux, as they are continually affected by processes such as diffusion and aeration, photosynthesis, respiration and decomposition. In Milne Inlet, DO concentrations range from 6.6 mg/L to 12.2 mg/L, corresponding to saturations ranging from 57% to 104%, indicating that oxygen is generally available within ranges that support ecological productivity. Chlorophyll-a is a photosynthetic pigment and, in marine systems, measures the amount of algae, specifically phytoplankton, growing in the water. It is an important water quality parameter because too much algae in the water can be a sign of eutrophication, which can negatively affect ecosystems through, for example, hypoxia, toxic algal blooms, and foam events (Perez-Ruzafa et al. 2019). Typically, for the Arctic Ocean, low surface chlorophyll-a is indicated by concentrations of 0 mg/m³ - 0.7 mg/m³ and high surface chlorophyll-a is indicated by concentrations of 0.7 mg/m³ to 30 mg/m³ (Ardyna et al. 2013). In Milne Inlet, chlorophyll-a concentrations are on the lower side, ranging from 0 mg/m³ to 0.9 mg/m³, showing evidence of primary productivity with little risk of eutrophication.

More detailed discussion of the Physical Oceanography Program results are presented in Appendix L.

5.1.3 Background Hydrology and Geomorphology

The deltaic environment and landforms near the Phillips Creek mouth into Milne Inlet are highly variable with complex depositional patterns that are further reworked by coastal processes. Within the period of available air photo records (1982-2016), the delta was reworked by natural geomorphic processes including sediment deposition, migration, and avulsion of Phillips Creek and the westward extension of a coastal spit on its eastern side. Sediment composition at any given location is expected to change due to this reworking.

The amount and size of sediment that is deposited by Phillips Creek on the delta in Milne Inlet is expected to change from year to year due to annual variability in the sediment load (caused by the flow rate, sediment supply, proximity to the active mouth of Phillips Creek, and proximity to the extent of the river sediment plume in any given year), coastal factors at the Phillips Creek delta, the rate of melt and subsequent presence of material dropped from floating ice, and the depth of wave-related stirring of seabed sediments during the open water period. The SW transect that crosses into the Phillips Creek mouth measures sediments in a highly variable deltaic environment with coastal and fluvial processes affecting the sedimentation. These processes create spatial and temporal variabilities that are larger than the size/area of the sampler (approximately 225 cm^2). Therefore, the measured sediment size percentages for the 2014 to 2017 samples are reasonable and within the expected range of natural variability. This implies that the conclusions from Golder (2018a), specifically that there had been a significant increase in the percentage of fines, is no longer valid. The observed changes in fines between 2014 and 2017 represent short term variation that is within natural norms.

More detailed discussion of the Background Review of Hydrology and Geomorphology in Phillips Creek Estuary are presented in Appendix M.

5.1.4 Sediment Quality

Similar to previous years, the physical composition of sediments collected in 2019 varied among stations and transects. Sediment along the coastal West and East Transects predominantly consisted of sand and silt, while the northern transects (Northwest and Northeast) had higher proportions of fines (i.e., silt and clay), which appeared to increase with greater distance from the Ore Dock. In 2019, concentrations of metals, volatile organic compounds, hydrocarbons, and PAHs in sediments sampled within the vicinity of the Ore Dock and along radial transects out into Milne Inlet, were determined to be less than applicable sediment quality guidelines. The only exceptions were arsenic and nickel (metals), as well as acenaphthene and dibenz[a,h]anthracene (organic constituents). With respect to arsenic and nickel, the infrequent and minor exceedances of conservative sediment quality guidelines suggested that measured sediment concentrations would not represent harm to the aquatic environment. Furthermore, these metals are not associated with ore processing at Mary River (Baffinland 2012) and the observed concentrations likely reflect regional background concentrations.

The assessment of sediment quality, primarily with respect to sediment metals, indicated that Port operations did not significantly impact Milne Inlet sediment quality in 2019. Evidence for this conclusion comes from an analysis of confounding influence of sediment grain size on sediment chemistry, regional background concentrations of metals above conservative guidelines (i.e., arsenic and nickel), additional context from comparisons to sediment guidelines not directly applicable within this jurisdiction (i.e., BC lower SQGs and NOAA benchmarks), and the assessment or iron.

Sediment Metals

The results of Spearman Rank Correlation analyses and PCA performed on 2019 sediment transect data suggested a strong relationship between metal concentrations and the proportion of fine-grained sediments (i.e., clay and silt sediment fractions), consistent with baseline observations in Milne Inlet (Baffinland 2013; SEM 2014; 2015) and observations made in previous MEEMPs (2014-2018). These analyses did not suggest that sediment metal concentrations were accumulating at elevated levels close to the Ore Dock relative to other locations sampled within Milne Port. Additionally, arsenic and nickel concentrations tended to increase with greater distance from the Ore Dock along the two northern transects, which is the opposite of what would be expected if the Ore Dock represented a significant point source of arsenic and nickel to Milne Inlet sediments.

Due to the observed relationship between sediment grain size, particularly the percentage of fines, and total metal concentrations, it was considered important to assess whether spatial and temporal changes in sediment percent fines content have occurred that might be related to Port operations. The results of general linear modeling indicated that no statistically significant differences were observed between years (2014-2019) at any of the distances evaluated along the transects extending out from the Ore Dock, suggesting that sediment percent fines have not been significantly impacted by Port operations relative to 2014 pre-Project conditions.

Importantly, iron concentrations were flagged as a concern by local Inuit due to the potential for increased deposition of iron ore in the form of dust or in runoff from storage stockpiles as a result of the Project. Marine sediment guidelines for iron are not currently available and, as such, the sediment data for iron were evaluated spatially and temporally along the transects using general linear modeling. Overall, increased iron content in sediments at concentrations greater than those observed during the 2014 baseline characterization program were rarely observed (i.e., only along the coastal East Transect at distances of 500 m and 1,000 m from the Ore Dock). Similar to the coastal West Transect, iron concentrations year-over-year along the coastal East Transect were determined to be more variable than the northern offshore transects. Monitoring of sediment quality within the study area will continue in 2020 to continue to evaluate the noted variability and the potential for Project-related effects.

Sediment Organic Constituents

For organic constituents, exceedances of sediment quality guidelines were rare and small in magnitude. Concentrations were generally low and not concentrated at a specific location (e.g., closer to the Ore Dock) and, as such, are not indicative of a specific point source. Interpretation of the few CCME ISQG exceedances for organics should acknowledge the high degree of conservatism in the individual ISQGs for PAHs. These guidelines have high uncertainty and are suitable only for use as conservative screening values (i.e., the ISQG is intended to represent a concentration below which adverse biological effects are rarely expected to occur). CCME PELs are intended to represent concentrations above which adverse effects are predicted to occur frequently, based on a concurrence data set with sediment chemical concentration and benthic invertebrate effects data from other sites. Notably, the FCSAP guidance for working harbours (FCSAP 2018) recommends use of PEL over ISQG for screening primary contaminants of potential concern, as screening with ISQGs is considered overly conservative and does not always correlate well with observed effects under field conditions (FCSAP 2018). In consideration of the above, the low-level concentrations of hydrocarbons identified in 2019 do not warrant management concern, though further monitoring is recommended to determine whether measured concentrations are an indication of an increasing trend.

5.1.5 Benthic Infauna

Benthic infauna sampling was introduced to the MEEMP in 2018 and, therefore, 2019 represents only the second year of sampling such that there is limited historical monitoring data against which to make comparisons. Similar to 2018, the 2019 benthic communities were dominated by polychaetes, with percent relative abundance values ranging between 17% and 88%. Other dominant taxa included crustaceans of the Class Malacostraca (1%–58%), bivalves (1%–23%), and seed shrimp (ostracods) (0%–21%).

Community indices (i.e., density, richness, SDI and SEI) were used to compare community composition along the four transects sampled and to look for differences between transects. The results suggested that benthic invertebrate density and richness were typically greater along the coastal transects (East and West Transects) relative to the results observed along the northern transects (Northeast and Northwest). The results of the linear regression analyses did not suggest that benthic invertebrate densities were lower closer to the Ore Dock, as densities were determined to either decrease with greater distance away from the Ore Dock (northern transects), or relationships were not determined to be significant (coastal transects). Furthermore, statistically significant temporal changes in benthic invertebrate densities were not observed between the 2018 and 2019 sampling programs along the coastal (East, West) or Northwest Transects. The Northeast Transect was sampled for the first time in 2019 and, therefore, temporal comparisons were not possible.

Species richness along the coastal East Transect was determined to be significantly lower between 200 m and 300 m from the Ore Dock relative to other stations sampled along the Transect. However, this statistically significant effect appeared to have minor ecological relevance because richness was greater at these stations in 2019 relative to the 2018 results. Additionally, effects were not observed at these stations in other community indices assessed, suggesting that the pattern is unlikely to represent a meaningful ecological alteration related to Port activities.

Overall, the results of the benthic infauna survey in 2019 do not indicate impairment of benthic communities related to the construction and operation of Milne Port. This is in line with FEIS predictions of no significant adverse residual effects to Arctic char habitat. At most stations, density and richness were variable, however, few statistically significant differences were observed spatially along the transects. Invertebrate density and richness were not significantly lower in 2019 relative to 2018 and, where a statistically significant difference was identified, 2019 values were greater. Furthermore, there were no indications of compromised functional status of the communities located closer to the Ore Dock; each of the sites generally had strong representation of major taxonomic groups and the relative proportions of major taxa (i.e., polychaetes, bivalves, malacostracan crustaceans, and ostracods) were similar.

5.1.6 Substrate, Macroflora and Benthic Epifauna

Underwater video surveys using belt transects were used for the monitoring effects on epibenthic communities (macroflora and epifauna) for the second time in 2019. Similar species were found in the belt transect surveys in 2018 and in 2019. More green algae (Chlorophyta) was observed in 2019 compared to 2018, but there were fewer recorded *Laminaria* sp. Additionally, relatively fewer brittle stars were observed in the 2019 surveys compared to 2018. Clam siphon holes were also observed in high numbers in two belt transects where no holes were observed in 2018 (TP09 and TP10). These differences were relatively minor between survey years and are likely due to natural variability or within the range of error due to survey methodology.

Six of the ten permanently established belt transects were moved or obscured, possibly due to ice scour in the 2019 ROV surveys and four were unusable for enumeration data. This pattern is exacerbated from 2018, where only one transect (one of the four unusable in 2019) was deemed unusable due to belt movement. Given the apparent propensity for the permanent belt transects to be heavily influenced by ice movement, it is anticipated that with no change in the setting of the transects, they are likely to be similarly influenced in future years. Currently the belt transects are placed and examined for suitability by an ROV. It is suggested that an alternative method is considered for setting the belt transects and complete the benthic surveys to ensure that all belts are usable. This could provide opportunities to increase the taxonomic resolution of identifications and offer the potential for specimen collection to gain clarity on species identifications.

5.1.7 Fish

Fishing efforts in 2019 yielded captures greater than previous sample years apart from 2018, likely a reflection of greater sampling efforts in 2018 and 2019 following an increase in the length of the fish sampling program. Relative taxonomic composition of fish captures did not materially change from previous sampling years, with fourhorn sculpin, shorthorn sculpin and Arctic char comprising over 99% of the total catch. Two other species were caught, a single sandlance and a single ninespine stickleback, the latter representing the first occurrence of this species in MEEMP surveys.

As in previous years, the highest total captures were realized using gill nets: 252 fish, representing 90% of the total catch. CPUE in gill net sampling was lower than in 2018, but comparable to previous years. Beach seines were the most effective method of capture in terms of CPUE; however, this method is limited by the necessity for sampling to occur in nearshore areas and in only a few locations in Milne Port, targeting small and juvenile fish. Short deployment times and limited sampling locations for beach seining led to considerably smaller total yields, despite a high CPUE, compared to other survey methods and excluded larger species that are present in Milne Port. Repeatedly surveying the suitable locations would potentially lead to multiple recaptures of the same individuals, subsequently misrepresenting the population in the nearshore area. Fukui traps remain the least effective method, in terms of fish caught per hour, although CPUE and total catch increased since 2018. Fyke nets were introduced in 2019 as a possible alternative passive fishing method to Fukui traps to address the low captures observed in that method. Fyke nets captured a total of 12 fish, representing three species, including an Arctic char, the first time in MEEMP surveys this species was caught outside of gill net efforts. CPUE for fyke nets was considerably higher than Fukui traps, indicating this method may be a suitable replacement.

A total of 13 fish taxa were captured or observed throughout all MEEMP and AIS/NIS surveys in 2019. Eight of these taxa were observed incidentally in components of the MEEMP and AIS/NIS surveys other than fishing efforts, indicating that dedicated fish survey methods are not fully characterizing the fish populations in Milne Port. Arctic char and ninespine sculpin were captured in fish collection surveys but were not captured or observed in any other method. Incidental captures in benthic infauna and zooplankton samples included larval and juvenile fish, age groups that are largely lacking in other fish survey methods. These differences between methodologies indicate the importance in a range of sampling techniques to fully characterize the species and age groups of fish in Milne Port.

ROV methods had the greatest number of fish taxa observations, including four taxa not observed in any other method. However, these fish were often not resolved to species level due to poor camera angle, camera motion, visibility in the water column and fish behavior limiting the ability to observe the fish in detail.

The length to weight relationships were compared between 2017, 2018 and 2019 for the three most abundant fish species, Arctic char, fourhorn sculpin and shorthorn sculpin. No significant differences in the length-to-weight relationships were found between any of the sample years. Fish of a certain size class are within a consistent weight class in each survey year, indicating there has been no change in fish condition over this time period. Project effects are not impacting fish health through a notable change in body condition.

Results of the 2019 Arctic char age to length relationships was consistent with previous findings that length is not an accurate predictor of age for the individuals sampled due to a large amount of variation in fish body length within age groups. Conversely, the age to length relationship for sculpin species was found to be much more accurate, with length being a good predictor of age for the fourhorn and shorthorn sculpins incidentally collected in 2019.

The shellfish *H. arctica* was collected as a supplement to fish tissue collection. Shellfish ranged in age from 7 years to 69 years with an average age of 28.1 years. *H. arctica* is a relatively long-lived bivalve species, and specimens have been collected with ages estimated at over 125 years (Sejr et al. 2002). The ages of *H. arctica* collected at Milne Port in 2019 represented a range of ages that fit within the expected range.

Fish sampling efforts and ROV surveys completed in 2019 showed comparable presence and composition of species within the Milne Port area compared to previous years, including baseline sampling. This suggests that there has not been a notable change in fish communities associated with the construction and operation of Milne Port. Fish survey results were consistent with FEIS predictions of no significant adverse residual effects on marine fish habitat and populations of Arctic char in Milne Inlet from Project construction and operation.

5.1.8 Tissue Chemistry

Arsenic, calcium, sodium, strontium, and titanium concentrations in Arctic Char tissue were significantly greater in 2019 relative to 2018; however, notably, concentrations of copper and iron both showed a trend of slightly decreased mean concentrations since 2010. Relatively large variance in metal concentrations have been observed in Arctic char tissues since baseline years, and samples in 2019 were generally within range of measured values reported since 2010. Documented increases in these metals in char tissue is unlikely to be Project-related, since (i) these metals are either not associated with iron ore processing (i.e., strontium) or present in the ore in very low concentrations (i.e., arsenic, calcium, sodium, titanium) compared to iron[23] (Baffinland 2012) and (ii) the generally pristine nature of Milne Inlet water and sediment quality has been demonstrated by extensive data collection in baseline studies (SEM 2015) and over the course of the MEEMP (i.e., during the period of 2014 to 2019). Therefore, the observed metals concentrations are believed to be less a reflection of local anthropogenic inputs in Milne Inlet, and more likely a product of natural geologic sources (e.g., contaminants mobilized from nearby watersheds, such as Phillips Creek) or atmospheric deposition, as has been demonstrated for metals and other contaminants (e.g., Kamman et al. 2005, Young et al. 2007).

[23] The chemical composition of the ore dust is 65% iron, on average (Baffinland 2012).

Sculpin metals concentrations could not be compared to previous years data, as 2019 was the first year sculpin tissue chemistry was analyzed. Sculpin metals concentrations were generally similar, but slightly greater, than those measured in Arctic Char in 2019.

For *H. arctica*, metals concentrations were significantly greater in 2019 compared to 2018 for all metals except barium, phosphorus, sodium, and strontium. Many metals exhibit strong associations with finer sediments (i.e., clay minerals), and would be expected to be enriched in areas with greater deposition of riverine silt-clays. The elevated metals concentrations in 2019 may also partially be explained by the reproductive status of the clams at the time of sampling. Biota that release a large portion of their body mass through reproductive output (i.e., spawning) can also reduce their body burdens of contaminants through a commensurate loss of contaminant mass. While this could account for observed interannual differences (i.e., if sampling occurred post-spawn in 2018, but pre-spawn in 2019), reproductive status of the clams is not known from the 2018 or 2019 sampling periods.

Tissue metals concentrations in *H. arctica* were consistently greater than concentrations measured in either Arctic Char or sculpin; numerous metals were measured at concentrations at least one order of magnitude greater in *H. arctica* relative to both fish species (e.g., antimony [Figure G-3, Appendix G and Figure F-5.3], boron [Figure G-8, Appendix G and Figure F-5.8]). Iron was measured at concentrations approximately two orders of magnitude greater in clams than fish (Figure G-14, Appendix G and Figure F-5.15). *H. arctica* is a filter-feeding infaunal species and is closely associated with bottom sediments; therefore, these organisms filter large quantities of water, making *H. arctica* more prone to exposure and accumulation of a variety of natural and anthropogenic contaminants relative to pelagic species such as Arctic char.

In as much as species are capable of bioaccumulating various contaminants from the environment, they are also capable and physiologically adapted to eliminate contaminants from their bodies (i.e., through excretion, before or after metabolic modification). While fish are capable of metabolizing several classes of contaminants through the Mixed Function Oxygenase (MFO) system (e.g., McMaster et al. 1991) or biochemical equivalent, many bivalves have a limited ability to metabolically modify and eliminate contaminants. This may, in whole or in part, explain observed differences in the measured concentrations of metals between species.

No samples (i.e., Arctic Char, sculpin or *H. arctica*) collected in 2018 or 2019 exceeded the CFIA commercial consumption guideline of 0.5 mg/kg wwt mercury.

Tissue chemistry monitoring results remain well within original FEIS predictions, which indicated the potential for non-significant, low magnitude effects on char health and condition.

5.2 AIS/NIS

To address PC Condition No. 87 the AIS/NIS program monitors for non-native introductions resulting from Project-related shipping through the assessment of all taxa identifications made through all program components

5.2.1 Zooplankton

A total of three new zooplankton taxa were identified during the 2019 AIS/NIS surveys; two identifiable to the species level, while one was only identifiable to genus. None of the newly observed zooplankton taxa were identified as taxa of concern or invasive species. Furthermore, a literature review of known geographic distributions for each taxon confirmed that each new species was known to occur in the Canadian Arctic, including Baffin Island. The taxon that was identified to genus was determined to be globally distributed and contained at least one species known to occur in the Canadian Arctic, suggesting that those specimens could also be native to the Arctic. Further review of natural ranges and vectors of introduction are required to confirm NIS status.

Taxa collected during the AIS/NIS monitoring surveys should continue to be compared to the best available literature (e.g., check for additions to the Canadian and global invasive species databases on an annual basis) to confirm the geographic ranges of known invasive species.

5.2.2 Benthic Infauna

Sampling locations for the benthic infauna component were increased in order to improve ability to detect potential Project-related changes. In 2019, benthic infauna samples were collected from 32 stations in Milne Port and 2 at Ragged Island for analysis of the species present and to update the AIS/NIS taxa database. All taxa were identified to the lowest practicable taxonomic level.

A total of 58,374 organisms were estimated in 2019 samples, representing 319 different taxa, including 41 unique taxa that were not identified in previous surveys at Milne Port and Ragged Island. The majority of the new taxa were identifiable to the species level, while approximately 30% were only identified to genus or a higher taxonomic level. New taxa identifications included species that were resolved from identifications made to higher taxonomic levels in previous surveys. An analysis of the available literature indicated that all but five of the identified taxa had described ranges or collection records that included Arctic waters, including the Canadian Arctic, or were north Atlantic species with unknown northern limits that presumably could have ranges that extended into the Canadian Arctic.

The AIS/NIS program is conducted at a surveillance level and designed to flag potential invasive or non-indigenous species. The following five examples serve as evidence that this program is functioning as intended:

- A sabellid polychaete worm was tentatively identified as *Pseudofabricia* sp. nr. *aberrans*. This taxon was also identified in 2018 and sent for independent review due to the defined range for this species being limited to the Mediterranean Sea (Giangrande and Cantone 1990, WoRMS 2020). *P. aberrans* is not considered an invasive species or a species of concern in Canadian or Arctic waters (Molnar et al. 2008, Casas-Monroy et al. 2014). A tentative alternative identification of *Manayunkia aesturiana* was assigned in 2018 (Golder 2019a), although the identification was uncertain. Specimens from 2019 samples were again sent to Laval for independent verification. Laval identified the specimens as *Fabricia sabella*, an unaccepted name for *Fabricia stellaris*. Neither *F. sabella* nor *F. stellaris* have been identified in previous surveys at Milne Port, but both have documented distributions that include the Canadian Arctic, with specimen collections made at Baffin Island. **Overall conclusion: species is not considered AIS, further review is required to determine NIS status.**
- A spionid polychaete was identified as *Marenzelleria viridis* and independent verification confirmed the identification. This species is listed in the Global Database and the National Risk Assessment as a species of concern for Canadian and Arctic waters, with a primary invasion vector through ballast water (Molnar et al. 2008, Casas-Monroy et al. 2014). Once established, management is considered highly difficult, being irreversible or impossible to contain or confine (Molnar et al. 2008). Specimen collection records for *M. viridis,* and under the superseded name *Scolecolepides viridis* indicate historical occurrences outside the natural range in the North Atlantic and Arctic Oceans, including the Canadian Arctic and Baffin Island (Cusson 2018, GBIF 2020, Miller et al. 2014). Further review of collection records around Baffin Island is needed to determine if this species is a recent invader in Milne Port. **Overall conclusion: Species was verified through independent review to be a taxa flagged as potentially invasive. Taxonomic record indicates potential existing presence in Arctic prior to operations at Milne Port. Further review is required to determine if presence in Milne Port is recent and/or whether species is established.**

- A terebellid polychaete worm was identified in 2019 samples that was similar to the description for *Sosane wireni*, a species with a taxonomic description limited to New England. Samples were classified as *Sosane* sp. nr. *wireni,* pending independent verification at Laval. *S. wireni* is not considered an invasive species or a species of concern in Canadian or Arctic waters (Molnar et al. 2008, Casas-Monroy et al. 2014) and specimen collection records exist for this species, and under the superseded name *Sosanopsis wireni*, in Scandinavian waters, Western Greenland and the Laptev Sea. **Overall conclusion: Not considered invasive to Arctic waters, but waiting on independent verification of species identification.**
- An unknown species of gammarid amphipod was identified from the *Monocorophium* genus in 2019 benthic infauna samples. No species within this genus have known distributions that include Arctic waters, and three species within this genus (*M. insidiosum, M. acherusicum* and *M. sextonae*) are considered invasive (Molnar et al. 2008). These specimens were sent to Laval for verification. **Overall conclusion: Independent verification of the genus, and resolving the identification to species level, are required to make a determination of NIS or AIS status.**
- A bryozoan was identified as an indeterminate species from the genus *Oncousoecia.* There are no recent specimen collections in Arctic waters and species within this genus with described ranges that include Arctic waters are limited to the European Arctic, the Barents Sea and Svalbard (WoRMS 2020). No species within the genus *Oncousoecia* are listed on any of the available databases on invasive species or species of concern. These specimens were sent for independent verification at Laval. **Overall conclusion: Independent verification of the genus and resolving of the identification to species level is required to make a determination of NIS or AIS status.**

Unlike 2018, in 2019 the taxa accumulation curve did not reach an asymptote, indicating that in each sample collected, at least one unique taxon was identified that was not present in any other sample, and that sampling was not sufficient to fully characterize the benthic infaunal community. This is likely a product of a shift in sampling design. In previous years, samples were collected in triplicate and each replicate was treated as a separate sample in the accumulation curve, which may have overestimated sampling efficiency. In contrast, in 2019, samples were taken as a composite of three collections using a standard Ponar or Van Veen grab, resulting in larger sample volumes compared to previous years, and subsequently, more organisms per sample; additionally, substrate penetration is greater with the standard Ponar and Van Veen compared to the petite Ponar, which may have increased the collection of organisms generally present in deeper sediments. Due to time and weather constraints benthic samples were collected at only 34 of the proposed 77 sampling stations, which also may have precluded the curve from reaching an asymptote. The increased number of stations were part of a revision to the MEEMP design resulting from a power analysis of the benthic sampling program indicating the sampling power required to detect a ± 2 SD change in benthic invertebrate densities and abundances (Golder 2019c)

Additionally, the Chao 2 estimator indicated a discrepancy of 29% between the estimated number of species and the observed number. While the discrepancy between the estimated and observed values is within range of discrepancies observed in previous benthic surveys since 2013 in Milne Port, the discrepancy is relatively high. A discrepancy of 29% suggests that samples collected as part of the MEEMP and AIS program represent approximately 70% of the community, indicating taxa richness is not being fully characterized by the sampling method. This discrepancy may be reduced by sampling all proposed sample locations in future surveys.

5.2.3 Macroflora and Benthic Epifauna

Underwater video surveys along the length of each of the four previously established AIS transects, as well as one additional transect establish in 2019, were analyzed for presence of macroflora and epifauna species. One macroflora taxa of brown algae (*Desmarestia* sp.) was identified in the 2019 survey that had not been previously in the 2018 survey. *Desmarestia* is a globally distributed genus with representative species found in Arctic waters, including the Canadian Arctic and collections at Baffin Island, additionally species in this genus have been observed during previous MEEMP underwater video surveys in 2017 (Golder 2018).

Two epifauna taxa that had not been previously observed during AIS/NIS surveys were identified in the 2019 AIS/NIS survey. One of the new taxa, Cephalopoda, which includes squid and octopus, has been identified as likely locally distributed after literature searches confirmed several species from this Order are present in the Canadian Arctic, including three species known to occur in Baffin Bay (Gardiner and Dick 2010). The second taxa observed was a prickleback fish (Family Stichaeidae), potentially of the genus *Lumpenus,* further discussed in Section 1.1.1.

Macroflora and benthic epifauna taxa identified in all underwater video survey methods or captured as part of MEEMP surveys were reviewed for their described distributions. All identified taxa had natural ranges that included Arctic waters, or for higher level taxa, had at least one representative species with Arctic distributions.

Taxa collected during the MEEMP and AIS/NIS monitoring surveys should continue to be compared to the best available literature (e.g., check for additions to the Canadian and global invasive species databases on an annual basis) to confirm the geographic ranges of known invasive species.

5.2.4 Encrusting Epifauna

Analysis of settlement substrate for the AIS program occurred for the second time in 2019. As in 2018, colonization appeared to be minimal, however, an apparent increase in abundance was noted in 2019 compared to 2018. In contrast to 2018, a large proportion of the organisms were in adult stages. An overall increase in total number of encrusting organisms and taxa was also observed.

Three new encrusting epifauna taxa were identified during the 2019 AIS/NIS surveys; two identifiable to the species level (*Circeis armoricana* and *Patinella verrucaria*), while one was only identifiable to genus (*Gonothyraea*). An additional new taxonomic identification in encrusting epifaunal samples was made to the Family level, although, identifications within this Family were made to the species level as new taxa in zooplankton samples in 2019, and therefore the Family Tubulariidae was not considered as a new taxon for the AIS/NIS analysis in epifaunal samples.

None of the newly observed encrusting epifauna taxa were identified as taxa of concern or invasive species. Furthermore, a literature review of known geographic distributions for each taxon confirmed that each new species was known to occur in Arctic and North Atlantic waters, including the Canadian Arctic and Baffin Island.

Taxa collected during the AIS/NIS monitoring surveys should continue to be compared to the best available literature (e.g., check for additions to the Canadian and global invasive species databases on an annual basis) to confirm the geographic ranges of known invasive species.

Due to the loss of the western Ore Dock settlement baskets and plates, substrate was only analyzed from one set of settlement baskets. The low number of deployed settlement baskets and plates is insufficient to characterize settlement in Milne Port. Therefore, the lost set will be replaced, and additional sets will be deployed at other locations in Milne Port.

5.2.5 Fish

All fish taxa observed in MEEMP and AIS/NIS surveys were cross-checked against a global database of marine invasive species and none of the taxa were identified as a globally recognized invasive species. Each fish was also researched independently to confirm their known distributions. All fish species had confirmed ranges that included the Arctic Ocean, and higher fish taxa had at least one representative species with a distribution that included Arctic waters.

Taxa collected during the AIS/NIS monitoring surveys should continue to be compared to the best available literature (e.g., check for additions to the Canadian and global invasive species databases on an annual basis) to confirm the geographic ranges of known invasive species.

5.2.6 Ship Hull Monitoring

In addition to PC No. 87, this monitoring component also specifically addresses PC No. 91. Ship hull monitoring was conducted for the second time in 2019. Underwater video surveys were conducted over the hulls of five ore carriers berthed alongside the Ore Dock. Most of the ships' surface below the waterline was found free of biofouling. Exceptions were small areas of the sterns of four ships; *Nordic Oasis*, *Golden Enterprise*, *Golden Bull*, and *Sagar Samrat,* where some amounts of colonization by aquatic organisms were found. On those four ships, this included barnacles of indeterminate species. A biofouling organism was also found on *Golden Enterprise*, but, along with the barnacles, could not be identified due to the taxonomic resolution requiring the collection of physical samples.

Survey lengths were shorter in 2019 compared to 2018 and were primarily concentrated on the stern sections of the vessels. Moreover, the taxonomic resolution of biofouling organisms did not improve in the second year of monitoring, despite the inclusion of a high-resolution camera. Many taxa were not resolved to species level due to the difficulty of identification of encrusting taxa without a specimen. Identifications could be improved in future years by having a biologist with local Arctic fauna knowledge present with the ROV operator when videos are collected to direct the operator to focus on specimens of interest and perform in-situ taxonomic identification. Alternatively, specimen collection could be performed by divers along the hulls, however, these surveys occur in an active shipping port, where diving on a berthed vessel may be severely hazardous.

Taxa collected during the AIS/NIS monitoring surveys should continue to be compared to the best available literature (e.g., check for additions to the Canadian and global invasive species databases on an annual basis) to confirm the geographic ranges of known invasive species.

5.3 Inuit Participant Interviews

No changes in fish populations, abundances or health, as well as no new or unusual fish since the beginning of Operations at Milne Port were reported by Inuit Participants in the 2019 MEEMP and AIS Program during post-season interviews. Responses to questions during the Participant interviews included suggestions and requests for adjustments to the program. Responses included requests for increased training in sampling methodology and in the use of sampling equipment, recommendations for sampling locations and methodologies, and a specific request for changes to the fish sampling program to allow for donation of fish tissue to the local community. All suggestions and requests provided by program participants will be considered during program planning for the 2020 MEEMP and AIS program.

6.0 CONCLUSION AND RECOMMENDATIONS

The MEEMP has been designed to meet the objectives of the various conditions associated with Project Certificate 005, as well as to evaluate whether Project activities have impacted the marine environment over time. Original FEIS predictions indicated the potential for low magnitude changes in some ecological parameters, such as water quality and Arctic char tissue chemistry, but characterised these as not significant. Overall, monitoring data align with these predictions, as observed changes are typically minor and either within established guidelines or consistent with baseline levels. Thus, monitoring to date suggests that mitigation measures are functioning as intended and that Project activities are being managed in a way that has not adversely affected the marine ecosystem. Moving forward, continued monitoring of all MEEMP components is recommended to ensure continuity in established time series (e.g., sediment quality) or to better characterize baseline data (e.g., sculpin tissue chemistry).

The main conclusions and recommendations based on the results of the 2019 MEEMP studies are as follows:

- **Water Quality**
  - To date, construction and operation of Milne Port does not appear to have negatively affected water quality, as measured concentrations were generally consistent with previous years and less than CCME water quality guidelines.
  - Lab analyses have not revealed a trend of increased levels of iron in water samples collected between 2014 and 2019.
  - Monitoring results remain within original FEIS predictions, which forecasted no significant residual effects on water quality but indicated the potential for minor localized increases in TSS, nutrient, metal, and hydrocarbon concentrations.
  - Relevant to PC No. 76, 89, 99(a)
  - It is recommended that the water quality sampling program continue in 2020 to continue to monitor for potential changes in water chemistry resulting from Site operations.
- **Physical Oceanography**
  - To date, construction and operation of Milne Port does not appear to have negatively affected the physical oceanography of Milne Inlet, as physical properties of the water column were consistent with applicable parameters in previous survey years (i.e., DO, turbidity, chlorophyll-a) and are within ranges that support ecological productivity.
  - Stratification of the water column is seasonal. The surface freshwater layer present in August begins to mix with deeper waters by September, aided by strong wind events; this enables transfer of particulates, such as nutrients, between surface and deeper layers.
  - There was no discernible trend, positive or negative, with respect to sea level rise in the three year water level dataset for the Milne Port Ore Dock tidal gauge. However, literature indicates Nunavut is expected to undergo land uplift (post-glacial rebound) in the next 100 years, effectively lowering sea levels by approximately 64 cm to 74 cm.
  - It is recommended that oceanographic data collection of water levels, currents, and physical (i.e. temperature and salinity) and physiochemical (i.e. turbidity, pH, DO, Chl-a) water properties continue

in 2020 in order to improve spatial and temporal resolution of the physical oceanographic data in Milne Inlet which, in turn, provides support for marine-based EEM programs and ballast water model validation.

- Relevant to PC No. 1, 76, 83, 89

- **Background Hydrology and Geomorphology**
  - The sediment transport and deposition within Phillips Creek delta at Milne Inlet has a high natural variability and is controlled/influenced by coastal and river factors at the same time. This, in turn, creates high variability in how sediments are distributed over time and space. These factors are more variable and have a much larger influence on the deposition patterns, compared to local Port activities.
  - Golder recommends that the sediment sampling program continue annually as planned to further evaluate potential changes in sediment chemistry and composition, and to confirm results of hydrodynamic and sediment transport modelling.

- **Sediment Quality**
  - To date, construction and operation of Milne Port does not appear to have negatively affected sediment quality, as measured concentrations were low and generally consistent with previous years.
  - Minor exceedances of sediment quality guidelines were noted for arsenic and nickel but are not considered to be Project-related as these metals tended to increase with greater distance away from the Ore Dock. Similarly, exceedances were noted for a few organic constituents but these were rare, small in magnitude (i.e., not considered to be at levels that would represent harm to the aquatic environment), and were not concentrated around the Ore Dock in a way that would suggest a specific point source.
  - Comparison of the percentage of fine sediment over time indicates no statistically significant changes in fines content between 2014 and 2019.
  - Increased iron content in sediments at concentrations greater than those observed during the 2014 baseline characterization program were rarely observed.
  - Monitoring results largely remain within original FEIS predictions, which forecasted no significant residual effects on sediment quality but indicated the potential for minor localized increases in nutrient, metal, or hydrocarbon concentrations that would not exceed CCME sediment quality guidelines
  - Relevant to PC No. 76, 83(a), 99(a)
  - It is recommended that the sediment sampling program continue in 2020 to continue to monitor for potential changes in sediment chemistry resulting from Site operations.

- **Benthic Infauna**
  - To date, construction and operation of Milne Port does not appear to have negatively affected benthic infaunal communities, which continue to be diverse and well established.
  - Sampling in Milne Inlet revealed a high degree of spatial variability in invertebrate community indices, which is common in marine benthic habitats
  - Levels of community density and richness were higher in 2019 relative to 2018 and few statistically significant differences were observed spatially along the transects.

- Relevant to PC No. 76, 99
- It is recommended that the benthic infauna sampling program continue in 2020 to continue to monitor for potential changes in benthic communities resulting from Site operations.

- **Substrate, Macroflora and Benthic Epifauna**
  - To date, construction and operation of Milne Port does not appear to have negatively affected substrate, macroflora, and benthic epifauna – differences observed between 2018 and 2019 were minor and in line with expected natural variability.
  - Disturbances to the belt transects, potentially due to ice movements resulted in four transects being unusable for enumeration data collection. Visibility in the water limited the ability to resolve taxonomic identifications despite the increased resolution of the camera on the ROV.
  - It is recommended that substrate, macroflora and epifauna surveys continue in 2020 to continue to monitor for potential changes in benthic communities resulting from Site operations.
  - Relevant to PC No. 76, 99

- **Fish**
  - To date, construction and operation of Milne Port does not appear to have negatively affected fish community structure or body condition
  - Presence and diversity data collected in 2019 was comparable to previous years, including baseline years.
  - Weight-length relationships indicate there has been no change in fish condition over the years sampled (2017-2019)
  - High number of taxa incidentally observed during surveys of other components indicate dedicated fish survey methods are not fully characterizing the fish populations in Milne Port and underscore the importance of using a range of sampling techniques.
  - Monitoring results align with original FEIS predictions, which forecasted that the Project would have no significant effects on marine fish habitat nor would it affect the size of Arctic char populations
  - Relevant to PC No. 99, 113, 114
  - It is recommended that fish sampling continue in 2020 with the following modifications:
    - increased trolling effort to target pelagic species observed by ROV; and,
    - replace Fukui nets with fyke nets to improve sampling efficiency.

- **Tissue Chemistry**
  - Monitoring results remain well within original FEIS predictions, which indicated the potential for non-significant, low magnitude effects on char health and condition that are expected to be reversible
  - Statistically significant elevations in tissue concentrations of metals were noted for the clam *H. arctica* and, to a lesser extent, Arctic char in 2019 relative to concentrations in 2018.

  - For Arctic char, samples in 2019 were generally within range of measured values reported since 2010 though concentrations of copper and iron have shown a slight downward trend since 2010.
  - Observed increases in metal concentrations in Arctic char tissues between 2018 and 2019 are not considered Project-related because the metals that were elevated are not materially associated with iron ore; as such, reported changes more likely reflect natural geologic sources or atmospheric deposition from further afield.
- Metals concentrations were consistently and notably greater in *H. arctica* relative to both fish species, occasionally by orders of magnitude. This is attributable to between species differences in habitat preferences, feeding modalities, and ability to metabolize/excrete pollutants. There is no indication that these concentrations of metals are affecting fish health.
- Relevant to PC No. 113, 114
- It is recommended that the fish tissue sampling program continue in 2020, with the following modifications:
  - qualitative documentation of reproductive status of *H. arctica*, such as presence of roe or spawn residue, to contextualize body burden results; and,
  - rather than relying on incidental mortalities, adjust sampling to target minimum sample sizes of sentinel species (i.e., *H. arctica* and sculpin). Arctic Char would be retained as an opportunistically sampled species.

The key findings and recommendations for the AIS/NIS program are as follows:

- **General**
  - AIS/NIS program satisfies PC No. 87, 89, and 91
  - Detection is conducted at a surveillance level and designed to flag potential invasive or non-indigenous species. Based on the number of specimens flagged and sent for independent verification, the program appears to be functioning as intended.
  - It is recommended that:
    - sampling across multiple trophic levels continues in 2020 and that all flagged specimens continue to be screened for known geographic ranges and AIS/NIS status; and,
    - the inventory of known species documented in Milne Inlet continues to be built.
- **Zooplankton**
  - Three new taxa were identified in zooplankton samples, which were cleared as non-invasive through literature review and comparisons to global and domestic databases.
- **Benthic Infauna**
  - Despite adjusting study design to increase sample size, field crews were only able to sample approximately half of the proposed stations; as such, 2019 sampling was insufficient to fully statistically characterize the benthic infaunal community at Milne Port.

  - A total of 41 new taxa were identified in benthic infauna; of these, eight taxa were flagged for further review. Independent verifications are incomplete due to ongoing lab closures in response to the COVID-19 pandemic. Prior to closure, Laval was able to confirm the identification of the invasive *Marenzelleria viridis*. Further review is required to confirm the AIS status of this species in Milne Inlet determine if presence of this species in Milne Port represents a recent invasion and/or whether species is established.
  - Moving forward, the following recommendations are proposed:
    - increase field resources to ensure all proposed locations are sampled to more accurately characterize the infaunal community at Milne Port;
    - continued use of an outside lab to confirm identifications of flagged specimens; and,
    - further review performed on the invasive spionid polychaete *Marenzelleria viridis* to determine the risk of invasion, its known range and confirm its historic collection records in the Canadian Arctic.

- **Macroflora and Benthic Epifauna**
  - Improved resolution of the ROV camera resulted in resolved identifications of species found in previous years.
  - All identified macroflora and benthic epifauna species had natural ranges that included Arctic waters, or for higher level taxa, had at least one representative species with Arctic distributions.
  - Moving forward, the following recommendations are proposed:
    - A biologist with local Arctic fauna knowledge be present with the ROV operator when videos are collected to direct the operator to focus on specimens of interest and perform in-situ taxonomic identifications.

- **Encrusting Epifauna**
  - An overall increase in the total number of encrusting organisms and taxa was observed in 2019 compared to previous years.
  - Three new encrusting epifauna taxa were identified, all with natural ranges that included Arctic waters or, for higher level taxa, at least one representative species with Arctic distribution.
  - Following the loss of one of two sets of settlement baskets and plates, it is recommended the lost deployment be replaced, and additional settlement baskets be placed at other locations in Milne Port so that settlement of encrusting epifauna can be better characterized.

- **Fish**
  - All fish taxa identified in MEEMP and AIS/NIS surveys were reviewed to determine their described distributions; all had natural ranges that included Arctic waters or, for higher level taxa, at least one representative species with Arctic distributions.
  - It is recommended that a biologist with local Arctic fauna knowledge be present with the ROV operator when videos are collected to direct the operator to focus on specimens of interest and perform in-situ taxonomic identifications.

- **Ship Hull Monitoring**
  - Small areas of biofouling were noted on the sterns of four ore carriers through underwater video. Biofouling organisms included barnacles of an undetermined species and an unidentified taxon.
  - Moving forward, the following recommendations are proposed:
    - A biologist with local Arctic fauna knowledge be present with the ROV operator when videos are collected to direct the operator to focus on specimens of interest and perform in-situ taxonomic identifications.
- **Inuit Participant Interviews**
  - Post-season interviews revealed no observed changes in fish populations, abundances or health, as well as no new or unusual fish since the beginning of Operations at Milne Port.
  - Participants highlighted concerns and suggestions for improvements to the program, including changes to the methodology for processing incidental fish mortalities to reduce waste of the unused fish tissue.
  - Recommendations from Inuit Participant interviews included requests for increased training in program equipment and sampling procedures.
  - In planning for the 2020 field programs, suggestions and concerns expressed in the interviews will be considered and applied where possible.
  - Relevant to PC No. 126.

7.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact Marina Winterbottom, on behalf of the undersigned, at 604-296-7312.

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APPENDIX A

Photo Log

Water Quality

Photo 1 – Golder Bruce Head mooring with an up-looking Nortek Signature 500 kHz ADCP, a down-looking TRDI Sentinel Workhorse 300 kHz ADCP, an RBR CTD, and a XEOS Kilo Iridium beacon deployed in August 2019

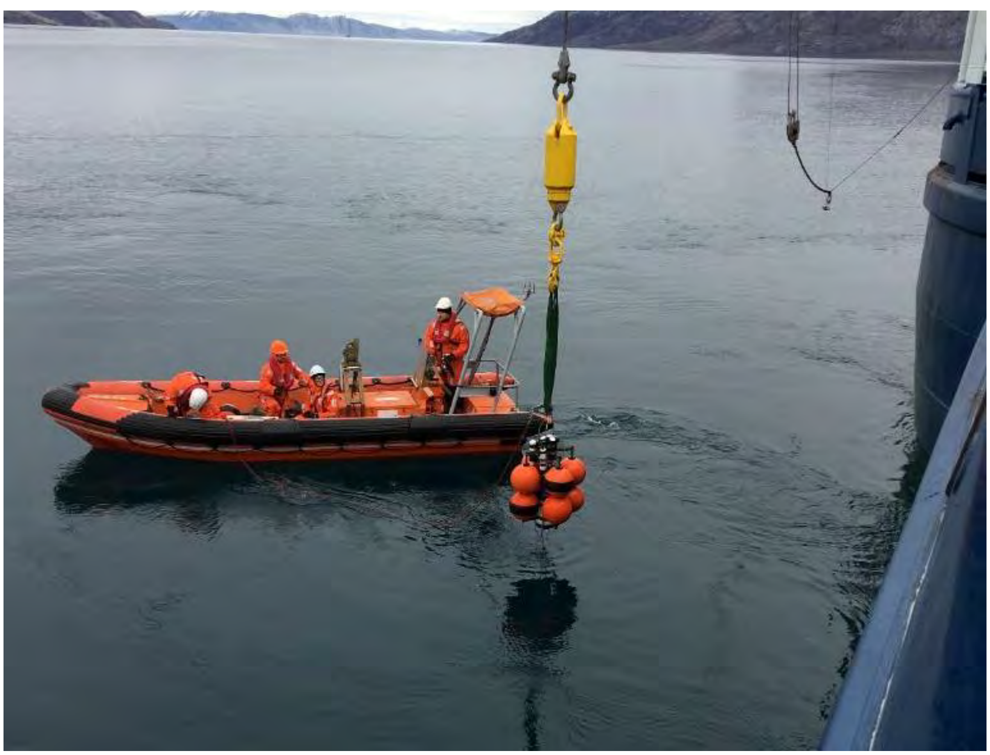

Photo 2 - Recovery of the Golder Bruce Head mooring in September 2019

Sediment Quality

Photo 3 - Sediment sample from SE18-1, collected on 21 September 2019 using a standard Ponar

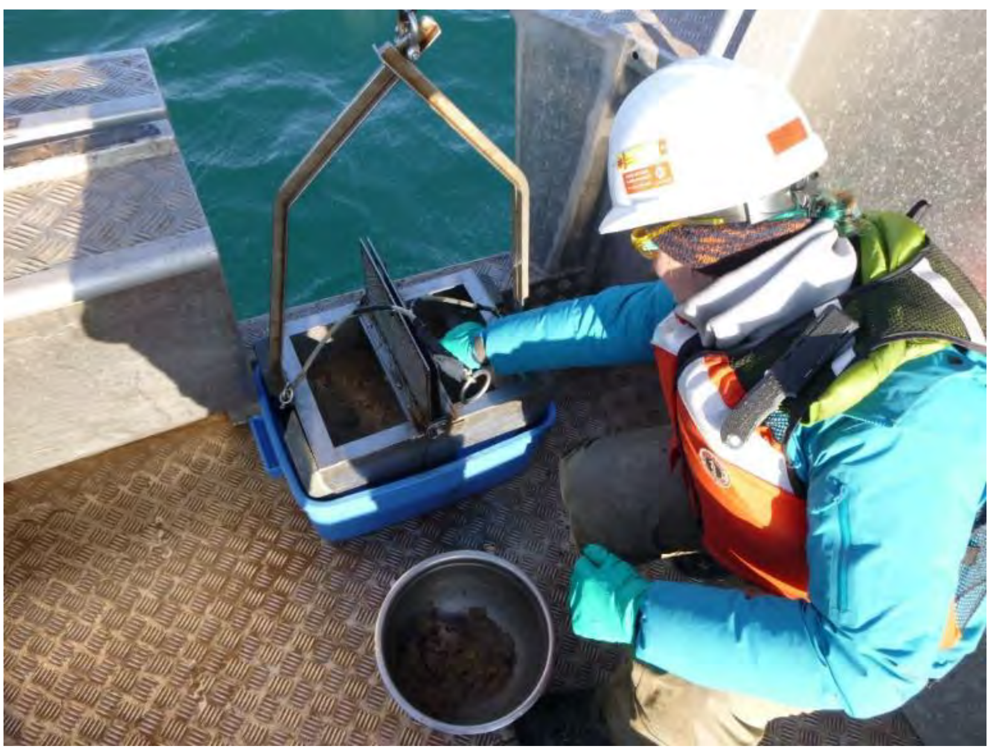

Photo 4 - Golder staff processing sediment sample 18-1 using a Van Veen on 21 September 2019

Photo 5 - Sediment sample from SE-5, collected on 23 September 2019 using a weighted Ponar

Benthic Infauna

Photo 6 - A-frame field splitter being used to split a benthic sample collected using the Van Veen grab sampler

Photo 7 - Benthic sample split using the A-frame field splitter

Photo 8 - Benthic invertebrates following sieving of sample BNE-2, collected 2 October 2019

Photo 9 – Benthic invertebrates following sieving of sample BE-1, collected 22 September 2019

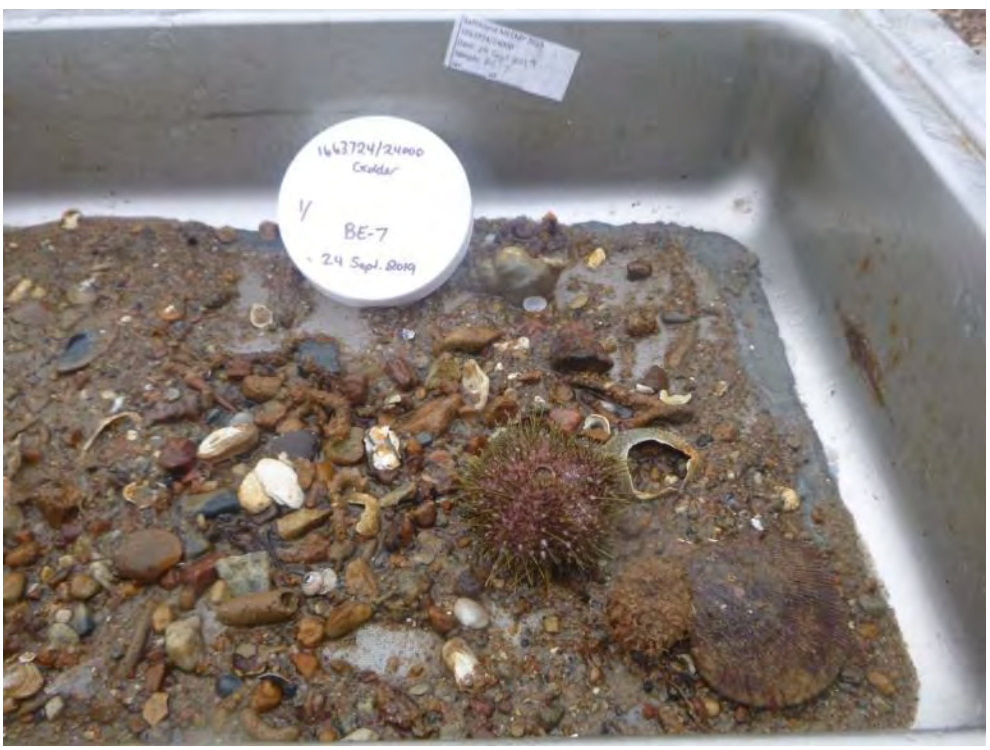

Photo 10 - Benthic invertebrates following sieving of sample BE-7, collected 24 September 2019

Photo 11 – Fish (*Zoarcidae* indet.) in benthic invertebrate sample following sieving of sample BE-7, collected 24 September 2019

Photo 12 – Part of a *Pandalus* sp. specimen, a genus of shrimp observed in benthic sample BNW-3, collected on 1 October 2019

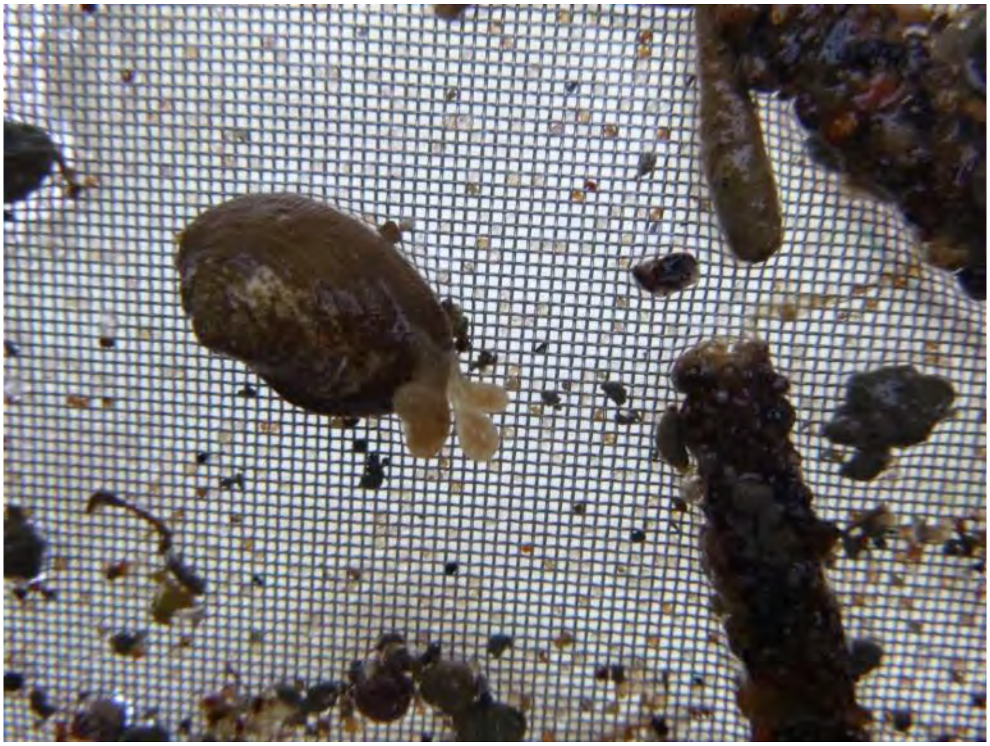

Photo 13 – Branching bryozoan attached to a bivalve shell in benthic sample BNE-6, collected 5 October 2019

Photo 14 - Sea cucumber (*Myriotrochus rinkii*) and a cumacean (red arrow) in benthic sample BW-7, collected 28 September 2019

Photo 15 – Bubble snail *Cylichna alba* in benthic infauna sample BW-6, collected 27 September 2019

Photo 16 – Encrusting bryozoans and an unidentified calcareous tube worm on a rock observed in benthic sample BNW-4, collected 1 October 2019

Fish

Photo 17 - Fyke net (FN-02) deployed near Milne Port Ore Dock in August 2019

Photo 18 - Sandlance captured in Fukui traps during fish sampling at Milne Port Ore Dock in August 2019

Photo 19 Shorthorn sculpin caught in gill nets as part of fish sampling at Milne Port in August 2019

Photo 20 Fourhorn sculpin captured during gill net sampling at Milne Port in July 2019

Photo 21 - Arctic char captured during gill net sampling at Milne Port in July 2019

Photo 22 – Arctic char collected during gill net sampling at Milne Port in July 2019

Photo 23 - Ninespine stickleback captured during seine net sampling at Milne Port in August 2019

Tissue Chemistry

Photo 24 – *Hiatella arctica* collected from station BE-7 for tissue analysis on 24 September 2019

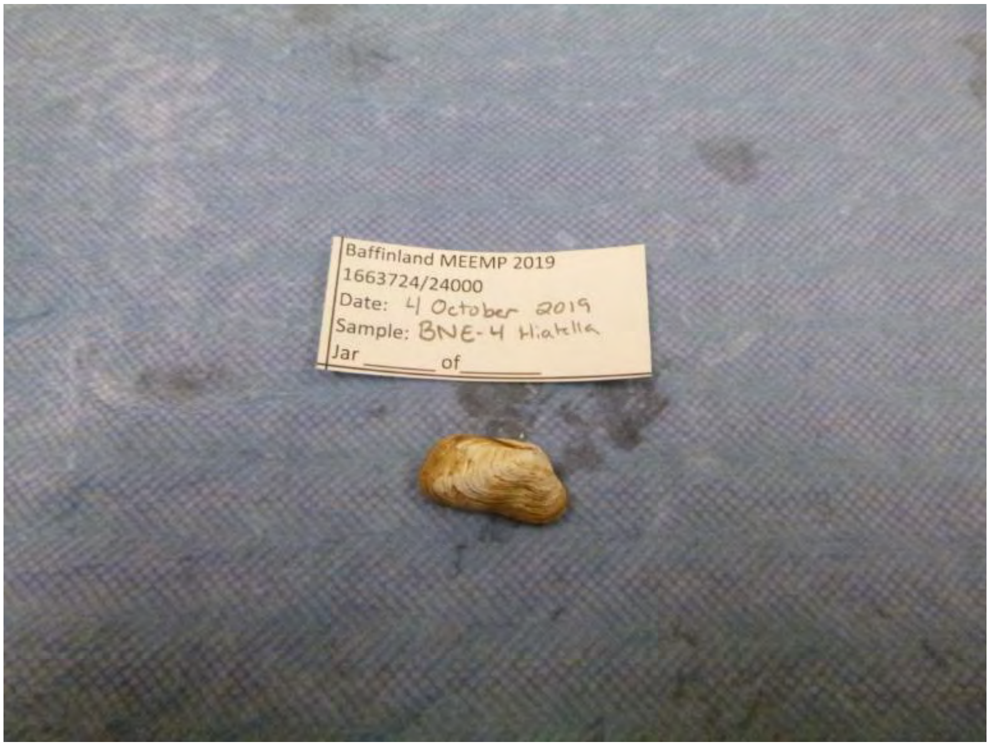

Photo 25 – *Hiatella arctica* collected from station BNE-4 for tissue analysis on 4 October 2019

Encrusting Epifauna

Photo 26 – Encrusting epifaunal growth on settlement plates and settlement basket (SBEO-1) retrieved from eastern side of Milne Port Ore Dock in August 2019

Photo 27 - Settlement basket (SBEO-1) retrieved from eastern side of the Milne Port Ore Dock in August 2019

Photo 28 – Settlement plates from western side of Milne Port Ore Dock (SBWO-1) found washed up on shore in August 2019

ROV Surveys

Photo 29 - Seamor Chinook 300F ROV video system used to undertake underwater video surveys of offset habitat along Milne Port Ore Dock in August 2019

Photo 30 – Topside view of underwater video survey of offset habitat along Transect 7 (T7) on east side of Milne Port Ore Dock in August 2019

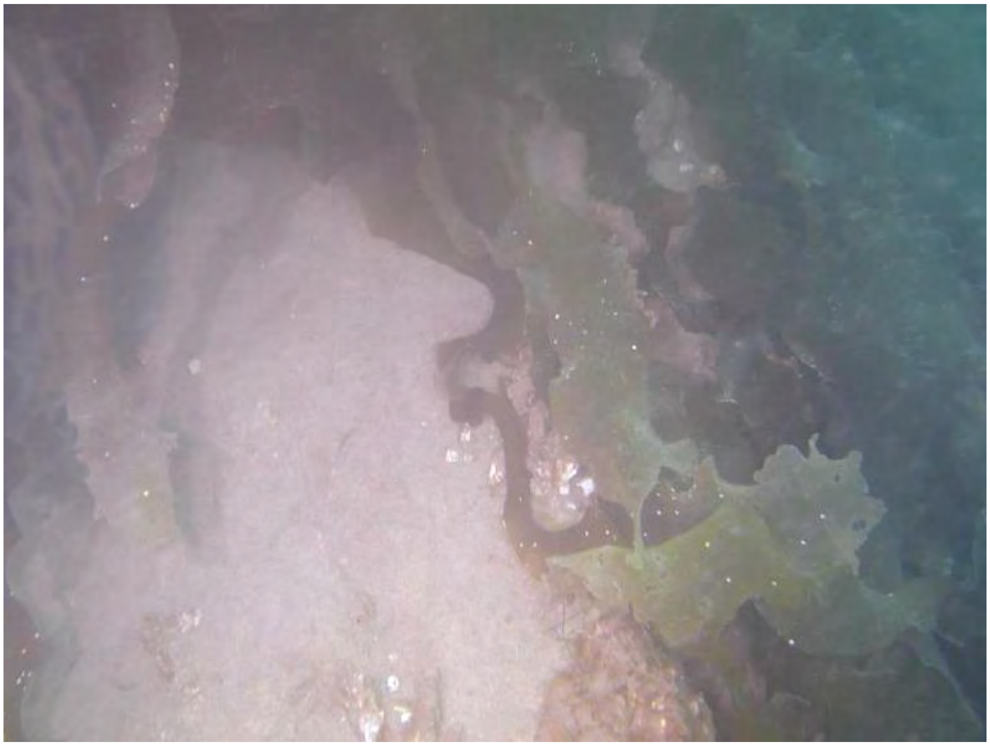

Photo 31 - Bladed kelp observed on west side of Milne Port Ore Dock (T1) in August 2019

Photo 32 - Thick algal cover on coarse rock on west side of Milne Port Ore Dock (T2) in August 2019

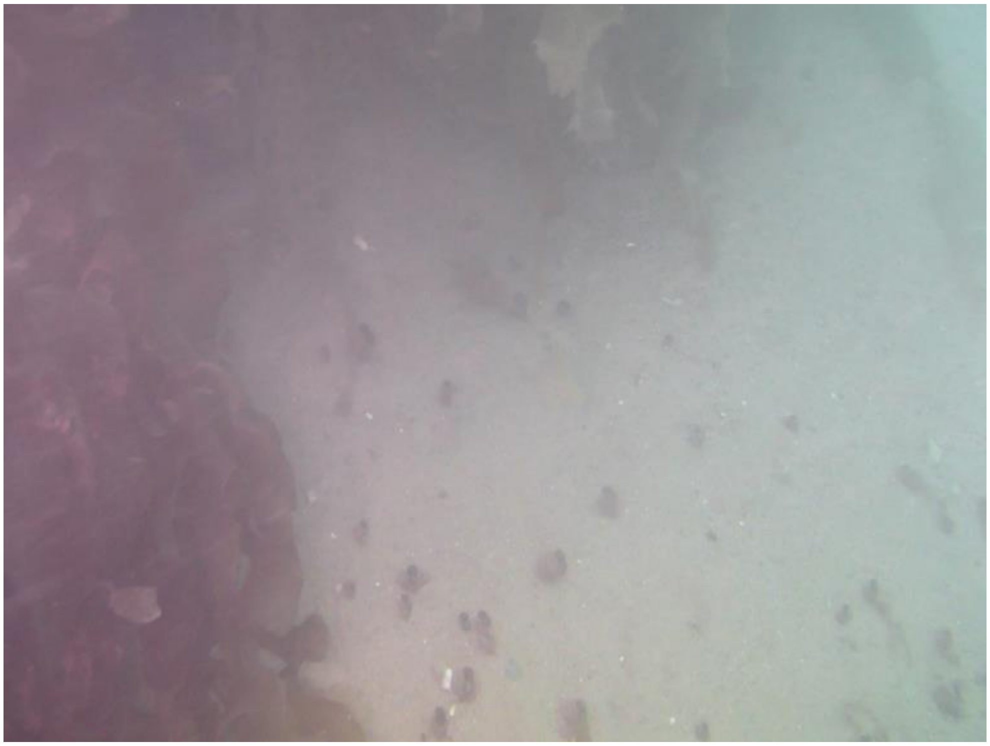

Photo 33 - Siphons of *Hiatella arctica* observed in sand next to bladed kelp covered offset habitat on west side of Milne Port Ore dock (T1) in August 2019

Photo 34 – Scallop observed on coarse rock habitat on west side of Milne Port Ore Dock (T1) in August 2019

Photo 35 - Crinoid observed on coarse rock on west side of Milne Port Ore Dock (T1) in August 2019

Photo 36 – Crinoid recorded on AIS transect

Photo 37 - Crinoid and tunicate (*Polycarpa pomeria*) recorded in AIS transect T4-2

Photo 38 - Mud scallops (*Similipecten greenlandicus*) recorded in T3

Photo 39 - *Crangonidae* sp. recorded on T1

Photo 40 - Scallops (*Chlamys* sp.) recorded in T3

Photo 41 - Eelblenny (Stichaeidae indet. sp. 1) recorded in T5

Photo 42 - Fish doctor (*Gymnelus viridis*) recorded in AIS transect T4-2

Photo 43 - Sculpin recorded on belt transect TP03

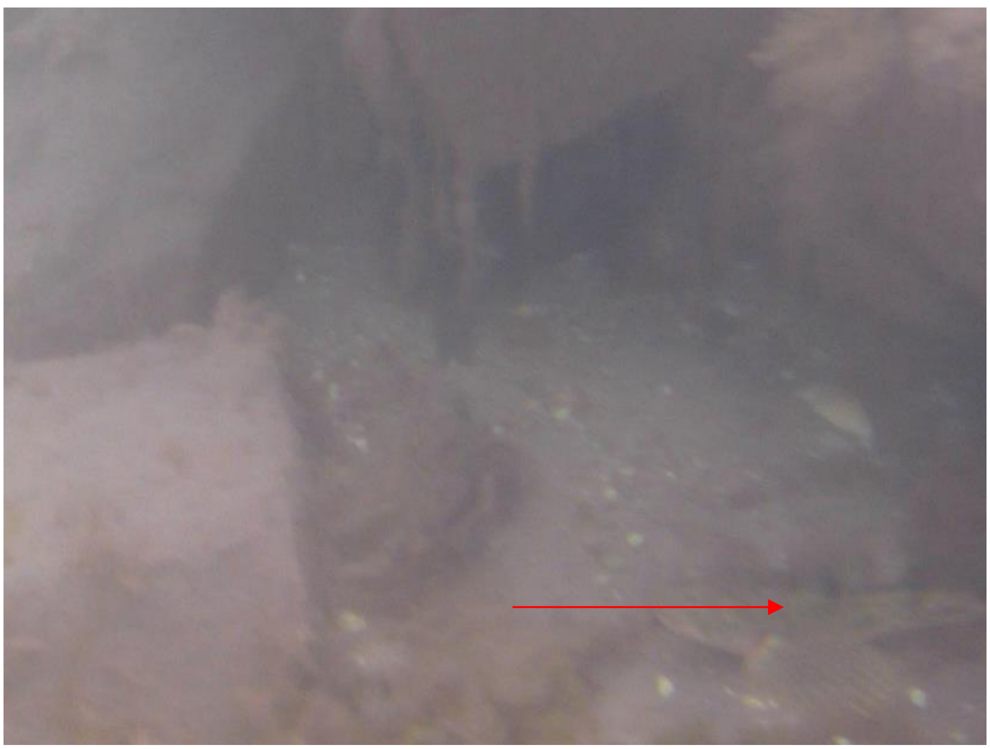

Photo 44 - Sculpin observed resting on offset habitat during ROV surveys on East Side (T7) of Milne Port Ore Dock in August 2019

Photo 45 - Same sculpin observed moving to cover during ROV surveys on East Side (T7) of Milne Port Ore Dock in August 2019

Photo 46 - Cod observed resting on offset habitat during ROV surveys on East Side (T7) of Milne Port Ore Dock in August 2019

Photo 47 - Opossum shrimp observed along North East Side (T7) of Milne Port Ore Dock in August 2019

Photo 48 - Fourhorn sculpin observed hiding in between boulders on coarse rock habitat on west side of Milne Port Ore Dock (T1) in August 2019

Photo 49 – Unidentified cephalopod recorded on T5

Ship Hull Monitoring

Photo 50 - Barnacles on the hull of *Sagar Samrat*

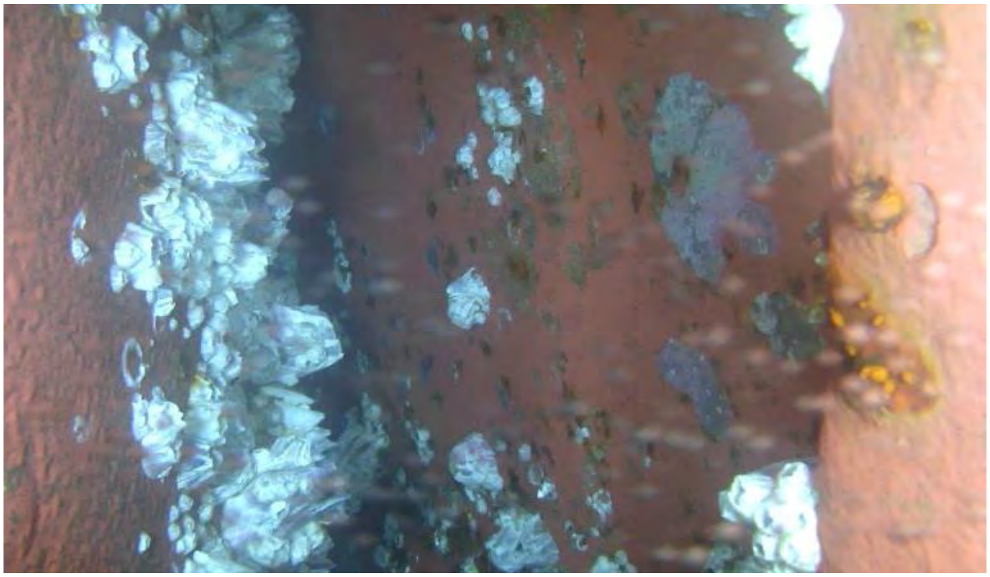

Photo 51 - Barnacles on the hull of the *Golden Enterprise*

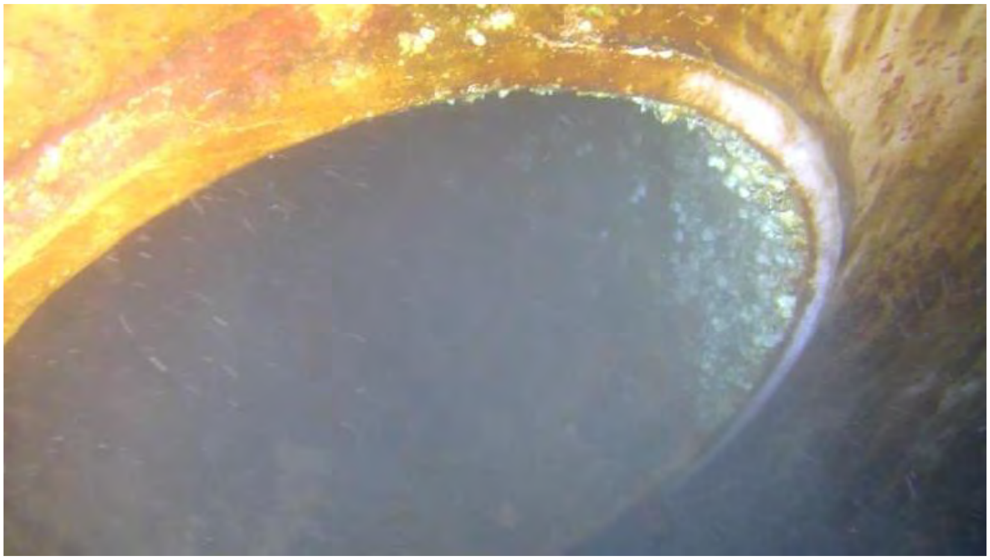

Photo 52 - Barnacles on the intake port on *Sagar Samart*

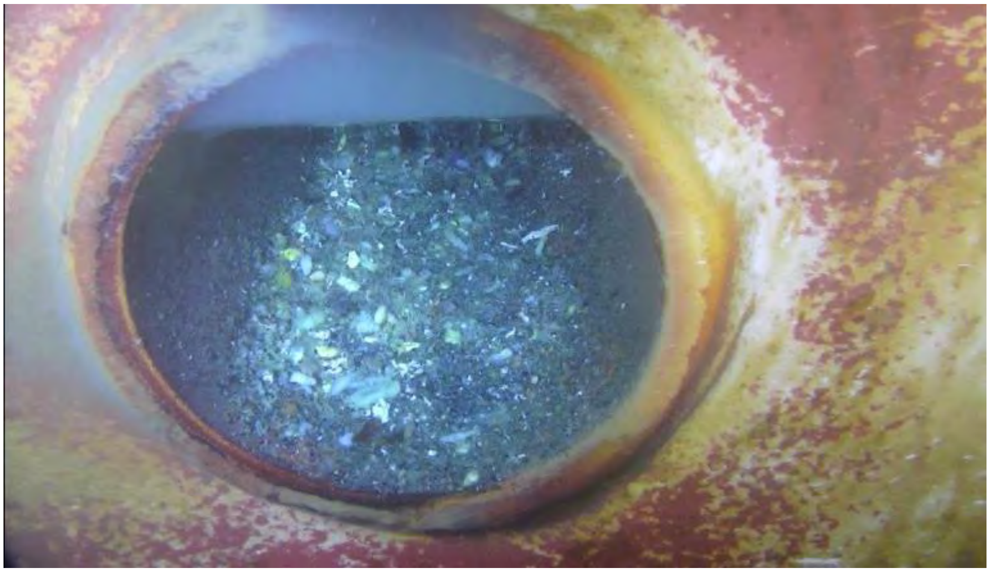

Photo 53 - Unknown debris in the intake port on *Sagar Samart*

APPENDIX B

Water Quality Analysis Data

GOLDER ASSOCIATES LTD.
ATTN: Arman Ospan
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 28-AUG-19
Report Date: 06-SEP-19 16:57 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2337246

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 17-739036
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2337246-1	L2337246-2	L2337246-3	L2337246-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19	
	Sampled Time	09:15	09:00	08:45	09:30	
	Client ID	SOURCE-1	WNW-1	NORTH-1	ENE-1	
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	47300	46300	47100	47100	
	pH (pH)	7.97	7.97	7.97	7.98	
	Salinity (psu)	31.5	30.7	31.3	31.3	
	Total Suspended Solids (mg/L)	2.0	<2.0	<2.0	2.0	
	Turbidity (NTU)	0.15	0.15	0.13	<0.10	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	112	112	112	112	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	53.6	59.5	58.7	57.2	
	Chloride (Cl) (mg/L)	15400	16900	16800	16200	
	Fluoride (F) (mg/L)	<1.0	1.0	<1.0	<1.0	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Total Kjeldahl Nitrogen (mg/L)	0.139	0.116	0.091	0.088	
	Sulfate (SO4) (mg/L)	2100	2330	2300	2220	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.96	1.77	1.72	1.13	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0142	0.0068	0.0056	<0.0050	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00162	0.00153	0.00158	0.00152	
	Barium (Ba)-Total (mg/L)	0.0095	0.0093	0.0095	0.0095	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	3.34	3.05	3.10	2.77	
	Cadmium (Cd)-Total (mg/L)	0.000041	0.000039	0.000046	0.000034	
	Calcium (Ca)-Total (mg/L)	402	386	396	366	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	<0.00050	0.00081	0.00127	<0.00050	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.018	<0.010	<0.010	<0.010	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.144	0.130	0.129	0.122	
	Magnesium (Mg)-Total (mg/L)	972	964	967	983	
	Manganese (Mn)-Total (mg/L)	0.00079	0.00100	0.00084	0.00070	
	Mercury (Hg)-Total (mg/L)	0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.0109	0.0106	0.0106	0.0103	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2337246-1 Seawater 26-AUG-19 09:15 SOURCE-1	L2337246-2 Seawater 26-AUG-19 09:00 WNW-1	L2337246-3 Seawater 26-AUG-19 08:45 NORTH-1	L2337246-4 Seawater 26-AUG-19 09:30 ENE-1	
Grouping	**Analyte**					
SEAWATER						
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	0.00054	0.00060	0.00057	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	432	410	408	423	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.117	0.111	0.113	0.115	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Total (mg/L)	9470	9000	9170	9300	
	Strontium (Sr)-Total (mg/L)	7.50	7.57	7.46	7.40	
	Sulfur (S)-Total (mg/L)	1070	1060	1090	1050	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00293	0.00276	0.00288	0.00270	
	Vanadium (V)-Total (mg/L)	0.00157	0.00142	0.00140	0.00142	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0034	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00154	0.00148	0.00157	0.00149	
	Barium (Ba)-Dissolved (mg/L)	0.0076	0.0077	0.0078	0.0080	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	3.71	3.55	3.25	3.02	
	Cadmium (Cd)-Dissolved (mg/L)	0.000028	0.000023	0.000025	0.000024	
	Calcium (Ca)-Dissolved (mg/L)	361	367	360	359	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00025	0.00055	0.00081	0.00020	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2337246-1	L2337246-2	L2337246-3	L2337246-4	
	Sample ID	L2337246-1	L2337246-2	L2337246-3	L2337246-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19	
	Sampled Time	09:15	09:00	08:45	09:30	
	Client ID	SOURCE-1	WNW-1	NORTH-1	ENE-1	
Grouping	**Analyte**					
SEAWATER						
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.145	0.135	0.117	0.112	
	Magnesium (Mg)-Dissolved (mg/L)	1120	1070	1060	1030	
	Manganese (Mn)-Dissolved (mg/L)	0.00043	0.00067	0.00051	0.00043	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0101	0.0100	0.0103	0.0101	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	358	347	358	349	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.107	0.105	0.110	0.108	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	10600	10500	10700	11100	
	Strontium (Sr)-Dissolved (mg/L)	6.88	6.64	7.04	6.79	
	Sulfur (S)-Dissolved (mg/L)	973	932	916	928	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00263	0.00280	0.00277	0.00264	
	Vanadium (V)-Dissolved (mg/L)	0.00133	0.00124	0.00133	0.00130	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0011	0.0018	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2337246-1	L2337246-2	L2337246-3	L2337246-4
	Description	Seawater	Seawater	Seawater	Seawater
	Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19
	Sampled Time	09:15	09:00	08:45	09:30
	Client ID	SOURCE-1	WNW-1	NORTH-1	ENE-1
WATER					
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	<1	<1	<1	<1
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	96.5	98.4	87.7	98.2
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acridine d9 (%)	102.0	105.2	104.8	102.5
	Surrogate: Chrysene d12 (%)	93.2	102.3	98.3	105.9
	Surrogate: Naphthalene d8 (%)	98.8	99.3	98.6	101.4
	Surrogate: Phenanthrene d10 (%)	101.2	105.4	103.5	100.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Boron (B)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2337246-1, -2, -3, -4
Matrix Spike	Yttrium (Y)-Total	RM-H	L2337246-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA	Seawater	Chloride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA	Seawater	Fluoride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA	Seawater	Sulfate by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA	Seawater	TOC by combustion (seawater)	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual

Reference Information

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

FCOLI-MF-ENV-VA	Water	Fecal coliform by membrane filtration	APHA METHOD 9222

This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation of the filter with the appropriate growth medium, positive results require further testing (up to an additional 48 hours) to confirm and quantify the total coliform. This method is used for non-turbid water with a low background bacteria level.

HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA	Seawater	Tot Metals in Seawater by CRC ICPMS (BC)	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA	Seawater	Diss. Sodium in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA	Water	PAHs in Water	EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA	Seawater	Salinity by conductivity meter	APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Reference Information

TKN-C-F-VA	Seawater	TKN in Seawater by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-739036

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Arman Ospan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4778471								
WG3147801-2 LCS								
EPH10-19			106.4		%		70-130	03-SEP-19
EPH19-32			102.1		%		70-130	03-SEP-19
WG3147801-1 MB								
EPH10-19			<0.25		mg/L		0.25	03-SEP-19
EPH19-32			<0.25		mg/L		0.25	03-SEP-19
Surrogate: 2-Bromobenzotrifluoride			86.4		%		60-140	03-SEP-19
FCOLI-MF-ENV-VA	**Water**							
Batch R4781088								
WG3145490-1 MB								
Coliform Bacteria - Fecal			<1		CFU/100mL		1	28-AUG-19
PAH-ME-MS-VA	**Water**							
Batch R4778494								
WG3147801-2 LCS								
Acenaphthene			106.0		%		60-130	03-SEP-19
Acenaphthylene			108.7		%		60-130	03-SEP-19
Acridine			107.1		%		60-130	03-SEP-19
Anthracene			116.4		%		60-130	03-SEP-19
Benz(a)anthracene			123.5		%		60-130	03-SEP-19
Benzo(a)pyrene			108.6		%		60-130	03-SEP-19
Benzo(b&j)fluoranthene			101.7		%		60-130	03-SEP-19
Benzo(g,h,i)perylene			113.9		%		60-130	03-SEP-19
Benzo(k)fluoranthene			104.2		%		60-130	03-SEP-19
Chrysene			117.4		%		60-130	03-SEP-19
Dibenz(a,h)anthracene			115.0		%		60-130	03-SEP-19
Fluoranthene			114.2		%		60-130	03-SEP-19
Fluorene			107.5		%		60-130	03-SEP-19
Indeno(1,2,3-c,d)pyrene			120.5		%		60-130	03-SEP-19
1-Methylnaphthalene			108.9		%		60-130	03-SEP-19
2-Methylnaphthalene			107.8		%		60-130	03-SEP-19
Naphthalene			106.3		%		50-130	03-SEP-19
Phenanthrene			113.4		%		60-130	03-SEP-19
Pyrene			114.9		%		60-130	03-SEP-19
Quinoline			116.1		%		60-130	03-SEP-19
WG3147801-1 MB								

Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4778494								
WG3147801-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	03-SEP-19
Acenaphthylene			<0.000010		mg/L		0.00001	03-SEP-19
Acridine			<0.000010		mg/L		0.00001	03-SEP-19
Anthracene			<0.000010		mg/L		0.00001	03-SEP-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	03-SEP-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	03-SEP-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	03-SEP-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	03-SEP-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	03-SEP-19
Chrysene			<0.000010		mg/L		0.00001	03-SEP-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	03-SEP-19
Fluoranthene			<0.000010		mg/L		0.00001	03-SEP-19
Fluorene			<0.000010		mg/L		0.00001	03-SEP-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	03-SEP-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	03-SEP-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	03-SEP-19
Naphthalene			<0.000050		mg/L		0.00005	03-SEP-19
Phenanthrene			<0.000020		mg/L		0.00002	03-SEP-19
Pyrene			<0.000010		mg/L		0.00001	03-SEP-19
Quinoline			<0.000050		mg/L		0.00005	03-SEP-19
Surrogate: Acridine d9			94.4		%		60-130	03-SEP-19
Surrogate: Chrysene d12			102.9		%		60-130	03-SEP-19
Surrogate: Naphthalene d8			103.2		%		50-130	03-SEP-19
Surrogate: Phenanthrene d10			104.3		%		60-130	03-SEP-19
ALK-TITR-VA	**Seawater**							
Batch R4782219								
WG3147604-4 DUP		**L2337246-1**						
Alkalinity, Total (as CaCO3)		112	112		mg/L	0.1	20	01-SEP-19
WG3147604-3 LCS								
Alkalinity, Total (as CaCO3)			101.7		%		70-130	01-SEP-19
WG3147604-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	01-SEP-19
ANIONS-C-BR-IC-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Bromide (Br)		53.6	58.8		mg/L	9.2	20	29-AUG-19
WG3147681-2 LCS								
Bromide (Br)			99.4		%		85-115	29-AUG-19
WG3147681-1 MB								
Bromide (Br)			<5.0		mg/L		5	29-AUG-19
ANIONS-C-CL-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Chloride (Cl)		15400	16900		mg/L	8.9	20	29-AUG-19
WG3147681-2 LCS								
Chloride (Cl)			101.3		%		90-110	29-AUG-19
WG3147681-1 MB								
Chloride (Cl)			<50		mg/L		50	29-AUG-19
ANIONS-C-F-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Fluoride (F)		<1.0	1.0	RPD-NA	mg/L	N/A	20	29-AUG-19
WG3147681-2 LCS								
Fluoride (F)			102.9		%		90-110	29-AUG-19
WG3147681-1 MB								
Fluoride (F)			<1.0		mg/L		1	29-AUG-19
ANIONS-C-NO2-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Nitrite (as N)		<0.10	0.10	RPD-NA	mg/L	N/A	20	29-AUG-19
WG3147681-2 LCS								
Nitrite (as N)			97.1		%		90-110	29-AUG-19
WG3147681-1 MB								
Nitrite (as N)			<0.10		mg/L		0.1	29-AUG-19
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Nitrate (as N)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	29-AUG-19
WG3147681-2 LCS								
Nitrate (as N)			99.5		%		90-110	29-AUG-19
WG3147681-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	29-AUG-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4778997								
WG3147681-3 DUP		**L2337246-1**						
Sulfate (SO4)		2100	2310		mg/L	9.6	20	29-AUG-19
WG3147681-2 LCS								
Sulfate (SO4)			101.6		%		90-110	29-AUG-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4783295								
WG3147851-3 DUP		**L2337246-1**						
Total Organic Carbon		1.96	1.30	J	mg/L	0.66	1	04-SEP-19
WG3147851-2 LCS								
Total Organic Carbon			103.3		%		80-120	04-SEP-19
WG3151113-4 LCS								
Total Organic Carbon			94.0		%		80-120	04-SEP-19
WG3147851-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-SEP-19
WG3151113-3 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-SEP-19
WG3147851-4 MS		**L2337246-2**						
Total Organic Carbon			109.4		%		70-130	04-SEP-19
EC-C-PCT-VA	**Seawater**							
Batch R4782219								
WG3147604-4 DUP		**L2337246-1**						
Conductivity		47300	47200		uS/cm	0.2	10	01-SEP-19
WG3147604-1 MB								
Conductivity			<2.0		uS/cm		2	01-SEP-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4782391								
WG3151041-2 LCS								
Mercury (Hg)-Dissolved			92.4		%		80-120	04-SEP-19
WG3151041-1 MB		**NP**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	04-SEP-19
WG3151041-4 MS		**L2337246-1**						
Mercury (Hg)-Dissolved			92.3		%		70-130	04-SEP-19
	Seawater							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4779571								
WG3149837-2 LCS								
Mercury (Hg)-Total			100.7		%		80-120	01-SEP-19
WG3149837-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	01-SEP-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4778932								
WG3146595-3 DUP		**L2337246-2**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	30-AUG-19
Arsenic (As)-Dissolved		0.00148	0.00147		mg/L	0.8	20	30-AUG-19
Barium (Ba)-Dissolved		0.0077	0.0077		mg/L	0.1	20	30-AUG-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Boron (B)-Dissolved		3.55	3.39		mg/L	4.8	20	30-AUG-19
Cadmium (Cd)-Dissolved		0.000023	0.000027		mg/L	16	20	30-AUG-19
Calcium (Ca)-Dissolved		367	354		mg/L	3.6	20	30-AUG-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	30-AUG-19
Copper (Cu)-Dissolved		0.00055	0.00052		mg/L	5.0	20	30-AUG-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	30-AUG-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	30-AUG-19
Lithium (Li)-Dissolved		0.135	0.122		mg/L	10	20	30-AUG-19
Magnesium (Mg)-Dissolved		1070	1050		mg/L	1.9	20	30-AUG-19
Manganese (Mn)-Dissolved		0.00067	0.00065		mg/L	3.3	20	30-AUG-19
Molybdenum (Mo)-Dissolved		0.0100	0.00980		mg/L	2.0	20	30-AUG-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	30-AUG-19
Potassium (K)-Dissolved		347	347		mg/L	0.1	20	30-AUG-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Rubidium (Rb)-Dissolved		0.105	0.104		mg/L	1.3	20	30-AUG-19
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	30-AUG-19
Strontium (Sr)-Dissolved		6.64	6.73		mg/L	1.5	20	30-AUG-19
Sulfur (S)-Dissolved		932	922		mg/L	1.1	20	30-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4778932								
WG3146595-3 DUP		**L2337246-2**						
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	30-AUG-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	30-AUG-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	30-AUG-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	30-AUG-19
Uranium (U)-Dissolved		0.00280	0.00273		mg/L	2.5	20	30-AUG-19
Vanadium (V)-Dissolved		0.00124	0.00127		mg/L	1.8	20	30-AUG-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
Zinc (Zn)-Dissolved		0.0011	<0.0010	RPD-NA	mg/L	N/A	20	30-AUG-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	30-AUG-19
WG3146595-2 LCS								
Aluminum (Al)-Dissolved			97.6		%		80-120	30-AUG-19
Antimony (Sb)-Dissolved			96.6		%		80-120	30-AUG-19
Arsenic (As)-Dissolved			97.1		%		80-120	30-AUG-19
Barium (Ba)-Dissolved			100.0		%		80-120	30-AUG-19
Beryllium (Be)-Dissolved			93.8		%		80-120	30-AUG-19
Bismuth (Bi)-Dissolved			101.3		%		80-120	30-AUG-19
Boron (B)-Dissolved			90.3		%		80-120	30-AUG-19
Cadmium (Cd)-Dissolved			101.6		%		80-120	30-AUG-19
Calcium (Ca)-Dissolved			94.4		%		80-120	30-AUG-19
Cesium (Cs)-Dissolved			104.7		%		80-120	30-AUG-19
Chromium (Cr)-Dissolved			100.0		%		80-120	30-AUG-19
Cobalt (Co)-Dissolved			99.8		%		80-120	30-AUG-19
Copper (Cu)-Dissolved			97.3		%		80-120	30-AUG-19
Gallium (Ga)-Dissolved			102.0		%		80-120	30-AUG-19
Iron (Fe)-Dissolved			99.8		%		80-120	30-AUG-19
Lead (Pb)-Dissolved			97.5		%		80-120	30-AUG-19
Lithium (Li)-Dissolved			92.1		%		80-120	30-AUG-19
Magnesium (Mg)-Dissolved			97.2		%		80-120	30-AUG-19
Manganese (Mn)-Dissolved			99.1		%		80-120	30-AUG-19
Molybdenum (Mo)-Dissolved			100.5		%		80-120	30-AUG-19
Nickel (Ni)-Dissolved			102.4		%		80-120	30-AUG-19
Phosphorus (P)-Dissolved			93.7		%		80-120	30-AUG-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4778932								
WG3146595-2 LCS								
Potassium (K)-Dissolved			101.0		%		80-120	30-AUG-19
Rhenium (Re)-Dissolved			100.7		%		80-120	30-AUG-19
Rubidium (Rb)-Dissolved			98.9		%		80-120	30-AUG-19
Selenium (Se)-Dissolved			104.9		%		80-120	30-AUG-19
Silver (Ag)-Dissolved			104.2		%		80-120	30-AUG-19
Strontium (Sr)-Dissolved			102.0		%		80-120	30-AUG-19
Sulfur (S)-Dissolved			99.7		%		80-120	30-AUG-19
Tellurium (Te)-Dissolved			108.6		%		80-120	30-AUG-19
Thallium (Tl)-Dissolved			98.1		%		80-120	30-AUG-19
Thorium (Th)-Dissolved			92.8		%		80-120	30-AUG-19
Tin (Sn)-Dissolved			98.0		%		80-120	30-AUG-19
Titanium (Ti)-Dissolved			96.4		%		80-120	30-AUG-19
Tungsten (W)-Dissolved			97.1		%		80-120	30-AUG-19
Uranium (U)-Dissolved			91.2		%		80-120	30-AUG-19
Vanadium (V)-Dissolved			97.7		%		80-120	30-AUG-19
Yttrium (Y)-Dissolved			95.4		%		80-120	30-AUG-19
Zinc (Zn)-Dissolved			102.2		%		80-120	30-AUG-19
Zirconium (Zr)-Dissolved			96.9		%		80-120	30-AUG-19
WG3146595-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	30-AUG-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	30-AUG-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	30-AUG-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	30-AUG-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	30-AUG-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	30-AUG-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	30-AUG-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	30-AUG-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	30-AUG-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	30-AUG-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4778932								
WG3146595-1 MB		**LF**						
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	30-AUG-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	30-AUG-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	30-AUG-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	30-AUG-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	30-AUG-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	30-AUG-19
Potassium (K)-Dissolved			<1.0		mg/L		1	30-AUG-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	30-AUG-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	30-AUG-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	30-AUG-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	30-AUG-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	30-AUG-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	30-AUG-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	30-AUG-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	30-AUG-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	30-AUG-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	30-AUG-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	30-AUG-19
WG3146595-4 MS		**L2337246-1**						
Aluminum (Al)-Dissolved			99.7		%		70-130	30-AUG-19
Antimony (Sb)-Dissolved			105.5		%		70-130	30-AUG-19
Arsenic (As)-Dissolved			92.0		%		70-130	30-AUG-19
Barium (Ba)-Dissolved			84.8		%		70-130	30-AUG-19
Beryllium (Be)-Dissolved			90.4		%		70-130	30-AUG-19
Bismuth (Bi)-Dissolved			80.4		%		70-130	30-AUG-19
Boron (B)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Cadmium (Cd)-Dissolved			87.0		%		70-130	30-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4778932								
WG3146595-4 MS		**L2337246-1**						
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Cesium (Cs)-Dissolved			99.5		%		70-130	30-AUG-19
Chromium (Cr)-Dissolved			99.2		%		70-130	30-AUG-19
Cobalt (Co)-Dissolved			91.7		%		70-130	30-AUG-19
Copper (Cu)-Dissolved			83.7		%		70-130	30-AUG-19
Gallium (Ga)-Dissolved			97.3		%		70-130	30-AUG-19
Iron (Fe)-Dissolved			93.5		%		70-130	30-AUG-19
Lead (Pb)-Dissolved			82.0		%		70-130	30-AUG-19
Lithium (Li)-Dissolved			80.6		%		70-130	30-AUG-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Manganese (Mn)-Dissolved			98.4		%		70-130	30-AUG-19
Molybdenum (Mo)-Dissolved			101.0		%		70-130	30-AUG-19
Nickel (Ni)-Dissolved			87.5		%		70-130	30-AUG-19
Phosphorus (P)-Dissolved			108.1		%		70-130	30-AUG-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Rhenium (Re)-Dissolved			89.2		%		70-130	30-AUG-19
Rubidium (Rb)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Selenium (Se)-Dissolved			90.6		%		70-130	30-AUG-19
Silver (Ag)-Dissolved			87.3		%		70-130	30-AUG-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	30-AUG-19
Tellurium (Te)-Dissolved			81.1		%		70-130	30-AUG-19
Thallium (Tl)-Dissolved			84.0		%		70-130	30-AUG-19
Thorium (Th)-Dissolved			93.3		%		70-130	30-AUG-19
Tin (Sn)-Dissolved			91.8		%		70-130	30-AUG-19
Titanium (Ti)-Dissolved			104.5		%		70-130	30-AUG-19
Tungsten (W)-Dissolved			95.4		%		70-130	30-AUG-19
Uranium (U)-Dissolved			86.5		%		70-130	30-AUG-19
Vanadium (V)-Dissolved			101.1		%		70-130	30-AUG-19
Yttrium (Y)-Dissolved			105.3		%		70-130	30-AUG-19
Zinc (Zn)-Dissolved			81.3		%		70-130	30-AUG-19
Zirconium (Zr)-Dissolved			104.2		%		70-130	30-AUG-19

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4781998								
WG3146595-3 DUP		**L2337246-2**						
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	31-AUG-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4781998								
WG3147689-3 DUP		**L2337246-1**						
Aluminum (Al)-Total		0.0142	0.0118		mg/L	18	20	31-AUG-19
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	31-AUG-19
Arsenic (As)-Total		0.00162	0.00160		mg/L	1.2	20	31-AUG-19
Barium (Ba)-Total		0.0095	0.0093		mg/L	1.8	20	31-AUG-19
Beryllium (Be)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Boron (B)-Total		3.34	3.09		mg/L	7.7	20	31-AUG-19
Cadmium (Cd)-Total		0.000041	0.000031	J	mg/L	0.000010	0.00002	31-AUG-19
Calcium (Ca)-Total		402	404		mg/L	0.5	20	31-AUG-19
Cesium (Cs)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Cobalt (Co)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	31-AUG-19
Copper (Cu)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Gallium (Ga)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Iron (Fe)-Total		0.018	0.018		mg/L	0.8	20	31-AUG-19
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	31-AUG-19
Lithium (Li)-Total		0.144	0.132		mg/L	9.0	20	31-AUG-19
Magnesium (Mg)-Total		972	992		mg/L	2.0	20	31-AUG-19
Manganese (Mn)-Total		0.00079	0.00083		mg/L	4.7	20	31-AUG-19
Molybdenum (Mo)-Total		0.0109	0.0106		mg/L	3.0	20	31-AUG-19
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	31-AUG-19
Potassium (K)-Total		432	424		mg/L	1.7	20	31-AUG-19
Rhenium (Re)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Rubidium (Rb)-Total		0.117	0.115		mg/L	1.5	20	31-AUG-19
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Silver (Ag)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	31-AUG-19
Strontium (Sr)-Total		7.50	7.66		mg/L	2.1	20	31-AUG-19
Sulfur (S)-Total		1070	1110		mg/L	3.7	20	31-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4781998								
WG3147689-3 DUP		**L2337246-1**						
Tellurium (Te)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Thallium (Tl)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	31-AUG-19
Thorium (Th)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	31-AUG-19
Titanium (Ti)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	31-AUG-19
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	31-AUG-19
Uranium (U)-Total		0.00293	0.00274		mg/L	6.7	20	31-AUG-19
Vanadium (V)-Total		0.00157	0.00148		mg/L	5.5	20	31-AUG-19
Yttrium (Y)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	31-AUG-19
Zirconium (Zr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	31-AUG-19
WG3147689-2 LCS								
Aluminum (Al)-Total			103.4		%		80-120	31-AUG-19
Antimony (Sb)-Total			104.1		%		80-120	31-AUG-19
Arsenic (As)-Total			103.2		%		80-120	31-AUG-19
Barium (Ba)-Total			102.0		%		80-120	31-AUG-19
Beryllium (Be)-Total			96.8		%		80-120	31-AUG-19
Bismuth (Bi)-Total			117.9		%		80-120	31-AUG-19
Boron (B)-Total			95.5		%		80-120	31-AUG-19
Cadmium (Cd)-Total			105.6		%		80-120	31-AUG-19
Calcium (Ca)-Total			93.7		%		80-120	31-AUG-19
Cesium (Cs)-Total			93.2		%		80-120	31-AUG-19
Chromium (Cr)-Total			104.4		%		80-120	31-AUG-19
Cobalt (Co)-Total			105.5		%		80-120	31-AUG-19
Copper (Cu)-Total			108.1		%		80-120	31-AUG-19
Gallium (Ga)-Total			101.1		%		80-120	31-AUG-19
Iron (Fe)-Total			99.9		%		80-120	31-AUG-19
Lead (Pb)-Total			105.3		%		80-120	31-AUG-19
Lithium (Li)-Total			100.6		%		80-120	31-AUG-19
Magnesium (Mg)-Total			101.1		%		80-120	31-AUG-19
Manganese (Mn)-Total			104.2		%		80-120	31-AUG-19
Molybdenum (Mo)-Total			95.0		%		80-120	31-AUG-19
Nickel (Ni)-Total			107.9		%		80-120	31-AUG-19
Phosphorus (P)-Total			104.5		%		80-120	31-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4781998								
WG3147689-2 LCS								
Potassium (K)-Total			105.4		%		80-120	31-AUG-19
Rhenium (Re)-Total			104.5		%		80-120	31-AUG-19
Rubidium (Rb)-Total			106.8		%		80-120	31-AUG-19
Selenium (Se)-Total			106.3		%		80-120	31-AUG-19
Silver (Ag)-Total			99.7		%		80-120	31-AUG-19
Strontium (Sr)-Total			96.3		%		80-120	31-AUG-19
Sulfur (S)-Total			99.5		%		80-120	31-AUG-19
Tellurium (Te)-Total			110.9		%		80-120	31-AUG-19
Thallium (Tl)-Total			114.0		%		80-120	31-AUG-19
Thorium (Th)-Total			92.2		%		80-120	31-AUG-19
Tin (Sn)-Total			95.9		%		80-120	31-AUG-19
Titanium (Ti)-Total			100.7		%		80-120	31-AUG-19
Tungsten (W)-Total			104.6		%		80-120	31-AUG-19
Uranium (U)-Total			101.0		%		80-120	31-AUG-19
Vanadium (V)-Total			101.8		%		80-120	31-AUG-19
Yttrium (Y)-Total			99.5		%		80-120	31-AUG-19
Zinc (Zn)-Total			104.1		%		80-120	31-AUG-19
Zirconium (Zr)-Total			95.6		%		80-120	31-AUG-19
WG3147689-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	31-AUG-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	31-AUG-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	31-AUG-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	31-AUG-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Boron (B)-Total			<0.30		mg/L		0.3	31-AUG-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	31-AUG-19
Calcium (Ca)-Total			<1.0		mg/L		1	31-AUG-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	31-AUG-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Iron (Fe)-Total			<0.010		mg/L		0.01	31-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4781998								
WG3147689-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	31-AUG-19
Lithium (Li)-Total			<0.020		mg/L		0.02	31-AUG-19
Magnesium (Mg)-Total			<1.0		mg/L		1	31-AUG-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	31-AUG-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	31-AUG-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	31-AUG-19
Potassium (K)-Total			<1.0		mg/L		1	31-AUG-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	31-AUG-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	31-AUG-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	31-AUG-19
Sulfur (S)-Total			<5.0		mg/L		5	31-AUG-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	31-AUG-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	31-AUG-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	31-AUG-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	31-AUG-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	31-AUG-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	31-AUG-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	31-AUG-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	31-AUG-19
WG3147689-4 MS		**L2337246-2**						
Aluminum (Al)-Total			114.7		%		70-130	31-AUG-19
Antimony (Sb)-Total			110.7		%		70-130	31-AUG-19
Arsenic (As)-Total			95.0		%		70-130	31-AUG-19
Barium (Ba)-Total			111.2		%		70-130	31-AUG-19
Beryllium (Be)-Total			93.5		%		70-130	31-AUG-19
Bismuth (Bi)-Total			84.1		%		70-130	31-AUG-19
Boron (B)-Total			N/A	MS-B	%		-	31-AUG-19
Cadmium (Cd)-Total			95.5		%		70-130	31-AUG-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4781998								
WG3147689-4 MS		**L2337246-2**						
Calcium (Ca)-Total			N/A	MS-B	%		-	31-AUG-19
Cesium (Cs)-Total			103.8		%		70-130	31-AUG-19
Chromium (Cr)-Total			109.4		%		70-130	31-AUG-19
Cobalt (Co)-Total			95.7		%		70-130	31-AUG-19
Copper (Cu)-Total			91.0		%		70-130	31-AUG-19
Gallium (Ga)-Total			112.0		%		70-130	31-AUG-19
Iron (Fe)-Total			104.1		%		70-130	31-AUG-19
Lead (Pb)-Total			87.2		%		70-130	31-AUG-19
Lithium (Li)-Total			86.0		%		70-130	31-AUG-19
Magnesium (Mg)-Total			N/A	MS-B	%		-	31-AUG-19
Manganese (Mn)-Total			106.6		%		70-130	31-AUG-19
Molybdenum (Mo)-Total			111.7		%		70-130	31-AUG-19
Nickel (Ni)-Total			91.6		%		70-130	31-AUG-19
Phosphorus (P)-Total			120.5		%		70-130	31-AUG-19
Potassium (K)-Total			N/A	MS-B	%		-	31-AUG-19
Rhenium (Re)-Total			103.6		%		70-130	31-AUG-19
Rubidium (Rb)-Total			N/A	MS-B	%		-	31-AUG-19
Selenium (Se)-Total			94.6		%		70-130	31-AUG-19
Silver (Ag)-Total			97.7		%		70-130	31-AUG-19
Strontium (Sr)-Total			N/A	MS-B	%		-	31-AUG-19
Sulfur (S)-Total			N/A	MS-B	%		-	31-AUG-19
Tellurium (Te)-Total			93.8		%		70-130	31-AUG-19
Thallium (Tl)-Total			85.7		%		70-130	31-AUG-19
Thorium (Th)-Total			108.4		%		70-130	31-AUG-19
Tin (Sn)-Total			100.9		%		70-130	31-AUG-19
Titanium (Ti)-Total			113.5		%		70-130	31-AUG-19
Tungsten (W)-Total			104.0		%		70-130	31-AUG-19
Uranium (U)-Total			94.8		%		70-130	31-AUG-19
Vanadium (V)-Total			111.5		%		70-130	31-AUG-19
Yttrium (Y)-Total			134.3	RM-H	%		70-130	31-AUG-19
Zinc (Zn)-Total			87.7		%		70-130	31-AUG-19
Zirconium (Zr)-Total			125.7		%		70-130	31-AUG-19
NA-D-CCMS-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NA-D-CCMS-VA	**Seawater**							
Batch R4781993								
WG3146595-3 DUP		**L2337246-2**						
Sodium (Na)-Dissolved		10500	10500		mg/L	0.4	20	31-AUG-19
WG3146595-2 LCS								
Sodium (Na)-Dissolved			107.9		%		80-120	31-AUG-19
WG3146595-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	31-AUG-19
WG3146595-4 MS		**L2337246-1**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	31-AUG-19
NA-T-CCMS-VA	**Seawater**							
Batch R4782044								
WG3147689-3 DUP		**L2337246-1**						
Sodium (Na)-Total		9470	9470		mg/L	0.0	20	01-SEP-19
WG3147689-2 LCS								
Sodium (Na)-Total			105.6		%		80-120	01-SEP-19
WG3147689-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	01-SEP-19
WG3147689-4 MS		**L2337246-2**						
Sodium (Na)-Total			N/A	MS-B	%		-	01-SEP-19
NH3-F-VA	**Seawater**							
Batch R4778812								
WG3147853-3 DUP		**L2337246-1**						
Ammonia, Total (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	30-AUG-19
WG3147853-2 LCS								
Ammonia, Total (as N)			98.8		%		85-115	30-AUG-19
WG3147853-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	30-AUG-19
PH-C-PCT-VA	**Seawater**							
Batch R4782219								
WG3147604-2 CRM		**VA-PH7-BUF**						
pH			7.00		pH		6.9-7.1	01-SEP-19
WG3147604-4 DUP		**L2337246-1**						
pH		7.97	7.98	J	pH	0.01	0.3	01-SEP-19
SI-D-CCMS-VA	**Seawater**							
Batch R4781993								
WG3146595-3 DUP		**L2337246-2**						
Silicon (Si)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	31-AUG-19
WG3146595-2 LCS								

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SI-D-CCMS-VA	**Seawater**							
Batch R4781993								
WG3146595-2 LCS								
Silicon (Si)-Dissolved			109.6		%		80-120	31-AUG-19
WG3146595-1 MB		**LF**						
Silicon (Si)-Dissolved			<1.0		mg/L		1	31-AUG-19
WG3146595-4 MS		**L2337246-1**						
Silicon (Si)-Dissolved			103.0		%		70-130	31-AUG-19
SI-T-CCMS-VA	**Seawater**							
Batch R4782044								
WG3147689-3 DUP		**L2337246-1**						
Silicon (Si)-Total		<1.0	<1.0	RPD-NA	mg/L	N/A	20	01-SEP-19
WG3147689-2 LCS								
Silicon (Si)-Total			113.0		%		80-120	01-SEP-19
WG3147689-1 MB								
Silicon (Si)-Total			<1.0		mg/L		1	01-SEP-19
WG3147689-4 MS		**L2337246-2**						
Silicon (Si)-Total			105.2		%		70-130	01-SEP-19
TKN-C-F-VA	**Seawater**							
Batch R4784195								
WG3147855-3 DUP		**L2337246-1**						
Total Kjeldahl Nitrogen		0.139	0.103	J	mg/L	0.036	0.1	05-SEP-19
WG3147855-2 LCS								
Total Kjeldahl Nitrogen			116.2		%		75-125	05-SEP-19
WG3147855-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	05-SEP-19
WG3147855-4 MS		**L2337246-2**						
Total Kjeldahl Nitrogen			119.3		%		70-130	05-SEP-19
TSS-C-VA	**Seawater**							
Batch R4781410								
WG3149580-2 LCS								
Total Suspended Solids			109.7		%		85-115	31-AUG-19
WG3149580-1 MB								
Total Suspended Solids			<2.0		mg/L		2	31-AUG-19
TURBIDITY-C-VA	**Seawater**							
Batch R4774794								
WG3146523-2 CRM		**VA-FORM-40**						
Turbidity			104.6		%		85-115	29-AUG-19
WG3146523-3 DUP		**L2337246-2**						

Quality Control Report

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-C-VA		**Seawater**							
Batch	**R4774794**								
WG3146523-3	**DUP**		**L2337246-2**						
Turbidity			0.15	0.13	J	NTU	0.020	0.2	29-AUG-19
WG3146523-1	**MB**								
Turbidity				<0.10		NTU		0.1	29-AUG-19

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated) (seawater)							
	1	26-AUG-19 09:15	01-SEP-19 10:27	0.25	145	hours	EHTR-FM
	2	26-AUG-19 09:00	01-SEP-19 10:27	0.25	145	hours	EHTR-FM
	3	26-AUG-19 08:45	01-SEP-19 10:27	0.25	146	hours	EHTR-FM
	4	26-AUG-19 09:30	01-SEP-19 10:27	0.25	145	hours	EHTR-FM
Bacteriological Tests							
Fecal coliform by membrane filtration							
	1	26-AUG-19 09:15	28-AUG-19 14:25	30	53	hours	EHTR
	2	26-AUG-19 09:00	28-AUG-19 14:25	30	54	hours	EHTR
	3	26-AUG-19 08:45	28-AUG-19 14:25	30	54	hours	EHTR
	4	26-AUG-19 09:30	28-AUG-19 14:25	30	53	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2337246 were received on 28-AUG-19 09:30.

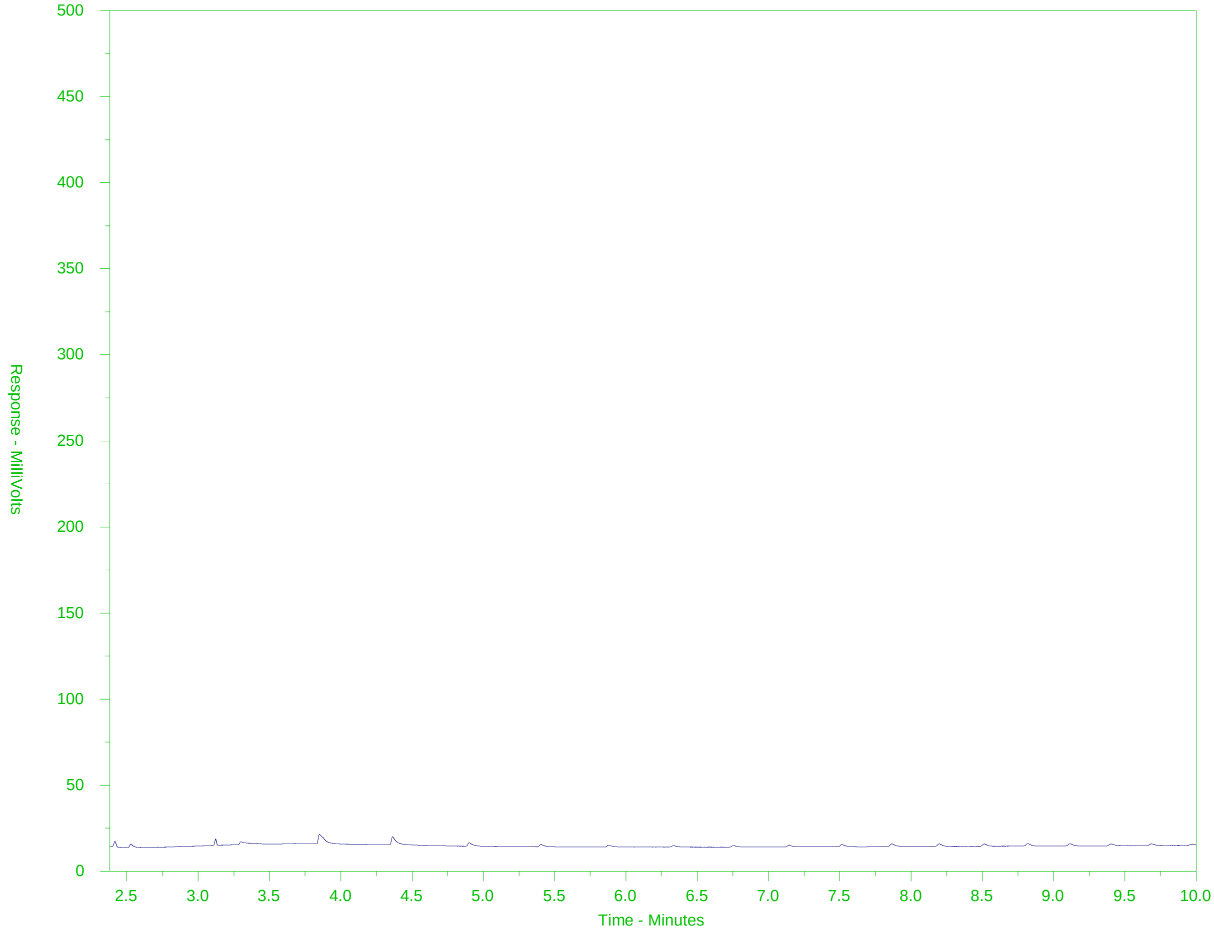
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2337246-1
Client Sample ID: SOURCE-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

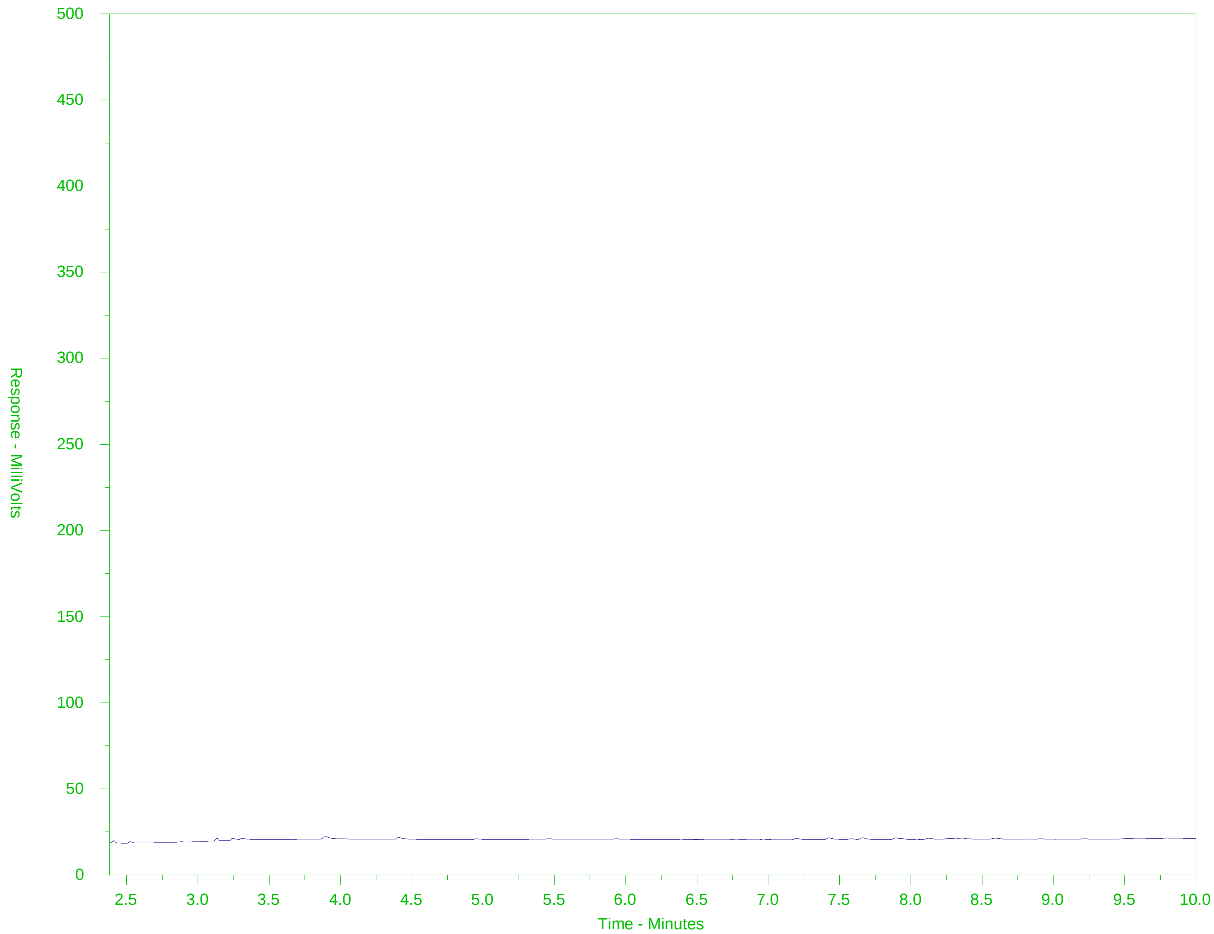
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2337246-2
Client Sample ID: WNW-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

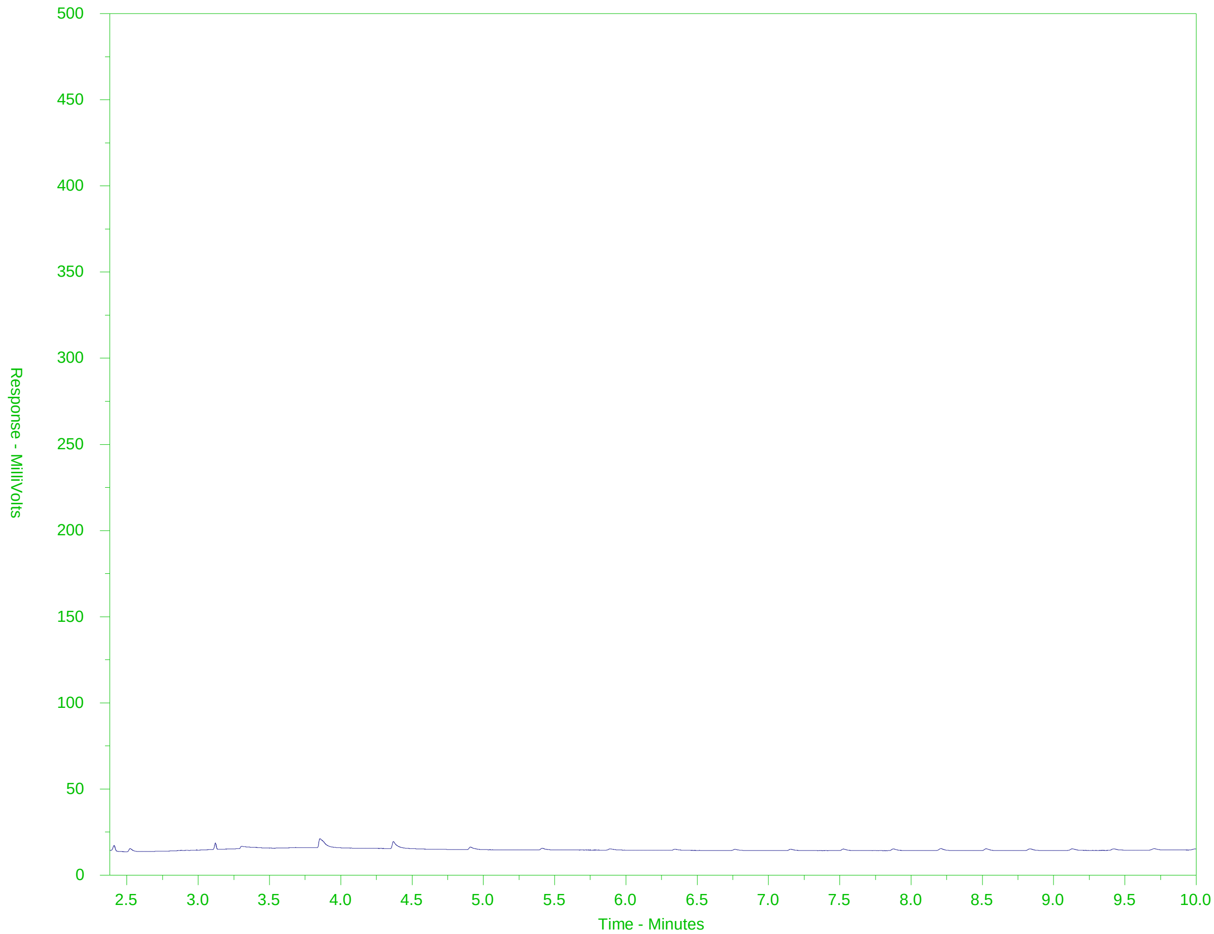
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2337246-3
Client Sample ID: NORTH-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

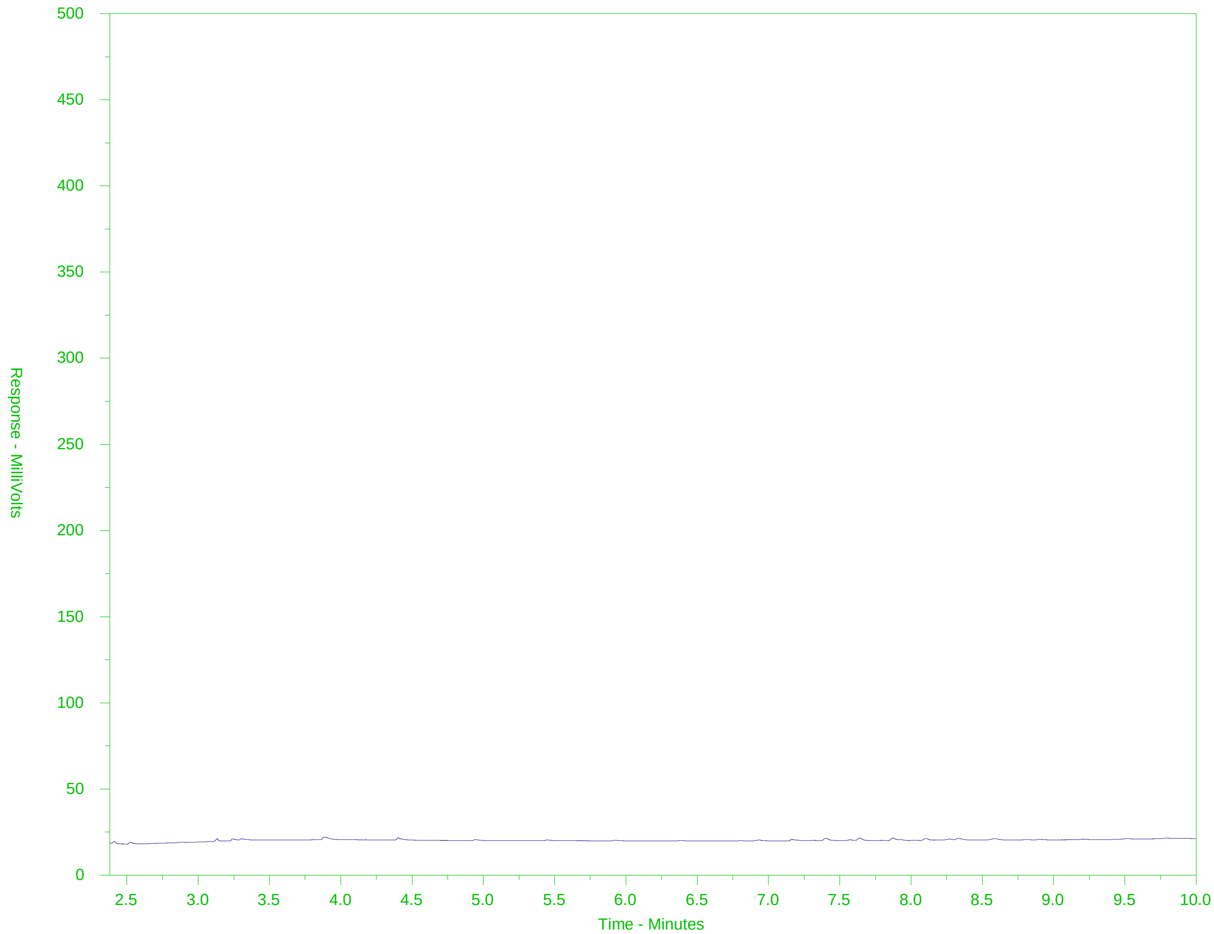
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2337246-4
Client Sample ID: ENE-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2337246-COFC

COC Number: 17 - 739036

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Aman Ospan
Phone:	1-250-888-3845
	Company address below will appear on the final report
Street:	2nd floor 3795 Carey Rd.
City/Province:	Victoria, BC
Postal Code:	V8Z 6T8

Report Format / Distribution	
Select Report Format:	[x] PDF [x] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[x] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	AOspan@golder.com
Email 2	PRouget@golder.com
Email 3	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Regular [R]	[x] Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days): 4 day [P4-20%] [ ]	EMERGENCY: 1 Business day [E - 100%] [ ]
3 day [P3-25%] [ ]	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]
2 day [P2-50%] [ ]	
Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To	
Same as Report To	[x] YES [ ] NO
Copy of Invoice with Report	[ ] YES [x] NO
Company:	
Contact:	

Invoice Distribution	
Select Invoice Distribution:	[x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	1663724 174000
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	General	TOC, Ammonia, TKN (P)	Dissolved Metals	Total Metals (P)	Dissolved Hg	Total Hg (P)	Hydrocarbons (P)	Fecal Coliform (P)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Source -1	26-Aug-2019	09:15	Sea Water	9	X	X	X	X	X	X	X	X		
	WNW - 1	26-Aug-2019	09:00	Sea Water	9	↓	↓	↓	↓	↓	↓	↓	↓		
	North -1	26-Aug-2019	08:45	Sea Water	9	↓	↓	↓	↓	↓	↓	↓	↓		
	ENE - 1	26-Aug-2019	09:30	Sea Water	9	↓	↓	↓	↓	↓	↓	↓	↓		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [ ] NO

Are samples for human consumption/ use? [ ] YES [ ] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ]		SIF Observations	Yes [ ]	No [ ]	
Ice Packs [x]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No [ ]	
Cooling Initiated [ ]					

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	14

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Amy Cordial / [signature]	Date: 26-Aug-2019	Time: 10:15	Received by:	Date:	Time:	Received by: JC	Date: AUG 28 2019	Time: 9:30am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Arman Ospan
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 03-SEP-19
Report Date: 12-SEP-19 11:33 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2340208

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 17-739034
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340208-1	L2340208-2	L2340208-3	L2340208-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	29-AUG-19	29-AUG-19	29-AUG-19	29-AUG-19	
	Sampled Time	09:30	10:00	09:15	09:45	
	Client ID	SOURCE-2	WNW-2	NORTH-2	ENE-2	
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	46300	44000	44400	46700	
	pH (pH)	8.00	8.01	8.01	8.01	
	Salinity (psu)	30.9	29.2	29.5	31.2	
	Total Suspended Solids (mg/L)	<2.0	<2.0	<2.0	2.9	
	Turbidity (NTU)	0.18	<0.10	0.24	0.64	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	116	115	116	117	
	Ammonia, Total (as N) (mg/L)	0.0161	0.0053	<0.0050	0.0051	
	Bromide (Br) (mg/L)	59.1	55.1	55.3	62.1	
	Chloride (Cl) (mg/L)	17300	16100	16000	17800	
	Fluoride (F) (mg/L)	1.1	<1.0	<1.0	1.1	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Total Kjeldahl Nitrogen (mg/L)	0.100	0.131	0.113	0.090	
	Sulfate (SO4) (mg/L)	2400	2230	2250	2510	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.15	1.06	1.14	1.19	
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050	0.0050	0.0094	0.0261	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00136	0.00129	0.00137	0.00139	
	Barium (Ba)-Total (mg/L)	0.0081	0.0083	0.0077	0.0087	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	4.09	3.91	3.91	4.13	
	Cadmium (Cd)-Total (mg/L)	0.000034	0.000040	0.000030	0.000030	
	Calcium (Ca)-Total (mg/L)	354	351	365	383	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	<0.010	<0.010	<0.010	0.020	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000061	
	Lithium (Li)-Total (mg/L)	0.151	0.141	0.141	0.159	
	Magnesium (Mg)-Total (mg/L)	992	985	975	1050	
	Manganese (Mn)-Total (mg/L)	0.00069	0.00087	0.00078 RRV	0.00148	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.0102	0.00965	0.00937	0.0103	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2340208-1 Seawater 29-AUG-19 09:30 SOURCE-2	L2340208-2 Seawater 29-AUG-19 10:00 WNW-2	L2340208-3 Seawater 29-AUG-19 09:15 NORTH-2	L2340208-4 Seawater 29-AUG-19 09:45 ENE-2	
Grouping	**Analyte**					
SEAWATER						
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	355	338	331	364	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0894	0.0877	0.0881	0.0961	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Total (mg/L)	9610	9080	8860	9730	
	Strontium (Sr)-Total (mg/L)	7.12	6.60	6.75	7.30	
	Sulfur (S)-Total (mg/L)	857	844	847	952	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00288	0.00277	0.00268	0.00290	
	Vanadium (V)-Total (mg/L)	0.00110	0.00100	0.00101	0.00113	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00153	0.00139	0.00143	0.00150	
	Barium (Ba)-Dissolved (mg/L)	0.0085	0.0084	0.0082	0.0082	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	3.62	3.40	3.40	3.54	
	Cadmium (Cd)-Dissolved (mg/L)	0.000038	0.000038	0.000040	0.000035	
	Calcium (Ca)-Dissolved (mg/L)	378	379	383	396	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00027	<0.00020	<0.00020	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2340208-1	L2340208-2	L2340208-3	L2340208-4
	Sample ID	L2340208-1	L2340208-2	L2340208-3	L2340208-4
	Description	Seawater	Seawater	Seawater	Seawater
	Sampled Date	29-AUG-19	29-AUG-19	29-AUG-19	29-AUG-19
	Sampled Time	09:30	10:00	09:15	09:45
	Client ID	SOURCE-2	WNW-2	NORTH-2	ENE-2
Grouping	**Analyte**				
SEAWATER					
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.164	0.148	0.150	0.152
	Magnesium (Mg)-Dissolved (mg/L)	1090	1070	1090	1110
	Manganese (Mn)-Dissolved (mg/L)	0.00051	0.00063	0.00044	0.00075
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0106	0.0103	0.00995	0.0107
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	350	341	347	361
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.104	0.0976	0.100	0.104
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	9200	8620	8760	9570
	Strontium (Sr)-Dissolved (mg/L)	7.32	7.26	7.11	7.63
	Sulfur (S)-Dissolved (mg/L)	990	932	942	1010
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00347	0.00313	0.00285	0.00312
	Vanadium (V)-Dissolved (mg/L)	0.00130	0.00124	0.00125	0.00127
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340208-1	L2340208-2	L2340208-3	L2340208-4
	Description	Seawater	Seawater	Seawater	Seawater
	Sampled Date	29-AUG-19	29-AUG-19	29-AUG-19	29-AUG-19
	Sampled Time	09:30	10:00	09:15	09:45
	Client ID	SOURCE-2	WNW-2	NORTH-2	ENE-2
Grouping	**Analyte**				
WATER					
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	<10 PEHR	<10 PEHR	<10 PEHR	<10 PEHR
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	88.8	82.5	94.9	91.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acridine d9 (%)	102.8	96.7	101.1	101.8
	Surrogate: Chrysene d12 (%)	99.3	93.1	99.1	95.8
	Surrogate: Naphthalene d8 (%)	94.2	91.7	97.5	94.7
	Surrogate: Phenanthrene d10 (%)	102.5	97.7	104.1	100.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Total	B	L2340208-1, -2
Method Blank	Manganese (Mn)-Total	B	L2340208-1, -2
Laboratory Control Sample	Sulfur (S)-Total	MES	L2340208-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2340208-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2340208-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2340208-1, -2
Matrix Spike	Potassium (K)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2340208-1, -2
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2340208-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2340208-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2340208-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2340208-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2340208-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA	Seawater	Chloride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA	Seawater	Fluoride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-C-NO3-IC-VA Seawater Nitrate in Seawater by IC EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA Seawater Sulfate by IC (seawater) EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA Seawater TOC by combustion (seawater) APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA Seawater Conductivity (Automated) (seawater) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-ME-FID-VA Water EPH in Water BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

FCOLI-MF-ENV-VA Water Fecal coliform by membrane filtration APHA METHOD 9222

This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation of the filter with the appropriate growth medium, positive results require further testing (up to an additional 48 hours) to confirm and quantify the total coliform. This method is used for non-turbid water with a low background bacteria level.

HG-DIS-C-CVAFS-VA Seawater Diss. Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA	Seawater	Salinity by conductivity meter	APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TKN-C-F-VA	Seawater	TKN in Seawater by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-739034

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Arman Ospan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4782815								
WG3151323-2 LCS								
EPH10-19			110.1		%		70-130	06-SEP-19
EPH19-32			108.8		%		70-130	06-SEP-19
WG3151323-1 MB								
EPH10-19			<0.25		mg/L		0.25	06-SEP-19
EPH19-32			<0.25		mg/L		0.25	06-SEP-19
Surrogate: 2-Bromobenzotrifluoride			92.6		%		60-140	06-SEP-19
FCOLI-MF-ENV-VA	**Water**							
Batch R4789068								
WG3150854-3 DUP		**L2340208-1**						
Coliform Bacteria - Fecal		<10	<10	RPD-NA	CFU/100mL	N/A	65	03-SEP-19
WG3150854-4 MB								
Coliform Bacteria - Fecal			<1		CFU/100mL		1	03-SEP-19
PAH-ME-MS-VA	**Water**							
Batch R4782199								
WG3151323-2 LCS								
Acenaphthene			103.1		%		60-130	04-SEP-19
Acenaphthylene			104.2		%		60-130	04-SEP-19
Acridine			97.1		%		60-130	04-SEP-19
Anthracene			108.8		%		60-130	04-SEP-19
Benz(a)anthracene			110.4		%		60-130	04-SEP-19
Benzo(a)pyrene			104.8		%		60-130	04-SEP-19
Benzo(b&j)fluoranthene			92.3		%		60-130	04-SEP-19
Benzo(g,h,i)perylene			111.0		%		60-130	04-SEP-19
Benzo(k)fluoranthene			107.0		%		60-130	04-SEP-19
Chrysene			114.9		%		60-130	04-SEP-19
Dibenz(a,h)anthracene			110.9		%		60-130	04-SEP-19
Fluoranthene			109.4		%		60-130	04-SEP-19
Fluorene			102.9		%		60-130	04-SEP-19
Indeno(1,2,3-c,d)pyrene			114.1		%		60-130	04-SEP-19
1-Methylnaphthalene			104.0		%		60-130	04-SEP-19
2-Methylnaphthalene			98.7		%		60-130	04-SEP-19
Naphthalene			101.6		%		50-130	04-SEP-19
Phenanthrene			110.1		%		60-130	04-SEP-19
Pyrene			111.0		%		60-130	04-SEP-19
Quinoline			113.6		%		60-130	04-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4782199								
WG3151323-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	04-SEP-19
Acenaphthylene			<0.000010		mg/L		0.00001	04-SEP-19
Acridine			<0.000010		mg/L		0.00001	04-SEP-19
Anthracene			<0.000010		mg/L		0.00001	04-SEP-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	04-SEP-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	04-SEP-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	04-SEP-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	04-SEP-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	04-SEP-19
Chrysene			<0.000010		mg/L		0.00001	04-SEP-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	04-SEP-19
Fluoranthene			<0.000010		mg/L		0.00001	04-SEP-19
Fluorene			<0.000010		mg/L		0.00001	04-SEP-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	04-SEP-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	04-SEP-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	04-SEP-19
Naphthalene			<0.000050		mg/L		0.00005	04-SEP-19
Phenanthrene			<0.000020		mg/L		0.00002	04-SEP-19
Pyrene			<0.000010		mg/L		0.00001	04-SEP-19
Quinoline			<0.000050		mg/L		0.00005	04-SEP-19
Surrogate: Acridine d9			104.3		%		60-130	04-SEP-19
Surrogate: Chrysene d12			100.9		%		60-130	04-SEP-19
Surrogate: Naphthalene d8			97.8		%		50-130	04-SEP-19
Surrogate: Phenanthrene d10			108.6		%		60-130	04-SEP-19
ALK-TITR-VA	**Seawater**							
Batch R4794411								
WG3155352-4 DUP		**L2340208-1**						
Alkalinity, Total (as CaCO3)		116	116		mg/L	0.3	20	10-SEP-19
WG3155352-3 LCS								
Alkalinity, Total (as CaCO3)			102.6		%		70-130	10-SEP-19
WG3155352-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	10-SEP-19
ANIONS-C-BR-IC-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Bromide (Br)		59.1	60.3		mg/L	2.0	20	08-SEP-19
WG3155452-2 LCS								
Bromide (Br)			99.2		%		85-115	08-SEP-19
WG3155452-1 MB								
Bromide (Br)			<5.0		mg/L		5	08-SEP-19
ANIONS-C-CL-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Chloride (Cl)		17300	17600		mg/L	1.7	20	08-SEP-19
WG3155452-2 LCS								
Chloride (Cl)			99.9		%		90-110	08-SEP-19
WG3155452-1 MB								
Chloride (Cl)			<50		mg/L		50	08-SEP-19
ANIONS-C-F-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Fluoride (F)		1.1	1.1		mg/L	5.3	20	08-SEP-19
WG3155452-2 LCS								
Fluoride (F)			105.1		%		90-110	08-SEP-19
WG3155452-1 MB								
Fluoride (F)			<1.0		mg/L		1	08-SEP-19
ANIONS-C-NO2-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Nitrite (as N)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	08-SEP-19
WG3155452-2 LCS								
Nitrite (as N)			103.7		%		90-110	08-SEP-19
WG3155452-1 MB								
Nitrite (as N)			<0.10		mg/L		0.1	08-SEP-19
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Nitrate (as N)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	08-SEP-19
WG3155452-2 LCS								
Nitrate (as N)			100.4		%		90-110	08-SEP-19
WG3155452-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	08-SEP-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4790392								
WG3155452-3 DUP		**L2340208-1**						
Sulfate (SO4)		2400	2430		mg/L	1.4	20	08-SEP-19
WG3155452-2 LCS								
Sulfate (SO4)			100.6		%		90-110	08-SEP-19
WG3155452-1 MB								
Sulfate (SO4)			<30		mg/L		30	08-SEP-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4791408								
WG3155040-2 LCS								
Total Organic Carbon			102.6		%		80-120	09-SEP-19
WG3155040-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	09-SEP-19
WG3155040-4 MS		**L2340208-2**						
Total Organic Carbon			101.1		%		70-130	09-SEP-19
Batch R4798130								
WG3156601-6 DUP		**L2340208-1**						
Total Organic Carbon		1.15	1.02		mg/L	12	20	10-SEP-19
WG3156601-5 LCS								
Total Organic Carbon			102.4		%		80-120	10-SEP-19
WG3156601-4 MB								
Total Organic Carbon			<0.50		mg/L		0.5	10-SEP-19
EC-C-PCT-VA	**Seawater**							
Batch R4794411								
WG3155352-4 DUP		**L2340208-1**						
Conductivity		46300	46100		uS/cm	0.4	10	10-SEP-19
WG3155352-1 MB								
Conductivity			<2.0		uS/cm		2	10-SEP-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4783386								
WG3153023-3 DUP		**L2340208-1**						
Mercury (Hg)-Dissolved		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	05-SEP-19
WG3153023-2 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4783386								
WG3153023-2 LCS								
Mercury (Hg)-Dissolved			97.9		%		80-120	05-SEP-19
WG3153023-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	05-SEP-19
WG3153023-4 MS		**L2340208-2**						
Mercury (Hg)-Dissolved			92.9		%		70-130	05-SEP-19
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4783384								
WG3152475-2 LCS								
Mercury (Hg)-Total			97.6		%		80-120	05-SEP-19
WG3152475-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	05-SEP-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-3 DUP		**L2340208-1**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	03-SEP-19
Arsenic (As)-Dissolved		0.00153	0.00155		mg/L	1.8	20	03-SEP-19
Barium (Ba)-Dissolved		0.0085	0.0087		mg/L	2.1	20	03-SEP-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Boron (B)-Dissolved		3.62	3.66		mg/L	1.0	20	03-SEP-19
Cadmium (Cd)-Dissolved		0.000038	0.000035		mg/L	9.6	20	03-SEP-19
Calcium (Ca)-Dissolved		378	402		mg/L	6.1	20	03-SEP-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	03-SEP-19
Copper (Cu)-Dissolved		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	03-SEP-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	03-SEP-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	03-SEP-19
Lithium (Li)-Dissolved		0.164	0.161		mg/L	1.9	20	03-SEP-19
Magnesium (Mg)-Dissolved		1090	1120		mg/L	3.2	20	03-SEP-19
Manganese (Mn)-Dissolved		0.00051	0.00052		mg/L	1.9	20	03-SEP-19
Molybdenum (Mo)-Dissolved		0.0106	0.0109		mg/L	2.7	20	03-SEP-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Phosphorus (P)-Dissolved		<0.050	0.059	RPD-NA	mg/L	N/A	20	03-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-3 DUP		**L2340208-1**						
Potassium (K)-Dissolved		350	362		mg/L	3.4	20	03-SEP-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Rubidium (Rb)-Dissolved		0.104	0.104		mg/L	0.0	20	03-SEP-19
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	03-SEP-19
Strontium (Sr)-Dissolved		7.32	7.54		mg/L	3.0	20	03-SEP-19
Sulfur (S)-Dissolved		990	987		mg/L	0.4	20	03-SEP-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	03-SEP-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	03-SEP-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	03-SEP-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	03-SEP-19
Uranium (U)-Dissolved		0.00347	0.00319		mg/L	8.4	20	03-SEP-19
Vanadium (V)-Dissolved		0.00130	0.00133		mg/L	1.8	20	03-SEP-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	03-SEP-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	03-SEP-19
WG3150871-2 LCS								
Aluminum (Al)-Dissolved			97.1		%		80-120	03-SEP-19
Antimony (Sb)-Dissolved			100.1		%		80-120	03-SEP-19
Arsenic (As)-Dissolved			96.2		%		80-120	03-SEP-19
Barium (Ba)-Dissolved			91.4		%		80-120	03-SEP-19
Beryllium (Be)-Dissolved			100.1		%		80-120	03-SEP-19
Bismuth (Bi)-Dissolved			110.6		%		80-120	03-SEP-19
Boron (B)-Dissolved			95.7		%		80-120	03-SEP-19
Cadmium (Cd)-Dissolved			96.5		%		80-120	03-SEP-19
Calcium (Ca)-Dissolved			94.5		%		80-120	03-SEP-19
Cesium (Cs)-Dissolved			103.1		%		80-120	03-SEP-19
Chromium (Cr)-Dissolved			93.3		%		80-120	03-SEP-19
Cobalt (Co)-Dissolved			96.9		%		80-120	03-SEP-19
Copper (Cu)-Dissolved			98.8		%		80-120	03-SEP-19
Gallium (Ga)-Dissolved			100.7		%		80-120	03-SEP-19
Iron (Fe)-Dissolved			96.7		%		80-120	03-SEP-19
Lead (Pb)-Dissolved			107.5		%		80-120	03-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-2 LCS								
Lithium (Li)-Dissolved			101.7		%		80-120	03-SEP-19
Magnesium (Mg)-Dissolved			92.6		%		80-120	03-SEP-19
Manganese (Mn)-Dissolved			96.9		%		80-120	03-SEP-19
Molybdenum (Mo)-Dissolved			97.0		%		80-120	03-SEP-19
Nickel (Ni)-Dissolved			99.3		%		80-120	03-SEP-19
Phosphorus (P)-Dissolved			96.6		%		80-120	03-SEP-19
Potassium (K)-Dissolved			88.5		%		80-120	03-SEP-19
Rhenium (Re)-Dissolved			101.5		%		80-120	03-SEP-19
Rubidium (Rb)-Dissolved			94.7		%		80-120	03-SEP-19
Selenium (Se)-Dissolved			100.0		%		80-120	03-SEP-19
Silver (Ag)-Dissolved			99.0		%		80-120	03-SEP-19
Strontium (Sr)-Dissolved			102.1		%		80-120	03-SEP-19
Sulfur (S)-Dissolved			93.8		%		80-120	03-SEP-19
Tellurium (Te)-Dissolved			113.7		%		80-120	03-SEP-19
Thallium (Tl)-Dissolved			107.7		%		80-120	03-SEP-19
Thorium (Th)-Dissolved			107.9		%		80-120	03-SEP-19
Tin (Sn)-Dissolved			91.3		%		80-120	03-SEP-19
Titanium (Ti)-Dissolved			88.5		%		80-120	03-SEP-19
Tungsten (W)-Dissolved			104.0		%		80-120	03-SEP-19
Uranium (U)-Dissolved			106.3		%		80-120	03-SEP-19
Vanadium (V)-Dissolved			95.2		%		80-120	03-SEP-19
Yttrium (Y)-Dissolved			90.8		%		80-120	03-SEP-19
Zinc (Zn)-Dissolved			99.0		%		80-120	03-SEP-19
Zirconium (Zr)-Dissolved			90.7		%		80-120	03-SEP-19
WG3150871-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	03-SEP-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	03-SEP-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	03-SEP-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	03-SEP-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	03-SEP-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	03-SEP-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	03-SEP-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-1 MB		**LF**						
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	03-SEP-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	03-SEP-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	03-SEP-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	03-SEP-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	03-SEP-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	03-SEP-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	03-SEP-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	03-SEP-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	03-SEP-19
Potassium (K)-Dissolved			<1.0		mg/L		1	03-SEP-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	03-SEP-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	03-SEP-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	03-SEP-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	03-SEP-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	03-SEP-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	03-SEP-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	03-SEP-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	03-SEP-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	03-SEP-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	03-SEP-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	03-SEP-19
WG3150871-4 MS		**L2340208-2**						
Aluminum (Al)-Dissolved			106.4		%		70-130	03-SEP-19
Antimony (Sb)-Dissolved			105.7		%		70-130	03-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-4 MS		**L2340208-2**						
Arsenic (As)-Dissolved			96.3		%		70-130	03-SEP-19
Barium (Ba)-Dissolved			92.9		%		70-130	03-SEP-19
Beryllium (Be)-Dissolved			101.0		%		70-130	03-SEP-19
Bismuth (Bi)-Dissolved			90.7		%		70-130	03-SEP-19
Boron (B)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Cadmium (Cd)-Dissolved			89.0		%		70-130	03-SEP-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Cesium (Cs)-Dissolved			102.5		%		70-130	03-SEP-19
Chromium (Cr)-Dissolved			98.6		%		70-130	03-SEP-19
Cobalt (Co)-Dissolved			91.8		%		70-130	03-SEP-19
Copper (Cu)-Dissolved			84.6		%		70-130	03-SEP-19
Gallium (Ga)-Dissolved			103.1		%		70-130	03-SEP-19
Iron (Fe)-Dissolved			98.9		%		70-130	03-SEP-19
Lead (Pb)-Dissolved			90.0		%		70-130	03-SEP-19
Lithium (Li)-Dissolved			91.1		%		70-130	03-SEP-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Manganese (Mn)-Dissolved			101.3		%		70-130	03-SEP-19
Molybdenum (Mo)-Dissolved			103.7		%		70-130	03-SEP-19
Nickel (Ni)-Dissolved			89.3		%		70-130	03-SEP-19
Phosphorus (P)-Dissolved			115.1		%		70-130	03-SEP-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Rhenium (Re)-Dissolved			90.5		%		70-130	03-SEP-19
Rubidium (Rb)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Selenium (Se)-Dissolved			93.9		%		70-130	03-SEP-19
Silver (Ag)-Dissolved			92.1		%		70-130	03-SEP-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	03-SEP-19
Tellurium (Te)-Dissolved			87.4		%		70-130	03-SEP-19
Thallium (Tl)-Dissolved			88.5		%		70-130	03-SEP-19
Thorium (Th)-Dissolved			102.6		%		70-130	03-SEP-19
Tin (Sn)-Dissolved			91.9		%		70-130	03-SEP-19
Titanium (Ti)-Dissolved			111.7		%		70-130	03-SEP-19
Tungsten (W)-Dissolved			102.0		%		70-130	03-SEP-19
Uranium (U)-Dissolved			97.5		%		70-130	03-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4782866								
WG3150871-4 MS		**L2340208-2**						
Vanadium (V)-Dissolved			103.9		%		70-130	03-SEP-19
Yttrium (Y)-Dissolved			110.2		%		70-130	03-SEP-19
Zinc (Zn)-Dissolved			87.4		%		70-130	03-SEP-19
Zirconium (Zr)-Dissolved			105.0		%		70-130	03-SEP-19
Batch R4784122								
WG3150871-3 DUP		**L2340208-1**						
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-3 DUP		**L2340208-1**						
Aluminum (Al)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	05-SEP-19
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Arsenic (As)-Total		0.00136	0.00146		mg/L	7.3	20	05-SEP-19
Barium (Ba)-Total		0.0081	0.0083		mg/L	2.4	20	05-SEP-19
Beryllium (Be)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Boron (B)-Total		4.09	4.05		mg/L	1.1	20	05-SEP-19
Cadmium (Cd)-Total		0.000034	0.000029		mg/L	18	20	05-SEP-19
Calcium (Ca)-Total		354	345		mg/L	2.7	20	05-SEP-19
Cesium (Cs)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Cobalt (Co)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Copper (Cu)-Total		<0.00050	0.00053	RPD-NA	mg/L	N/A	20	05-SEP-19
Gallium (Ga)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Iron (Fe)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	05-SEP-19
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Lithium (Li)-Total		0.151	0.144		mg/L	4.4	20	05-SEP-19
Magnesium (Mg)-Total		992	1060		mg/L	7.0	20	05-SEP-19
Manganese (Mn)-Total		0.00069	0.00076		mg/L	9.6	20	05-SEP-19
Molybdenum (Mo)-Total		0.0102	0.00966		mg/L	5.2	20	05-SEP-19
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	05-SEP-19
Potassium (K)-Total		355	356		mg/L	0.5	20	05-SEP-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-3 DUP		**L2340208-1**						
Rhenium (Re)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Rubidium (Rb)-Total		0.0894	0.0912		mg/L	1.9	20	05-SEP-19
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Strontium (Sr)-Total		7.12	6.82		mg/L	4.3	20	05-SEP-19
Sulfur (S)-Total		857	923		mg/L	7.5	20	05-SEP-19
Tellurium (Te)-Total		<0.00050	0.00051	RPD-NA	mg/L	N/A	20	05-SEP-19
Thallium (Tl)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Thorium (Th)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Titanium (Ti)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	05-SEP-19
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Uranium (U)-Total		0.00288	0.00277		mg/L	4.0	20	05-SEP-19
Vanadium (V)-Total		0.00110	0.00112		mg/L	2.6	20	05-SEP-19
Yttrium (Y)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	05-SEP-19
Zirconium (Zr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
WG3152142-2 LCS								
Aluminum (Al)-Total			95.3		%		80-120	05-SEP-19
Antimony (Sb)-Total			105.8		%		80-120	05-SEP-19
Arsenic (As)-Total			96.7		%		80-120	05-SEP-19
Barium (Ba)-Total			93.8		%		80-120	05-SEP-19
Beryllium (Be)-Total			96.4		%		80-120	05-SEP-19
Bismuth (Bi)-Total			108.6		%		80-120	05-SEP-19
Boron (B)-Total			94.0		%		80-120	05-SEP-19
Cadmium (Cd)-Total			105.6		%		80-120	05-SEP-19
Calcium (Ca)-Total			92.4		%		80-120	05-SEP-19
Cesium (Cs)-Total			104.0		%		80-120	05-SEP-19
Chromium (Cr)-Total			94.9		%		80-120	05-SEP-19
Cobalt (Co)-Total			102.5		%		80-120	05-SEP-19
Copper (Cu)-Total			101.4		%		80-120	05-SEP-19
Gallium (Ga)-Total			95.7		%		80-120	05-SEP-19
Iron (Fe)-Total			96.0		%		80-120	05-SEP-19
Lead (Pb)-Total			105.8		%		80-120	05-SEP-19
Lithium (Li)-Total			95.7		%		80-120	05-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-2 LCS								
Magnesium (Mg)-Total			103.2		%		80-120	05-SEP-19
Manganese (Mn)-Total			98.1		%		80-120	05-SEP-19
Molybdenum (Mo)-Total			95.5		%		80-120	05-SEP-19
Nickel (Ni)-Total			101.1		%		80-120	05-SEP-19
Phosphorus (P)-Total			91.0		%		80-120	05-SEP-19
Potassium (K)-Total			88.8		%		80-120	05-SEP-19
Rhenium (Re)-Total			106.5		%		80-120	05-SEP-19
Rubidium (Rb)-Total			100.7		%		80-120	05-SEP-19
Selenium (Se)-Total			101.6		%		80-120	05-SEP-19
Silver (Ag)-Total			101.1		%		80-120	05-SEP-19
Strontium (Sr)-Total			99.0		%		80-120	05-SEP-19
Sulfur (S)-Total			78.4	MES	%		80-120	05-SEP-19
Tellurium (Te)-Total			115.2		%		80-120	05-SEP-19
Thallium (Tl)-Total			105.8		%		80-120	05-SEP-19
Thorium (Th)-Total			101.5		%		80-120	05-SEP-19
Tin (Sn)-Total			99.6		%		80-120	05-SEP-19
Titanium (Ti)-Total			91.7		%		80-120	05-SEP-19
Tungsten (W)-Total			104.6		%		80-120	05-SEP-19
Uranium (U)-Total			108.0		%		80-120	05-SEP-19
Vanadium (V)-Total			94.5		%		80-120	05-SEP-19
Yttrium (Y)-Total			95.2		%		80-120	05-SEP-19
Zinc (Zn)-Total			99.1		%		80-120	05-SEP-19
Zirconium (Zr)-Total			90.3		%		80-120	05-SEP-19
WG3152142-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	05-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	05-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	05-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	05-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	05-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	05-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	05-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-1 MB								
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	05-SEP-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	05-SEP-19
Magnesium (Mg)-Total			<1.0		mg/L		1	05-SEP-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	05-SEP-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	05-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	05-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	05-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	05-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	05-SEP-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	05-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	05-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	05-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	05-SEP-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	05-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	05-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	05-SEP-19
WG3152142-4 MS		**L2340208-2**						
Aluminum (Al)-Total			93.4		%		70-130	05-SEP-19
Antimony (Sb)-Total			96.5		%		70-130	05-SEP-19
Arsenic (As)-Total			86.7		%		70-130	05-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-4 MS		**L2340208-2**						
Barium (Ba)-Total			94.8		%		70-130	05-SEP-19
Beryllium (Be)-Total			99.6		%		70-130	05-SEP-19
Bismuth (Bi)-Total			82.4		%		70-130	05-SEP-19
Boron (B)-Total			N/A	MS-B	%		-	05-SEP-19
Cadmium (Cd)-Total			88.1		%		70-130	05-SEP-19
Calcium (Ca)-Total			N/A	MS-B	%		-	05-SEP-19
Cesium (Cs)-Total			99.5		%		70-130	05-SEP-19
Chromium (Cr)-Total			87.3		%		70-130	05-SEP-19
Cobalt (Co)-Total			84.9		%		70-130	05-SEP-19
Copper (Cu)-Total			78.0		%		70-130	05-SEP-19
Gallium (Ga)-Total			86.7		%		70-130	05-SEP-19
Iron (Fe)-Total			89.2		%		70-130	05-SEP-19
Lead (Pb)-Total			85.0		%		70-130	05-SEP-19
Lithium (Li)-Total			85.8		%		70-130	05-SEP-19
Magnesium (Mg)-Total			N/A	MS-B	%		-	05-SEP-19
Manganese (Mn)-Total			91.1		%		70-130	05-SEP-19
Molybdenum (Mo)-Total			95.3		%		70-130	05-SEP-19
Nickel (Ni)-Total			79.0		%		70-130	05-SEP-19
Phosphorus (P)-Total			107.1		%		70-130	05-SEP-19
Potassium (K)-Total			N/A	MS-B	%		-	05-SEP-19
Rhenium (Re)-Total			91.2		%		70-130	05-SEP-19
Rubidium (Rb)-Total			N/A	MS-B	%		-	05-SEP-19
Selenium (Se)-Total			85.1		%		70-130	05-SEP-19
Strontium (Sr)-Total			N/A	MS-B	%		-	05-SEP-19
Sulfur (S)-Total			N/A	MS-B	%		-	05-SEP-19
Tellurium (Te)-Total			90.8		%		70-130	05-SEP-19
Thallium (Tl)-Total			85.0		%		70-130	05-SEP-19
Thorium (Th)-Total			93.3		%		70-130	05-SEP-19
Tin (Sn)-Total			89.8		%		70-130	05-SEP-19
Titanium (Ti)-Total			95.3		%		70-130	05-SEP-19
Tungsten (W)-Total			98.7		%		70-130	05-SEP-19
Uranium (U)-Total			86.9		%		70-130	05-SEP-19
Vanadium (V)-Total			91.9		%		70-130	05-SEP-19
Yttrium (Y)-Total			105.5		%		70-130	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-4 MS		**L2340208-2**						
Zinc (Zn)-Total			75.2		%		70-130	05-SEP-19
Zirconium (Zr)-Total			95.0		%		70-130	05-SEP-19
Batch R4792950								
WG3154806-3 DUP		**L2340208-1**						
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	09-SEP-19
Arsenic (As)-Total		0.00136	0.00167		mg/L	2.8	20	09-SEP-19
Barium (Ba)-Total		0.0081	0.0084		mg/L	2.9	20	09-SEP-19
Beryllium (Be)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Boron (B)-Total		4.09	3.77		mg/L	0.5	20	09-SEP-19
Cadmium (Cd)-Total		0.000034	0.000033		mg/L	16	20	09-SEP-19
Calcium (Ca)-Total		354	413		mg/L	2.9	20	09-SEP-19
Cesium (Cs)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Cobalt (Co)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	09-SEP-19
Copper (Cu)-Total		<0.00050	0.00059		mg/L	3.6	20	09-SEP-19
Gallium (Ga)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Iron (Fe)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	09-SEP-19
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	09-SEP-19
Lithium (Li)-Total		0.151	0.165		mg/L	0.5	20	09-SEP-19
Magnesium (Mg)-Total		992	1240		mg/L	3.7	20	09-SEP-19
Manganese (Mn)-Total		0.00069	0.00096		mg/L	7.7	20	09-SEP-19
Molybdenum (Mo)-Total		0.0102	0.0102		mg/L	4.4	20	09-SEP-19
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	09-SEP-19
Potassium (K)-Total		355	406		mg/L	1.2	20	09-SEP-19
Rhenium (Re)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Rubidium (Rb)-Total		0.0894	0.109		mg/L	1.0	20	09-SEP-19
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Silver (Ag)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	09-SEP-19
Strontium (Sr)-Total		7.12	7.20		mg/L	1.2	20	09-SEP-19
Sulfur (S)-Total		857	1050		mg/L	2.6	20	09-SEP-19
Tellurium (Te)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Thallium (Tl)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	09-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4792950								
WG3154806-3 DUP		**L2340208-1**						
Thorium (Th)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	09-SEP-19
Titanium (Ti)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	09-SEP-19
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	09-SEP-19
Uranium (U)-Total		0.00288	0.00297		mg/L	0.2	20	09-SEP-19
Vanadium (V)-Total		0.00110	0.00163		mg/L	7.3	20	09-SEP-19
Yttrium (Y)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	09-SEP-19
Zirconium (Zr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	09-SEP-19
WG3154806-2 LCS								
Aluminum (Al)-Total			92.9		%		80-120	09-SEP-19
Antimony (Sb)-Total			99.6		%		80-120	09-SEP-19
Arsenic (As)-Total			94.4		%		80-120	09-SEP-19
Barium (Ba)-Total			90.1		%		80-120	09-SEP-19
Beryllium (Be)-Total			96.2		%		80-120	09-SEP-19
Bismuth (Bi)-Total			97.8		%		80-120	09-SEP-19
Boron (B)-Total			92.3		%		80-120	09-SEP-19
Cadmium (Cd)-Total			99.0		%		80-120	09-SEP-19
Calcium (Ca)-Total			91.7		%		80-120	09-SEP-19
Cesium (Cs)-Total			96.0		%		80-120	09-SEP-19
Chromium (Cr)-Total			99.7		%		80-120	09-SEP-19
Cobalt (Co)-Total			98.9		%		80-120	09-SEP-19
Copper (Cu)-Total			99.2		%		80-120	09-SEP-19
Gallium (Ga)-Total			96.7		%		80-120	09-SEP-19
Iron (Fe)-Total			93.0		%		80-120	09-SEP-19
Lead (Pb)-Total			92.8		%		80-120	09-SEP-19
Lithium (Li)-Total			96.6		%		80-120	09-SEP-19
Magnesium (Mg)-Total			99.0		%		80-120	09-SEP-19
Manganese (Mn)-Total			98.9		%		80-120	09-SEP-19
Molybdenum (Mo)-Total			94.3		%		80-120	09-SEP-19
Nickel (Ni)-Total			100.6		%		80-120	09-SEP-19
Phosphorus (P)-Total			97.8		%		80-120	09-SEP-19
Potassium (K)-Total			103.7		%		80-120	09-SEP-19
Rhenium (Re)-Total			94.2		%		80-120	09-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4792950								
WG3154806-2 LCS								
Rubidium (Rb)-Total			97.5		%		80-120	09-SEP-19
Selenium (Se)-Total			99.8		%		80-120	09-SEP-19
Silver (Ag)-Total			96.3		%		80-120	09-SEP-19
Strontium (Sr)-Total			90.7		%		80-120	09-SEP-19
Sulfur (S)-Total			83.2		%		80-120	09-SEP-19
Tellurium (Te)-Total			101.9		%		80-120	09-SEP-19
Thallium (Tl)-Total			93.3		%		80-120	09-SEP-19
Thorium (Th)-Total			87.4		%		80-120	09-SEP-19
Tin (Sn)-Total			94.6		%		80-120	09-SEP-19
Titanium (Ti)-Total			88.8		%		80-120	09-SEP-19
Tungsten (W)-Total			90.4		%		80-120	09-SEP-19
Uranium (U)-Total			87.3		%		80-120	09-SEP-19
Vanadium (V)-Total			94.5		%		80-120	09-SEP-19
Yttrium (Y)-Total			92.1		%		80-120	09-SEP-19
Zinc (Zn)-Total			98.8		%		80-120	09-SEP-19
Zirconium (Zr)-Total			90.7		%		80-120	09-SEP-19
WG3154806-1 MB								
Aluminum (Al)-Total			0.415	B	mg/L		0.005	09-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	09-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	09-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	09-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	09-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	09-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	09-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	09-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	09-SEP-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	09-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	09-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4792950								
WG3154806-1 MB								
Magnesium (Mg)-Total			<1.0		mg/L		1	09-SEP-19
Manganese (Mn)-Total			0.00041	B	mg/L		0.0002	09-SEP-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	09-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	09-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	09-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	09-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	09-SEP-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	09-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	09-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	09-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	09-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	09-SEP-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	09-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	09-SEP-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	09-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	09-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	09-SEP-19
NA-D-CCMS-VA	**Seawater**							
Batch R4783022								
WG3150871-3 DUP		**L2340208-1**						
Sodium (Na)-Dissolved		9200	9310		mg/L	1.2	20	04-SEP-19
WG3150871-2 LCS								
Sodium (Na)-Dissolved			95.3		%		80-120	04-SEP-19
WG3150871-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	04-SEP-19
WG3150871-4 MS		**L2340208-2**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	04-SEP-19
NA-T-CCMS-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NA-T-CCMS-VA	**Seawater**							
Batch R4784624								
WG3152142-3 DUP		**L2340208-1**						
Sodium (Na)-Total		9610	9390		mg/L	2.3	20	06-SEP-19
WG3152142-2 LCS								
Sodium (Na)-Total			100.6		%		80-120	06-SEP-19
WG3152142-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	06-SEP-19
WG3152142-4 MS		**L2340208-2**						
Sodium (Na)-Total			N/A	MS-B	%		-	06-SEP-19
NH3-F-VA	**Seawater**							
Batch R4790049								
WG3155036-2 LCS								
Ammonia, Total (as N)			102.9		%		85-115	08-SEP-19
WG3155036-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	08-SEP-19
PH-C-PCT-VA	**Seawater**							
Batch R4794411								
WG3155352-2 CRM		**VA-PH7-BUF**						
pH			7.03		pH		6.9-7.1	10-SEP-19
WG3155352-4 DUP		**L2340208-1**						
pH		8.00	8.00	J	pH	0.00	0.3	10-SEP-19
SI-D-CCMS-VA	**Seawater**							
Batch R4783022								
WG3150871-3 DUP		**L2340208-1**						
Silicon (Si)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	04-SEP-19
WG3150871-2 LCS								
Silicon (Si)-Dissolved			97.2		%		80-120	04-SEP-19
WG3150871-1 MB		**LF**						
Silicon (Si)-Dissolved			<1.0		mg/L		1	04-SEP-19
WG3150871-4 MS		**L2340208-2**						
Silicon (Si)-Dissolved			93.4		%		70-130	04-SEP-19
SI-T-CCMS-VA	**Seawater**							
Batch R4784624								
WG3152142-3 DUP		**L2340208-1**						
Silicon (Si)-Total		<1.0	<1.0	RPD-NA	mg/L	N/A	20	06-SEP-19
WG3152142-2 LCS								
Silicon (Si)-Total			99.7		%		80-120	06-SEP-19
WG3152142-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SI-T-CCMS-VA	**Seawater**							
Batch R4784624								
WG3152142-1 MB								
Silicon (Si)-Total			<1.0		mg/L		1	06-SEP-19
WG3152142-4 MS		**L2340208-2**						
Silicon (Si)-Total			96.7		%		70-130	06-SEP-19
TKN-C-F-VA	**Seawater**							
Batch R4790768								
WG3155038-2 LCS								
Total Kjeldahl Nitrogen			111.1		%		75-125	09-SEP-19
WG3155038-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-SEP-19
TSS-C-VA	**Seawater**							
Batch R4784793								
WG3152457-4 LCS								
Total Suspended Solids			99.7		%		85-115	05-SEP-19
WG3152457-3 MB								
Total Suspended Solids			<2.0		mg/L		2	05-SEP-19
TURBIDITY-C-VA	**Seawater**							
Batch R4787418								
WG3155110-2 CRM		**VA-FORM-40**						
Turbidity			106.8		%		85-115	07-SEP-19
WG3155110-3 DUP		**L2340208-1**						
Turbidity		0.18	0.17		NTU	1.7	15	07-SEP-19
WG3155110-1 MB								
Turbidity			<0.10		NTU		0.1	07-SEP-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Turbidity by Meter in Seawater							
	1	29-AUG-19 09:30	07-SEP-19 14:40	3	9	days	EHTR
	2	29-AUG-19 10:00	07-SEP-19 14:40	3	9	days	EHTR
	3	29-AUG-19 09:15	07-SEP-19 14:40	3	9	days	EHTR
	4	29-AUG-19 09:45	07-SEP-19 14:40	3	9	days	EHTR
pH by Meter (Automated) (seawater)							
	1	29-AUG-19 09:30	10-SEP-19 14:47	0.25	293	hours	EHTR-FM
	2	29-AUG-19 10:00	10-SEP-19 14:47	0.25	293	hours	EHTR-FM
	3	29-AUG-19 09:15	10-SEP-19 14:47	0.25	294	hours	EHTR-FM
	4	29-AUG-19 09:45	10-SEP-19 14:47	0.25	293	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Seawater by IC							
	1	29-AUG-19 09:30	08-SEP-19 08:51	3	10	days	EHTR
	2	29-AUG-19 10:00	08-SEP-19 08:51	3	10	days	EHTR
	3	29-AUG-19 09:15	08-SEP-19 08:51	3	10	days	EHTR
	4	29-AUG-19 09:45	08-SEP-19 08:51	3	10	days	EHTR
Nitrite in Seawater by IC							
	1	29-AUG-19 09:30	08-SEP-19 08:51	3	10	days	EHTR
	2	29-AUG-19 10:00	08-SEP-19 08:51	3	10	days	EHTR
	3	29-AUG-19 09:15	08-SEP-19 08:51	3	10	days	EHTR
	4	29-AUG-19 09:45	08-SEP-19 08:51	3	10	days	EHTR
Bacteriological Tests							
Fecal coliform by membrane filtration							
	1	29-AUG-19 09:30	03-SEP-19 16:00	30	126	hours	EHTR
	2	29-AUG-19 10:00	03-SEP-19 16:00	30	126	hours	EHTR
	3	29-AUG-19 09:15	03-SEP-19 16:00	30	127	hours	EHTR
	4	29-AUG-19 09:45	03-SEP-19 16:00	30	126	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2340208 were received on 03-SEP-19 13:00.

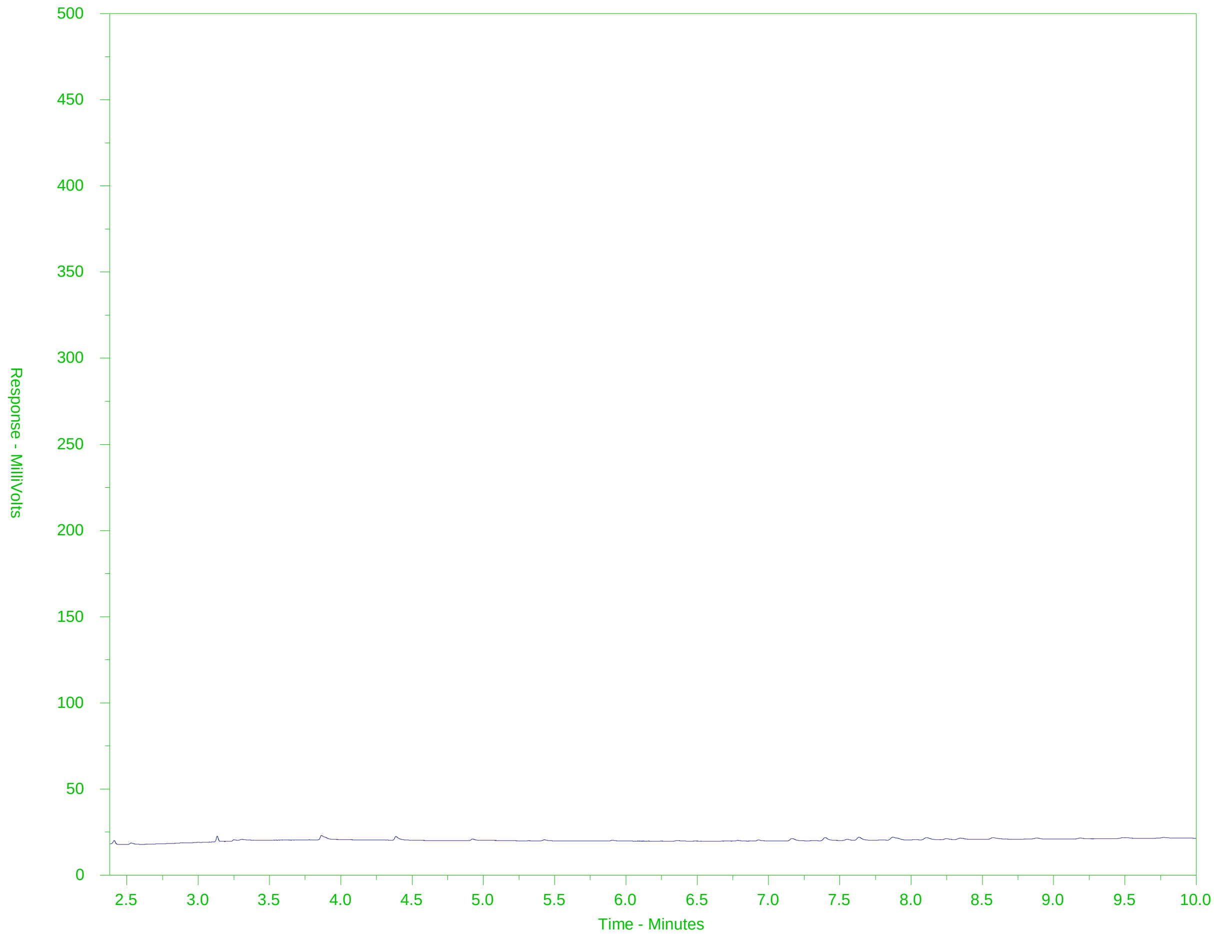
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340208-1
Client Sample ID: SOURCE-2



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

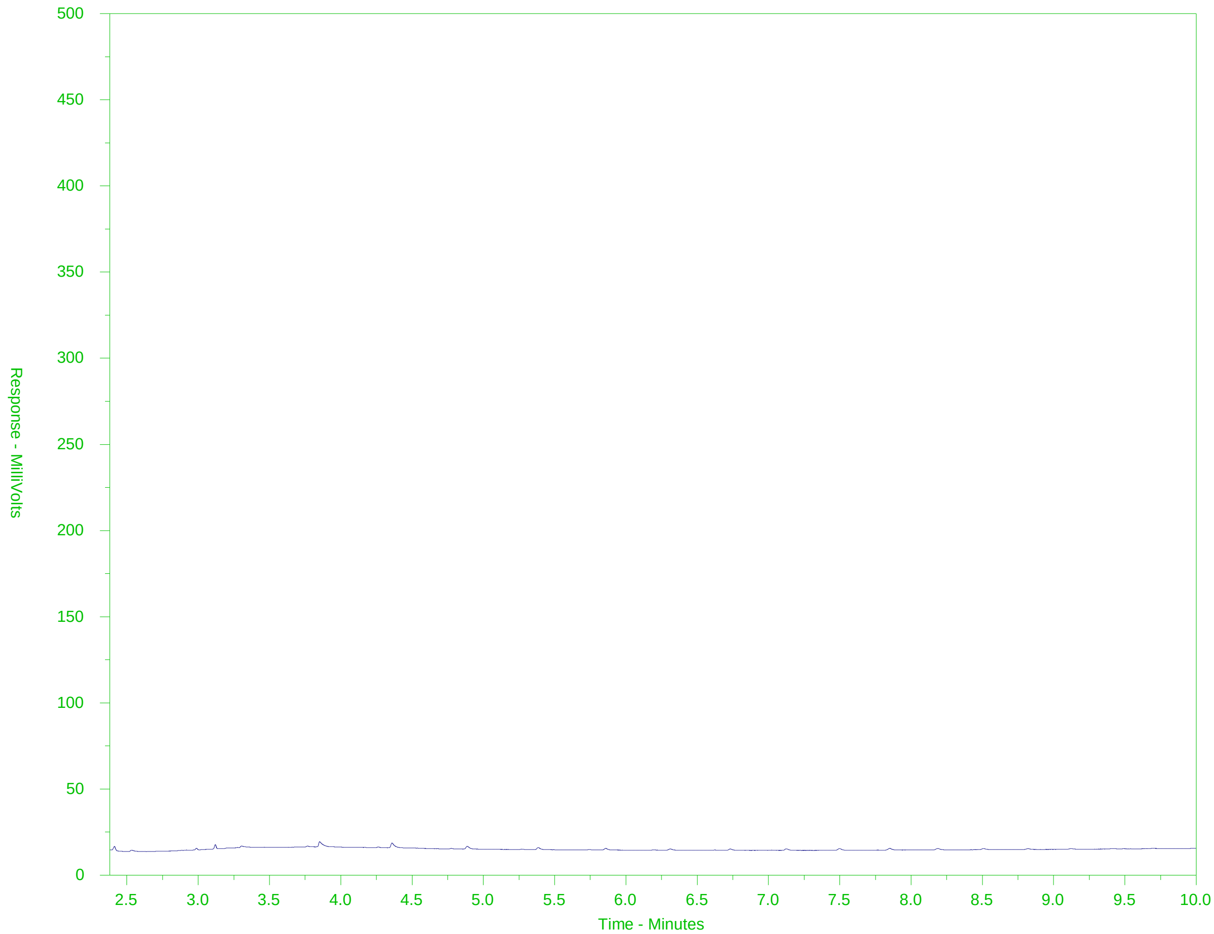
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340208-2
Client Sample ID: WNW-2



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

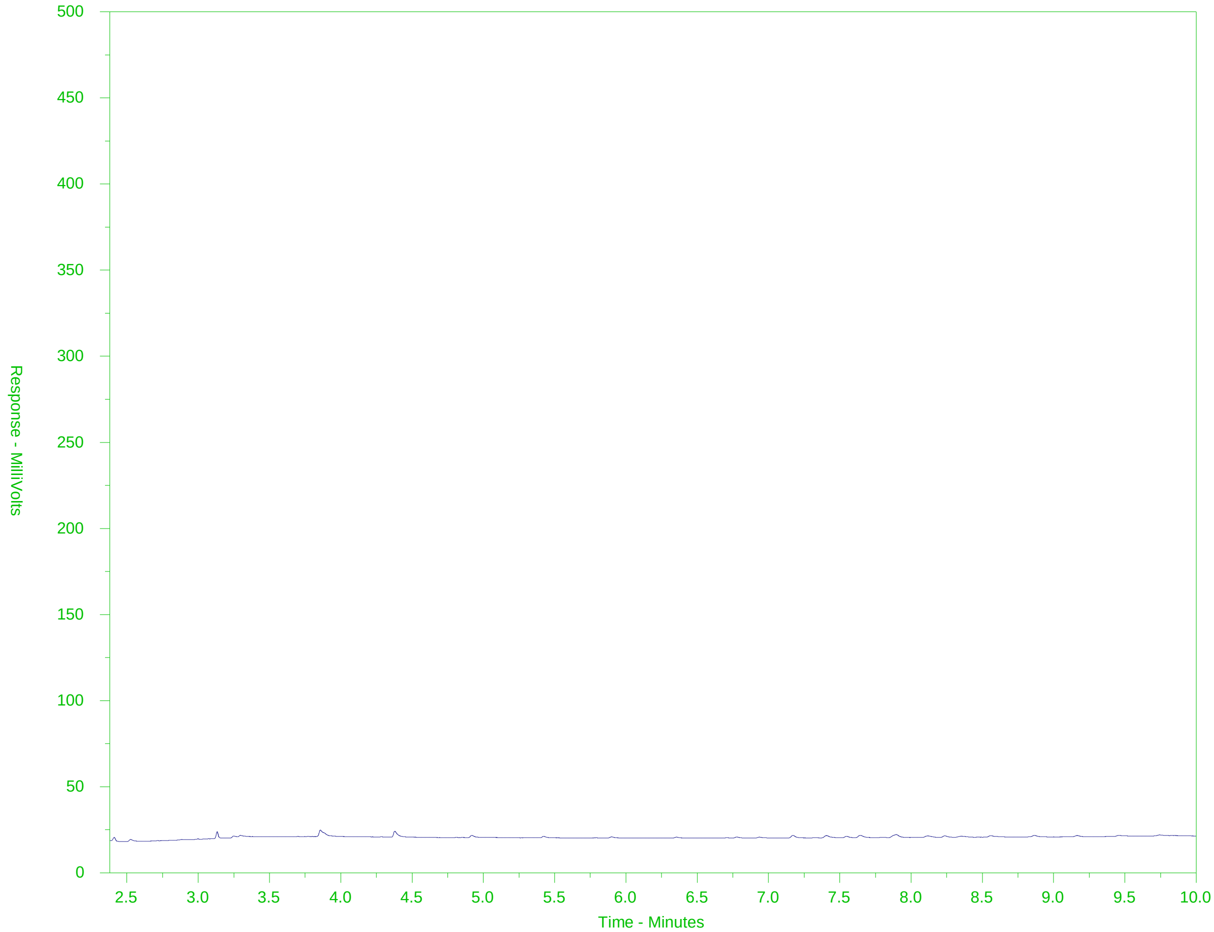
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340208-3
Client Sample ID: NORTH-2



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

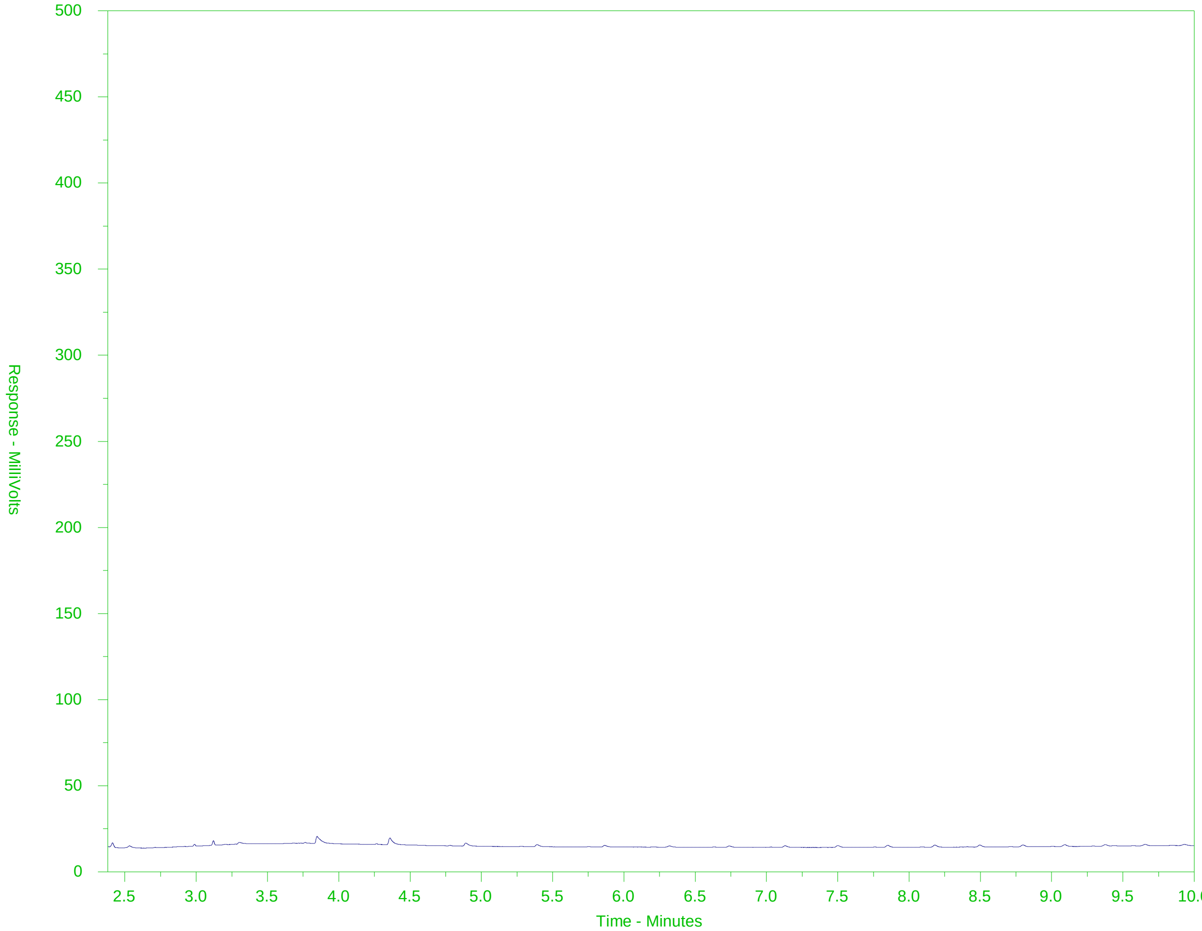
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340208-4
Client Sample ID: ENE-2



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2340208-COFC

COC Number: 17 - 739034

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Arman Ospan
Phone:	1-250-888-3845
	Company address below will appear on the final report
Street:	2nd floor 3795 Carey Road
City/Province:	Victoria, BC
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Aospan@golder.com

Email 2: Prouget@golder.com

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #: 1663724 / 24000

PO / AFE:

LSD:

ALS Lab Work Order # (lab use only):

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact: Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	General	TOC, Ammonia, TKN (P)	Dissolved Metals	Total Metals (P)	Dissolved Hg	Total Hg (P)	Hydrocarbons (P)	Fecal Coliform (P)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Source - 2	29-Aug-2019	9:30	Sea Water	9	X	X	X	X	X	X	X	X		
	WNW - 2	29-Aug-2019	10:00	↓	9	↓	↓	↓	↓	↓	↓	↓	↓		
	North - 2	29-Aug-2019	9:15	↓	9	↓	↓	↓	↓	↓	↓	↓	↓		
	ENE - 2	29-Aug-2019	9:45	↓	9	↓	↓	↓	↓	↓	↓	↓	↓		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C: 1.9

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Arnaf Cardinal	Date: 29-Aug-2019	Time: 10:30	Received by:	Date:	Time:	Received by: HA	Date: 9/3	Time: 1pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Arman Ospan & Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 04-SEP-19
Report Date: 11-SEP-19 14:58 (MT)
Version: FINAL

Client Phone: 250-888-3845

Certificate of Analysis

Lab Work Order #: L2340688

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724-24000
C of C Numbers: 17-739033
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340688-1	L2340688-2	L2340688-3	L2340688-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	02-SEP-19	02-SEP-19	02-SEP-19	02-SEP-19	
	Sampled Time	09:10	09:05	09:00	09:20	
	Client ID	SOURCE-3	WNW-3	NORTH-3	ENE-3	
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	17200	20800	10900	20200	
	pH (pH)	8.14	8.13	8.20	8.13	
	Salinity (psu)	10.4	12.8	6.4	12.4	
	Total Suspended Solids (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Turbidity (NTU)	0.49	0.65	0.46	0.67	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	113	116	115	115	
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0075	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	18.0	20.5	11.0	20.3	
	Chloride (Cl) (mg/L)	5410	6190	3240	6000	
	Fluoride (F) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Total Kjeldahl Nitrogen (mg/L)	0.204	0.227	0.250	0.218	
	Sulfate (SO4) (mg/L)	718	819	411	788	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.44	1.67	1.36	1.46	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0121	0.334	0.0480	0.0216	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00054	0.00055	<0.00040	0.00061	
	Barium (Ba)-Total (mg/L)	0.0069	0.0067	0.0063	0.0069	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	1.50	1.47	1.01	1.70	
	Cadmium (Cd)-Total (mg/L)	0.000015	0.000013	<0.000010	0.000020	
	Calcium (Ca)-Total (mg/L)	146	140	98.7	165	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	<0.00050	0.00068	<0.00050	<0.00050	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.014	0.020	0.015	0.020	
	Lead (Pb)-Total (mg/L)	<0.000050	0.000120	<0.000050	0.000053	
	Lithium (Li)-Total (mg/L)	0.054	0.052	0.033	0.063	
	Magnesium (Mg)-Total (mg/L)	367	354	217	431	
	Manganese (Mn)-Total (mg/L)	0.00113	0.00171	0.00113	0.00266	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00329	0.00359	0.00205	0.00393	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340688-1	L2340688-2	L2340688-3	L2340688-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	02-SEP-19	02-SEP-19	02-SEP-19	02-SEP-19	
	Sampled Time	09:10	09:05	09:00	09:20	
	Client ID	SOURCE-3	WNW-3	NORTH-3	ENE-3	
Grouping	**Analyte**					
SEAWATER						
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	0.00057	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	114	118	69.6	134	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0326	0.0334	0.0210	0.0388	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Total (mg/L)	3110	3150	2030	3680	
	Strontium (Sr)-Total (mg/L)	2.26	2.38	1.37	2.68	
	Sulfur (S)-Total (mg/L)	270	282	168	324	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00298	0.00420	0.00319	0.00322	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00047	0.00046	<0.00040	0.00058	
	Barium (Ba)-Dissolved (mg/L)	0.0066	0.0067	0.0059	0.0069	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	1.35	1.32	0.85	1.52	
	Cadmium (Cd)-Dissolved (mg/L)	0.000011	<0.000010	<0.000010	<0.000010	
	Calcium (Ca)-Dissolved (mg/L)	133	140	87.4	159	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00038	0.00068	0.00031	0.00036	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340688-1	L2340688-2	L2340688-3	L2340688-4
	Description	Seawater	Seawater	Seawater	Seawater
	Sampled Date	02-SEP-19	02-SEP-19	02-SEP-19	02-SEP-19
	Sampled Time	09:10	09:05	09:00	09:20
	Client ID	SOURCE-3	WNW-3	NORTH-3	ENE-3
Grouping	**Analyte**				
SEAWATER					
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.054	0.051	0.030	0.063
	Magnesium (Mg)-Dissolved (mg/L)	345	335	184	427
	Manganese (Mn)-Dissolved (mg/L)	0.00054	0.00066	0.00052	0.00176
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00314	0.00317	0.00180	0.00382
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	103	101	58.1	132
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.0322	0.0316	0.0174	0.0396
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	3170	3130	1800	3870
	Strontium (Sr)-Dissolved (mg/L)	2.21	2.24	1.24	2.58
	Sulfur (S)-Dissolved (mg/L)	276	258	150	330
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00311	0.00406	0.00288	0.00336
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2340688-1	L2340688-2	L2340688-3	L2340688-4	
	Description	Seawater	Seawater	Seawater	Seawater	
	Sampled Date	02-SEP-19	02-SEP-19	02-SEP-19	02-SEP-19	
	Sampled Time	09:10	09:05	09:00	09:20	
	Client ID	SOURCE-3	WNW-3	NORTH-3	ENE-3	
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	1	1	<1	2	
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	
	Surrogate: 2-Bromobenzotrifluoride (%)	93.5	100.8	95.3	94.3	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015	
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Surrogate: Acridine d9 (%)	103.3	110.1	108.2	100.1	
	Surrogate: Chrysene d12 (%)	102.1	107.8	105.4	105.8	
	Surrogate: Naphthalene d8 (%)	96.0	104.6	102.8	97.5	
	Surrogate: Phenanthrene d10 (%)	102.1	110.2	108.0	103.4	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Sulfur (S)-Total	MES	L2340688-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2340688-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2340688-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA	Seawater	Chloride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA	Seawater	Fluoride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA	Seawater	Sulfate by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA	Seawater	TOC by combustion (seawater)	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

Reference Information

FCOLI-MF-ENV-VA Water Fecal coliform by membrane filtration APHA METHOD 9222

This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation of the filter with the appropriate growth medium, positive results require further testing (up to an additional 48 hours) to confirm and quantify the total coliform. This method is used for non-turbid water with a low background bacteria level.

HG-DIS-C-CVAFS-VA Seawater Diss. Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA Seawater Salinity by conductivity meter APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TKN-C-F-VA Seawater TKN in Seawater by Fluorescence APHA 4500-NORG D.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-739033

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8
Contact: Arman Ospan & Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4782815								
WG3152080-2 LCS								
EPH10-19			109.3		%		70-130	06-SEP-19
EPH19-32			108.7		%		70-130	06-SEP-19
WG3152080-1 MB								
EPH10-19			<0.25		mg/L		0.25	06-SEP-19
EPH19-32			<0.25		mg/L		0.25	06-SEP-19
Surrogate: 2-Bromobenzotrifluoride			99.4		%		60-140	06-SEP-19
FCOLI-MF-ENV-VA	**Water**							
Batch R4789189								
WG3151608-2 MB								
Coliform Bacteria - Fecal			<1		CFU/100mL		1	04-SEP-19
PAH-ME-MS-VA	**Water**							
Batch R4784251								
WG3152080-2 LCS								
Acenaphthene			105.0		%		60-130	05-SEP-19
Acenaphthylene			105.3		%		60-130	05-SEP-19
Acridine			98.4		%		60-130	05-SEP-19
Anthracene			117.3		%		60-130	05-SEP-19
Benz(a)anthracene			119.0		%		60-130	05-SEP-19
Benzo(a)pyrene			112.7		%		60-130	05-SEP-19
Benzo(b&j)fluoranthene			99.4		%		60-130	05-SEP-19
Benzo(g,h,i)perylene			114.3		%		60-130	05-SEP-19
Benzo(k)fluoranthene			108.0		%		60-130	05-SEP-19
Chrysene			122.6		%		60-130	05-SEP-19
Dibenz(a,h)anthracene			115.8		%		60-130	05-SEP-19
Fluoranthene			115.3		%		60-130	05-SEP-19
Fluorene			108.7		%		60-130	05-SEP-19
Indeno(1,2,3-c,d)pyrene			122.6		%		60-130	05-SEP-19
1-Methylnaphthalene			98.2		%		60-130	05-SEP-19
2-Methylnaphthalene			93.4		%		60-130	05-SEP-19
Naphthalene			91.0		%		50-130	05-SEP-19
Phenanthrene			114.1		%		60-130	05-SEP-19
Pyrene			118.6		%		60-130	05-SEP-19
Quinoline			119.0		%		60-130	05-SEP-19
WG3152080-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4784251								
WG3152080-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	05-SEP-19
Acenaphthylene			<0.000010		mg/L		0.00001	05-SEP-19
Acridine			<0.000010		mg/L		0.00001	05-SEP-19
Anthracene			<0.000010		mg/L		0.00001	05-SEP-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	05-SEP-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	05-SEP-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	05-SEP-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	05-SEP-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	05-SEP-19
Chrysene			<0.000010		mg/L		0.00001	05-SEP-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	05-SEP-19
Fluoranthene			<0.000010		mg/L		0.00001	05-SEP-19
Fluorene			<0.000010		mg/L		0.00001	05-SEP-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	05-SEP-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	05-SEP-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	05-SEP-19
Naphthalene			<0.000050		mg/L		0.00005	05-SEP-19
Phenanthrene			<0.000020		mg/L		0.00002	05-SEP-19
Pyrene			<0.000010		mg/L		0.00001	05-SEP-19
Quinoline			<0.000050		mg/L		0.00005	05-SEP-19
Surrogate: Acridine d9			101.7		%		60-130	05-SEP-19
Surrogate: Chrysene d12			106.5		%		60-130	05-SEP-19
Surrogate: Naphthalene d8			111.2		%		50-130	05-SEP-19
Surrogate: Phenanthrene d10			110.3		%		60-130	05-SEP-19
ALK-TITR-VA	**Seawater**							
Batch R4794411								
WG3154846-4 DUP		**L2340688-1**						
Alkalinity, Total (as CaCO3)		113	114		mg/L	1.0	20	10-SEP-19
WG3154846-3 LCS								
Alkalinity, Total (as CaCO3)			101.8		%		70-130	10-SEP-19
WG3154846-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	10-SEP-19
ANIONS-C-BR-IC-VA	**Seawater**							

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA		**Seawater**							
Batch	**R4788049**								
WG3154834-3	**DUP**		**L2340688-1**						
Bromide (Br)			18.0	17.6		mg/L	2.0	20	07-SEP-19
WG3154834-2	**LCS**								
Bromide (Br)				100.3		%		85-115	07-SEP-19
WG3154834-1	**MB**								
Bromide (Br)				<5.0		mg/L		5	07-SEP-19
ANIONS-C-CL-IC-VA		**Seawater**							
Batch	**R4788049**								
WG3154834-3	**DUP**		**L2340688-1**						
Chloride (Cl)			5410	5300		mg/L	2.0	20	07-SEP-19
WG3154834-2	**LCS**								
Chloride (Cl)				100.7		%		90-110	07-SEP-19
WG3154834-1	**MB**								
Chloride (Cl)				<50		mg/L		50	07-SEP-19
ANIONS-C-F-IC-VA		**Seawater**							
Batch	**R4788049**								
WG3154834-3	**DUP**		**L2340688-1**						
Fluoride (F)			<1.0	<1.0	RPD-NA	mg/L	N/A	20	07-SEP-19
WG3154834-2	**LCS**								
Fluoride (F)				105.6		%		90-110	07-SEP-19
WG3154834-1	**MB**								
Fluoride (F)				<1.0		mg/L		1	07-SEP-19
ANIONS-C-NO2-IC-VA		**Seawater**							
Batch	**R4788049**								
WG3154834-3	**DUP**		**L2340688-1**						
Nitrite (as N)			<0.10	<0.10	RPD-NA	mg/L	N/A	20	07-SEP-19
WG3154834-2	**LCS**								
Nitrite (as N)				104.2		%		90-110	07-SEP-19
WG3154834-1	**MB**								
Nitrite (as N)				<0.10		mg/L		0.1	07-SEP-19
ANIONS-C-NO3-IC-VA		**Seawater**							
Batch	**R4788049**								
WG3154834-3	**DUP**		**L2340688-1**						
Nitrate (as N)			<0.50	<0.50	RPD-NA	mg/L	N/A	20	07-SEP-19
WG3154834-2	**LCS**								
Nitrate (as N)				101.1		%		90-110	07-SEP-19
WG3154834-1	**MB**								

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4788049								
WG3154834-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	07-SEP-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4788049								
WG3154834-3 DUP		**L2340688-1**						
Sulfate (SO4)		718	712		mg/L	0.9	20	07-SEP-19
WG3154834-2 LCS								
Sulfate (SO4)			101.0		%		90-110	07-SEP-19
WG3154834-1 MB								
Sulfate (SO4)			<30		mg/L		30	07-SEP-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4791408								
WG3155040-2 LCS								
Total Organic Carbon			102.6		%		80-120	09-SEP-19
WG3155040-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	09-SEP-19
EC-C-PCT-VA	**Seawater**							
Batch R4794411								
WG3154846-4 DUP		**L2340688-1**						
Conductivity		17200	17400		uS/cm	0.7	10	10-SEP-19
WG3154846-1 MB								
Conductivity			<2.0		uS/cm		2	10-SEP-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4783386								
WG3153023-2 LCS								
Mercury (Hg)-Dissolved			97.9		%		80-120	05-SEP-19
WG3153023-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	05-SEP-19
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4783386								
WG3152490-18 DUP		**L2340688-2**						
Mercury (Hg)-Total		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	05-SEP-19
WG3152490-2 LCS								
Mercury (Hg)-Total			99.4		%		80-120	05-SEP-19
WG3152490-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4783386								
WG3152490-17 MS		**L2340688-1**						
Mercury (Hg)-Total			97.3		%		70-130	05-SEP-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4784122								
WG3152270-3 DUP		**L2340688-1**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	05-SEP-19
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Arsenic (As)-Dissolved		0.00047	0.00048		mg/L	1.5	20	05-SEP-19
Barium (Ba)-Dissolved		0.0066	0.0062		mg/L	6.2	20	05-SEP-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Boron (B)-Dissolved		1.35	1.39		mg/L	2.9	20	05-SEP-19
Cadmium (Cd)-Dissolved		0.000011	0.000014	J	mg/L	0.000003	0.00002	05-SEP-19
Calcium (Ca)-Dissolved		133	139		mg/L	4.3	20	05-SEP-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Copper (Cu)-Dissolved		0.00038	0.00038		mg/L	0.5	20	05-SEP-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	05-SEP-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Lithium (Li)-Dissolved		0.054	0.053		mg/L	1.5	20	05-SEP-19
Magnesium (Mg)-Dissolved		345	335		mg/L	3.0	20	05-SEP-19
Manganese (Mn)-Dissolved		0.00054	0.00053		mg/L	1.1	20	05-SEP-19
Molybdenum (Mo)-Dissolved		0.00314	0.00322		mg/L	2.7	20	05-SEP-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	05-SEP-19
Potassium (K)-Dissolved		103	105		mg/L	1.0	20	05-SEP-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Rubidium (Rb)-Dissolved		0.0322	0.0319		mg/L	0.9	20	05-SEP-19
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	05-SEP-19
Strontium (Sr)-Dissolved		2.21	2.27		mg/L	2.4	20	05-SEP-19
Sulfur (S)-Dissolved		276	269		mg/L	2.8	20	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4784122								
WG3152270-3 DUP		**L2340688-1**						
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	05-SEP-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	05-SEP-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Uranium (U)-Dissolved		0.00311	0.00316		mg/L	1.6	20	05-SEP-19
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-SEP-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	05-SEP-19
WG3152270-2 LCS								
Aluminum (Al)-Dissolved			92.4		%		80-120	05-SEP-19
Antimony (Sb)-Dissolved			92.9		%		80-120	05-SEP-19
Arsenic (As)-Dissolved			92.0		%		80-120	05-SEP-19
Barium (Ba)-Dissolved			95.8		%		80-120	05-SEP-19
Beryllium (Be)-Dissolved			94.3		%		80-120	05-SEP-19
Bismuth (Bi)-Dissolved			114.9		%		80-120	05-SEP-19
Boron (B)-Dissolved			96.5		%		80-120	05-SEP-19
Cadmium (Cd)-Dissolved			95.4		%		80-120	05-SEP-19
Calcium (Ca)-Dissolved			85.8		%		80-120	05-SEP-19
Cesium (Cs)-Dissolved			98.2		%		80-120	05-SEP-19
Chromium (Cr)-Dissolved			92.3		%		80-120	05-SEP-19
Cobalt (Co)-Dissolved			93.6		%		80-120	05-SEP-19
Copper (Cu)-Dissolved			93.8		%		80-120	05-SEP-19
Gallium (Ga)-Dissolved			89.8		%		80-120	05-SEP-19
Iron (Fe)-Dissolved			88.7		%		80-120	05-SEP-19
Lead (Pb)-Dissolved			106.0		%		80-120	05-SEP-19
Lithium (Li)-Dissolved			94.8		%		80-120	05-SEP-19
Magnesium (Mg)-Dissolved			91.7		%		80-120	05-SEP-19
Manganese (Mn)-Dissolved			93.6		%		80-120	05-SEP-19
Molybdenum (Mo)-Dissolved			92.7		%		80-120	05-SEP-19
Nickel (Ni)-Dissolved			93.9		%		80-120	05-SEP-19
Phosphorus (P)-Dissolved			89.3		%		80-120	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4784122								
WG3152270-2 LCS								
Potassium (K)-Dissolved			97.7		%		80-120	05-SEP-19
Rhenium (Re)-Dissolved			99.0		%		80-120	05-SEP-19
Rubidium (Rb)-Dissolved			92.3		%		80-120	05-SEP-19
Selenium (Se)-Dissolved			94.7		%		80-120	05-SEP-19
Silver (Ag)-Dissolved			95.2		%		80-120	05-SEP-19
Strontium (Sr)-Dissolved			97.3		%		80-120	05-SEP-19
Sulfur (S)-Dissolved			85.5		%		80-120	05-SEP-19
Tellurium (Te)-Dissolved			109.6		%		80-120	05-SEP-19
Thallium (Tl)-Dissolved			107.0		%		80-120	05-SEP-19
Thorium (Th)-Dissolved			104.8		%		80-120	05-SEP-19
Tin (Sn)-Dissolved			95.0		%		80-120	05-SEP-19
Titanium (Ti)-Dissolved			90.9		%		80-120	05-SEP-19
Tungsten (W)-Dissolved			105.6		%		80-120	05-SEP-19
Uranium (U)-Dissolved			109.9		%		80-120	05-SEP-19
Vanadium (V)-Dissolved			92.9		%		80-120	05-SEP-19
Yttrium (Y)-Dissolved			89.7		%		80-120	05-SEP-19
Zinc (Zn)-Dissolved			90.6		%		80-120	05-SEP-19
Zirconium (Zr)-Dissolved			89.6		%		80-120	05-SEP-19
WG3152270-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	05-SEP-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	05-SEP-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	05-SEP-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	05-SEP-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	05-SEP-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	05-SEP-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	05-SEP-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	05-SEP-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	05-SEP-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	05-SEP-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4784122								
WG3152270-1 MB		**LF**						
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	05-SEP-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	05-SEP-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	05-SEP-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	05-SEP-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	05-SEP-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	05-SEP-19
Potassium (K)-Dissolved			<1.0		mg/L		1	05-SEP-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	05-SEP-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	05-SEP-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	05-SEP-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	05-SEP-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	05-SEP-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	05-SEP-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	05-SEP-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	05-SEP-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	05-SEP-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	05-SEP-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	05-SEP-19
WG3152270-4 MS		**L2340688-2**						
Aluminum (Al)-Dissolved			92.7		%		70-130	05-SEP-19
Antimony (Sb)-Dissolved			93.5		%		70-130	05-SEP-19
Arsenic (As)-Dissolved			91.3		%		70-130	05-SEP-19
Barium (Ba)-Dissolved			86.2		%		70-130	05-SEP-19
Beryllium (Be)-Dissolved			100.9		%		70-130	05-SEP-19
Bismuth (Bi)-Dissolved			90.3		%		70-130	05-SEP-19
Boron (B)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Cadmium (Cd)-Dissolved			88.7		%		70-130	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4784122								
WG3152270-4 MS		**L2340688-2**						
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Cesium (Cs)-Dissolved			101.1		%		70-130	05-SEP-19
Chromium (Cr)-Dissolved			88.3		%		70-130	05-SEP-19
Cobalt (Co)-Dissolved			89.6		%		70-130	05-SEP-19
Copper (Cu)-Dissolved			84.6		%		70-130	05-SEP-19
Gallium (Ga)-Dissolved			89.0		%		70-130	05-SEP-19
Iron (Fe)-Dissolved			87.8		%		70-130	05-SEP-19
Lead (Pb)-Dissolved			92.7		%		70-130	05-SEP-19
Lithium (Li)-Dissolved			102.6		%		70-130	05-SEP-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Manganese (Mn)-Dissolved			91.2		%		70-130	05-SEP-19
Molybdenum (Mo)-Dissolved			94.1		%		70-130	05-SEP-19
Nickel (Ni)-Dissolved			84.8		%		70-130	05-SEP-19
Phosphorus (P)-Dissolved			98.3		%		70-130	05-SEP-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Rhenium (Re)-Dissolved			90.9		%		70-130	05-SEP-19
Rubidium (Rb)-Dissolved			90.0		%		70-130	05-SEP-19
Selenium (Se)-Dissolved			89.5		%		70-130	05-SEP-19
Silver (Ag)-Dissolved			92.3		%		70-130	05-SEP-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	05-SEP-19
Tellurium (Te)-Dissolved			101.7		%		70-130	05-SEP-19
Thallium (Tl)-Dissolved			93.2		%		70-130	05-SEP-19
Thorium (Th)-Dissolved			105.8		%		70-130	05-SEP-19
Tin (Sn)-Dissolved			92.0		%		70-130	05-SEP-19
Titanium (Ti)-Dissolved			90.8		%		70-130	05-SEP-19
Tungsten (W)-Dissolved			101.9		%		70-130	05-SEP-19
Uranium (U)-Dissolved			98.0		%		70-130	05-SEP-19
Vanadium (V)-Dissolved			93.5		%		70-130	05-SEP-19
Yttrium (Y)-Dissolved			95.5		%		70-130	05-SEP-19
Zinc (Zn)-Dissolved			84.1		%		70-130	05-SEP-19
Zirconium (Zr)-Dissolved			104.5		%		70-130	05-SEP-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-2 LCS								
Aluminum (Al)-Total			95.3		%		80-120	05-SEP-19
Antimony (Sb)-Total			105.8		%		80-120	05-SEP-19
Arsenic (As)-Total			96.7		%		80-120	05-SEP-19
Barium (Ba)-Total			93.8		%		80-120	05-SEP-19
Beryllium (Be)-Total			96.4		%		80-120	05-SEP-19
Bismuth (Bi)-Total			108.6		%		80-120	05-SEP-19
Boron (B)-Total			94.0		%		80-120	05-SEP-19
Cadmium (Cd)-Total			105.6		%		80-120	05-SEP-19
Calcium (Ca)-Total			92.4		%		80-120	05-SEP-19
Cesium (Cs)-Total			104.0		%		80-120	05-SEP-19
Chromium (Cr)-Total			94.9		%		80-120	05-SEP-19
Cobalt (Co)-Total			102.5		%		80-120	05-SEP-19
Copper (Cu)-Total			101.4		%		80-120	05-SEP-19
Gallium (Ga)-Total			95.7		%		80-120	05-SEP-19
Iron (Fe)-Total			96.0		%		80-120	05-SEP-19
Lead (Pb)-Total			105.8		%		80-120	05-SEP-19
Lithium (Li)-Total			95.7		%		80-120	05-SEP-19
Magnesium (Mg)-Total			103.2		%		80-120	05-SEP-19
Manganese (Mn)-Total			98.1		%		80-120	05-SEP-19
Molybdenum (Mo)-Total			95.5		%		80-120	05-SEP-19
Nickel (Ni)-Total			101.1		%		80-120	05-SEP-19
Phosphorus (P)-Total			91.0		%		80-120	05-SEP-19
Potassium (K)-Total			88.8		%		80-120	05-SEP-19
Rhenium (Re)-Total			106.5		%		80-120	05-SEP-19
Rubidium (Rb)-Total			100.7		%		80-120	05-SEP-19
Selenium (Se)-Total			101.6		%		80-120	05-SEP-19
Silver (Ag)-Total			101.1		%		80-120	05-SEP-19
Strontium (Sr)-Total			99.0		%		80-120	05-SEP-19
Sulfur (S)-Total			78.4	MES	%		80-120	05-SEP-19
Tellurium (Te)-Total			115.2		%		80-120	05-SEP-19
Thallium (Tl)-Total			105.8		%		80-120	05-SEP-19
Thorium (Th)-Total			101.5		%		80-120	05-SEP-19
Tin (Sn)-Total			99.6		%		80-120	05-SEP-19
Titanium (Ti)-Total			91.7		%		80-120	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-2 LCS								
Tungsten (W)-Total			104.6		%		80-120	05-SEP-19
Uranium (U)-Total			108.0		%		80-120	05-SEP-19
Vanadium (V)-Total			94.5		%		80-120	05-SEP-19
Yttrium (Y)-Total			95.2		%		80-120	05-SEP-19
Zinc (Zn)-Total			99.1		%		80-120	05-SEP-19
Zirconium (Zr)-Total			90.3		%		80-120	05-SEP-19
WG3152142-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	05-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	05-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	05-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	05-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	05-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	05-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	05-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	05-SEP-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	05-SEP-19
Magnesium (Mg)-Total			<1.0		mg/L		1	05-SEP-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	05-SEP-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	05-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	05-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	05-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	05-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	05-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4784122								
WG3152142-1 MB								
Strontium (Sr)-Total			<0.010		mg/L		0.01	05-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	05-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	05-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	05-SEP-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	05-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	05-SEP-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	05-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	05-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	05-SEP-19
NA-D-CCMS-VA	**Seawater**							
Batch R4784963								
WG3152270-3 DUP		**L2340688-1**						
Sodium (Na)-Dissolved		3170	3250		mg/L	2.6	20	06-SEP-19
WG3152270-2 LCS								
Sodium (Na)-Dissolved			102.4		%		80-120	06-SEP-19
WG3152270-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	06-SEP-19
WG3152270-4 MS		**L2340688-2**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	06-SEP-19
NA-T-CCMS-VA	**Seawater**							
Batch R4784624								
WG3152142-2 LCS								
Sodium (Na)-Total			100.6		%		80-120	06-SEP-19
WG3152142-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	06-SEP-19
NH3-F-VA	**Seawater**							
Batch R4790049								
WG3155036-2 LCS								
Ammonia, Total (as N)			102.9		%		85-115	08-SEP-19
WG3155036-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	08-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-C-PCT-VA	**Seawater**							
Batch R4794411								
WG3154846-2 CRM		**VA-PH7-BUF**						
pH			7.03		pH		6.9-7.1	10-SEP-19
WG3154846-4 DUP		**L2340688-1**						
pH		8.14	8.13	J	pH	0.01	0.3	10-SEP-19
SI-D-CCMS-VA	**Seawater**							
Batch R4784963								
WG3152270-3 DUP		**L2340688-1**						
Silicon (Si)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	06-SEP-19
WG3152270-2 LCS								
Silicon (Si)-Dissolved			104.7		%		80-120	06-SEP-19
WG3152270-1 MB		**LF**						
Silicon (Si)-Dissolved			<1.0		mg/L		1	06-SEP-19
WG3152270-4 MS		**L2340688-2**						
Silicon (Si)-Dissolved			97.7		%		70-130	06-SEP-19
SI-T-CCMS-VA	**Seawater**							
Batch R4784624								
WG3152142-2 LCS								
Silicon (Si)-Total			99.7		%		80-120	06-SEP-19
WG3152142-1 MB								
Silicon (Si)-Total			<1.0		mg/L		1	06-SEP-19
TKN-C-F-VA	**Seawater**							
Batch R4790768								
WG3155038-2 LCS								
Total Kjeldahl Nitrogen			111.1		%		75-125	09-SEP-19
WG3155038-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-SEP-19
TSS-C-VA	**Seawater**							
Batch R4789069								
WG3154768-2 LCS								
Total Suspended Solids			91.1		%		85-115	06-SEP-19
WG3154768-1 MB								
Total Suspended Solids			<2.0		mg/L		2	06-SEP-19
TURBIDITY-C-VA	**Seawater**							
Batch R4783007								
WG3151857-2 CRM		**VA-FORM-40**						
Turbidity			105.6		%		85-115	04-SEP-19
WG3151857-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-C-VA	**Seawater**							
Batch R4783007								
WG3151857-1 MB								
Turbidity			<0.10		NTU		0.1	04-SEP-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated) (seawater)							
	1	02-SEP-19 09:10	10-SEP-19 10:03	0.25	193	hours	EHTR-FM
	2	02-SEP-19 09:05	10-SEP-19 10:03	0.25	193	hours	EHTR-FM
	3	02-SEP-19 09:00	10-SEP-19 10:03	0.25	193	hours	EHTR-FM
	4	02-SEP-19 09:20	10-SEP-19 10:03	0.25	193	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Seawater by IC							
	1	02-SEP-19 09:10	07-SEP-19 08:20	3	5	days	EHTL
	2	02-SEP-19 09:05	07-SEP-19 08:20	3	5	days	EHTL
	3	02-SEP-19 09:00	07-SEP-19 08:20	3	5	days	EHTL
	4	02-SEP-19 09:20	07-SEP-19 08:20	3	5	days	EHTL
Nitrite in Seawater by IC							
	1	02-SEP-19 09:10	07-SEP-19 08:20	3	5	days	EHTL
	2	02-SEP-19 09:05	07-SEP-19 08:20	3	5	days	EHTL
	3	02-SEP-19 09:00	07-SEP-19 08:20	3	5	days	EHTL
	4	02-SEP-19 09:20	07-SEP-19 08:20	3	5	days	EHTL
Bacteriological Tests							
Fecal coliform by membrane filtration							
	1	02-SEP-19 09:10	04-SEP-19 13:20	30	52	hours	EHTR
	2	02-SEP-19 09:05	04-SEP-19 13:20	30	52	hours	EHTR
	3	02-SEP-19 09:00	04-SEP-19 13:20	30	52	hours	EHTR
	4	02-SEP-19 09:20	04-SEP-19 13:20	30	52	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2340688 were received on 04-SEP-19 09:34.

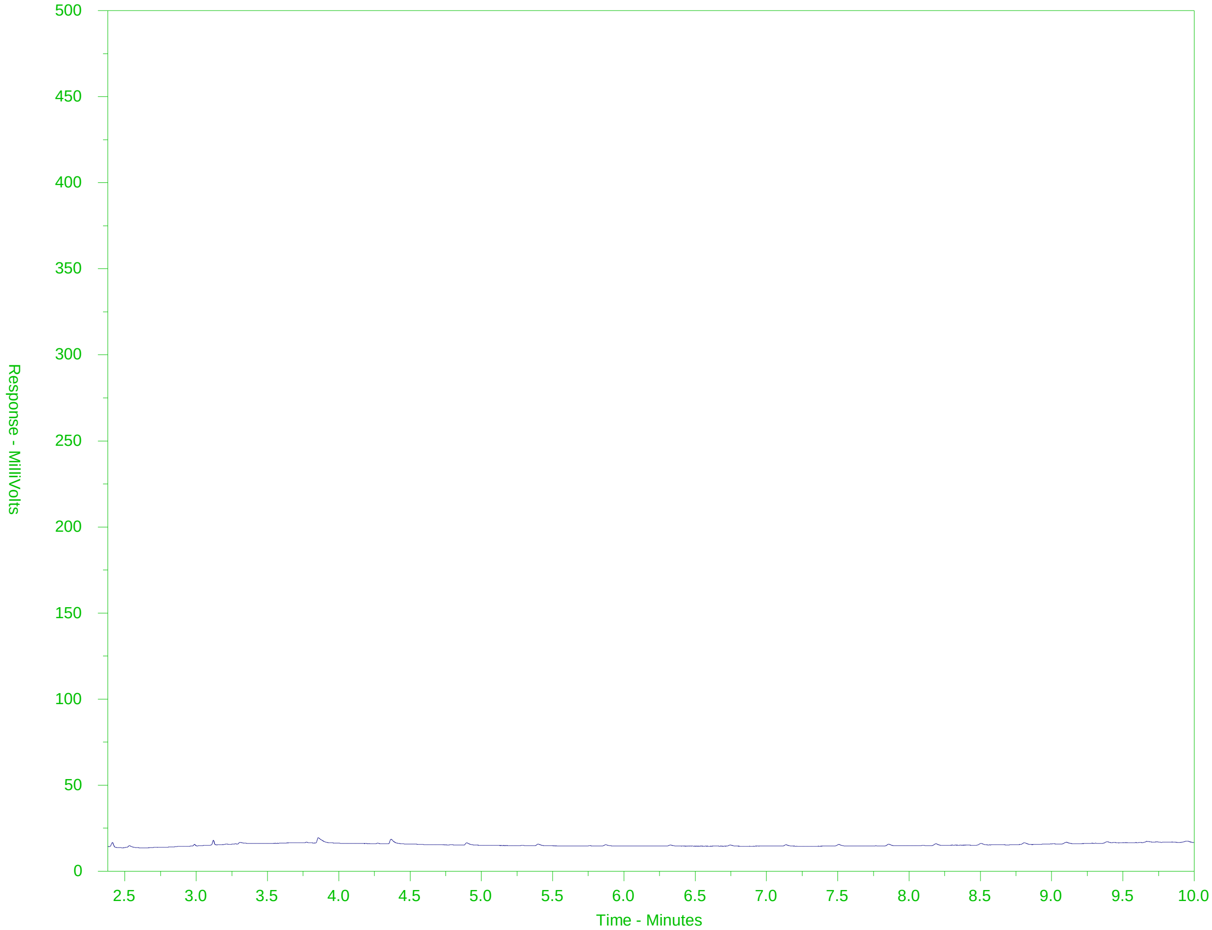
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

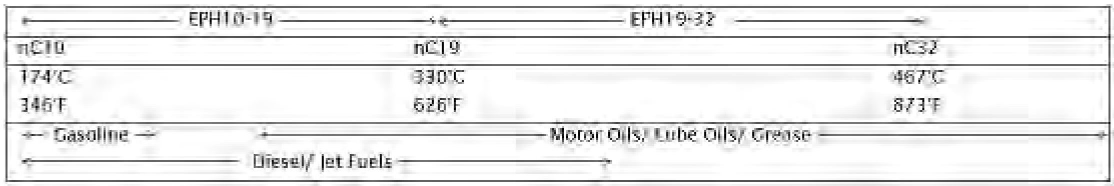
The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340688-1
Client Sample ID: SOURCE-3





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

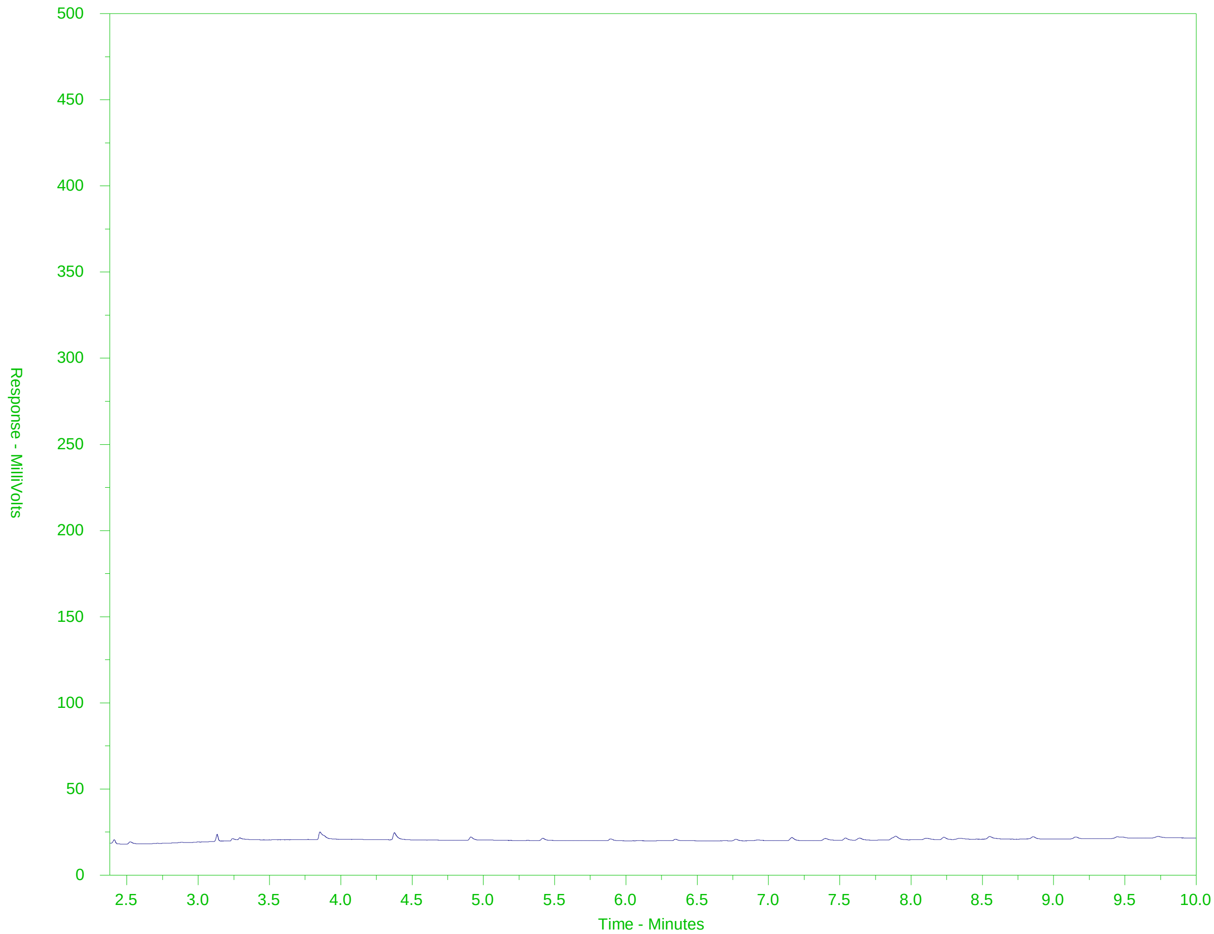
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340688-2
Client Sample ID: WNW-3



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

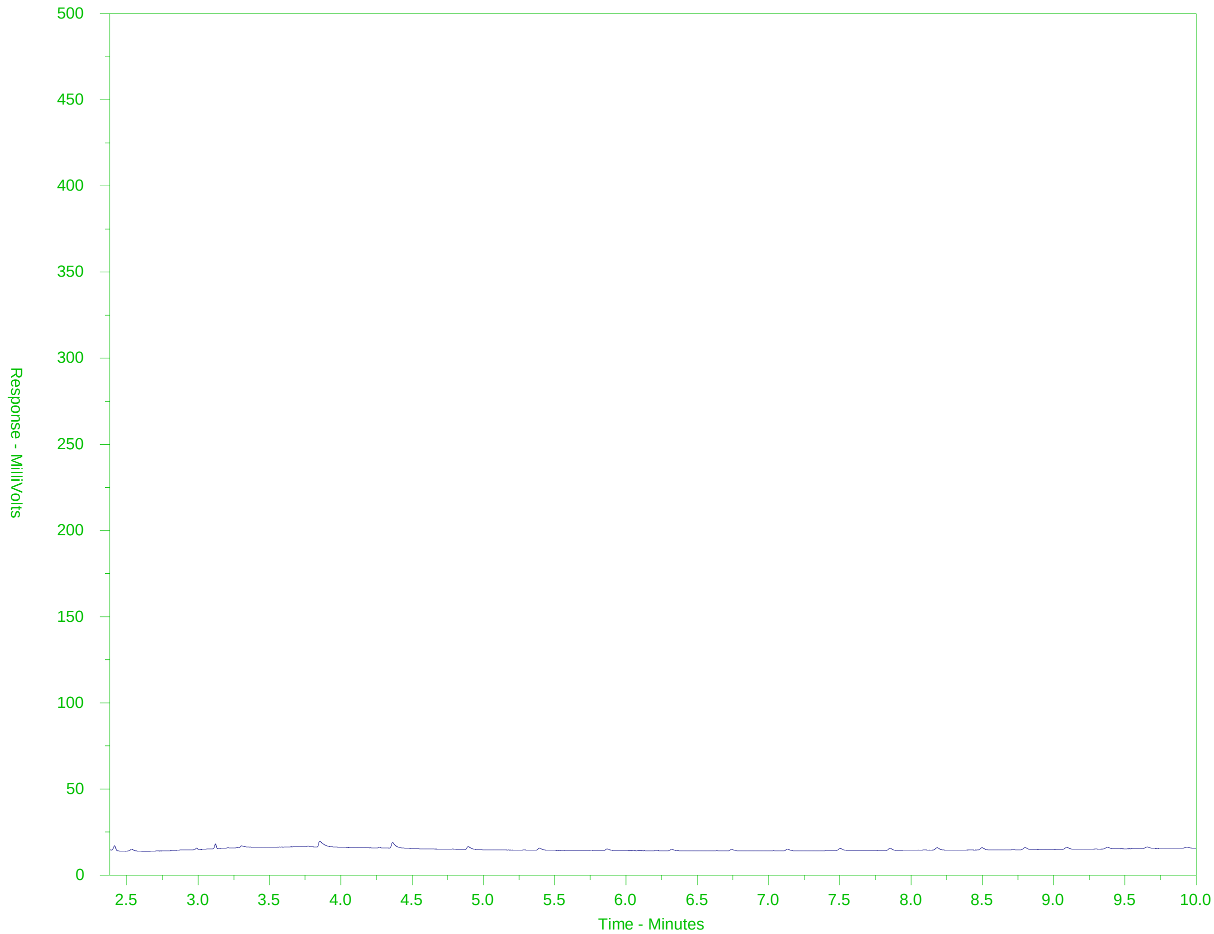
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340688-3
Client Sample ID: NORTH-3



EPH10-19	EPH19-32	
nC10	nC19	nC32
174'C	330'C	467'C
346'F	626'F	873'F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

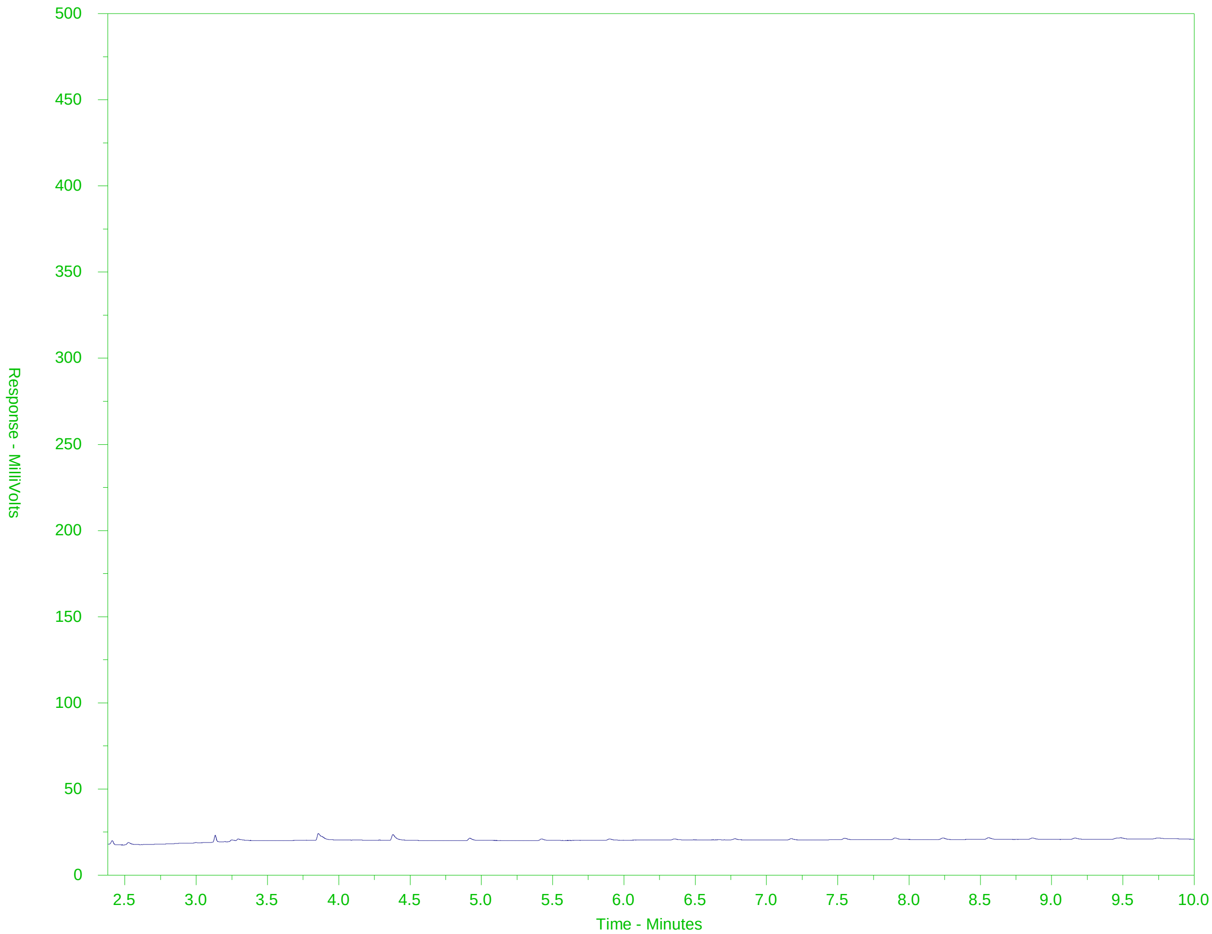
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2340688-4
Client Sample ID: ENE-3



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2340688-COFC

COC Number: 17 - 739033

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Arman Osgan, Phil Rouget
Phone:	1-250-888-3845
	Company address below will appear on the final report
Street:	2nd Floor 3795 Carey Rd.
City/Province:	Victoria, BC
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: aosgan@golder.com
Email 2: prouget@golder.com
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:
Job #: 1663724-24000
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: DV/AC

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	General	TOC, Ammonia, TKN (P)	Dissolved Metals	Total Metals (P)	Dissolved Hg	Total Hg (P)	Hydrocarbons (P)	Fecal Coliform (P)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Source-3	02-Sept-19	9:10	Sea water	9	X	X	X	X	X	X	X	X		
	WNW-3	02-Sept-19	9:05	Sea water	9	X	X	X	X	X	X	X	X		
	North-3	02-Sept-19	9:00	Sea water	9	X	X	X	X	X	X	X	X		
	ENE-3	02-Sept-19	9:20	Sea water	9	X	X	X	X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C:
FINAL COOLER TEMPERATURES °C: 13

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Amy Cardinal [signature]	Date: 02-Sept-2019	Time: 1015	Received by:	Date:	Time:	Received by: JC	Date: SEP 04 2019	Time: 9:34am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 11-SEP-19
Report Date: 19-SEP-19 12:32 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2344898

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724-24000
C of C Numbers: 17-697665
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2344898-1	L2344898-2	L2344898-3	L2344898-4	
	Description	SEAWATER	SEAWATER	SEAWATER	SEAWATER	
	Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19	
	Sampled Time	14:40	14:25	14:10	14:35	
	Client ID	SOURCE-4	WNW-4	NORTH-4	ENE-4	
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	20700	22700	23800	22800	
	pH (pH)	8.09	8.07	8.08	8.08	
	Salinity (psu)	12.9	14.3	15.0	14.3	
	Total Suspended Solids (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Turbidity (NTU)	0.29	0.47	0.29	0.34	
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	112	110	108	109	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	25.3	28.3	29.6	28.1	
	Chloride (Cl) (mg/L)	7270	7800	8520	7830	
	Fluoride (F) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	0.12	<0.10	<0.10	<0.10	
	Total Kjeldahl Nitrogen (mg/L)	0.123	0.105	0.082	0.097	
	Sulfate (SO4) (mg/L)	1030	1090	1190	1090	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.06	0.98	1.06	1.39	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0100	0.0095	0.0120	0.0082	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00074	0.00074	0.00078	0.00070	
	Barium (Ba)-Total (mg/L)	0.0073	0.0078	0.0075	0.0076	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	1.69	1.75	1.87	1.78	
	Cadmium (Cd)-Total (mg/L)	0.000013	0.000015	0.000016	0.000012	
	Calcium (Ca)-Total (mg/L)	172	185	191	198	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	<0.00050	0.00108	0.00067	<0.00050	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.018	0.014	0.012	0.010	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.067	0.071	0.072	0.074	
	Magnesium (Mg)-Total (mg/L)	446	511	564	509	
	Manganese (Mn)-Total (mg/L)	0.00131	0.00099	0.00097	0.00092	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00453	0.00497	0.00506	0.00495	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte				
	Sample ID	L2344898-1	L2344898-2	L2344898-3	L2344898-4
	Description	SEAWATER	SEAWATER	SEAWATER	SEAWATER
	Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19
	Sampled Time	14:40	14:25	14:10	14:35
	Client ID	SOURCE-4	WNW-4	NORTH-4	ENE-4
SEAWATER					
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	153	169	181	170
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Total (mg/L)	0.0445	0.0493	0.0508	0.0507
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	4320	4720	4940	4780
	Strontium (Sr)-Total (mg/L)	2.79	3.41	3.40	3.37
	Sulfur (S)-Total (mg/L)	401	445	475	447
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Total (mg/L)	0.000058	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Total (mg/L)	0.00288	0.00253	0.00258	0.00270
	Vanadium (V)-Total (mg/L)	0.00057	0.00066	0.00067	0.00065
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	0.00051	<0.00050
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Dissolved (mg/L)	0.00067	0.00073	0.00076	0.00078
	Barium (Ba)-Dissolved (mg/L)	0.0067	0.0077	0.0075	0.0075
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	1.74	1.84	1.94	1.85
	Cadmium (Cd)-Dissolved (mg/L)	0.000013	0.000015	0.000014	0.000013
	Calcium (Ca)-Dissolved (mg/L)	176	199	192	184
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Dissolved (mg/L)	0.00034	0.00093	0.00047	0.00033

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2344898-1	L2344898-2	L2344898-3	L2344898-4
	Description	SEAWATER	SEAWATER	SEAWATER	SEAWATER
	Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19
	Sampled Time	14:40	14:25	14:10	14:35
	Client ID	SOURCE-4	WNW-4	NORTH-4	ENE-4
Grouping	**Analyte**				
SEAWATER					
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.068	0.076	0.076	0.076
	Magnesium (Mg)-Dissolved (mg/L)	461	508	557	543
	Manganese (Mn)-Dissolved (mg/L)	0.00056	0.00032	0.00031	0.00034
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00433	0.00482	0.00498	0.00464
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	150	160	175	170
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.0449	0.0485	0.0514	0.0514
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	4280	4830	5000	4840
	Strontium (Sr)-Dissolved (mg/L)	2.82	3.35	3.52	3.17
	Sulfur (S)-Dissolved (mg/L)	391	434	457	448
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00286	0.00268	0.00265	0.00259
	Vanadium (V)-Dissolved (mg/L)	0.00056	0.00051	0.00061	0.00063
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2344898-1	L2344898-2	L2344898-3	L2344898-4	
	Description	SEAWATER	SEAWATER	SEAWATER	SEAWATER	
	Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19	
	Sampled Time	14:40	14:25	14:10	14:35	
	Client ID	SOURCE-4	WNW-4	NORTH-4	ENE-4	
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Fecal Coliforms (CFU/100mL)	0	0	0	0	
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	
	Surrogate: 2-Bromobenzotrifluoride (%)	91.4	90.2	94.8	90.9	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015	
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Surrogate: Acridine d9 (%)	90.7	87.3	93.6	85.0	
	Surrogate: Chrysene d12 (%)	94.1	88.2	98.7	85.9	
	Surrogate: Naphthalene d8 (%)	98.6	91.9	102.6	91.6	
	Surrogate: Phenanthrene d10 (%)	102.9	96.9	110.0	96.2	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Sodium (Na)-Total	B	L2344898-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Boron (B)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Total	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2344898-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2344898-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA	Seawater	Chloride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA	Seawater	Fluoride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA	Seawater	Sulfate by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA	Seawater	TOC by combustion (seawater)	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual

Reference Information

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

FC-MF-WT	Water	Fecal Coliforms	SM 9222D

A 100mL volume of sample is filtered through a membrane, the membrane is placed on mFC agar and incubated at 24–2h@44.5–0.2°C. Method ID: WT-TM-1200

HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA	Seawater	Tot Metals in Seawater by CRC ICPMS (BC)	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA	Seawater	Diss. Sodium in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA	Water	PAHs in Water	EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA	Seawater	Salinity by conductivity meter	APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TKN-C-F-VA	Seawater	TKN in Seawater by Fluorescence	APHA 4500-NORG D.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-697665

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2344898 Report Date: 19-SEP-19

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4805355								
WG3160627-2 LCS								
EPH10-19			107.2		%		70-130	15-SEP-19
EPH19-32			107.6		%		70-130	15-SEP-19
WG3160627-1 MB								
EPH10-19			<0.25		mg/L		0.25	15-SEP-19
EPH19-32			<0.25		mg/L		0.25	15-SEP-19
Surrogate: 2-Bromobenzotrifluoride			88.2		%		60-140	15-SEP-19
FC-MF-WT	**Water**							
Batch R4800630								
WG3158400-1 MB								
Fecal Coliforms			0		CFU/100mL		1	11-SEP-19
PAH-ME-MS-VA	**Water**							
Batch R4803838								
WG3160627-2 LCS								
Acenaphthene			92.9		%		60-130	13-SEP-19
Acenaphthylene			99.2		%		60-130	13-SEP-19
Acridine			86.0		%		60-130	13-SEP-19
Anthracene			101.6		%		60-130	13-SEP-19
Benz(a)anthracene			103.7		%		60-130	13-SEP-19
Benzo(a)pyrene			96.5		%		60-130	13-SEP-19
Benzo(b&j)fluoranthene			84.5		%		60-130	13-SEP-19
Benzo(g,h,i)perylene			101.8		%		60-130	13-SEP-19
Benzo(k)fluoranthene			87.0		%		60-130	13-SEP-19
Chrysene			101.4		%		60-130	13-SEP-19
Dibenz(a,h)anthracene			103.4		%		60-130	13-SEP-19
Fluoranthene			100.0		%		60-130	13-SEP-19
Fluorene			98.9		%		60-130	13-SEP-19
Indeno(1,2,3-c,d)pyrene			112.6		%		60-130	13-SEP-19
1-Methylnaphthalene			86.2		%		60-130	13-SEP-19
2-Methylnaphthalene			88.9		%		60-130	13-SEP-19
Naphthalene			91.0		%		50-130	13-SEP-19
Phenanthrene			99.2		%		60-130	13-SEP-19
Pyrene			102.7		%		60-130	13-SEP-19
Quinoline			110.5		%		60-130	13-SEP-19
WG3160627-1 MB								

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4803838								
WG3160627-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	13-SEP-19
Acenaphthylene			<0.000010		mg/L		0.00001	13-SEP-19
Acridine			<0.000010		mg/L		0.00001	13-SEP-19
Anthracene			<0.000010		mg/L		0.00001	13-SEP-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	13-SEP-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	13-SEP-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	13-SEP-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	13-SEP-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	13-SEP-19
Chrysene			<0.000010		mg/L		0.00001	13-SEP-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	13-SEP-19
Fluoranthene			<0.000010		mg/L		0.00001	13-SEP-19
Fluorene			<0.000010		mg/L		0.00001	13-SEP-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	13-SEP-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	13-SEP-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	13-SEP-19
Naphthalene			<0.000050		mg/L		0.00005	13-SEP-19
Phenanthrene			<0.000020		mg/L		0.00002	13-SEP-19
Pyrene			<0.000010		mg/L		0.00001	13-SEP-19
Quinoline			<0.000050		mg/L		0.00005	13-SEP-19
Surrogate: Acridine d9			91.1		%		60-130	13-SEP-19
Surrogate: Chrysene d12			99.9		%		60-130	13-SEP-19
Surrogate: Naphthalene d8			101.4		%		50-130	13-SEP-19
Surrogate: Phenanthrene d10			106.7		%		60-130	13-SEP-19
ALK-TITR-VA	**Seawater**							
Batch R4818975								
WG3163042-4 DUP		**L2344898-1**						
Alkalinity, Total (as CaCO3)		112	110		mg/L	1.5	20	17-SEP-19
WG3163042-3 LCS								
Alkalinity, Total (as CaCO3)			101.3		%		70-130	17-SEP-19
WG3163042-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	17-SEP-19
ANIONS-C-BR-IC-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Bromide (Br)		25.3	23.3		mg/L	8.2	20	13-SEP-19
WG3160415-2 LCS								
Bromide (Br)			98.4		%		85-115	13-SEP-19
WG3160415-1 MB								
Bromide (Br)			<5.0		mg/L		5	13-SEP-19
ANIONS-C-CL-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Chloride (Cl)		7270	6620		mg/L	9.4	20	13-SEP-19
WG3160415-2 LCS								
Chloride (Cl)			98.8		%		90-110	13-SEP-19
WG3160415-1 MB								
Chloride (Cl)			<50		mg/L		50	13-SEP-19
ANIONS-C-F-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Fluoride (F)		<1.0	<1.0	RPD-NA	mg/L	N/A	20	13-SEP-19
WG3160415-2 LCS								
Fluoride (F)			100.1		%		90-110	13-SEP-19
WG3160415-1 MB								
Fluoride (F)			<1.0		mg/L		1	13-SEP-19
ANIONS-C-NO2-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Nitrite (as N)		0.12	<0.10	RPD-NA	mg/L	N/A	20	13-SEP-19
WG3160415-2 LCS								
Nitrite (as N)			98.6		%		90-110	13-SEP-19
WG3160415-1 MB								
Nitrite (as N)			<0.10		mg/L		0.1	13-SEP-19
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Nitrate (as N)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	13-SEP-19
WG3160415-2 LCS								
Nitrate (as N)			99.6		%		90-110	13-SEP-19
WG3160415-1 MB								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	13-SEP-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4811270								
WG3160415-3 DUP		**L2344898-1**						
Sulfate (SO4)		1030	924		mg/L	11	20	13-SEP-19
WG3160415-2 LCS								
Sulfate (SO4)			99.6		%		90-110	13-SEP-19
WG3160415-1 MB								
Sulfate (SO4)			<30		mg/L		30	13-SEP-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4808430								
WG3160941-3 DUP		**L2344898-1**						
Total Organic Carbon		1.06	1.13		mg/L	5.9	20	13-SEP-19
WG3160941-2 LCS								
Total Organic Carbon			97.4		%		80-120	13-SEP-19
WG3160941-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	13-SEP-19
WG3160941-4 MS		**L2344898-2**						
Total Organic Carbon			105.7		%		70-130	13-SEP-19
EC-C-PCT-VA	**Seawater**							
Batch R4808591								
WG3160435-4 DUP		**L2344898-1**						
Conductivity		20700	20800		uS/cm	0.5	10	14-SEP-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4812188								
WG3163184-3 DUP		**L2344898-1**						
Mercury (Hg)-Dissolved		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	16-SEP-19
WG3163184-2 LCS								
Mercury (Hg)-Dissolved			96.1		%		80-120	16-SEP-19
WG3163184-1 MB								
Mercury (Hg)-Dissolved			<0.000005C		mg/L		0.000005	16-SEP-19
WG3163184-4 MS		**L2344898-2**						
Mercury (Hg)-Dissolved			96.1		%		70-130	16-SEP-19
HG-TOT-C-CVAFS-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4812188								
WG3163282-14 DUP		**L2344898-2**						
Mercury (Hg)-Total		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	16-SEP-19
WG3163282-2 LCS								
Mercury (Hg)-Total			97.0		%		80-120	16-SEP-19
WG3163282-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	16-SEP-19
WG3163282-13 MS		**L2344898-1**						
Mercury (Hg)-Total			98.6		%		70-130	16-SEP-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-3 DUP		**L2344898-1**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	14-SEP-19
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Arsenic (As)-Dissolved		0.00067	0.00064		mg/L	3.9	20	14-SEP-19
Barium (Ba)-Dissolved		0.0067	0.0073		mg/L	9.7	20	14-SEP-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Boron (B)-Dissolved		1.74	1.83		mg/L	4.8	20	14-SEP-19
Cadmium (Cd)-Dissolved		0.000013	<0.000010	RPD-NA	mg/L	N/A	20	14-SEP-19
Calcium (Ca)-Dissolved		176	172		mg/L	2.6	20	14-SEP-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Copper (Cu)-Dissolved		0.00034	0.00035		mg/L	2.8	20	14-SEP-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	14-SEP-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Lithium (Li)-Dissolved		0.068	0.068		mg/L	0.2	20	14-SEP-19
Magnesium (Mg)-Dissolved		461	475		mg/L	2.9	20	14-SEP-19
Manganese (Mn)-Dissolved		0.00056	0.00053		mg/L	5.1	20	14-SEP-19
Molybdenum (Mo)-Dissolved		0.00433	0.00439		mg/L	1.4	20	14-SEP-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	14-SEP-19
Potassium (K)-Dissolved		150	159		mg/L	5.6	20	14-SEP-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Rubidium (Rb)-Dissolved		0.0449	0.0451		mg/L	0.3	20	14-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-3 DUP		**L2344898-1**						
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	14-SEP-19
Strontium (Sr)-Dissolved		2.82	2.97		mg/L	5.2	20	14-SEP-19
Sulfur (S)-Dissolved		391	398		mg/L	1.7	20	14-SEP-19
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	14-SEP-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Uranium (U)-Dissolved		0.00286	0.00273		mg/L	4.6	20	14-SEP-19
Vanadium (V)-Dissolved		0.00056	0.00054		mg/L	3.2	20	14-SEP-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
WG3161329-2 LCS								
Aluminum (Al)-Dissolved			98.6		%		80-120	14-SEP-19
Antimony (Sb)-Dissolved			100.9		%		80-120	14-SEP-19
Arsenic (As)-Dissolved			103.9		%		80-120	14-SEP-19
Barium (Ba)-Dissolved			104.6		%		80-120	14-SEP-19
Beryllium (Be)-Dissolved			100.0		%		80-120	14-SEP-19
Bismuth (Bi)-Dissolved			107.3		%		80-120	14-SEP-19
Boron (B)-Dissolved			105.8		%		80-120	14-SEP-19
Cadmium (Cd)-Dissolved			112.3		%		80-120	14-SEP-19
Calcium (Ca)-Dissolved			94.7		%		80-120	14-SEP-19
Cesium (Cs)-Dissolved			104.4		%		80-120	14-SEP-19
Chromium (Cr)-Dissolved			102.1		%		80-120	14-SEP-19
Cobalt (Co)-Dissolved			103.2		%		80-120	14-SEP-19
Copper (Cu)-Dissolved			101.9		%		80-120	14-SEP-19
Gallium (Ga)-Dissolved			102.3		%		80-120	14-SEP-19
Iron (Fe)-Dissolved			99.8		%		80-120	14-SEP-19
Lead (Pb)-Dissolved			106.6		%		80-120	14-SEP-19
Lithium (Li)-Dissolved			99.5		%		80-120	14-SEP-19
Magnesium (Mg)-Dissolved			109.0		%		80-120	14-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-2 LCS								
Manganese (Mn)-Dissolved			101.4		%		80-120	14-SEP-19
Molybdenum (Mo)-Dissolved			103.1		%		80-120	14-SEP-19
Nickel (Ni)-Dissolved			104.4		%		80-120	14-SEP-19
Phosphorus (P)-Dissolved			102.1		%		80-120	14-SEP-19
Potassium (K)-Dissolved			99.6		%		80-120	14-SEP-19
Rhenium (Re)-Dissolved			105.6		%		80-120	14-SEP-19
Rubidium (Rb)-Dissolved			102.7		%		80-120	14-SEP-19
Selenium (Se)-Dissolved			110.0		%		80-120	14-SEP-19
Silver (Ag)-Dissolved			108.4		%		80-120	14-SEP-19
Strontium (Sr)-Dissolved			104.4		%		80-120	14-SEP-19
Sulfur (S)-Dissolved			99.7		%		80-120	14-SEP-19
Tellurium (Te)-Dissolved			111.6		%		80-120	14-SEP-19
Thallium (Tl)-Dissolved			103.4		%		80-120	14-SEP-19
Thorium (Th)-Dissolved			100.6		%		80-120	14-SEP-19
Tin (Sn)-Dissolved			103.9		%		80-120	14-SEP-19
Titanium (Ti)-Dissolved			99.2		%		80-120	14-SEP-19
Tungsten (W)-Dissolved			105.4		%		80-120	14-SEP-19
Uranium (U)-Dissolved			104.3		%		80-120	14-SEP-19
Vanadium (V)-Dissolved			100.1		%		80-120	14-SEP-19
Yttrium (Y)-Dissolved			99.2		%		80-120	14-SEP-19
Zinc (Zn)-Dissolved			100.4		%		80-120	14-SEP-19
Zirconium (Zr)-Dissolved			99.7		%		80-120	14-SEP-19
WG3161329-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	14-SEP-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	14-SEP-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	14-SEP-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	14-SEP-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	14-SEP-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	14-SEP-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	14-SEP-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-1 MB		**LF**						
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	14-SEP-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	14-SEP-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	14-SEP-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	14-SEP-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	14-SEP-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	14-SEP-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	14-SEP-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	14-SEP-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	14-SEP-19
Potassium (K)-Dissolved			<1.0		mg/L		1	14-SEP-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	14-SEP-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	14-SEP-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	14-SEP-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	14-SEP-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	14-SEP-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	14-SEP-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	14-SEP-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	14-SEP-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	14-SEP-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	14-SEP-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	14-SEP-19
WG3161329-4 MS		**L2344898-2**						
Aluminum (Al)-Dissolved			100.7		%		70-130	14-SEP-19
Antimony (Sb)-Dissolved			94.3		%		70-130	14-SEP-19
Arsenic (As)-Dissolved			94.2		%		70-130	14-SEP-19
Barium (Ba)-Dissolved			102.6		%		70-130	14-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-4 MS		**L2344898-2**						
Beryllium (Be)-Dissolved			93.0		%		70-130	14-SEP-19
Bismuth (Bi)-Dissolved			86.3		%		70-130	14-SEP-19
Boron (B)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Cadmium (Cd)-Dissolved			93.9		%		70-130	14-SEP-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Cesium (Cs)-Dissolved			96.4		%		70-130	14-SEP-19
Chromium (Cr)-Dissolved			99.3		%		70-130	14-SEP-19
Cobalt (Co)-Dissolved			92.3		%		70-130	14-SEP-19
Copper (Cu)-Dissolved			86.9		%		70-130	14-SEP-19
Gallium (Ga)-Dissolved			94.2		%		70-130	14-SEP-19
Iron (Fe)-Dissolved			97.6		%		70-130	14-SEP-19
Lead (Pb)-Dissolved			90.3		%		70-130	14-SEP-19
Lithium (Li)-Dissolved			91.5		%		70-130	14-SEP-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Manganese (Mn)-Dissolved			98.8		%		70-130	14-SEP-19
Molybdenum (Mo)-Dissolved			100.1		%		70-130	14-SEP-19
Nickel (Ni)-Dissolved			88.7		%		70-130	14-SEP-19
Phosphorus (P)-Dissolved			108.0		%		70-130	14-SEP-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Rhenium (Re)-Dissolved			99.97		%		70-130	14-SEP-19
Rubidium (Rb)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Selenium (Se)-Dissolved			98.0		%		70-130	14-SEP-19
Silver (Ag)-Dissolved			91.4		%		70-130	14-SEP-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	14-SEP-19
Tellurium (Te)-Dissolved			76.8		%		70-130	14-SEP-19
Thallium (Tl)-Dissolved			89.0		%		70-130	14-SEP-19
Thorium (Th)-Dissolved			102.0		%		70-130	14-SEP-19
Tin (Sn)-Dissolved			93.3		%		70-130	14-SEP-19
Titanium (Ti)-Dissolved			106.5		%		70-130	14-SEP-19
Tungsten (W)-Dissolved			99.3		%		70-130	14-SEP-19
Uranium (U)-Dissolved			99.9		%		70-130	14-SEP-19
Vanadium (V)-Dissolved			102.8		%		70-130	14-SEP-19
Yttrium (Y)-Dissolved			105.9		%		70-130	14-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4808548								
WG3161329-4 MS		**L2344898-2**						
Zinc (Zn)-Dissolved			78.9		%		70-130	14-SEP-19
Zirconium (Zr)-Dissolved			105.8		%		70-130	14-SEP-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4808548								
WG3161558-3 DUP		**L2344898-2**						
Aluminum (Al)-Total		0.0095	0.0104		mg/L	8.2	20	14-SEP-19
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Arsenic (As)-Total		0.00074	0.00078		mg/L	5.5	20	14-SEP-19
Barium (Ba)-Total		0.0078	0.0073		mg/L	6.2	20	14-SEP-19
Beryllium (Be)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Boron (B)-Total		1.75	1.84		mg/L	4.7	20	14-SEP-19
Cadmium (Cd)-Total		0.000015	0.000015		mg/L	3.7	20	14-SEP-19
Calcium (Ca)-Total		185	192		mg/L	4.2	20	14-SEP-19
Cesium (Cs)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Cobalt (Co)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Copper (Cu)-Total		0.00108	0.00110		mg/L	1.6	20	14-SEP-19
Gallium (Ga)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Iron (Fe)-Total		0.014	0.019	J	mg/L	0.005	0.02	14-SEP-19
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Lithium (Li)-Total		0.071	0.072		mg/L	2.4	20	14-SEP-19
Magnesium (Mg)-Total		511	515		mg/L	0.8	20	14-SEP-19
Manganese (Mn)-Total		0.00099	0.00104		mg/L	4.9	20	14-SEP-19
Molybdenum (Mo)-Total		0.00497	0.00496		mg/L	0.3	20	14-SEP-19
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	14-SEP-19
Potassium (K)-Total		169	168		mg/L	0.3	20	14-SEP-19
Rhenium (Re)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Rubidium (Rb)-Total		0.0493	0.0496		mg/L	0.6	20	14-SEP-19
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Silver (Ag)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	14-SEP-19
Strontium (Sr)-Total		3.41	3.42		mg/L	0.2	20	14-SEP-19
Sulfur (S)-Total		445	447		mg/L	0.5	20	14-SEP-19

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4808548								
WG3161558-3 DUP		**L2344898-2**						
Tellurium (Te)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Thallium (Tl)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	14-SEP-19
Thorium (Th)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Titanium (Ti)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	14-SEP-19
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-19
Uranium (U)-Total		0.00253	0.00281		mg/L	11	20	14-SEP-19
Vanadium (V)-Total		0.00066	0.00064		mg/L	2.7	20	14-SEP-19
Yttrium (Y)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	14-SEP-19
Zirconium (Zr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	14-SEP-19
WG3161558-2 LCS								
Aluminum (Al)-Total			98.3		%		80-120	14-SEP-19
Antimony (Sb)-Total			106.2		%		80-120	14-SEP-19
Arsenic (As)-Total			101.8		%		80-120	14-SEP-19
Barium (Ba)-Total			100.4		%		80-120	14-SEP-19
Beryllium (Be)-Total			98.2		%		80-120	14-SEP-19
Bismuth (Bi)-Total			111.5		%		80-120	14-SEP-19
Boron (B)-Total			93.1		%		80-120	14-SEP-19
Cadmium (Cd)-Total			102.2		%		80-120	14-SEP-19
Calcium (Ca)-Total			88.2		%		80-120	14-SEP-19
Cesium (Cs)-Total			97.4		%		80-120	14-SEP-19
Chromium (Cr)-Total			97.3		%		80-120	14-SEP-19
Cobalt (Co)-Total			101.9		%		80-120	14-SEP-19
Copper (Cu)-Total			102.6		%		80-120	14-SEP-19
Gallium (Ga)-Total			105.8		%		80-120	14-SEP-19
Iron (Fe)-Total			101.3		%		80-120	14-SEP-19
Lead (Pb)-Total			109.2		%		80-120	14-SEP-19
Lithium (Li)-Total			90.4		%		80-120	14-SEP-19
Magnesium (Mg)-Total			95.4		%		80-120	14-SEP-19
Manganese (Mn)-Total			101.3		%		80-120	14-SEP-19
Molybdenum (Mo)-Total			98.2		%		80-120	14-SEP-19
Nickel (Ni)-Total			104.2		%		80-120	14-SEP-19
Phosphorus (P)-Total			98.7		%		80-120	14-SEP-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4808548								
WG3161558-2 LCS								
Potassium (K)-Total			98.9		%		80-120	14-SEP-19
Rhenium (Re)-Total			101.7		%		80-120	14-SEP-19
Rubidium (Rb)-Total			97.2		%		80-120	14-SEP-19
Selenium (Se)-Total			108.3		%		80-120	14-SEP-19
Silver (Ag)-Total			101.5		%		80-120	14-SEP-19
Strontium (Sr)-Total			97.1		%		80-120	14-SEP-19
Sulfur (S)-Total			103.0		%		80-120	14-SEP-19
Tellurium (Te)-Total			102.9		%		80-120	14-SEP-19
Thallium (Tl)-Total			108.7		%		80-120	14-SEP-19
Thorium (Th)-Total			104.5		%		80-120	14-SEP-19
Tin (Sn)-Total			97.0		%		80-120	14-SEP-19
Titanium (Ti)-Total			91.5		%		80-120	14-SEP-19
Tungsten (W)-Total			106.5		%		80-120	14-SEP-19
Uranium (U)-Total			109.9		%		80-120	14-SEP-19
Vanadium (V)-Total			97.2		%		80-120	14-SEP-19
Yttrium (Y)-Total			91.3		%		80-120	14-SEP-19
Zinc (Zn)-Total			101.4		%		80-120	14-SEP-19
Zirconium (Zr)-Total			92.8		%		80-120	14-SEP-19
WG3161558-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	14-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	14-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	14-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	14-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	14-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	14-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	14-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	14-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	14-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4808548								
WG3161558-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	14-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	14-SEP-19
Magnesium (Mg)-Total			<1.0		mg/L		1	14-SEP-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	14-SEP-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	14-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	14-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	14-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	14-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	14-SEP-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	14-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	14-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	14-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	14-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	14-SEP-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	14-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	14-SEP-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	14-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	14-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	14-SEP-19
WG3161558-4 MS		**L2344898-1**						
Aluminum (Al)-Total			99.5		%		70-130	14-SEP-19
Antimony (Sb)-Total			95.5		%		70-130	14-SEP-19
Arsenic (As)-Total			92.7		%		70-130	14-SEP-19
Barium (Ba)-Total			91.0		%		70-130	14-SEP-19
Beryllium (Be)-Total			89.4		%		70-130	14-SEP-19
Bismuth (Bi)-Total			87.6		%		70-130	14-SEP-19
Boron (B)-Total			N/A	MS-B	%		-	14-SEP-19
Cadmium (Cd)-Total			92.1		%		70-130	14-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4808548								
WG3161558-4 MS		**L2344898-1**						
Calcium (Ca)-Total			N/A	MS-B	%		-	14-SEP-19
Cesium (Cs)-Total			93.1		%		70-130	14-SEP-19
Chromium (Cr)-Total			94.9		%		70-130	14-SEP-19
Cobalt (Co)-Total			93.3		%		70-130	14-SEP-19
Copper (Cu)-Total			88.4		%		70-130	14-SEP-19
Gallium (Ga)-Total			105.0		%		70-130	14-SEP-19
Iron (Fe)-Total			99.9		%		70-130	14-SEP-19
Lead (Pb)-Total			91.5		%		70-130	14-SEP-19
Lithium (Li)-Total			84.4		%		70-130	14-SEP-19
Magnesium (Mg)-Total			N/A	MS-B	%		-	14-SEP-19
Manganese (Mn)-Total			100.4		%		70-130	14-SEP-19
Molybdenum (Mo)-Total			96.4		%		70-130	14-SEP-19
Nickel (Ni)-Total			91.1		%		70-130	14-SEP-19
Phosphorus (P)-Total			102.4		%		70-130	14-SEP-19
Potassium (K)-Total			N/A	MS-B	%		-	14-SEP-19
Rhenium (Re)-Total			88.6		%		70-130	14-SEP-19
Rubidium (Rb)-Total			N/A	MS-B	%		-	14-SEP-19
Selenium (Se)-Total			95.3		%		70-130	14-SEP-19
Silver (Ag)-Total			87.6		%		70-130	14-SEP-19
Strontium (Sr)-Total			N/A	MS-B	%		-	14-SEP-19
Sulfur (S)-Total			N/A	MS-B	%		-	14-SEP-19
Tellurium (Te)-Total			75.6		%		70-130	14-SEP-19
Thallium (Tl)-Total			88.4		%		70-130	14-SEP-19
Thorium (Th)-Total			103.0		%		70-130	14-SEP-19
Tin (Sn)-Total			88.2		%		70-130	14-SEP-19
Titanium (Ti)-Total			98.9		%		70-130	14-SEP-19
Tungsten (W)-Total			99.1		%		70-130	14-SEP-19
Uranium (U)-Total			97.5		%		70-130	14-SEP-19
Vanadium (V)-Total			101.7		%		70-130	14-SEP-19
Yttrium (Y)-Total			109.2		%		70-130	14-SEP-19
Zinc (Zn)-Total			79.8		%		70-130	14-SEP-19
Zirconium (Zr)-Total			98.3		%		70-130	14-SEP-19
NA-D-CCMS-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NA-D-CCMS-VA	**Seawater**							
Batch R4810411								
WG3161329-3 DUP		**L2344898-1**						
Sodium (Na)-Dissolved		4280	4280		mg/L	0.1	20	15-SEP-19
WG3161329-2 LCS								
Sodium (Na)-Dissolved			113.1		%		80-120	15-SEP-19
WG3161329-4 MS		**L2344898-2**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	15-SEP-19
NA-T-CCMS-VA	**Seawater**							
Batch R4810411								
WG3161558-3 DUP		**L2344898-2**						
Sodium (Na)-Total		4720	4690		mg/L	0.7	20	15-SEP-19
WG3161558-2 LCS								
Sodium (Na)-Total			110.3		%		80-120	15-SEP-19
WG3161558-1 MB								
Sodium (Na)-Total			3.0	B	mg/L		2.5	15-SEP-19
WG3161558-4 MS		**L2344898-1**						
Sodium (Na)-Total			N/A	MS-B	%		-	15-SEP-19
NH3-F-VA	**Seawater**							
Batch R4808500								
WG3160942-2 LCS								
Ammonia, Total (as N)			102.1		%		85-115	15-SEP-19
WG3160942-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	15-SEP-19
PH-C-PCT-VA	**Seawater**							
Batch R4808591								
WG3160435-4 DUP		**L2344898-1**						
pH		8.09	8.08	J	pH	0.01	0.3	14-SEP-19
SI-D-CCMS-VA	**Seawater**							
Batch R4810411								
WG3161329-3 DUP		**L2344898-1**						
Silicon (Si)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	15-SEP-19
WG3161329-2 LCS								
Silicon (Si)-Dissolved			107.6		%		80-120	15-SEP-19
WG3161329-1 MB		**LF**						
Silicon (Si)-Dissolved			<1.0		mg/L		1	15-SEP-19
WG3161329-4 MS		**L2344898-2**						
Silicon (Si)-Dissolved			95.4		%		70-130	15-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SI-T-CCMS-VA	**Seawater**							
Batch R4810411								
WG3161558-3 DUP		**L2344898-2**						
Silicon (Si)-Total		<1.0	<1.0	RPD-NA	mg/L	N/A	20	15-SEP-19
WG3161558-2 LCS								
Silicon (Si)-Total			99.8		%		80-120	15-SEP-19
WG3161558-1 MB								
Silicon (Si)-Total			<1.0		mg/L		1	15-SEP-19
WG3161558-4 MS		**L2344898-1**						
Silicon (Si)-Total			95.2		%		70-130	15-SEP-19
TKN-C-F-VA	**Seawater**							
Batch R4814640								
WG3160934-3 DUP		**L2344898-1**						
Total Kjeldahl Nitrogen		0.123	0.128		mg/L	3.9	20	16-SEP-19
WG3160934-2 LCS								
Total Kjeldahl Nitrogen			114.9		%		75-125	16-SEP-19
WG3160934-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	16-SEP-19
WG3160934-4 MS		**L2344898-2**						
Total Kjeldahl Nitrogen			107.1		%		70-130	16-SEP-19
TSS-C-VA	**Seawater**							
Batch R4814289								
WG3162580-2 LCS								
Total Suspended Solids			92.8		%		85-115	16-SEP-19
WG3162580-1 MB								
Total Suspended Solids			<2.0		mg/L		2	16-SEP-19
TURBIDITY-C-VA	**Seawater**							
Batch R4803834								
WG3160367-2 CRM		**VA-FORM-40**						
Turbidity			105.3		%		85-115	13-SEP-19
WG3160367-1 MB								
Turbidity			<0.10		NTU		0.1	13-SEP-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated) (seawater)							
	1	09-SEP-19 14:40	14-SEP-19 15:40	0.25	121	hours	EHTR-FM
	2	09-SEP-19 14:25	14-SEP-19 15:40	0.25	121	hours	EHTR-FM
	3	09-SEP-19 14:10	14-SEP-19 15:40	0.25	121	hours	EHTR-FM
	4	09-SEP-19 14:35	14-SEP-19 15:40	0.25	121	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Seawater by IC							
	1	09-SEP-19 14:40	13-SEP-19 09:28	3	4	days	EHT
	2	09-SEP-19 14:25	13-SEP-19 09:28	3	4	days	EHT
	3	09-SEP-19 14:10	13-SEP-19 09:28	3	4	days	EHT
	4	09-SEP-19 14:35	13-SEP-19 09:28	3	4	days	EHT
Nitrite in Seawater by IC							
	1	09-SEP-19 14:40	13-SEP-19 09:28	3	4	days	EHT
	2	09-SEP-19 14:25	13-SEP-19 09:28	3	4	days	EHT
	3	09-SEP-19 14:10	13-SEP-19 09:28	3	4	days	EHT
	4	09-SEP-19 14:35	13-SEP-19 09:28	3	4	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2344898 were received on 11-SEP-19 09:30.

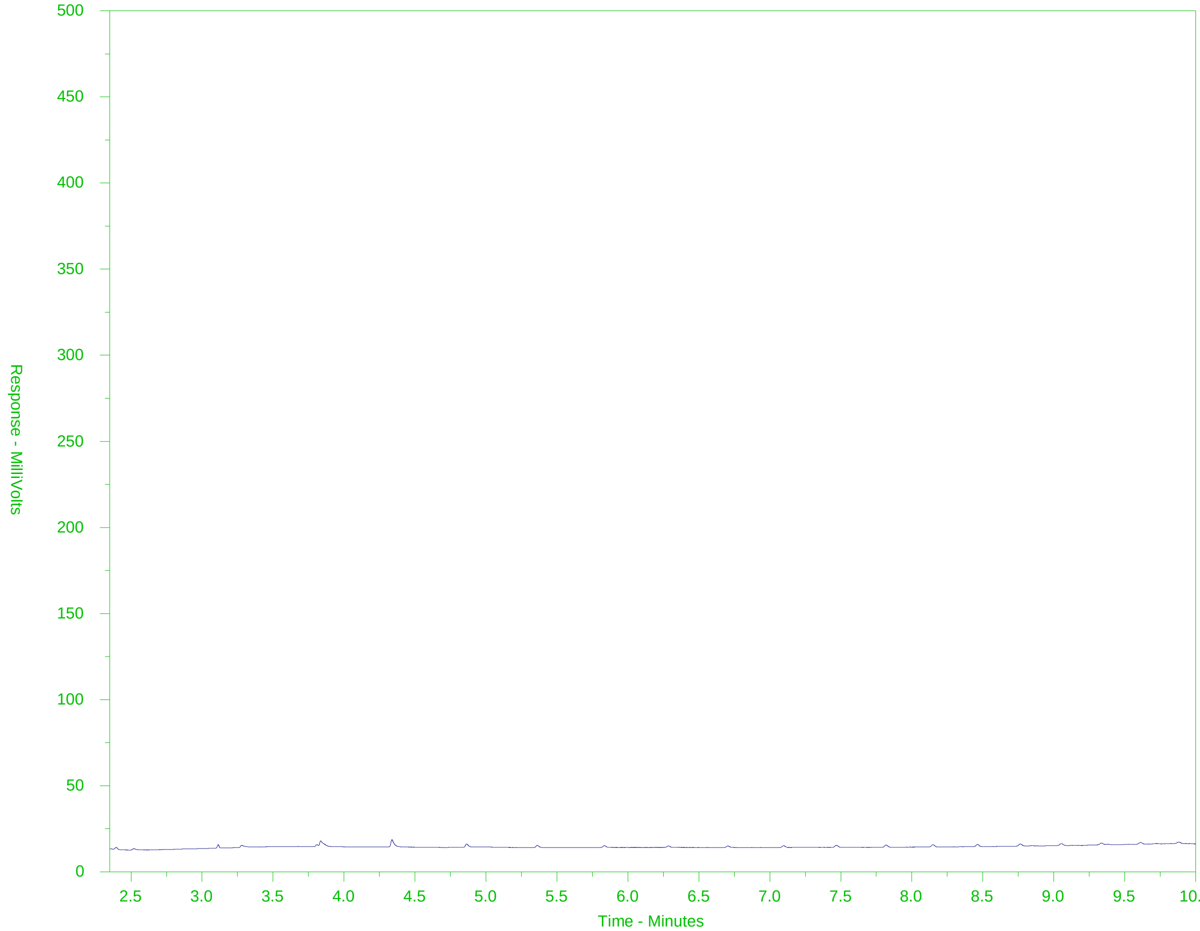
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2344898-1
Client Sample ID: SOURCE-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

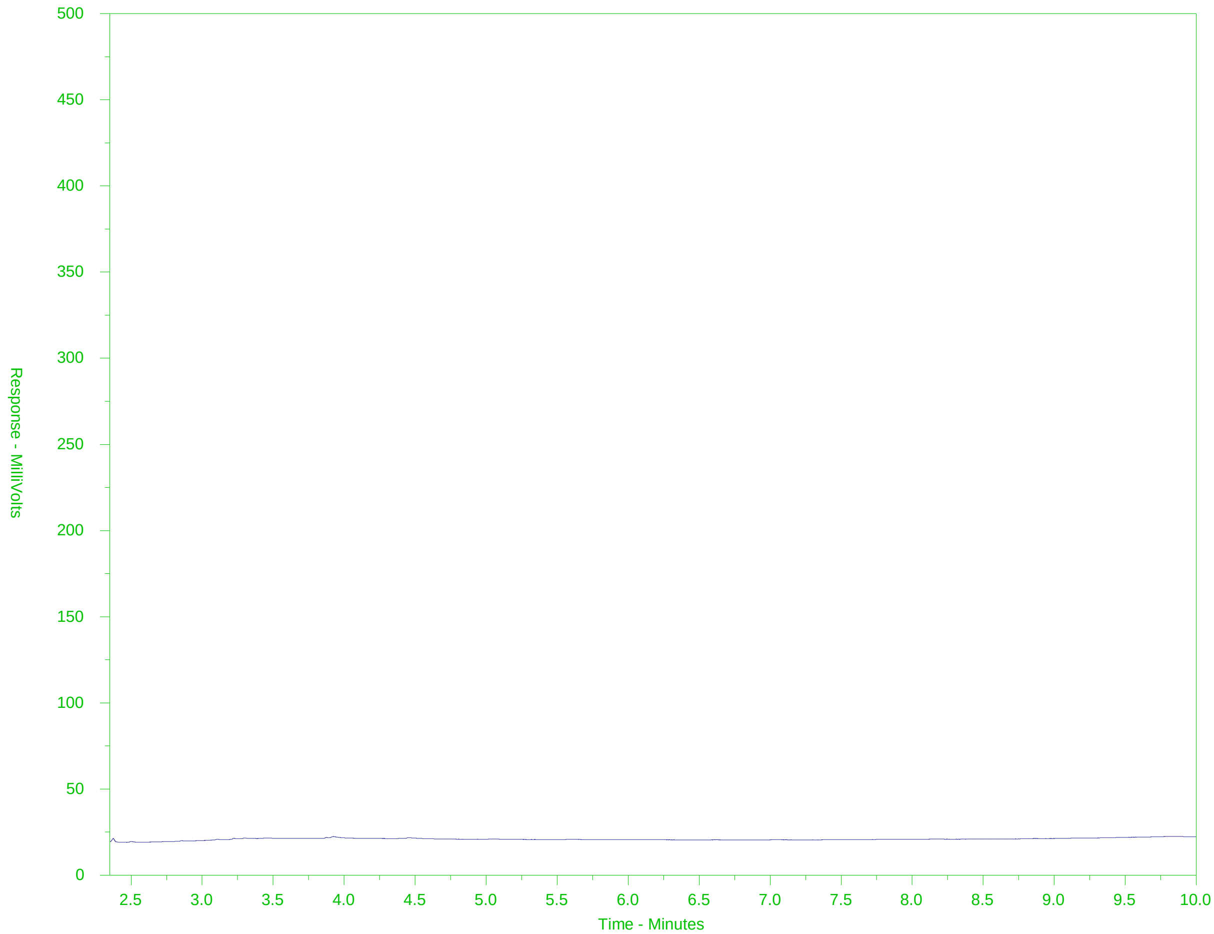
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2344898-2
Client Sample ID: WNW-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

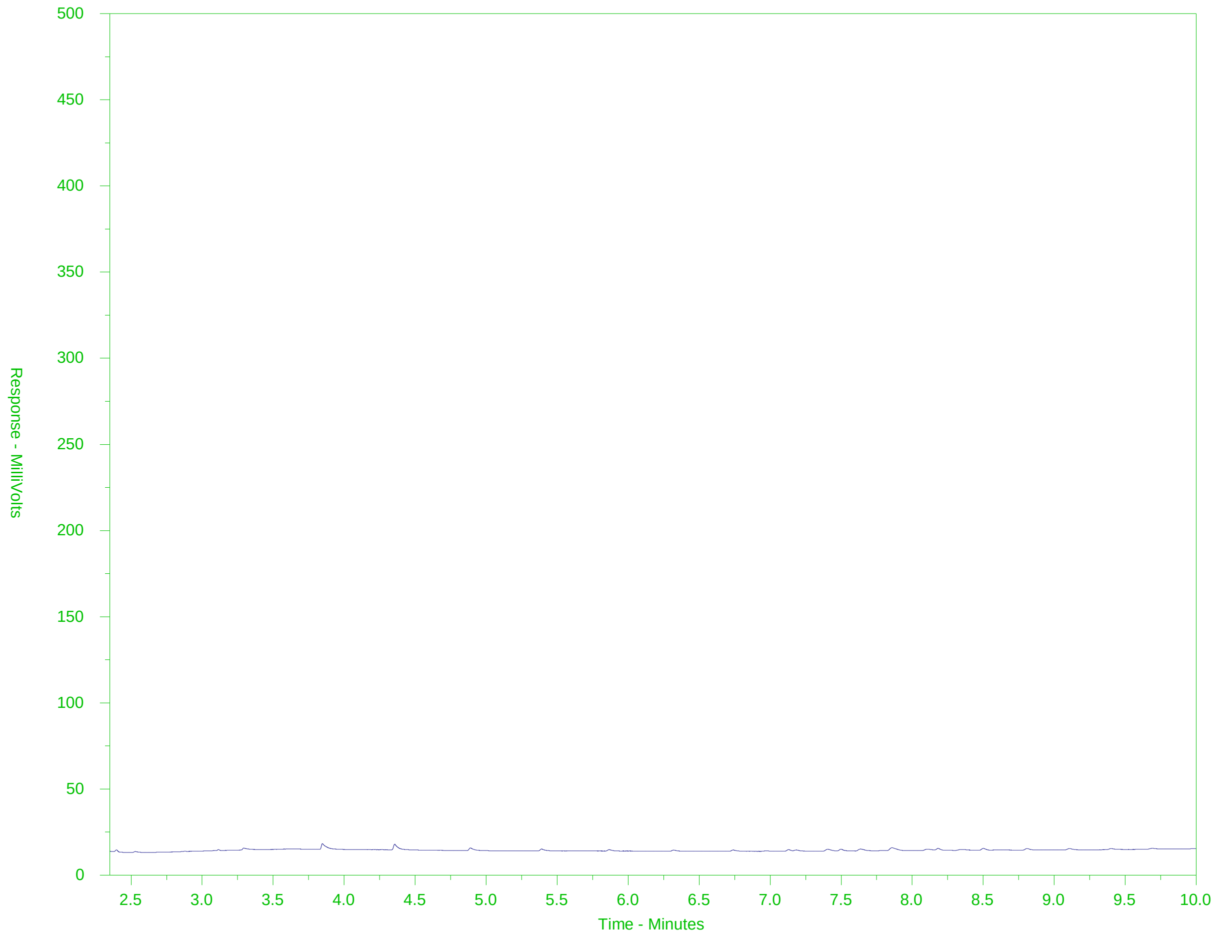
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2344898-3
Client Sample ID: NORTH-4



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

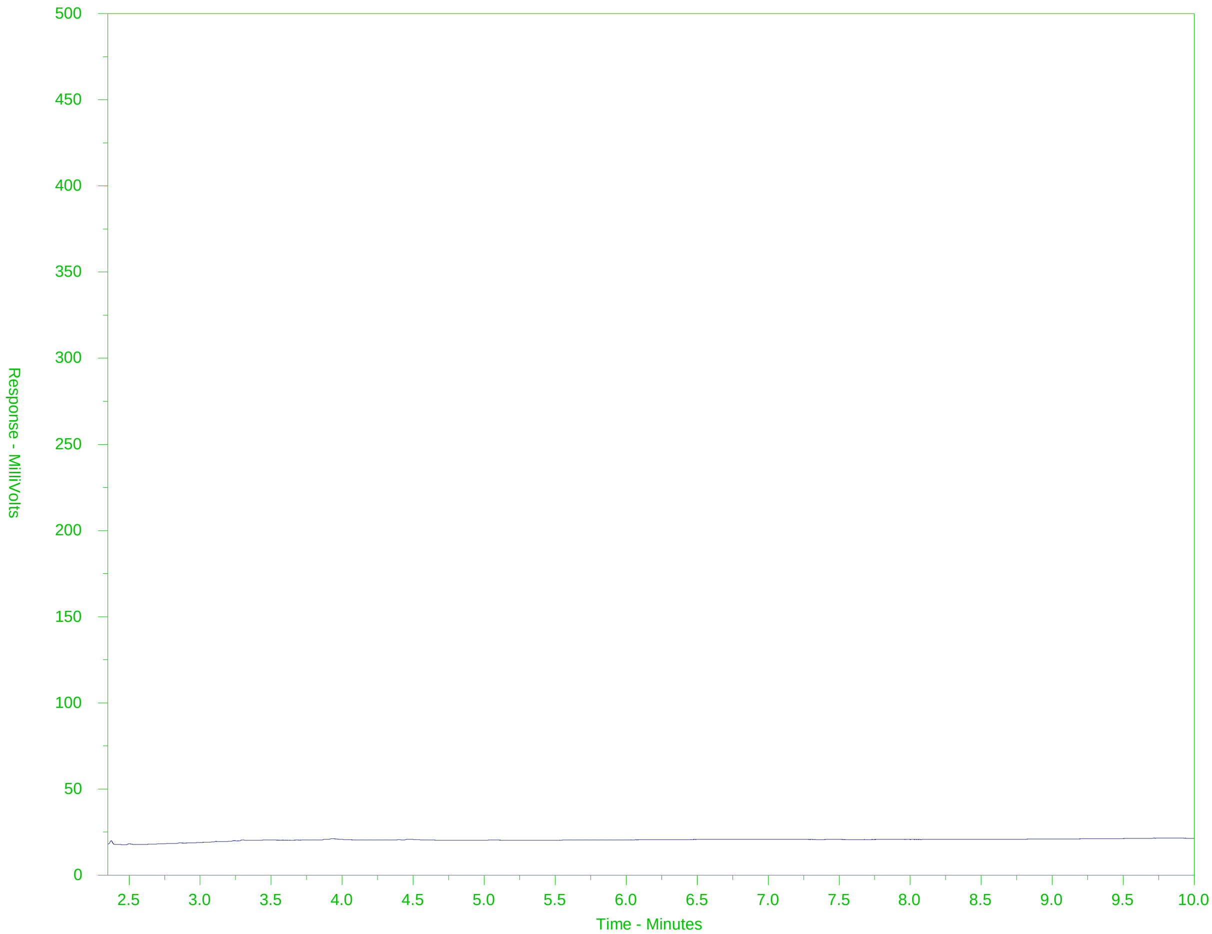
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2344898-4
Client Sample ID: ENE-4



← EPH10-19 →		← EPH19-32 →
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2344898-COFC

COC Number: 17 - 697665

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Phil Rouget
Phone:	250 888 1100
	Company address below will appear on the final report
Street:	2nd Floor, 3795 Carey Rd
City/Province:	Victoria BC
Postal Code:	V8Z 6T8
Invoice To	Same as Report To [✓] YES [ ] NO
	Copy of Invoice with Report [ ] YES [✓] NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: [✓] PDF [✓] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [ ] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [✓] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: prouget@golder.com
Email 2: Patricia_Tomliens@golder.c...
Email 3:

Invoice Distribution

Select Invoice Distribution: [✓] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax
Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [✓] Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days): 4 day [P4-20%] [ ] 3 day [P3-25%] [ ] 2 day [P2-50%] [ ]
EMERGENCY: 1 Business day [E-100%] [ ] Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
Date and Time Required for all E&P TATs:
For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:
Job #: 1663724-24000
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L2344898 AP
ALS Contact:
Sampler: MA / LL / AK

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers	General	TOC, Ammonia, TKN (P)	Dissolved Metals	Total Metals (P)	Dissolved Hg	Total Hg (P)	Hydrocarbons (P)	Fecal Coliform (P)	Samples on Hold	Sample is hazardous (please provide further details)	Number of Containers
	Source - 4	09-Sept2019	14:40	Seawater	9	X	X	X	X	X	X	X	X			9
	WNW - 4	09-Sept2019	14:25	Seawater	9	X	X	X	X	X	X	X	X			9
	North - 4	09-Sept2019	14:10	Seawater	9	X	X	X	X	X	X	X	X			9
	ENE - 4	09-Sept2019	14:35	Seawater	9	X	X	X	X	X	X	X	X			9

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [✓] NO
Are samples for human consumption/ use? [ ] YES [✓] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]
Ice Pack [✓] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]
INITIAL COOLER TEMPERATURES °C:
FINAL COOLER TEMPERATURES °C: 10.9

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Dominic Ritgen	Date: 9-Sept-19	Time: 16:10	Received by:	Date:	Time:	Received by: AP	Date: 11-Sept-19	Time: 9:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

JG 12Sep 19 9:20AM
8°C

White Paper Co. 604 951-3900

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 25-SEP-19
Report Date: 02-OCT-19 16:14 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2353810

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724-24000
C of C Numbers: 15-560001
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2353810-1	L2353810-2	L2353810-3	L2353810-4	L2353810-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	23-SEP-19	23-SEP-19	23-SEP-19	23-SEP-19	23-SEP-19
	Sampled Time	13:30	13:50	14:10	16:20	14:55
	Client ID	WNW-5	NORTH-5	ENE-5	SOURCE-5	EQUIP-BLANK
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	34900	38100	36500	36100	276
	pH (pH)	7.96	7.93	7.96	7.96	6.10
	Salinity (psu)	22.1	24.4	23.2	23.0	<1.0
	Total Suspended Solids (mg/L)	<2.0	2.2	2.6	<2.0	<2.0
	Turbidity (NTU)	0.33	0.26	0.30	0.31	RRV 0.22
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	107	105	107	106	1.7
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0055	<0.0050	<0.0050
	Bromide (Br) (mg/L)	43.7	45.2	44.9	43.7	<5.0
	Chloride (Cl) (mg/L)	12700	13200	12900	12700	RRV 105
	Fluoride (F) (mg/L)	<1.0	1.0	<1.0	<1.0	<1.0
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Total Kjeldahl Nitrogen (mg/L)	0.098	0.090	0.082	0.092	<0.050
	Sulfate (SO4) (mg/L)	1750	1820	1760	1730	<30
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.11	0.96	1.00	0.97	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0078	0.0116	0.0096	0.0105	<0.0050
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Total (mg/L)	0.00103	0.00122	0.00119	0.00108	<0.00040
	Barium (Ba)-Total (mg/L)	0.0081	0.0088	0.0084	0.0085	<0.0010
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	3.24	3.52	3.48	3.49	<0.30
	Cadmium (Cd)-Total (mg/L)	0.000037	0.000039	0.000041	0.000038	<0.000010
	Calcium (Ca)-Total (mg/L)	271	309	279	285	<1.0
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Total (mg/L)	0.00174	0.00460	0.00533	0.00587	0.00079
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.013	0.016	0.016	0.019	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	0.000067	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.097	0.108	0.102	0.104	<0.020
	Magnesium (Mg)-Total (mg/L)	784	891	830	849	<1.0
	Manganese (Mn)-Total (mg/L)	0.00093	0.00123	0.00159	0.00114	<0.00020
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00728	0.00754	0.00757	0.00757	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2353810-1 Seawater 23-SEP-19 13:30 WNW-5	L2353810-2 Seawater 23-SEP-19 13:50 NORTH-5	L2353810-3 Seawater 23-SEP-19 14:10 ENE-5	L2353810-4 Seawater 23-SEP-19 16:20 SOURCE-5	L2353810-5 Seawater 23-SEP-19 14:55 EQUIP-BLANK
Grouping	**Analyte**					
SEAWATER						
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	255	288	275	278	<1.0
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Total (mg/L)	0.0651	0.0757	0.0700	0.0711	<0.0050
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	6840	7820	7320	7850	8.9
	Strontium (Sr)-Total (mg/L)	4.95	5.42	5.38	5.15	<0.010
	Sulfur (S)-Total (mg/L)	672	718	669	717	<5.0
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Total (mg/L)	0.00241	0.00251	0.00260	0.00258	<0.000050
	Vanadium (V)-Total (mg/L)	0.00105	0.00119	0.00111	0.00119	<0.00050
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0043	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	LAB
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Dissolved (mg/L)	0.00111	0.00123	0.00114	0.00116	<0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0080	0.0087	0.0082	0.0088	<0.0010
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	3.13	3.64	3.48	3.38	<0.30
	Cadmium (Cd)-Dissolved (mg/L)	0.000041	0.000032	0.000038	0.000026	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	269	317	282	285	<1.0
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Dissolved (mg/L)	0.00073	0.00246	0.00186	0.00131	0.00023

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2353810-1 Seawater 23-SEP-19 13:30 WNW-5	L2353810-2 Seawater 23-SEP-19 13:50 NORTH-5	L2353810-3 Seawater 23-SEP-19 14:10 ENE-5	L2353810-4 Seawater 23-SEP-19 16:20 SOURCE-5	L2353810-5 Seawater 23-SEP-19 14:55 EQUIP-BLANK
Grouping	**Analyte**					
SEAWATER						
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.102	0.109	0.105	0.106	<0.020
	Magnesium (Mg)-Dissolved (mg/L)	811	919	885	873	<1.0
	Manganese (Mn)-Dissolved (mg/L)	0.00060	0.00069	0.00122	0.00065	<0.00010
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00711	0.00805	0.00769	0.00765	<0.00010
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	265	300	284	286	<1.0
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.0700	0.0781	0.0745	0.0754	<0.0050
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	6900	7140	7170	7120	8.6
	Strontium (Sr)-Dissolved (mg/L)	4.91	5.82	5.30	5.48	<0.010
	Sulfur (S)-Dissolved (mg/L)	618	800	722	741	<5.0
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00264	0.00236	0.00258	0.00248	<0.000050
	Vanadium (V)-Dissolved (mg/L)	0.00096	0.00106	0.00100	0.00102	<0.00050
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0011	0.0043	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2353810-1	L2353810-2	L2353810-3	L2353810-4	L2353810-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	23-SEP-19	23-SEP-19	23-SEP-19	23-SEP-19	23-SEP-19
	Sampled Time	13:30	13:50	14:10	16:20	14:55
	Client ID	WNW-5	NORTH-5	ENE-5	SOURCE-5	EQUIP-BLANK
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	1 PEHR	<1 PEHR	2 PEHR	1 PEHR	<1 PEHR
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	102.2	98.6	105.3	94.5	121.4
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acridine d9 (%)	124.4	122.1	119.3	116.9	119.1
	Surrogate: Chrysene d12 (%)	121.3	121.4	120.8	121.0	138.6 SURR-ND
	Surrogate: Naphthalene d8 (%)	124.4	122.6	119.2	118.4	130.0
	Surrogate: Phenanthrene d10 (%)	127.5	127.7	125.8	126.0	130.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Vanadium (V)-Total	B	L2353810-5
Laboratory Control Sample	Boron (B)-Dissolved	MES	L2353810-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2353810-5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2353810-5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2353810-5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2353810-5
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2353810-5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2353810-5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2353810-5
Matrix Spike	Boron (B)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2353810-5
Matrix Spike	Sodium (Na)-Total	MS-B	L2353810-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2353810-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
RRV	Reported Result Verified By Repeat Analysis
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA Seawater Chloride by IC (seawater) EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA Seawater Fluoride by IC (seawater) EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA Seawater Nitrite in Seawater by IC EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-C-NO3-IC-VA Seawater Nitrate in Seawater by IC EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA Seawater Sulfate by IC (seawater) EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA Seawater TOC by combustion (seawater) APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA Seawater Conductivity (Automated) (seawater) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-ME-FID-VA Water EPH in Water BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

FCOLI-MF-ENV-VA Water Fecal coliform by membrane filtration APHA METHOD 9222

This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation of the filter with the appropriate growth medium, positive results require further testing (up to an additional 48 hours) to confirm and quantify the total coliform. This method is used for non-turbid water with a low background bacteria level.

HG-DIS-C-CVAFS-VA Seawater Diss. Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Reference Information

NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA	Water	PAHs in Water	EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA	Seawater	Salinity by conductivity meter	APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TKN-C-F-VA	Seawater	TKN in Seawater by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-560001

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8
Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4851379								
WG3177072-2 LCS								
EPH10-19			101.6		%		70-130	01-OCT-19
EPH19-32			101.1		%		70-130	01-OCT-19
WG3177072-1 MB								
EPH10-19			<0.25		mg/L		0.25	01-OCT-19
EPH19-32			<0.25		mg/L		0.25	01-OCT-19
Surrogate: 2-Bromobenzotrifluoride			97.0		%		60-140	01-OCT-19
FCOLI-MF-ENV-VA	**Water**							
Batch R4848312								
WG3172128-2 MB								
Coliform Bacteria - Fecal			<1		CFU/100mL		1	25-SEP-19
PAH-ME-MS-VA	**Water**							
Batch R4847252								
WG3177072-2 LCS								
Acenaphthene			105.9		%		60-130	02-OCT-19
Acenaphthylene			107.0		%		60-130	02-OCT-19
Acridine			100.5		%		60-130	02-OCT-19
Anthracene			112.6		%		60-130	02-OCT-19
Benz(a)anthracene			115.9		%		60-130	02-OCT-19
Benzo(a)pyrene			109.9		%		60-130	02-OCT-19
Benzo(b&j)fluoranthene			98.9		%		60-130	02-OCT-19
Benzo(g,h,i)perylene			123.2		%		60-130	02-OCT-19
Benzo(k)fluoranthene			107.0		%		60-130	02-OCT-19
Chrysene			114.2		%		60-130	02-OCT-19
Dibenz(a,h)anthracene			120.6		%		60-130	02-OCT-19
Fluoranthene			115.0		%		60-130	02-OCT-19
Fluorene			110.2		%		60-130	02-OCT-19
Indeno(1,2,3-c,d)pyrene			129.1		%		60-130	02-OCT-19
1-Methylnaphthalene			94.6		%		60-130	02-OCT-19
2-Methylnaphthalene			94.5		%		60-130	02-OCT-19
Naphthalene			88.4		%		50-130	02-OCT-19
Phenanthrene			117.6		%		60-130	02-OCT-19
Pyrene			119.4		%		60-130	02-OCT-19
Quinoline			114.7		%		60-130	02-OCT-19
WG3177072-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4847252								
WG3177072-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	02-OCT-19
Acenaphthylene			<0.000010		mg/L		0.00001	02-OCT-19
Acridine			<0.000010		mg/L		0.00001	02-OCT-19
Anthracene			<0.000010		mg/L		0.00001	02-OCT-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	02-OCT-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	02-OCT-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	02-OCT-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	02-OCT-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	02-OCT-19
Chrysene			<0.000010		mg/L		0.00001	02-OCT-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	02-OCT-19
Fluoranthene			<0.000010		mg/L		0.00001	02-OCT-19
Fluorene			<0.000010		mg/L		0.00001	02-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	02-OCT-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	02-OCT-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	02-OCT-19
Naphthalene			<0.000050		mg/L		0.00005	02-OCT-19
Phenanthrene			<0.000020		mg/L		0.00002	02-OCT-19
Pyrene			<0.000010		mg/L		0.00001	02-OCT-19
Quinoline			<0.000050		mg/L		0.00005	02-OCT-19
Surrogate: Acridine d9			100.6		%		60-130	02-OCT-19
Surrogate: Chrysene d12			107.0		%		60-130	02-OCT-19
Surrogate: Naphthalene d8			113.5		%		50-130	02-OCT-19
Surrogate: Phenanthrene d10			115.4		%		60-130	02-OCT-19
ALK-TITR-VA	**Seawater**							
Batch R4850047								
WG3172885-4 DUP		**L2353810-1**						
Alkalinity, Total (as CaCO3)		107	106		mg/L	1.4	20	27-SEP-19
WG3172885-3 LCS								
Alkalinity, Total (as CaCO3)			98.5		%		70-130	27-SEP-19
WG3172885-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	27-SEP-19
ANIONS-C-BR-IC-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Bromide (Br)		45.2	47.7		mg/L	5.3	20	25-SEP-19
WG3172880-2 LCS								
Bromide (Br)			99.5		%		85-115	25-SEP-19
WG3172880-1 MB								
Bromide (Br)			<5.0		mg/L		5	25-SEP-19
ANIONS-C-CL-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Chloride (Cl)		13200	14000		mg/L	5.8	20	25-SEP-19
WG3172880-2 LCS								
Chloride (Cl)			105.7		%		90-110	25-SEP-19
WG3172880-1 MB								
Chloride (Cl)			<50		mg/L		50	25-SEP-19
ANIONS-C-F-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Fluoride (F)		1.0	<1.0	RPD-NA	mg/L	N/A	20	25-SEP-19
WG3172880-2 LCS								
Fluoride (F)			101.3		%		90-110	25-SEP-19
WG3172880-1 MB								
Fluoride (F)			<1.0		mg/L		1	25-SEP-19
ANIONS-C-NO2-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Nitrite (as N)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	25-SEP-19
WG3172880-2 LCS								
Nitrite (as N)			101.1		%		90-110	25-SEP-19
WG3172880-1 MB								
Nitrite (as N)			<0.10		mg/L		0.1	25-SEP-19
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Nitrate (as N)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	25-SEP-19
WG3172880-2 LCS								
Nitrate (as N)			107.1		%		90-110	25-SEP-19
WG3172880-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	25-SEP-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4850702								
WG3172880-3 DUP		**L2353810-2**						
Sulfate (SO4)		1820	1930		mg/L	6.1	20	25-SEP-19
WG3172880-2 LCS								
Sulfate (SO4)			106.8		%		90-110	25-SEP-19
WG3172880-1 MB								
Sulfate (SO4)			<30		mg/L		30	25-SEP-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4850008								
WG3174890-3 DUP		**L2353810-1**						
Total Organic Carbon		1.11	1.08		mg/L	2.5	20	27-SEP-19
WG3174890-2 LCS								
Total Organic Carbon			99.0		%		80-120	27-SEP-19
WG3174890-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	27-SEP-19
WG3174890-4 MS		**L2353810-2**						
Total Organic Carbon			96.4		%		70-130	27-SEP-19
EC-C-PCT-VA	**Seawater**							
Batch R4850047								
WG3172885-4 DUP		**L2353810-1**						
Conductivity		34900	35000		uS/cm	0.3	10	27-SEP-19
WG3172885-1 MB								
Conductivity			<2.0		uS/cm		2	27-SEP-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4847972								
WG3174088-2 LCS								
Mercury (Hg)-Dissolved			100.7		%		80-120	27-SEP-19
WG3174088-6 LCS								
Mercury (Hg)-Dissolved			99.8		%		80-120	27-SEP-19
WG3174088-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	27-SEP-19
WG3174088-5 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	27-SEP-19
	Seawater							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4847972								
WG3174710-5 DUP		**L2353810-2**						
Mercury (Hg)-Total		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	27-SEP-19
WG3174710-2 LCS								
Mercury (Hg)-Total			98.4		%		80-120	27-SEP-19
WG3174710-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	27-SEP-19
WG3174710-6 MS		**L2353810-1**						
Mercury (Hg)-Total			97.0		%		70-130	27-SEP-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-3 DUP		**L2353810-1**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	26-SEP-19
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	26-SEP-19
Arsenic (As)-Dissolved		0.00111	0.00105		mg/L	5.6	20	26-SEP-19
Barium (Ba)-Dissolved		0.0080	0.0084		mg/L	3.8	20	26-SEP-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Boron (B)-Dissolved		3.13	3.29		mg/L	4.9	20	26-SEP-19
Cadmium (Cd)-Dissolved		0.000041	0.000030	J	mg/L	0.000011	0.00002	26-SEP-19
Calcium (Ca)-Dissolved		269	278		mg/L	3.2	20	26-SEP-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	26-SEP-19
Copper (Cu)-Dissolved		0.00073	0.00073		mg/L	0.2	20	26-SEP-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	26-SEP-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	26-SEP-19
Lithium (Li)-Dissolved		0.102	0.102		mg/L	0.5	20	26-SEP-19
Magnesium (Mg)-Dissolved		811	832		mg/L	2.6	20	26-SEP-19
Manganese (Mn)-Dissolved		0.00060	0.00057		mg/L	5.0	20	26-SEP-19
Molybdenum (Mo)-Dissolved		0.00711	0.00734		mg/L	3.2	20	26-SEP-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	26-SEP-19
Potassium (K)-Dissolved		265	269		mg/L	1.5	20	26-SEP-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Rubidium (Rb)-Dissolved		0.0700	0.0700		mg/L	0.0	20	26-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-3 DUP		**L2353810-1**						
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	26-SEP-19
Strontium (Sr)-Dissolved		4.91	5.18		mg/L	5.3	20	26-SEP-19
Sulfur (S)-Dissolved		618	627		mg/L	1.4	20	26-SEP-19
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	26-SEP-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	26-SEP-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	26-SEP-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	26-SEP-19
Uranium (U)-Dissolved		0.00264	0.00253		mg/L	4.3	20	26-SEP-19
Vanadium (V)-Dissolved		0.00096	0.00097		mg/L	0.7	20	26-SEP-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
Zinc (Zn)-Dissolved		0.0011	<0.0010	RPD-NA	mg/L	N/A	20	26-SEP-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-SEP-19
WG3172841-2 LCS								
Aluminum (Al)-Dissolved			99.97		%		80-120	26-SEP-19
Antimony (Sb)-Dissolved			94.6		%		80-120	26-SEP-19
Arsenic (As)-Dissolved			96.8		%		80-120	26-SEP-19
Barium (Ba)-Dissolved			104.4		%		80-120	26-SEP-19
Beryllium (Be)-Dissolved			99.4		%		80-120	26-SEP-19
Bismuth (Bi)-Dissolved			113.0		%		80-120	26-SEP-19
Boron (B)-Dissolved			128.8	MES	%		80-120	26-SEP-19
Cadmium (Cd)-Dissolved			97.5		%		80-120	26-SEP-19
Calcium (Ca)-Dissolved			93.1		%		80-120	26-SEP-19
Cesium (Cs)-Dissolved			97.2		%		80-120	26-SEP-19
Chromium (Cr)-Dissolved			98.9		%		80-120	26-SEP-19
Cobalt (Co)-Dissolved			100.7		%		80-120	26-SEP-19
Copper (Cu)-Dissolved			98.9		%		80-120	26-SEP-19
Gallium (Ga)-Dissolved			95.8		%		80-120	26-SEP-19
Iron (Fe)-Dissolved			95.8		%		80-120	26-SEP-19
Lead (Pb)-Dissolved			104.7		%		80-120	26-SEP-19
Lithium (Li)-Dissolved			95.5		%		80-120	26-SEP-19
Magnesium (Mg)-Dissolved			103.1		%		80-120	26-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-2 LCS								
Manganese (Mn)-Dissolved			99.0		%		80-120	26-SEP-19
Molybdenum (Mo)-Dissolved			96.8		%		80-120	26-SEP-19
Nickel (Ni)-Dissolved			100.5		%		80-120	26-SEP-19
Phosphorus (P)-Dissolved			102.8		%		80-120	26-SEP-19
Potassium (K)-Dissolved			113.0		%		80-120	26-SEP-19
Rhenium (Re)-Dissolved			102.4		%		80-120	26-SEP-19
Rubidium (Rb)-Dissolved			96.5		%		80-120	26-SEP-19
Selenium (Se)-Dissolved			106.2		%		80-120	26-SEP-19
Silver (Ag)-Dissolved			98.8		%		80-120	26-SEP-19
Strontium (Sr)-Dissolved			95.1		%		80-120	26-SEP-19
Sulfur (S)-Dissolved			106.7		%		80-120	26-SEP-19
Tellurium (Te)-Dissolved			103.5		%		80-120	26-SEP-19
Thallium (Tl)-Dissolved			103.6		%		80-120	26-SEP-19
Thorium (Th)-Dissolved			92.3		%		80-120	26-SEP-19
Tin (Sn)-Dissolved			94.9		%		80-120	26-SEP-19
Titanium (Ti)-Dissolved			96.2		%		80-120	26-SEP-19
Tungsten (W)-Dissolved			103.9		%		80-120	26-SEP-19
Uranium (U)-Dissolved			96.3		%		80-120	26-SEP-19
Vanadium (V)-Dissolved			96.1		%		80-120	26-SEP-19
Yttrium (Y)-Dissolved			95.5		%		80-120	26-SEP-19
Zinc (Zn)-Dissolved			103.2		%		80-120	26-SEP-19
Zirconium (Zr)-Dissolved			88.4		%		80-120	26-SEP-19
WG3172841-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	26-SEP-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	26-SEP-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	26-SEP-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	26-SEP-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	26-SEP-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	26-SEP-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	26-SEP-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-1 MB		**LF**						
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	26-SEP-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	26-SEP-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	26-SEP-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	26-SEP-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	26-SEP-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	26-SEP-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	26-SEP-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	26-SEP-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	26-SEP-19
Potassium (K)-Dissolved			<1.0		mg/L		1	26-SEP-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	26-SEP-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	26-SEP-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	26-SEP-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	26-SEP-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	26-SEP-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	26-SEP-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	26-SEP-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	26-SEP-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	26-SEP-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	26-SEP-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	26-SEP-19
WG3172841-4 MS		**L2353810-2**						
Aluminum (Al)-Dissolved			103.2		%		70-130	26-SEP-19
Antimony (Sb)-Dissolved			102.8		%		70-130	26-SEP-19
Arsenic (As)-Dissolved			95.0		%		70-130	26-SEP-19
Barium (Ba)-Dissolved			104.3		%		70-130	26-SEP-19

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-4 MS		**L2353810-2**						
Beryllium (Be)-Dissolved			97.4		%		70-130	26-SEP-19
Bismuth (Bi)-Dissolved			85.7		%		70-130	26-SEP-19
Boron (B)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Cadmium (Cd)-Dissolved			92.0		%		70-130	26-SEP-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Cesium (Cs)-Dissolved			99.4		%		70-130	26-SEP-19
Chromium (Cr)-Dissolved			99.8		%		70-130	26-SEP-19
Cobalt (Co)-Dissolved			94.1		%		70-130	26-SEP-19
Copper (Cu)-Dissolved			87.3		%		70-130	26-SEP-19
Gallium (Ga)-Dissolved			96.3		%		70-130	26-SEP-19
Iron (Fe)-Dissolved			99.6		%		70-130	26-SEP-19
Lead (Pb)-Dissolved			88.6		%		70-130	26-SEP-19
Lithium (Li)-Dissolved			85.8		%		70-130	26-SEP-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Manganese (Mn)-Dissolved			99.4		%		70-130	26-SEP-19
Molybdenum (Mo)-Dissolved			102.5		%		70-130	26-SEP-19
Nickel (Ni)-Dissolved			89.8		%		70-130	26-SEP-19
Phosphorus (P)-Dissolved			112.3		%		70-130	26-SEP-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Rhenium (Re)-Dissolved			96.5		%		70-130	26-SEP-19
Rubidium (Rb)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Selenium (Se)-Dissolved			96.7		%		70-130	26-SEP-19
Silver (Ag)-Dissolved			92.8		%		70-130	26-SEP-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Tellurium (Te)-Dissolved			90.8		%		70-130	26-SEP-19
Thallium (Tl)-Dissolved			86.7		%		70-130	26-SEP-19
Thorium (Th)-Dissolved			90.8		%		70-130	26-SEP-19
Tin (Sn)-Dissolved			95.5		%		70-130	26-SEP-19
Titanium (Ti)-Dissolved			104.5		%		70-130	26-SEP-19
Tungsten (W)-Dissolved			99.6		%		70-130	26-SEP-19
Uranium (U)-Dissolved			91.8		%		70-130	26-SEP-19
Vanadium (V)-Dissolved			101.4		%		70-130	26-SEP-19
Yttrium (Y)-Dissolved			109.2		%		70-130	26-SEP-19

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4846268								
WG3172841-4 MS		**L2353810-2**						
Zinc (Zn)-Dissolved			87.8		%		70-130	26-SEP-19
Zirconium (Zr)-Dissolved			100.9		%		70-130	26-SEP-19
Batch R4849899								
WG3175435-3 DUP		**L2353810-5**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	28-SEP-19
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-SEP-19
Arsenic (As)-Dissolved		<0.00040	<0.00040	RPD-NA	mg/L	N/A	20	28-SEP-19
Barium (Ba)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-SEP-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Boron (B)-Dissolved		<0.30	<0.30	RPD-NA	mg/L	N/A	20	28-SEP-19
Cadmium (Cd)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	28-SEP-19
Calcium (Ca)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	28-SEP-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	28-SEP-19
Copper (Cu)-Dissolved		0.00023	0.00021		mg/L	12	20	28-SEP-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	28-SEP-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	28-SEP-19
Lithium (Li)-Dissolved		<0.020	<0.020	RPD-NA	mg/L	N/A	20	28-SEP-19
Magnesium (Mg)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	28-SEP-19
Manganese (Mn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	28-SEP-19
Molybdenum (Mo)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	28-SEP-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	28-SEP-19
Potassium (K)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	28-SEP-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Rubidium (Rb)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	28-SEP-19
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	28-SEP-19
Strontium (Sr)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	28-SEP-19
Sulfur (S)-Dissolved		<5.0	<5.0	RPD-NA	mg/L	N/A	20	28-SEP-19
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4849899								
WG3175435-3 DUP		**L2353810-5**						
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	28-SEP-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-SEP-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	28-SEP-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-SEP-19
Uranium (U)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	28-SEP-19
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	28-SEP-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	28-SEP-19
WG3175435-2 LCS								
Aluminum (Al)-Dissolved			101.8		%		80-120	28-SEP-19
Antimony (Sb)-Dissolved			93.3		%		80-120	28-SEP-19
Arsenic (As)-Dissolved			97.5		%		80-120	28-SEP-19
Barium (Ba)-Dissolved			103.5		%		80-120	28-SEP-19
Beryllium (Be)-Dissolved			96.9		%		80-120	28-SEP-19
Bismuth (Bi)-Dissolved			111.8		%		80-120	28-SEP-19
Boron (B)-Dissolved			105.1		%		80-120	28-SEP-19
Cadmium (Cd)-Dissolved			99.2		%		80-120	28-SEP-19
Calcium (Ca)-Dissolved			100.3		%		80-120	28-SEP-19
Cesium (Cs)-Dissolved			97.2		%		80-120	28-SEP-19
Chromium (Cr)-Dissolved			98.0		%		80-120	28-SEP-19
Cobalt (Co)-Dissolved			100.1		%		80-120	28-SEP-19
Copper (Cu)-Dissolved			98.1		%		80-120	28-SEP-19
Gallium (Ga)-Dissolved			99.6		%		80-120	28-SEP-19
Iron (Fe)-Dissolved			92.9		%		80-120	28-SEP-19
Lead (Pb)-Dissolved			103.7		%		80-120	28-SEP-19
Lithium (Li)-Dissolved			104.0		%		80-120	28-SEP-19
Magnesium (Mg)-Dissolved			100.5		%		80-120	28-SEP-19
Manganese (Mn)-Dissolved			98.5		%		80-120	28-SEP-19
Molybdenum (Mo)-Dissolved			96.8		%		80-120	28-SEP-19
Nickel (Ni)-Dissolved			100.6		%		80-120	28-SEP-19
Phosphorus (P)-Dissolved			102.5		%		80-120	28-SEP-19
Potassium (K)-Dissolved			98.6		%		80-120	28-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4849899								
WG3175435-2 LCS								
Rhenium (Re)-Dissolved			103.2		%		80-120	28-SEP-19
Rubidium (Rb)-Dissolved			96.3		%		80-120	28-SEP-19
Selenium (Se)-Dissolved			105.5		%		80-120	28-SEP-19
Silver (Ag)-Dissolved			96.9		%		80-120	28-SEP-19
Strontium (Sr)-Dissolved			95.7		%		80-120	28-SEP-19
Sulfur (S)-Dissolved			106.1		%		80-120	28-SEP-19
Tellurium (Te)-Dissolved			118.3		%		80-120	28-SEP-19
Thallium (Tl)-Dissolved			106.0		%		80-120	28-SEP-19
Thorium (Th)-Dissolved			101.3		%		80-120	28-SEP-19
Tin (Sn)-Dissolved			96.8		%		80-120	28-SEP-19
Titanium (Ti)-Dissolved			98.7		%		80-120	28-SEP-19
Tungsten (W)-Dissolved			98.7		%		80-120	28-SEP-19
Uranium (U)-Dissolved			104.0		%		80-120	28-SEP-19
Vanadium (V)-Dissolved			96.1		%		80-120	28-SEP-19
Yttrium (Y)-Dissolved			94.3		%		80-120	28-SEP-19
Zinc (Zn)-Dissolved			95.9		%		80-120	28-SEP-19
Zirconium (Zr)-Dissolved			90.3		%		80-120	28-SEP-19
WG3175435-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	28-SEP-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	28-SEP-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	28-SEP-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	28-SEP-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	28-SEP-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	28-SEP-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	28-SEP-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	28-SEP-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	28-SEP-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	28-SEP-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	28-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4849899								
WG3175435-1 MB		**LF**						
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	28-SEP-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	28-SEP-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	28-SEP-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	28-SEP-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	28-SEP-19
Potassium (K)-Dissolved			<1.0		mg/L		1	28-SEP-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	28-SEP-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	28-SEP-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	28-SEP-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	28-SEP-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	28-SEP-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	28-SEP-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	28-SEP-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	28-SEP-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	28-SEP-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	28-SEP-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	28-SEP-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4846268								
WG3172939-2 LCS								
Aluminum (Al)-Total			99.1		%		80-120	26-SEP-19
Antimony (Sb)-Total			101.6		%		80-120	26-SEP-19
Arsenic (As)-Total			96.7		%		80-120	26-SEP-19
Barium (Ba)-Total			103.6		%		80-120	26-SEP-19
Beryllium (Be)-Total			87.6		%		80-120	26-SEP-19
Bismuth (Bi)-Total			117.8		%		80-120	26-SEP-19
Boron (B)-Total			117.5		%		80-120	26-SEP-19

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4846268								
WG3172939-2 LCS								
Cadmium (Cd)-Total			100.3		%		80-120	26-SEP-19
Calcium (Ca)-Total			88.8		%		80-120	26-SEP-19
Cesium (Cs)-Total			92.9		%		80-120	26-SEP-19
Chromium (Cr)-Total			99.9		%		80-120	26-SEP-19
Cobalt (Co)-Total			101.5		%		80-120	26-SEP-19
Copper (Cu)-Total			100.5		%		80-120	26-SEP-19
Gallium (Ga)-Total			103.8		%		80-120	26-SEP-19
Iron (Fe)-Total			100.1		%		80-120	26-SEP-19
Lead (Pb)-Total			102.7		%		80-120	26-SEP-19
Lithium (Li)-Total			88.1		%		80-120	26-SEP-19
Magnesium (Mg)-Total			109.7		%		80-120	26-SEP-19
Manganese (Mn)-Total			100.2		%		80-120	26-SEP-19
Molybdenum (Mo)-Total			91.9		%		80-120	26-SEP-19
Nickel (Ni)-Total			100.7		%		80-120	26-SEP-19
Phosphorus (P)-Total			101.8		%		80-120	26-SEP-19
Potassium (K)-Total			117.5		%		80-120	26-SEP-19
Rhenium (Re)-Total			100.3		%		80-120	26-SEP-19
Rubidium (Rb)-Total			98.0		%		80-120	26-SEP-19
Selenium (Se)-Total			106.1		%		80-120	26-SEP-19
Silver (Ag)-Total			94.3		%		80-120	26-SEP-19
Strontium (Sr)-Total			95.1		%		80-120	26-SEP-19
Sulfur (S)-Total			108.9		%		80-120	26-SEP-19
Tellurium (Te)-Total			103.2		%		80-120	26-SEP-19
Thallium (Tl)-Total			102.5		%		80-120	26-SEP-19
Thorium (Th)-Total			87.7		%		80-120	26-SEP-19
Tin (Sn)-Total			96.3		%		80-120	26-SEP-19
Titanium (Ti)-Total			96.4		%		80-120	26-SEP-19
Tungsten (W)-Total			102.1		%		80-120	26-SEP-19
Uranium (U)-Total			97.7		%		80-120	26-SEP-19
Vanadium (V)-Total			97.2		%		80-120	26-SEP-19
Yttrium (Y)-Total			99.4		%		80-120	26-SEP-19
Zinc (Zn)-Total			105.4		%		80-120	26-SEP-19
Zirconium (Zr)-Total			85.9		%		80-120	26-SEP-19
WG3172939-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4846268								
WG3172939-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	26-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	26-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	26-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	26-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	26-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	26-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	26-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	26-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	26-SEP-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	26-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	26-SEP-19
Magnesium (Mg)-Total			<1.0		mg/L		1	26-SEP-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	26-SEP-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	26-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	26-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	26-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	26-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	26-SEP-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	26-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	26-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	26-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	26-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	26-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4846268								
WG3172939-1 MB								
Tungsten (W)-Total			<0.0010		mg/L		0.001	26-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	26-SEP-19
Vanadium (V)-Total			0.00084	B	mg/L		0.0005	26-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	26-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	26-SEP-19
Batch R4849899								
WG3175716-2 LCS								
Aluminum (Al)-Total			100.9		%		80-120	28-SEP-19
Antimony (Sb)-Total			103.5		%		80-120	28-SEP-19
Arsenic (As)-Total			101.4		%		80-120	28-SEP-19
Barium (Ba)-Total			114.3		%		80-120	28-SEP-19
Beryllium (Be)-Total			100.8		%		80-120	28-SEP-19
Bismuth (Bi)-Total			119.9		%		80-120	28-SEP-19
Boron (B)-Total			98.9		%		80-120	28-SEP-19
Cadmium (Cd)-Total			95.7		%		80-120	28-SEP-19
Calcium (Ca)-Total			99.3		%		80-120	28-SEP-19
Cesium (Cs)-Total			97.4		%		80-120	28-SEP-19
Chromium (Cr)-Total			101.2		%		80-120	28-SEP-19
Cobalt (Co)-Total			104.1		%		80-120	28-SEP-19
Copper (Cu)-Total			103.3		%		80-120	28-SEP-19
Gallium (Ga)-Total			102.1		%		80-120	28-SEP-19
Iron (Fe)-Total			98.2		%		80-120	28-SEP-19
Lead (Pb)-Total			103.5		%		80-120	28-SEP-19
Lithium (Li)-Total			104.3		%		80-120	28-SEP-19
Magnesium (Mg)-Total			100.3		%		80-120	28-SEP-19
Manganese (Mn)-Total			101.8		%		80-120	28-SEP-19
Molybdenum (Mo)-Total			93.9		%		80-120	28-SEP-19
Nickel (Ni)-Total			105.1		%		80-120	28-SEP-19
Phosphorus (P)-Total			104.7		%		80-120	28-SEP-19
Potassium (K)-Total			103.8		%		80-120	28-SEP-19
Rhenium (Re)-Total			109.3		%		80-120	28-SEP-19
Rubidium (Rb)-Total			104.7		%		80-120	28-SEP-19
Selenium (Se)-Total			111.3		%		80-120	28-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4849899								
WG3175716-2 LCS								
Silver (Ag)-Total			94.9		%		80-120	28-SEP-19
Strontium (Sr)-Total			92.2		%		80-120	28-SEP-19
Sulfur (S)-Total			106.8		%		80-120	28-SEP-19
Tellurium (Te)-Total			117.3		%		80-120	28-SEP-19
Thallium (Tl)-Total			104.5		%		80-120	28-SEP-19
Thorium (Th)-Total			98.0		%		80-120	28-SEP-19
Tin (Sn)-Total			94.7		%		80-120	28-SEP-19
Titanium (Ti)-Total			98.9		%		80-120	28-SEP-19
Tungsten (W)-Total			101.1		%		80-120	28-SEP-19
Uranium (U)-Total			101.0		%		80-120	28-SEP-19
Vanadium (V)-Total			101.3		%		80-120	28-SEP-19
Yttrium (Y)-Total			94.0		%		80-120	28-SEP-19
Zinc (Zn)-Total			99.0		%		80-120	28-SEP-19
Zirconium (Zr)-Total			88.2		%		80-120	28-SEP-19
WG3175716-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	28-SEP-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	28-SEP-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	28-SEP-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	28-SEP-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Boron (B)-Total			<0.30		mg/L		0.3	28-SEP-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	28-SEP-19
Calcium (Ca)-Total			<1.0		mg/L		1	28-SEP-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	28-SEP-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Iron (Fe)-Total			<0.010		mg/L		0.01	28-SEP-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	28-SEP-19
Lithium (Li)-Total			<0.020		mg/L		0.02	28-SEP-19
Magnesium (Mg)-Total			<1.0		mg/L		1	28-SEP-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	28-SEP-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4849899								
WG3175716-1 MB								
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	28-SEP-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	28-SEP-19
Potassium (K)-Total			<1.0		mg/L		1	28-SEP-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	28-SEP-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	28-SEP-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	28-SEP-19
Sulfur (S)-Total			<5.0		mg/L		5	28-SEP-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	28-SEP-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	28-SEP-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	28-SEP-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	28-SEP-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	28-SEP-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	28-SEP-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	28-SEP-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	28-SEP-19
NA-D-CCMS-VA	**Seawater**							
Batch R4842208								
WG3172841-3 DUP		**L2353810-1**						
Sodium (Na)-Dissolved		6900	6830		mg/L	1.0	20	26-SEP-19
WG3172841-2 LCS								
Sodium (Na)-Dissolved			106.7		%		80-120	26-SEP-19
WG3172841-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	26-SEP-19
WG3172841-4 MS		**L2353810-2**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	26-SEP-19
Batch R4849092								
WG3175435-3 DUP		**L2353810-5**						
Sodium (Na)-Dissolved		8.6	8.8		mg/L	1.9	20	27-SEP-19
WG3175435-2 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NA-D-CCMS-VA	**Seawater**							
Batch R4849092								
WG3175435-2 LCS								
Sodium (Na)-Dissolved			110.1		%		80-120	27-SEP-19
WG3175435-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	27-SEP-19
NA-T-CCMS-VA	**Seawater**							
Batch R4848770								
WG3172939-2 LCS								
Sodium (Na)-Total			110.2		%		80-120	27-SEP-19
WG3172939-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	27-SEP-19
Batch R4849933								
WG3175716-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	28-SEP-19
Batch R4850000								
WG3175716-2 LCS								
Sodium (Na)-Total			102.0		%		80-120	30-SEP-19
NH3-F-VA	**Seawater**							
Batch R4854169								
WG3174921-2 LCS								
Ammonia, Total (as N)			100.3		%		85-115	02-OCT-19
WG3174921-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	02-OCT-19
PH-C-PCT-VA	**Seawater**							
Batch R4850047								
WG3172885-2 CRM		**VA-PH7-BUF**						
pH			6.92		pH		6.9-7.1	27-SEP-19
WG3172885-4 DUP		**L2353810-1**						
pH		7.96	7.96	J	pH	0.00	0.3	27-SEP-19
SI-D-CCMS-VA	**Seawater**							
Batch R4842208								
WG3172841-3 DUP		**L2353810-1**						
Silicon (Si)-Dissolved		<1.0	<1.0	RPD-NA	mg/L	N/A	20	26-SEP-19
WG3172841-2 LCS								
Silicon (Si)-Dissolved			97.3		%		80-120	26-SEP-19
WG3172841-1 MB		**LF**						

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SI-D-CCMS-VA	**Seawater**							
Batch R4842208								
WG3172841-1 MB		**LF**						
Silicon (Si)-Dissolved			<1.0		mg/L		1	26-SEP-19
WG3172841-4 MS		**L2353810-2**						
Silicon (Si)-Dissolved			92.3		%		70-130	26-SEP-19
SI-T-CCMS-VA	**Seawater**							
Batch R4848770								
WG3172939-2 LCS								
Silicon (Si)-Total			104.7		%		80-120	27-SEP-19
WG3172939-1 MB								
Silicon (Si)-Total			<1.0		mg/L		1	27-SEP-19
TKN-C-F-VA	**Seawater**							
Batch R4849450								
WG3174875-2 LCS								
Total Kjeldahl Nitrogen			115.5		%		75-125	27-SEP-19
WG3174875-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	27-SEP-19
TSS-C-VA	**Seawater**							
Batch R4854955								
WG3178172-2 LCS								
Total Suspended Solids			86.3		%		85-115	01-OCT-19
WG3178172-1 MB								
Total Suspended Solids			<2.0		mg/L		2	01-OCT-19
TURBIDITY-C-VA	**Seawater**							
Batch R4842429								
WG3173193-2 CRM		**VA-FORM-40**						
Turbidity			102.8		%		85-115	26-SEP-19
WG3173193-3 DUP		**L2353810-2**						
Turbidity		0.26	0.26		NTU	0.8	15	26-SEP-19
WG3173193-1 MB								
Turbidity			<0.10		NTU		0.1	26-SEP-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Total Suspended Solids by Gravimetric							
	1	23-SEP-19 13:30	01-OCT-19 11:40	7	8	days	EHT
	2	23-SEP-19 13:50	01-OCT-19 11:40	7	8	days	EHT
	3	23-SEP-19 14:10	01-OCT-19 11:40	7	8	days	EHT
	4	23-SEP-19 16:20	01-OCT-19 11:40	7	8	days	EHT
	5	23-SEP-19 14:55	01-OCT-19 11:40	7	8	days	EHT
pH by Meter (Automated) (seawater)							
	1	23-SEP-19 13:30	27-SEP-19 14:41	0.25	97	hours	EHTR-FM
	2	23-SEP-19 13:50	27-SEP-19 14:41	0.25	97	hours	EHTR-FM
	3	23-SEP-19 14:10	27-SEP-19 14:41	0.25	96	hours	EHTR-FM
	4	23-SEP-19 16:20	27-SEP-19 14:41	0.25	94	hours	EHTR-FM
	5	23-SEP-19 14:55	27-SEP-19 14:41	0.25	96	hours	EHTR-FM
Bacteriological Tests							
Fecal coliform by membrane filtration							
	1	23-SEP-19 13:30	25-SEP-19 15:00	30	49	hours	EHTR
	2	23-SEP-19 13:50	25-SEP-19 15:00	30	49	hours	EHTR
	3	23-SEP-19 14:10	25-SEP-19 15:00	30	49	hours	EHTR
	4	23-SEP-19 16:20	25-SEP-19 15:00	30	47	hours	EHTR
	5	23-SEP-19 14:55	25-SEP-19 15:00	30	48	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2353810 were received on 25-SEP-19 09:50.

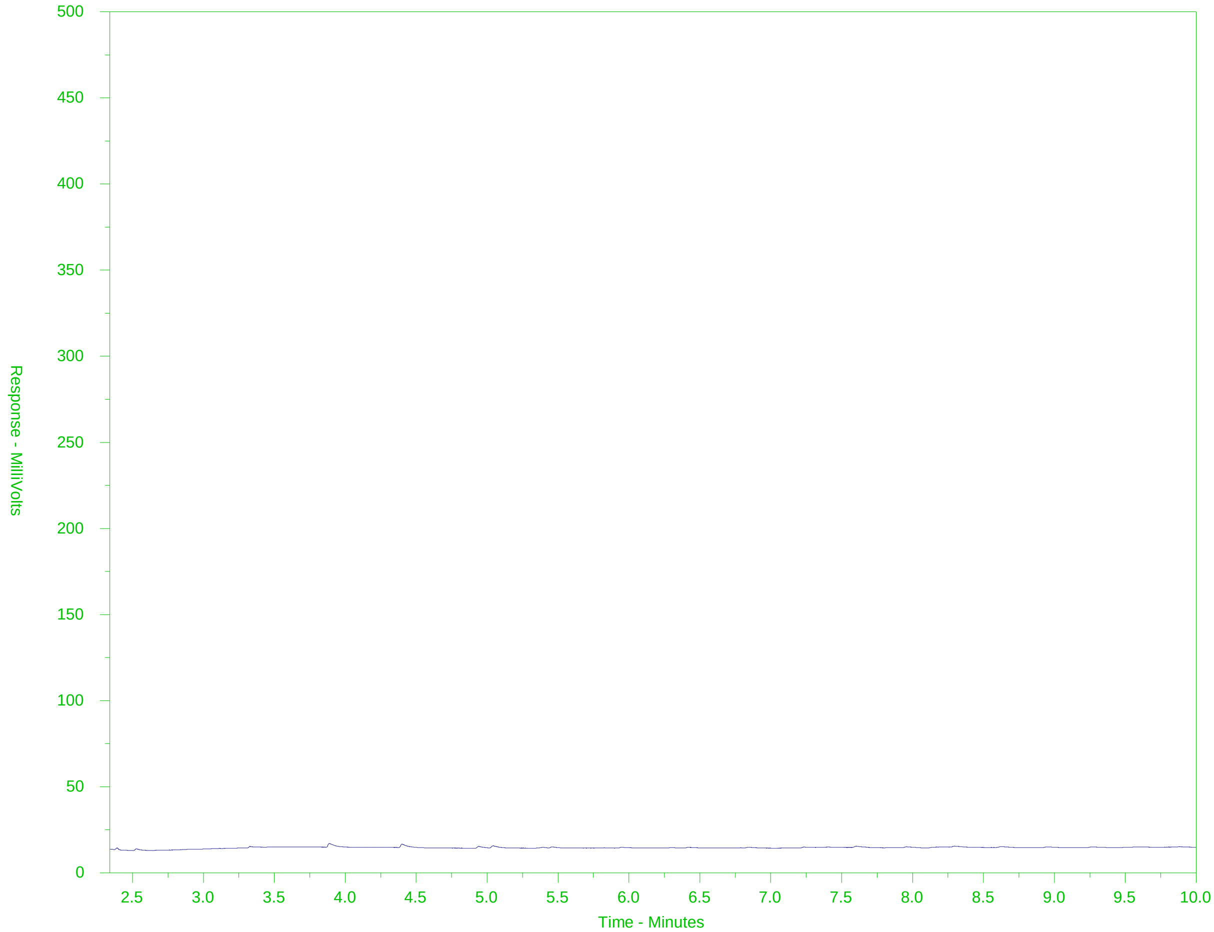
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2353810-1
Client Sample ID: WNW-5



← EPH10-19 →		← EPH19-32 →
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

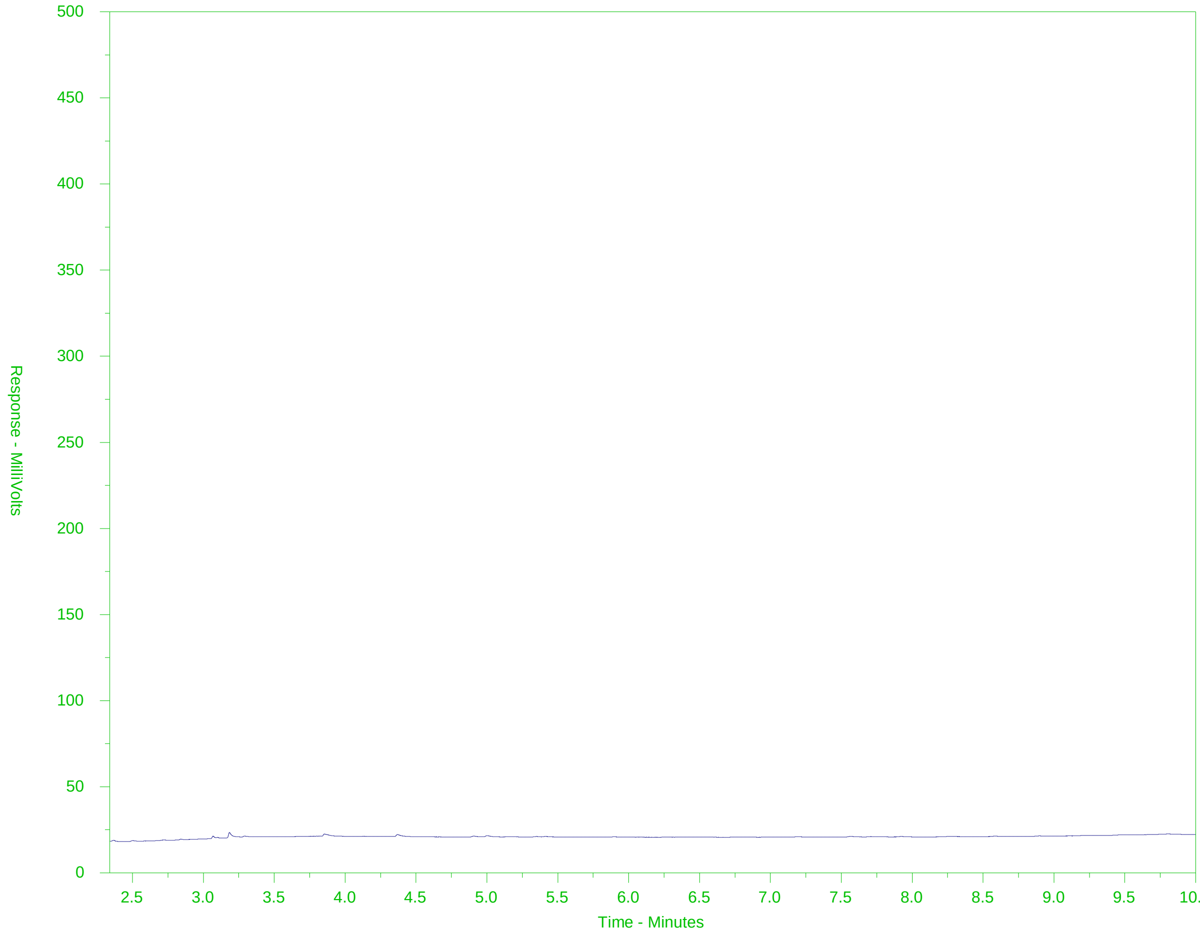
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2353810-2
Client Sample ID: NORTH-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

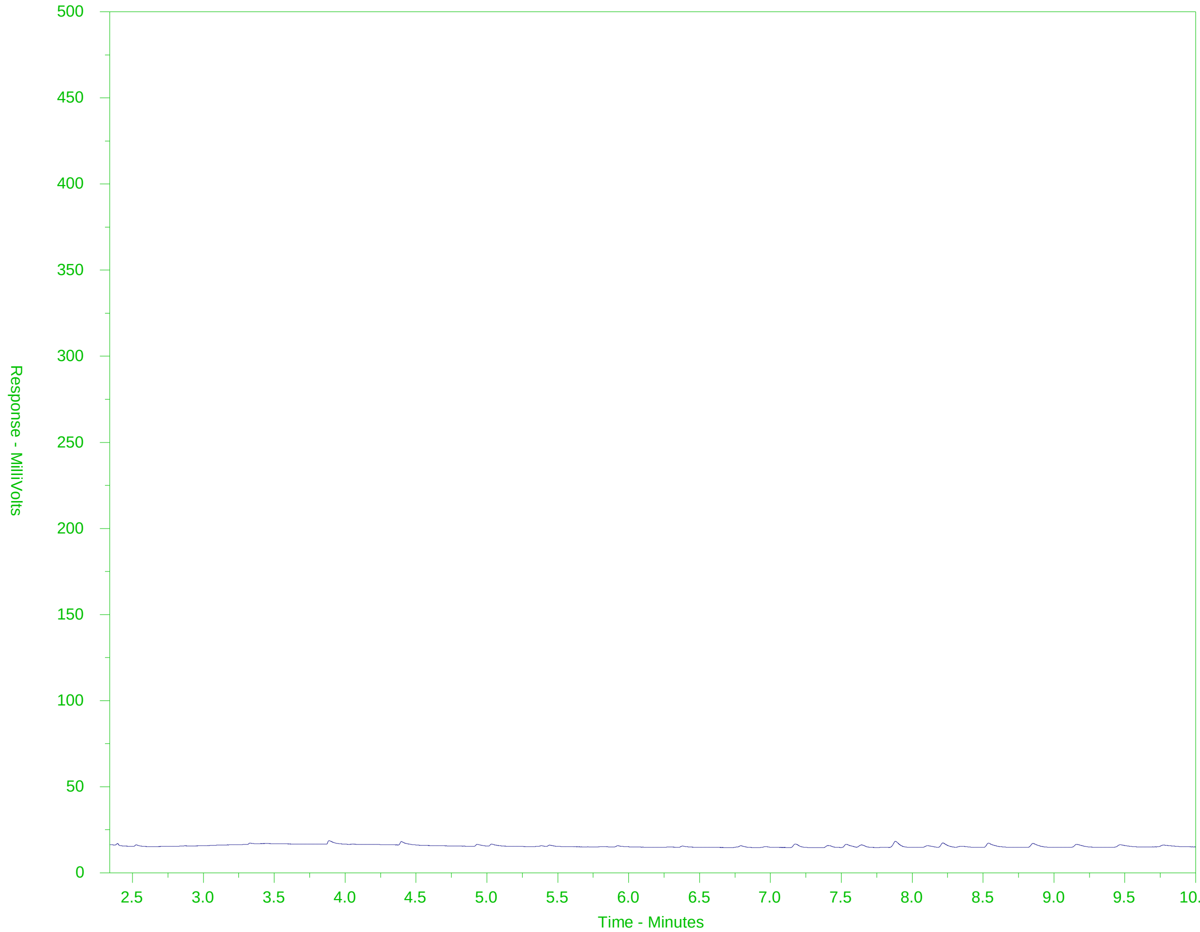
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2353810-3
Client Sample ID: ENE-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

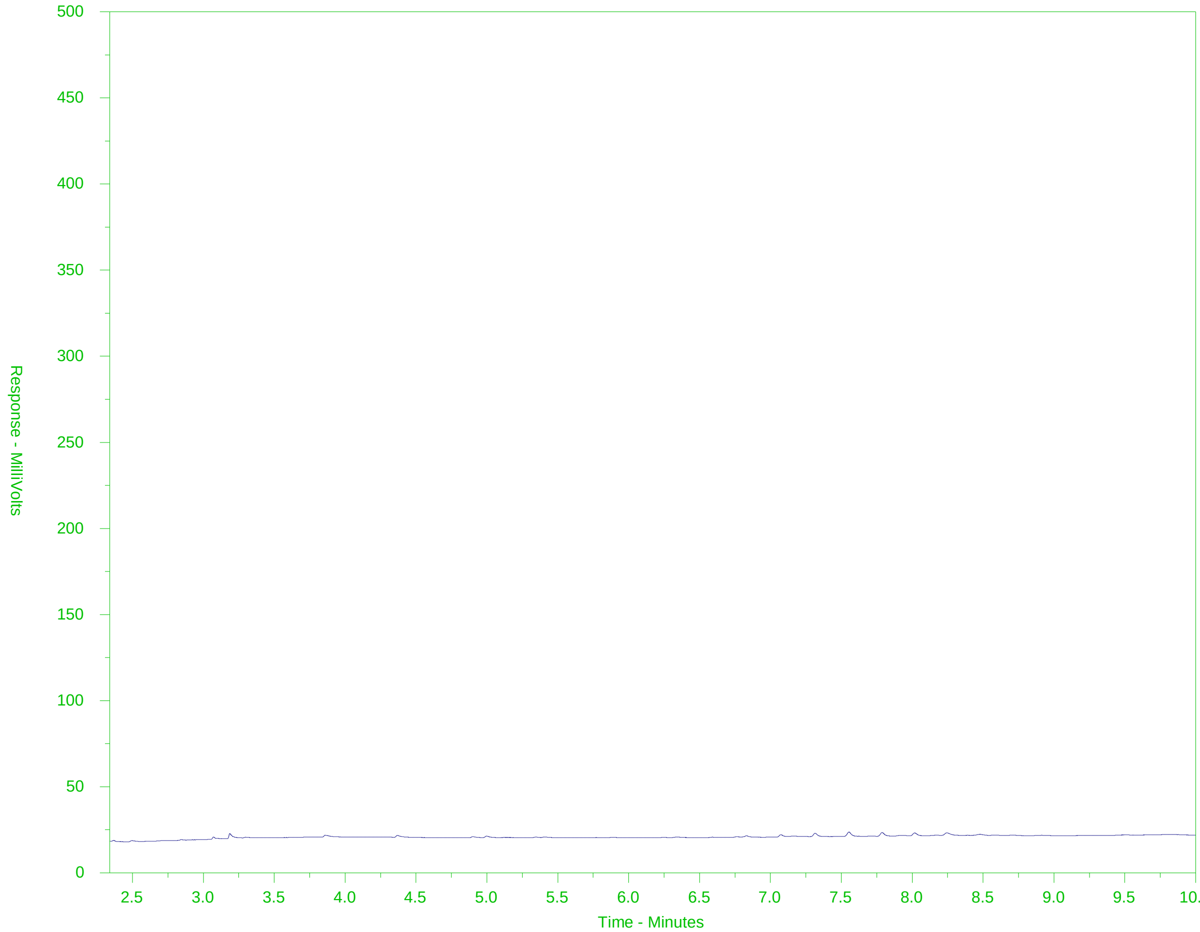
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2353810-4
Client Sample ID: SOURCE-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

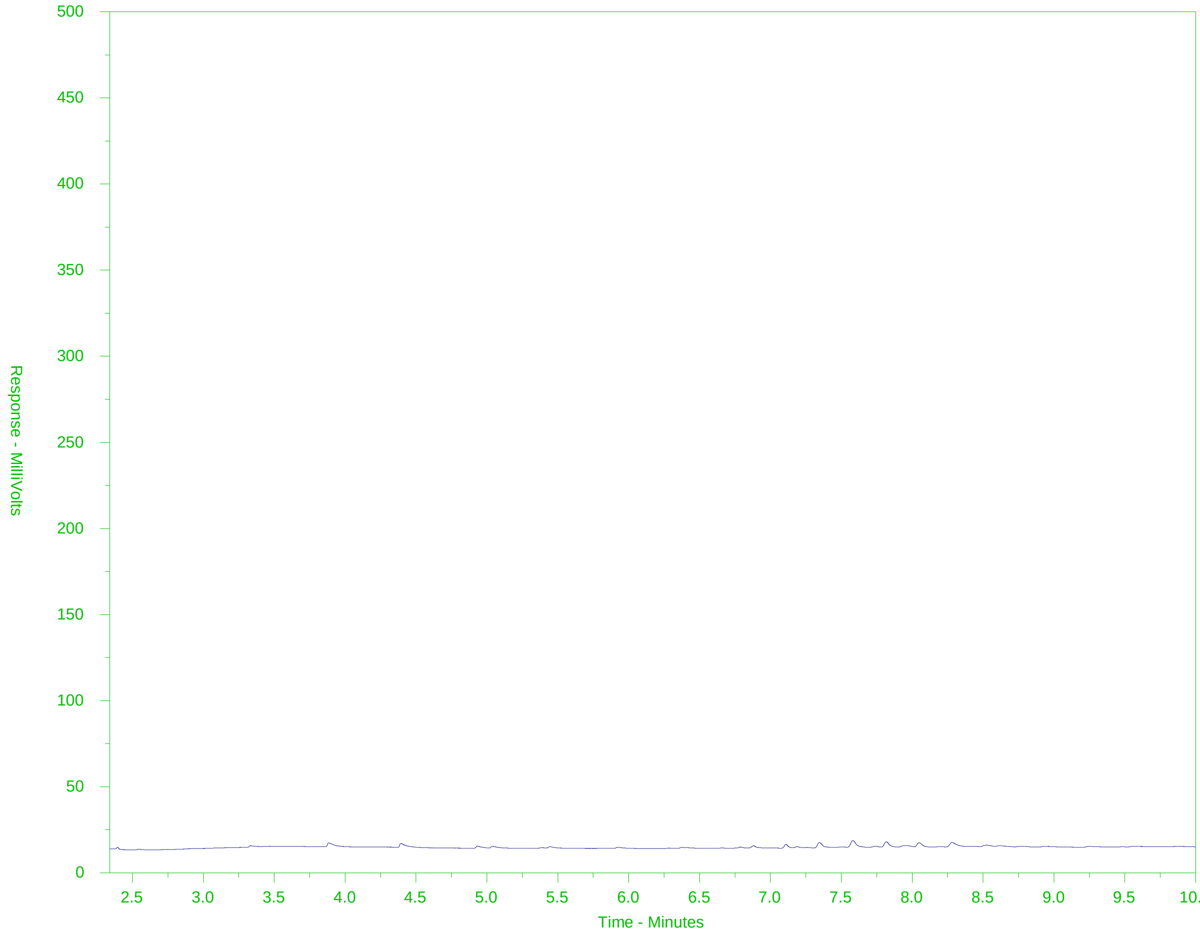
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2353810-5
Client Sample ID: EQUIP-BLANK



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2353810-COFC

COC Number: 15 - 560001

Page of

Report To	Contact and company name below will appear on the final report
Company:	GOLDER ASSOCIATES LTD
Contact:	PHIL ROUGET
Phone:	250 888 1100
	Company address below will appear on the final report
Street:	2ND FLOOR, 3795 CAREY RD
City/Province:	VICTORIA, BC
Postal Code:	V8Z 6T8

Report Format / Distribution

Select Report Format: [✓] PDF [✓] EXCEL [ ] EDD (DIGITAL)

Quality Control (QC) Report with Report [ ] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [✓] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: prouget@golder.com

Email 2: Patricia_Tomlkins@golder.com

Email 3:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [✓] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] [ ] 3 day [P3] [ ] 2 day [P2] [ ]

EMERGENCY: 1 Business day [E1] [ ] Same Day, Weekend or Statutory holiday [E0] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To		
Same as Report To	[✓] YES	[ ] NO
Copy of Invoice with Report	[ ] YES	[✓] NO
Company:		
Contact:		

Invoice Distribution

Select Invoice Distribution: [ ] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax

Email 2

Project Information

ALS Account # / Quote #:

Job #: 1663724-24000

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact:

Sampler: CB/TT/LC

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	GENERAL	TOC, AMMONIA, TKN (P)	DISSOLVED METALS	DISSOLVED HG	TOTAL METALS (P)	TOTAL HG (P)	HYDROCARBONS (P)	FECAL COLIFORMS (P)	Number of Containers
	WNW-5	23-SEP-19	13:30	SEAWATER	X	X	X	X	X	X	X	X	9
	NORTH-5	23-SEP-19	13:50	SEAWATER	X	X	X	X	X	X	X	X	9
	ENE-5	23-SEP-19	14:10	SEAWATER	X	X	X	X	X	X	X	X	9
	SOURCE-5	23-SEP-19	14:20	SEAWATER	X	X	X	X	X	X	X	X	9
	EQUIP-BLANK	23-SEP-19	14:55	SEAWATER	X	X	X	X	X	X	X	X	9

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [✓] NO

Are samples for human drinking water use? [ ] YES [✓] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [✓] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C: 14C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Lauren Corlett	Date: 23-SEP-19	Time: 15:30	Received by:	Date:	Time:	Received by: JG	Date: 25 sep 19	Time: 9:30AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 04-OCT-19
Report Date: 11-OCT-19 13:27 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2359806

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 15-56004
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359806-1	L2359806-2	L2359806-3	L2359806-4	L2359806-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19
	Sampled Time	14:00	13:30	13:45	14:10	08:00
	Client ID	WNW-6	NORTH-6	ENE-6	SOURCE-6	ENE-604
Grouping	**Analyte**					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	28200	19300	21600	20600	19.7
	pH (pH)	7.96	8.03	8.01	8.02	6.17
	Salinity (psu)	19.5	12.9	14.6	13.8	<1.0
	Total Suspended Solids (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Turbidity (NTU)	0.22	0.28	0.44	0.27	0.12
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	108	112	111	111	<1.0
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0062
	Bromide (Br) (mg/L)	30.4	22.8	26.9	25.7	<5.0
	Chloride (Cl) (mg/L)	8660	6730	7620	7300	<50
	Fluoride (F) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Total Kjeldahl Nitrogen (mg/L)	0.091	0.070	<0.050	0.084	<0.050
	Sulfate (SO4) (mg/L)	1200	931	1050	1010	<30
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.24	1.47	1.18	1.17	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0069	0.0101	0.0098	0.0087	<0.0050
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Total (mg/L)	0.00073	0.00064	0.00077	0.00068	<0.00040
	Barium (Ba)-Total (mg/L)	0.0061	0.0065	0.0067	0.0067	<0.0010
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	1.70	1.46	1.71	1.64	<0.30
	Cadmium (Cd)-Total (mg/L)	0.000028	0.000019	0.000017	0.000016	<0.000010
	Calcium (Ca)-Total (mg/L)	194	173	201	194	<1.0
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Total (mg/L)	<0.00050	0.00054	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Total (mg/L)	<0.00050	0.00103	0.00174	0.0110	<0.00050
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	<0.010	0.015	0.016	0.011	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.075	0.062	0.073	0.070	<0.020
	Magnesium (Mg)-Total (mg/L)	523	404	488	479	<1.0
	Manganese (Mn)-Total (mg/L)	0.00082	0.00095	0.00106	0.00093	<0.00020
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00482	0.00401	0.00447	0.00433	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359806-1	L2359806-2	L2359806-3	L2359806-4	L2359806-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19
	Sampled Time	14:00	13:30	13:45	14:10	08:00
	Client ID	WNW-6	NORTH-6	ENE-6	SOURCE-6	ENE-604
Grouping	**Analyte**					
SEAWATER						
Total Metals	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	168	135	158	155	<1.0
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Total (mg/L)	0.0499	0.0383	0.0473	0.0436	<0.0050
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	5440	3780	4230	4130	<2.5
	Strontium (Sr)-Total (mg/L)	3.29	2.61	3.08	2.90	<0.010
	Sulfur (S)-Total (mg/L)	410	327	399	386	<5.0
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Total (mg/L)	0.00241	0.00282	0.00296	0.00282	<0.000050
	Vanadium (V)-Total (mg/L)	0.00074	0.00060	0.00072	0.00064	<0.00050
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	LAB
	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Dissolved (mg/L)	0.00077	0.00076	0.00057	0.00067	<0.00040
	Barium (Ba)-Dissolved (mg/L)	0.0065	0.0069	0.0066	0.0068	<0.0010
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	1.81	1.77	1.55	1.69	<0.30
	Cadmium (Cd)-Dissolved (mg/L)	0.000019	0.000017	0.000011	0.000015	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	203	199	172	190	<1.0
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Dissolved (mg/L)	0.00146	0.00026	0.00027	0.00451	RRV 0.00024

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359806-1	L2359806-2	L2359806-3	L2359806-4	L2359806-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19
	Sampled Time	14:00	13:30	13:45	14:10	08:00
	Client ID	WNW-6	NORTH-6	ENE-6	SOURCE-6	ENE-604
Grouping	**Analyte**					
SEAWATER						
Dissolved Metals	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.076	0.074	0.064	0.071	<0.020
	Magnesium (Mg)-Dissolved (mg/L)	545	522	437	484	<1.0
	Manganese (Mn)-Dissolved (mg/L)	0.00051	0.00064	0.00050	0.00066	RRV 0.00012
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00440	0.00454	0.00376	0.00441	<0.00010
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	168	164	136	151	<1.0
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.0471	0.0466	0.0401	0.0444	<0.0050
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	4420	4540	3700	4260	<2.5
	Strontium (Sr)-Dissolved (mg/L)	3.18	3.12	2.65	2.98	<0.010
	Sulfur (S)-Dissolved (mg/L)	420	394	350	393	<5.0
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00263	0.00285	0.00299	0.00276	<0.000050
	Vanadium (V)-Dissolved (mg/L)	0.00065	0.00065	0.00053	0.00066	<0.00050
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	RRV 0.0012
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359806-1	L2359806-2	L2359806-3	L2359806-4	L2359806-5
	Description	Seawater	Seawater	Seawater	Seawater	Seawater
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19	01-OCT-19
	Sampled Time	14:00	13:30	13:45	14:10	08:00
	Client ID	WNW-6	NORTH-6	ENE-6	SOURCE-6	ENE-604
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	1 PEHR	1 PEHR	<1 PEHR	2 PEHR	<1 PEHR
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	87.4	90.1	93.7	90.2	94.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
	Benzo(g,h,i)perylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(k)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Fluorene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acridine d9 (%)	87.3	91.4	92.9	89.2	88.1
	Surrogate: Chrysene d12 (%)	87.5	96.8	94.1	91.9	89.0
	Surrogate: Naphthalene d8 (%)	84.4	93.5	96.4	94.3	94.1
	Surrogate: Phenanthrene d10 (%)	96.7	103.3	103.8	102.1	99.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity	B	L2359806-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2359806-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2359806-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Seawater	Alkalinity Spec by Titration (Seawater)	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-C-BR-IC-VA	Seawater	Bromide by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-CL-IC-VA	Seawater	Chloride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-F-IC-VA	Seawater	Fluoride by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-C-SO4-IC-VA	Seawater	Sulfate by IC (seawater)	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-C-TOC-VA	Seawater	TOC by combustion (seawater)	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

Reference Information

EPH-ME-FID-VA Water EPH in Water BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

FCOLI-MF-ENV-VA Water Fecal coliform by membrane filtration APHA METHOD 9222

This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation of the filter with the appropriate growth medium, positive results require further testing (up to an additional 48 hours) to confirm and quantify the total coliform. This method is used for non-turbid water with a low background bacteria level.

HG-DIS-C-CVAFS-VA Seawater Diss. Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SALINITY-CALC-VA Seawater Salinity by conductivity meter APHA 2520B

Salinity is determined by the APHA 2520B Electrical Conductivity Method. Salinity is a unitless parameter that is roughly equivalent to grams per Litre. ALS applies the unit of psu (practical salinity unit) to indicate that salinity values are derived from the Practical Salinity Scale.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Reference Information

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TKN-C-F-VA	Seawater	TKN in Seawater by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-C-VA	Seawater	Turbidity by Meter in Seawater	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-56004

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2359806 Report Date: 11-OCT-19

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-ME-FID-VA	**Water**							
Batch R4861531								
WG3184135-2 LCS								
EPH10-19			108.0		%		70-130	08-OCT-19
EPH19-32			105.4		%		70-130	08-OCT-19
WG3184135-1 MB								
EPH10-19			<0.25		mg/L		0.25	08-OCT-19
EPH19-32			<0.25		mg/L		0.25	08-OCT-19
Surrogate: 2-Bromobenzotrifluoride			88.0		%		60-140	08-OCT-19
FCOLI-MF-ENV-VA	**Water**							
Batch R4860087								
WG3181819-2 MB								
Coliform Bacteria - Fecal			<1		CFU/100mL		1	04-OCT-19
PAH-ME-MS-VA	**Water**							
Batch R4861224								
WG3184135-2 LCS								
Acenaphthene			88.9		%		60-130	08-OCT-19
Acenaphthylene			95.4		%		60-130	08-OCT-19
Acridine			92.9		%		60-130	08-OCT-19
Anthracene			99.8		%		60-130	08-OCT-19
Benz(a)anthracene			98.7		%		60-130	08-OCT-19
Benzo(a)pyrene			93.4		%		60-130	08-OCT-19
Benzo(b&j)fluoranthene			84.6		%		60-130	08-OCT-19
Benzo(g,h,i)perylene			96.2		%		60-130	08-OCT-19
Benzo(k)fluoranthene			86.6		%		60-130	08-OCT-19
Chrysene			99.0		%		60-130	08-OCT-19
Dibenz(a,h)anthracene			104.2		%		60-130	08-OCT-19
Fluoranthene			97.0		%		60-130	08-OCT-19
Fluorene			95.2		%		60-130	08-OCT-19
Indeno(1,2,3-c,d)pyrene			108.6		%		60-130	08-OCT-19
1-Methylnaphthalene			87.7		%		60-130	08-OCT-19
2-Methylnaphthalene			86.4		%		60-130	08-OCT-19
Naphthalene			84.2		%		50-130	08-OCT-19
Phenanthrene			96.5		%		60-130	08-OCT-19
Pyrene			99.3		%		60-130	08-OCT-19
Quinoline			118.0		%		60-130	08-OCT-19
WG3184135-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-ME-MS-VA	**Water**							
Batch R4861224								
WG3184135-1 MB								
Acenaphthene			<0.000010		mg/L		0.00001	08-OCT-19
Acenaphthylene			<0.000010		mg/L		0.00001	08-OCT-19
Acridine			<0.000010		mg/L		0.00001	08-OCT-19
Anthracene			<0.000010		mg/L		0.00001	08-OCT-19
Benz(a)anthracene			<0.000010		mg/L		0.00001	08-OCT-19
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	08-OCT-19
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	08-OCT-19
Benzo(g,h,i)perylene			<0.000010		mg/L		0.00001	08-OCT-19
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	08-OCT-19
Chrysene			<0.000010		mg/L		0.00001	08-OCT-19
Dibenz(a,h)anthracene			<0.0000050		mg/L		0.000005	08-OCT-19
Fluoranthene			<0.000010		mg/L		0.00001	08-OCT-19
Fluorene			<0.000010		mg/L		0.00001	08-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.000010		mg/L		0.00001	08-OCT-19
1-Methylnaphthalene			<0.000050		mg/L		0.00005	08-OCT-19
2-Methylnaphthalene			<0.000050		mg/L		0.00005	08-OCT-19
Naphthalene			<0.000050		mg/L		0.00005	08-OCT-19
Phenanthrene			<0.000020		mg/L		0.00002	08-OCT-19
Pyrene			<0.000010		mg/L		0.00001	08-OCT-19
Quinoline			<0.000050		mg/L		0.00005	08-OCT-19
Surrogate: Acridine d9			96.2		%		60-130	08-OCT-19
Surrogate: Chrysene d12			102.4		%		60-130	08-OCT-19
Surrogate: Naphthalene d8			96.3		%		50-130	08-OCT-19
Surrogate: Phenanthrene d10			107.4		%		60-130	08-OCT-19
ALK-TITR-VA	**Seawater**							
Batch R4862531								
WG3184079-4 DUP		**L2359806-1**						
Alkalinity, Total (as CaCO3)		108	108		mg/L	0.5	20	08-OCT-19
WG3184079-3 LCS								
Alkalinity, Total (as CaCO3)			101.7		%		70-130	08-OCT-19
WG3184079-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	08-OCT-19
ANIONS-C-BR-IC-VA	**Seawater**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-BR-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Bromide (Br)		30.4	34.5		mg/L	13	20	04-OCT-19
WG3182461-2 LCS								
Bromide (Br)			100.5		%		85-115	04-OCT-19
WG3182461-1 MB								
Bromide (Br)			<5.0		mg/L		5	04-OCT-19
ANIONS-C-CL-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Chloride (Cl)		8660	9710		mg/L	11	20	04-OCT-19
WG3182461-2 LCS								
Chloride (Cl)			100.1		%		90-110	04-OCT-19
WG3182461-1 MB								
Chloride (Cl)			<50		mg/L		50	04-OCT-19
ANIONS-C-F-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Fluoride (F)		<1.0	<1.0	RPD-NA	mg/L	N/A	20	04-OCT-19
WG3182461-2 LCS								
Fluoride (F)			98.7		%		90-110	04-OCT-19
WG3182461-1 MB								
Fluoride (F)			<1.0		mg/L		1	04-OCT-19
ANIONS-C-NO2-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Nitrite (as N)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	04-OCT-19
WG3182461-2 LCS								
Nitrite (as N)			97.3		%		90-110	04-OCT-19
WG3182461-1 MB								
Nitrite (as N)			<0.10		mg/L		0.1	04-OCT-19
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Nitrate (as N)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	04-OCT-19
WG3182461-2 LCS								
Nitrate (as N)			100.8		%		90-110	04-OCT-19
WG3182461-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-C-NO3-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-1 MB								
Nitrate (as N)			<0.50		mg/L		0.5	04-OCT-19
ANIONS-C-SO4-IC-VA	**Seawater**							
Batch R4859991								
WG3182461-3 DUP		**L2359806-1**						
Sulfate (SO4)		1200	1340		mg/L	11	20	04-OCT-19
WG3182461-2 LCS								
Sulfate (SO4)			102.5		%		90-110	04-OCT-19
WG3182461-1 MB								
Sulfate (SO4)			<30		mg/L		30	04-OCT-19
CARBONS-C-TOC-VA	**Seawater**							
Batch R4860767								
WG3183163-3 DUP		**L2359806-1**						
Total Organic Carbon		1.24	1.24		mg/L	0.0	20	06-OCT-19
WG3183163-2 LCS								
Total Organic Carbon			97.6		%		80-120	06-OCT-19
WG3183163-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	06-OCT-19
WG3183163-4 MS		**L2359806-2**						
Total Organic Carbon			100.2		%		70-130	06-OCT-19
EC-C-PCT-VA	**Seawater**							
Batch R4861492								
WG3182535-4 DUP		**L2359806-1**						
Conductivity		28200	28200		uS/cm	0.0	10	07-OCT-19
WG3182535-1 MB								
Conductivity			52.3	B	uS/cm		2	07-OCT-19
Batch R4866106								
WG3187726-1 MB								
Conductivity			<2.0		uS/cm		2	09-OCT-19
HG-DIS-C-CVAFS-VA	**Seawater**							
Batch R4860242								
WG3183376-6 LCS								
Mercury (Hg)-Dissolved			98.2		%		80-120	06-OCT-19
WG3183376-5 MB								
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	06-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-C-CVAFS-VA	**Seawater**							
Batch R4860974								
WG3184388-6 DUP		**L2359806-4**						
Mercury (Hg)-Total		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	07-OCT-19
WG3184388-2 LCS								
Mercury (Hg)-Total			101.3		%		80-120	07-OCT-19
WG3184388-1 MB								
Mercury (Hg)-Total			<0.000005C		mg/L		0.000005	07-OCT-19
WG3184388-5 MS		**L2359806-3**						
Mercury (Hg)-Total			100.7		%		70-130	07-OCT-19
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-3 DUP		**L2359806-1**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	08-OCT-19
Antimony (Sb)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	08-OCT-19
Arsenic (As)-Dissolved		0.00077	0.00076		mg/L	1.8	20	08-OCT-19
Barium (Ba)-Dissolved		0.0065	0.0069		mg/L	6.7	20	08-OCT-19
Beryllium (Be)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Bismuth (Bi)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Boron (B)-Dissolved		1.81	1.76		mg/L	2.8	20	08-OCT-19
Cadmium (Cd)-Dissolved		0.000019	0.000019		mg/L	1.1	20	08-OCT-19
Calcium (Ca)-Dissolved		203	208		mg/L	2.6	20	08-OCT-19
Cesium (Cs)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Cobalt (Co)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	08-OCT-19
Copper (Cu)-Dissolved		0.00146	0.00150		mg/L	2.4	20	08-OCT-19
Gallium (Ga)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	08-OCT-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	08-OCT-19
Lithium (Li)-Dissolved		0.076	0.078		mg/L	3.4	20	08-OCT-19
Magnesium (Mg)-Dissolved		545	540		mg/L	0.9	20	08-OCT-19
Manganese (Mn)-Dissolved		0.00051	0.00055		mg/L	6.3	20	08-OCT-19
Molybdenum (Mo)-Dissolved		0.00440	0.00447		mg/L	1.4	20	08-OCT-19
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	08-OCT-19
Potassium (K)-Dissolved		168	168		mg/L	0.1	20	08-OCT-19
Rhenium (Re)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Rubidium (Rb)-Dissolved		0.0471	0.0487		mg/L	3.2	20	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-3 DUP		**L2359806-1**						
Selenium (Se)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	08-OCT-19
Strontium (Sr)-Dissolved		3.18	3.19		mg/L	0.2	20	08-OCT-19
Sulfur (S)-Dissolved		420	435		mg/L	3.5	20	08-OCT-19
Tellurium (Te)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Thallium (Tl)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	08-OCT-19
Thorium (Th)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Tin (Sn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	08-OCT-19
Titanium (Ti)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	08-OCT-19
Tungsten (W)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	08-OCT-19
Uranium (U)-Dissolved		0.00263	0.00265		mg/L	1.0	20	08-OCT-19
Vanadium (V)-Dissolved		0.00065	0.00067		mg/L	3.2	20	08-OCT-19
Yttrium (Y)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	08-OCT-19
Zirconium (Zr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	08-OCT-19
WG3182665-2 LCS								
Aluminum (Al)-Dissolved			98.7		%		80-120	08-OCT-19
Antimony (Sb)-Dissolved			93.5		%		80-120	08-OCT-19
Arsenic (As)-Dissolved			98.3		%		80-120	08-OCT-19
Barium (Ba)-Dissolved			98.3		%		80-120	08-OCT-19
Beryllium (Be)-Dissolved			98.3		%		80-120	08-OCT-19
Bismuth (Bi)-Dissolved			110.1		%		80-120	08-OCT-19
Boron (B)-Dissolved			100.2		%		80-120	08-OCT-19
Cadmium (Cd)-Dissolved			101.4		%		80-120	08-OCT-19
Calcium (Ca)-Dissolved			99.8		%		80-120	08-OCT-19
Cesium (Cs)-Dissolved			96.0		%		80-120	08-OCT-19
Chromium (Cr)-Dissolved			104.1		%		80-120	08-OCT-19
Cobalt (Co)-Dissolved			103.5		%		80-120	08-OCT-19
Copper (Cu)-Dissolved			101.7		%		80-120	08-OCT-19
Gallium (Ga)-Dissolved			99.9		%		80-120	08-OCT-19
Iron (Fe)-Dissolved			97.6		%		80-120	08-OCT-19
Lead (Pb)-Dissolved			105.5		%		80-120	08-OCT-19
Lithium (Li)-Dissolved			105.9		%		80-120	08-OCT-19
Magnesium (Mg)-Dissolved			100.6		%		80-120	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-2 LCS								
Manganese (Mn)-Dissolved			103.0		%		80-120	08-OCT-19
Molybdenum (Mo)-Dissolved			96.7		%		80-120	08-OCT-19
Nickel (Ni)-Dissolved			103.7		%		80-120	08-OCT-19
Phosphorus (P)-Dissolved			102.8		%		80-120	08-OCT-19
Potassium (K)-Dissolved			100.2		%		80-120	08-OCT-19
Rhenium (Re)-Dissolved			101.9		%		80-120	08-OCT-19
Rubidium (Rb)-Dissolved			101.7		%		80-120	08-OCT-19
Selenium (Se)-Dissolved			105.0		%		80-120	08-OCT-19
Silver (Ag)-Dissolved			97.3		%		80-120	08-OCT-19
Strontium (Sr)-Dissolved			95.4		%		80-120	08-OCT-19
Sulfur (S)-Dissolved			102.0		%		80-120	08-OCT-19
Tellurium (Te)-Dissolved			104.5		%		80-120	08-OCT-19
Thallium (Tl)-Dissolved			103.6		%		80-120	08-OCT-19
Thorium (Th)-Dissolved			99.8		%		80-120	08-OCT-19
Tin (Sn)-Dissolved			95.6		%		80-120	08-OCT-19
Titanium (Ti)-Dissolved			92.3		%		80-120	08-OCT-19
Tungsten (W)-Dissolved			104.1		%		80-120	08-OCT-19
Uranium (U)-Dissolved			100.2		%		80-120	08-OCT-19
Vanadium (V)-Dissolved			99.0		%		80-120	08-OCT-19
Yttrium (Y)-Dissolved			97.6		%		80-120	08-OCT-19
Zinc (Zn)-Dissolved			102.5		%		80-120	08-OCT-19
Zirconium (Zr)-Dissolved			97.2		%		80-120	08-OCT-19
WG3182665-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	08-OCT-19
Antimony (Sb)-Dissolved			<0.0010		mg/L		0.001	08-OCT-19
Arsenic (As)-Dissolved			<0.00040		mg/L		0.0004	08-OCT-19
Barium (Ba)-Dissolved			<0.0010		mg/L		0.001	08-OCT-19
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Boron (B)-Dissolved			<0.30		mg/L		0.3	08-OCT-19
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	08-OCT-19
Calcium (Ca)-Dissolved			<1.0		mg/L		1	08-OCT-19
Cesium (Cs)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-1 MB		**LF**						
Cobalt (Co)-Dissolved			<0.000050		mg/L		0.00005	08-OCT-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	08-OCT-19
Gallium (Ga)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	08-OCT-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	08-OCT-19
Lithium (Li)-Dissolved			<0.020		mg/L		0.02	08-OCT-19
Magnesium (Mg)-Dissolved			<1.0		mg/L		1	08-OCT-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	08-OCT-19
Molybdenum (Mo)-Dissolved			<0.00010		mg/L		0.0001	08-OCT-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	08-OCT-19
Potassium (K)-Dissolved			<1.0		mg/L		1	08-OCT-19
Rhenium (Re)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Rubidium (Rb)-Dissolved			<0.0050		mg/L		0.005	08-OCT-19
Selenium (Se)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Silver (Ag)-Dissolved			<0.00010		mg/L		0.0001	08-OCT-19
Strontium (Sr)-Dissolved			<0.010		mg/L		0.01	08-OCT-19
Sulfur (S)-Dissolved			<5.0		mg/L		5	08-OCT-19
Tellurium (Te)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Thallium (Tl)-Dissolved			<0.000050		mg/L		0.00005	08-OCT-19
Thorium (Th)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Tin (Sn)-Dissolved			<0.0010		mg/L		0.001	08-OCT-19
Titanium (Ti)-Dissolved			<0.0050		mg/L		0.005	08-OCT-19
Tungsten (W)-Dissolved			<0.0010		mg/L		0.001	08-OCT-19
Uranium (U)-Dissolved			<0.000050		mg/L		0.00005	08-OCT-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Yttrium (Y)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	08-OCT-19
Zirconium (Zr)-Dissolved			<0.00050		mg/L		0.0005	08-OCT-19
WG3182665-4 MS		**L2359806-2**						
Aluminum (Al)-Dissolved			100.5		%		70-130	08-OCT-19
Antimony (Sb)-Dissolved			89.4		%		70-130	08-OCT-19
Arsenic (As)-Dissolved			94.6		%		70-130	08-OCT-19
Barium (Ba)-Dissolved			94.1		%		70-130	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-4 MS		**L2359806-2**						
Beryllium (Be)-Dissolved			98.8		%		70-130	08-OCT-19
Bismuth (Bi)-Dissolved			86.3		%		70-130	08-OCT-19
Boron (B)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Cadmium (Cd)-Dissolved			89.4		%		70-130	08-OCT-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Cesium (Cs)-Dissolved			93.2		%		70-130	08-OCT-19
Chromium (Cr)-Dissolved			102.6		%		70-130	08-OCT-19
Cobalt (Co)-Dissolved			93.5		%		70-130	08-OCT-19
Copper (Cu)-Dissolved			88.8		%		70-130	08-OCT-19
Gallium (Ga)-Dissolved			99.8		%		70-130	08-OCT-19
Iron (Fe)-Dissolved			99.2		%		70-130	08-OCT-19
Lead (Pb)-Dissolved			90.5		%		70-130	08-OCT-19
Lithium (Li)-Dissolved			99.1		%		70-130	08-OCT-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Manganese (Mn)-Dissolved			101.0		%		70-130	08-OCT-19
Molybdenum (Mo)-Dissolved			92.0		%		70-130	08-OCT-19
Nickel (Ni)-Dissolved			90.5		%		70-130	08-OCT-19
Phosphorus (P)-Dissolved			111.2		%		70-130	08-OCT-19
Potassium (K)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Rhenium (Re)-Dissolved			96.1		%		70-130	08-OCT-19
Rubidium (Rb)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Selenium (Se)-Dissolved			99.0		%		70-130	08-OCT-19
Silver (Ag)-Dissolved			85.9		%		70-130	08-OCT-19
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Sulfur (S)-Dissolved			N/A	MS-B	%		-	08-OCT-19
Tellurium (Te)-Dissolved			85.9		%		70-130	08-OCT-19
Thallium (Tl)-Dissolved			89.9		%		70-130	08-OCT-19
Thorium (Th)-Dissolved			93.0		%		70-130	08-OCT-19
Tin (Sn)-Dissolved			88.7		%		70-130	08-OCT-19
Titanium (Ti)-Dissolved			101.3		%		70-130	08-OCT-19
Tungsten (W)-Dissolved			96.6		%		70-130	08-OCT-19
Uranium (U)-Dissolved			92.4		%		70-130	08-OCT-19
Vanadium (V)-Dissolved			99.7		%		70-130	08-OCT-19
Yttrium (Y)-Dissolved			104.2		%		70-130	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-F-HMI-CCMS-VA	**Seawater**							
Batch R4861948								
WG3182665-4 MS		**L2359806-2**						
Zinc (Zn)-Dissolved			90.5		%		70-130	08-OCT-19
Zirconium (Zr)-Dissolved			100.5		%		70-130	08-OCT-19
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4861948								
WG3183295-2 LCS								
Aluminum (Al)-Total			102.4		%		80-120	08-OCT-19
Antimony (Sb)-Total			99.97		%		80-120	08-OCT-19
Arsenic (As)-Total			100.0		%		80-120	08-OCT-19
Barium (Ba)-Total			97.2		%		80-120	08-OCT-19
Beryllium (Be)-Total			104.0		%		80-120	08-OCT-19
Bismuth (Bi)-Total			114.2		%		80-120	08-OCT-19
Boron (B)-Total			97.7		%		80-120	08-OCT-19
Cadmium (Cd)-Total			103.1		%		80-120	08-OCT-19
Calcium (Ca)-Total			103.3		%		80-120	08-OCT-19
Cesium (Cs)-Total			99.6		%		80-120	08-OCT-19
Chromium (Cr)-Total			105.9		%		80-120	08-OCT-19
Cobalt (Co)-Total			104.7		%		80-120	08-OCT-19
Copper (Cu)-Total			104.6		%		80-120	08-OCT-19
Gallium (Ga)-Total			103.2		%		80-120	08-OCT-19
Iron (Fe)-Total			97.1		%		80-120	08-OCT-19
Lead (Pb)-Total			106.7		%		80-120	08-OCT-19
Lithium (Li)-Total			107.2		%		80-120	08-OCT-19
Magnesium (Mg)-Total			104.7		%		80-120	08-OCT-19
Manganese (Mn)-Total			106.4		%		80-120	08-OCT-19
Molybdenum (Mo)-Total			98.6		%		80-120	08-OCT-19
Nickel (Ni)-Total			106.2		%		80-120	08-OCT-19
Phosphorus (P)-Total			112.6		%		80-120	08-OCT-19
Potassium (K)-Total			101.2		%		80-120	08-OCT-19
Rhenium (Re)-Total			100.2		%		80-120	08-OCT-19
Rubidium (Rb)-Total			102.2		%		80-120	08-OCT-19
Selenium (Se)-Total			108.1		%		80-120	08-OCT-19
Silver (Ag)-Total			99.2		%		80-120	08-OCT-19
Strontium (Sr)-Total			98.7		%		80-120	08-OCT-19
Sulfur (S)-Total			99.98		%		80-120	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4861948								
WG3183295-2 LCS								
Tellurium (Te)-Total			113.2		%		80-120	08-OCT-19
Thallium (Tl)-Total			103.3		%		80-120	08-OCT-19
Thorium (Th)-Total			103.3		%		80-120	08-OCT-19
Tin (Sn)-Total			99.8		%		80-120	08-OCT-19
Titanium (Ti)-Total			96.3		%		80-120	08-OCT-19
Tungsten (W)-Total			103.0		%		80-120	08-OCT-19
Uranium (U)-Total			100.2		%		80-120	08-OCT-19
Vanadium (V)-Total			101.6		%		80-120	08-OCT-19
Yttrium (Y)-Total			99.1		%		80-120	08-OCT-19
Zinc (Zn)-Total			104.7		%		80-120	08-OCT-19
Zirconium (Zr)-Total			101.0		%		80-120	08-OCT-19
WG3183295-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	08-OCT-19
Antimony (Sb)-Total			<0.0010		mg/L		0.001	08-OCT-19
Arsenic (As)-Total			<0.00040		mg/L		0.0004	08-OCT-19
Barium (Ba)-Total			<0.0010		mg/L		0.001	08-OCT-19
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Boron (B)-Total			<0.30		mg/L		0.3	08-OCT-19
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	08-OCT-19
Calcium (Ca)-Total			<1.0		mg/L		1	08-OCT-19
Cesium (Cs)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Cobalt (Co)-Total			<0.000050		mg/L		0.00005	08-OCT-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Gallium (Ga)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Iron (Fe)-Total			<0.010		mg/L		0.01	08-OCT-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	08-OCT-19
Lithium (Li)-Total			<0.020		mg/L		0.02	08-OCT-19
Magnesium (Mg)-Total			<1.0		mg/L		1	08-OCT-19
Manganese (Mn)-Total			<0.00020		mg/L		0.0002	08-OCT-19
Molybdenum (Mo)-Total			<0.00010		mg/L		0.0001	08-OCT-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-HB-F-HMI-MS-VA	**Seawater**							
Batch R4861948								
WG3183295-1 MB								
Potassium (K)-Total			<1.0		mg/L		1	08-OCT-19
Rhenium (Re)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Rubidium (Rb)-Total			<0.0050		mg/L		0.005	08-OCT-19
Selenium (Se)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Silver (Ag)-Total			<0.00010		mg/L		0.0001	08-OCT-19
Strontium (Sr)-Total			<0.010		mg/L		0.01	08-OCT-19
Sulfur (S)-Total			<5.0		mg/L		5	08-OCT-19
Tellurium (Te)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Thallium (Tl)-Total			<0.000050		mg/L		0.00005	08-OCT-19
Thorium (Th)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Tin (Sn)-Total			<0.0010		mg/L		0.001	08-OCT-19
Titanium (Ti)-Total			<0.0050		mg/L		0.005	08-OCT-19
Tungsten (W)-Total			<0.0010		mg/L		0.001	08-OCT-19
Uranium (U)-Total			<0.000050		mg/L		0.00005	08-OCT-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Yttrium (Y)-Total			<0.00050		mg/L		0.0005	08-OCT-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	08-OCT-19
Zirconium (Zr)-Total			<0.00050		mg/L		0.0005	08-OCT-19
NA-D-CCMS-VA	**Seawater**							
Batch R4863006								
WG3182665-3 DUP		**L2359806-1**						
Sodium (Na)-Dissolved		4420	4540		mg/L	2.7	20	09-OCT-19
WG3182665-2 LCS								
Sodium (Na)-Dissolved			101.3		%		80-120	09-OCT-19
WG3182665-1 MB		**LF**						
Sodium (Na)-Dissolved			<2.5		mg/L		2.5	09-OCT-19
WG3182665-4 MS		**L2359806-2**						
Sodium (Na)-Dissolved			N/A	MS-B	%		-	09-OCT-19
NA-T-CCMS-VA	**Seawater**							
Batch R4863006								
WG3183295-2 LCS								
Sodium (Na)-Total			99.8		%		80-120	09-OCT-19
WG3183295-1 MB								
Sodium (Na)-Total			<2.5		mg/L		2.5	09-OCT-19
NH3-F-VA	**Seawater**							

Quality Control Report

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA		**Seawater**							
Batch	**R4860603**								
WG3183159-3	**DUP**		**L2359806-1**						
Ammonia, Total (as N)			<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	06-OCT-19
WG3183159-2	**LCS**								
Ammonia, Total (as N)				99.8		%		85-115	06-OCT-19
WG3183159-1	**MB**								
Ammonia, Total (as N)				<0.0050		mg/L		0.005	06-OCT-19
WG3183159-4	**MS**		**L2359806-2**						
Ammonia, Total (as N)				109.0		%		75-125	06-OCT-19
PH-C-PCT-VA		**Seawater**							
Batch	**R4861492**								
WG3182535-2	**CRM**		**VA-PH7-BUF**						
pH				7.04		pH		6.9-7.1	07-OCT-19
WG3182535-4	**DUP**		**L2359806-1**						
pH			7.96	7.97	J	pH	0.01	0.3	07-OCT-19
SI-D-CCMS-VA		**Seawater**							
Batch	**R4863006**								
WG3182665-3	**DUP**		**L2359806-1**						
Silicon (Si)-Dissolved			<1.0	<1.0	RPD-NA	mg/L	N/A	20	09-OCT-19
WG3182665-2	**LCS**								
Silicon (Si)-Dissolved				103.1		%		80-120	09-OCT-19
WG3182665-1	**MB**		**LF**						
Silicon (Si)-Dissolved				<1.0		mg/L		1	09-OCT-19
WG3182665-4	**MS**		**L2359806-2**						
Silicon (Si)-Dissolved				102.7		%		70-130	09-OCT-19
SI-T-CCMS-VA		**Seawater**							
Batch	**R4863006**								
WG3183295-2	**LCS**								
Silicon (Si)-Total				107.1		%		80-120	09-OCT-19
WG3183295-1	**MB**								
Silicon (Si)-Total				<1.0		mg/L		1	09-OCT-19
TKN-C-F-VA		**Seawater**							
Batch	**R4864707**								
WG3183160-3	**DUP**		**L2359806-1**						
Total Kjeldahl Nitrogen			0.091	0.096		mg/L	5.0	20	09-OCT-19
WG3183160-2	**LCS**								
Total Kjeldahl Nitrogen				106.5		%		75-125	09-OCT-19
WG3183160-1	**MB**								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-C-F-VA	**Seawater**							
Batch R4864707								
WG3183160-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	09-OCT-19
WG3183160-4 MS		**L2359806-2**						
Total Kjeldahl Nitrogen			80.0		%		70-130	09-OCT-19
TSS-C-VA	**Seawater**							
Batch R4862727								
WG3185770-2 LCS								
Total Suspended Solids			92.7		%		85-115	08-OCT-19
WG3185770-1 MB								
Total Suspended Solids			<2.0		mg/L		2	08-OCT-19
TURBIDITY-C-VA	**Seawater**							
Batch R4859803								
WG3182994-2 CRM		**VA-FORM-40**						
Turbidity			99.8		%		85-115	05-OCT-19
WG3182994-3 DUP		**L2359806-1**						
Turbidity		0.22	0.23		NTU	2.2	15	05-OCT-19
WG3182994-1 MB								
Turbidity			<0.10		NTU		0.1	05-OCT-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Turbidity by Meter in Seawater							
	1	01-OCT-19 14:00	05-OCT-19 09:36	3	4	days	EHTL
	2	01-OCT-19 13:30	05-OCT-19 09:36	3	4	days	EHTL
	3	01-OCT-19 13:45	05-OCT-19 09:36	3	4	days	EHTL
	4	01-OCT-19 14:10	05-OCT-19 09:36	3	4	days	EHTL
	5	01-OCT-19 08:00	05-OCT-19 09:36	3	4	days	EHTR
pH by Meter (Automated) (seawater)							
	1	01-OCT-19 14:00	07-OCT-19 10:25	0.25	140	hours	EHTR-FM
	2	01-OCT-19 13:30	07-OCT-19 10:25	0.25	141	hours	EHTR-FM
	3	01-OCT-19 13:45	07-OCT-19 10:25	0.25	141	hours	EHTR-FM
	4	01-OCT-19 14:10	07-OCT-19 10:25	0.25	140	hours	EHTR-FM
	5	01-OCT-19 08:00	07-OCT-19 10:25	0.25	146	hours	EHTR-FM
Bacteriological Tests							
Fecal coliform by membrane filtration							
	1	01-OCT-19 14:00	04-OCT-19 02:30	30	60	hours	EHTR
	2	01-OCT-19 13:30	04-OCT-19 02:30	30	61	hours	EHTR
	3	01-OCT-19 13:45	04-OCT-19 02:30	30	61	hours	EHTR
	4	01-OCT-19 14:10	04-OCT-19 02:30	30	60	hours	EHTR
	5	01-OCT-19 08:00	04-OCT-19 02:30	30	66	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2359806 were received on 04-OCT-19 09:15.

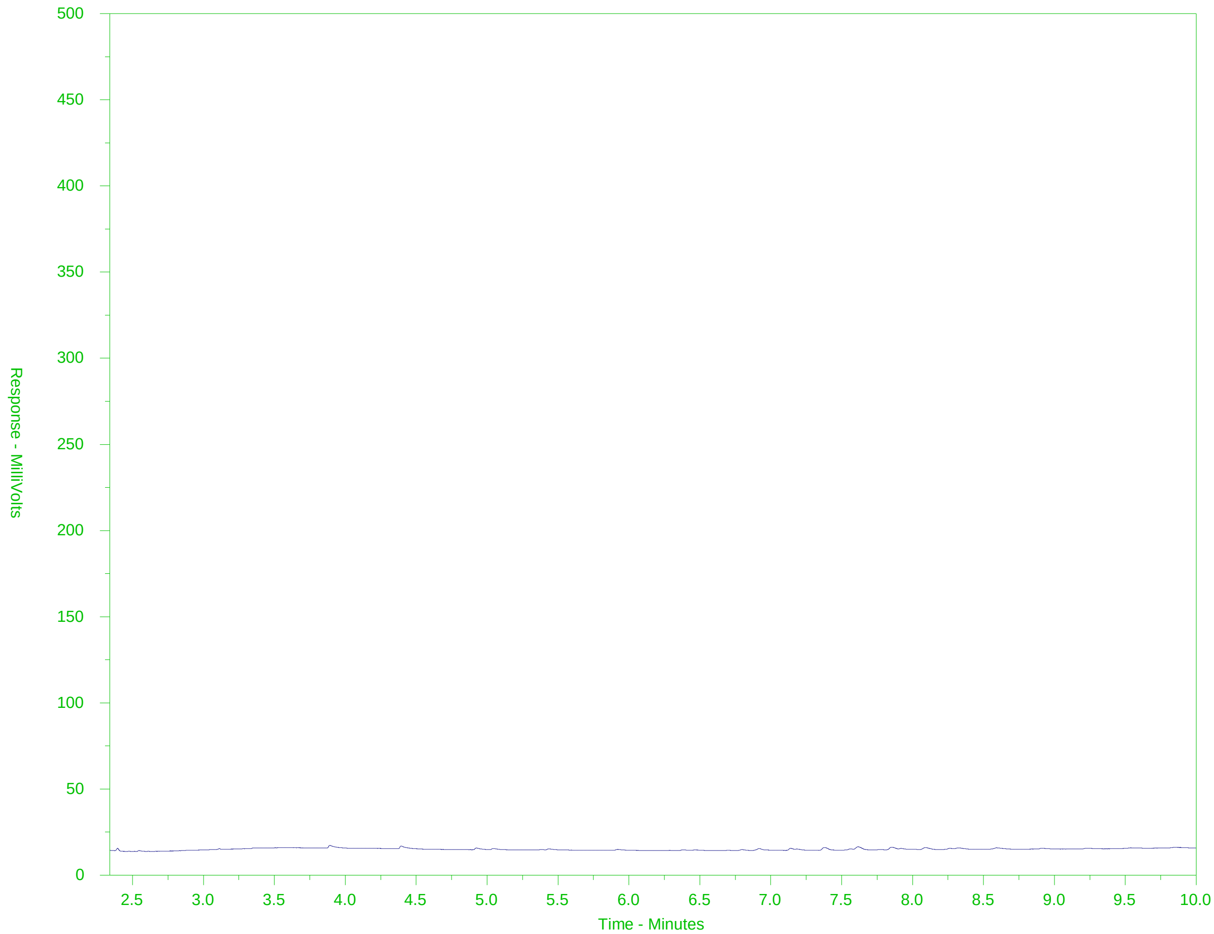
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359806-1
Client Sample ID: WNW-6



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

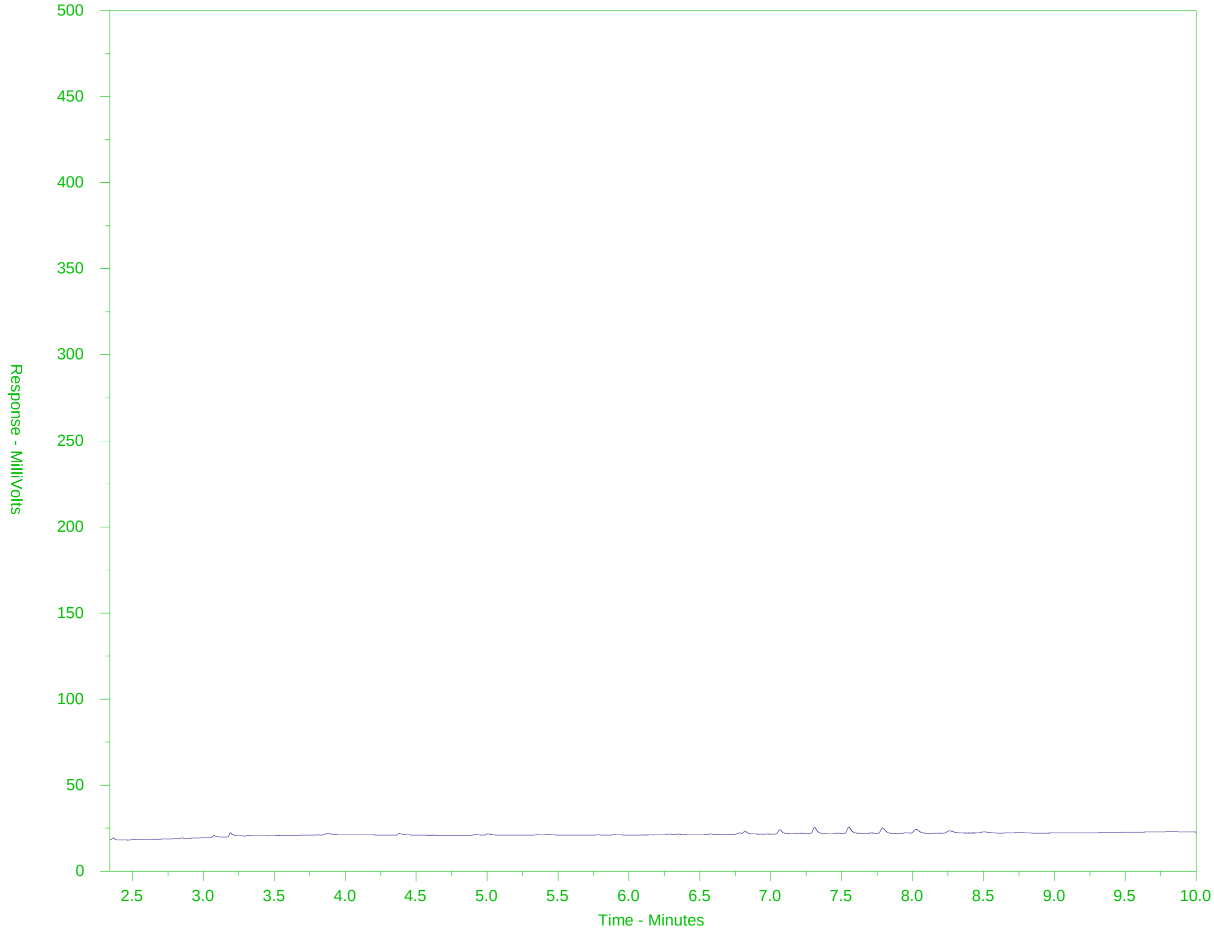
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359806-2
Client Sample ID: NORTH-6



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

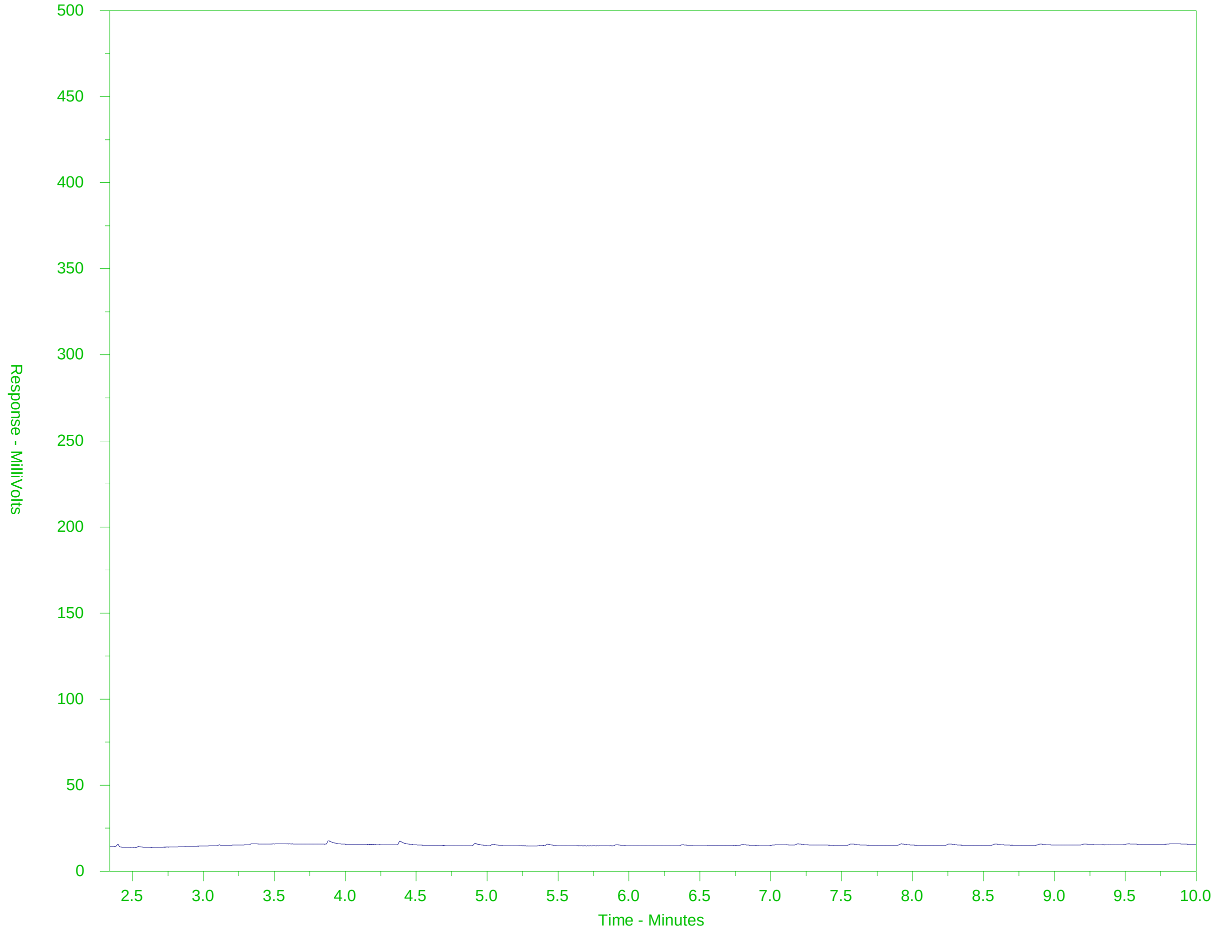
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359806-3
Client Sample ID: ENE-6



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

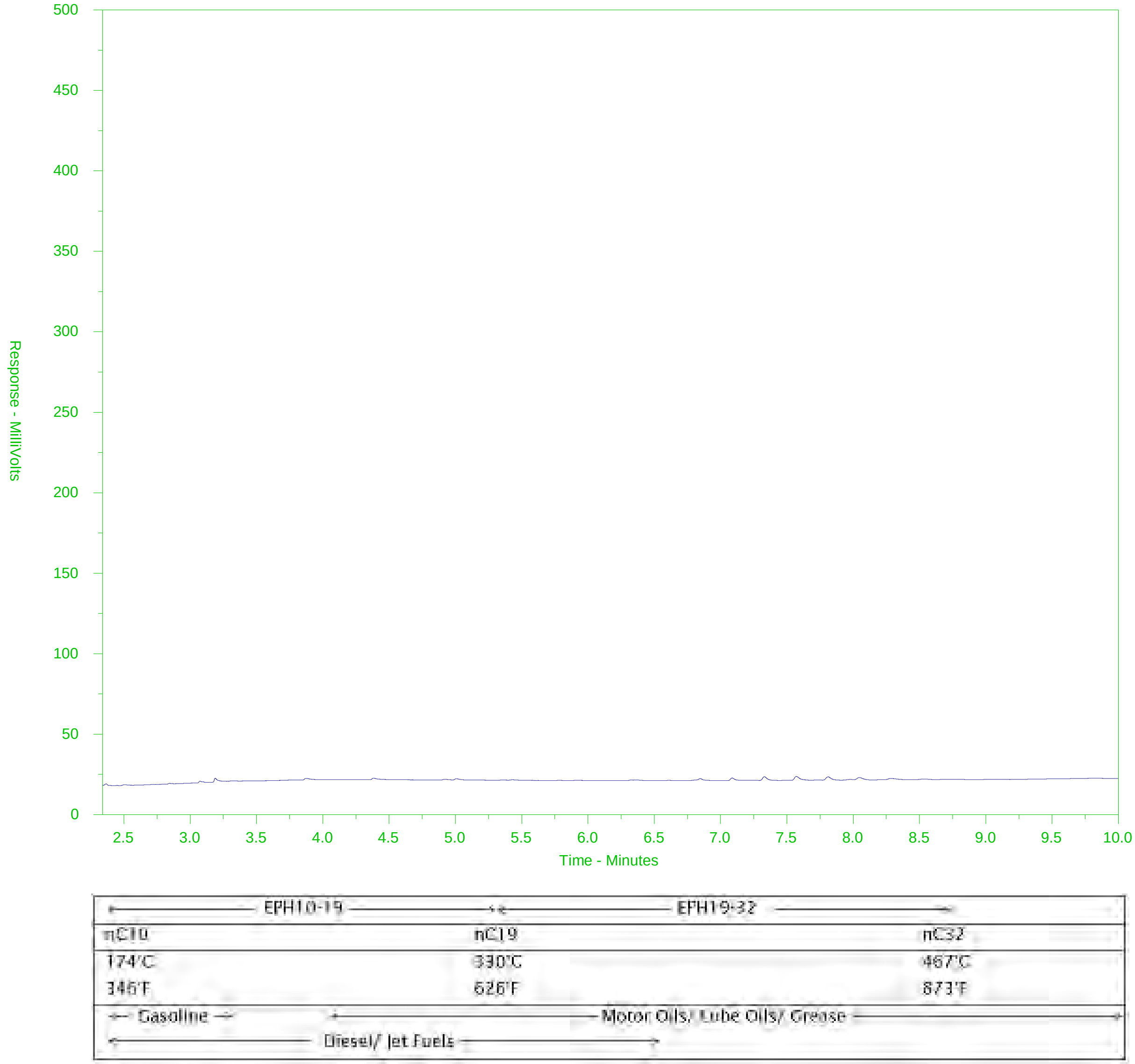
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359806-4
Client Sample ID: SOURCE-6



The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

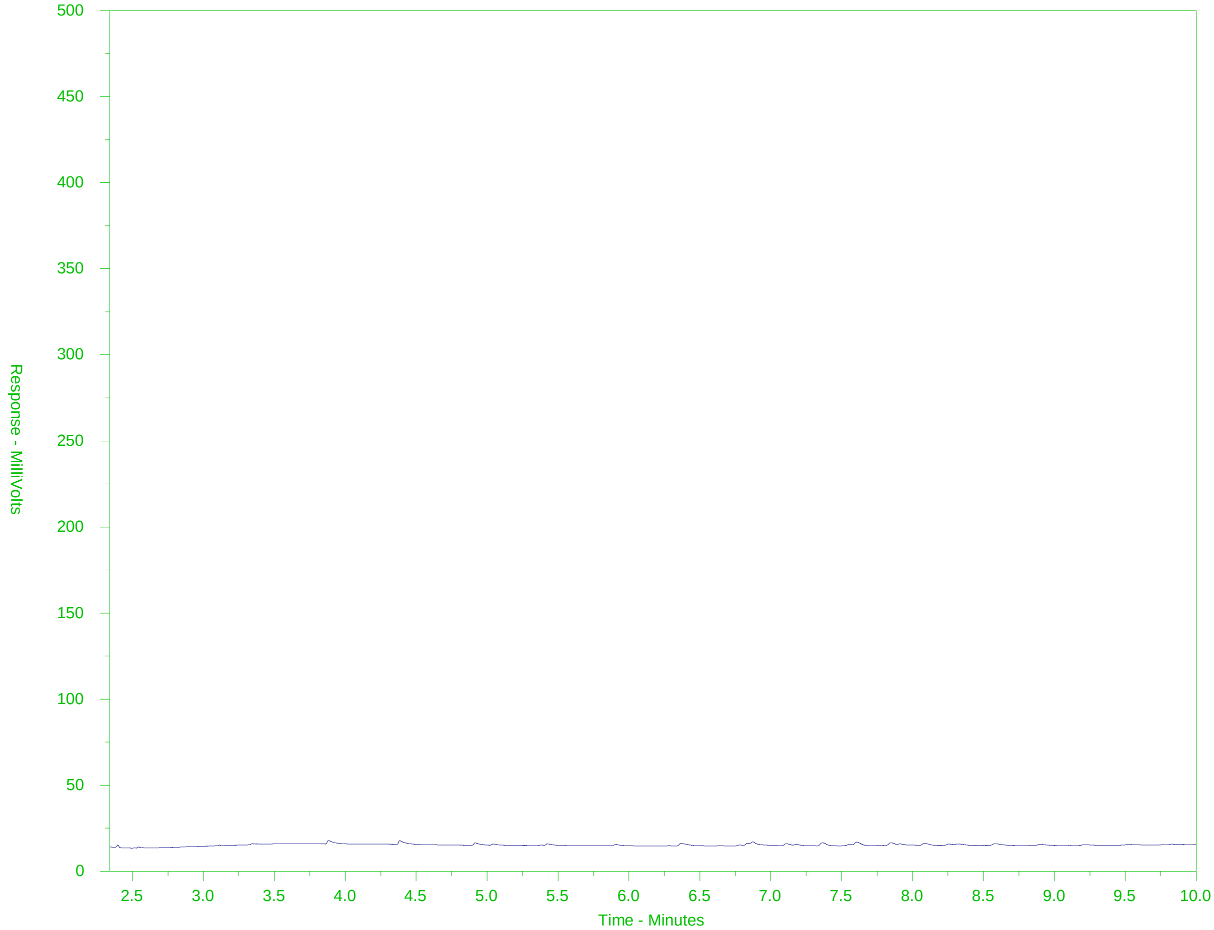
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359806-5
Client Sample ID: ENE-604



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2359806-COFC

COC Number: 15 - 560004

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Phil Rouget
Phone:	250 888-1100
	Company address below will appear on the final report
Street:	2nd floor, 3795 Carey Rd.
City/Province:	Victoria, B.C.
Postal Code:	V8Z 6T8

Invoice To	
Same as Report To	☑ YES ☐ NO
Copy of Invoice with Report	☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☐ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax prouget@golder.com

Email 2 ptomlienson@golder.com

Email 3 chlenga@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #: 1663724/24000

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact:

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General	TOC, Ammonia, TKN (P)	Dissolved Metals	Total Metals (P)	Dissolved Hg	Total Hg (P)	Hydrocarbons (P)	Fecal coliform (P)	Number of Containers
	WNW-6	01-OCT-19	14:00	Seawater	X	X	X	X	X	X	X	X	9
	North-6	↓	13:30	↓	X	X	X	X	X	X	X	X	↓
	ENE-6	↓	13:45	↓	X	X	X	X	X	X	X	X	↓
	Source-6	↓	14:10	↓	X	X	X	X	X	X	X	X	↓
	~~NR-2~~ ENE-604	↓	08:00	↓	X	X	X	X	X	X	X	X	↓

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human drinking water use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C:

FINAL COOLER TEMPERATURES °C: 13°C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: TK	Date: 4 oct 19	Time: 9:15

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WATER QUALITY SCREENING TABLE

Client Sample ID				SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE
Date Sampled		CCME Marine WQG for Protection of Aquatic Life		26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	2-Sep-19	2-Sep-19	2-Sep-19	2-Sep-19	9-Sep-19	9-Sep-19	9-Sep-19	9-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	1-Oct-19	1-Oct-19	1-Oct-19	1-Oct-19
Time Sampled	Units			9:15	9:00	8:45	9:30	9:30	10:00	9:15	9:45	9:10	9:05	9:00	9:20	14:40	14:25	14:10	14:35	16:20	13:30	13:50	14:10	14:10	14:00	13:30	13:45
ALS Sample ID				L2337246-1	L2337246-2	L2337246-3	L2337246-4	L2340208-1	L2340208-2	L2340208-3	L2340208-4	L2340688-1	L2340688-2	L2340688-3	L2340688-4	L2344898-1	L2344898-2	L2344898-3	L2344898-4	L2353810-4	L2353810-1	L2353810-2	L2359806-3	L2359806-4	L2359806-1	L2359806-2	L2359806-3
Parameter		Short Term	Long Term	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater
Physical Parameters																											
Salinity (calculated by Golder)	mg/L			31500	30700	31300	31300	30900	29200	29500	31200	10400	12800	6400	12400	12900	14300	15000	14300	23000	22100	24400	23200	13800	19500	12900	14600
Conductivity	µS/cm			47300	46300	47100	47100	46300	44000	44400	46700	17200	20800	10900	20200	20700	22700	23800	22800	36100	34900	38100	36500	20600	28200	19300	21600
Hardness (as CaCO3)																											
pH	pH Units		7.0-8.7	7.97	7.97	7.97	7.98	8	8.01	8.01	8.01	8.14	8.13	8.2	8.13	8.09	8.07	8.08	8.08	7.96	7.96	7.93	7.96	8.02	7.96	8.03	8.01
Total Suspended Solids	mg/L	< 25 mg/L above background	< 5mg/L above background	2	< 2.0	< 2.0	2	< 2.0	< 2.0	< 2.0	2.9	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.2	2.6	< 2.0	< 2.0	< 2.0	< 2.0
Turbidity	NTU	<8 NTU above background	<2 NTU above background	0.15	0.15	0.13	< 0.10	0.18	< 0.10	0.24	0.64	0.49	0.65	0.46	0.67	0.29	0.47	0.29	0.34	0.31	0.33	0.26	0.3	0.27	0.22	0.28	0.44
Anions and Nutrients																											
Alkalinity, Total (as CaCO3)	mg/L			112	112	112	112	116	115	116	117	113	116	115	115	112	110	108	109	106	107	105	107	111	108	112	111
Ammonia, Total (as N)	µg/L			< 5.0	< 5.0	< 5.0	< 5.0	16.1	5.3	< 5.0	5.1	< 5.0	7.5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5.5	< 5.0	< 5.0	< 5.0	< 5.0
Bromide (Br)	mg/L			53.6	59.5	58.7	57.2	59.1	55.1	55.3	62.1	18	20.5	11	20.3	25.3	28.3	29.6	28.1	43.7	43.7	45.2	44.9	25.7	30.4	22.8	26.9
Chloride (Cl)	mg/L			15400	16900	16800	16200	17300	16100	16000	17800	5410	6190	3240	6000	7270	7800	8520	7830	12700	12700	13200	12900	7300	8660	6730	7620
Fluoride (F)	µg/L			< 1.0	1	< 1.0	< 1.0	1.1	< 1.0	< 1.0	1.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nitrate (as N)	mg/L	1500	200	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Nitrite (as N)	mg/L			< 0.100	< 0.100	< 0.100	< 0.100	<0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.12	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Total Kjeldahl Nitrogen	mg/L			0.139	0.116	0.091	0.088	< 0.101	0.131	0.113	0.09	0.204	0.227	0.25	0.218	0.123	0.105	0.082	0.097	0.092	0.098	0.09	0.082	0.084	0.091	0.07	< 0.050
Sulfate (SO4)	mg/L			2100	2330	2300	2220	< 102	2230	2250	2510	718	819	411	788	1030	1090	1190	1090	1730	1750	1820	1760	1010	1200	931	1050
Organic / Inorganic Carbon																											
Total Organic Carbon	mg/L			1.96	1.77	1.72	1.13	1.15	1.06	1.14	1.19	1.44	1.67	1.36	1.46	1.06	0.98	1.06	1.39	0.97	1.11	0.96	1	1.17	1.24	1.47	1.18
Bacteriological Tests																											
Coliform Bacteria - Fecal	CFU/100mL			< 1	< 1	< 1	< 1	< 10	< 10	< 10	< 10	1	1	< 1	2	0	0	0	0	1	1	< 1	2	2	1	1	< 1
Total Metals																											
Aluminum (Al)-Total	µg/L			14.2	6.8	5.6	< 5.0	< 5.0	5	9.4	26.1	12.1	334	48	21.6	10	9.5	12	8.2	10.5	7.8	11.6	9.6	8.7	6.9	10.1	9.8
Antimony (Sb)-Total	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic (As)-Total	µg/L		12.5	1.62	1.53	1.58	1.52	1.36	1.29	1.37	1.39	0.54	0.55	< 0.40	0.61	0.74	0.74	0.78	0.7	1.08	1.03	1.22	1.19	0.68	0.73	0.64	0.77
Barium (Ba)-Total	µg/L			9.5	9.3	9.5	9.5	8.1	8.3	7.7	8.7	6.9	6.7	6.3	6.9	7.3	7.8	7.5	7.6	8.5	8.1	8.8	8.4	6.7	6.1	6.5	6.7
Beryllium (Be)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bismuth (Bi)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Boron (B)-Total	µg/L			3340	3050	3100	2770	4090	3910	3910	4130	1500	1470	1010	1700	1690	1750	1870	1780	3490	3240	3520	3480	1640	1700	1460	1710
Cadmium (Cd)-Total	µg/L		0.12	0.041	0.039	0.046	0.034	0.034	0.04	0.03	0.03	0.015	0.013	< 0.010	0.02	0.013	0.015	0.016	0.012	0.038	0.037	0.039	0.041	0.016	0.028	0.019	0.017
Calcium (Ca)-Total	µg/L			402	386	396	366	354	351	365	383	146	140	98.7	165	172	185	191	198	285	271	309	279	194	194	173	201
Cesium (Cs)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chromium (Cr)-Total	µg/L		1.5 (Cr(VI))	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.54	< 0.50
Cobalt (Co)-Total	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Copper (Cu)-Total	µg/L			< 0.50	0.81	1.27	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.68	< 0.50	< 0.50	< 0.50	1.08	0.67	< 0.50	5.87	1.74	4.6	5.33	11	< 0.50	1.03	1.74
Gallium (Ga)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Iron (Fe)-Total	µg/L			18	< 10	< 10	< 10	< 10	< 10	< 10	20	14	20	15	20	18	14	12	10	19	13	16	16	11	< 10	15	16
Lead (Pb)-Total	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.061	< 0.050	0.12	< 0.050	0.053	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.067	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Lithium (Li)-Total	µg/L			144	130	129	122	151	141	141	159	54	52	33	63	67	71	72	74	104	97	108	102	70	75	62	73
Magnesium (Mg)-Total	mg/L			972	964	967	983	992	985	975	1050	367	354	217	431	446	511	564	509	849	784	891	830	479	523	404	488
Manganese (Mn)-Total	µg/L			0.79	1	0.84	0.7	0.69	0.87	0.78	1.48	1.13	1.71	1.13	2.66	1.31	0.99	0.97	0.92	1.14	0.93	1.23	1.59	0.93	0.82	0.95	1.06
Mercury (Hg)-Total	µg/L		0.016	0.005	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Molybdenum (Mo)-Total	µg/L			10.9	10.6	10.6	10.3	10.2	9.65	9.37	10.3	3.29	3.59	2.05	3.93	4.53	4.97	5.06	4.95	7.57	7.28	7.54	7.57	4.33	4.82	4.01	4.47
Nickel (Ni)-Total	µg/L			< 0.50	0.54	0.6	0.57	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.57	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phosphorus (P)-Total	µg/L			< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Potassium (K)-Total	mg/L			432	410	408	423	355	338	331	364	114	118	69.6	134	153	169	181	170	278	255	288	275	155	168	135	158
Rhenium (Re)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Rubidium (Rb)-Total	µg/L			117	111	113	115	89.4	87.7	88.1	96.1	32.6	33.4	21	38.8	44.5	49.3	50.8	50.7	71.1	65.1	75.7	70	43.6	49.9	38.3	47.3
Selenium (Se)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silicon (Si)-Total	µg/L			< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
Silver (Ag)-Total	µg/L	7.5		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Sodium (Na)-Total	mg/L			9470	9000	9170	9300	9610	9080	8860	9730	3110	3150	2030	3680	4320	4720	4940	4780	7850	6840	7820	7320	4130	5440	3780	4230
Strontium (Sr)-Total	mg/L			7.5	7.57	7.46	7.4	7.12	6.6	6.75	7.3	2.26	2.38	1.37	2.68	2.79	3.41	3.4	3.37	5.15	4.95	5.42	5.38	2.9	3.29	2.61	3.08
Sulfur (S)-Total	mg/L			1070	1060	1090	1050	857	844	847	952	270	282	168	324	401	445	475	447	717	672	718	669	386	410	327	399
Tellurium (Te)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thallium (Tl)-Total	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.058	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Thorium (Th)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Tin (Sn)-Total	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Titanium (Ti)-Total	µg/L			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Tungsten (W)-Total	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Uranium (U)-Total	µg/L			2.93	2.76	2.88	2.7	2.88	2.77	2.68	2.9	2.98	4.2	3.19	3.22	2.88	2.53	2.58	2.7	2.58	2.41	2.51	2.6	2.82	2.41	2.82	2.96
Vanadium (V)-Total	µg/L			1.57	1.42	1.4	1.42	1.1	1	1.01	1.13	< 0.50	< 0.50	< 0.50	< 0.50	0.57	0.66	0.67	0.65	1.19	1.05	1.19	1.11	0.64	0.74	0.6	0.72
Yttrium (Y)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Zinc (Zn)-Total	µg/L			< 3.0	< 3.0	< 3.0	3.4	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	4.3	< 3.0	< 3.0	< 3.0	< 3.0
Zirconium (Zr)-Total	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.51	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Client Sample ID		CCME Marine WQG for Protection of Aquatic Life		SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE
Date Sampled				26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	2-Sep-19	2-Sep-19	2-Sep-19	2-Sep-19	9-Sep-19	9-Sep-19	9-Sep-19	9-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	1-Oct-19	1-Oct-19	1-Oct-19	1-Oct-19
Time Sampled	Units			9:15	9:00	8:45	9:30	9:30	10:00	9:15	9:45	9:10	9:05	9:00	9:20	14:40	14:25	14:10	14:35	16:20	13:30	13:50	14:10	14:10	14:00	13:30	13:45
ALS Sample ID				L2337246-1	L2337246-2	L2337246-3	L2337246-4	L2340208-1	L2340208-2	L2340208-3	L2340208-4	L2340688-1	L2340688-2	L2340688-3	L2340688-4	L2344898-1	L2344898-2	L2344898-3	L2344898-4	L2353810-4	L2353810-1	L2353810-2	L2359806-3	L2359806-4	L2359806-1	L2359806-2	L2359806-3
Parameter		Short Term	Long Term	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater
Dissolved Metals																											
Aluminum (Al)-Dissolved	µg/L			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony (Sb)-Dissolved	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic (As)-Dissolved	µg/L			1.54	1.48	1.57	1.49	1.53	1.39	1.43	1.5	0.47	0.46	< 0.40	0.58	0.67	0.73	0.76	0.78	1.16	1.11	1.23	1.14	0.67	0.77	0.76	0.57
Barium (Ba)-Dissolved	µg/L			7.6	7.7	7.8	8	8.5	8.4	8.2	8.2	6.6	6.7	5.9	6.9	6.7	7.7	7.5	7.5	8.8	8	8.7	8.2	6.8	6.5	6.9	6.6
Beryllium (Be)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bismuth (Bi)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Boron (B)-Dissolved	µg/L			3710	3550	3250	3020	3620	3400	3400	3540	1350	1320	850	1520	1740	1840	1940	1850	3380	3130	3640	3480	1690	1810	1770	1550
Cadmium (Cd)-Dissolved	µg/L			0.028	0.023	0.025	0.024	0.038	0.038	0.04	0.035	0.011	< 0.010	< 0.010	< 0.010	0.013	0.015	0.014	0.013	0.026	0.041	0.032	0.038	0.015	0.019	0.017	0.011
Calcium (Ca)-Dissolved	µg/L			361	367	360	359	378	379	383	396	133	140	87.4	159	176	199	192	184	285	269	317	282	190	203	199	172
Cesium (Cs)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chromium (Cr)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cobalt (Co)-Dissolved	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Copper (Cu)-Dissolved	µg/L			0.25	0.55	0.81	0.2	< 0.20	0.27	< 0.20	< 0.20	0.38	0.68	0.31	0.36	0.34	0.93	0.47	0.33	1.31	0.73	2.46	1.86	4.51	1.46	0.26	0.27
Gallium (Ga)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Iron (Fe)-Dissolved	µg/L			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Lead (Pb)-Dissolved	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Lithium (Li)-Dissolved	µg/L			145	135	117	112	164	148	150	152	54	51	30	63	68	76	76	76	106	102	109	105	71	76	74	64
Magnesium (Mg)-Dissolved	mg/L			1120	1070	1060	1030	1090	1070	1090	1110	345	335	184	427	461	508	557	543	873	811	919	885	484	545	522	437
Manganese (Mn)-Dissolved	µg/L			0.43	0.67	0.51	0.43	0.51	0.63	0.44	0.75	0.54	0.66	0.52	1.76	0.56	0.32	0.31	0.34	0.65	0.6	0.69	1.22	0.66	0.51	0.64	0.5
Mercury (Hg)-Dissolved	µg/L			< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Molybdenum (Mo)-Dissolved	µg/L			10.1	10	10.3	10.1	10.6	10.3	9.95	10.7	3.14	3.17	1.8	3.82	4.33	4.82	4.98	4.64	7.65	7.11	8.05	7.69	4.41	4.4	4.54	3.76
Nickel (Ni)-Dissolved	µg/L			< 0.50	< 0.50	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Phosphorus (P)-Dissolved	µg/L			< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Potassium (K)-Dissolved	mg/L			358	347	358	349	350	341	347	361	103	101	58.1	132	150	160	175	170	286	265	300	284	151	168	164	136
Rhenium (Re)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Rubidium (Rb)-Dissolved	µg/L			107	105	110	108	104	97.6	100	104	32.2	31.6	17.4	39.6	44.9	48.5	51.4	51.4	75.4	70	78.1	74.5	44.4	47.1	46.6	40.1
Selenium (Se)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Silicon (Si)-Dissolved	µg/L			< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000	< 1000
Silver (Ag)-Dissolved	µg/L			< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Sodium (Na)-Dissolved	mg/L			10600	10500	10700	11100	9200	8620	8760	9570	3170	3130	1800	3870	4280	4830	5000	4840	7120	6900	7140	7170	4260	4420	4540	3700
Strontium (Sr)-Dissolved	mg/L			6.88	6.64	7.04	6.79	7.32	7.26	7.11	7.63	2.21	2.24	1.24	2.58	2.82	3.35	3.52	3.17	5.48	4.91	5.82	5.3	2.98	3.18	3.12	2.65
Sulfur (S)-Dissolved	mg/L			973	932	916	928	990	932	942	1010	276	258	150	330	391	434	457	448	741	618	800	722	393	420	394	350
Tellurium (Te)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thallium (Tl)-Dissolved	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Thorium (Th)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Tin (Sn)-Dissolved	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Titanium (Ti)-Dissolved	µg/L			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Tungsten (W)-Dissolved	µg/L			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Uranium (U)-Dissolved	µg/L			2.63	2.8	2.77	2.64	3.47	3.13	2.85	3.12	3.11	4.06	2.88	3.36	2.86	2.68	2.65	2.59	2.48	2.64	2.36	2.58	2.76	2.63	2.85	2.99
Vanadium (V)-Dissolved	µg/L			1.33	1.24	1.33	1.3	1.3	1.24	1.25	1.27	< 0.50	< 0.50	< 0.50	< 0.50	0.56	0.51	0.61	0.63	1.02	0.96	1.06	1	0.66	0.65	0.65	0.53
Yttrium (Y)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Zinc (Zn)-Dissolved	µg/L			< 1.0	1.1	1.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1	1.1	4.3	< 1.0	< 1.0	< 1.0	< 1.0
Zirconium (Zr)-Dissolved	µg/L			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Client Sample ID		CCME Marine WQG for Protection of Aquatic Life		SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE
Date Sampled				26-Aug-19	26-Aug-19	26-Aug-19	26-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19	2-Sep-19	2-Sep-19	2-Sep-19	2-Sep-19
Time Sampled	Units			9:15	9:00	8:45	9:30	9:30	10:00	9:15	9:45	9:10	9:05	9:00	9:20
ALS Sample ID				L2337246-1	L2337246-2	L2337246-3	L2337246-4	L2340208-1	L2340208-2	L2340208-3	L2340208-4	L2340688-1	L2340688-2	L2340688-3	L2340688-4
Parameter		Short Term	Long Term	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater
Hydrocarbons															
EPH10-19	µg/L			< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
EPH19-32	µg/L			< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
LEPH	µg/L			< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
HEPH	µg/L			< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
2-Bromobenzotrifluoride															
Polycyclic Aromatic Hydrocarbons															
Acenaphthene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acridine	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Anthracene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benz(a)anthracene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(a)pyrene	µg/L			< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Benzo(b&j)fluoranthene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(b+j+k)fluoranthene	µg/L			< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Benzo(g,h,i)perylene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(k)fluoranthene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chrysene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)anthracene	µg/L			< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Fluoranthene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)pyrene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1-Methylnaphthalene	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Methylnaphthalene	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	µg/L		1.4	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	µg/L			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Pyrene	µg/L			< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Quinoline	µg/L			< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

Client Sample ID		SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE	SOURCE	WNW	NORTH	ENE
Date Sampled		9-Sep-19	9-Sep-19	9-Sep-19	9-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	23-Sep-19	1-Oct-19	1-Oct-19	1-Oct-19	1-Oct-19
Time Sampled	Units	14:40	14:25	14:10	14:35	16:20	13:30	13:50	14:10	14:10	14:00	13:30	13:45
ALS Sample ID		L2344898-1	L2344898-2	L2344898-3	L2344898-4	L2353810-4	L2353810-1	L2353810-2	L2359806-3	L2359806-4	L2359806-1	L2359806-2	L2359806-3
Parameter		Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater
Hydrocarbons													
EPH10-19	µg/L	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
EPH19-32	µg/L	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
LEPH	µg/L	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
HEPH	µg/L	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
2-Bromobenzotrifluoride													
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acridine	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Anthracene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benz(a)anthracene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(a)pyrene	µg/L	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Benzo(b&j)fluoranthene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(b+j+k)fluoranthene	µg/L	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Benzo(g,h,i)perylene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(k)fluoranthene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chrysene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)anthracene	µg/L	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Fluoranthene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)pyrene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1-Methylnaphthalene	µg/L	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Methylnaphthalene	µg/L	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	µg/L	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	µg/L	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Pyrene	µg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Quinoline	µg/L	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

Notes: µg/L = microgram per litre; mg/L = milligram per litre; < = less than; µS/cm = micro siemens per centimeter; WQG = Water quality guideline; CCME = Canadian Council of Ministers of the Environment; NTU = nephelometric turbidity unit; CaCO3 = Calcium carbonate; CFU/100ml = colony forming unit per 100 millilitres; NA = not applicable; % = percentage

Values — Exceeds CCME short term marine water quality guideline for the protection of aquatic life

Values — Exceeds CCME long term marine water quality guideline for the protection of aquatic life

Table B-3: MEEMP Annual Comparisons Table

		2015				2016				2017				2018				2019			
Parameter	**Units**	**Overall Mean**	**Overall Min**	**Overall Max**	**Overall Std. Dev.**	**Overall Mean**	**Overall Min**	**Overall Max**	**Overall Std. Dev.**	**Overall Mean**	**Overall Min**	**Overall Max**	**Overall Std. Dev.**	**Overall Mean**	**Overall Min**	**Overall Max**	**Overall Std. Dev.**	**Overall Mean**	**Overall Min**	**Overall Max**	**Overall Std. Dev.**
Conventional Parameters																					
pH	pH	7.8	7.5	7.9	0.1	7.9	7.7	7.9	0.1	7.8	7.0	8.0	0.3	8.0	7.1	8.1	0.2	8.0	7.9	8.2	0.1
Total Alkalinity	mg·L^{-1}	91	86	98	4	90	83	100	6	85	45	105	18	90	80	99	6	112	105	117	3
Conductivity	uS·cm^{-1}	29417	23000	33000	3013	29390	8800	47000	15000	22666	7470	38400	12055	14743	9460	29800	5915	31817	10900	47300	12165
Hardness	mg·L^{-1}	3358	2600	3800	315	3382	930	5500	1837	2467	828	4220	1326	1521	876	3440	677	-	-	-	-
Turbidity	NTU	0.23	0.05	0.92	0.23	0.43	0.10	0.99	0.26	1.06	0.27	9.60	2.05	0.76	0.21	2.52	0.57	0.32	<0.1	0.67	0.17
TSS	mg·L^{-1}	1.20	0.50	2.20	0.57	1.61	1.00	3.00	0.71	4.44	2.00	25.50	6.69	2.19	<2	4.30	0.57	2.07	<2	2.90	0.22
Total Organic Carbon	mg·L^{-1}	0.99	0.25	1.70	0.56	0.71	0.55	0.92	0.12	9.25	1.07	31.80	10.76	1.27	0.92	1.77	0.23	1.28	0.96	1.96	0.28
Nutrients																					
Nitrite	mg·L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.11	<0.1	0.18	0.02	<0.1	<0.1	<0.1	0.00	0.10	<0.1	0.12	0.00
Nitrate	mg·L^{-1}	0.04	0.03	0.16	0.04	0.16	0.05	0.58	0.24	<0.5	<0.5	<0.5	0.00	<0.5	<0.5	<0.5	0.00	<0.5	<0.5	<0.5	0.00
Nitrogen (Ammonia Nitrogen)	mg·L^{-1}	0.390	0.170	0.870	0.180	0.150	0.060	0.230	0.050	<0.005	<0.005	<0.005	0.000	0.005	<0.005	0.014	0.002	0.006	<0.005	0.002	0.002
Major Ions																					
Total Calcium	mg·L^{-1}	227	180	250	18	230	76	380	119	189	64	335	103	114	76	229	43	259	99	402	97
Total Magnesium	mg·L^{-1}	680	520	770	65	674	180	1100	368	495	150	829	272	296	178	674	137	689	217	1050	267
Total Potassium	mg·L^{-1}	212	170	240	20	207	54	350	117	149	46	275	82	88	49	200	42	245	70	432	114
Total Sodium	mg·L^{-1}	5583	4300	6300	527	5595	1500	9100	3098	4139	1300	7490	2271	2351	1410	5390	1101	6348	2030	9730	2549
Dissolved Chloride	mg·L^{-1}	107,67	8500	13000	1410	10100	2800	17000	5494	8654	2290	14900	4992	4623	2950	9550	1859	11107	3240	17800	4637
Dissolved Sulphate	mg·L^{-1}	1101	790	1300	164	1119	340	1900	507	1220	319	2100	709	626	396	1330	262	1530	411	2510	649
Metals																					
Total Aluminum	µg·L^{-1}	-	-	50.0	-	16.0	9.0	25.0	7.0	25.4	7.7	142.0	29.7	18.0	47.8	9.1	9.6	25.3	5.0	334.0	66.4
Total Antimony	µg·L^{-1}	<10	<10	<10	<10	<10	<10	<10	<10	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<1	<1	<1	0.0
Total Arsenic	µg·L^{-1}	<10	<10	<10	<10	<10	<10	<10	<10	<2	<2	<2	0.00	<2	<2	<2	0.00	1.00	<0.4	1.62	0.39
Total Barium	µg·L^{-1}	<10	<10	<10	<10	5.80	5.20	6.70	0.50	6.74	4.60	9.30	1.69	5.68	4.60	8.00	0.95	7.81	6.10	9.50	1.07
Total Beryllium	µg·L^{-1}	<10	<10	<10	<10	<10	<10	<10	<10	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Bismuth	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Boron	µg·L^{-1}	2450	2000	2900	278	2501	660	4400	1444	2038	600	3710	1176	1193	2610	710	557	2555	1010	4130	1026
Total Cadmium	µg·L^{-1}	<0.01	<0.01	<0.01	<0.01	0.016	0.013	0.018	0.003	<0.05	<0.05	<0.05	0.000	<0.05	<0.05	<0.05	0.000	0.027	<0.01	0.046	0.012
Total Cesium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Chromium	µg·L^{-1}	<10	<10	<10	<10	<10	<10	<10	<10	<0.5	<0.5	<0.5	0.00	<0.5	<0.5	<0.5	0.00	0.50	<0.5	0.54	0.01
Total Cobalt	µg·L^{-1}	<4	<4	<4	<4	<4	<4	<4	<4	0.06	<0.05	0.15	0.03	<0.05	<0.05	<0.05	0.00	<0.05	<0.05	<0.05	0.00
Total Copper	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	0.61	<0.5	0.97	0.15	0.59	<0.5	0.88	0.15	1.74	<0.5	11.00	2.52
Total Gallium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Iron	µg·L^{-1}	<500	<500	<500	<500	<500	<500	<500	<500	37.1	<10	286.0	60.5	25.3	<10	93.0	21.1	14.0	<10	20.0	3.7
Total Lead	µg·L^{-1}	<5	<5	<5	<5	<5	<5	<5	<5	0.30	<0.3	0.35	0.01	<0.3	<0.3	<0.3	0.00	0.05	<0.05	0.12	0.01
Lithium	µg·L^{-1}	-	-	-	-	-	-	-	-	87.4	30.0	171.0	52.9	45.6	101.0	27.0	20.8	95.6	33.0	159.0	36.5
Total Manganese	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	1.42	0.64	6.54	1.29	1.35	3.66	0.79	0.70	1.11	0.69	2.66	0.42
Total Mercury	µg·L^{-1}	0.010	0.010	0.030	0.010	<0.013	<0.013	<0.013	<0.013	0.011	<0.01	<0.03	0.004	<0.01	<0.01	<0.01	0.000	<0.005	<0.005	<0.005	0.000
Total Molybdenum	µg·L^{-1}	<20	<20	<20	<20	2.90	2.10	3.60	0.60	4.89	<2	9.30	2.73	2.87	<2	6.30	1.25	6.75	2.05	10.90	2.87
Total Nickel	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	<0.5	<0.5	<0.5	0.000	<0.5	<0.5	<0.5	0.000	0.512	<0.5	0.600	0.028
Total Phosphorus	µg·L^{-1}	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	430.0	<50	<1000	477.5	<50	<50	<50	0.0	<50	<50	<50	0.0
Total Rhenium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Rubidium	µg·L^{-1}	-	-	-	-	-	-	-	-	57.2	18.2	109.0	34.0	29.0	66.3	17.1	13.8	66.6	21.0	117.0	29.3
Total Selenium	µg·L^{-1}	<10	<10	<10	<10	<10	<10	<10	<10	<2	<2	<2	0.0	<2	<2	<2	0.0	<0.5	<0.5	<0.5	0.0
Total Silicon	µg·L^{-1}	-	-	-	-	-	-	-	-	800.0	<500	<1000	251.3	<1000	<1000	<1000	0.0	<1000	<1000	<1000	0.0
Total Silver	µg·L^{-1}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.0	<0.1	<0.1	<0.1	0.0	<0.1	<0.1	<0.1	0.0
Total Strontium	µg·L^{-1}	4067	3100	4600	370	4155	1200	7000	2316	2780	896	4610	1378	1802	3980	1140	789	4673	1370	7570	2087
Total Sulfur	µg·L^{-1}	-	-	-	-	-	-	-	-	482083	177000	656000	207923	222316	514000	137000	104842	620000	168000	1090000	293840
Total Tellurium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Thallium	µg·L^{-1}	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	0.000	0.050	<0.05	0.057	0.002	0.050	<0.05	0.058	0.002
Total Thorium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Tin	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	<1	<1	<1	0.0	<1	<1	<1	0.0	<1	<1	<1	0.0
Total Titanium	µg·L^{-1}	<20	<20	<20	<20	2.6	2.6	2.6	NA	5.2	<5	8.8	0.8	<5	<5	<5	0.0	<5	<5	<5	0.0
Total Tungsten	µg·L^{-1}	-	-	-	-	-	-	-	-	<1	<1	<1	0.0	<1	<1	<1	0.0	<1	<1	<1	0.0
Total Uranium	µg·L^{-1}	2.13	2.00	2.30	0.11	2.30	1.40	3.20	0.70	2.06	0.93	4.23	0.77	1.81	2.81	1.15	0.44	2.83	2.41	4.20	0.36
Total Vanadium	µg·L^{-1}	<20	<20	<20	<20	<20	<20	<20	<20	0.69	<0.5	1.37	0.26	0.52	<0.5	0.69	0.06	0.91	<0.5	1.57	0.34
Total Yttrium	µg·L^{-1}	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0	<0.5	<0.5	<0.5	0.0
Total Zinc	µg·L^{-1}	<50	<50	<50	<50	15.0	5.0	25.0	14.0	3.2	<3	4.3	0.4	3.0	3.1	3.0	0.0	3.1	<3	4.3	0.3
Total Zirconium	µg·L^{-1}	-	-	-	-	-	-	-	-	0.51	<0.5	0.70	0.04	<0.5	<0.5	<0.5	0.00	0.50	<0.5	0.51	0.00

Notes; Min = minimum; Max = maximum; Std. Dev. = Standard Deviation; TSS=Total Suspended Solids; mg/L = miligrams per liter; uS/cm = micro siemens per centimetre; NTU = nephelometric turbidity unit; µg/L = micrograms per liter; < = less than; NA = not applicable; - = no value recorded

APPENDIX C

Sediment Quality Analysis Data

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 21 September 2019

Inspected by: TT/CB

Station Number (ID): BE-1

Sampling Method: ~~Ponar~~, Van Veen

Weather: Clear skies, -1 to -3°C

Lat/Longitude: WP012 0503907, 7976716

Sampling Depth: 12.1m / 3.8°C

# of Attempts to Obtain Sample: Ponar IIII / Van Veen IIII

Time of Collection: 15:00 - 15:45

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Grab 2 - sea urchin caught in jaws of grab
Too many attempts with Ponar so switching back to Van Veen

Approx % collected in grab sample 50%, Van Veen Grab 2 - 40%, 3 - 55%, 4 - 55% %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ ~~PAH~~
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	22 Sept. 2019	Inspected by:	TY
Station Number (ID):	BE-2	Sampling Method:	Ponar
Weather:	Overcast, -1 to -4°C	Lat/Longitude:	WP13
Sampling Depth:	10.3m		
# of Attempts to Obtain Sample:	~~HHH~~ III	Time of Collection:	13:40 - 14:02

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 3rd (25%), 4th (25%), 8th (40%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 22 Sept. 2019

Inspected by: TT

Station Number (ID): BE-3

Sampling Method: Ponar

Weather: Overcast, -1 to -4°C

Lat/Longitude: WP016 504106; 7976701

Sampling Depth: 18.6 m

# of Attempts to Obtain Sample: ~~||||~~

Time of Collection: 15:30 – 15:50

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1st (40%), 2nd (35%), 5th (40%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______

# of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Date: 22 Sept. 2014

Station Number (ID): BE-4

Weather: Overcast, -1 to -4°C

Sampling Depth: 14.0 m

# of Attempts to Obtain Sample: IIII

Project Title: Baffinland MEEMP 2019

Inspected by: TT

Sampling Method: Ponar

Lat/Longitude: WP 017 504192; 7976679

Time of Collection: 16:50 - 17:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1st (45%), 2nd (30%), 4th (30%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

# of Grabs for Analysis:

AEC:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	23 September 2019	Inspected by:	TT
Station Number (ID):	BE-5	Sampling Method:	Ponar
Weather:	Overcast, -3 to -4°C	Lat/Longitude:	018 504301, 7976637
Sampling Depth:	14.9m		
# of Attempts to Obtain Sample:	~~||||~~	Time of Collection:	16:40 – 17:05

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Rock ~~g~~ caught in grab jaws

Approx % collected in grab sample 2nd (65%), 3rd (40%), ~~4~~ 5 (45%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 24 Sept 2019

Inspected by: TT

Station Number (ID): BE-6

Sampling Method: Ponar

Weather: Light Snow, -3 to -6°C

Lat/Longitude: 021 - 504396; 7976654

Sampling Depth: 18.5m

# of Attempts to Obtain Sample: ~~||||~~ |

Time of Collection: 10:40 – 11:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample ~~1(40%)~~ 3(45%) 4(35%) 5(35%) %

↑ Drifted too far, dumped sample

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	24 Sept 2019	Inspected by:	TT
Station Number (ID):	BE-7	Sampling Method:	Ponar
Weather:	Overcast/Light snow, -3 to -6°C	Lat/Longitude:	022 504487; 7976680
Sampling Depth:	16.5m		
# of Attempts to Obtain Sample:	1111	Time of Collection:	12:40 - 13:02

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 2(40%), 3(50%), 4(40%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 24 Sept 2019

Inspected by: TT

Station Number (ID): BE-8

Sampling Method: Ponar

Weather: Overcast / Light snow, -3 to -6°C

Lat/Longitude: 023 504558; 7976731

Sampling Depth: 15.8 m

Time of Collection: 14:30 - 15:05

# of Attempts to Obtain Sample: ~~||||~~ |

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Rock caught in jaw of grab and some not triggering

Approx % collected in grab sample 1 (25%), 3 (20%), 6 (20%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Date: 27 Sept 2019

Station Number (ID): BW-1

Weather: Clear skies, 0-6°C

Sampling Depth: 16.7 m, 9.9°C

# of Attempts to Obtain Sample: |||

Project Title: Baffinland MEEMP 2019

Inspected by: TT

Sampling Method: Ponar

Lat/Longitude: 025 503148, 7976588

Time of Collection: 9:15 - 9:45

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1st (45%), 2nd (35%), 3rd (40%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 27 Sept 2019

Inspected by: TT

Station Number (ID): BW-2

Sampling Method: Ponar

Weather: Some cloud cover, 0-6°C

Lat/Longitude: 026 503055; 7976532

Sampling Depth: 21m

# of Attempts to Obtain Sample: 𝍸 |

Time of Collection: 10:25 - 10:55

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

A couple grabs had gravel, polychaete caught in the jaws

Approx % collected in grab sample 2nd (40%) 5th (40%) 6 (35%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 27 Sept 2019

Inspected by: TT

Station Number (ID): BW-3

Sampling Method: Ponar

Weather: Overcast, 0-6°C

Lat/Longitude: 027 502961, 7976473

Sampling Depth: 22m

Time of Collection: 11:40-12:20

# of Attempts to Obtain Sample: ~~||||~~

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Rock caught in jaws of grab

Approx % collected in grab sample ~~1~~ 3(25%), 4(30%), 5(30%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 27 Sept 2019

Inspected by: TT

Station Number (ID): BW-4

Sampling Method: Ponar

Weather: Overcast, 0-6°C

Lat/Longitude: 029 502878, 7976439

Sampling Depth: 16.3m

\# of Attempts to Obtain Sample: ~~||||~~

Time of Collection: 14:30 -

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

2-rock caught in jaws of grab

Approx % collected in grab sample 1(40%), 3(50%), %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

\# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 27 Sept 2019

Inspected by: TT

Station Number (ID): BW-5

Sampling Method: Ponar

Weather: Overcast, 0-6°C

Lat/Longitude: 030 502768; 7976398

Sampling Depth: 16.7m

# of Attempts to Obtain Sample: 𝍸 I

Time of Collection: 15:30 - 16:10

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

2-grab didn't trigger, 4 grab didn't trigger, 5 didn't trigger

Approx % collected in grab sample 1(50%), 3(35%), 6(45%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 28 Sept 2019

Inspected by: TT

Station Number (ID): BW-6

Sampling Method: Pona ✓

Weather: Overcast, 0-3°C

Lat/Longitude: 031 502677, 7976449

Sampling Depth: 15.4m

# of Attempts to Obtain Sample: ~~||||~~ |

Time of Collection: 9:20 - 9:45

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Drifted too far off station for grab 5

Approx % collected in grab sample 1(50%), 4th (45%), 6th (45%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 28 Sept 2019
Inspected by: TT
Station Number (ID): BW-7
Sampling Method: Ponar
Weather: Overcast, fog, 0-3°C
Lat/Longitude: 032 502593, 7976480
Sampling Depth: 18.2m
# of Attempts to Obtain Sample: III
Time of Collection: 12:25 - 12:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(40%), 2(55%), 3(45%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	28 Sept 2019	Inspected by:	TT
Station Number (ID):	BW-8	Sampling Method:	Ponar
Weather:	Overcast, 0-3°C	Lat/Longitude:	033 502486; 7976524
Sampling Depth:	17.6m		
# of Attempts to Obtain Sample:	111	Time of Collection:	13:15 - 13:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(60%), 2(50%), 3(50%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 28 Sept 2019

Inspected by: TT

Station Number (ID): BNW-1

Sampling Method: Ponar

Weather: Overcast, 0-3°C

Lat/Longitude: 034 503305; 7976766

Sampling Depth: 37.0 m

Time of Collection: ~~13:55~~ 16:18

# of Attempts to Obtain Sample: ~~4~~ HHT III

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- grab didn't trigger, 2- rock caught in grab jaws, 5- didn't trigger

Approx % collected in grab sample 4 (45%), 7 (35%), 8 (50%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	30 Sept 2019	Inspected by:	TT
Station Number (ID):	BNW-2	Sampling Method:	Ponar
Weather:	Overcast, 1-2°C	Lat/Longitude:	035 503268; 7976895
Sampling Depth:	50.1m / 7.3°C		
# of Attempts to Obtain Sample:	||||	Time of Collection:	12:20 – 13:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

2-didn't trigger

It is taking approx 2 mins to deploy and another 2 mins to retrieve the grab

Approx % collected in grab sample 1(55%), 3(50%), 4(50%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 30 Sept 2019

Inspected by: TT

Station Number (ID): BNW-3

Sampling Method: Ponar

Weather: Overcast, 1-2°C

Lat/Longitude: 036 503269; 7977038

Sampling Depth: 62.4m

# of Attempts to Obtain Sample: ||||

Time of Collection: 13:55-14:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1-grab full of water

Approx % collected in grab sample 2(50%), 3(55%), 4(50%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 01 Oct 2019

Inspected by: TT

Station Number (ID): BNW-5

Sampling Method: Ponar

Weather: Low lying fog, 0+/-1°C

Lat/Longitude: 038 503272, 7977363

Sampling Depth: 71.9m / 7.1°C

# of Attempts to Obtain Sample: ~~||||~~ 1

Time of Collection: 11:45 / 12:30 - 13:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- didn't trigger, going to add more line to the spool as we don't have much line left on spool sampling in 72m
3- grab didn't trigger, 4- didn't trigger,

Approx % collected in grab sample ______ %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

Other Notes:

# of Grabs for Analysis:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	01 Oct 2019	Inspected by:	TT
Station Number (ID):	BNE-1	Sampling Method:	Ponar
Weather:	Overcast, 0-1°C	Lat/Longitude:	040 503834; 7976806
Sampling Depth:	29.4m		
# of Attempts to Obtain Sample:	IIII	Time of Collection:	15:40 - 16:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- grab didn't trigger

Approx % collected in grab sample 2(45%), 3(40%), 4(35%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	01 Oct 2019	Inspected by:	TT
Station Number (ID):	BNE-2	Sampling Method:	Ponar
Weather:	Overcast, 0-1°C	Lat/Longitude:	041 503908, 7976947
Sampling Depth:	52.3m		
# of Attempts to Obtain Sample:	III	Time of Collection:	16:40-17:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(45%), 2(55%), 3(55%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

½ split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 02 Oct 2019

Inspected by: TT

Station Number (ID): BNW-5

Sampling Method: Van Veen / Splitter

Weather: Overcast, 0 - -1°C, low lying fog

Lat/Longitude: 042 503263; 7977359

Sampling Depth: 73.6m / 11.3°C

# of Attempts to Obtain Sample: IIII

Time of Collection: 9:11 / 9:46 - 10:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Attempted 1 grab with Ponar and didn't trigger so switching to the Van Veen grab and going to try the fabricated A-frame splitter

Approx % collected in grab sample 2(70%), 3(60%), 4(60%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

½ split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 02 Oct 2019

Inspected by: TT

Station Number (ID): BNW-7

Sampling Method: Van Veen / Splitter

Weather: Lowlying fog, overcast, 0 to -1°C

Lat/Longitude: 043 503270; 7977662

Sampling Depth: 80m

# of Attempts to Obtain Sample: III

Time of Collection: 12:55-13:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- wasn't the most accurate split, took ¼ of the sediment from one tote to have ½ and ½ of the sediment

Approx % collected in grab sample 1(65%), 2(70%), 3(70%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

1/2 split (3 composites)

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	02 Oct 2019	Inspected by:	TT
Station Number (ID):	BNW-8	Sampling Method:	Van Veen / Splitter
Weather:	Low lying fog Overcast, 0 to -1°C	Lat/Longitude:	044 503282; 7977780
Sampling Depth:	85.4m 86.8m		
# of Attempts to Obtain Sample:	IIII	Time of Collection:	14:40 – 15:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

2 - rock caught in jaws of grab

Approx % collected in grab sample 1(70%), 3(75%), 4(65%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: _ _ _ _ _ _ _ _

½ split (3 composites)

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	03 Oct 2017	Inspected by:	TT
Station Number (ID):	BNE-3	Sampling Method:	Van Veen / splitter
Weather:	Low lying fog Overcast, -1 to -3°C	Lat/Longitude:	045 503946; 7977081
Sampling Depth:	56.8m		
# of Attempts to Obtain Sample:	(1)	Time of Collection:	10:00 - 10:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(50%), 2(40%), 3(55%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

1/2 split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 03 Oct 2019

Inspected by: TT

Station Number (ID): BNE-4

Sampling Method: Van Veen / Splitter

Weather: Low lying fog Overcast, -1 to -3°C

Lat/Longitude: 046 504018; 7977219
047 504019; 7977208

Sampling Depth: 66.9 m

# of Attempts to Obtain Sample: IIII

Time of Collection: 11:30-12:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- rock caught in jaws of grab

Approx % collected in grab sample 2(45%), 3(50%), 4(50%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

1/2 split (Van Veen)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 03 Oct 2019

Inspected by: TT

Station Number (ID): BNE-5

Sampling Method: Van Veen | Splitter

Weather: Low lying fog overcast, -1 to -3°C

Lat/Longitude: 048 504071; 7977356

Sampling Depth: 81.8m

# of Attempts to Obtain Sample: ||||

Time of Collection: 13:50 - 14:55

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

3-rock caught in jaws of grab

Approx % collected in grab sample 1(75%), 2(75%), 4(75%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

½ split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 04 Oct 2019

Inspected by: TT

Station Number (ID): BNE-6

Sampling Method: Van Veen / Splitter

Weather: Overcast, light snow, -5 to -6C

Lat/Longitude: 052 504132 ; 7977484

Sampling Depth: 89.5m

# of Attempts to Obtain Sample: ||||

Time of Collection: 10:54 - 12:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1 - rock caught in grab jaws

Approx % collected in grab sample 2 (70%), 3 (75%), 4 (75%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

½ split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 04 Oct 2019

Inspected by: TT

Station Number (ID): BNE-7

Sampling Method: VanVeen/Splitter

Weather: Overcast, -5 to -6°C

Lat/Longitude: 053 504191, 7977631

Sampling Depth: 95.7m

# of Attempts to Obtain Sample: III

Time of Collection: 12:05 - 13:06

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(50%), 2(55%), 3(55%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ PAH
- ☐ TBT
- ☐ Grain Size
- ☐ Benthic
- ☐ AVS CEM
- ☐ PCB
- ☐ Dioxins and Furans
- ☐ PFOA/PFOS
- ☐ Other

AEC: ____ # of Grabs for Analysis: ____

Other Notes:

SAMPLE NUMBER: ________

1/2 split (3 composites)

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 04 Oct 2019

Inspected by: TT

Station Number (ID): BNE-8

Sampling Method: Van Veen/Splitter

Weather: Overcast, -5 to -6°C

Lat/Longitude: 054 504252; 7977767

Sampling Depth: 101.4 m / 5.2°C - water

# of Attempts to Obtain Sample: III

Time of Collection: 13:40 - 14:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Approx % collected in grab sample 1(80%), 2(80%), 3(65%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	21 Sept. 2019	Inspected by:	TT /CB
Station Number (ID):	SE18-1	Sampling Method:	Van Veen
Weather:	Clear skies, -1 to -3°C	Lat/Longitude:	WP009 0503425; 7976692
Sampling Depth:	16.5m		
# of Attempts to Obtain Sample:	III	Time of Collection:	11:50 - 12:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, firm, 98% fine to coarse sand, low plasticity, no odour and no sheen present, polychaetes, Mya, Hiatella, brittle stars, Pectinarids present

Approx % collected in grab sample 20% (~4cm), 50% (4.5cm), 45% (4.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____ # of Grabs for Analysis: ____

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	21 Sept. 2019	Inspected by:	TT/CB
Station Number (ID):	SE18-2	Sampling Method:	Van Veen
Weather:	Clear skies, -1 to -3°C	Lat/Longitude:	WP010 503647; 7976729 WP011
Sampling Depth:	26.4m, water temp 3.3°C		
# of Attempts to Obtain Sample:	WP010 WP011 𝍸 / IIII	Time of Collection:	13:08

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, firm, brown, 5% fines, 95% fine sand, low plasticity, no odour or sheen present, Hiatella, amphipods and polychaetes present

Approx % collected in grab sample 20% (3cm), 20% (3cm), 15% (2cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

rocks getting caught in grab, 5 attempts and then relocated anchor due to heavy gravel load.

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	21 September 2019	Inspected by:	TT / CB
Station Number (ID):	SE-1	Sampling Method:	VanVeen
Weather:	Clear skies, -1 to -3°C	Lat/Longitude:	WP012 0503907, 7976716
Sampling Depth:	12.1m / 3.8°C		
# of Attempts to Obtain Sample:	11	Time of Collection:	14:35

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Sediment sample collected from one grab

SILT with SAND, moist, loose, brown, 70% fines, 30% f-sand, medium plasticity, trace gravel, no odour and no sheen present, polychaetes, clams, brittle star

Approx % collected in grab sample 50% (5.0cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ PAH
- ☐ TBT
- ☐ Grain Size
- ☐ Benthic
- ☐ AVS CEM
- ☐ PCB
- ☐ Dioxins and Furans
- ☐ PFOA/PFOS
- ☐ Other

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 21 Sept. 2019
Inspected by: TT, CB
Sampling Method: Van Veen
Station Number (ID): SE-2
Weather: Clear skies, -1 to -3°C
Lat/Longitude: WP013 504046, 7976688
Sampling Depth: 11.4m / 2.9°C - water temp
Time of Collection: 16:09
# of Attempts to Obtain Sample: 1

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Amsteel line was severed and Van Veen grab was lost. Going to fabricate a hook to try and retrieve tomorrow

Approx % collected in grab sample ______ %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☑ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:

Other Notes:
Freight Dock has been built over proposed sample location. New location is approximately 50m NE of proposed location

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	22 Sept. 2019	Inspected by:	TT
Station Number (ID):	SE-2	Sampling Method:	Ponar
Weather:	Overcast, -1 to -4°C	Lat/Longitude:	WP 13 need to mark
Sampling Depth:	10.3m 12.4°C		
# of Attempts to Obtain Sample:	1	Time of Collection:	13:10

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, firm, brown with some striations of black, fine to coarse sand, low plasticity, no odour and no sheen present, trace gravel, amphipod and Pectinarid polychaete

Approx % collected in grab sample 1-50% (6.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: # of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	22 September 2019	Inspected by:	TT
Station Number (ID):	SE-3	Sampling Method:	Ponar
Weather:	Overcast, -1 To -4°C	Lat/Longitude:	WP016 504106; 7976701
Sampling Depth:	18.6m / 0.8°C		
# of Attempts to Obtain Sample:	IIII	Time of Collection:	14:54 – 15:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, light brown, 70% fines, 30% f to coarse sand, med plasticity, no odour and no sheen, trace gravel, polychaete tubes, trace seaweed

Approx % collected in grab sample 2nd (30%, 4cm), 3rd (35%, 5.5cm), 4th (35%, 5.0cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ________ # of Grabs for Analysis: ________

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	22 Sept. 2019	Inspected by:	TT
Station Number (ID):	SE-4	Sampling Method:	Ponar
Weather:	Overcast, -1 to -4°C	Lat/Longitude:	WP017 504192; 7976679
Sampling Depth:	14.0m / 1.2°C - water temp		
# of Attempts to Obtain Sample:	~~IIII~~ III	Time of Collection:	16:30 - 17:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND; wet, firm, brown, 90% f to coarse sand, 10% fines, low plasticity, no odour and no sheen present, trace ~~gravel~~ cobble, amphipod, Pectinarid, Hiatella, trace shell debris

Approx % collected in grab sample 4th (40%, 5cm), 7th (25%, 3cm), 8th (15%, 2.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____ # of Grabs for Analysis: ____

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 23 September 2019
Inspected by: TT
Station Number (ID): SE-5
Sampling Method: Ponar (weighted)
Weather: Overcast, -3 to -4°C
Lat/Longitude: 018 504301; 7976637
Sampling Depth: 14.9m / 1.3°C - water
# of Attempts to Obtain Sample: IIII
Time of Collection: 15:30 - ~~17:05~~ 16:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

2nd grab - brought up lrg cobble ~16 cm long, covered with coraline algae, attached Scallop and Chitons 16:20 - drifted off site

SILT with SAND, moist, loose, layer of brown silt (~2cm) over top of a gray layer, 70% fine, 30% f to coarse sand, no odour or sheen present, trace gravel, polychaetes, brittle stars, Hiatella

Approx % collected in grab sample 1 (40%, 6cm), 4th (6.5cm, 45%) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SE-6 / DUP A

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 24 Sept. 2019

Inspected by: TT

Station Number (ID): SE-6 / DUP A

Sampling Method: Ponar

Weather: Overcast with light snow -3 to -6°C

Lat/Longitude: 021 504396, 7976654

Sampling Depth: 18.5m / 0.8°C

# of Attempts to Obtain Sample: ||||

Time of Collection: 9:50 - 10:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, ~~moist~~ wet, loose, brown, 65% fines, 35% f to coarse sand, 10% gravel (1 to 5cm), medium plasticity, no odour and no sheen present, Shell debris, Pectinarid, amphipods, polychaetes, poly tubes, Hiatella

Approx % collected in grab sample Grab 2 (40%, 5cm), 3 (45%, 6.5cm), 4 (35%, 5.0cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: _ _ _ _ _ _ _ _

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 24 Sept 2019

Inspected by: TT

Station Number (ID): SE-7

Sampling Method: Ponar

Weather: Light snow/overcast, -3 to -6°C

Lat/Longitude: 022 504487; 7976680

Sampling Depth: 16.5m / 0.1°C

# of Attempts to Obtain Sample: ~~HHH~~

Time of Collection: 12:05-12:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Silt with SAND, moist, loose, brown, 70% fines, 30% f to coarse sand, ~~trace~~ 10% gravel (2-4cm), medium plasticity, shell debris, no odour and no sheen present, polychaetes, clams

Approx % collected in grab sample 2(25%, 5cm), 4(20%, 4cm), 5(25%, 5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 24 Sept 2019

Inspected by: TT

Station Number (ID): SE-8

Sampling Method: Ponar

Weather: Overcast/Light snow, -3 to -6°C

Lat/Longitude: 023 504558; 7976731

Sampling Depth: 15.8m / 0.7°C - water

Time of Collection: 13:30 - 14:30

# of Attempts to Obtain Sample: ~~||||~~ ~~||||~~

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Gravel getting caught in jaws of grab, empty grabs and grabs with just gravel

SILT with SAND, wet, loose, brown, some dark grey layers, 80% fines, 20% f to coarse sand, medium plasticity, no odour and no sheen present, polychaetes, Hiatella, seaweed

Approx % collected in grab sample ~~5~~(20%, 3.5cm), 5(20%, 5.5cm), 10(25%, 5.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SW-1 / DUP B

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	27 Sept 2019	Inspected by:	TT
Station Number (ID):	SW-1 / DUP B	Sampling Method:	Ponar
Weather:	Clear skies, 0-6°C	Lat/Longitude:	025 503148, 7976588
Sampling Depth:	16.7 m 9.9°C (ship discharging?)		
# of Attempts to Obtain Sample:	~~||||~~	Time of Collection:	8:50 - 9:15

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, firm brown and black, 100% fine sand, low plasticity, trace gravel rounded, trace silt, no odour and no sheen present, Pectinarids, Hiatella, brittle stars, polychaetes, amphipods, clams, scallop (translucent)

Approx % collected in grab sample 3rd (35%, 4.5cm), 4th (20%, 4cm), 5th (35%, 5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	27 Sept 2019	Inspected by:	TT
Station Number (ID):	SW-2	Sampling Method:	Ponar
Weather:	Some cloud cover, 0-6°C	Lat/Longitude:	026 503055, 7976532
Sampling Depth:	21m		
# of Attempts to Obtain Sample:	11	Time of Collection:	10:00 - 10:25

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, firm, brown and black, 95% f sand, 5% fines, low plasticity, no odour and no sheen present, shell debris, clams, (translucent) scallops, polychaetes, brittle star

Approx % collected in grab sample 1st (40%, 5cm), 2nd (35%, 4.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	27 Sept 2019	Inspected by:	TT
Station Number (ID):	SW-3	Sampling Method:	Ponar
Weather:	Overcast, 0-6°C	Lat/Longitude:	027 502961, 7976473
Sampling Depth:	22m / 11°C		
# of Attempts to Obtain Sample:	11	Time of Collection:	11:10-1135

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, 2cm brown silt layer over grey ~~sand~~ silt with sand layer, 70% fines, 30% f-sand medium plasticity, no odour and no sheen present, trace gravel, shell debris, scallops, brittle star, Pectinarids, seaweed

Approx % collected in grab sample 1 (30%, 5cm), 2(30%, %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	27 Sept 2019	Inspected by:	TT
Station Number (ID):	SW-4	Sampling Method:	Ponar
Weather:	Overcast, 0-6°C	Lat/Longitude:	029 502878, 7976439
Sampling Depth:	16.3m 17.8°C water temp		
# of Attempts to Obtain Sample:	11	Time of Collection:	14:10 - 14:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, brown, 70% fines, 30% f.sand, medium plasticity, no odour and no sheen present, brittle star, red seaweed, shell debris, scallops, clams, polychaetes

Approx % collected in grab sample 1(30%, 5cm) 2(25%, 5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____________ # of Grabs for Analysis: ____________

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 27 Sept 2019
Inspected by: TT
Station Number (ID): SW-5
Sampling Method: Ponar
Weather: Overcast, 0-6°C
Lat/Longitude: 030 502768; 7976398
Sampling Depth: 16.7m, 8.1°C-water temp
# of Attempts to Obtain Sample: III
Time of Collection: 15:10 - 15:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, layer of brown silt (2cm) over top a layer of grey sand/silt, 80% fines, 20% f-sand, medium plasticity, no odour and no sheen present, shell debris, trace gravel (rounded and subrounded), red seaweed, amphipods, translucent scallop, polychaetes, Pectinarid, brittle star

Approx % collected in grab sample 1(35%, 5.5cm), 3(30%, 5.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 28 Sept 2019
Inspected by: TT
Station Number (ID): SW-6
Sampling Method: Ponar
Weather: Overcast, 0-3°C
Lat/Longitude: 031 502677; 7976449
Sampling Depth: 15.4m / 7.3°C - water temp
# of Attempts to Obtain Sample: 1
Time of Collection: 09:00 - 9:20

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, brown, with a layer of grey substrate, 70% fines, 30% f-sand, medium plasticity, no odour and no sheen present, brittle star, red seaweed, polychaete

Approx % collected in grab sample 1st (40%, 7cm), %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 28 Sept 2019
Inspected by: TT
Station Number (ID): SW-7
Sampling Method: Ponar
Weather: Overcast, fog, 0-3°C
Lat/Longitude: 032 502593; 7976480
Sampling Depth: 18.2m / 6.8°C
# of Attempts to Obtain Sample: 11
Time of Collection: 12:10 - 12:25

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- Piece of Laminaria caught in jaws of grab

SILT with SAND, moist, loose, ~~brown~~, brownish grey, 70% fines, 30% f. sand, medium plasticity, shell debris, ~~&~~ trace gravel, polychaetes, Laminaria and red sea weed, poly tubes, lrg tunicate

Approx % collected in grab sample 1 (30%, 7cm), 2 (40%, 7cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 28 Sept 2019
Inspected by: TT
Station Number (ID): SW-8
Sampling Method: Ponar
Weather: Overcast, 0-3°C
Lat/Longitude: 033 502486; 7976524
Sampling Depth: 17.6m / 6.1°C
# of Attempts to Obtain Sample: 1
Time of Collection: 12:55 - 13:15

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, 2cm layer of brown silt over top of a grey silt/sand layer, medium plasticity, no odour and no sheen present, polychaetes, shell debris, trace gravel, seaweed, brittle star

Approx % collected in grab sample 1(45%, 7cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 28 Sept 2019

Inspected by: TT

Station Number (ID): SNW-1

Sampling Method: Ponar

Weather: Overcast, 0-3°C

Lat/Longitude: 034 503305, 7976766

Sampling Depth: 37.0m / 6.1°C-water

# of Attempts to Obtain Sample: 1

Time of Collection: 13:40 - 13:55

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, brown silt overlying a grey sand/silt layer, 60% fines, 40% f-sands, medium plasticity, slight sulfur-like odour, no sheen present, trace gravel, shell debris, polychaetes

Approx % collected in grab sample 1(45%, 6.5cm), %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____

# of Grabs for Analysis: ____

Other Notes:

SAMPLE NUMBER: ________

SNW-2 / DUP C

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	30 Sept 2019	Inspected by:	TT
Station Number (ID):	SNW-2 / DUP C	Sampling Method:	Ponar
Weather:	Overcast, 1-2°C	Lat/Longitude:	035 503268, 7976895
Sampling Depth:	~~49.7m~~ 50.1m / 17.3°C		
# of Attempts to Obtain Sample:	III	Time of Collection:	~~9:05~~ 11:40 - back on location 12:20

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1- grab didn't trigger, 2- grab didn't trigger

SILT with SAND, moist, loose, brown, overtop a layer of grey silt with sand, 70% fines, 30% f-coarse sand, medium plasticity, no odour and no sheen present, trace gravel and shell debris, polychaetes

Approx % collected in grab sample 3 (50%, 7cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 30 Sept 2019

Inspected by: TT

Station Number (ID): SNW-3

Sampling Method: Ponar

Weather: Overcast, 1-2°C

Lat/Longitude: 036 503269, 7977038

Sampling Depth: 62.4 / 7.4°C - water

# of Attempts to Obtain Sample: 1111

Time of Collection: 13:02 - 13:55

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Shell, brittle star, 2-didn't trigger, 3-didn't trigger
4th grab - gravel caught in grab jaws, 3/4 of grab surface remained intact so accepted it as a good grab

Silty sand with gravel, moist, loose, brown sediment overtop a grey layer, 50% fines, 30% f-c sand, 20% gravel, medium plasticity, shell debris, polychaetes, brittle star, Mya

Approx % collected in grab sample 1 (25%, 3.0cm), 4 (30%, 7cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 01 Oct 2019
Inspected by: TT
Station Number (ID): SNW-4
Sampling Method: Ponar
Weather: Overcast, low lying fog, 0-1°C
Lat/Longitude: 037 503264; 7977196
Sampling Depth: 66.8 m | 6.3°C
# of Attempts to Obtain Sample: 1
Time of Collection: 9:54

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, brown, 80% fines, 20% f-coarse sand, trace gravel, medium plasticity, no odour and no sheen present, polychaete tubes

Approx % collected in grab sample 1(50%, 8.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 01 Oct 2019

Inspected by: TT

Station Number (ID): SNW-5

Sampling Method: Ponar

Weather: Low-lying fog, 0-1°C

Lat/Longitude: 038 503272, 7977363

Sampling Depth: 71.9m / 7.1°C

# of Attempts to Obtain Sample: 1

Time of Collection: 11:25 – 11:45

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, brown sediment (1-2cm) over top of a grey sediment, 80% fines, 20% f-sand, trace gravel, no odour and no sheen present, brittle stars, polychaetes

Approx % collected in grab sample 1 (40%, 8.0cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 01 oct 2019

Inspected by: TT

Station Number (ID): SNE-1

Sampling Method: Ponar

Weather: Overcast, 0-1°C

Lat/Longitude: 040 503834, 7976806

Sampling Depth: 29.4m / 7.1°C

# of Attempts to Obtain Sample: 1

Time of Collection: 15:13 - 15:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Silty sand with gravel, moist, loose brown sediment over top of a grey sediment, 50% fines, 35% f-coarse sand, 15% gravel (rounded and sub rounded, no odour and no sheen present, shell debris, polychaetes, urchin

Approx % collected in grab sample 1 (40%, 7.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SNE-2 /DUP D

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Date: 01 Oct 2019

Project Title: Baffinland MEEMP 2019

Inspected by: TT

Station Number (ID): SNE-2 / DUP D

Sampling Method: Ponar

Weather: Overcast, 0-1°C

Lat/Longitude: 041 503908; 7976942

Sampling Depth: 52.3m 17.1°C

# of Attempts to Obtain Sample: 11

Time of Collection: 16:10 - 16:37

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1-didn't trigger

Silt with SAND, moist, loose, brown sediment overtop of grey, 70% fines, 30% f-c sand, trace gravel, medium plasticity, no odour and no sheen present, brittle stars, shell debris, polychaete, snail

Approx % collected in grab sample 2(50%, 8.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☒ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

Other Notes:

# of Grabs for Analysis:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	02 Oct 2019	Inspected by:	TT
Station Number (ID):	SNW-6	Sampling Method:	Van Veen
Weather:	Overcast, 0-1°C	Lat/Longitude:	0~~4~~3 503254, 7977502
Sampling Depth:	7~~4~~.8m / T2.4°C		
# of Attempts to Obtain Sample:	1	Time of Collection:	10:30 - 11:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

poly, brittlestar, scallop

~~SILT with SAND, moist, loose~~

SILTY SAND and GRAVEL, moist, loose, brown sediment (2cm) overtop of grey sediment, 60% fines, 25% f-c sand, 15% gravel (rounded, sub-rounded), medium plasticity, no odour and no sheen present, shell debris, polychaete tubes, brittlestar, scallop

Approx % collected in grab sample 1 (80%, 9cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 02 Oct 2019

Inspected by: TT

Station Number (ID): SNW-7

Sampling Method: Van Veen

Weather: Low lying fog, overcast 0 to -1°C

Lat/Longitude: 043 503270; 7977662

Sampling Depth: 80 m / 14.2°C - water

# of Attempts to Obtain Sample: 1

Time of Collection: 12:25 - 12:50

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY SAND with GRAVEL, moist, loose, brown sediment (3-4cm) overtop of a grey sediment layer, 50% fines, 35% f-c sand and 15% gravel, medium plasticity, no odour and no sheen present, brittlestars, shell debris, polychaete tubes, polychaetes

Approx % collected in grab sample 1 (65%, 9.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 02 Oct 2019
Inspected by: TT
Station Number (ID): SNW-8
Sampling Method: Van Veen
Weather: Lowlying fog, overcast, 0 to -1°C
Lat/Longitude: 044 503282; 7977780
Sampling Depth: 85.4m / 9.6°C - water temp
# of Attempts to Obtain Sample: 1
Time of Collection: 14:15 - 14:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Poly tubes, brittle star,

SILT and SAND, moist, firm, 3-4 cm brown sediment overtop of a grey ~~sticky~~ firm sediment layer, 80% fines, 20% f-c sand, trace (rounded subangular) gravel, shell debris, medium plasticity, no odour and no sheen present, polychaete tubes, polychaetes, brittle stars

Approx % collected in grab sample 1(50%, 8cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 03 Oct 2019
Inspected by: TT
Station Number (ID): SNE-3
Sampling Method: Van Veen
Weather: Low lying fog Overcast, -1 to -3°C
Lat/Longitude: 045 503946; 7977081
Sampling Depth: 56.8 m /
# of Attempts to Obtain Sample: III
Time of Collection: 9:13 - 10:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1-didn't trigger, 2-didn't trigger using the Ponar so switching to the Van Veen grab

SILTY SAND with GRAVEL, moist, loose, 2-3cm brown layer over top a firm grey layer, 50% fines, 35% f-c sand, 15% gravel, medium plasticity, no odour and no sheen present, shell debris, brittle stars, polychaet

Approx % collected in grab sample 1(50%, 8cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____
# of Grabs for Analysis: ____
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 03 Oct 2019
Inspected by: TT
Station Number (ID): SNE-4
Sampling Method: Van Veen
Weather: Low lying fog Overcast, -1 to -3°C
Lat/Longitude: 046 504018; 7977219
Sampling Depth: 66.9m
# of Attempts to Obtain Sample: 11
Time of Collection: 11:00 - 11:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1 - rock caught in jaws of grab

SILT with SAND, moist, loose, 2-3cm brown sediment overtop of a firm grey sediment, 70% fines, 30% f-c sand, trace gravel, ~~no~~ medium plasticity, no odour and no sheen present, polychaetes, brittle stars

Approx % collected in grab sample 2 (50%, 8.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 03 Oct 2019

Inspected by: TT

Station Number (ID): SNE-5

Sampling Method: Van Veen

Weather: Low lying fog Overcast, -1 to -3°C

Lat/Longitude: 048 504071; 7977356

Sampling Depth: 81.8m

# of Attempts to Obtain Sample: 1

Time of Collection: 13:15 - 13:50

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT and SAND, moist, firm, 1-2cm layer of brown overtop of a firm grey layer with clay content, 80% fines, 20% f-c sand, 10% clay, medium plasticity, no odour and no sheen present, trace gravel, brittlestars, Polychaetes, shell debris

Approx % collected in grab sample 1 (85%, 12.0cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	03 oct 2019	Inspected by:	TT
Station Number (ID):	SNE-6	Sampling Method:	Van Veen
Weather:	Overcast, -1 to -3°C	Lat/Longitude:	049 504136; 7977487
Sampling Depth:	90.1 m		
# of Attempts to Obtain Sample:	1	Time of Collection:	14:55-15:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1-2 cm brown SILT and SAND, moist, loose, brown, 70% silt, 30% f-c sand, trace gravel, overtop of a SILTY CLAY layer, moist, firm, grey, 60% silt, 40% clay, medium plasticity, no odour and no sheen present, brittlestars, polychaetes, poly tubes

Approx % collected in grab sample 1(75%, 12.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	03 Oct 2019	Inspected by:	TT
Station Number (ID):	SNE-7	Sampling Method:	Van Veen
Weather:	Overcast, with light snow, -1 to -3°C	Lat/Longitude:	050 504187; 7977629
Sampling Depth:	97.9m		
# of Attempts to Obtain Sample:	1	Time of Collection:	15:35 - 16:01

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY CLAY, moist, soft, 1-2 cm brown silt overtop of a grey silty clay layer, 70% Fines, 30% clay, trace fine sand, medium plasticity, no odour and no sheen present, brittle star, polys, polychaete tubes

Approx % collected in grab sample 1 (95%, 15.5cm) sampled 6cm %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

Other Notes:

# of Grabs for Analysis:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	03 Oct 2019	Inspected by:	TT
Station Number (ID):	SNE-8	Sampling Method:	Van Veen
Weather:	Light snow, -1 to -3°C	Lat/Longitude:	051 504249 / 7977761
Sampling Depth:	101.9m		
# of Attempts to Obtain Sample:	1	Time of Collection:	16:05 - 16:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY CLAY, moist, soft, 1-2 cm brown silt layer overtop of a soft grey clay silt layer, 60% fines, 40% clay, trace sand, medium plasticity, no odour and no sheen present, polychaetes, polychaete tubes, brittle stars

Approx % collected in grab sample 1 (75%, 10.5cm) sampled ≈ 5-6 cm %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ________ # of Grabs for Analysis: ________

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 04 Oct 2019

Inspected by: TT

Station Number (ID): SE-9

Sampling Method: Van Veen

Weather: Overcast, -5 to -6°C

Lat/Longitude: 055 504651, 7976767

Sampling Depth: 17.7m

# of Attempts to Obtain Sample: ~~||||~~

Time of Collection: 15:00 - 15:45

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1 - grab didn't trigger, 2 - didn't trigger, switched back to Van Veen
3 - rock caught in jaws of grab
SILTY SAND with gravel, moist, loose brownish grey, 55% fines, 30% f-c sand, 15% gravel (rounded and sub-angular), medium plasticity, no odour and no sheen present, brittle stars, polychaetes, Pectinarid

Approx % collected in grab sample 4(25%, 5cm), 5(30%, 4.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 04 Oct 2019
Inspected by: TT
Station Number (ID): SE-10
Sampling Method: Van Veen
Weather: Overcast, -5 to -6°C
Lat/Longitude: 056 504754, 7976769
Sampling Depth: 19.1m
# of Attempts to Obtain Sample: 1
Time of Collection: 15:54 - 16:20

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, 1-2cm brown layer overtop of a dark grey layer, 60% fines, 40% f-c sand, trace gravel, shell debris (scallop), medium plasticity, no odour and no sheen present, brittle stars, urchin, polychaetes, lrg scallop, Pectinarid, H. arctica

Approx % collected in grab sample 1 (75%, 9cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 05 Oct 2019

Inspected by: TT

Station Number (ID): SW-10

Sampling Method: Van Veen

Weather: Light Snow, -5 to -7°C

Lat/Longitude: 058 502264, 7976521

Sampling Depth: 21.3 m

# of Attempts to Obtain Sample: 1

Time of Collection: 10:50 - 11:10

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND with SILT, wet, loose, brown, 60% f-sand, 40% fines, loose plasticity, no odour and no sheen present, polychaete tubes, polychaetes

Approx % collected in grab sample 1 (35%, 5.5 cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

Other Notes:

# of Grabs for Analysis:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	05 Oct 2019	Inspected by:	TT
Station Number (ID):	SNW-9	Sampling Method:	Van Veen
Weather:	Overcast, -5 to -7°C	Lat/Longitude:	059 503288; 7977911
Sampling Depth:	87.8m		
# of Attempts to Obtain Sample:	11	Time of Collection:	11:21-12:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1-2 15% full

SILTY CLAY with GRAVEL, moist, loose, 1-2cm brown silt overtop of a grey silty clay layer, 60% fines, 25% clay, 15% gravel (rounded and sub angular), medium plasticity, no odour and no sheen present, trace shell debris, brittle stars, polychaetes

Approx % collected in grab sample 2 (90%, 15cm) sampled 2 to cm depth %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000
Project Title: Baffinland MEEMP 2019
Date: 05 Oct 2019
Inspected by: TT

Station Number (ID): SNW-10
Sampling Method: Van Veen

Weather: Overcast, -5 to -7°C
Lat/Longitude: 060 503283; 7978046

Sampling Depth: 91.2m

\# of Attempts to Obtain Sample: 1
Time of Collection: 12:05 - 12:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, 1-2 cm brown layer over top of a firmer grey layer (trace clay), 60% fines, 40% f-sand, trace clay and trace gravel (subangular, rounded), shell debris, medium plasticity, no odour and no sheen present, brittlestars, polychaetes and polychaete tubes

Approx % collected in grab sample (75%, 12.5cm) sampled ~5-6 cm depth %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:
\# of Grabs for Analysis:
Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 05 Oct 2019

Inspected by: TT

Station Number (ID): SNE-9

Sampling Method: Van Veen

Weather: Overcast, -5 to -7°C

Lat/Longitude: 061 504302; 7977896

Sampling Depth: 104.4m

# of Attempts to Obtain Sample: 1

Time of Collection: 12:40 - 13:10

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILT with SAND, moist, loose, 1-2cm brown layer overtop of a grey layer, 60% fines, 40% f-sand, trace gravel (rounded, sub rounded), shell debris, medium plasticity, no odour and no sheen present, polychaetes, polychaet tubes, brittle stars

Approx % collected in grab sample 1 (75%, 12.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	05 Oct 2019	Inspected by:	TT
Station Number (ID):	SNE-10	Sampling Method:	Van Veen
Weather:	Overcast, -5 to -7°C	Lat/Longitude:	062 504377; 7978053
Sampling Depth:	104.8m		
# of Attempts to Obtain Sample:	1	Time of Collection:	13:25 - 13:55

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY CLAY with SAND, moist, loose, 1-2cm brown overtop of a grey layer (firmer), 55% fines, 30% clay, 15% f-sand, trace shell debris, trace gravel, medium plasticity, no odour and no sheen present, polychaetes, brittle stars

Approx % collected in grab sample 1 (70%, 10.5cm), sampling 5-6cm depth %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 05 Oct 2019

Inspected by: TT

Station Number (ID): SNE-11

Sampling Method: Van Veen

Weather: Overcast, -5 to -7 °C

Lat/Longitude: 063 504431; 797818)

Sampling Depth: 121.2m

# of Attempts to Obtain Sample: 1

Time of Collection: 14:10 - 14:30

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY CLAY with SAND, moist, firm, 50% fines, 30% clay, 20% f-c sand, 1-2cm brown layer (silt) overtop grey layer (silty clay), trace gravel, medium plasticity, no odour and no sheen present, brittlestar, cobble, polychaete tubes)

Approx % collected in grab sample 1(70%, 10cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	05 oct 2019	Inspected by:	TT
Station Number (ID):	SE-11	Sampling Method:	Van Veen
Weather:	Light snow, -5 to -7°C	Lat/Longitude:	064 504840; 7976731
Sampling Depth:	19.8m		
# of Attempts to Obtain Sample:	1	Time of Collection:	14:40 - 15:00

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SILTY SAND with GRAVEL, moist, loose, 1-2cm brown (silty sand) overtop of a grey (silty sand with gravel), 55% fines, 30% f-c sand, 15% gravel (rounded and subrounded), trace shell debris, medium plasticity, no odour and no sheen present, urchin, olychaete tubes, polychaetes

Approx % collected in grab sample 1 (60%, 10.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: # of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000

Project Title: Baffinland MEEMP 2019

Date: 06 Oct 2019

Inspected by: TT

Station Number (ID): SW-11

Sampling Method: Van Veen

Weather: Overcast, -5 to -6°C

Lat/Longitude: 06 5 502154; 7976496

Sampling Depth: 19.3 m

# of Attempts to Obtain Sample: 1

Time of Collection: 11:00 - 11:15

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, loose, brown to black, 95% f-sand, 5% fines, low plasticity, trace seaweed, no odour and no sheen present

Approx % collected in grab sample 1st (35%, 5.5 cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC:

# of Grabs for Analysis:

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	06 Oct 2019	Inspected by:	TT
Station Number (ID):	SW-12	Sampling Method:	Van Veen
Weather:	Overcast, -5 to -6°C	Lat/Longitude:	0.66 502040; 7976484
Sampling Depth:	19.5m		
# of Attempts to Obtain Sample:	1	Time of Collection:	11:22 - 11:35

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

SAND, wet, loose, brown to black, 95% f-sand, 5% fines, low plasticity, trace gravel (sub angular), no odour and no sheen present, trace seaweed and fine organics, brittlestar, sea cucumber, amphipod

Approx % collected in grab sample 1 (70%, 10cm) sampling 5-6cm deepth %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ______ # of Grabs for Analysis: ______

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No:	1663724-24000	Project Title:	Baffinland MEEMP 2019
Date:	06 Oct 2019	Inspected by:	TT
Station Number (ID):	SNW-11	Sampling Method:	Van Veen
Weather:	Overcast, -5 to -6°C	Lat/Longitude:	067 503272; 7978212
Sampling Depth:	96.5m		
# of Attempts to Obtain Sample:	1	Time of Collection:	11:43 -

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

Lost Van Veen grab. Line snapped when the grab was almost on board.

Approx % collected in grab sample ____ %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:

- ☐ Full Metals
- ☐ Grain Size
- ☐ PCB
- ☐ Other
- ☐ PAH
- ☐ Benthic
- ☐ Dioxins and Furans
- ☐ TBT
- ☐ AVS CEM
- ☐ PFOA/PFOS

AEC: ____ # of Grabs for Analysis: ____

Other Notes:

SAMPLE NUMBER: ________

SEDIMENT SAMPLING LOG

Project No: 1663724-24000 | Project Title: Baffinland MEEMP 2019

Date: 05 Oct 2019 | Inspected by: TT

Station Number (ID): SW-9 | Sampling Method: Van Veen

Weather: Light snow, -5 to -7°C | Lat/Longitude: 057 502372; 7976525

Sampling Depth: 14.4 m

# of Attempts to Obtain Sample: 11 | Time of Collection: 10:00 - 10:40

Sediment Description (including colour, type/grain size, anthropogenic debris, organic material, shell, wood, odour, HC sheen, staining, organisms/biota etc.):

1 - ~15% full grab

SAND with SILT, wet, loose, brown, 60% f-sand, 40% fines, low plasticity, no odour and no sheen present, trace seaweed, brittle star, polychaetes, clams

Approx % collected in grab sample 2 (30%, 5.5cm) %

Photograph Notes (grab, sampling location, field sampling methods, public use, etc):

Sample Control Number (SCN):

Analysis for:
- ☐ Full Metals
- ☐ PAH
- ☐ TBT
- ☐ Grain Size
- ☐ Benthic
- ☐ AVS CEM
- ☐ PCB
- ☐ Dioxins and Furans
- ☐ PFOA/PFOS
- ☐ Other

AEC: ________ # of Grabs for Analysis: ________

Other Notes:

SAMPLE NUMBER: ________

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 27-SEP-19
Report Date: 24-OCT-19 16:14 (MT)
Version: FINAL REV. 2

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2355484

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 15-56003
Legal Site Desc:

Comments:

24-OCT-2019 VOC/F1 data is included.

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-1	L2355484-2	L2355484-3	L2355484-4	L2355484-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	21-SEP-19	21-SEP-19	21-SEP-19	22-SEP-19	22-SEP-19
	Sampled Time	12:30	13:08	14:35	13:10	15:30
	Client ID	SE18-1	SE18-2	SE-1	SE-2	SE-3
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	17.7	16.9	27.9	14.2	25.3
	pH (1:2 soil:water) (pH)	8.39	8.35	8.15	8.43	8.23
Particle Size	% Gravel (>2mm) (%)	6.0	15.2	23.9	12.4	11.9
	% Sand (2.0mm - 0.063mm) (%)	85.0	66.5	45.4	83.5	55.7
	% Silt (0.063mm - 4um) (%)	7.0	14.3	24.3	2.8	25.6
	% Clay (<4um) (%)	2.0	3.9	6.4	1.3	6.8
	Texture	Sand	Loamy sand	Sandy loam	Sand	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.883	1.42	1.48	0.872	1.66
	Inorganic Carbon (as CaCO3 Equivalent) (%)	7.35	11.8	12.3	7.26	13.8
	Total Carbon by Combustion (%)	1.24	2.29	3.80	1.29	3.16
	Total Organic Carbon (%)	0.36	0.87	2.32	0.42	1.50
Metals	Aluminum (Al) (mg/kg)	1520	3190	4570	1160	4730
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.02	2.70	3.78	0.67	3.89
	Barium (Ba) (mg/kg)	4.88	10.5	15.1	3.97	14.4
	Beryllium (Be) (mg/kg)	<0.10	0.22	0.28	<0.10	0.26
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	10.3	20.4	32.0	8.9	31.5
	Cadmium (Cd) (mg/kg)	<0.020	0.024	0.046	<0.020	0.032
	Calcium (Ca) (mg/kg)	23500	42100	59700	21700	52700
	Chromium (Cr) (mg/kg)	6.46	12.0	15.4	3.93	14.9
	Cobalt (Co) (mg/kg)	0.99	2.09	2.69	0.73	2.60
	Copper (Cu) (mg/kg)	1.86	3.87	5.83	1.20	5.20
	Iron (Fe) (mg/kg)	6170	9090	11600	3040	10600
	Lead (Pb) (mg/kg)	1.51	3.01	4.68	1.32	4.53
	Lithium (Li) (mg/kg)	6.4	14.3	21.6	6.0	19.9
	Magnesium (Mg) (mg/kg)	12400	21700	30400	12500	29500
	Manganese (Mn) (mg/kg)	45.1	86.5	117	37.1	114
	Mercury (Hg) (mg/kg)	<0.0050	0.0069	0.0100	<0.0050	0.0113
	Molybdenum (Mo) (mg/kg)	0.18	0.30	0.69	0.32	0.39
	Nickel (Ni) (mg/kg)	3.27	6.65	8.88	2.22	8.23
	Phosphorus (P) (mg/kg)	163	301	408	145	425
	Potassium (K) (mg/kg)	670	1410	1950	500	2050
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	1600	2110	4290	1180	3970

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-6	L2355484-7	L2355484-8	L2355484-9	L2355484-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	22-SEP-19	23-SEP-19	24-SEP-19	24-SEP-19	24-SEP-19
	Sampled Time	17:30	16:40	10:40	12:40	14:30
	Client ID	SE-4	SE-5	SE-6	SE-7	SE-8
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	16.4	30.1	26.7	26.4	33.3
	pH (1:2 soil:water) (pH)	8.46	8.11	8.12	8.10	8.03
Particle Size	% Gravel (>2mm) (%)	6.8	15.8	14.0	16.1	8.2
	% Sand (2.0mm - 0.063mm) (%)	81.1	38.4	48.0	56.0	58.7
	% Silt (0.063mm - 4um) (%)	9.1	35.8	29.0	21.0	25.6
	% Clay (<4um) (%)	3.1	10.0	9.0	6.9	7.4
	Texture	Sand	Loam	Sandy loam	Sandy loam	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	1.08	1.71	1.83	1.74	1.44
	Inorganic Carbon (as CaCO3 Equivalent) (%)	8.97	14.3	15.3	14.5	12.0
	Total Carbon by Combustion (%)	1.69	4.14	3.54	3.00	2.92
	Total Organic Carbon (%)	0.61	2.43	1.71	1.26	1.48
Metals	Aluminum (Al) (mg/kg)	2270	5890	5090	4440	4150
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.79	4.21	4.02	4.72	4.41
	Barium (Ba) (mg/kg)	6.58	15.3	14.1	12.0	12.6
	Beryllium (Be) (mg/kg)	0.18	0.35	0.31	0.27	0.25
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	15.3	38.0	35.1	28.2	27.7
	Cadmium (Cd) (mg/kg)	<0.020	0.048	0.043	0.029	0.031
	Calcium (Ca) (mg/kg)	31700	60600	55200	43600	41100
	Chromium (Cr) (mg/kg)	8.10	18.7	16.1	14.3	13.9
	Cobalt (Co) (mg/kg)	1.47	3.11	2.73	2.58	2.56
	Copper (Cu) (mg/kg)	2.65	6.70	5.69	4.98	5.51
	Iron (Fe) (mg/kg)	5810	11700	10600	9910	9850
	Lead (Pb) (mg/kg)	2.22	5.45	5.02	4.29	4.39
	Lithium (Li) (mg/kg)	9.8	24.5	21.5	18.3	17.2
	Magnesium (Mg) (mg/kg)	15900	35900	30100	25600	23300
	Manganese (Mn) (mg/kg)	60.1	125	113	104	106
	Mercury (Hg) (mg/kg)	<0.0050	0.0122	0.0124	0.0102	0.0109
	Molybdenum (Mo) (mg/kg)	0.27	0.45	0.38	0.32	0.41
	Nickel (Ni) (mg/kg)	4.46	10.3	8.87	8.49	8.20
	Phosphorus (P) (mg/kg)	197	439	441	390	448
	Potassium (K) (mg/kg)	1000	2450	2120	1800	1740
	Selenium (Se) (mg/kg)	<0.20	0.21	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	2010	4630	3970	3810	4700

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-11
	Description	Sediment
	Sampled Date	24-SEP-19
	Sampled Time	10:40
	Client ID	DUPA
Grouping	**Analyte**	
SOIL		
Physical Tests	Moisture (%)	27.7
	pH (1:2 soil:water) (pH)	8.13
Particle Size	% Gravel (>2mm) (%)	14.0
	% Sand (2.0mm - 0.063mm) (%)	54.1
	% Silt (0.063mm - 4um) (%)	25.2
	% Clay (<4um) (%)	6.6
	Texture	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	1.82
	Inorganic Carbon (as CaCO3 Equivalent) (%)	15.1
	Total Carbon by Combustion (%)	3.40
	Total Organic Carbon (%)	1.58
Metals	Aluminum (Al) (mg/kg)	4630
	Antimony (Sb) (mg/kg)	0.10
	Arsenic (As) (mg/kg)	4.13
	Barium (Ba) (mg/kg)	14.0
	Beryllium (Be) (mg/kg)	0.29
	Bismuth (Bi) (mg/kg)	<0.20
	Boron (B) (mg/kg)	31.3
	Cadmium (Cd) (mg/kg)	0.046
	Calcium (Ca) (mg/kg)	60600
	Chromium (Cr) (mg/kg)	15.5
	Cobalt (Co) (mg/kg)	2.79
	Copper (Cu) (mg/kg)	6.02
	Iron (Fe) (mg/kg)	10100
	Lead (Pb) (mg/kg)	4.88
	Lithium (Li) (mg/kg)	20.5
	Magnesium (Mg) (mg/kg)	31500
	Manganese (Mn) (mg/kg)	117
	Mercury (Hg) (mg/kg)	0.0129
	Molybdenum (Mo) (mg/kg)	0.62
	Nickel (Ni) (mg/kg)	9.18
	Phosphorus (P) (mg/kg)	460
	Potassium (K) (mg/kg)	1960
	Selenium (Se) (mg/kg)	<0.20
	Silver (Ag) (mg/kg)	<0.10
	Sodium (Na) (mg/kg)	4700

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-1	L2355484-2	L2355484-3	L2355484-4	L2355484-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	21-SEP-19	21-SEP-19	21-SEP-19	22-SEP-19	22-SEP-19
	Sampled Time	12:30	13:08	14:35	13:10	15:30
	Client ID	SE18-1	SE18-2	SE-1	SE-2	SE-3
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	15.2	27.5	50.2	12.3	38.5
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	<0.050	0.064	0.087	<0.050	0.085
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	88.3	193	237	77.7	231
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.330	0.542	1.07	0.405	0.839
	Vanadium (V) (mg/kg)	6.04	12.8	18.7	4.86	18.3
	Zinc (Zn) (mg/kg)	5.2	9.8	16.3	4.3	14.5
	Zirconium (Zr) (mg/kg)	2.0	3.5	4.6	1.9	4.6
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-6	L2355484-7	L2355484-8	L2355484-9	L2355484-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	22-SEP-19	23-SEP-19	24-SEP-19	24-SEP-19	24-SEP-19
	Sampled Time	17:30	16:40	10:40	12:40	14:30
	Client ID	SE-4	SE-5	SE-6	SE-7	SE-8
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	22.5	39.2	38.7	34.4	36.3
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	<0.050	0.101	0.087	0.075	0.078
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	124	252	232	195	217
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.566	0.987	0.771	0.662	0.784
	Vanadium (V) (mg/kg)	8.89	22.3	20.2	18.3	17.4
	Zinc (Zn) (mg/kg)	6.6	16.9	14.8	13.9	13.4
	Zirconium (Zr) (mg/kg)	2.9	5.1	4.8	4.1	3.3
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	0.0107	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-11				
	Description	Sediment				
	Sampled Date	24-SEP-19				
	Sampled Time	10:40				
	Client ID	DUPA				
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	57.3				
	Sulfur (S) (mg/kg)	<1000				
	Thallium (Tl) (mg/kg)	0.083				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	216				
	Tungsten (W) (mg/kg)	<0.50				
	Uranium (U) (mg/kg)	0.798				
	Vanadium (V) (mg/kg)	20.2				
	Zinc (Zn) (mg/kg)	14.7				
	Zirconium (Zr) (mg/kg)	4.0				
Volatile Organic Compounds	VOC Sample Container	Field MeOH				
	Benzene (mg/kg)	<0.0050				
	Bromodichloromethane (mg/kg)	<0.050				
	Bromoform (mg/kg)	<0.050				
	Carbon Tetrachloride (mg/kg)	<0.050				
	Chlorobenzene (mg/kg)	<0.050				
	Dibromochloromethane (mg/kg)	<0.050				
	Chloroethane (mg/kg)	<0.10				
	Chloroform (mg/kg)	<0.10				
	Chloromethane (mg/kg)	<0.10				
	1,2-Dichlorobenzene (mg/kg)	<0.050				
	1,3-Dichlorobenzene (mg/kg)	<0.050				
	1,4-Dichlorobenzene (mg/kg)	<0.050				
	1,1-Dichloroethane (mg/kg)	<0.050				
	1,2-Dichloroethane (mg/kg)	<0.050				
	1,1-Dichloroethylene (mg/kg)	<0.050				
	cis-1,2-Dichloroethylene (mg/kg)	<0.050				
	trans-1,2-Dichloroethylene (mg/kg)	<0.050				
	Dichloromethane (mg/kg)	<0.30				
	1,2-Dichloropropane (mg/kg)	<0.050				
	cis-1,3-Dichloropropylene (mg/kg)	<0.050				
	trans-1,3-Dichloropropylene (mg/kg)	<0.050				
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10				
	Ethylbenzene (mg/kg)	<0.015				
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20				
	Styrene (mg/kg)	<0.050				
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050				

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355484-1	L2355484-2	L2355484-3	L2355484-4	L2355484-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	21-SEP-19	21-SEP-19	21-SEP-19	22-SEP-19	22-SEP-19
	Sampled Time	12:30	13:08	14:35	13:10	15:30
	Client ID	SE18-1	SE18-2	SE-1	SE-2	SE-3
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	82.4	74.6	77.2	78.2	80.1
	Surrogate: 1,4-Difluorobenzene (SS) (%)	92.6	84.9	78.9	73.5	91.0
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	89.0	86.1	88.4	90.9	89.2
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.011
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.016
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-6	L2355484-7	L2355484-8	L2355484-9	L2355484-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	22-SEP-19	23-SEP-19	24-SEP-19	24-SEP-19	24-SEP-19
	Sampled Time	17:30	16:40	10:40	12:40	14:30
	Client ID	SE-4	SE-5	SE-6	SE-7	SE-8
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	0.103	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	93.4	86.3	99.6	96.1	88.4
	Surrogate: 1,4-Difluorobenzene (SS) (%)	100.6	87.3	111.8	102.6	80.6
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	85.8	84.9	90.7	84.6	90.3
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-11				
	Description	Sediment				
	Sampled Date	24-SEP-19				
	Sampled Time	10:40				
	Client ID	DUPA				
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050				
	Tetrachloroethylene (mg/kg)	<0.050				
	Toluene (mg/kg)	<0.050				
	1,1,1-Trichloroethane (mg/kg)	<0.050				
	1,1,2-Trichloroethane (mg/kg)	<0.050				
	Trichloroethylene (mg/kg)	<0.010				
	Trichlorofluoromethane (mg/kg)	<0.10				
	Vinyl Chloride (mg/kg)	<0.10				
	ortho-Xylene (mg/kg)	<0.050				
	meta- & para-Xylene (mg/kg)	<0.050				
	Xylenes (mg/kg)	<0.075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	75.4				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	83.3				
Hydrocarbons	EPH10-19 (mg/kg)	<200				
	EPH19-32 (mg/kg)	<200				
	LEPH (mg/kg)	<200				
	HEPH (mg/kg)	<200				
	F1 (C6-C10) (mg/kg)	<10				
	Surrogate: 2-Bromobenzotrifluoride (%)	88.5				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050				
	Acenaphthylene (mg/kg)	<0.0050				
	Anthracene (mg/kg)	<0.0040				
	Benz(a)anthracene (mg/kg)	<0.010				
	Benzo(a)pyrene (mg/kg)	<0.010				
	Benzo(b&j)fluoranthene (mg/kg)	<0.010				
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015				
	Benzo(g,h,i)perylene (mg/kg)	<0.010				
	Benzo(k)fluoranthene (mg/kg)	<0.010				
	Chrysene (mg/kg)	<0.010				
	Dibenz(a,h)anthracene (mg/kg)	<0.0050				
	Fluoranthene (mg/kg)	<0.010				
	Fluorene (mg/kg)	<0.010				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010				
	1-Methylnaphthalene (mg/kg)	<0.050				
	2-Methylnaphthalene (mg/kg)	<0.010				
	Naphthalene (mg/kg)	<0.010				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-1	L2355484-2	L2355484-3	L2355484-4	L2355484-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	21-SEP-19	21-SEP-19	21-SEP-19	22-SEP-19	22-SEP-19
	Sampled Time	12:30	13:08	14:35	13:10	15:30
	Client ID	SE18-1	SE18-2	SE-1	SE-2	SE-3
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.013
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.011
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	101.5	111.2	113.8	111.6	102.3
	Surrogate: Naphthalene d8 (%)	101.7	112.6	111.4	115.2	107.1
	Surrogate: Phenanthrene d10 (%)	102.9	114.6	114.0	116.2	107.0
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355484-6	L2355484-7	L2355484-8	L2355484-9	L2355484-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	22-SEP-19	23-SEP-19	24-SEP-19	24-SEP-19	24-SEP-19
	Sampled Time	17:30	16:40	10:40	12:40	14:30
	Client ID	SE-4	SE-5	SE-6	SE-7	SE-8
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	108.9	92.0	108.2	105.1	105.1
	Surrogate: Naphthalene d8 (%)	109.1	103.7	112.6	105.9	108.7
	Surrogate: Phenanthrene d10 (%)	110.5	104.8	111.1	106.5	109.3
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	
	Sample ID	L2355484-11
	Description	Sediment
	Sampled Date	24-SEP-19
	Sampled Time	10:40
	Client ID	DUPA
SOIL		
Polycyclic Aromatic Hydrocarbons	Phenanthrene (mg/kg)	<0.010
	Pyrene (mg/kg)	<0.010
	Quinoline (mg/kg)	<0.050
	Surrogate: Chrysene d12 (%)	112.3
	Surrogate: Naphthalene d8 (%)	112.9
	Surrogate: Phenanthrene d10 (%)	113.8
	B(a)P Total Potency Equivalent (mg/kg)	<0.020
	IACR (CCME)	<0.15

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-HSFID-VA	Soil	CCME F1 by headspace GCMS	CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LEPH/HEPH-CALC-VA	Soil	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference Information

VOC-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-L-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Soil	VOC7 and/or VOC Surrogates for Soils	EPA 5035A/5021A/8260C
XYLENES-CALC-VA	Soil	Sum of Xylene Isomer Concentrations	EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-56003

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8
Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4859310								
WG3172986-4 IRM		**08-109_SOIL**						
Inorganic Carbon			94.7		%		80-120	04-OCT-19
WG3172986-2 LCS		**0.5**						
Inorganic Carbon			97.6		%		80-120	04-OCT-19
WG3172986-3 MB								
Inorganic Carbon			<0.050		%		0.05	04-OCT-19
C-TOT-LECO-SK	**Soil**							
Batch R4858986								
WG3181947-1 DUP		**L2355484-1**						
Total Carbon by Combustion		1.24	1.36		%	9.0	20	03-OCT-19
WG3181947-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			99.8		%		80-120	03-OCT-19
WG3181947-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			99.4		%		90-110	03-OCT-19
Batch R4859495								
WG3177818-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			101.5		%		80-120	04-OCT-19
WG3177818-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			103.5		%		90-110	04-OCT-19
WG3177818-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	04-OCT-19
Batch R4859930								
WG3179622-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			104.8		%		80-120	04-OCT-19
WG3179622-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			101.1		%		90-110	04-OCT-19
WG3179622-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	04-OCT-19
EPH-TUMB-FID-VA	**Soil**							
Batch R4857466								
WG3178770-3 DUP		**L2355484-1**						
EPH10-19		<200	<200	RPD-NA	mg/kg	N/A	40	02-OCT-19
EPH19-32		<200	<200	RPD-NA	mg/kg	N/A	40	02-OCT-19
WG3178770-4 IRM		**ALS PHC RM3**						
EPH10-19			98.4		%		70-130	02-OCT-19
EPH19-32			91.4		%		70-130	02-OCT-19
WG3178770-2 LCS								
EPH10-19			87.3		%		70-130	02-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-TUMB-FID-VA	**Soil**							
Batch R4857466								
WG3178770-2 LCS								
EPH19-32			80.7		%		70-130	02-OCT-19
WG3178770-1 MB								
EPH10-19			<200		mg/kg		200	02-OCT-19
EPH19-32			<200		mg/kg		200	02-OCT-19
Surrogate: 2-Bromobenzotrifluoride			87.1		%		60-140	02-OCT-19
F1-HSFID-VA	**Soil**							
Batch R4855049								
WG3196803-3 DUP		**L2355484-5**						
F1 (C6-C10)		<10	<10	RPD-NA	mg/kg	N/A	40	23-OCT-19
WG3196803-2 LCS								
F1 (C6-C10)			102.4		%		70-130	22-OCT-19
WG3196808-2 LCS								
F1 (C6-C10)			91.5		%		70-130	24-OCT-19
WG3196803-1 MB								
F1 (C6-C10)			<10		mg/kg		10	22-OCT-19
WG3196808-1 MB								
F1 (C6-C10)			<10		mg/kg		10	24-OCT-19
HG-200.2-CVAF-VA	**Soil**							
Batch R4857657								
WG3178825-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			116.0		%		70-130	03-OCT-19
WG3178825-2 DUP		**L2355484-1**						
Mercury (Hg)		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	40	03-OCT-19
WG3178825-3 LCS								
Mercury (Hg)			110.3		%		80-120	03-OCT-19
WG3178825-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	03-OCT-19
MET-200.2-CCMS-VA	**Soil**							
Batch R4858098								
WG3178825-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			96.9		%		70-130	04-OCT-19
Antimony (Sb)			101.4		%		70-130	04-OCT-19
Arsenic (As)			104.0		%		70-130	04-OCT-19
Barium (Ba)			97.6		%		70-130	04-OCT-19
Beryllium (Be)			95.1		%		70-130	04-OCT-19
Bismuth (Bi)			101.8		%		70-130	04-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4858098								
WG3178825-4 CRM		**VA-CANMET-TILL2**						
Cadmium (Cd)			103.3		%		70-130	04-OCT-19
Calcium (Ca)			103.3		%		70-130	04-OCT-19
Copper (Cu)			97.4		%		70-130	04-OCT-19
Iron (Fe)			99.3		%		70-130	04-OCT-19
Lead (Pb)			98.1		%		70-130	04-OCT-19
Lithium (Li)			100.5		%		70-130	04-OCT-19
Magnesium (Mg)			95.1		%		70-130	04-OCT-19
Manganese (Mn)			97.2		%		70-130	04-OCT-19
Molybdenum (Mo)			100.4		%		70-130	04-OCT-19
Nickel (Ni)			100.3		%		70-130	04-OCT-19
Phosphorus (P)			105.4		%		70-130	04-OCT-19
Potassium (K)			101.4		%		70-130	04-OCT-19
Selenium (Se)			0.29		mg/kg		0.15-0.55	04-OCT-19
Silver (Ag)			0.27		mg/kg		0.16-0.36	04-OCT-19
Sodium (Na)			97.5		%		70-130	04-OCT-19
Strontium (Sr)			105.0		%		70-130	04-OCT-19
Thallium (Tl)			102.6		%		70-130	04-OCT-19
Tin (Sn)			2.4		mg/kg		0.2-4.2	04-OCT-19
Titanium (Ti)			102.9		%		70-130	04-OCT-19
Tungsten (W)			1.42		mg/kg		1-2	04-OCT-19
Uranium (U)			105.4		%		70-130	04-OCT-19
Vanadium (V)			101.1		%		70-130	04-OCT-19
Zinc (Zn)			97.5		%		70-130	04-OCT-19
WG3178825-2 DUP		**L2355484-1**						
Aluminum (Al)		1520	1410		mg/kg	7.1	40	04-OCT-19
Antimony (Sb)		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	04-OCT-19
Arsenic (As)		1.02	0.99		mg/kg	2.4	30	04-OCT-19
Barium (Ba)		4.88	7.05		mg/kg	36	40	04-OCT-19
Beryllium (Be)		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	04-OCT-19
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	04-OCT-19
Boron (B)		10.3	9.6		mg/kg	6.7	30	04-OCT-19
Cadmium (Cd)		<0.020	<0.020	RPD-NA	mg/kg	N/A	30	04-OCT-19
Calcium (Ca)		23500	20500		mg/kg	14	30	04-OCT-19
Chromium (Cr)		6.46	5.57		mg/kg	15	30	04-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4858098								
WG3178825-2 DUP		**L2355484-1**						
Cobalt (Co)		0.99	0.98		mg/kg	1.0	30	04-OCT-19
Copper (Cu)		1.86	1.96		mg/kg	5.0	30	04-OCT-19
Iron (Fe)		6170	5580		mg/kg	10	30	04-OCT-19
Lead (Pb)		1.51	1.41		mg/kg	6.9	40	04-OCT-19
Lithium (Li)		6.4	6.1		mg/kg	5.7	30	04-OCT-19
Magnesium (Mg)		12400	11200		mg/kg	10	30	04-OCT-19
Manganese (Mn)		45.1	44.1		mg/kg	2.4	30	04-OCT-19
Molybdenum (Mo)		0.18	0.16		mg/kg	12	40	04-OCT-19
Nickel (Ni)		3.27	3.14		mg/kg	4.2	30	04-OCT-19
Phosphorus (P)		163	191		mg/kg	16	30	04-OCT-19
Potassium (K)		670	670		mg/kg	1.0	40	04-OCT-19
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	04-OCT-19
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	04-OCT-19
Sodium (Na)		1600	1880		mg/kg	16	40	04-OCT-19
Strontium (Sr)		15.2	17.2		mg/kg	13	40	04-OCT-19
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	04-OCT-19
Thallium (Tl)		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	04-OCT-19
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	04-OCT-19
Titanium (Ti)		88.3	97.4		mg/kg	9.8	40	04-OCT-19
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	04-OCT-19
Uranium (U)		0.330	0.281		mg/kg	16	30	04-OCT-19
Vanadium (V)		6.04	6.19		mg/kg	2.4	30	04-OCT-19
Zinc (Zn)		5.2	4.7		mg/kg	8.8	30	04-OCT-19
Zirconium (Zr)		2.0	1.8		mg/kg	8.9	30	04-OCT-19
WG3178825-3 LCS								
Aluminum (Al)			104.0		%		80-120	04-OCT-19
Antimony (Sb)			101.0		%		80-120	04-OCT-19
Arsenic (As)			102.0		%		80-120	04-OCT-19
Barium (Ba)			107.4		%		80-120	04-OCT-19
Beryllium (Be)			100.1		%		80-120	04-OCT-19
Bismuth (Bi)			91.9		%		80-120	04-OCT-19
Boron (B)			99.1		%		80-120	04-OCT-19
Cadmium (Cd)			104.0		%		80-120	04-OCT-19
Calcium (Ca)			100.8		%		80-120	04-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4858098								
WG3178825-3 LCS								
Chromium (Cr)			104.0		%		80-120	04-OCT-19
Cobalt (Co)			101.6		%		80-120	04-OCT-19
Copper (Cu)			99.9		%		80-120	04-OCT-19
Iron (Fe)			102.0		%		80-120	04-OCT-19
Lead (Pb)			95.3		%		80-120	04-OCT-19
Lithium (Li)			97.8		%		80-120	04-OCT-19
Magnesium (Mg)			105.3		%		80-120	04-OCT-19
Manganese (Mn)			103.7		%		80-120	04-OCT-19
Molybdenum (Mo)			105.0		%		80-120	04-OCT-19
Nickel (Ni)			100.4		%		80-120	04-OCT-19
Phosphorus (P)			109.3		%		80-120	04-OCT-19
Potassium (K)			103.4		%		80-120	04-OCT-19
Selenium (Se)			97.2		%		80-120	04-OCT-19
Silver (Ag)			101.7		%		80-120	04-OCT-19
Sodium (Na)			105.7		%		80-120	04-OCT-19
Strontium (Sr)			104.5		%		80-120	04-OCT-19
Sulfur (S)			91.0		%		80-120	04-OCT-19
Thallium (Tl)			92.9		%		80-120	04-OCT-19
Tin (Sn)			101.0		%		80-120	04-OCT-19
Titanium (Ti)			97.7		%		80-120	04-OCT-19
Tungsten (W)			95.4		%		80-120	04-OCT-19
Uranium (U)			106.4		%		80-120	04-OCT-19
Vanadium (V)			104.5		%		80-120	04-OCT-19
Zinc (Zn)			98.8		%		80-120	04-OCT-19
Zirconium (Zr)			98.4		%		70-130	04-OCT-19
WG3178825-1 MB								
Aluminum (Al)			<50		mg/kg		50	04-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	04-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	04-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	04-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	04-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	04-OCT-19
Boron (B)			<5.0		mg/kg		5	04-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	04-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4858098								
WG3178825-1 MB								
Calcium (Ca)			<50		mg/kg		50	04-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	04-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	04-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	04-OCT-19
Iron (Fe)			<50		mg/kg		50	04-OCT-19
Lead (Pb)			<0.50		mg/kg		0.5	04-OCT-19
Lithium (Li)			<2.0		mg/kg		2	04-OCT-19
Magnesium (Mg)			<20		mg/kg		20	04-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	04-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	04-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	04-OCT-19
Phosphorus (P)			<50		mg/kg		50	04-OCT-19
Potassium (K)			<100		mg/kg		100	04-OCT-19
Selenium (Se)			<0.20		mg/kg		0.2	04-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	04-OCT-19
Sodium (Na)			<50		mg/kg		50	04-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	04-OCT-19
Sulfur (S)			<1000		mg/kg		1000	04-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	04-OCT-19
Tin (Sn)			<2.0		mg/kg		2	04-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	04-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	04-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	04-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	04-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	04-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	04-OCT-19
MOISTURE-VA	**Soil**							
Batch R4853829								
WG3178768-2 LCS								
Moisture			101.7		%		90-110	01-OCT-19
WG3178768-1 MB								
Moisture			<0.25		%		0.25	01-OCT-19
PAH-TMB-H/A-MS-VA	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4856908								
WG3178770-3 DUP		**L2355484-1**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	03-OCT-19
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	03-OCT-19
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	03-OCT-19
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	03-OCT-19
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	03-OCT-19
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	03-OCT-19
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	03-OCT-19
WG3178770-5 IRM		**ALS PAH RM2**						
Acenaphthene			107.4		%		60-130	02-OCT-19
Acenaphthylene			119.1		%		60-130	02-OCT-19
Anthracene			118.6		%		60-130	02-OCT-19
Benz(a)anthracene			107.2		%		60-130	02-OCT-19
Benzo(a)pyrene			98.1		%		60-130	02-OCT-19
Benzo(b&j)fluoranthene			107.4		%		60-130	02-OCT-19
Benzo(g,h,i)perylene			103.3		%		60-130	02-OCT-19
Benzo(k)fluoranthene			95.8		%		60-130	02-OCT-19
Chrysene			113.0		%		60-130	02-OCT-19
Dibenz(a,h)anthracene			101.8		%		60-130	02-OCT-19
Fluoranthene			107.3		%		60-130	02-OCT-19
Fluorene			107.6		%		60-130	02-OCT-19
Indeno(1,2,3-c,d)pyrene			100.4		%		60-130	02-OCT-19
1-Methylnaphthalene			102.7		%		60-130	02-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4856908								
WG3178770-5 IRM		**ALS PAH RM2**						
2-Methylnaphthalene			110.9		%		60-130	02-OCT-19
Naphthalene			110.7		%		50-130	02-OCT-19
Phenanthrene			109.0		%		60-130	02-OCT-19
Pyrene			109.7		%		60-130	02-OCT-19
WG3178770-2 LCS								
Acenaphthene			101.9		%		60-130	02-OCT-19
Acenaphthylene			100.7		%		60-130	02-OCT-19
Anthracene			101.0		%		60-130	02-OCT-19
Benz(a)anthracene			101.0		%		60-130	02-OCT-19
Benzo(a)pyrene			94.3		%		60-130	02-OCT-19
Benzo(b&j)fluoranthene			103.1		%		60-130	02-OCT-19
Benzo(g,h,i)perylene			92.6		%		60-130	02-OCT-19
Benzo(k)fluoranthene			94.9		%		60-130	02-OCT-19
Chrysene			93.2		%		60-130	02-OCT-19
Dibenz(a,h)anthracene			95.7		%		60-130	02-OCT-19
Fluoranthene			97.4		%		60-130	02-OCT-19
Fluorene			99.9		%		60-130	02-OCT-19
Indeno(1,2,3-c,d)pyrene			96.5		%		60-130	02-OCT-19
1-Methylnaphthalene			92.9		%		60-130	02-OCT-19
2-Methylnaphthalene			104.3		%		60-130	02-OCT-19
Naphthalene			100.2		%		50-130	02-OCT-19
Phenanthrene			101.3		%		60-130	02-OCT-19
Pyrene			100.2		%		60-130	02-OCT-19
Quinoline			95.5		%		60-130	02-OCT-19
WG3178770-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	02-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	02-OCT-19
Anthracene			<0.0040		mg/kg		0.004	02-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	02-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	02-OCT-19
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	02-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	02-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	02-OCT-19
Chrysene			<0.010		mg/kg		0.01	02-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	02-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4856908								
WG3178770-1 MB								
Fluoranthene			<0.010		mg/kg		0.01	02-OCT-19
Fluorene			<0.010		mg/kg		0.01	02-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	02-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	02-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	02-OCT-19
Naphthalene			<0.010		mg/kg		0.01	02-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	02-OCT-19
Pyrene			<0.010		mg/kg		0.01	02-OCT-19
Quinoline			<0.050		mg/kg		0.05	02-OCT-19
Surrogate: Naphthalene d8			113.0		%		50-130	02-OCT-19
Surrogate: Phenanthrene d10			113.0		%		60-130	02-OCT-19
Surrogate: Chrysene d12			109.5		%		60-130	02-OCT-19
PH-1:2-VA	**Soil**							
Batch R4858593								
WG3178825-2 DUP		**L2355484-1**						
pH (1:2 soil:water)		8.39	8.50	J	pH	0.11	0.2	03-OCT-19
PSA-PIPET+GRAVEL-SK	**Soil**							
Batch R4862546								
WG3179970-1 DUP		**L2355484-2**						
% Gravel (>2mm)		15.2	15.2	J	%	0.0	5	09-OCT-19
% Sand (2.0mm - 0.063mm)		66.5	67.5	J	%	1.0	5	09-OCT-19
% Silt (0.063mm - 4um)		14.3	13.5	J	%	0.9	5	09-OCT-19
% Clay (<4um)		3.9	3.8	J	%	0.1	5	09-OCT-19
WG3179970-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.063mm)			44.6		%		39.1-49.1	09-OCT-19
% Silt (0.063mm - 4um)			38.0		%		32.5-42.5	09-OCT-19
% Clay (<4um)			17.4		%		13.4-23.4	09-OCT-19
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-3 DUP		**L2355484-5**						
Bromodichloromethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Bromoform		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Carbon Tetrachloride		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Chlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-3 DUP		**L2355484-5**						
Dibromochloromethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Chloroethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	23-OCT-19
Chloroform		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	23-OCT-19
Chloromethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Dichloromethane		<0.30	<0.30	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
cis-1,3-Dichloropropylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
trans-1,3-Dichloropropylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Tetrachloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	23-OCT-19
Trichloroethylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	23-OCT-19
Trichlorofluoromethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	23-OCT-19
Vinyl Chloride		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	23-OCT-19
WG3196803-2 LCS								
Bromodichloromethane			82.3		%		70-130	22-OCT-19
Bromoform			78.9		%		70-130	22-OCT-19
Carbon Tetrachloride			96.6		%		70-130	22-OCT-19
Chlorobenzene			89.2		%		70-130	22-OCT-19
Dibromochloromethane			88.8		%		70-130	22-OCT-19
Chloroethane			85.0		%		60-140	22-OCT-19
Chloroform			90.0		%		70-130	22-OCT-19
Chloromethane			98.0		%		60-140	22-OCT-19
1,2-Dichlorobenzene			90.4		%		70-130	22-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-2 LCS								
1,3-Dichlorobenzene			87.0		%		70-130	22-OCT-19
1,4-Dichlorobenzene			88.9		%		70-140	22-OCT-19
1,1-Dichloroethane			88.1		%		70-130	22-OCT-19
1,2-Dichloroethane			78.2		%		70-130	22-OCT-19
1,1-Dichloroethylene			88.0		%		70-130	22-OCT-19
cis-1,2-Dichloroethylene			78.9		%		70-130	22-OCT-19
trans-1,2-Dichloroethylene			83.4		%		70-130	22-OCT-19
Dichloromethane			82.4		%		60-140	22-OCT-19
1,2-Dichloropropane			89.3		%		70-130	22-OCT-19
cis-1,3-Dichloropropylene			90.6		%		70-130	22-OCT-19
trans-1,3-Dichloropropylene			75.0		%		70-130	22-OCT-19
1,1,1,2-Tetrachloroethane			86.9		%		70-130	22-OCT-19
1,1,2,2-Tetrachloroethane			76.5		%		70-130	22-OCT-19
Tetrachloroethylene			97.2		%		70-130	22-OCT-19
1,1,1-Trichloroethane			97.8		%		70-130	22-OCT-19
1,1,2-Trichloroethane			74.0		%		70-130	22-OCT-19
Trichloroethylene			93.2		%		70-130	22-OCT-19
Trichlorofluoromethane			111.9		%		60-140	22-OCT-19
Vinyl Chloride			100.4		%		60-140	22-OCT-19
WG3196808-2 LCS								
Bromodichloromethane			104.7		%		70-130	23-OCT-19
Bromoform			113.7		%		70-130	23-OCT-19
Carbon Tetrachloride			116.6		%		70-130	23-OCT-19
Chlorobenzene			107.7		%		70-130	23-OCT-19
Dibromochloromethane			114.6		%		70-130	23-OCT-19
Chloroethane			104.9		%		60-140	23-OCT-19
Chloroform			112.1		%		70-130	23-OCT-19
Chloromethane			122.8		%		60-140	23-OCT-19
1,2-Dichlorobenzene			109.3		%		70-130	23-OCT-19
1,3-Dichlorobenzene			108.3		%		70-130	23-OCT-19
1,4-Dichlorobenzene			111.3		%		70-140	23-OCT-19
1,1-Dichloroethane			107.9		%		70-130	23-OCT-19
1,2-Dichloroethane			98.6		%		70-130	23-OCT-19
1,1-Dichloroethylene			107.0		%		70-130	23-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196808-2 LCS								
cis-1,2-Dichloroethylene			95.1		%		70-130	23-OCT-19
trans-1,2-Dichloroethylene			106.3		%		70-130	23-OCT-19
Dichloromethane			105.1		%		60-140	23-OCT-19
1,2-Dichloropropane			112.8		%		70-130	23-OCT-19
cis-1,3-Dichloropropylene			119.2		%		70-130	23-OCT-19
trans-1,3-Dichloropropylene			95.1		%		70-130	23-OCT-19
1,1,1,2-Tetrachloroethane			106.3		%		70-130	23-OCT-19
1,1,2,2-Tetrachloroethane			95.9		%		70-130	23-OCT-19
Tetrachloroethylene			124.4		%		70-130	23-OCT-19
1,1,1-Trichloroethane			117.3		%		70-130	23-OCT-19
1,1,2-Trichloroethane			90.3		%		70-130	23-OCT-19
Trichloroethylene			114.9		%		70-130	23-OCT-19
Trichlorofluoromethane			138.3		%		60-140	23-OCT-19
Vinyl Chloride			120.6		%		60-140	23-OCT-19
WG3196803-1 MB								
Bromodichloromethane			<0.050		mg/kg		0.05	22-OCT-19
Bromoform			<0.050		mg/kg		0.05	22-OCT-19
Carbon Tetrachloride			<0.050		mg/kg		0.05	22-OCT-19
Chlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
Dibromochloromethane			<0.050		mg/kg		0.05	22-OCT-19
Chloroethane			<0.10		mg/kg		0.1	22-OCT-19
Chloroform			<0.10		mg/kg		0.1	22-OCT-19
Chloromethane			<0.10		mg/kg		0.1	22-OCT-19
1,2-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,3-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,4-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,1-Dichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,2-Dichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
cis-1,2-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
trans-1,2-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
Dichloromethane			<0.30		mg/kg		0.3	22-OCT-19
1,2-Dichloropropane			<0.050		mg/kg		0.05	22-OCT-19
cis-1,3-Dichloropropylene			<0.050		mg/kg		0.05	22-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-1 MB								
trans-1,3-Dichloropropylene			<0.050		mg/kg		0.05	22-OCT-19
1,1,1,2-Tetrachloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	22-OCT-19
Tetrachloroethylene			<0.050		mg/kg		0.05	22-OCT-19
1,1,1-Trichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1,2-Trichloroethane			<0.050		mg/kg		0.05	22-OCT-19
Trichloroethylene			<0.010		mg/kg		0.01	22-OCT-19
Trichlorofluoromethane			<0.10		mg/kg		0.1	22-OCT-19
Vinyl Chloride			<0.10		mg/kg		0.1	22-OCT-19
WG3196808-1 MB								
Bromodichloromethane			<0.050		mg/kg		0.05	23-OCT-19
Bromoform			<0.050		mg/kg		0.05	23-OCT-19
Carbon Tetrachloride			<0.050		mg/kg		0.05	23-OCT-19
Chlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
Dibromochloromethane			<0.050		mg/kg		0.05	23-OCT-19
Chloroethane			<0.10		mg/kg		0.1	23-OCT-19
Chloroform			<0.10		mg/kg		0.1	23-OCT-19
Chloromethane			<0.10		mg/kg		0.1	23-OCT-19
1,2-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,3-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,4-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,1-Dichloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,2-Dichloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,1-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
cis-1,2-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
trans-1,2-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
Dichloromethane			<0.30		mg/kg		0.3	23-OCT-19
1,2-Dichloropropane			<0.050		mg/kg		0.05	23-OCT-19
cis-1,3-Dichloropropylene			<0.050		mg/kg		0.05	23-OCT-19
trans-1,3-Dichloropropylene			<0.050		mg/kg		0.05	23-OCT-19
1,1,1,2-Tetrachloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	23-OCT-19
Tetrachloroethylene			<0.050		mg/kg		0.05	23-OCT-19
1,1,1-Trichloroethane			<0.050		mg/kg		0.05	23-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196808-1 MB								
1,1,2-Trichloroethane			<0.050		mg/kg		0.05	23-OCT-19
Trichloroethylene			<0.010		mg/kg		0.01	23-OCT-19
Trichlorofluoromethane			<0.10		mg/kg		0.1	23-OCT-19
Vinyl Chloride			<0.10		mg/kg		0.1	23-OCT-19
VOC7-L-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-3 DUP		**L2355484-5**						
Benzene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	40	23-OCT-19
Ethylbenzene		<0.015	<0.015	RPD-NA	mg/kg	N/A	40	23-OCT-19
Methyl t-butyl ether (MTBE)		<0.20	<0.20	RPD-NA	mg/kg	N/A	40	23-OCT-19
Styrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	23-OCT-19
Toluene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	23-OCT-19
meta- & para-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	23-OCT-19
ortho-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	23-OCT-19
WG3196803-2 LCS								
Benzene			88.5		%		70-130	22-OCT-19
Ethylbenzene			109.4		%		70-130	22-OCT-19
Methyl t-butyl ether (MTBE)			92.2		%		70-130	22-OCT-19
Styrene			84.4		%		70-130	22-OCT-19
Toluene			87.6		%		70-130	22-OCT-19
meta- & para-Xylene			93.9		%		70-130	22-OCT-19
ortho-Xylene			92.6		%		70-130	22-OCT-19
WG3196808-2 LCS								
Benzene			107.6		%		70-130	23-OCT-19
Ethylbenzene			114.3		%		70-130	23-OCT-19
Methyl t-butyl ether (MTBE)			103.1		%		70-130	23-OCT-19
Styrene			100.4		%		70-130	23-OCT-19
Toluene			102.3		%		70-130	23-OCT-19
meta- & para-Xylene			110.9		%		70-130	23-OCT-19
ortho-Xylene			109.0		%		70-130	23-OCT-19
WG3196803-1 MB								
Benzene			<0.0050		mg/kg		0.005	22-OCT-19
Ethylbenzene			<0.015		mg/kg		0.015	22-OCT-19
Methyl t-butyl ether (MTBE)			<0.20		mg/kg		0.2	22-OCT-19
Styrene			<0.050		mg/kg		0.05	22-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC7-L-HSMS-VA	**Soil**							
Batch R4851265								
WG3196803-1 MB								
Toluene			<0.050		mg/kg		0.05	22-OCT-19
meta- & para-Xylene			<0.050		mg/kg		0.05	22-OCT-19
ortho-Xylene			<0.050		mg/kg		0.05	22-OCT-19
WG3196808-1 MB								
Benzene			<0.0050		mg/kg		0.005	23-OCT-19
Ethylbenzene			<0.015		mg/kg		0.015	23-OCT-19
Methyl t-butyl ether (MTBE)			<0.20		mg/kg		0.2	23-OCT-19
Styrene			<0.050		mg/kg		0.05	23-OCT-19
Toluene			<0.050		mg/kg		0.05	23-OCT-19
meta- & para-Xylene			<0.050		mg/kg		0.05	23-OCT-19
ortho-Xylene			<0.050		mg/kg		0.05	23-OCT-19

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

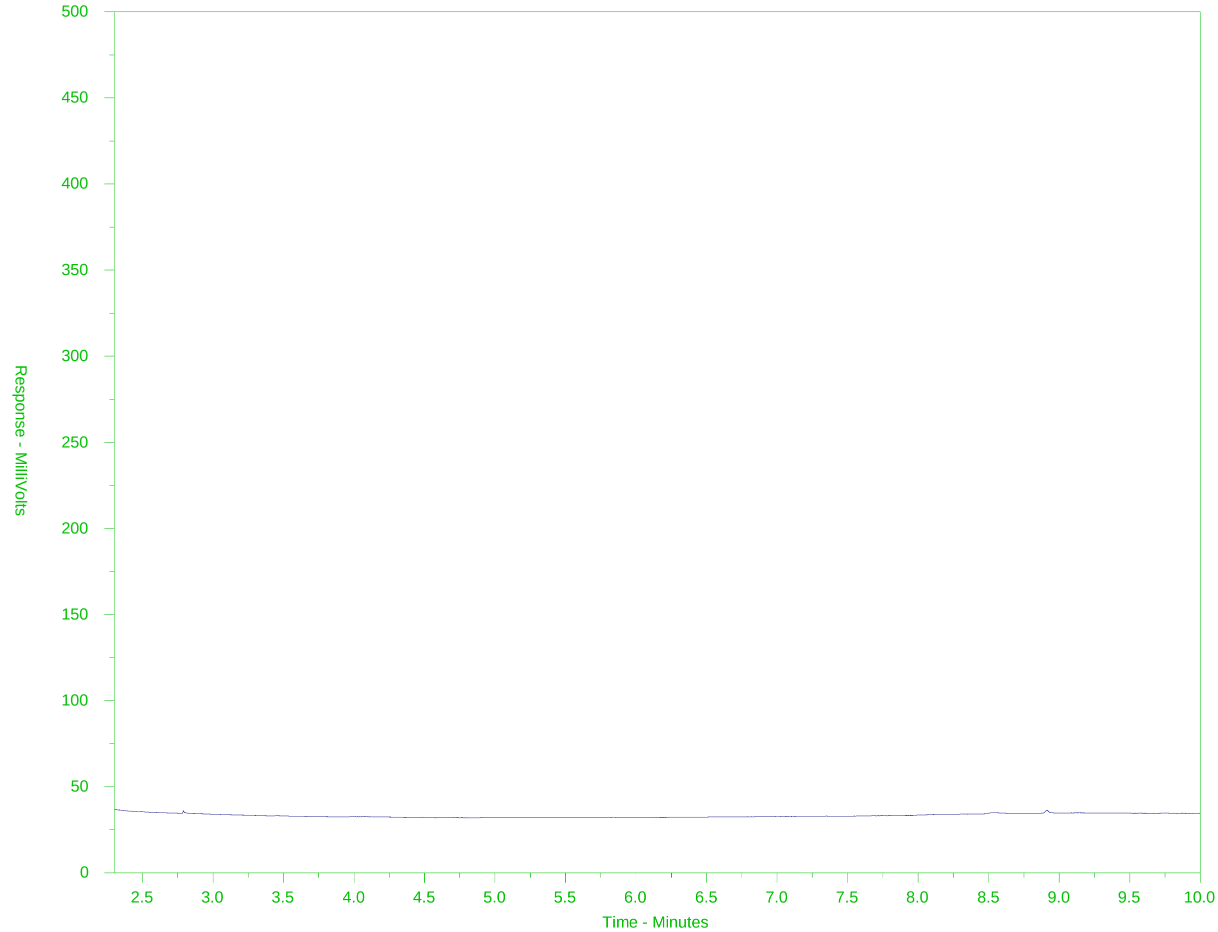
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-1
Client Sample ID: SE18-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

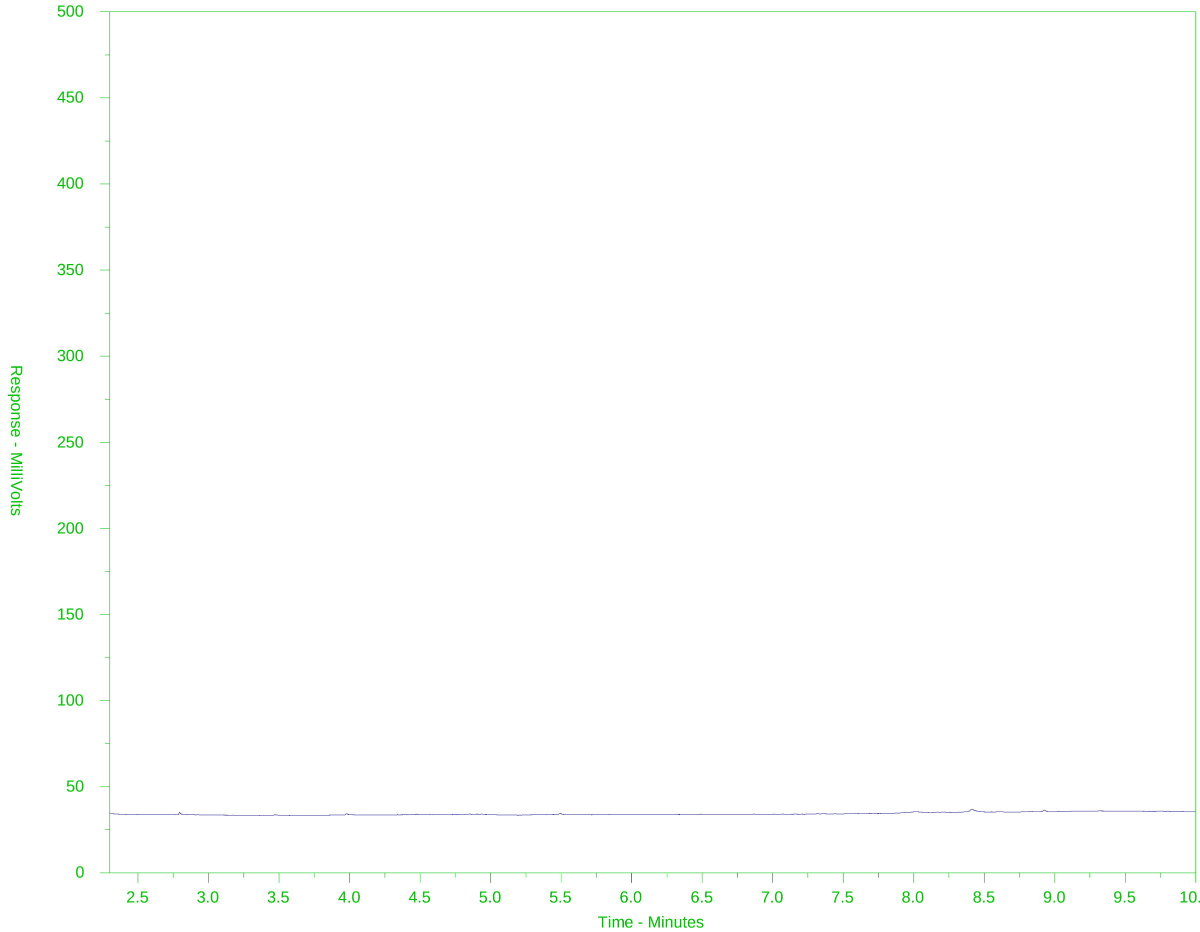
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WG3178770-3#L2355484-1
Client Sample ID: SE18-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

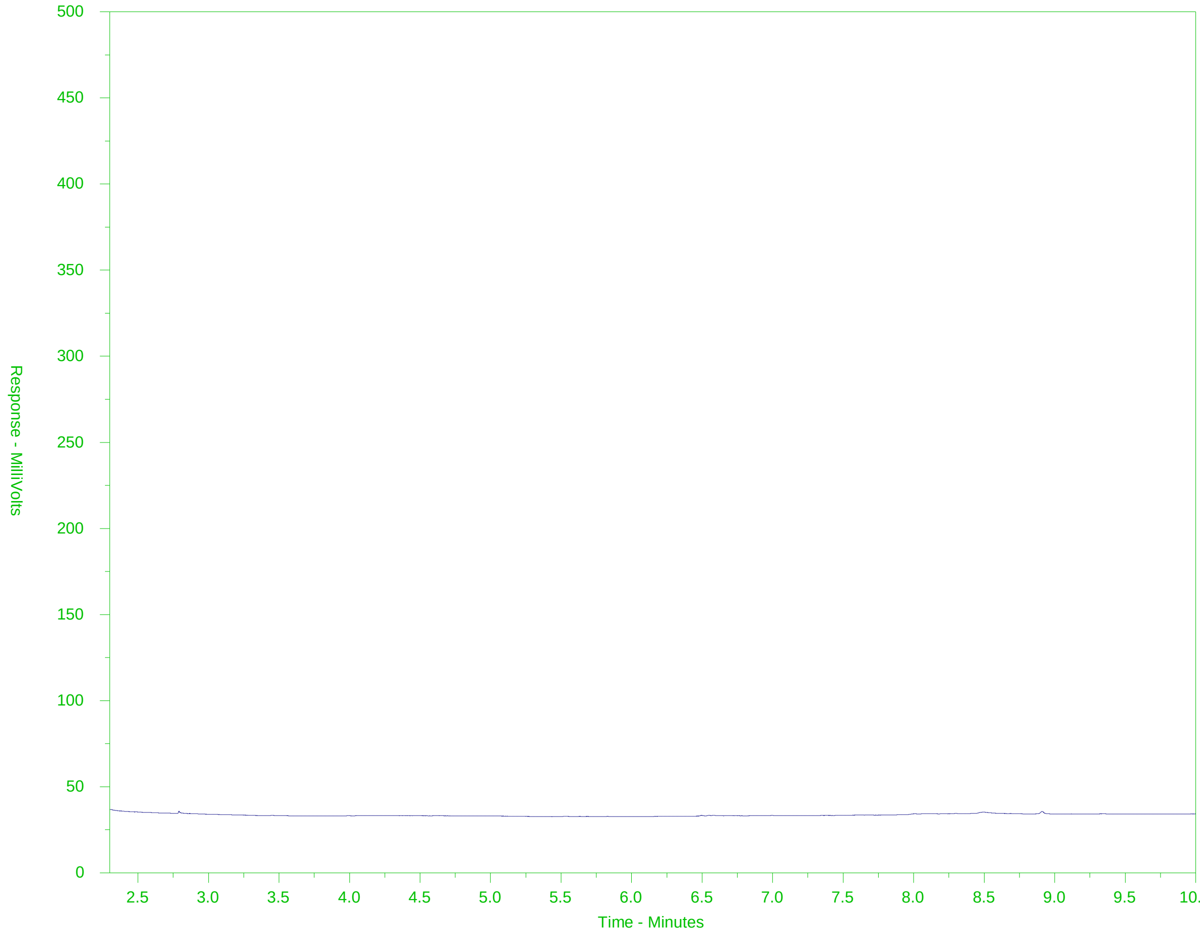
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-2
Client Sample ID: SE18-2



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

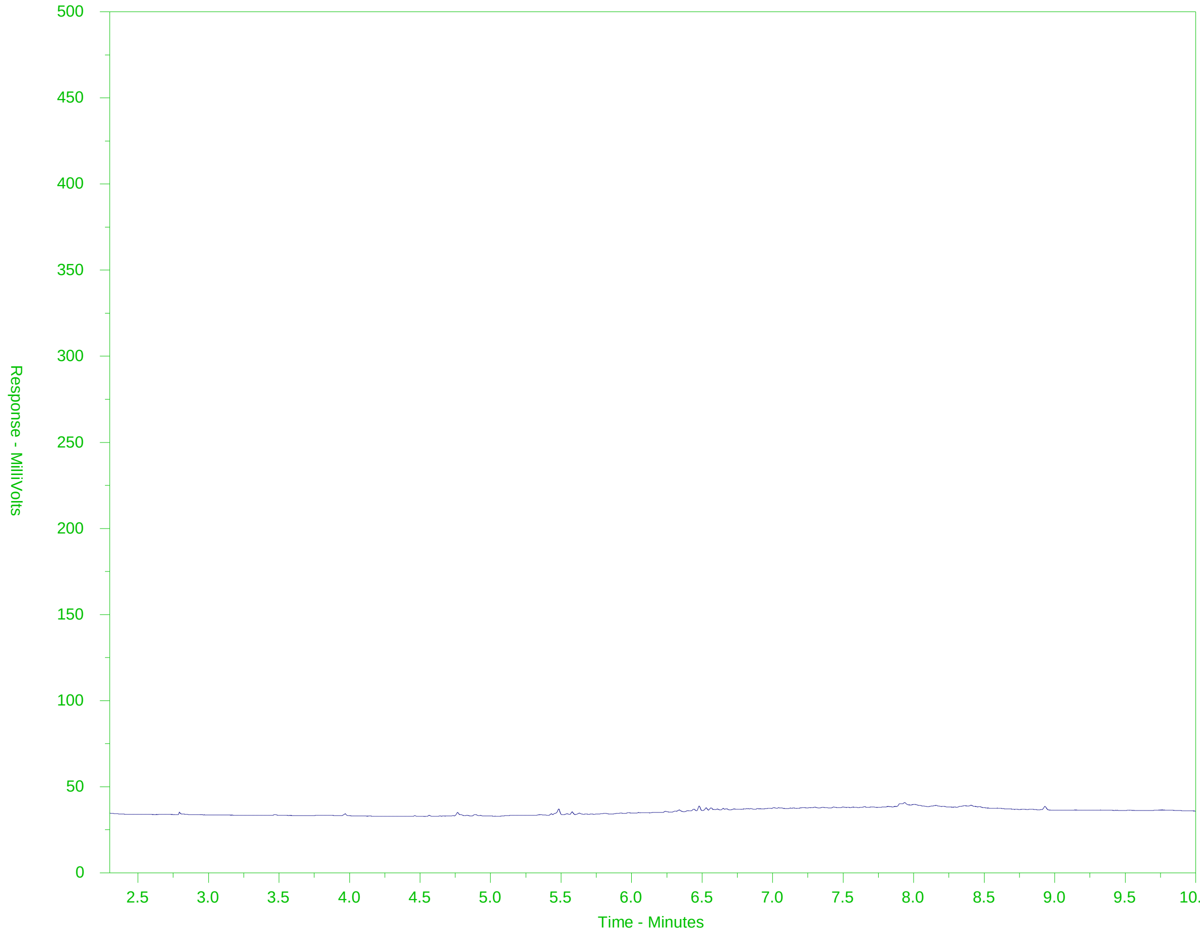
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-3
Client Sample ID: SE-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

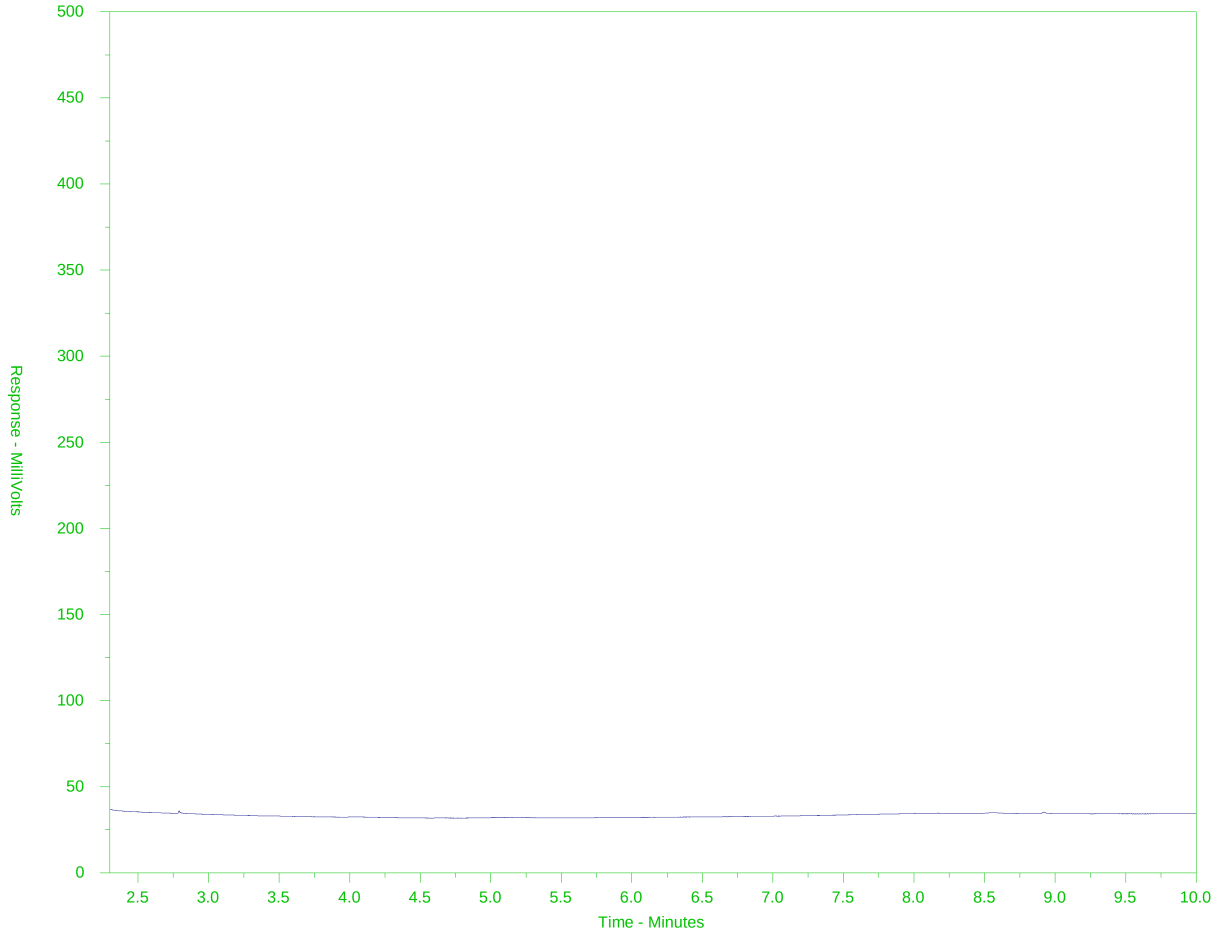
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-4
Client Sample ID: SE-2



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

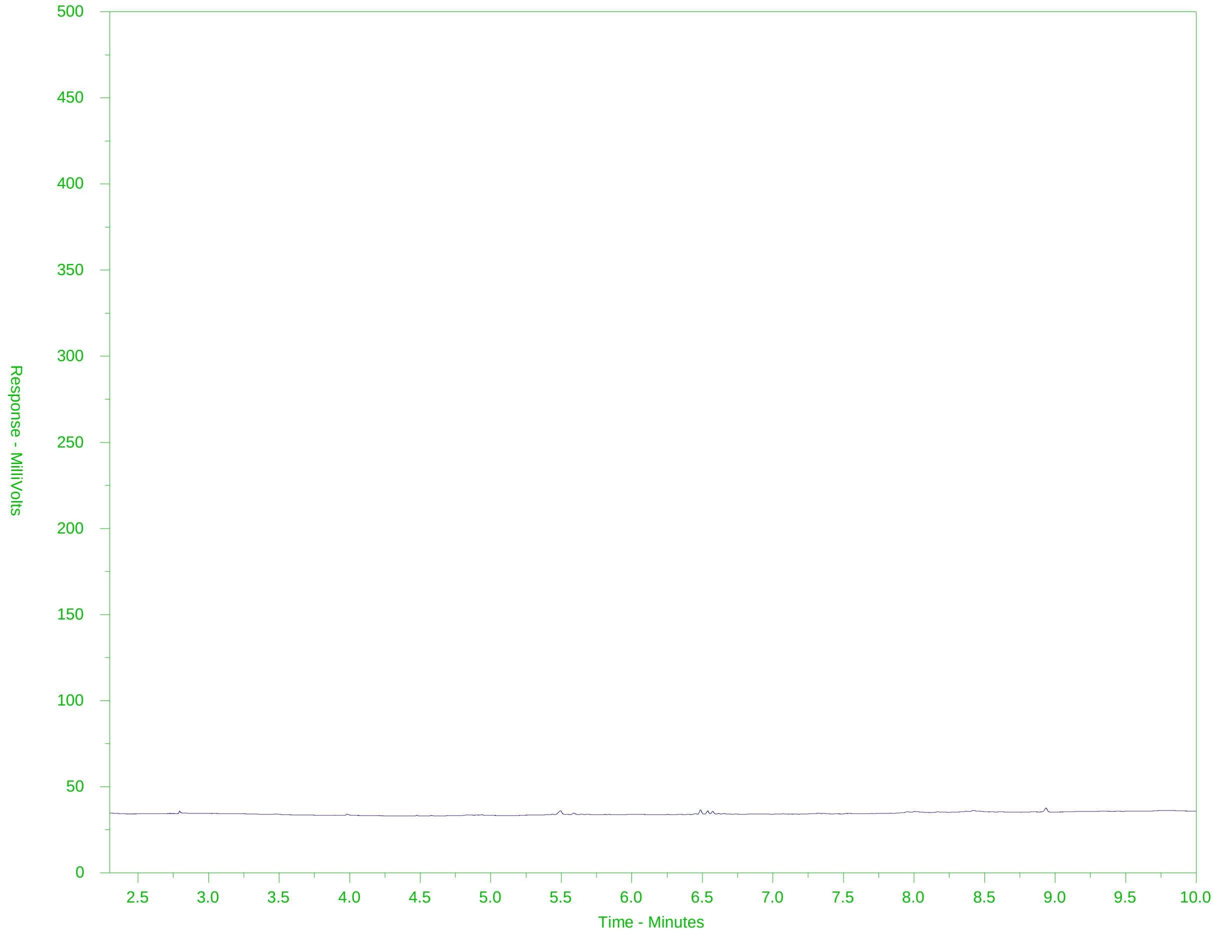
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-5
Client Sample ID: SE-3



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

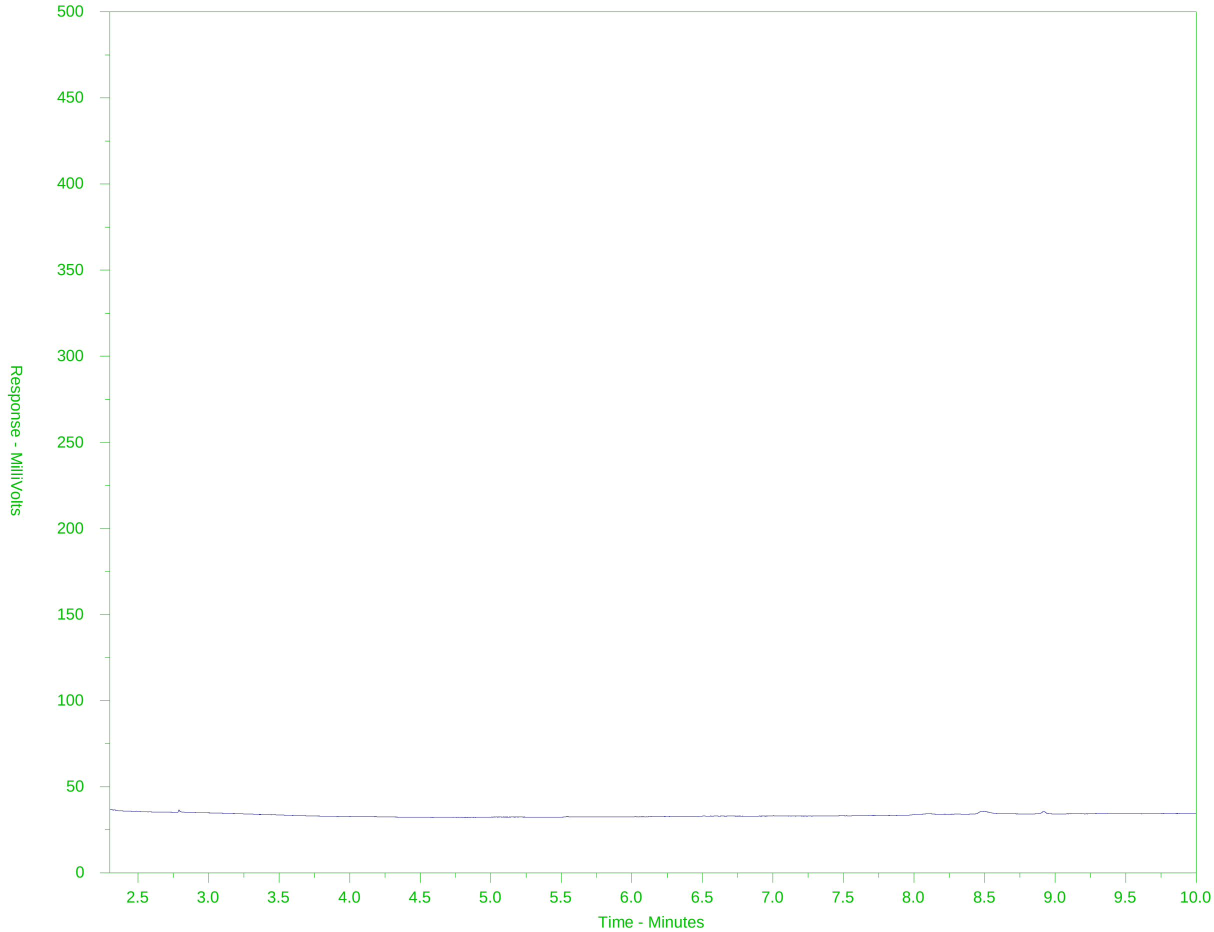
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-6
Client Sample ID: SE-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

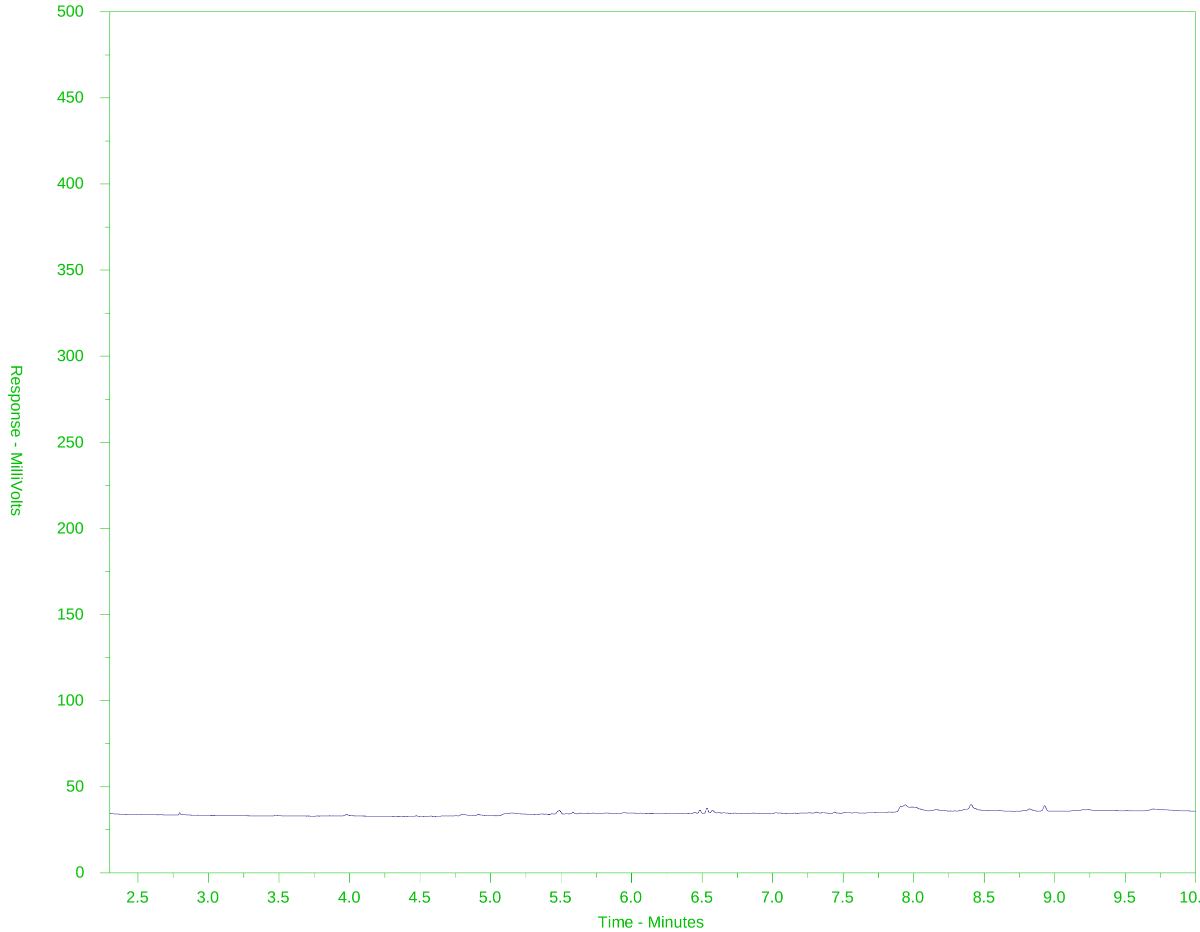
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-7
Client Sample ID: SE-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

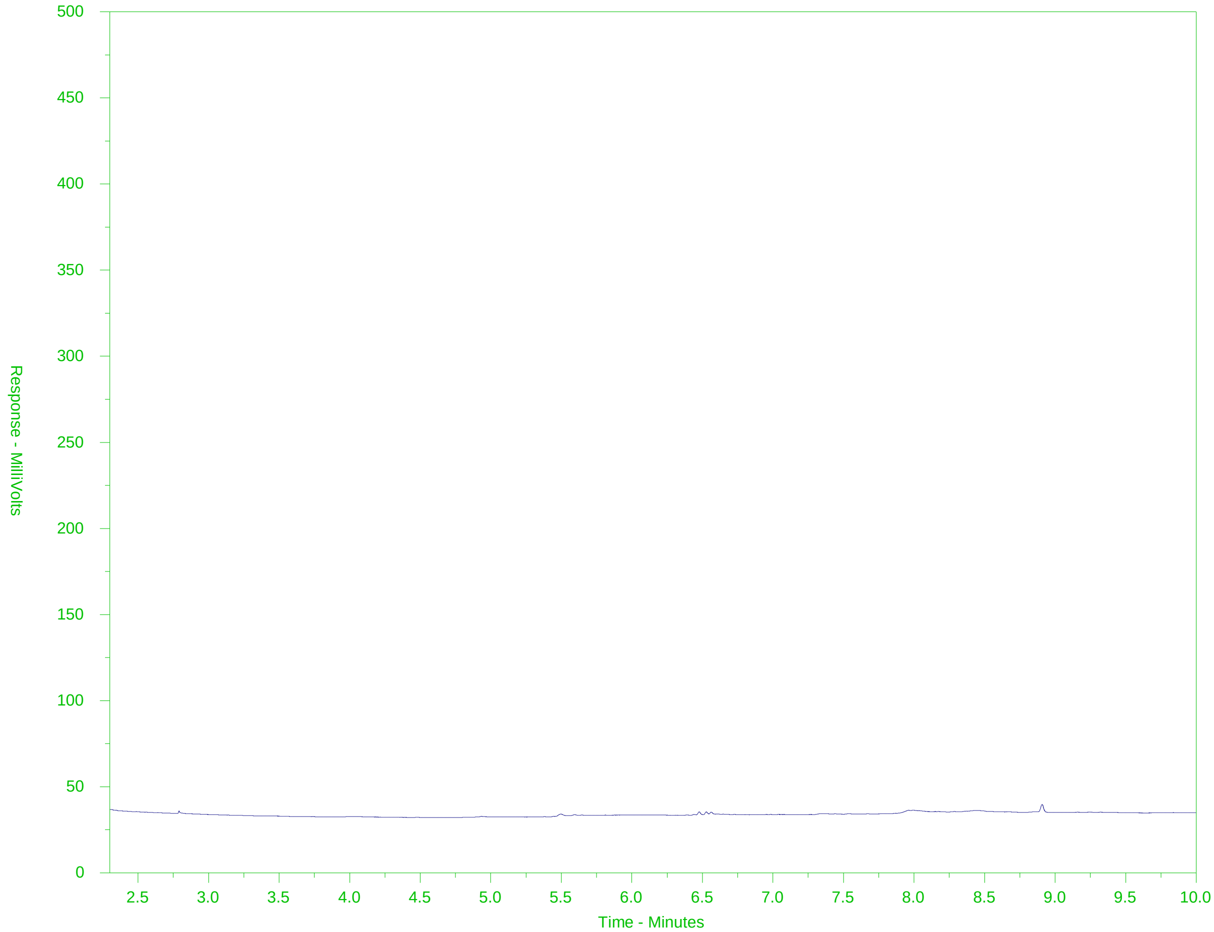
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

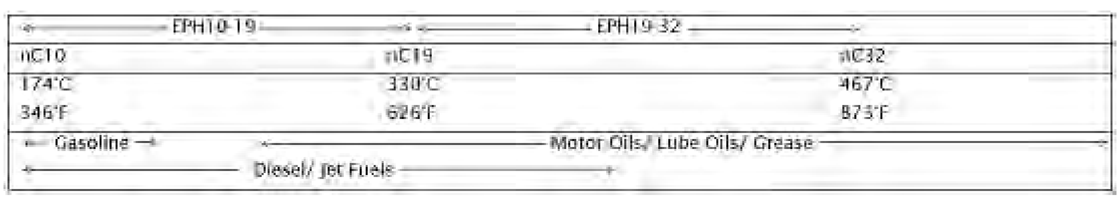
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-8
Client Sample ID: SE-6





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

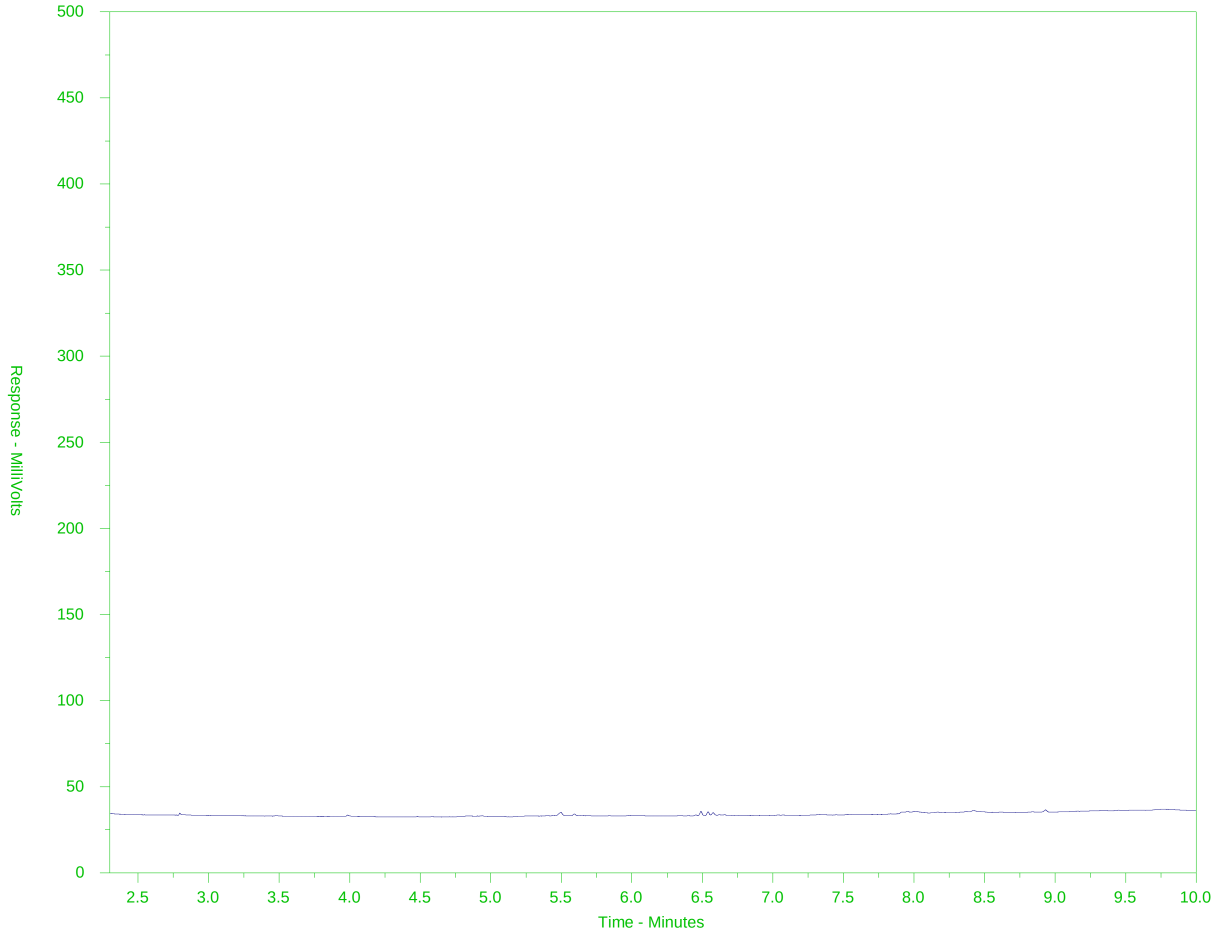
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-9
Client Sample ID: SE-7



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

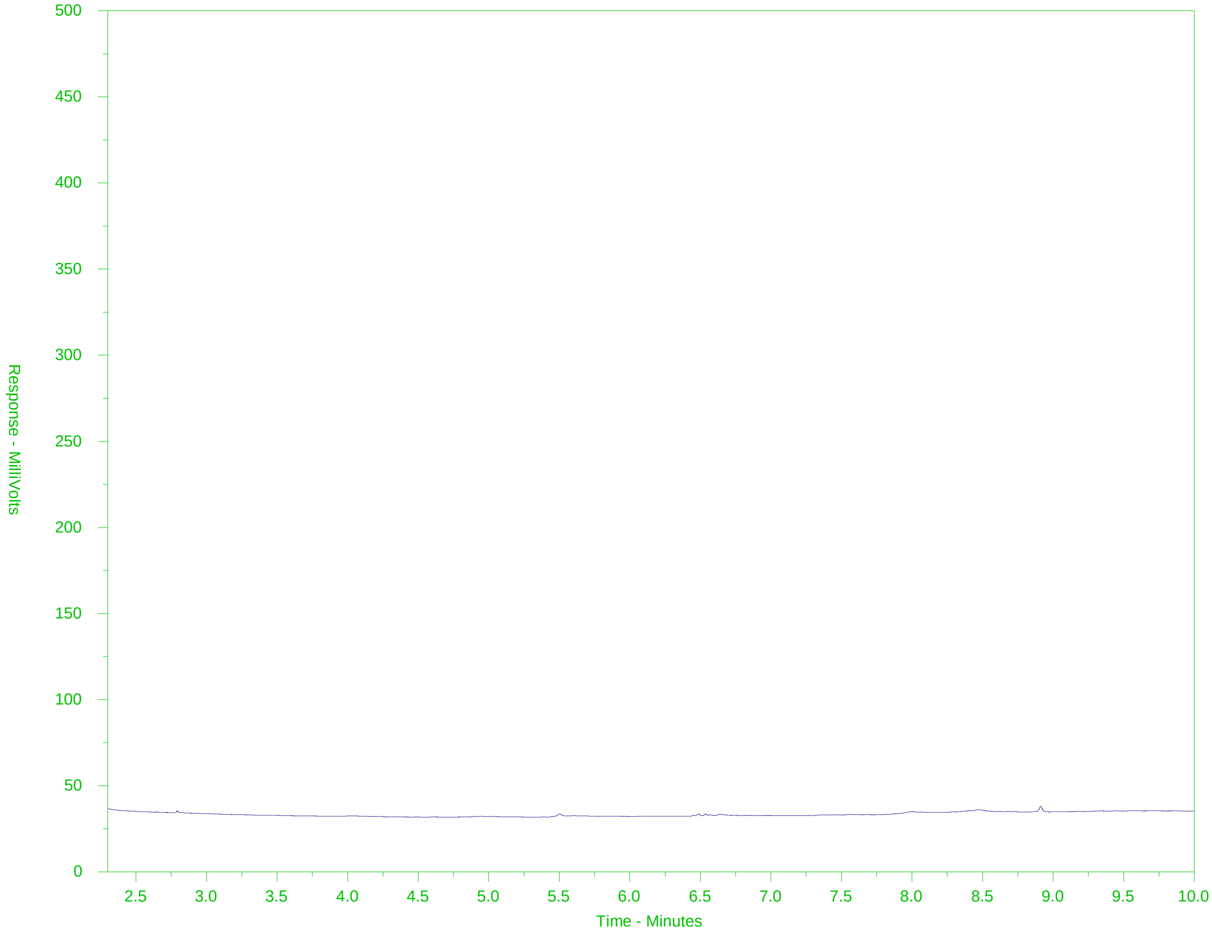
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-10
Client Sample ID: SE-8



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

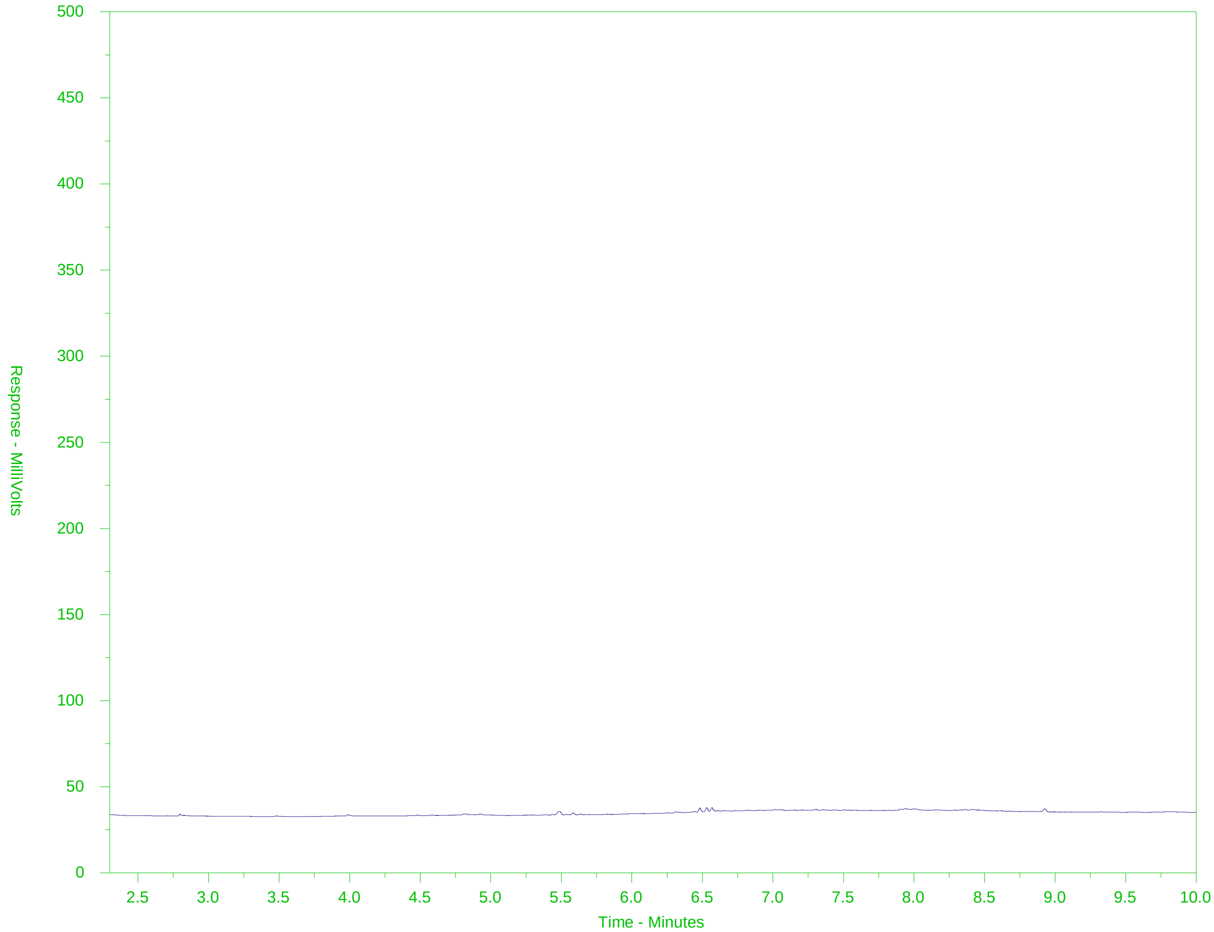
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2355484-11
Client Sample ID: DUPA



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355484-COFC

COC Number: 15 - 560003

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	PHIL ROUGET
Phone:	250 888 1100
	Company address below will appear on the final report
Street:	2nd Floor 3795 CAREY RD.
City/Province:	VICTORIA, B.C.
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	PROUGET@GOLDER.COM
Email 2	Patricia_tomliens@golder.com
Email 3	cbylenga@golder.com
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑	Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days): 4 day [P4] ☐	EMERGENCY: 1 Business day [E1] ☐
3 day [P3] ☐	Same Day, Weekend or Statutory holiday [E0] ☐
2 day [P2] ☐	
Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	
Job #:	1663724/24000
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler: Christine Bylenga, Trish Tomliens

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture + pH	Extractable Metals	TOC and TIC	Hydrocarbons (EPH, LEPH, HEPH)	PAH	BETX and VOC (P)	Particle Size							Number of Containers
	SE18-1	21-SEPT-19	12:30	SEDIMENT	X	X	X	X	X	X	X							4
	SE18-2	21-SEPT-19	13:08	SEDIMENT	X	X	X	X	X	X	X							4
	SE-1	21-SEPT-19	14:35	SEDIMENT	X	X	X	X	X	X	X							4
	SE-2	22-SEPT-19	13:10	SEDIMENT	X	X	X	X	X	X	X							4
	SE-3	22-SEPT-19	15:30	SEDIMENT	X	X	X	X	X	X	X							4
	SE-4	22-SEPT-19	17:30	SEDIMENT	X	X	X	X	X	X	X							4
	SE-5	23-SEPT-19	16:40	SEDIMENT	X	X	X	X	X	X	X							4
	SE-6	24-SEPT-19	10:40	SEDIMENT	X	X	X	X	X	X	X							4
	SE-7	24-SEPT-19	12:40	SEDIMENT	X	X	X	X	X	X	X							4
	SE-8	24-SEPT-19	14:30	SEDIMENT	X	X	X	X	X	X	X							4
	DUP A	24 SEPT-19	10:40	SEDIMENT	X	X	X	X	X	X	X							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐ No ☐
Ice Packs ☑	Ice Cubes ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated ☐			

INITIAL COOLER TEMPERATURES °C:

FINAL COOLER TEMPERATURES °C: 11.2, 11.5 C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Christine Bylenga	Date: 25 Sept 2019	Time: 9:00	Received by:	Date:	Time:	Received by: KG	Date: 27 Sep 19	Time: 9:15 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 04-OCT-19
Report Date: 24-OCT-19 13:05 (MT)
Version: FINAL REV. 2

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2359868

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 17-76621
Legal Site Desc:

Comments:

24-OCT-2019 VOC/F1 data is included.

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Sample ID	L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19
	Sampled Time	08:50	09:15	10:25	11:35	14:30
	Client ID	SW-1	DUP B	SW-2	SW-3	SW-4
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	16.4	15.8	22.6	26.3	24.6
	pH (1:2 soil:water) (pH)	8.48	8.49	8.25	8.00	8.19
Particle Size	% Gravel (>2mm) (%)	6.7	4.8	2.5	6.1	6.7
	% Sand (2.0mm - 0.063mm) (%)	82.9	86.5	83.0	57.3	56.6
	% Silt (0.063mm - 4um) (%)	8.1	6.6	11.2	29.5	29.2
	% Clay (<4um) (%)	2.3	2.1	3.3	7.1	7.5
	Texture	Sand	Sand	Sand / Loamy sand	Sandy loam	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	1.02	0.821	0.947	1.69	1.66
	Inorganic Carbon (as CaCO3 Equivalent) (%)	8.52	6.84	7.89	14.1	13.8
	Total Carbon by Combustion (%)	1.87	2.01	2.22	4.58	4.19
	Total Organic Carbon (%)	0.85	1.19	1.27	2.89	2.53
Metals	Aluminum (Al) (mg/kg)	1840	1710	2570	4490	5040
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.76	1.84	2.60	3.90	4.45
	Barium (Ba) (mg/kg)	7.12	5.39	9.26	15.3	16.8
	Beryllium (Be) (mg/kg)	0.12	0.12	0.17	0.28	0.31
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	10.8	11.0	16.0	29.1	32.7
	Cadmium (Cd) (mg/kg)	<0.020	<0.020	<0.020	0.023	0.031
	Calcium (Ca) (mg/kg)	26200	26000	36100	62700	66000
	Chromium (Cr) (mg/kg)	7.03	7.02	10.2	16.5	17.6
	Cobalt (Co) (mg/kg)	1.23	1.20	1.72	2.82	3.05
	Copper (Cu) (mg/kg)	2.35	2.27	3.15	5.38	5.67
	Iron (Fe) (mg/kg)	6750	6970	8500	12300	13300
	Lead (Pb) (mg/kg)	1.75	1.71	2.35	4.51	4.24
	Lithium (Li) (mg/kg)	7.5	7.4	11.1	19.9	21.8
	Magnesium (Mg) (mg/kg)	13600	13600	20700	32900	37600
	Manganese (Mn) (mg/kg)	56.3	59.9	80.0	124	134
	Mercury (Hg) (mg/kg)	<0.0050	<0.0050	<0.0050	0.0087	0.0087
	Molybdenum (Mo) (mg/kg)	0.14	0.15	0.20	0.34	0.34
	Nickel (Ni) (mg/kg)	3.91	3.82	5.30	9.14	9.48
	Phosphorus (P) (mg/kg)	204	219	340	438	431
	Potassium (K) (mg/kg)	820	790	1240	2020	2240
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	2110	1530	2300	3370	3920

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-6	L2359868-7	L2359868-8	L2359868-9	L2359868-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19
	Sampled Time	15:40	09:20	12:25	13:15	13:55
	Client ID	SW-5	SW-6	SW-7	SW-8	SNW-1
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	28.5	24.1	28.4	27.4	23.4
	pH (1:2 soil:water) (pH)	7.96	7.92	8.29	8.10	8.33
Particle Size	% Gravel (>2mm) (%)	6.0	2.3	4.4	3.4	5.8
	% Sand (2.0mm - 0.063mm) (%)	53.4	54.0	53.3	50.8	55.7
	% Silt (0.063mm - 4um) (%)	32.3	35.6	33.9	37.9	30.7
	% Clay (<4um) (%)	8.4	8.1	8.3	7.9	7.7
	Texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	1.65	1.54	1.67	1.53	1.80
	Inorganic Carbon (as CaCO3 Equivalent) (%)	13.8	12.8	13.9	12.7	15.0
	Total Carbon by Combustion (%)	4.69	4.62	4.93	5.29	4.45
	Total Organic Carbon (%)	3.04	3.08	3.26	3.76	2.65
Metals	Aluminum (Al) (mg/kg)	5020	5110	5530	5700	4460
	Antimony (Sb) (mg/kg)	<0.10	<0.10	0.11	<0.10	<0.10
	Arsenic (As) (mg/kg)	5.57	6.29	4.86	4.01	3.67
	Barium (Ba) (mg/kg)	16.4	19.3	19.4	19.7	13.1
	Beryllium (Be) (mg/kg)	0.33	0.31	0.33	0.34	0.28
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	35.2	34.8	35.2	35.3	29.6
	Cadmium (Cd) (mg/kg)	0.033	0.031	0.033	0.027	0.029
	Calcium (Ca) (mg/kg)	68400	71500	73800	76100	59600
	Chromium (Cr) (mg/kg)	18.1	19.1	20.1	21.6	15.0
	Cobalt (Co) (mg/kg)	2.97	3.15	3.29	3.51	2.65
	Copper (Cu) (mg/kg)	5.74	6.10	6.87	7.06	5.75
	Iron (Fe) (mg/kg)	13300	13300	13300	12300	12300
	Lead (Pb) (mg/kg)	4.38	4.36	4.58	4.58	4.07
	Lithium (Li) (mg/kg)	23.0	23.3	23.7	25.7	19.1
	Magnesium (Mg) (mg/kg)	37400	40200	42900	46300	33100
	Manganese (Mn) (mg/kg)	135	146	144	143	129
	Mercury (Hg) (mg/kg)	0.0097	0.0097	0.0121	0.0108	0.0092
	Molybdenum (Mo) (mg/kg)	0.31	0.36	0.37	0.34	0.29
	Nickel (Ni) (mg/kg)	9.69	10.1	10.6	11.6	8.41
	Phosphorus (P) (mg/kg)	559	684	588	470	378
	Potassium (K) (mg/kg)	2310	2340	2560	2620	1900
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	4800	3550	4670	3990	3340

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Sample ID	L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19
	Sampled Time	08:50	09:15	10:25	11:35	14:30
	Client ID	SW-1	DUP B	SW-2	SW-3	SW-4
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	18.6	17.4	23.8	38.0	41.0
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	<0.050	<0.050	0.053	0.092	0.088
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	119	111	172	280	264
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.314	0.353	0.450	0.717	0.692
	Vanadium (V) (mg/kg)	7.57	7.54	10.4	17.6	19.5
	Zinc (Zn) (mg/kg)	8.2	6.3	8.9	13.8	14.1
	Zirconium (Zr) (mg/kg)	1.9	2.4	2.9	4.5	4.8
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-6	L2359868-7	L2359868-8	L2359868-9	L2359868-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19
	Sampled Time	15:40	09:20	12:25	13:15	13:55
	Client ID	SW-5	SW-6	SW-7	SW-8	SNW-1
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	44.4	45.8	50.8	45.9	35.9
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.093	0.089	0.105	0.100	0.074
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	264	290	287	327	216
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.721	0.766	0.761	0.756	0.701
	Vanadium (V) (mg/kg)	19.5	19.7	23.5	22.6	17.2
	Zinc (Zn) (mg/kg)	14.0	13.9	15.0	14.9	12.5
	Zirconium (Zr) (mg/kg)	4.9	5.4	5.5	6.7	5.1
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19
	Sampled Time	08:50	09:15	10:25	11:35	14:30
	Client ID	SW-1	DUP B	SW-2	SW-3	SW-4
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	93.0	78.6	97.3	86.4	78.3
	Surrogate: 1,4-Difluorobenzene (SS) (%)	75.6	90.9	96.4	87.4	91.5
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	93.9	85.0	90.4	91.6	92.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-6	L2359868-7	L2359868-8	L2359868-9	L2359868-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19
	Sampled Time	15:40	09:20	12:25	13:15	13:55
	Client ID	SW-5	SW-6	SW-7	SW-8	SNW-1
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	88.9	81.8	83.1	78.5	83.7
	Surrogate: 1,4-Difluorobenzene (SS) (%)	66.1 SURR-ND	73.4	73.4	88.3	71.7
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	87.2	86.0	94.7	95.4	91.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19	27-SEP-19
	Sampled Time	08:50	09:15	10:25	11:35	14:30
	Client ID	SW-1	DUP B	SW-2	SW-3	SW-4
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	101.4	110.0	94.0	109.8	102.8
	Surrogate: Naphthalene d8 (%)	109.7	114.8	102.6	111.2	100.9
	Surrogate: Phenanthrene d10 (%)	112.4	115.2	105.7	114.9	101.9
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359868-6	L2359868-7	L2359868-8	L2359868-9	L2359868-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	27-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19	28-SEP-19
	Sampled Time	15:40	09:20	12:25	13:15	13:55
	Client ID	SW-5	SW-6	SW-7	SW-8	SNW-1
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	104.2	100.6	111.9	110.9	103.3
	Surrogate: Naphthalene d8 (%)	108.3	103.2	109.6	108.0	101.1
	Surrogate: Phenanthrene d10 (%)	110.0	108.0	113.1	113.0	108.5
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Molybdenum (Mo)	DUP-H	L2359868-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-HSFID-VA	Soil	CCME F1 by headspace GCMS	CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LEPH/HEPH-CALC-VA	Soil	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

Reference Information

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

VOC-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-L-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Soil	VOC7 and/or VOC Surrogates for Soils	EPA 5035A/5021A/8260C
XYLENES-CALC-VA	Soil	Sum of Xylene Isomer Concentrations	EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-76621

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2359868 Report Date: 24-OCT-19

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4867862								
WG3185269-4 IRM		**08-109_SOIL**						
Inorganic Carbon			95.9		%		80-120	11-OCT-19
WG3185269-2 LCS		**0.5**						
Inorganic Carbon			97.8		%		80-120	11-OCT-19
WG3185269-3 MB								
Inorganic Carbon			<0.050		%		0.05	11-OCT-19
C-TOT-LECO-SK	**Soil**							
Batch R4867635								
WG3185379-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			100.0		%		80-120	10-OCT-19
WG3185379-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			102.2		%		90-110	10-OCT-19
WG3185379-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	10-OCT-19
EPH-TUMB-FID-VA	**Soil**							
Batch R4864727								
WG3186677-4 IRM		**ALS PHC RM3**						
EPH10-19			97.9		%		70-130	10-OCT-19
EPH19-32			98.4		%		70-130	10-OCT-19
WG3187147-4 IRM		**ALS PHC RM3**						
EPH10-19			99.4		%		70-130	10-OCT-19
EPH19-32			99.8		%		70-130	10-OCT-19
WG3186677-2 LCS								
EPH10-19			96.7		%		70-130	10-OCT-19
EPH19-32			89.9		%		70-130	10-OCT-19
WG3187147-2 LCS								
EPH10-19			95.3		%		70-130	10-OCT-19
EPH19-32			85.5		%		70-130	10-OCT-19
WG3186677-1 MB								
EPH10-19			<200		mg/kg		200	10-OCT-19
EPH19-32			<200		mg/kg		200	10-OCT-19
Surrogate: 2-Bromobenzotrifluoride			95.7		%		60-140	10-OCT-19
WG3187147-1 MB								
EPH10-19			<200		mg/kg		200	10-OCT-19
EPH19-32			<200		mg/kg		200	10-OCT-19
Surrogate: 2-Bromobenzotrifluoride			91.4		%		60-140	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-TUMB-FID-VA	**Soil**							
Batch R4867384								
WG3187147-3 DUP		**L2359868-9**						
EPH10-19		<200	<200	RPD-NA	mg/kg	N/A	40	11-OCT-19
EPH19-32		<200	<200	RPD-NA	mg/kg	N/A	40	11-OCT-19
HG-200.2-CVAF-VA	**Soil**							
Batch R4865287								
WG3187132-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			116.0		%		70-130	10-OCT-19
WG3187132-3 LCS								
Mercury (Hg)			106.9		%		80-120	10-OCT-19
WG3187132-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	10-OCT-19
Batch R4866984								
WG3186872-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			112.1		%		70-130	11-OCT-19
WG3186872-3 LCS								
Mercury (Hg)			105.5		%		80-120	11-OCT-19
WG3186872-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	11-OCT-19
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3186872-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			93.5		%		70-130	10-OCT-19
Antimony (Sb)			90.8		%		70-130	10-OCT-19
Arsenic (As)			100.1		%		70-130	10-OCT-19
Barium (Ba)			98.5		%		70-130	10-OCT-19
Beryllium (Be)			86.3		%		70-130	10-OCT-19
Bismuth (Bi)			102.5		%		70-130	10-OCT-19
Cadmium (Cd)			103.7		%		70-130	10-OCT-19
Calcium (Ca)			89.3		%		70-130	10-OCT-19
Copper (Cu)			95.7		%		70-130	10-OCT-19
Iron (Fe)			94.0		%		70-130	10-OCT-19
Lead (Pb)			98.1		%		70-130	10-OCT-19
Lithium (Li)			89.3		%		70-130	10-OCT-19
Magnesium (Mg)			94.9		%		70-130	10-OCT-19
Manganese (Mn)			93.0		%		70-130	10-OCT-19
Molybdenum (Mo)			95.5		%		70-130	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3186872-4 CRM		**VA-CANMET-TILL2**						
Nickel (Ni)			97.1		%		70-130	10-OCT-19
Phosphorus (P)			94.4		%		70-130	10-OCT-19
Potassium (K)			96.1		%		70-130	10-OCT-19
Selenium (Se)			0.32		mg/kg		0.15-0.55	10-OCT-19
Silver (Ag)			0.26		mg/kg		0.16-0.36	10-OCT-19
Sodium (Na)			104.8		%		70-130	10-OCT-19
Strontium (Sr)			94.2		%		70-130	10-OCT-19
Thallium (Tl)			92.9		%		70-130	10-OCT-19
Tin (Sn)			2.1		mg/kg		0.2-4.2	10-OCT-19
Titanium (Ti)			93.6		%		70-130	10-OCT-19
Tungsten (W)			1.50		mg/kg		1-2	10-OCT-19
Uranium (U)			98.4		%		70-130	10-OCT-19
Vanadium (V)			98.7		%		70-130	10-OCT-19
Zinc (Zn)			95.2		%		70-130	10-OCT-19
WG3187132-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			93.6		%		70-130	10-OCT-19
Antimony (Sb)			91.3		%		70-130	10-OCT-19
Arsenic (As)			100.1		%		70-130	10-OCT-19
Barium (Ba)			95.9		%		70-130	10-OCT-19
Beryllium (Be)			87.4		%		70-130	10-OCT-19
Bismuth (Bi)			100.8		%		70-130	10-OCT-19
Cadmium (Cd)			96.8		%		70-130	10-OCT-19
Calcium (Ca)			90.4		%		70-130	10-OCT-19
Copper (Cu)			98.2		%		70-130	10-OCT-19
Iron (Fe)			95.0		%		70-130	10-OCT-19
Lead (Pb)			97.7		%		70-130	10-OCT-19
Lithium (Li)			88.7		%		70-130	10-OCT-19
Magnesium (Mg)			95.9		%		70-130	10-OCT-19
Manganese (Mn)			96.0		%		70-130	10-OCT-19
Molybdenum (Mo)			92.8		%		70-130	10-OCT-19
Nickel (Ni)			99.1		%		70-130	10-OCT-19
Phosphorus (P)			95.8		%		70-130	10-OCT-19
Potassium (K)			99.3		%		70-130	10-OCT-19
Selenium (Se)			0.34		mg/kg		0.15-0.55	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3187132-4 CRM		**VA-CANMET-TILL2**						
Silver (Ag)			0.26		mg/kg		0.16-0.36	10-OCT-19
Sodium (Na)			122.6		%		70-130	10-OCT-19
Strontium (Sr)			96.1		%		70-130	10-OCT-19
Thallium (Tl)			93.1		%		70-130	10-OCT-19
Tin (Sn)			2.2		mg/kg		0.2-4.2	10-OCT-19
Titanium (Ti)			96.5		%		70-130	10-OCT-19
Tungsten (W)			1.53		mg/kg		1-2	10-OCT-19
Uranium (U)			97.5		%		70-130	10-OCT-19
Vanadium (V)			100.0		%		70-130	10-OCT-19
Zinc (Zn)			94.5		%		70-130	10-OCT-19
WG3186872-3 LCS								
Aluminum (Al)			106.4		%		80-120	10-OCT-19
Antimony (Sb)			99.1		%		80-120	10-OCT-19
Arsenic (As)			100.7		%		80-120	10-OCT-19
Barium (Ba)			107.5		%		80-120	10-OCT-19
Beryllium (Be)			90.9		%		80-120	10-OCT-19
Bismuth (Bi)			99.8		%		80-120	10-OCT-19
Boron (B)			89.3		%		80-120	10-OCT-19
Cadmium (Cd)			96.9		%		80-120	10-OCT-19
Calcium (Ca)			92.3		%		80-120	10-OCT-19
Chromium (Cr)			102.4		%		80-120	10-OCT-19
Cobalt (Co)			98.6		%		80-120	10-OCT-19
Copper (Cu)			97.1		%		80-120	10-OCT-19
Iron (Fe)			101.4		%		80-120	10-OCT-19
Lead (Pb)			101.3		%		80-120	10-OCT-19
Lithium (Li)			89.6		%		80-120	10-OCT-19
Magnesium (Mg)			104.9		%		80-120	10-OCT-19
Manganese (Mn)			103.0		%		80-120	10-OCT-19
Molybdenum (Mo)			102.1		%		80-120	10-OCT-19
Nickel (Ni)			98.7		%		80-120	10-OCT-19
Phosphorus (P)			108.7		%		80-120	10-OCT-19
Potassium (K)			103.3		%		80-120	10-OCT-19
Selenium (Se)			98.3		%		80-120	10-OCT-19
Silver (Ag)			101.1		%		80-120	10-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3186872-3 LCS								
Sodium (Na)			100.8		%		80-120	10-OCT-19
Strontium (Sr)			100.2		%		80-120	10-OCT-19
Sulfur (S)			90.3		%		80-120	10-OCT-19
Thallium (Tl)			95.8		%		80-120	10-OCT-19
Tin (Sn)			97.3		%		80-120	10-OCT-19
Titanium (Ti)			98.0		%		80-120	10-OCT-19
Tungsten (W)			102.1		%		80-120	10-OCT-19
Uranium (U)			103.1		%		80-120	10-OCT-19
Vanadium (V)			105.0		%		80-120	10-OCT-19
Zinc (Zn)			97.7		%		80-120	10-OCT-19
Zirconium (Zr)			95.8		%		70-130	10-OCT-19
WG3187132-3 LCS								
Aluminum (Al)			108.1		%		80-120	10-OCT-19
Antimony (Sb)			104.5		%		80-120	10-OCT-19
Arsenic (As)			104.9		%		80-120	10-OCT-19
Barium (Ba)			111.4		%		80-120	10-OCT-19
Beryllium (Be)			96.0		%		80-120	10-OCT-19
Bismuth (Bi)			100.8		%		80-120	10-OCT-19
Boron (B)			95.1		%		80-120	10-OCT-19
Cadmium (Cd)			99.4		%		80-120	10-OCT-19
Calcium (Ca)			96.9		%		80-120	10-OCT-19
Chromium (Cr)			105.9		%		80-120	10-OCT-19
Cobalt (Co)			103.9		%		80-120	10-OCT-19
Copper (Cu)			103.7		%		80-120	10-OCT-19
Iron (Fe)			105.5		%		80-120	10-OCT-19
Lead (Pb)			100.8		%		80-120	10-OCT-19
Lithium (Li)			94.3		%		80-120	10-OCT-19
Magnesium (Mg)			111.6		%		80-120	10-OCT-19
Manganese (Mn)			109.6		%		80-120	10-OCT-19
Molybdenum (Mo)			103.6		%		80-120	10-OCT-19
Nickel (Ni)			104.1		%		80-120	10-OCT-19
Phosphorus (P)			103.5		%		80-120	10-OCT-19
Potassium (K)			108.5		%		80-120	10-OCT-19
Selenium (Se)			101.6		%		80-120	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3187132-3 LCS								
Silver (Ag)			103.8		%		80-120	10-OCT-19
Sodium (Na)			104.1		%		80-120	10-OCT-19
Strontium (Sr)			106.4		%		80-120	10-OCT-19
Sulfur (S)			96.3		%		80-120	10-OCT-19
Thallium (Tl)			96.7		%		80-120	10-OCT-19
Tin (Sn)			100.1		%		80-120	10-OCT-19
Titanium (Ti)			102.5		%		80-120	10-OCT-19
Tungsten (W)			102.4		%		80-120	10-OCT-19
Uranium (U)			104.8		%		80-120	10-OCT-19
Vanadium (V)			109.4		%		80-120	10-OCT-19
Zinc (Zn)			100.3		%		80-120	10-OCT-19
Zirconium (Zr)			105.0		%		70-130	10-OCT-19
WG3186872-1 MB								
Aluminum (Al)			<50		mg/kg		50	10-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	10-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	10-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	10-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	10-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	10-OCT-19
Boron (B)			<5.0		mg/kg		5	10-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	10-OCT-19
Calcium (Ca)			<50		mg/kg		50	10-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	10-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	10-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	10-OCT-19
Iron (Fe)			<50		mg/kg		50	10-OCT-19
Lead (Pb)			<0.50		mg/kg		0.5	10-OCT-19
Lithium (Li)			<2.0		mg/kg		2	10-OCT-19
Magnesium (Mg)			<20		mg/kg		20	10-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	10-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	10-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	10-OCT-19
Phosphorus (P)			<50		mg/kg		50	10-OCT-19
Potassium (K)			<100		mg/kg		100	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3186872-1 MB								
Selenium (Se)			<0.20		mg/kg		0.2	10-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	10-OCT-19
Sodium (Na)			<50		mg/kg		50	10-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	10-OCT-19
Sulfur (S)			<1000		mg/kg		1000	10-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	10-OCT-19
Tin (Sn)			<2.0		mg/kg		2	10-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	10-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	10-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	10-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	10-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	10-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	10-OCT-19
WG3187132-1 MB								
Aluminum (Al)			<50		mg/kg		50	10-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	10-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	10-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	10-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	10-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	10-OCT-19
Boron (B)			<5.0		mg/kg		5	10-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	10-OCT-19
Calcium (Ca)			<50		mg/kg		50	10-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	10-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	10-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	10-OCT-19
Iron (Fe)			<50		mg/kg		50	10-OCT-19
Lead (Pb)			<0.50		mg/kg		0.5	10-OCT-19
Lithium (Li)			<2.0		mg/kg		2	10-OCT-19
Magnesium (Mg)			<20		mg/kg		20	10-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	10-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	10-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	10-OCT-19
Phosphorus (P)			<50		mg/kg		50	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4866392								
WG3187132-1 MB								
Potassium (K)			<100		mg/kg		100	10-OCT-19
Selenium (Se)			<0.20		mg/kg		0.2	10-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	10-OCT-19
Sodium (Na)			<50		mg/kg		50	10-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	10-OCT-19
Sulfur (S)			<1000		mg/kg		1000	10-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	10-OCT-19
Tin (Sn)			<2.0		mg/kg		2	10-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	10-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	10-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	10-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	10-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	10-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	10-OCT-19
MOISTURE-VA	**Soil**							
Batch R4864766								
WG3186927-2 LCS								
Moisture			97.0		%		90-110	09-OCT-19
WG3186927-1 MB								
Moisture			<0.25		%		0.25	09-OCT-19
Batch R4865080								
WG3187158-3 DUP		**L2359868-9**						
Moisture		27.4	28.0		%	2.1	20	09-OCT-19
WG3187158-2 LCS								
Moisture			100.2		%		90-110	09-OCT-19
WG3187158-1 MB								
Moisture			<0.25		%		0.25	09-OCT-19
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3187147-3 DUP		**L2359868-9**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	10-OCT-19
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	10-OCT-19
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	10-OCT-19
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3187147-3 DUP		**L2359868-9**						
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	10-OCT-19
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	10-OCT-19
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	10-OCT-19
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	10-OCT-19
WG3186677-5 IRM		**ALS PAH RM2**						
Acenaphthene			104.7		%		60-130	10-OCT-19
Acenaphthylene			83.8		%		60-130	10-OCT-19
Anthracene			98.1		%		60-130	10-OCT-19
Benz(a)anthracene			103.3		%		60-130	10-OCT-19
Benzo(a)pyrene			93.8		%		60-130	10-OCT-19
Benzo(b&j)fluoranthene			98.2		%		60-130	10-OCT-19
Benzo(g,h,i)perylene			102.0		%		60-130	10-OCT-19
Benzo(k)fluoranthene			114.5		%		60-130	10-OCT-19
Chrysene			99.8		%		60-130	10-OCT-19
Dibenz(a,h)anthracene			102.7		%		60-130	10-OCT-19
Fluoranthene			104.2		%		60-130	10-OCT-19
Fluorene			106.5		%		60-130	10-OCT-19
Indeno(1,2,3-c,d)pyrene			99.1		%		60-130	10-OCT-19
1-Methylnaphthalene			104.8		%		60-130	10-OCT-19
2-Methylnaphthalene			104.8		%		60-130	10-OCT-19
Naphthalene			106.0		%		50-130	10-OCT-19
Phenanthrene			106.4		%		60-130	10-OCT-19
Pyrene			103.6		%		60-130	10-OCT-19
WG3187147-5 IRM		**ALS PAH RM2**						
Acenaphthene			104.3		%		60-130	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3187147-5 IRM		**ALS PAH RM2**						
Acenaphthylene			88.2		%		60-130	10-OCT-19
Anthracene			111.7		%		60-130	10-OCT-19
Benz(a)anthracene			95.3		%		60-130	10-OCT-19
Benzo(a)pyrene			98.8		%		60-130	10-OCT-19
Benzo(b&j)fluoranthene			97.4		%		60-130	10-OCT-19
Benzo(g,h,i)perylene			98.3		%		60-130	10-OCT-19
Benzo(k)fluoranthene			106.7		%		60-130	10-OCT-19
Chrysene			102.9		%		60-130	10-OCT-19
Dibenz(a,h)anthracene			104.6		%		60-130	10-OCT-19
Fluoranthene			102.2		%		60-130	10-OCT-19
Fluorene			106.9		%		60-130	10-OCT-19
Indeno(1,2,3-c,d)pyrene			95.1		%		60-130	10-OCT-19
1-Methylnaphthalene			104.5		%		60-130	10-OCT-19
2-Methylnaphthalene			108.3		%		60-130	10-OCT-19
Naphthalene			107.7		%		50-130	10-OCT-19
Phenanthrene			109.0		%		60-130	10-OCT-19
Pyrene			102.6		%		60-130	10-OCT-19
WG3186677-2 LCS								
Acenaphthene			112.4		%		60-130	10-OCT-19
Acenaphthylene			113.2		%		60-130	10-OCT-19
Anthracene			115.8		%		60-130	10-OCT-19
Benz(a)anthracene			107.0		%		60-130	10-OCT-19
Benzo(a)pyrene			101.2		%		60-130	10-OCT-19
Benzo(b&j)fluoranthene			109.5		%		60-130	10-OCT-19
Benzo(g,h,i)perylene			106.7		%		60-130	10-OCT-19
Benzo(k)fluoranthene			113.6		%		60-130	10-OCT-19
Chrysene			113.8		%		60-130	10-OCT-19
Dibenz(a,h)anthracene			107.9		%		60-130	10-OCT-19
Fluoranthene			109.8		%		60-130	10-OCT-19
Fluorene			114.8		%		60-130	10-OCT-19
Indeno(1,2,3-c,d)pyrene			109.5		%		60-130	10-OCT-19
1-Methylnaphthalene			108.0		%		60-130	10-OCT-19
2-Methylnaphthalene			112.5		%		60-130	10-OCT-19
Naphthalene			107.1		%		50-130	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3186677-2 LCS								
Phenanthrene			115.3		%		60-130	10-OCT-19
Pyrene			109.4		%		60-130	10-OCT-19
Quinoline			96.5		%		60-130	10-OCT-19
WG3187147-2 LCS								
Acenaphthene			128.3		%		60-130	10-OCT-19
Acenaphthylene			128.9		%		60-130	10-OCT-19
Anthracene			127.8		%		60-130	10-OCT-19
Benz(a)anthracene			123.8		%		60-130	10-OCT-19
Benzo(a)pyrene			120.8		%		60-130	10-OCT-19
Benzo(b&j)fluoranthene			126.3		%		60-130	10-OCT-19
Benzo(g,h,i)perylene			123.1		%		60-130	10-OCT-19
Benzo(k)fluoranthene			129.2		%		60-130	10-OCT-19
Chrysene			129.1		%		60-130	10-OCT-19
Dibenz(a,h)anthracene			125.6		%		60-130	10-OCT-19
Fluoranthene			126.5		%		60-130	10-OCT-19
Fluorene			129.8		%		60-130	10-OCT-19
Indeno(1,2,3-c,d)pyrene			125.7		%		60-130	10-OCT-19
1-Methylnaphthalene			122.8		%		60-130	10-OCT-19
2-Methylnaphthalene			129.1		%		60-130	10-OCT-19
Naphthalene			122.9		%		50-130	10-OCT-19
Phenanthrene			129.3		%		60-130	10-OCT-19
Pyrene			129.8		%		60-130	10-OCT-19
Quinoline			109.2		%		60-130	10-OCT-19
WG3186677-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	10-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	10-OCT-19
Anthracene			<0.0040		mg/kg		0.004	10-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	10-OCT-19
Chrysene			<0.010		mg/kg		0.01	10-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	10-OCT-19
Fluoranthene			<0.010		mg/kg		0.01	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3186677-1 MB								
Fluorene			<0.010		mg/kg		0.01	10-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	10-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	10-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	10-OCT-19
Naphthalene			<0.010		mg/kg		0.01	10-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	10-OCT-19
Pyrene			<0.010		mg/kg		0.01	10-OCT-19
Quinoline			<0.050		mg/kg		0.05	10-OCT-19
Surrogate: Naphthalene d8			104.8		%		50-130	10-OCT-19
Surrogate: Phenanthrene d10			106.1		%		60-130	10-OCT-19
Surrogate: Chrysene d12			99.2		%		60-130	10-OCT-19
WG3187147-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	10-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	10-OCT-19
Anthracene			<0.0040		mg/kg		0.004	10-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	10-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	10-OCT-19
Chrysene			<0.010		mg/kg		0.01	10-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	10-OCT-19
Fluoranthene			<0.010		mg/kg		0.01	10-OCT-19
Fluorene			<0.010		mg/kg		0.01	10-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	10-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	10-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	10-OCT-19
Naphthalene			<0.010		mg/kg		0.01	10-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	10-OCT-19
Pyrene			<0.010		mg/kg		0.01	10-OCT-19
Quinoline			<0.050		mg/kg		0.05	10-OCT-19
Surrogate: Naphthalene d8			100.7		%		50-130	10-OCT-19
Surrogate: Phenanthrene d10			104.9		%		60-130	10-OCT-19
Surrogate: Chrysene d12			98.0		%		60-130	10-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET+GRAVEL-SK	**Soil**							
Batch R4867699								
WG3185618-1 DUP		**L2359868-1**						
% Gravel (>2mm)		6.7	6.7	J	%	0.0	5	11-OCT-19
% Sand (2.0mm - 0.063mm)		82.9	83.2	J	%	0.3	5	11-OCT-19
% Silt (0.063mm - 4um)		8.1	7.7	J	%	0.4	5	11-OCT-19
% Clay (<4um)		2.3	2.4	J	%	0.1	5	11-OCT-19
WG3185618-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.063mm)			45.5		%		39.1-49.1	11-OCT-19
% Silt (0.063mm - 4um)			37.9		%		32.5-42.5	11-OCT-19
% Clay (<4um)			16.6		%		13.4-23.4	11-OCT-19
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196808-2 LCS								
Bromodichloromethane			104.7		%		70-130	23-OCT-19
Bromoform			113.7		%		70-130	23-OCT-19
Carbon Tetrachloride			116.6		%		70-130	23-OCT-19
Chlorobenzene			107.7		%		70-130	23-OCT-19
Dibromochloromethane			114.6		%		70-130	23-OCT-19
Chloroethane			104.9		%		60-140	23-OCT-19
Chloroform			112.1		%		70-130	23-OCT-19
Chloromethane			122.8		%		60-140	23-OCT-19
1,2-Dichlorobenzene			109.3		%		70-130	23-OCT-19
1,3-Dichlorobenzene			108.3		%		70-130	23-OCT-19
1,4-Dichlorobenzene			111.3		%		70-140	23-OCT-19
1,1-Dichloroethane			107.9		%		70-130	23-OCT-19
1,2-Dichloroethane			98.6		%		70-130	23-OCT-19
1,1-Dichloroethylene			107.0		%		70-130	23-OCT-19
cis-1,2-Dichloroethylene			95.1		%		70-130	23-OCT-19
trans-1,2-Dichloroethylene			106.3		%		70-130	23-OCT-19
Dichloromethane			105.1		%		60-140	23-OCT-19
1,2-Dichloropropane			112.8		%		70-130	23-OCT-19
cis-1,3-Dichloropropylene			119.2		%		70-130	23-OCT-19
trans-1,3-Dichloropropylene			95.1		%		70-130	23-OCT-19
1,1,1,2-Tetrachloroethane			106.3		%		70-130	23-OCT-19
1,1,2,2-Tetrachloroethane			95.9		%		70-130	23-OCT-19
Tetrachloroethylene			124.4		%		70-130	23-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196808-2 LCS								
1,1,1-Trichloroethane			117.3		%		70-130	23-OCT-19
1,1,2-Trichloroethane			90.3		%		70-130	23-OCT-19
Trichloroethylene			114.9		%		70-130	23-OCT-19
Trichlorofluoromethane			138.3		%		60-140	23-OCT-19
Vinyl Chloride			120.6		%		60-140	23-OCT-19
WG3196808-1 MB								
Bromodichloromethane			<0.050		mg/kg		0.05	23-OCT-19
Bromoform			<0.050		mg/kg		0.05	23-OCT-19
Carbon Tetrachloride			<0.050		mg/kg		0.05	23-OCT-19
Chlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
Dibromochloromethane			<0.050		mg/kg		0.05	23-OCT-19
Chloroethane			<0.10		mg/kg		0.1	23-OCT-19
Chloroform			<0.10		mg/kg		0.1	23-OCT-19
Chloromethane			<0.10		mg/kg		0.1	23-OCT-19
1,2-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,3-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,4-Dichlorobenzene			<0.050		mg/kg		0.05	23-OCT-19
1,1-Dichloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,2-Dichloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,1-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
cis-1,2-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
trans-1,2-Dichloroethylene			<0.050		mg/kg		0.05	23-OCT-19
Dichloromethane			<0.30		mg/kg		0.3	23-OCT-19
1,2-Dichloropropane			<0.050		mg/kg		0.05	23-OCT-19
cis-1,3-Dichloropropylene			<0.050		mg/kg		0.05	23-OCT-19
trans-1,3-Dichloropropylene			<0.050		mg/kg		0.05	23-OCT-19
1,1,1,2-Tetrachloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	23-OCT-19
Tetrachloroethylene			<0.050		mg/kg		0.05	23-OCT-19
1,1,1-Trichloroethane			<0.050		mg/kg		0.05	23-OCT-19
1,1,2-Trichloroethane			<0.050		mg/kg		0.05	23-OCT-19
Trichloroethylene			<0.010		mg/kg		0.01	23-OCT-19
Trichlorofluoromethane			<0.10		mg/kg		0.1	23-OCT-19
Vinyl Chloride			<0.10		mg/kg		0.1	23-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC7-L-HSMS-VA	**Soil**							
Batch R4851265								
WG3196808-2 LCS								
Benzene			107.6		%		70-130	23-OCT-19
Ethylbenzene			114.3		%		70-130	23-OCT-19
Methyl t-butyl ether (MTBE)			103.1		%		70-130	23-OCT-19
Styrene			100.4		%		70-130	23-OCT-19
Toluene			102.3		%		70-130	23-OCT-19
meta- & para-Xylene			110.9		%		70-130	23-OCT-19
ortho-Xylene			109.0		%		70-130	23-OCT-19
WG3196808-1 MB								
Benzene			<0.0050		mg/kg		0.005	23-OCT-19
Ethylbenzene			<0.015		mg/kg		0.015	23-OCT-19
Methyl t-butyl ether (MTBE)			<0.20		mg/kg		0.2	23-OCT-19
Styrene			<0.050		mg/kg		0.05	23-OCT-19
Toluene			<0.050		mg/kg		0.05	23-OCT-19
meta- & para-Xylene			<0.050		mg/kg		0.05	23-OCT-19
ortho-Xylene			<0.050		mg/kg		0.05	23-OCT-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

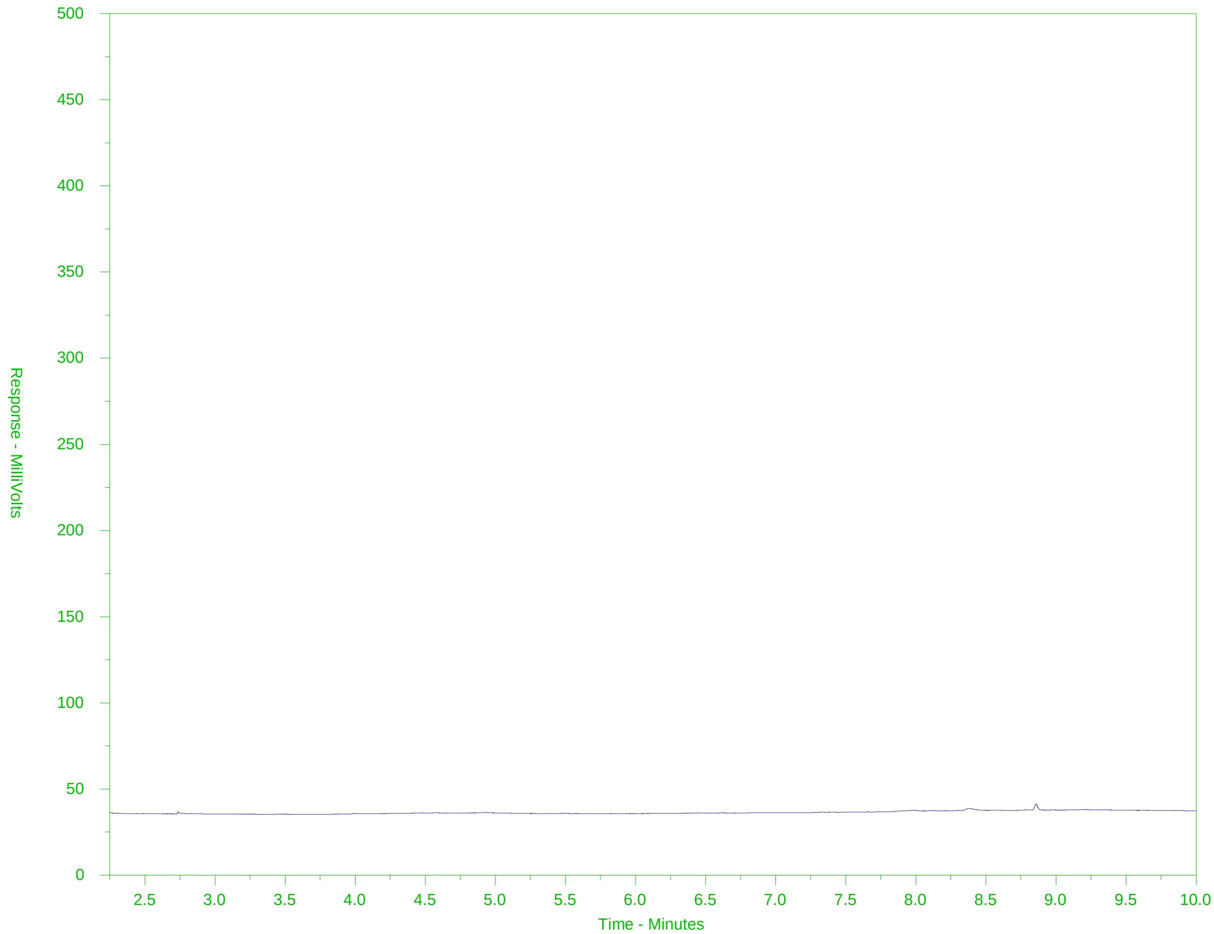
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

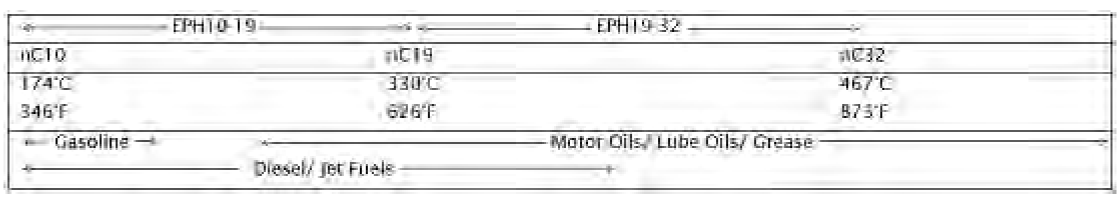
The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-1
Client Sample ID: SW-1





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

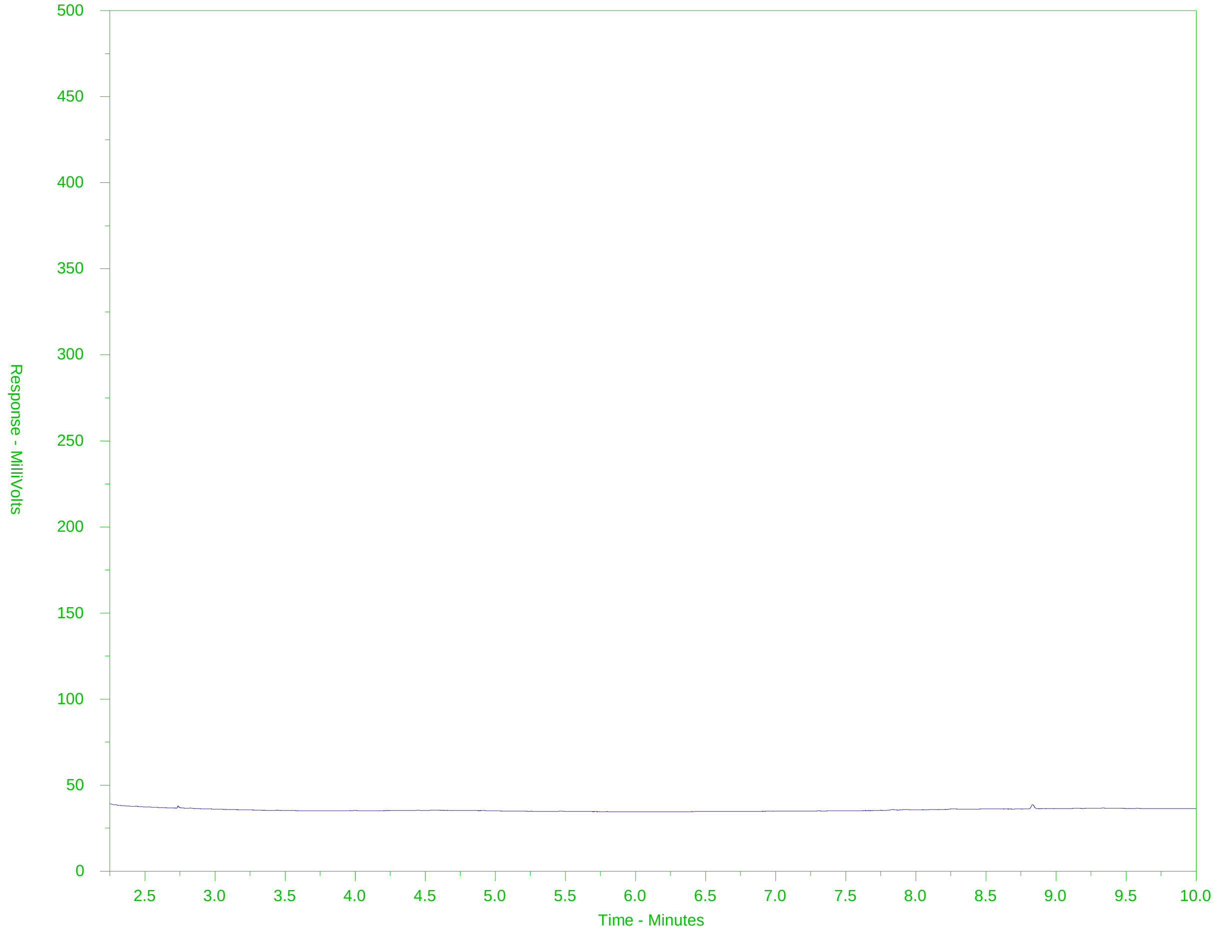
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-2
Client Sample ID: DUP B



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

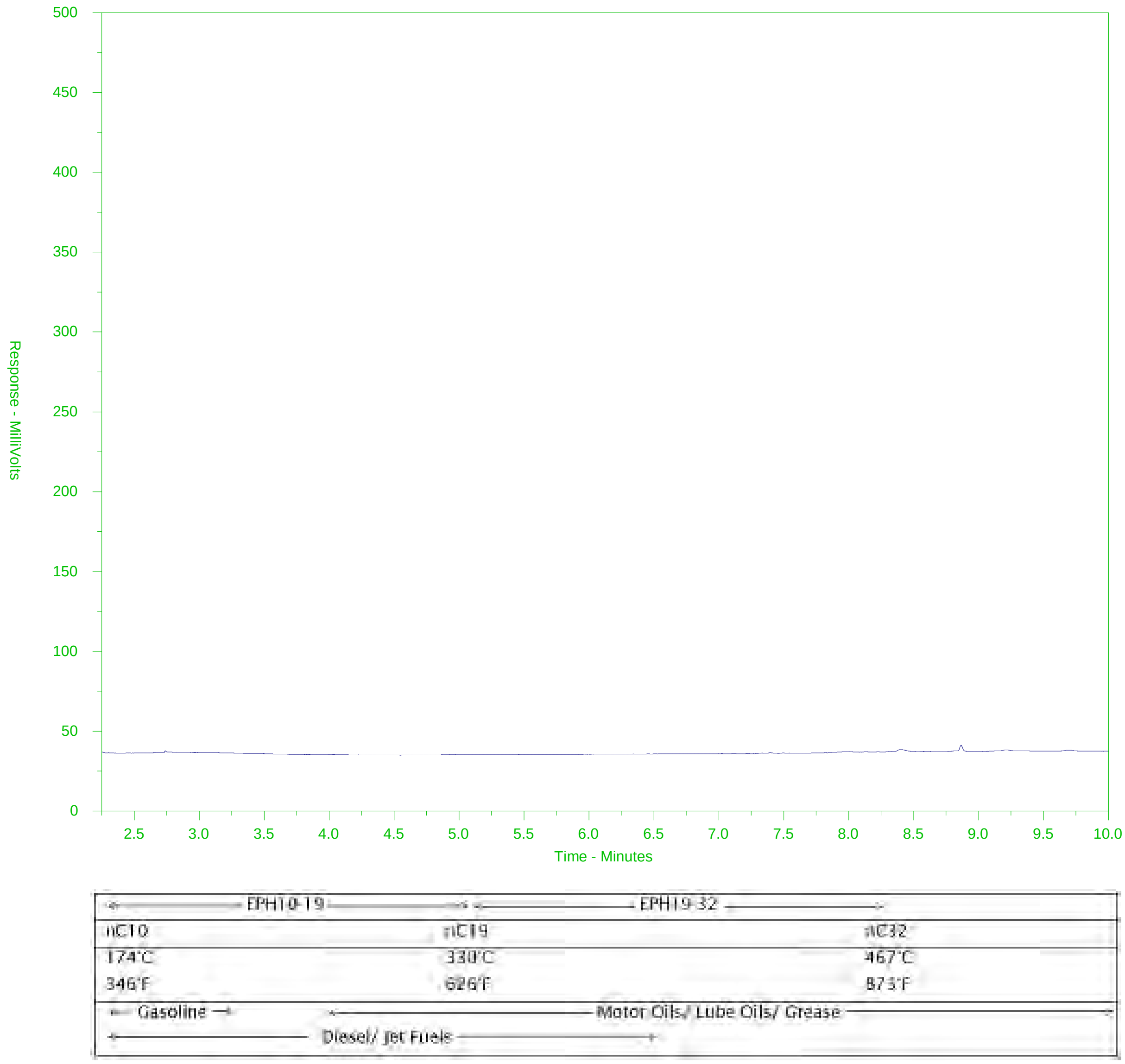
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-3
Client Sample ID: SW-2



The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

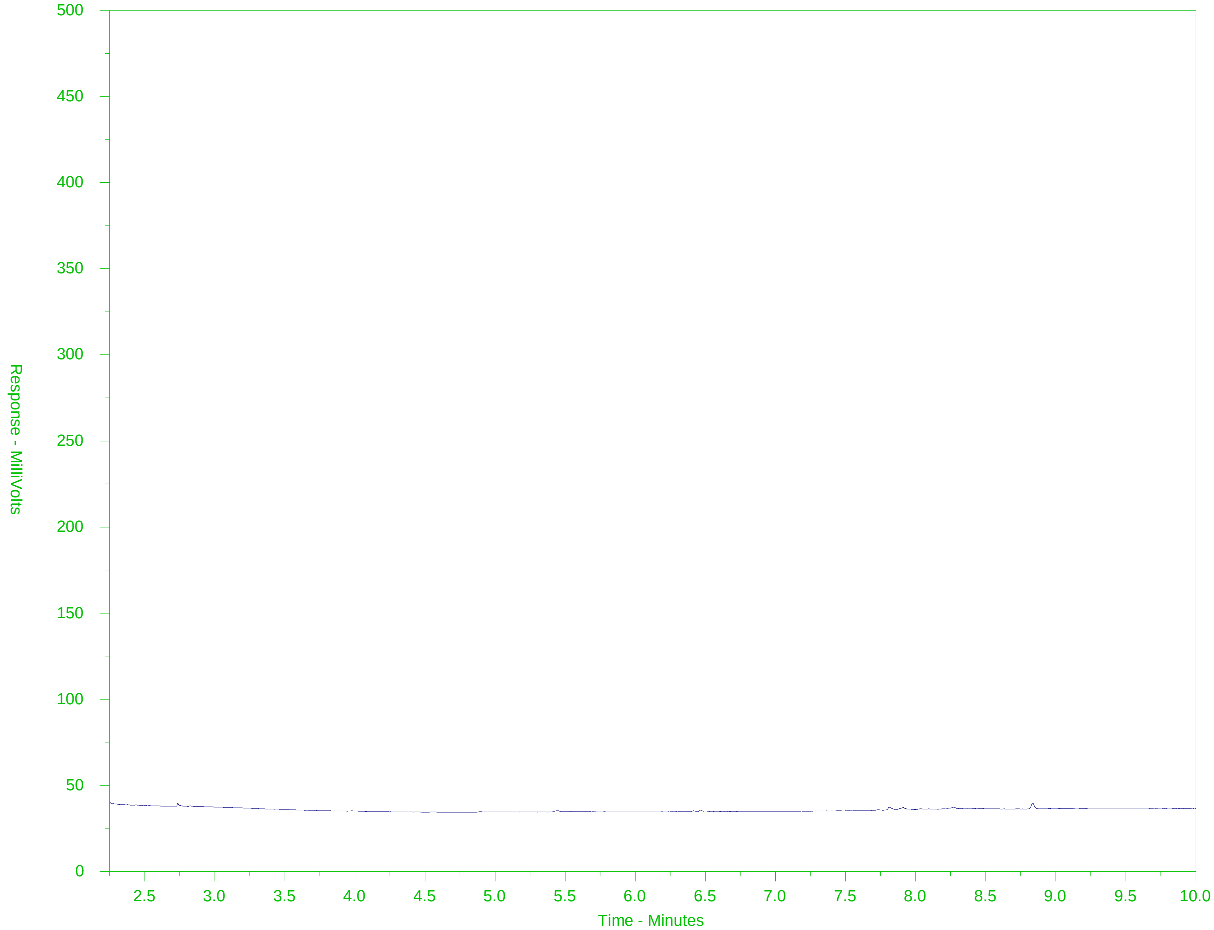
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-4
Client Sample ID: SW-3



← EPH10-19 →		← EPH19-32 →
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

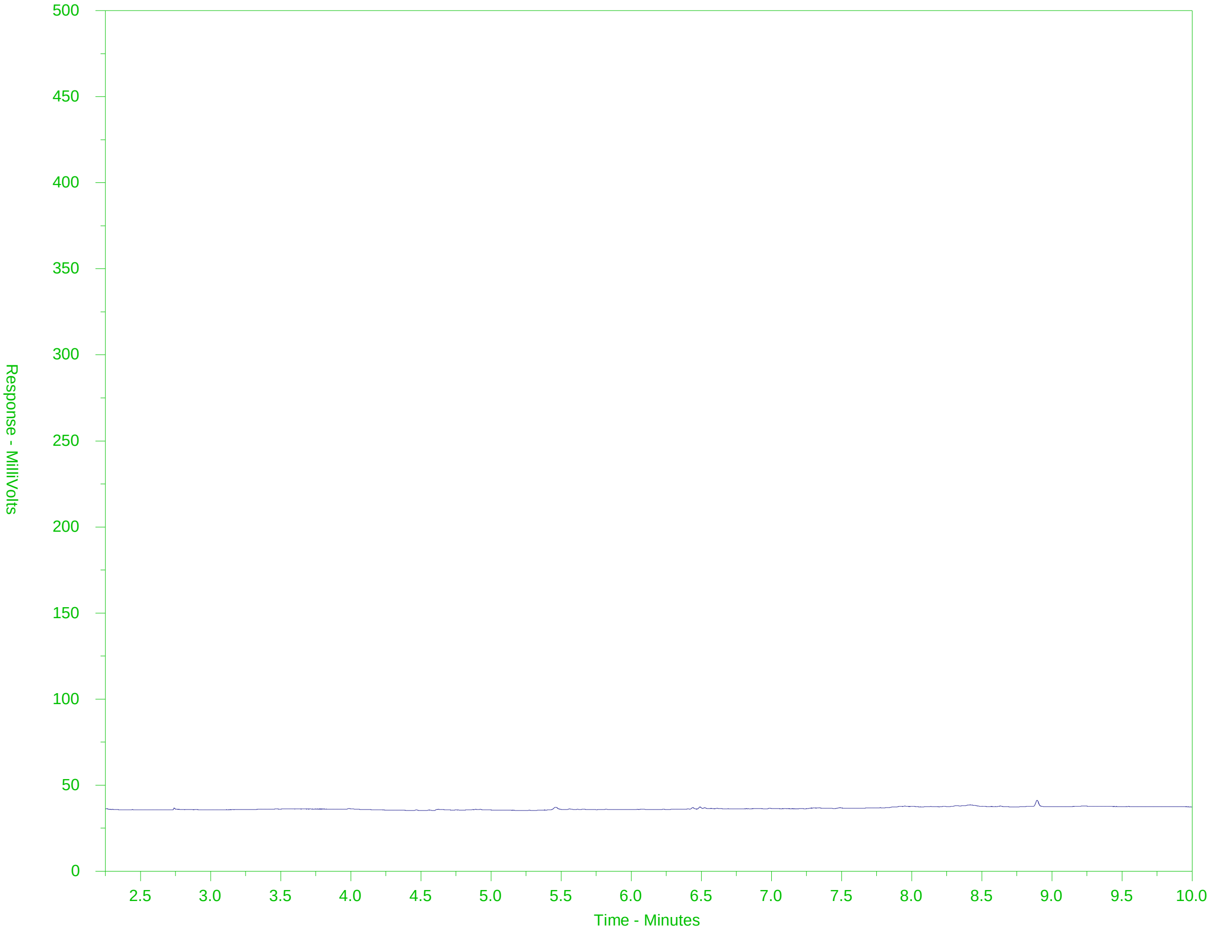
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-5
Client Sample ID: SW-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

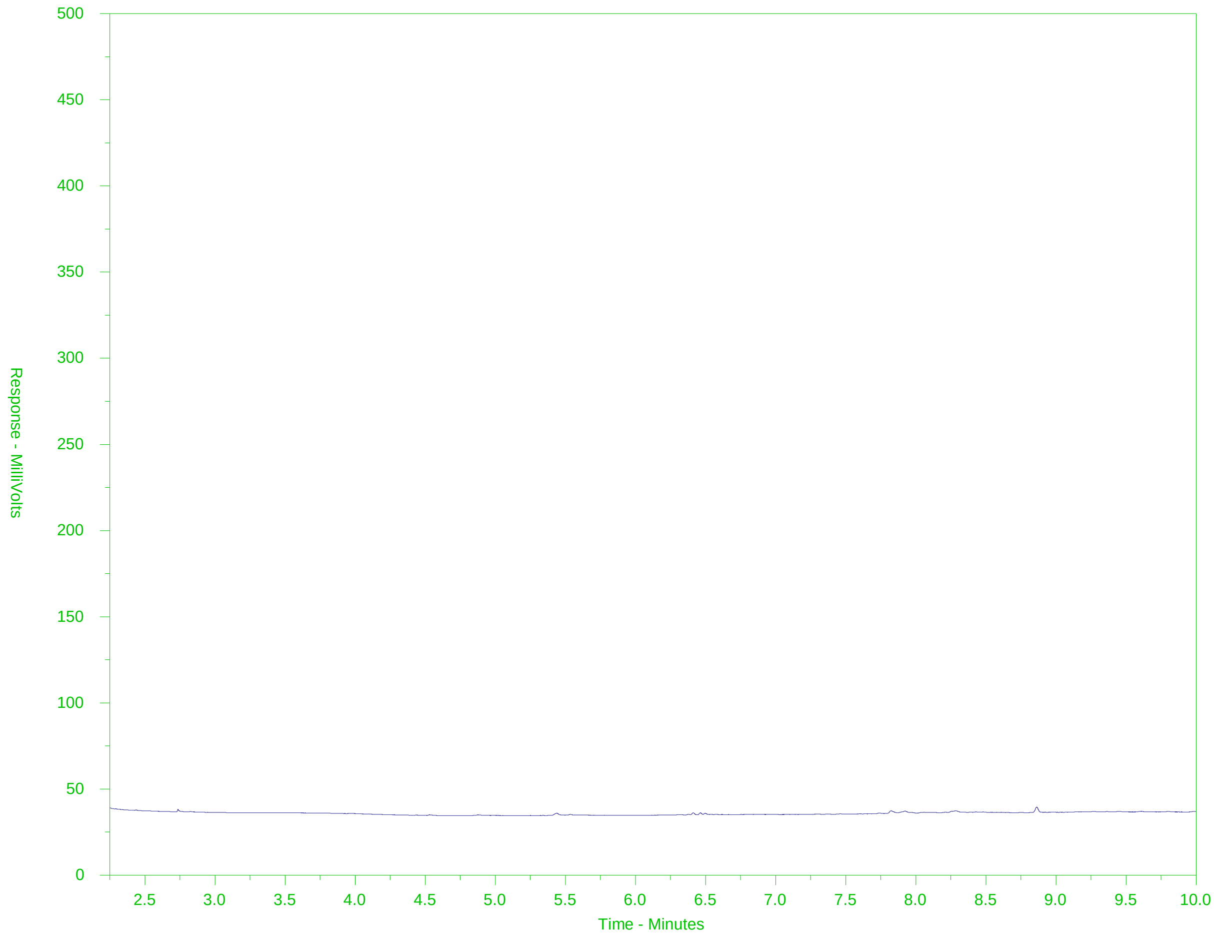
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-6
Client Sample ID: SW-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

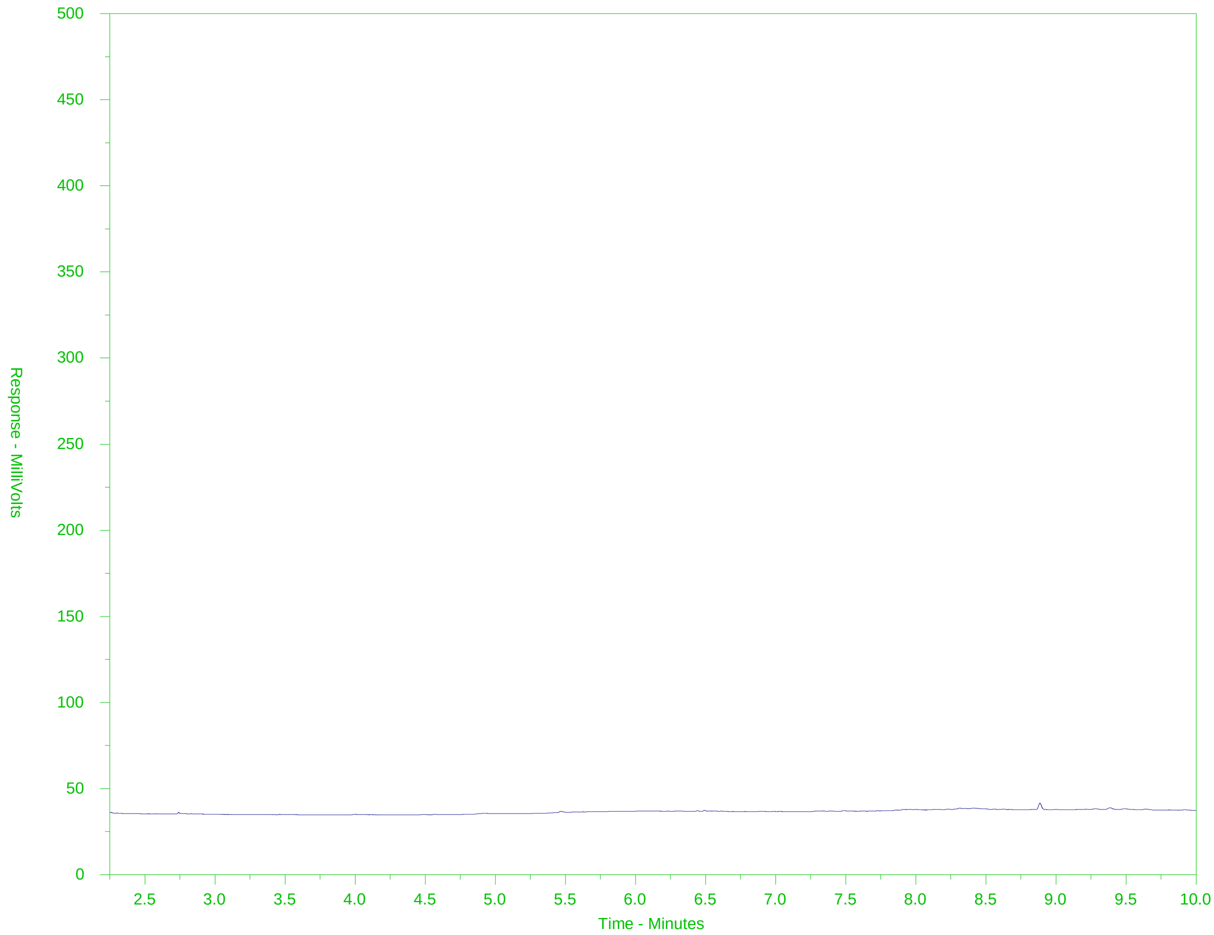
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

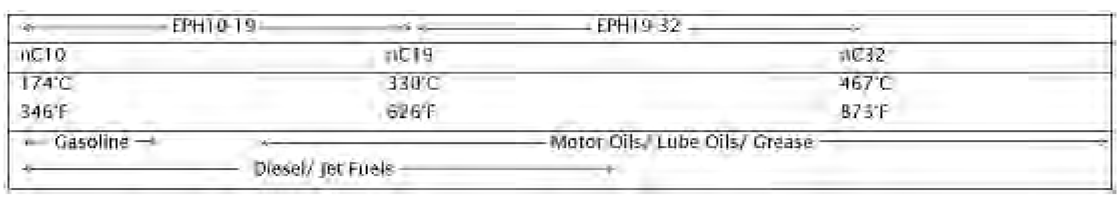
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-7
Client Sample ID: SW-6





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

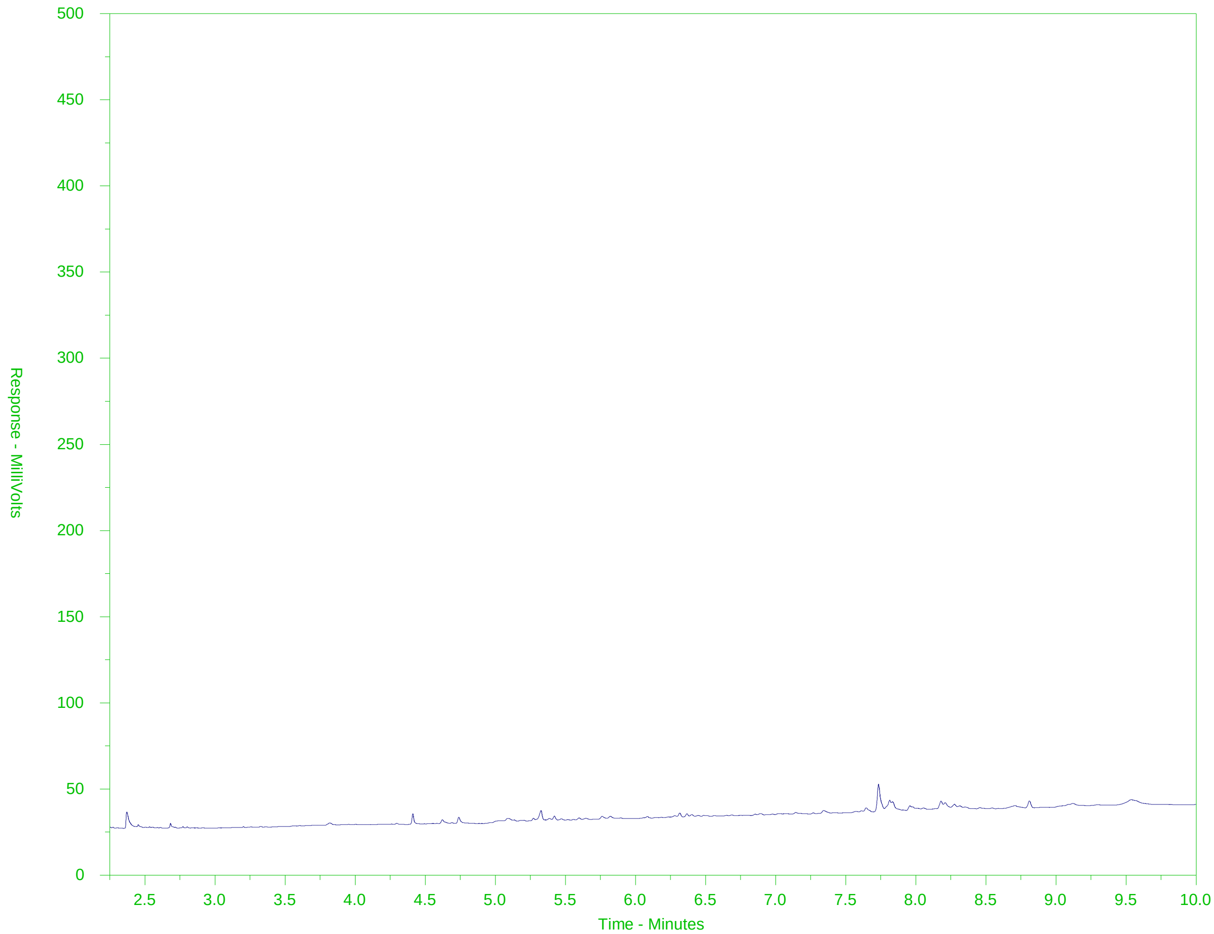
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-8
Client Sample ID: SW-7



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

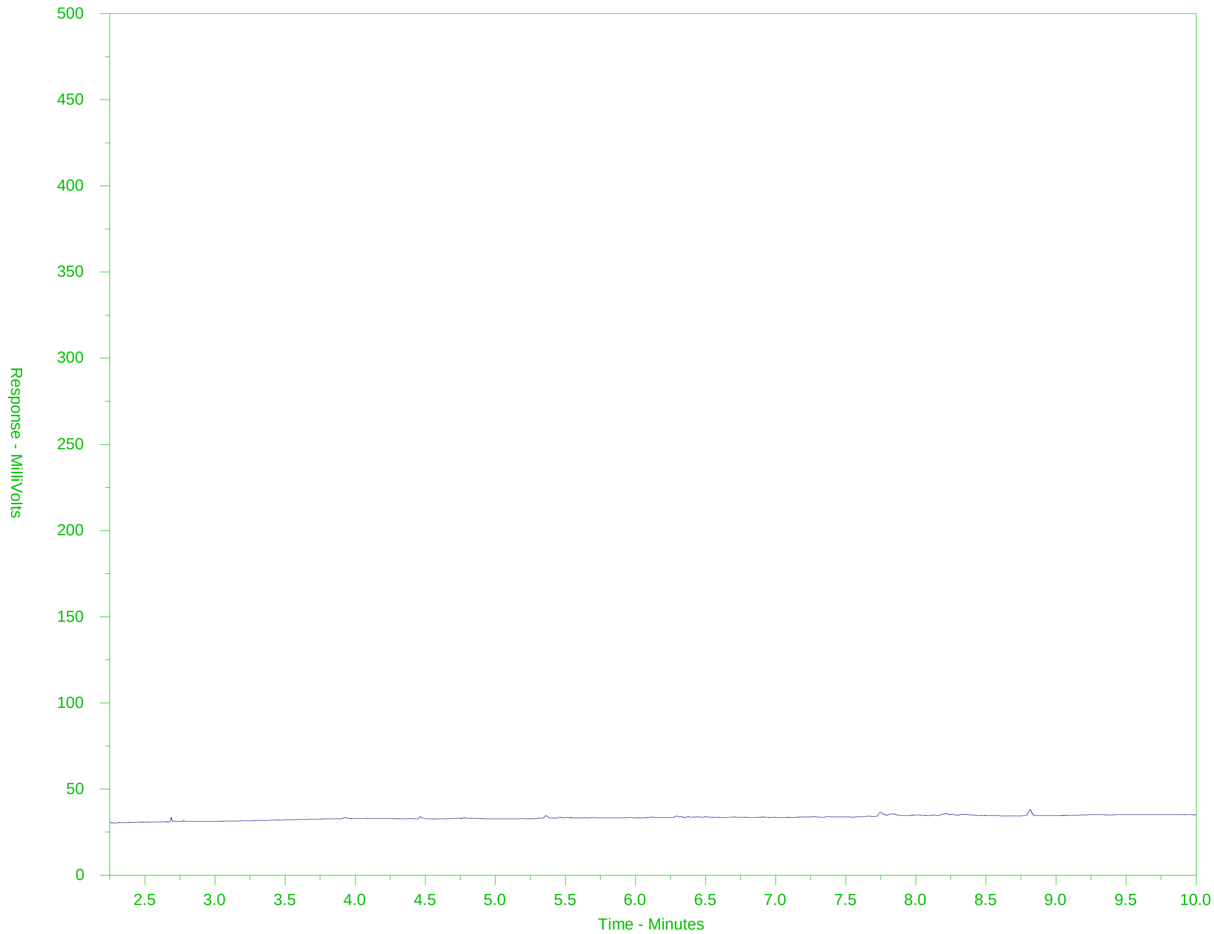
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

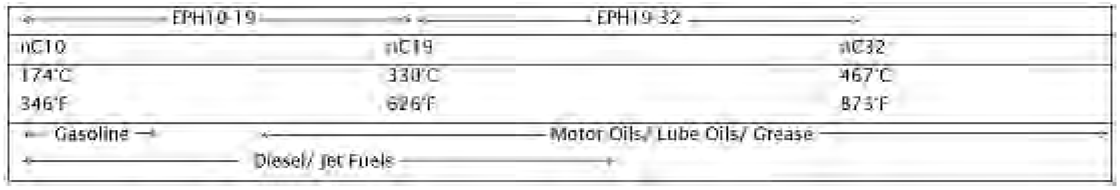
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-9
Client Sample ID: SW-8





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

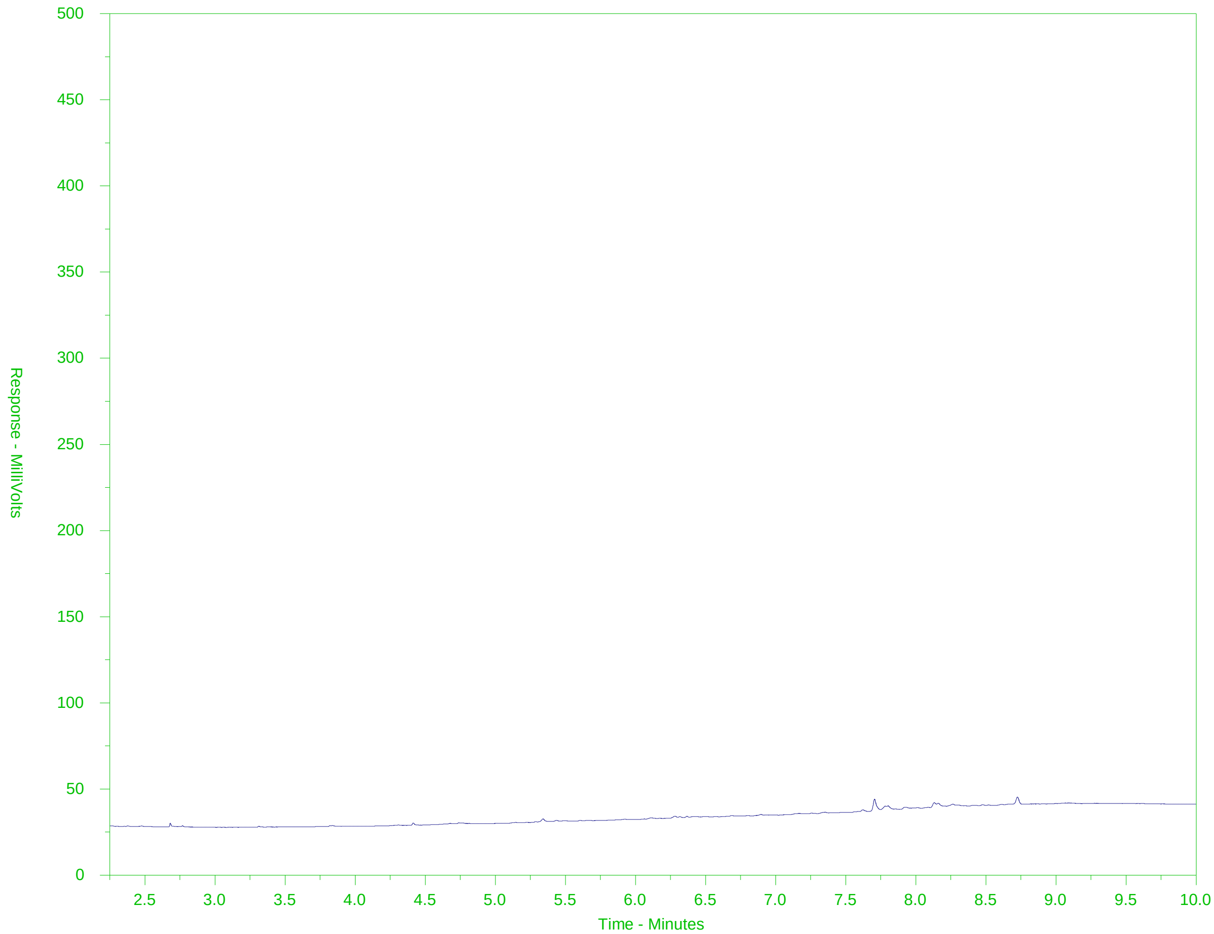
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WG3187147-3#L2359868-9

Client Sample ID: SW-8



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2359868-10
Client Sample ID: SNW-1

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2359868-COFC

COC Number: 17- 766321

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	PHIL ROUGET
Phone:	250 888 1100
Company address below will appear on the final report	
Street:	2nd FLOOR 3795 CAREY RD
City/Province:	VICTORIA B.C.
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☐ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: PROUGET@GOLDER.COM

Email 2: Patricia_Tomlinson@Golder.com

Email 3: CBYLENGA@GOLDER.COM

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #: 1663724 / 24000

PO / AFE:

LSD:

ALS Lab Work Order # (lab use only):

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact:

Sampler: Christine Bylenga, Trish Tomlinson

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Moisture and pH	Extractable Metals	TOC and TIC	Hydrocarbons (EPH, LEPH, HEPH)	PAH	Particle size	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	SW-1	27-SEPT-19	08:50	SEDIMENT	4	X	X	X	X	X	X		
	DUP B	27-SEPT-19	09:15	SEDIMENT	4	X	X	X	X	X	X		
	SW-2	27-SEPT-19	10:25	SEDIMENT	4	X	X	X	X	X	X		
	SW-3	27-SEPT-19	11:35	SEDIMENT	4	X	X	X	X	X	X		
	SW-4	27-SEPT-19	14:30	SEDIMENT	4	X	X	X	X	X	X		
	SW-5	27-SEPT-19	15:40	SEDIMENT	4	X	X	X	X	X	X		
	SW-6	28-SEPT-19	09:20	SEDIMENT	4	X	X	X	X	X	X		
	SW-7	28-SEPT-19	12:25	SEDIMENT	4	X	X	X	X	X	X		
	SW-8	28-SEPT-19	13:15	SEDIMENT	4	X	X	X	X	X	X		
	SNW-1	28-SEPT-19	13:55	SEDIMENT	4	X	X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C:

FINAL COOLER TEMPERATURES °C: 9, 11 °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Patricia Tomlinson	Date: 01 Oct 2019	Time: 08:30	Received by:	Date:	Time:	Received by: JCN	Date: 4 Oct 19	Time: 9:15 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 05-OCT-19
Report Date: 15-OCT-19 13:04 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2360531

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 17-766305
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-1	L2360531-2	L2360531-3	L2360531-4	L2360531-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	30-SEP-19	30-SEP-19	30-SEP-19	01-OCT-19	01-OCT-19
	Sampled Time	12:20	12:20	13:55	09:54	11:45
	Client ID	SNW-2	DUP-C	SNW-3	SNW-4	SNW-5
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	26.3	24.4	28.9	29.4	31.6
	pH (1:2 soil:water) (pH)	8.37	8.35	8.29	8.23	8.26
Particle Size	% Gravel (>2mm) (%)	8.0	13.4	9.1	11.7	9.7
	% Sand (2.0mm - 0.063mm) (%)	39.3	40.3	38.6	28.4	32.7
	% Silt (0.063mm - 4um) (%)	40.4	35.6	40.4	45.1	41.9
	% Clay (<4um) (%)	12.3	10.7	11.8	14.8	15.7
	Texture	Loam	Loam	Loam	Silt loam	Silt loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	2.07	1.80	2.13	2.40	2.27
	Inorganic Carbon (as CaCO3 Equivalent) (%)	17.2	15.0	17.7	20.0	18.9
	Total Carbon by Combustion (%)	4.65	4.61	5.19	5.51	5.06
	Total Organic Carbon (%)	2.58	2.81	3.1	3.1	2.8
Metals	Aluminum (Al) (mg/kg)	5970	5770	6170	7160	7430
	Antimony (Sb) (mg/kg)	0.13	0.12	0.12	0.14	0.14
	Arsenic (As) (mg/kg)	4.76	4.39	7.72	5.48	6.99
	Barium (Ba) (mg/kg)	17.9	17.1	17.9	19.8	23.4
	Beryllium (Be) (mg/kg)	0.35	0.37	0.39	0.45	0.48
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	37.4	39.2	45.0	45.8	50.1
	Cadmium (Cd) (mg/kg)	0.093	0.083	0.062	0.089	0.084
	Calcium (Ca) (mg/kg)	74900	76500	83200	77200	80500
	Chromium (Cr) (mg/kg)	20.6	19.1	19.8	22.4	23.0
	Cobalt (Co) (mg/kg)	3.73	3.53	3.53	4.06	4.19
	Copper (Cu) (mg/kg)	8.32	8.00	7.84	9.25	9.53
	Iron (Fe) (mg/kg)	12700	11900	13300	13600	14200
	Lead (Pb) (mg/kg)	5.98	5.79	6.08	7.17	7.30
	Lithium (Li) (mg/kg)	26.4	27.0	29.2	33.4	35.5
	Magnesium (Mg) (mg/kg)	46100	41000	43400	45000	42700
	Manganese (Mn) (mg/kg)	155	142	160	154	164
	Mercury (Hg) (mg/kg)	0.0109	0.0128	0.0126	0.0130	0.0140
	Molybdenum (Mo) (mg/kg)	0.34	0.35	0.37	0.36	0.37
	Nickel (Ni) (mg/kg)	11.7	11.1	11.5	12.9	13.5
	Phosphorus (P) (mg/kg)	514	456	608	502	522
	Potassium (K) (mg/kg)	2530	2460	2730	3000	3120
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.20	<0.20	0.22
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	4730	4470	5010	4910	5220

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-6	L2360531-7	L2360531-8	L2360531-9	L2360531-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	02-OCT-19	02-OCT-19
	Sampled Time	15:40	16:37	16:37	11:00	12:50
	Client ID	SNE-1	SNE-2	DUP-D	SNW-6	SNW-7
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	17.5	30.1	28.9	27.5	31.5
	pH (1:2 soil:water) (pH)	8.53	7.30	7.82	8.34	8.26
Particle Size	% Gravel (>2mm) (%)	11.4	10.1	13.9	6.2	5.0
	% Sand (2.0mm - 0.063mm) (%)	64.2	39.2	38.8	39.2	37.8
	% Silt (0.063mm - 4um) (%)	18.8	38.5	36.6	37.6	39.7
	% Clay (<4um) (%)	5.6	12.2	10.7	17.1	17.4
	Texture	Sandy loam	Loam	Loam	Loam	Loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	1.24	2.48	2.00	2.35	2.42
	Inorganic Carbon (as CaCO3 Equivalent) (%)	10.3	20.7	16.6	19.6	20.2
	Total Carbon by Combustion (%)	2.93	5.39	4.73	4.77	4.82
	Total Organic Carbon (%)	1.69	2.9	2.73	2.42	2.40
Metals	Aluminum (Al) (mg/kg)	3440	5890	5610	6690	8640
	Antimony (Sb) (mg/kg)	<0.10	0.11	0.11	0.17	0.19
	Arsenic (As) (mg/kg)	2.40	6.27	6.04	6.32	9.11
	Barium (Ba) (mg/kg)	11.1	18.5	16.4	19.6	24.6
	Beryllium (Be) (mg/kg)	0.20	0.36	0.37	0.40	0.54
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	22.5	40.3	38.0	45.0	58.0
	Cadmium (Cd) (mg/kg)	0.050	0.119	0.055	0.089	0.116
	Calcium (Ca) (mg/kg)	41900	67600	64500	75500	90500
	Chromium (Cr) (mg/kg)	11.2	18.1	17.6	20.1	25.3
	Cobalt (Co) (mg/kg)	1.87	3.40	3.37	3.77	4.70
	Copper (Cu) (mg/kg)	4.22	7.26	6.99	9.20	10.5
	Iron (Fe) (mg/kg)	7460	12200	11900	12500	16800
	Lead (Pb) (mg/kg)	3.59	5.73	5.76	6.80	8.23
	Lithium (Li) (mg/kg)	14.3	25.4	25.6	30.4	40.3
	Magnesium (Mg) (mg/kg)	24500	37800	35500	36800	47300
	Manganese (Mn) (mg/kg)	81.5	155	151	137	199
	Mercury (Hg) (mg/kg)	0.0074	0.0116	0.0121	0.0128	0.0146
	Molybdenum (Mo) (mg/kg)	0.26	0.35	0.36	0.38	0.46
	Nickel (Ni) (mg/kg)	6.12	10.5	10.5	12.0	14.6
	Phosphorus (P) (mg/kg)	323	489	460	508	647
	Potassium (K) (mg/kg)	1510	2570	2360	2740	3570
	Selenium (Se) (mg/kg)	<0.20	0.21	<0.20	0.20	0.26
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	2540	5720	4520	4570	6530

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2360531-11 Sediment 02-OCT-19 14:40 SNW-8				
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	33.2				
	pH (1:2 soil:water) (pH)	8.26				
Particle Size	% Gravel (>2mm) (%)	7.1				
	% Sand (2.0mm - 0.063mm) (%)	31.1				
	% Silt (0.063mm - 4um) (%)	42.6				
	% Clay (<4um) (%)	19.1				
	Texture	Silt loam				
Organic / Inorganic Carbon	Inorganic Carbon (%)	2.66				
	Inorganic Carbon (as CaCO3 Equivalent) (%)	22.1				
	Total Carbon by Combustion (%)	5.31				
	Total Organic Carbon (%)	2.7				
Metals	Aluminum (Al) (mg/kg)	7820				
	Antimony (Sb) (mg/kg)	0.13				
	Arsenic (As) (mg/kg)	7.13				
	Barium (Ba) (mg/kg)	20.6				
	Beryllium (Be) (mg/kg)	0.45				
	Bismuth (Bi) (mg/kg)	<0.20				
	Boron (B) (mg/kg)	53.1				
	Cadmium (Cd) (mg/kg)	0.077				
	Calcium (Ca) (mg/kg)	91900				
	Chromium (Cr) (mg/kg)	22.4				
	Cobalt (Co) (mg/kg)	4.26				
	Copper (Cu) (mg/kg)	9.28				
	Iron (Fe) (mg/kg)	13900				
	Lead (Pb) (mg/kg)	7.04				
	Lithium (Li) (mg/kg)	32.3				
	Magnesium (Mg) (mg/kg)	42000				
	Manganese (Mn) (mg/kg)	165				
	Mercury (Hg) (mg/kg)	0.0137				
	Molybdenum (Mo) (mg/kg)	0.37				
	Nickel (Ni) (mg/kg)	13.0				
	Phosphorus (P) (mg/kg)	470				
	Potassium (K) (mg/kg)	3140				
	Selenium (Se) (mg/kg)	0.20				
	Silver (Ag) (mg/kg)	<0.10				
	Sodium (Na) (mg/kg)	5040				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-1	L2360531-2	L2360531-3	L2360531-4	L2360531-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	30-SEP-19	30-SEP-19	30-SEP-19	01-OCT-19	01-OCT-19
	Sampled Time	12:20	12:20	13:55	09:54	11:45
	Client ID	SNW-2	DUP-C	SNW-3	SNW-4	SNW-5
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	48.7	52.2	57.1	51.0	57.2
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.117	0.107	0.105	0.132	0.128
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	250	239	255	273	274
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.926	0.937	0.901	1.05	0.958
	Vanadium (V) (mg/kg)	25.4	23.8	25.1	29.2	31.1
	Zinc (Zn) (mg/kg)	18.1	17.4	18.1	21.0	21.5
	Zirconium (Zr) (mg/kg)	6.5	6.7	6.5	7.3	7.8
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	Surrogate: 2-Bromobenzotrifluoride (%)	87.5	90.7	90.5	90.9	88.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0070 DLQ	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	71.4	73.9	71.1	69.6	69.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-6	L2360531-7	L2360531-8	L2360531-9	L2360531-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	02-OCT-19	02-OCT-19
	Sampled Time	15:40	16:37	16:37	11:00	12:50
	Client ID	SNE-1	SNE-2	DUP-D	SNW-6	SNW-7
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	29.8	57.3	47.7	52.7	66.3
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.059	0.106	0.098	0.117	0.137
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	160	234	228	245	343
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.600	0.770	0.774	1.00	1.07
	Vanadium (V) (mg/kg)	13.5	24.3	23.6	28.2	37.2
	Zinc (Zn) (mg/kg)	10.1	19.3	17.6	21.0	24.9
	Zirconium (Zr) (mg/kg)	4.4	5.7	5.5	6.9	8.5
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	Surrogate: 2-Bromobenzotrifluoride (%)	92.5	88.0	98.4	91.1	88.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	0.0130	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	0.0080	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	0.031	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	0.033	<0.010	<0.010	0.028	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	0.048	<0.010	<0.010	0.032	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	0.069	<0.015	<0.015	0.047	<0.015
	Benzo(g,h,i)perylene (mg/kg)	0.040	<0.010	<0.010	0.051	<0.010
	Benzo(k)fluoranthene (mg/kg)	0.022	<0.010	<0.010	0.015	<0.010
	Chrysene (mg/kg)	0.041	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	0.0177	<0.0070 DLQ	<0.0050	0.0098	<0.0050
	Fluoranthene (mg/kg)	0.050	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	0.034	<0.010	<0.010	0.038	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	0.043	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	0.042	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	74.2	76.7	102.6	71.2	69.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-11
	Description	Sediment
	Sampled Date	02-OCT-19
	Sampled Time	14:40
	Client ID	SNW-8
Grouping	**Analyte**	
SOIL		
Metals	Strontium (Sr) (mg/kg)	60.4
	Sulfur (S) (mg/kg)	<1000
	Thallium (Tl) (mg/kg)	0.116
	Tin (Sn) (mg/kg)	<2.0
	Titanium (Ti) (mg/kg)	260
	Tungsten (W) (mg/kg)	<0.50
	Uranium (U) (mg/kg)	0.904
	Vanadium (V) (mg/kg)	31.1
	Zinc (Zn) (mg/kg)	20.4
	Zirconium (Zr) (mg/kg)	7.2
Hydrocarbons	EPH10-19 (mg/kg)	<200
	EPH19-32 (mg/kg)	<200
	LEPH (mg/kg)	<200
	HEPH (mg/kg)	<200
	Surrogate: 2-Bromobenzotrifluoride (%)	93.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050
	Acenaphthylene (mg/kg)	<0.0050
	Anthracene (mg/kg)	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010
	Chrysene (mg/kg)	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050
	Fluoranthene (mg/kg)	<0.010
	Fluorene (mg/kg)	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010
	Naphthalene (mg/kg)	<0.010
	Phenanthrene (mg/kg)	<0.010
	Pyrene (mg/kg)	<0.010
	Quinoline (mg/kg)	<0.050
	Surrogate: Chrysene d12 (%)	95.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-1	L2360531-2	L2360531-3	L2360531-4	L2360531-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	30-SEP-19	30-SEP-19	30-SEP-19	01-OCT-19	01-OCT-19
	Sampled Time	12:20	12:20	13:55	09:54	11:45
	Client ID	SNW-2	DUP-C	SNW-3	SNW-4	SNW-5
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: Naphthalene d8 (%)	91.0	91.6	90.8	88.5	89.5
	Surrogate: Phenanthrene d10 (%)	88.2	92.8	92.2	88.2	90.7
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-6	L2360531-7	L2360531-8	L2360531-9	L2360531-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	01-OCT-19	01-OCT-19	01-OCT-19	02-OCT-19	02-OCT-19
	Sampled Time	15:40	16:37	16:37	11:00	12:50
	Client ID	SNE-1	SNE-2	DUP-D	SNW-6	SNW-7
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: Naphthalene d8 (%)	90.3	97.6	101.9	90.3	90.3
	Surrogate: Phenanthrene d10 (%)	90.8	96.3	72.7	89.7	89.1
	B(a)P Total Potency Equivalent (mg/kg)	0.065	<0.020	<0.020	0.047	<0.020
	IACR (CCME)	0.73	<0.15	<0.15	0.45	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2360531-11				
	Description	Sediment				
	Sampled Date	02-OCT-19				
	Sampled Time	14:40				
	Client ID	SNW-8				
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: Naphthalene d8 (%)	93.6				
	Surrogate: Phenanthrene d10 (%)	97.8				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME)	<0.15				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bismuth (Bi)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Boron (B)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Copper (Cu)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Lead (Pb)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Manganese (Mn)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nickel (Ni)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Silver (Ag)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Tin (Sn)	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Benzo(a)pyrene	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -9
Duplicate	Benzo(b&j)fluoranthene	DUP-H	L2360531-1, -10, -2, -3, -4, -5, -6, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLQ	Detection Limit raised due to co-eluting interference. GCMS qualifier ion ratio did not meet acceptance criteria.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LEPH/HEPH-CALC-VA	Soil	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the

Reference Information

sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-766305

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8
Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4868000								
WG3185266-1 DUP		**L2360531-9**						
Inorganic Carbon		2.35	2.43		%	3.3	20	12-OCT-19
WG3185266-4 IRM		**08-109_SOIL**						
Inorganic Carbon			95.1		%		80-120	12-OCT-19
WG3185266-2 LCS		**0.5**						
Inorganic Carbon			99.0		%		80-120	12-OCT-19
WG3185266-3 MB								
Inorganic Carbon			<0.050		%		0.05	12-OCT-19
C-TOT-LECO-SK	**Soil**							
Batch R4867625								
WG3185371-1 DUP		**L2360531-10**						
Total Carbon by Combustion		4.82	4.76		%	1.3	20	10-OCT-19
WG3185371-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			98.3		%		80-120	10-OCT-19
WG3185371-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			102.5		%		90-110	10-OCT-19
WG3185371-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	10-OCT-19
EPH-TUMB-FID-VA	**Soil**							
Batch R4861540								
WG3184511-3 DUP		**L2360531-2**						
EPH10-19		<200	<200	RPD-NA	mg/kg	N/A	40	08-OCT-19
EPH19-32		<200	<200	RPD-NA	mg/kg	N/A	40	08-OCT-19
WG3184511-4 IRM		**ALS PHC RM3**						
EPH10-19			97.5		%		70-130	08-OCT-19
EPH19-32			96.9		%		70-130	08-OCT-19
WG3184511-2 LCS								
EPH10-19			97.9		%		70-130	08-OCT-19
EPH19-32			94.1		%		70-130	08-OCT-19
WG3184511-1 MB								
EPH10-19			<200		mg/kg		200	08-OCT-19
EPH19-32			<200		mg/kg		200	08-OCT-19
Surrogate: 2-Bromobenzotrifluoride			94.4		%		60-140	08-OCT-19
Batch R4867384								
WG3188464-4 IRM		**ALS PHC RM3**						
EPH10-19			105.7		%		70-130	12-OCT-19
EPH19-32			98.5		%		70-130	12-OCT-19
WG3188464-2								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-TUMB-FID-VA	**Soil**							
Batch R4867384								
WG3188464-2 LCS								
EPH10-19			106.6		%		70-130	12-OCT-19
EPH19-32			111.5		%		70-130	12-OCT-19
WG3188464-1 MB								
EPH10-19			<200		mg/kg		200	12-OCT-19
EPH19-32			<200		mg/kg		200	12-OCT-19
Surrogate: 2-Bromobenzotrifluoride			90.1		%		60-140	12-OCT-19
HG-200.2-CVAF-VA	**Soil**							
Batch R4861227								
WG3184510-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			100.7		%		70-130	08-OCT-19
WG3184510-2 DUP		**L2360531-3**						
Mercury (Hg)		0.0126	0.0116		mg/kg	8.9	40	08-OCT-19
WG3184510-3 LCS								
Mercury (Hg)			100.8		%		80-120	08-OCT-19
WG3184510-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	08-OCT-19
Batch R4866984								
WG3188532-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			104.9		%		70-130	11-OCT-19
WG3188532-3 LCS								
Mercury (Hg)			103.6		%		80-120	11-OCT-19
WG3188532-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	11-OCT-19
MET-200.2-CCMS-VA	**Soil**							
Batch R4861709								
WG3184510-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			92.3		%		70-130	08-OCT-19
Antimony (Sb)			94.1		%		70-130	08-OCT-19
Arsenic (As)			102.1		%		70-130	08-OCT-19
Barium (Ba)			98.8		%		70-130	08-OCT-19
Beryllium (Be)			89.7		%		70-130	08-OCT-19
Bismuth (Bi)			103.4		%		70-130	08-OCT-19
Cadmium (Cd)			102.1		%		70-130	08-OCT-19
Calcium (Ca)			91.9		%		70-130	08-OCT-19
Copper (Cu)			100.0		%		70-130	08-OCT-19
Iron (Fe)			100.0		%		70-130	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4861709								
WG3184510-4 CRM		**VA-CANMET-TILL2**						
Lead (Pb)			99.6		%		70-130	08-OCT-19
Lithium (Li)			86.0		%		70-130	08-OCT-19
Magnesium (Mg)			100.1		%		70-130	08-OCT-19
Manganese (Mn)			98.4		%		70-130	08-OCT-19
Molybdenum (Mo)			97.0		%		70-130	08-OCT-19
Nickel (Ni)			99.0		%		70-130	08-OCT-19
Phosphorus (P)			111.6		%		70-130	08-OCT-19
Potassium (K)			98.3		%		70-130	08-OCT-19
Selenium (Se)			0.32		mg/kg		0.15-0.55	08-OCT-19
Silver (Ag)			0.27		mg/kg		0.16-0.36	08-OCT-19
Sodium (Na)			125.0		%		70-130	08-OCT-19
Strontium (Sr)			99.7		%		70-130	08-OCT-19
Thallium (Tl)			95.7		%		70-130	08-OCT-19
Tin (Sn)			2.2		mg/kg		0.2-4.2	08-OCT-19
Titanium (Ti)			97.2		%		70-130	08-OCT-19
Tungsten (W)			1.52		mg/kg		1-2	08-OCT-19
Uranium (U)			101.1		%		70-130	08-OCT-19
Vanadium (V)			99.3		%		70-130	08-OCT-19
Zinc (Zn)			102.0		%		70-130	08-OCT-19
WG3184510-2 DUP		**L2360531-3**						
Aluminum (Al)		6170	6340		mg/kg	2.8	40	08-OCT-19
Antimony (Sb)		0.12	0.12		mg/kg	0.0	30	08-OCT-19
Arsenic (As)		7.72	7.95		mg/kg	2.8	30	08-OCT-19
Barium (Ba)		17.9	18.6		mg/kg	4.3	40	08-OCT-19
Beryllium (Be)		0.39	0.41		mg/kg	3.1	30	08-OCT-19
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	08-OCT-19
Boron (B)		45.0	44.7		mg/kg	0.5	30	08-OCT-19
Cadmium (Cd)		0.062	0.061		mg/kg	1.7	30	08-OCT-19
Calcium (Ca)		83200	82500		mg/kg	0.8	30	08-OCT-19
Chromium (Cr)		19.8	21.2		mg/kg	6.9	30	08-OCT-19
Cobalt (Co)		3.53	3.73		mg/kg	5.4	30	08-OCT-19
Copper (Cu)		7.84	8.23		mg/kg	4.8	30	08-OCT-19
Iron (Fe)		13300	13800		mg/kg	3.3	30	08-OCT-19
Lead (Pb)		6.08	6.32		mg/kg	3.9	40	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4861709								
WG3184510-2 DUP		**L2360531-3**						
Lithium (Li)		29.2	28.6		mg/kg	2.2	30	08-OCT-19
Magnesium (Mg)		43400	43800		mg/kg	1.1	30	08-OCT-19
Manganese (Mn)		160	164		mg/kg	2.8	30	08-OCT-19
Molybdenum (Mo)		0.37	0.37		mg/kg	0.4	40	08-OCT-19
Nickel (Ni)		11.5	11.8		mg/kg	2.8	30	08-OCT-19
Phosphorus (P)		608	655		mg/kg	7.4	30	08-OCT-19
Potassium (K)		2730	2710		mg/kg	0.7	40	08-OCT-19
Selenium (Se)		0.20	<0.20	RPD-NA	mg/kg	N/A	30	08-OCT-19
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	08-OCT-19
Sodium (Na)		5010	4900		mg/kg	2.3	40	08-OCT-19
Strontium (Sr)		57.1	58.0		mg/kg	1.5	40	08-OCT-19
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	08-OCT-19
Thallium (Tl)		0.105	0.115		mg/kg	8.3	30	08-OCT-19
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	08-OCT-19
Titanium (Ti)		255	262		mg/kg	2.7	40	08-OCT-19
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	08-OCT-19
Uranium (U)		0.901	0.912		mg/kg	1.3	30	08-OCT-19
Vanadium (V)		25.1	25.8		mg/kg	3.0	30	08-OCT-19
Zinc (Zn)		18.1	18.4		mg/kg	2.1	30	08-OCT-19
Zirconium (Zr)		6.5	6.8		mg/kg	3.9	30	08-OCT-19
WG3184510-3 LCS								
Aluminum (Al)			102.7		%		80-120	08-OCT-19
Antimony (Sb)			99.9		%		80-120	08-OCT-19
Arsenic (As)			100.7		%		80-120	08-OCT-19
Barium (Ba)			107.1		%		80-120	08-OCT-19
Beryllium (Be)			92.0		%		80-120	08-OCT-19
Bismuth (Bi)			100.6		%		80-120	08-OCT-19
Boron (B)			93.6		%		80-120	08-OCT-19
Cadmium (Cd)			99.5		%		80-120	08-OCT-19
Calcium (Ca)			94.3		%		80-120	08-OCT-19
Chromium (Cr)			100.3		%		80-120	08-OCT-19
Cobalt (Co)			99.5		%		80-120	08-OCT-19
Copper (Cu)			99.4		%		80-120	08-OCT-19
Iron (Fe)			103.8		%		80-120	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4861709								
WG3184510-3 LCS								
Lead (Pb)			101.1		%		80-120	08-OCT-19
Lithium (Li)			91.2		%		80-120	08-OCT-19
Magnesium (Mg)			110.3		%		80-120	08-OCT-19
Manganese (Mn)			104.1		%		80-120	08-OCT-19
Molybdenum (Mo)			98.3		%		80-120	08-OCT-19
Nickel (Ni)			99.7		%		80-120	08-OCT-19
Phosphorus (P)			111.5		%		80-120	08-OCT-19
Potassium (K)			107.7		%		80-120	08-OCT-19
Selenium (Se)			101.4		%		80-120	08-OCT-19
Silver (Ag)			97.4		%		80-120	08-OCT-19
Sodium (Na)			106.8		%		80-120	08-OCT-19
Strontium (Sr)			102.9		%		80-120	08-OCT-19
Sulfur (S)			100.2		%		80-120	08-OCT-19
Thallium (Tl)			97.2		%		80-120	08-OCT-19
Tin (Sn)			97.8		%		80-120	08-OCT-19
Titanium (Ti)			97.1		%		80-120	08-OCT-19
Tungsten (W)			103.7		%		80-120	08-OCT-19
Uranium (U)			106.8		%		80-120	08-OCT-19
Vanadium (V)			104.4		%		80-120	08-OCT-19
Zinc (Zn)			102.7		%		80-120	08-OCT-19
Zirconium (Zr)			99.97		%		70-130	08-OCT-19
WG3184510-1 MB								
Aluminum (Al)			<50		mg/kg		50	08-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	08-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	08-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	08-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	08-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	08-OCT-19
Boron (B)			<5.0		mg/kg		5	08-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	08-OCT-19
Calcium (Ca)			<50		mg/kg		50	08-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	08-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	08-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	08-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4861709								
WG3184510-1 MB								
Iron (Fe)			<50		mg/kg		50	08-OCT-19
Lead (Pb)			<0.50		mg/kg		0.5	08-OCT-19
Lithium (Li)			<2.0		mg/kg		2	08-OCT-19
Magnesium (Mg)			<20		mg/kg		20	08-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	08-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	08-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	08-OCT-19
Phosphorus (P)			<50		mg/kg		50	08-OCT-19
Potassium (K)			<100		mg/kg		100	08-OCT-19
Selenium (Se)			<0.20		mg/kg		0.2	08-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	08-OCT-19
Sodium (Na)			<50		mg/kg		50	08-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	08-OCT-19
Sulfur (S)			<1000		mg/kg		1000	08-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	08-OCT-19
Tin (Sn)			<2.0		mg/kg		2	08-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	08-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	08-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	08-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	08-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	08-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	08-OCT-19
Batch R4867779								
WG3188532-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			112.9		%		70-130	11-OCT-19
Antimony (Sb)			100.3		%		70-130	11-OCT-19
Arsenic (As)			105.5		%		70-130	11-OCT-19
Barium (Ba)			93.9		%		70-130	11-OCT-19
Beryllium (Be)			95.1		%		70-130	11-OCT-19
Bismuth (Bi)			94.7		%		70-130	11-OCT-19
Cadmium (Cd)			108.2		%		70-130	11-OCT-19
Calcium (Ca)			104.3		%		70-130	11-OCT-19
Copper (Cu)			101.3		%		70-130	11-OCT-19
Iron (Fe)			101.1		%		70-130	11-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4867779								
WG3188532-4 CRM		**VA-CANMET-TILL2**						
Lead (Pb)			96.6		%		70-130	11-OCT-19
Lithium (Li)			89.7		%		70-130	11-OCT-19
Magnesium (Mg)			104.7		%		70-130	11-OCT-19
Manganese (Mn)			105.9		%		70-130	11-OCT-19
Molybdenum (Mo)			95.9		%		70-130	11-OCT-19
Nickel (Ni)			102.8		%		70-130	11-OCT-19
Phosphorus (P)			103.0		%		70-130	11-OCT-19
Potassium (K)			103.4		%		70-130	11-OCT-19
Selenium (Se)			0.34		mg/kg		0.15-0.55	11-OCT-19
Silver (Ag)			0.25		mg/kg		0.16-0.36	11-OCT-19
Sodium (Na)			125.4		%		70-130	11-OCT-19
Strontium (Sr)			98.3		%		70-130	11-OCT-19
Thallium (Tl)			95.9		%		70-130	11-OCT-19
Tin (Sn)			2.3		mg/kg		0.2-4.2	11-OCT-19
Titanium (Ti)			101.7		%		70-130	11-OCT-19
Tungsten (W)			1.48		mg/kg		1-2	11-OCT-19
Uranium (U)			101.6		%		70-130	11-OCT-19
Vanadium (V)			104.1		%		70-130	11-OCT-19
Zinc (Zn)			102.0		%		70-130	11-OCT-19
WG3188532-3 LCS								
Aluminum (Al)			106.2		%		80-120	11-OCT-19
Antimony (Sb)			110.0		%		80-120	11-OCT-19
Arsenic (As)			102.6		%		80-120	11-OCT-19
Barium (Ba)			98.2		%		80-120	11-OCT-19
Beryllium (Be)			96.2		%		80-120	11-OCT-19
Bismuth (Bi)			102.0		%		80-120	11-OCT-19
Boron (B)			99.3		%		80-120	11-OCT-19
Cadmium (Cd)			99.3		%		80-120	11-OCT-19
Calcium (Ca)			103.9		%		80-120	11-OCT-19
Chromium (Cr)			102.5		%		80-120	11-OCT-19
Cobalt (Co)			101.4		%		80-120	11-OCT-19
Copper (Cu)			99.6		%		80-120	11-OCT-19
Iron (Fe)			96.7		%		80-120	11-OCT-19
Lead (Pb)			104.6		%		80-120	11-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4867779								
WG3188532-3 LCS								
Lithium (Li)			89.6		%		80-120	11-OCT-19
Magnesium (Mg)			107.1		%		80-120	11-OCT-19
Manganese (Mn)			100.8		%		80-120	11-OCT-19
Molybdenum (Mo)			103.1		%		80-120	11-OCT-19
Nickel (Ni)			101.5		%		80-120	11-OCT-19
Phosphorus (P)			112.6		%		80-120	11-OCT-19
Potassium (K)			102.8		%		80-120	11-OCT-19
Selenium (Se)			98.9		%		80-120	11-OCT-19
Silver (Ag)			96.0		%		80-120	11-OCT-19
Sodium (Na)			101.8		%		80-120	11-OCT-19
Strontium (Sr)			100.3		%		80-120	11-OCT-19
Sulfur (S)			101.7		%		80-120	11-OCT-19
Thallium (Tl)			101.5		%		80-120	11-OCT-19
Tin (Sn)			100.1		%		80-120	11-OCT-19
Titanium (Ti)			97.4		%		80-120	11-OCT-19
Tungsten (W)			100.4		%		80-120	11-OCT-19
Uranium (U)			104.8		%		80-120	11-OCT-19
Vanadium (V)			104.8		%		80-120	11-OCT-19
Zinc (Zn)			101.3		%		80-120	11-OCT-19
Zirconium (Zr)			96.3		%		70-130	11-OCT-19
WG3188532-1 MB								
Aluminum (Al)			<50		mg/kg		50	11-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	11-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	11-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	11-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	11-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	11-OCT-19
Boron (B)			<5.0		mg/kg		5	11-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	11-OCT-19
Calcium (Ca)			<50		mg/kg		50	11-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	11-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	11-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	11-OCT-19
Iron (Fe)			<50		mg/kg		50	11-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4867779								
WG3188532-1 MB								
Lead (Pb)			<0.50		mg/kg		0.5	11-OCT-19
Lithium (Li)			<2.0		mg/kg		2	11-OCT-19
Magnesium (Mg)			<20		mg/kg		20	11-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	11-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	11-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	11-OCT-19
Phosphorus (P)			<50		mg/kg		50	11-OCT-19
Potassium (K)			<100		mg/kg		100	11-OCT-19
Selenium (Se)			<0.20		mg/kg		0.2	11-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	11-OCT-19
Sodium (Na)			<50		mg/kg		50	11-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	11-OCT-19
Sulfur (S)			<1000		mg/kg		1000	11-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	11-OCT-19
Tin (Sn)			<2.0		mg/kg		2	11-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	11-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	11-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	11-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	11-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	11-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	11-OCT-19
MOISTURE-VA	**Soil**							
Batch R4861185								
WG3184570-3 DUP		**L2360531-9**						
Moisture		27.5	25.7		%	6.5	20	07-OCT-19
WG3184570-2 LCS								
Moisture			100.5		%		90-110	07-OCT-19
WG3184570-1 MB								
Moisture			<0.25		%		0.25	07-OCT-19
Batch R4861241								
WG3184502-3 DUP		**L2360531-1**						
Moisture		26.3	27.0		%	2.9	20	07-OCT-19
WG3184502-2 LCS								
Moisture			100.4		%		90-110	07-OCT-19
WG3184502-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R4861241								
WG3184502-1 MB								
Moisture			<0.25		%		0.25	07-OCT-19
Batch R4867287								
WG3188467-3 DUP		**L2360531-11**						
Moisture		33.2	33.1		%	0.1	20	10-OCT-19
WG3188467-2 LCS								
Moisture			100.2		%		90-110	10-OCT-19
WG3188467-1 MB								
Moisture			<0.25		%		0.25	10-OCT-19
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4860201								
WG3184511-3 DUP		**L2360531-2**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-OCT-19
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-OCT-19
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	08-OCT-19
Benz(a)anthracene		<0.010	0.019	RPD-NA	mg/kg	N/A	50	08-OCT-19
Benzo(a)pyrene		<0.010	0.022	DUP-H	mg/kg	N/A	50	08-OCT-19
Benzo(b&j)fluoranthene		<0.010	0.032	DUP-H	mg/kg	N/A	50	08-OCT-19
Benzo(g,h,i)perylene		<0.010	0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Benzo(k)fluoranthene		<0.010	0.014	RPD-NA	mg/kg	N/A	50	08-OCT-19
Chrysene		<0.010	0.019	RPD-NA	mg/kg	N/A	50	08-OCT-19
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	08-OCT-19
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Indeno(1,2,3-c,d)pyrene		<0.010	0.014	RPD-NA	mg/kg	N/A	50	08-OCT-19
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	08-OCT-19
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	08-OCT-19
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	08-OCT-19
WG3184511-5 IRM		**ALS PAH RM2**						
Acenaphthene			93.1		%		60-130	08-OCT-19
Acenaphthylene			110.3		%		60-130	08-OCT-19
Anthracene			107.2		%		60-130	08-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4860201								
WG3184511-5 IRM		**ALS PAH RM2**						
Benz(a)anthracene			93.2		%		60-130	08-OCT-19
Benzo(a)pyrene			81.1		%		60-130	08-OCT-19
Benzo(b&j)fluoranthene			94.8		%		60-130	08-OCT-19
Benzo(g,h,i)perylene			115.9		%		60-130	08-OCT-19
Benzo(k)fluoranthene			84.9		%		60-130	08-OCT-19
Chrysene			90.3		%		60-130	08-OCT-19
Dibenz(a,h)anthracene			95.2		%		60-130	08-OCT-19
Fluoranthene			87.1		%		60-130	08-OCT-19
Fluorene			86.2		%		60-130	08-OCT-19
Indeno(1,2,3-c,d)pyrene			103.4		%		60-130	08-OCT-19
1-Methylnaphthalene			87.8		%		60-130	08-OCT-19
2-Methylnaphthalene			91.1		%		60-130	08-OCT-19
Naphthalene			92.1		%		50-130	08-OCT-19
Phenanthrene			88.9		%		60-130	08-OCT-19
Pyrene			90.7		%		60-130	08-OCT-19
WG3184511-2 LCS								
Acenaphthene			96.0		%		60-130	08-OCT-19
Acenaphthylene			93.1		%		60-130	08-OCT-19
Anthracene			91.4		%		60-130	08-OCT-19
Benz(a)anthracene			91.9		%		60-130	08-OCT-19
Benzo(a)pyrene			76.7		%		60-130	08-OCT-19
Benzo(b&j)fluoranthene			96.8		%		60-130	08-OCT-19
Benzo(g,h,i)perylene			125.0		%		60-130	08-OCT-19
Benzo(k)fluoranthene			87.0		%		60-130	08-OCT-19
Chrysene			88.4		%		60-130	08-OCT-19
Dibenz(a,h)anthracene			87.3		%		60-130	08-OCT-19
Fluoranthene			89.3		%		60-130	08-OCT-19
Fluorene			89.3		%		60-130	08-OCT-19
Indeno(1,2,3-c,d)pyrene			111.3		%		60-130	08-OCT-19
1-Methylnaphthalene			100.2		%		60-130	08-OCT-19
2-Methylnaphthalene			97.4		%		60-130	08-OCT-19
Naphthalene			92.6		%		50-130	08-OCT-19
Phenanthrene			93.8		%		60-130	08-OCT-19
Pyrene			92.1		%		60-130	08-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4860201								
WG3184511-2 LCS								
Quinoline			83.8		%		60-130	08-OCT-19
WG3184511-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	08-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	08-OCT-19
Anthracene			<0.0040		mg/kg		0.004	08-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	08-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	08-OCT-19
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	08-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	08-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	08-OCT-19
Chrysene			<0.010		mg/kg		0.01	08-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	08-OCT-19
Fluoranthene			<0.010		mg/kg		0.01	08-OCT-19
Fluorene			<0.010		mg/kg		0.01	08-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	08-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	08-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	08-OCT-19
Naphthalene			<0.010		mg/kg		0.01	08-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	08-OCT-19
Pyrene			<0.010		mg/kg		0.01	08-OCT-19
Quinoline			<0.050		mg/kg		0.05	08-OCT-19
Surrogate: Naphthalene d8			96.5		%		50-130	08-OCT-19
Surrogate: Phenanthrene d10			96.5		%		60-130	08-OCT-19
Surrogate: Chrysene d12			70.6		%		60-130	08-OCT-19
Batch R4866601								
WG3188464-5 IRM		**ALS PAH RM2**						
Acenaphthene			109.8		%		60-130	13-OCT-19
Acenaphthylene			101.5		%		60-130	13-OCT-19
Anthracene			128.8		%		60-130	13-OCT-19
Benz(a)anthracene			93.9		%		60-130	13-OCT-19
Benzo(a)pyrene			92.9		%		60-130	13-OCT-19
Benzo(b&j)fluoranthene			96.9		%		60-130	13-OCT-19
Benzo(g,h,i)perylene			102.2		%		60-130	13-OCT-19
Benzo(k)fluoranthene			106.8		%		60-130	13-OCT-19
Chrysene			106.3		%		60-130	13-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3188464-5 IRM		**ALS PAH RM2**						
Dibenz(a,h)anthracene			100.4		%		60-130	13-OCT-19
Fluoranthene			105.9		%		60-130	13-OCT-19
Fluorene			108.2		%		60-130	13-OCT-19
Indeno(1,2,3-c,d)pyrene			100.9		%		60-130	13-OCT-19
1-Methylnaphthalene			104.7		%		60-130	13-OCT-19
2-Methylnaphthalene			105.4		%		60-130	13-OCT-19
Naphthalene			103.7		%		50-130	13-OCT-19
Phenanthrene			112.0		%		60-130	13-OCT-19
Pyrene			107.2		%		60-130	13-OCT-19
WG3188464-2 LCS								
Acenaphthene			107.4		%		60-130	13-OCT-19
Acenaphthylene			109.3		%		60-130	13-OCT-19
Anthracene			114.2		%		60-130	13-OCT-19
Benz(a)anthracene			99.9		%		60-130	13-OCT-19
Benzo(a)pyrene			100.7		%		60-130	13-OCT-19
Benzo(b&j)fluoranthene			106.3		%		60-130	13-OCT-19
Benzo(g,h,i)perylene			107.6		%		60-130	13-OCT-19
Benzo(k)fluoranthene			105.8		%		60-130	13-OCT-19
Chrysene			97.3		%		60-130	13-OCT-19
Dibenz(a,h)anthracene			103.8		%		60-130	13-OCT-19
Fluoranthene			108.2		%		60-130	13-OCT-19
Fluorene			112.0		%		60-130	13-OCT-19
Indeno(1,2,3-c,d)pyrene			109.4		%		60-130	13-OCT-19
1-Methylnaphthalene			104.8		%		60-130	13-OCT-19
2-Methylnaphthalene			109.4		%		60-130	13-OCT-19
Naphthalene			100.7		%		50-130	13-OCT-19
Phenanthrene			116.3		%		60-130	13-OCT-19
Pyrene			110.9		%		60-130	13-OCT-19
Quinoline			95.3		%		60-130	13-OCT-19
WG3188464-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	13-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	13-OCT-19
Anthracene			<0.0040		mg/kg		0.004	13-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	13-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	13-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4866601								
WG3188464-1 MB								
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	13-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	13-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	13-OCT-19
Chrysene			<0.010		mg/kg		0.01	13-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	13-OCT-19
Fluoranthene			<0.010		mg/kg		0.01	13-OCT-19
Fluorene			<0.010		mg/kg		0.01	13-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	13-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	13-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	13-OCT-19
Naphthalene			<0.010		mg/kg		0.01	13-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	13-OCT-19
Pyrene			<0.010		mg/kg		0.01	13-OCT-19
Quinoline			<0.050		mg/kg		0.05	13-OCT-19
Surrogate: Naphthalene d8			88.5		%		50-130	13-OCT-19
Surrogate: Phenanthrene d10			94.4		%		60-130	13-OCT-19
Surrogate: Chrysene d12			92.7		%		60-130	13-OCT-19
PH-1:2-VA	**Soil**							
Batch R4861657								
WG3184510-2 DUP		**L2360531-3**						
pH (1:2 soil:water)		8.29	8.24	J	pH	0.05	0.2	08-OCT-19
PSA-PIPET+GRAVEL-SK	**Soil**							
Batch R4867789								
WG3185627-1 DUP		**L2360531-5**						
% Gravel (>2mm)		9.7	9.7	J	%	0.0	5	11-OCT-19
% Sand (2.0mm - 0.063mm)		32.7	32.4	J	%	0.3	5	11-OCT-19
% Silt (0.063mm - 4um)		41.9	40.9	J	%	1.0	5	11-OCT-19
% Clay (<4um)		15.7	17.0	J	%	1.3	5	11-OCT-19
WG3185627-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.063mm)			44.7		%		39.1-49.1	11-OCT-19
% Silt (0.063mm - 4um)			36.9		%		32.5-42.5	11-OCT-19
% Clay (<4um)			18.4		%		13.4-23.4	11-OCT-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

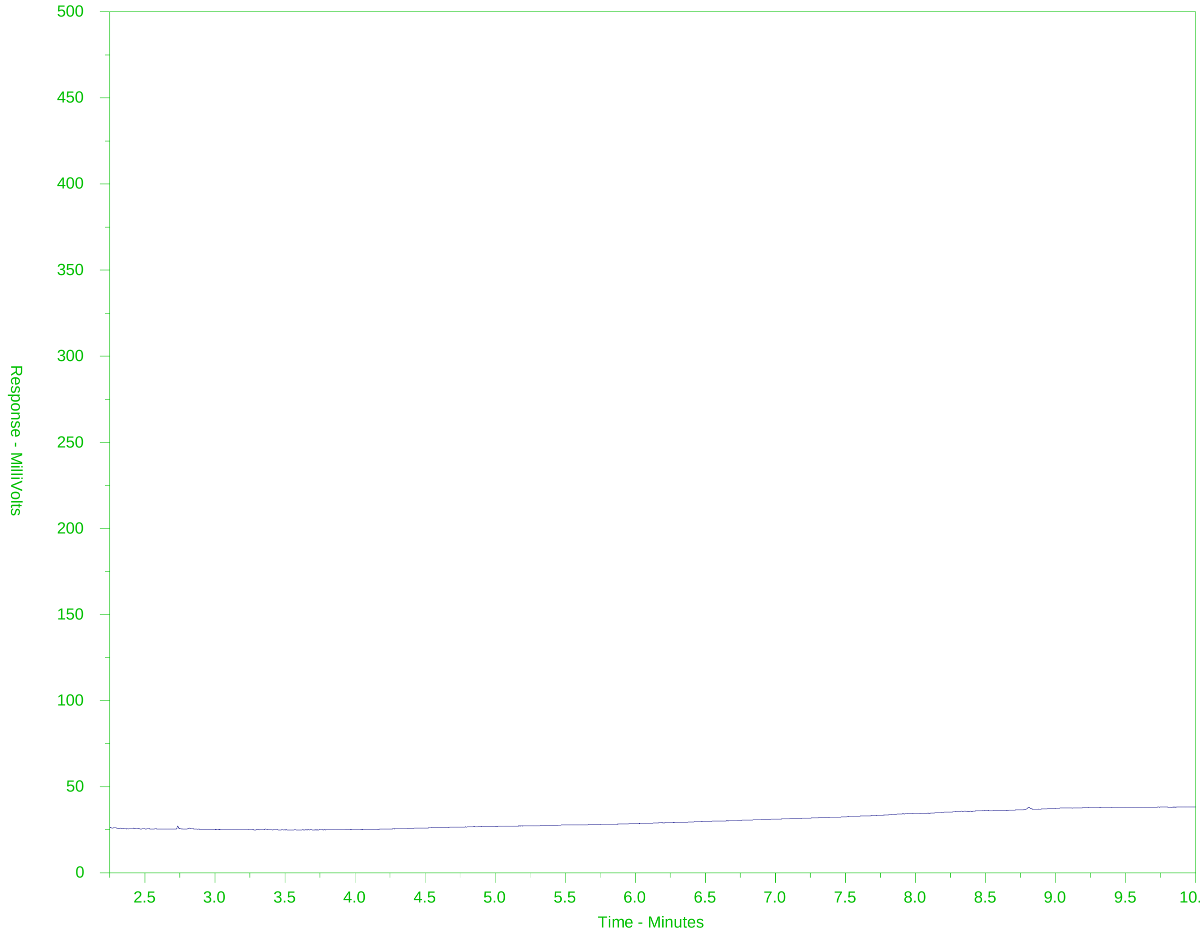
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-1
Client Sample ID: SNW-2



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

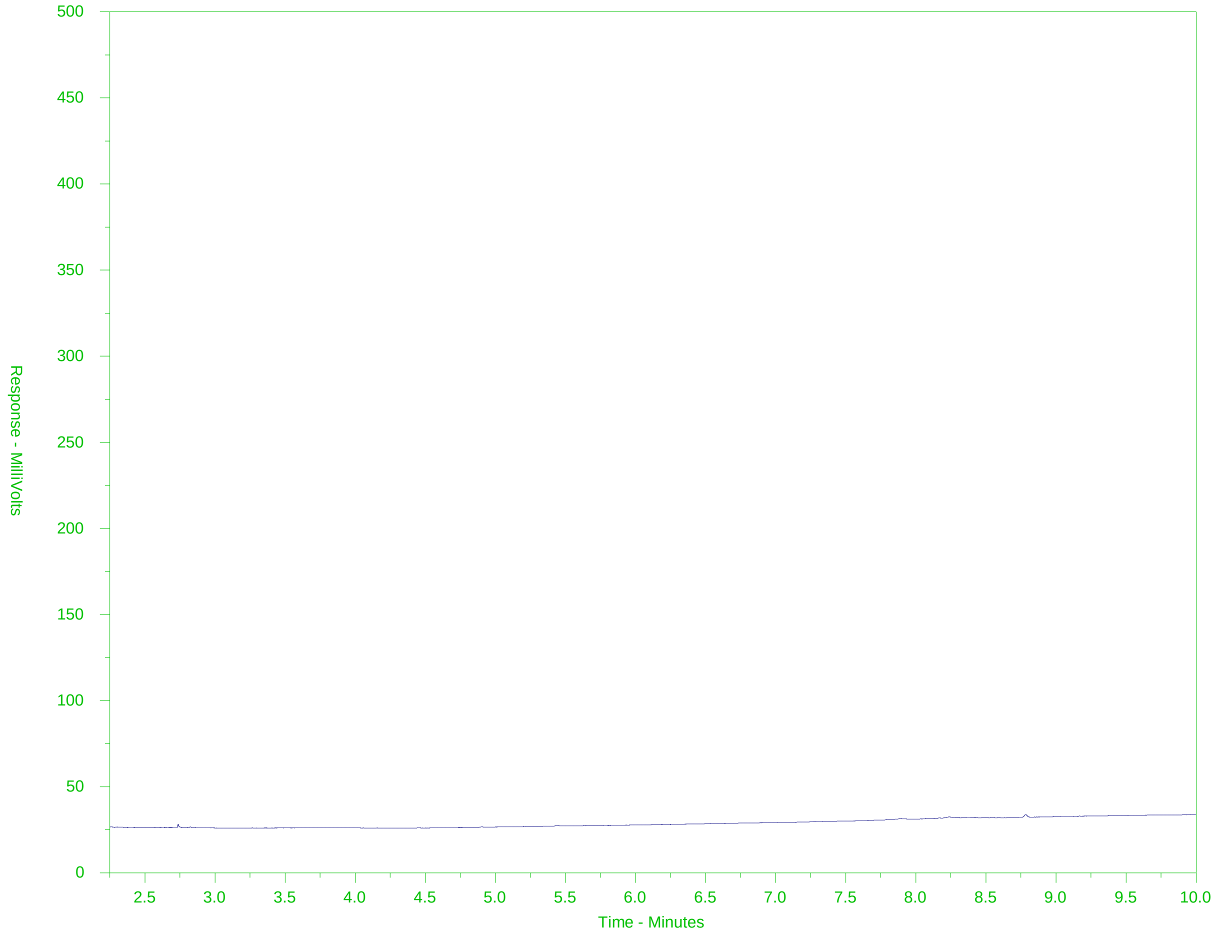
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-2
Client Sample ID: DUP-C



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

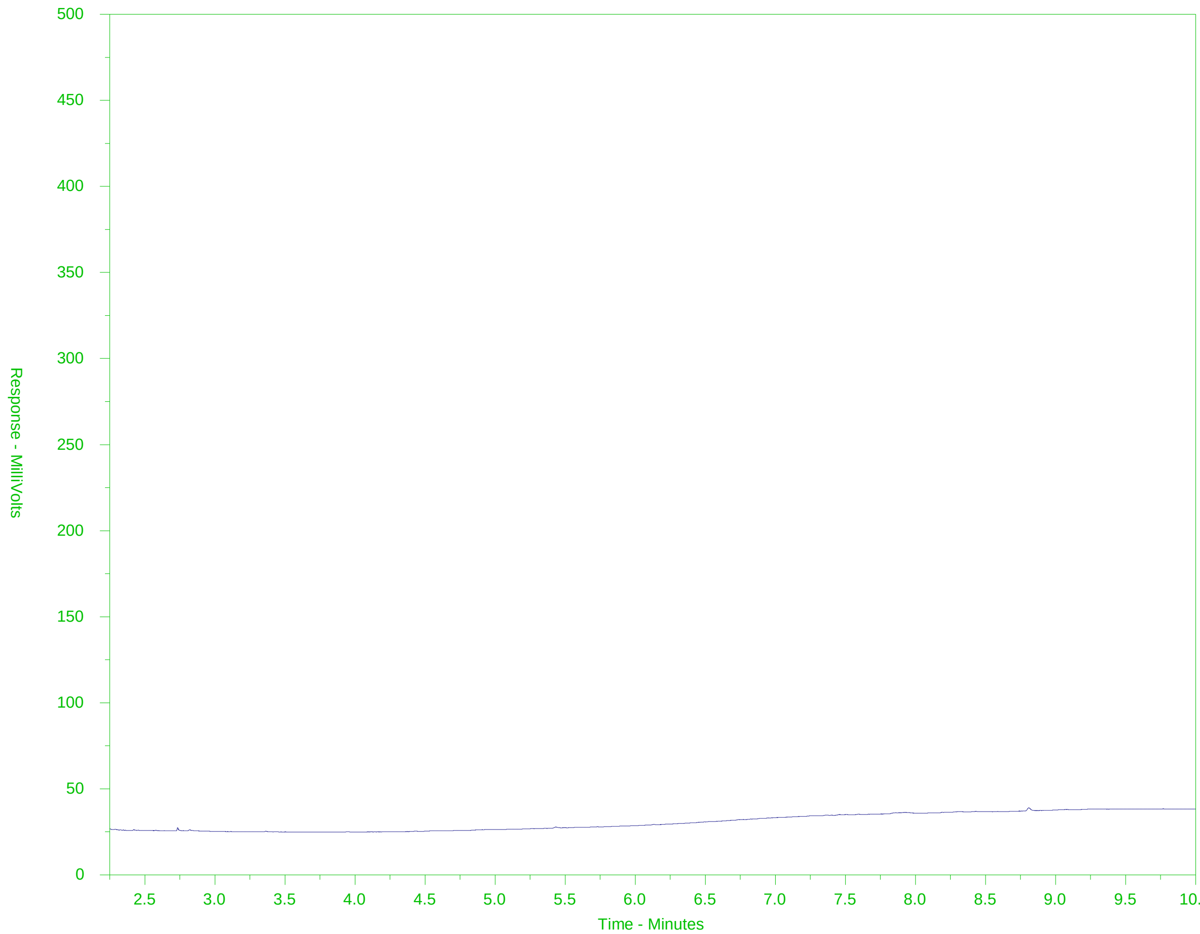
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WG3184511-3#L2360531-2
Client Sample ID: DUP-C



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

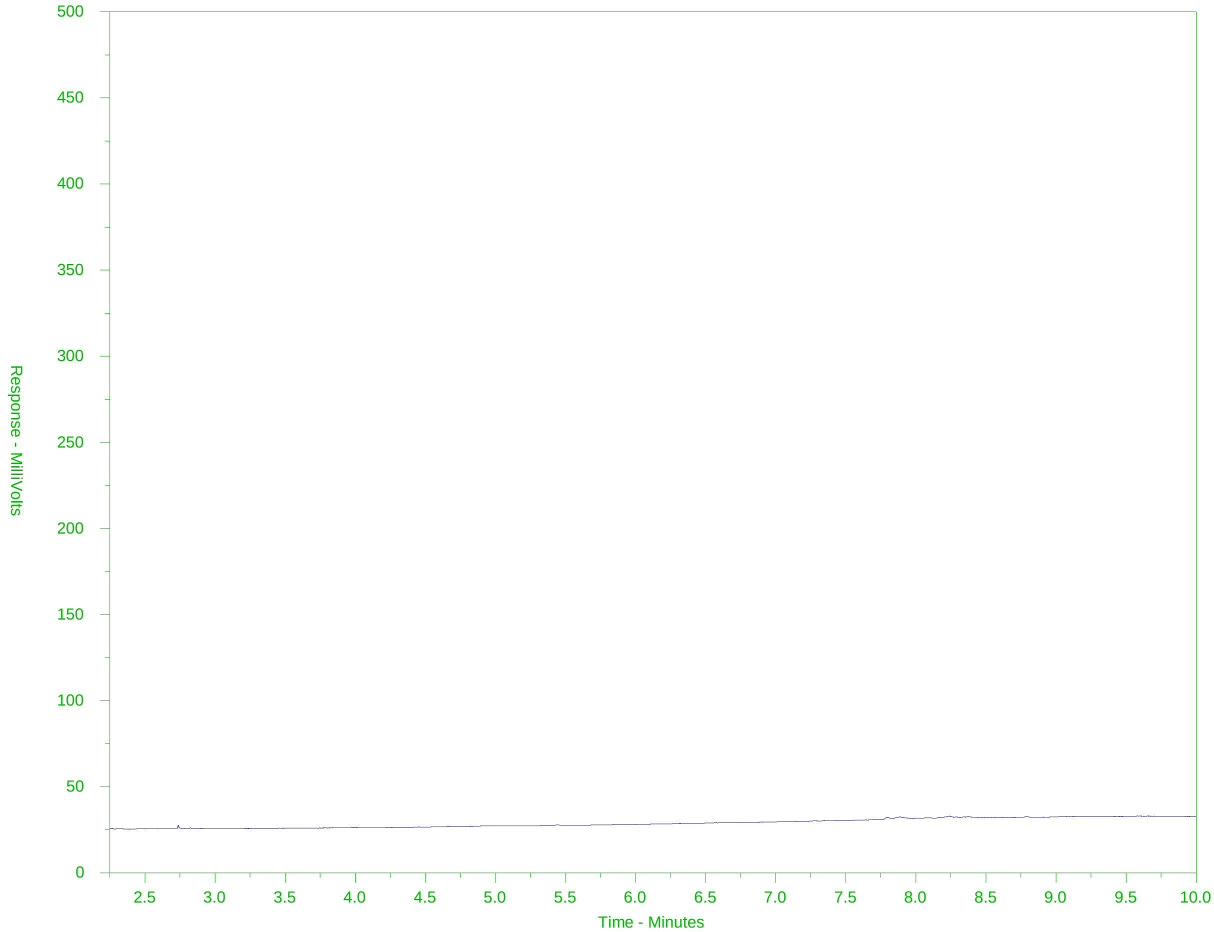
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-3
Client Sample ID: SNW-3



EPH10-19	EPH19-32	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
	Diesel/ Jet Fuels	

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

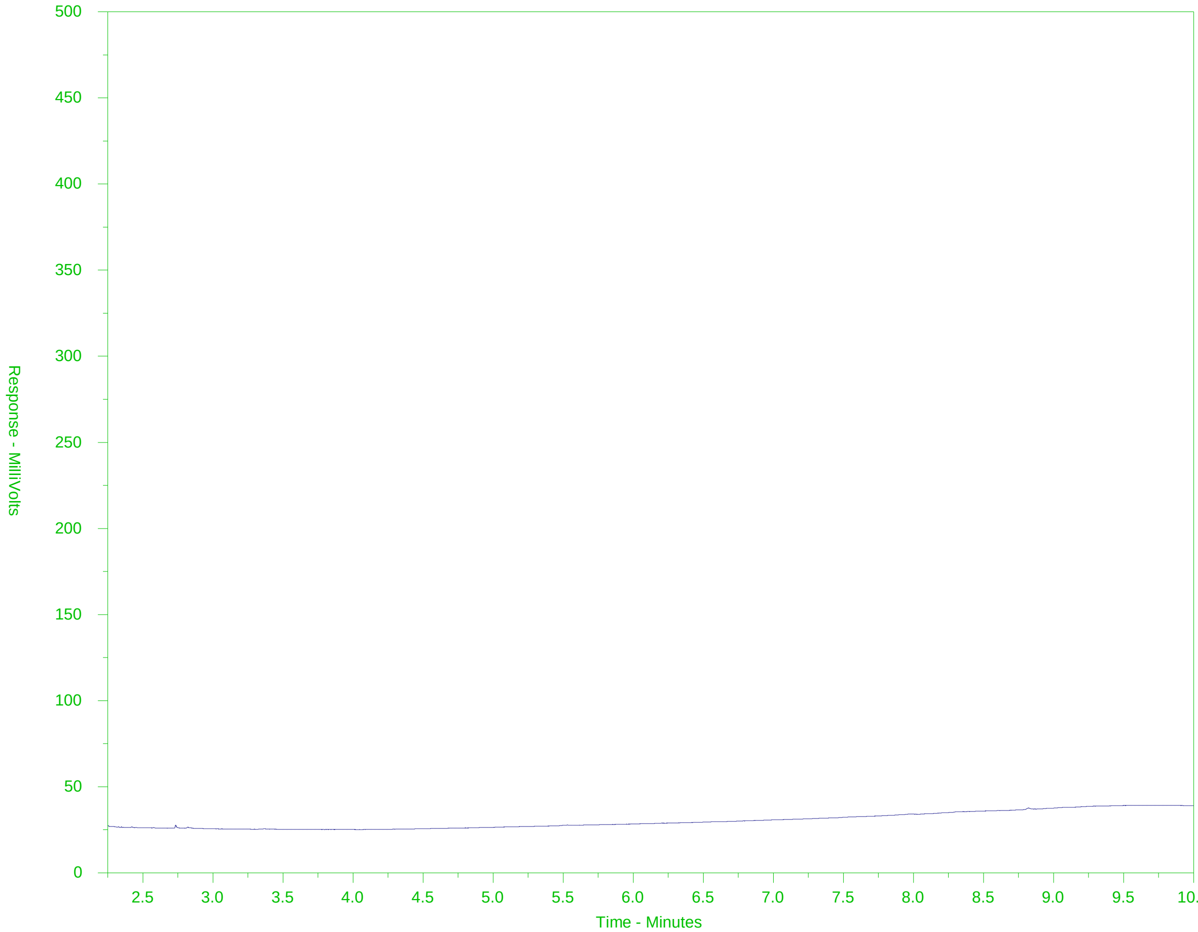
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-4
Client Sample ID: SNW-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

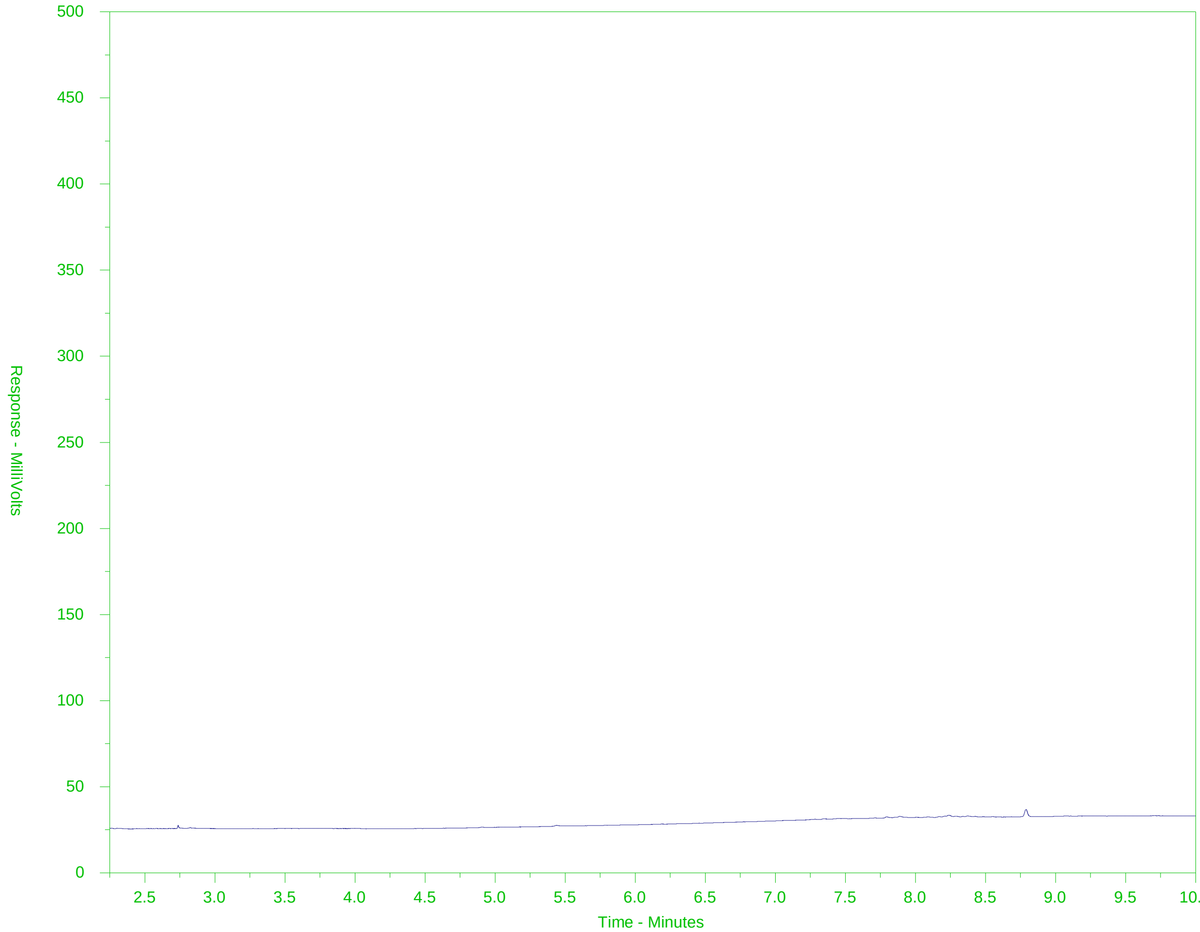
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-5
Client Sample ID: SNW-5



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

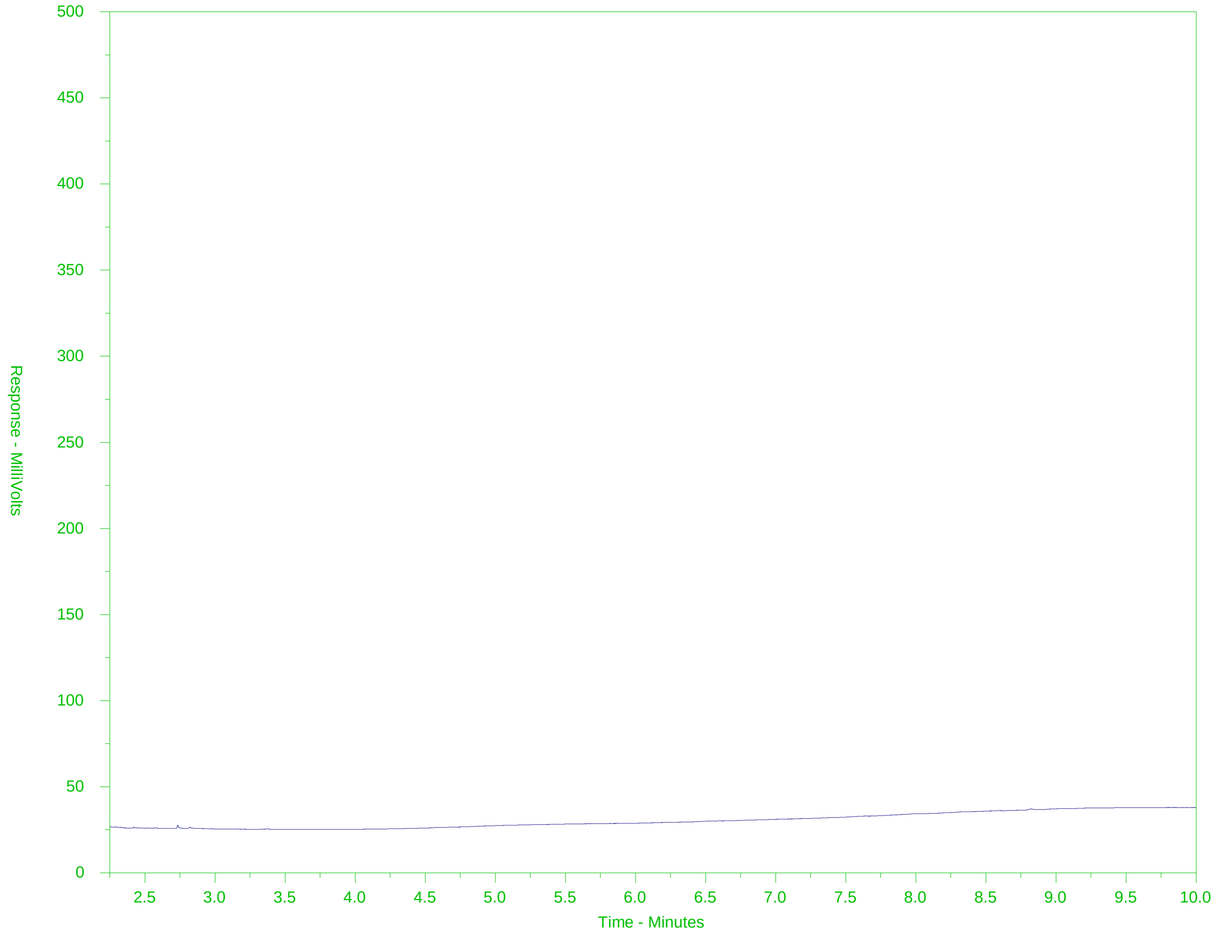
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-6
Client Sample ID: SNE-1



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

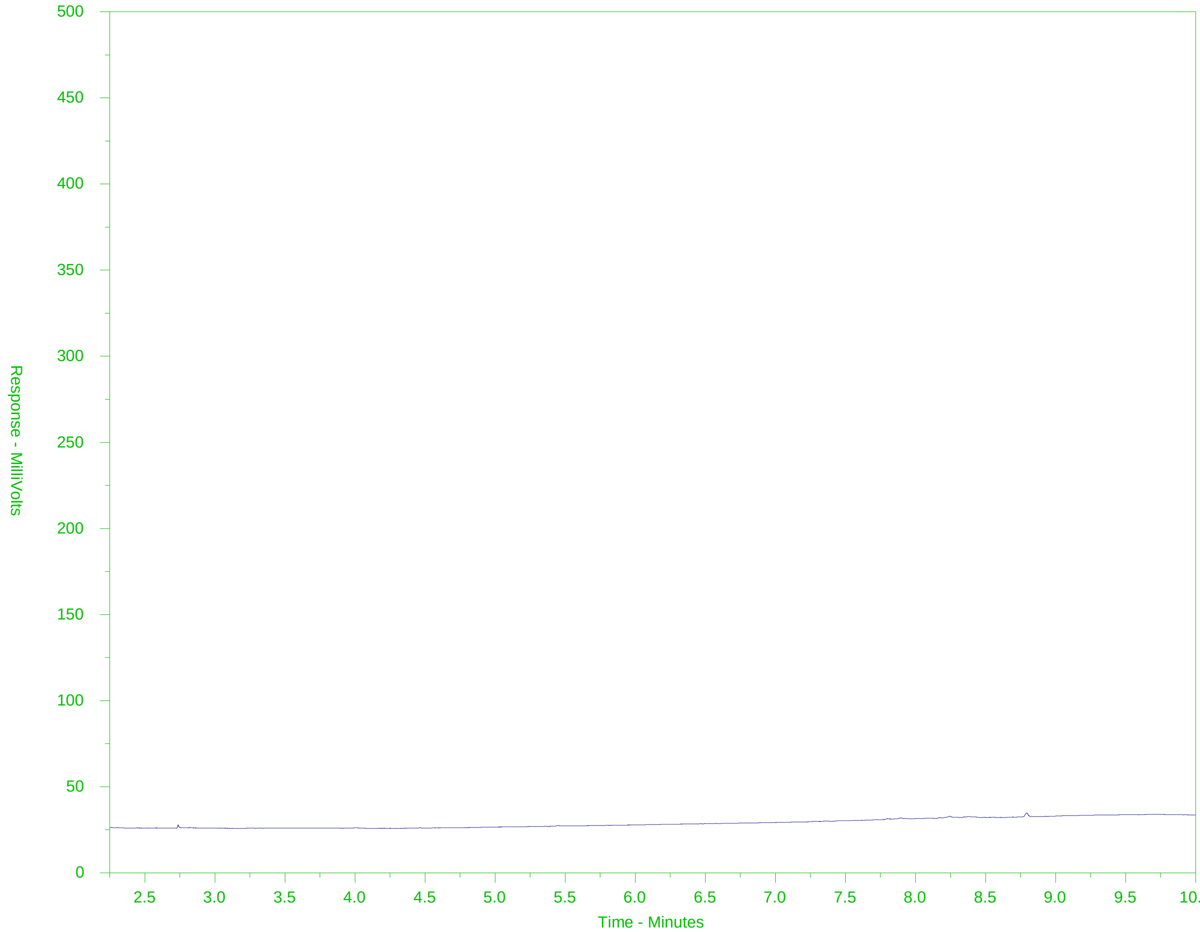
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-7
Client Sample ID: SNE-2



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

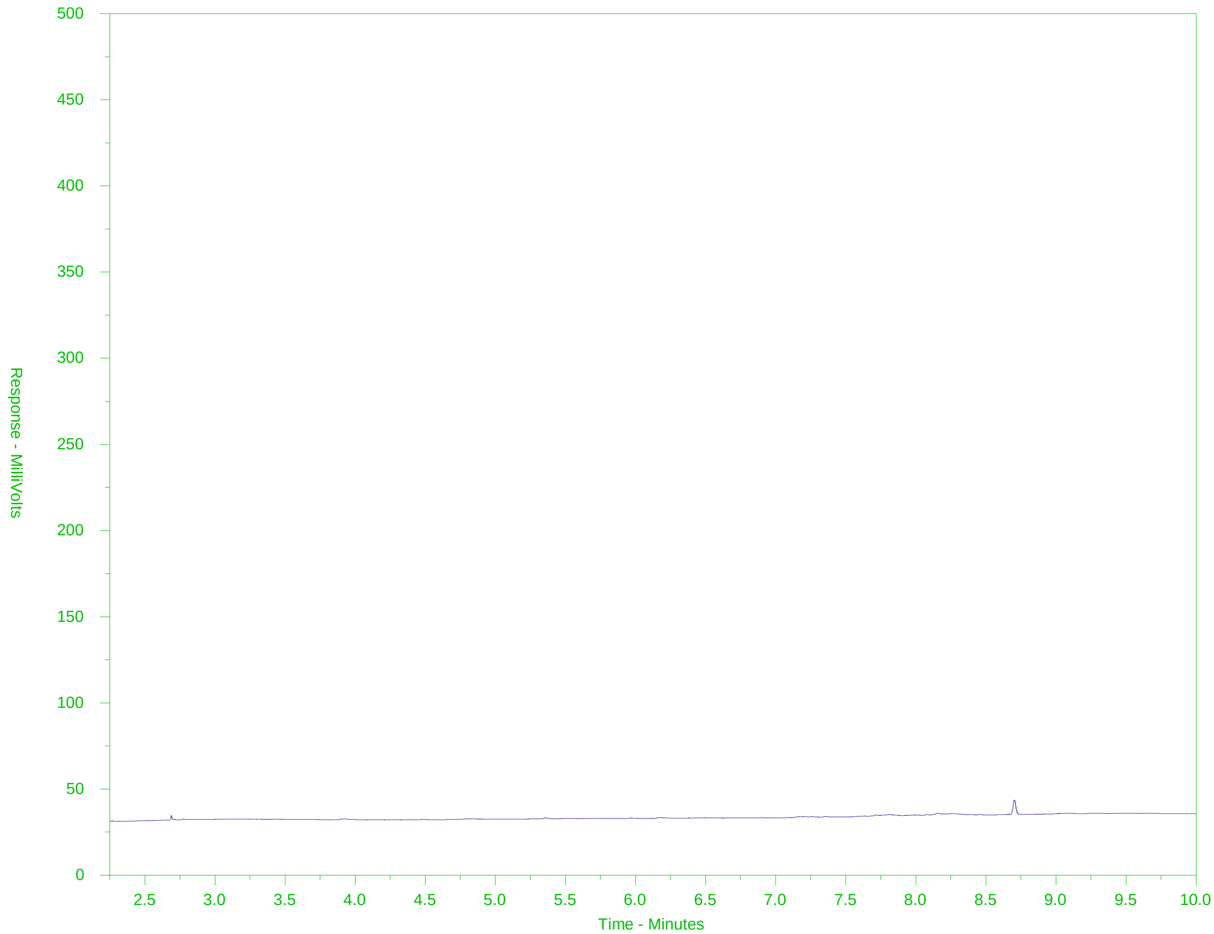
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-8
Client Sample ID: DUP-D



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

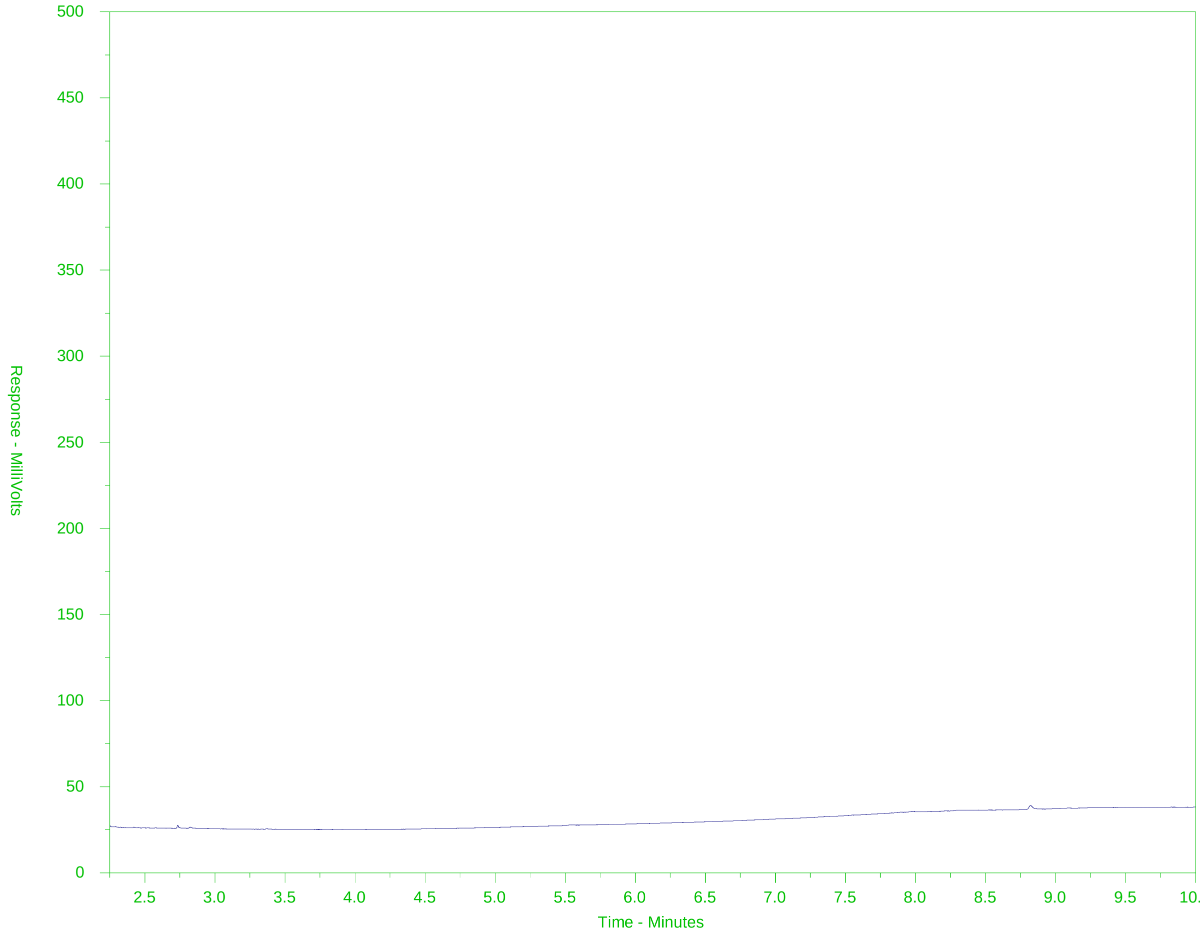
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-9
Client Sample ID: SNW-6



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

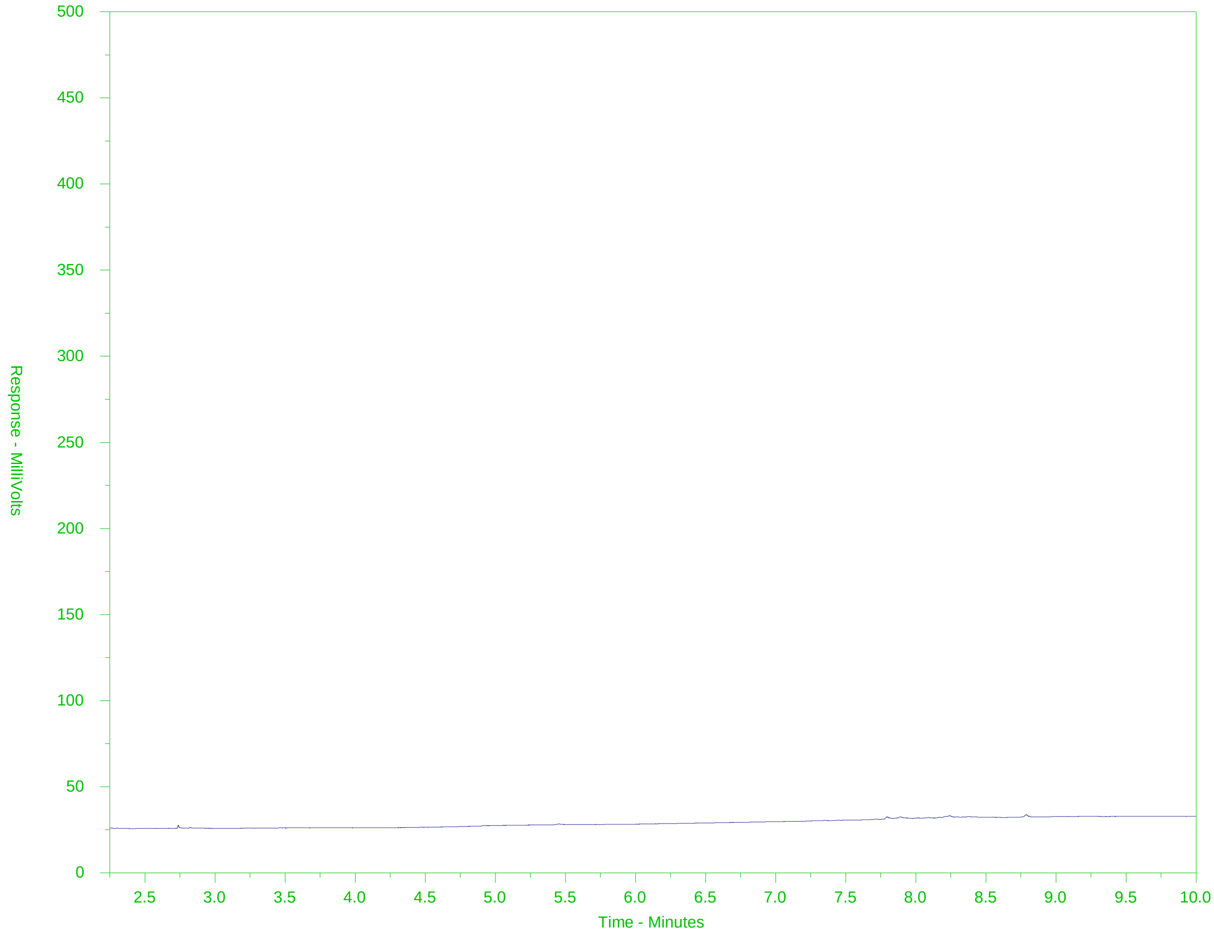
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-10
Client Sample ID: SNW-7



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

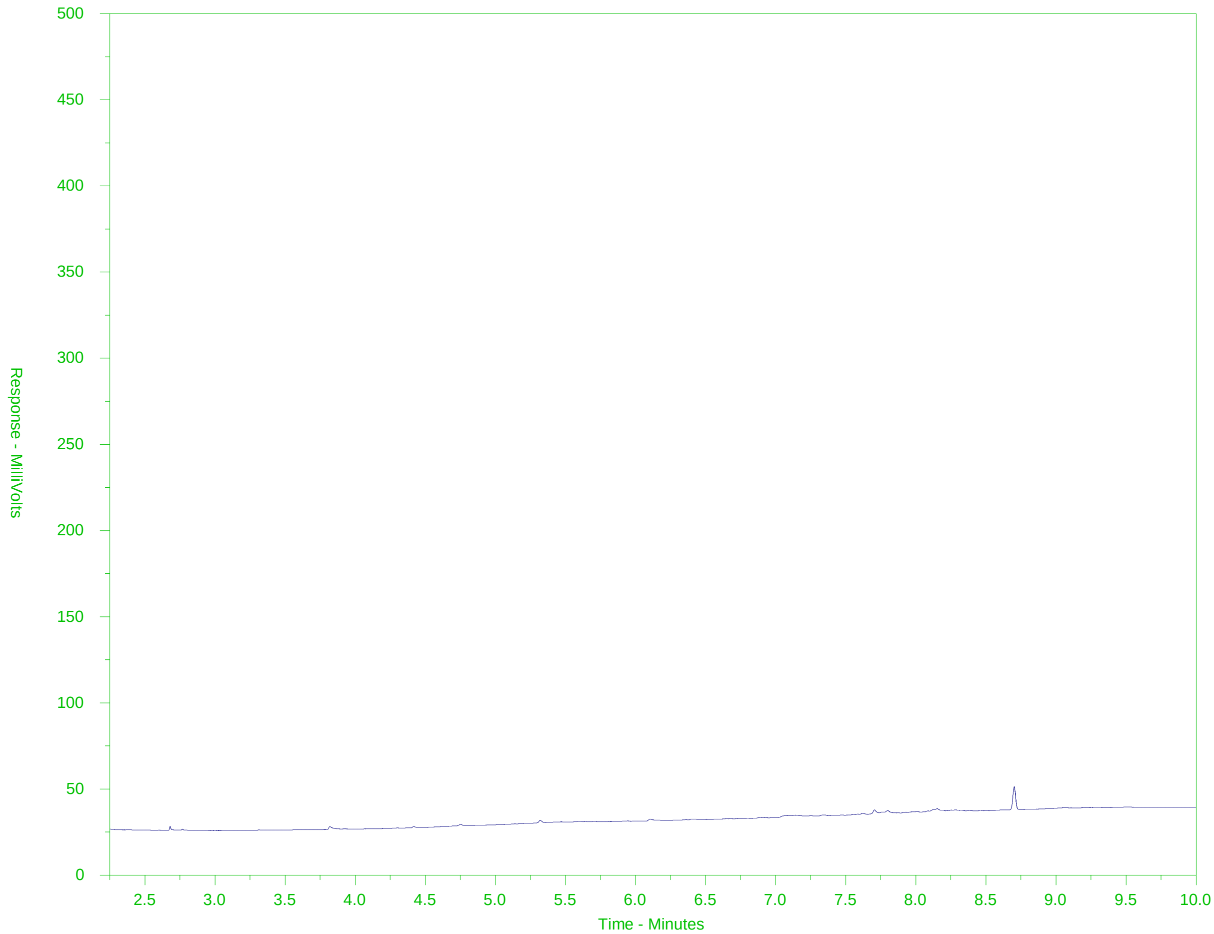
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

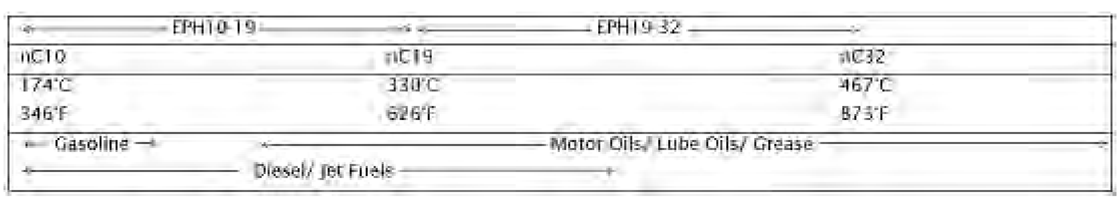
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2360531-11
Client Sample ID: SNW-8





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2360531-COFC

COC Number: 17 - 766305

Page 1 of 1

Report To — Contact and company name below will appear on the final report

Company:	Golder Associates Ltd.
Contact:	PHIL ROUGET
Phone:	250 888 1100
Company address below will appear on the final report	
Street:	2nd Floor 3795 Carey Rd.
City/Province:	Victoria B.C.
Postal Code:	V8Z 6T8

Report Format / Distribution

Select Report Format: [✓] PDF [✓] EXCEL [ ] EDD (DIGITAL)

Quality Control (QC) Report with Report [ ] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [✓] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: PROUGET@GOLDER.COM

Email 2: Patricia_Tomliens@Golder.com

Email 3: cbylenga@golder.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [✓] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E - 100%] [ ]; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To

Same as Report To [✓] YES [ ] NO

Copy of Invoice with Report [ ] YES [✓] NO

Company:

Contact:

Invoice Distribution

Select Invoice Distribution: [✓] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax

Email 2

Project Information

ALS Account # / Quote #:

Job #: 1663724/24000

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: Christine Bylenga, Trish Tomliens

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Moisture and pH	Extractable Metals	TOC and TIC	Hydrocarbons (EPH, LEPH, HEPH)	PAH	Particle Size	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
1	SNW-2	30 SEPT 19	12:20	SEDIMENT	4	X	X	X	X	X	X		
2	DUP-C	30 SEPT 19	12:20	SEDIMENT	4	X	X	X	X	X	X		
3	SNW-3	30 SEPT 19	13:55	SEDIMENT	4	X	X	X	X	X	X		
4	SNW-4	1 OCT 19	09:54	SEDIMENT	4	X	X	X	X	X	X		
5	SNW-5	1 OCT 19	11:45	SEDIMENT	4	X	X	X	X	X	X		
6	SNE-1	1 OCT 19	15:40	SEDIMENT	4	X	X	X	X	X	X		
7	SNE-2	1 OCT 19	16:37	SEDIMENT	4	X	X	X	X	X	X		
8	DUP-D	1 OCT 19	16:37	SEDIMENT	4	X	X	X	X	X	X		
9	SNW-6	2 OCT 19	11:00	SEDIMENT	4	X	X	X	X	X	X		
10	SNW-7	2 OCT 19	12:50	SEDIMENT	4	X	X	X	X	X	X		
11	SNW-8	2 OCT 19	14:40	SEDIMENT	4	X	X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [✓] NO

Are samples for human consumption/ use? [ ] YES [✓] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [✓] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C:

FINAL COOLER TEMPERATURES °C: 7° 4°

SHIPMENT RELEASE (client use)

Released by: Patricia Tomliens Date: 02 Oct 2019 Time: 19:30

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: RD Date: Oct 5 19 Time: 10:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

GOLDER ASSOCIATES LTD.
ATTN: Phil Rouget
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Date Received: 16-OCT-19
Report Date: 24-OCT-19 12:43 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L2365825

Project P.O. #: NOT SUBMITTED
Job Reference: 1663724/24000
C of C Numbers: 15-560006, 17-766304
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-1	L2365825-2	L2365825-3	L2365825-4	L2365825-5
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	03-OCT-19	03-OCT-19	03-OCT-19	03-OCT-19	03-OCT-19
	Sampled Time	10:00	11:30	13:50	15:30	16:01
	Client ID	SNE-3	SNE-4	SNE-5	SNE-6	SNE-7
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	22.5	32.1	34.2	34.1	36.0
	pH (1:2 soil:water) (pH)	8.14	8.11	8.09	8.12	8.11
Particle Size	% Gravel (>2mm) (%)	33.2	9.5	5.4	8.3	1.6
	% Sand (2.0mm - 0.063mm) (%)	34.6	30.8	22.7	23.7	21.1
	% Silt (0.063mm - 4um) (%)	24.8	43.4	49.4	47.8	53.3
	% Clay (<4um) (%)	7.4	16.2	22.5	20.2	24.0
	Texture	Loam / Sandy loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	2.43	2.40	2.90	2.82	2.93
	Inorganic Carbon (as CaCO3 Equivalent) (%)	20.3	20.0	24.2	23.5	24.4
	Total Carbon by Combustion (%)	4.07	4.88	5.27	4.58	5.26
	Total Organic Carbon (%)	1.64	2.48	2.4	1.76	2.3
Metals	Aluminum (Al) (mg/kg)	5400	8960	10900	9620	12000
	Antimony (Sb) (mg/kg)	0.10	0.16	0.21	0.20	0.23
	Arsenic (As) (mg/kg)	6.54	8.46	12.4	11.0	8.23
	Barium (Ba) (mg/kg)	15.8	25.2	29.8	27.1	30.1
	Beryllium (Be) (mg/kg)	0.34	0.58	0.69	0.64	0.73
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	38.6	62.0	74.3	68.7	77.6
	Cadmium (Cd) (mg/kg)	0.056	0.069	0.117	0.095	0.133
	Calcium (Ca) (mg/kg)	75700	87200	90500	90600	92400
	Chromium (Cr) (mg/kg)	16.8	26.3	29.3	28.4	32.7
	Cobalt (Co) (mg/kg)	3.17	4.87	5.32	5.30	5.82
	Copper (Cu) (mg/kg)	6.46	10.3	11.9	11.7	13.2
	Iron (Fe) (mg/kg)	11500	17000	19800	18400	19500
	Lead (Pb) (mg/kg)	5.23	8.34	9.57	9.60	10.3
	Lithium (Li) (mg/kg)	26.8	43.2	49.9	47.2	54.0
	Magnesium (Mg) (mg/kg)	35100	46600	44800	45300	46600
	Manganese (Mn) (mg/kg)	143	194	194	207	196
	Mercury (Hg) (mg/kg)	0.0122	0.0166	0.0197	0.0214	0.0199
	Molybdenum (Mo) (mg/kg)	0.33	0.41	0.50	0.61	0.50
	Nickel (Ni) (mg/kg)	9.66	15.0	16.8	16.7	18.6
	Phosphorus (P) (mg/kg)	477	626	922	679	613
	Potassium (K) (mg/kg)	2190	3590	4370	3770	4510
	Selenium (Se) (mg/kg)	<0.20	0.30	0.31	0.33	0.32
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	3860	5850	6530	6470	6430

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2365825-6	L2365825-7	L2365825-8	L2365825-9	L2365825-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	03-OCT-19	04-OCT-19	04-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	16:30	15:45	16:20	10:40	11:10
	Client ID	SNE-8	SE-9	SE-10	SW-9	SW-10
SOIL						
Physical Tests	Moisture (%)	34.8	25.7	29.6	27.3	25.4
	pH (1:2 soil:water) (pH)	8.09	8.19	8.24	8.28	8.25
Particle Size	% Gravel (>2mm) (%)	2.9	17.7	14.1	3.0	1.0
	% Sand (2.0mm - 0.063mm) (%)	21.1	57.8	59.9	54.4	66.9
	% Silt (0.063mm - 4um) (%)	53.0	19.3	20.1	36.9	28.2
	% Clay (<4um) (%)	22.9	5.2	5.8	5.7	3.9
	Texture	Silt loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	2.56	1.50	1.74	2.12	1.82
	Inorganic Carbon (as CaCO3 Equivalent) (%)	21.3	12.5	14.5	17.6	15.2
	Total Carbon by Combustion (%)	5.22	3.28	3.26	5.02	4.31
	Total Organic Carbon (%)	2.7	1.78	1.52	2.9	2.49
Metals	Aluminum (Al) (mg/kg)	10900	4500	4750	5650	4190
	Antimony (Sb) (mg/kg)	0.20	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	7.39	5.37	4.08	4.25	3.94
	Barium (Ba) (mg/kg)	28.5	11.9	12.6	18.3	12.5
	Beryllium (Be) (mg/kg)	0.69	0.30	0.29	0.38	0.28
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	70.9	32.6	33.3	40.6	31.7
	Cadmium (Cd) (mg/kg)	0.095	0.031	0.029	0.024	<0.020
	Calcium (Ca) (mg/kg)	86900	46500	45500	90900	74100
	Chromium (Cr) (mg/kg)	30.8	13.8	15.1	21.1	16.0
	Cobalt (Co) (mg/kg)	5.52	2.67	2.66	3.57	2.86
	Copper (Cu) (mg/kg)	12.3	5.14	5.66	7.25	5.42
	Iron (Fe) (mg/kg)	18500	10600	9760	14000	12900
	Lead (Pb) (mg/kg)	9.66	4.33	4.63	4.60	3.49
	Lithium (Li) (mg/kg)	52.1	18.7	19.5	32.2	23.0
	Magnesium (Mg) (mg/kg)	44600	22500	22100	45100	37200
	Manganese (Mn) (mg/kg)	191	125	103	153	136
	Mercury (Hg) (mg/kg)	0.0192	0.0097	0.0101	0.0093	0.0068
	Molybdenum (Mo) (mg/kg)	0.46	0.30	0.31	0.36	0.29
	Nickel (Ni) (mg/kg)	17.4	7.84	8.35	11.0	8.21
	Phosphorus (P) (mg/kg)	585	540	452	494	493
	Potassium (K) (mg/kg)	4410	1780	1880	2410	1830
	Selenium (Se) (mg/kg)	0.32	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	6350	3900	4470	4100	4480

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2365825-11	L2365825-12	L2365825-13	L2365825-14	L2365825-15
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	12:00	12:30	13:10	13:55	14:30
	Client ID	SNW-9	SNW-10	SNE-9	SNE-10	SNE-11
SOIL						
Physical Tests	Moisture (%)	31.5	28.2	37.6	36.5	35.8
	pH (1:2 soil:water) (pH)	8.20	7.92	8.06	8.14	8.17
Particle Size	% Gravel (>2mm) (%)	10.6	24.7	4.0	5.6	5.3
	% Sand (2.0mm - 0.063mm) (%)	22.8	29.5	15.8	21.7	26.7
	% Silt (0.063mm - 4um) (%)	45.6	31.2	54.7	49.5	46.3
	% Clay (<4um) (%)	21.0	14.5	25.4	23.2	21.7
	Texture	Silt loam	Loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon	Inorganic Carbon (%)	3.10	3.05	3.15	3.11	3.65
	Inorganic Carbon (as CaCO3 Equivalent) (%)	25.8	25.4	26.3	25.9	30.4
	Total Carbon by Combustion (%)	5.79	4.99	5.35	5.24	5.04
	Total Organic Carbon (%)	2.7	1.9	2.2	2.1	1.4
Metals	Aluminum (Al) (mg/kg)	9530	8890	12100	11200	12100
	Antimony (Sb) (mg/kg)	0.17	0.19	0.25	0.23	0.23
	Arsenic (As) (mg/kg)	5.65	10.1	10.2	8.97	11.0
	Barium (Ba) (mg/kg)	23.9	24.1	33.4	31.6	32.4
	Beryllium (Be) (mg/kg)	0.63	0.55	0.73	0.69	0.71
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	66.2	61.6	77.3	73.8	78.7
	Cadmium (Cd) (mg/kg)	0.127	0.085	0.101	0.095	0.122
	Calcium (Ca) (mg/kg)	103000	88300	90600	89100	89400
	Chromium (Cr) (mg/kg)	27.4	25.5	33.8	31.1	33.3
	Cobalt (Co) (mg/kg)	5.03	4.73	6.15	5.63	6.02
	Copper (Cu) (mg/kg)	11.2	10.3	13.6	12.9	13.5
	Iron (Fe) (mg/kg)	15300	16500	20700	19100	20600
	Lead (Pb) (mg/kg)	8.75	8.05	10.2	10.1	10.4
	Lithium (Li) (mg/kg)	48.7	42.9	52.5	49.5	52.7
	Magnesium (Mg) (mg/kg)	44500	38600	47500	44500	44400
	Manganese (Mn) (mg/kg)	178	193	230	208	220
	Mercury (Hg) (mg/kg)	0.0146	0.0181	0.0221	0.0207	0.0215
	Molybdenum (Mo) (mg/kg)	0.49	0.45	0.54	0.52	0.54
	Nickel (Ni) (mg/kg)	15.8	14.9	19.0	17.7	18.9
	Phosphorus (P) (mg/kg)	470	627	767	603	645
	Potassium (K) (mg/kg)	3780	3520	4640	4400	4730
	Selenium (Se) (mg/kg)	0.27	0.28	0.34	0.33	0.35
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	5430	5960	8240	6500	7680

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-16	L2365825-17	L2365825-18		
	Description	Sediment	Sediment	Sediment		
	Sampled Date	05-OCT-19	06-OCT-19	06-OCT-19		
	Sampled Time	15:00	11:15	11:35		
	Client ID	SE-11	SW-11	SW-12		
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	32.1	22.3	21.8		
	pH (1:2 soil:water) (pH)	8.24	8.74	8.63		
Particle Size	% Gravel (>2mm) (%)	9.7	<1.0	1.9		
	% Sand (2.0mm - 0.063mm) (%)	37.2	81.3	77.0		
	% Silt (0.063mm - 4um) (%)	41.0	15.1	18.2		
	% Clay (<4um) (%)	12.1	2.8	2.9		
	Texture	Loam	Loamy sand	Loamy sand		
Organic / Inorganic Carbon	Inorganic Carbon (%)	2.40	1.81	1.88		
	Inorganic Carbon (as CaCO3 Equivalent) (%)	20.0	15.1	15.6		
	Total Carbon by Combustion (%)	4.63	3.26	3.30		
	Total Organic Carbon (%)	2.23	1.45	1.42		
Metals	Aluminum (Al) (mg/kg)	7440	2900	3110		
	Antimony (Sb) (mg/kg)	0.14	<0.10	<0.10		
	Arsenic (As) (mg/kg)	5.13	1.51	1.54		
	Barium (Ba) (mg/kg)	19.2	8.97	10.2		
	Beryllium (Be) (mg/kg)	0.45	0.19	0.21		
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20		
	Boron (B) (mg/kg)	52.9	22.2	24.1		
	Cadmium (Cd) (mg/kg)	0.064	<0.020	<0.020		
	Calcium (Ca) (mg/kg)	67400	56000	68100		
	Chromium (Cr) (mg/kg)	22.8	10.9	12.7		
	Cobalt (Co) (mg/kg)	3.61	2.04	2.18		
	Copper (Cu) (mg/kg)	8.04	3.83	4.21		
	Iron (Fe) (mg/kg)	12800	9860	9960		
	Lead (Pb) (mg/kg)	6.86	2.50	2.75		
	Lithium (Li) (mg/kg)	31.4	16.2	19.2		
	Magnesium (Mg) (mg/kg)	36000	26500	33800		
	Manganese (Mn) (mg/kg)	134	92.7	108		
	Mercury (Hg) (mg/kg)	0.0152	<0.0050	<0.0050		
	Molybdenum (Mo) (mg/kg)	0.49	0.28	0.28		
	Nickel (Ni) (mg/kg)	12.4	5.80	6.46		
	Phosphorus (P) (mg/kg)	535	254	277		
	Potassium (K) (mg/kg)	3040	1330	1340		
	Selenium (Se) (mg/kg)	0.30	<0.20	<0.20		
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10		
	Sodium (Na) (mg/kg)	6060	3400	2020		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L2365825-1 Sediment 03-OCT-19 10:00 SNE-3	L2365825-2 Sediment 03-OCT-19 11:30 SNE-4	L2365825-3 Sediment 03-OCT-19 13:50 SNE-5	L2365825-4 Sediment 03-OCT-19 15:30 SNE-6	L2365825-5 Sediment 03-OCT-19 16:01 SNE-7
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	47.1	59.0	73.8	64.1	61.3
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.089	0.143	0.170	0.160	0.185
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	219	338	358	334	391
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.731	1.07	1.32	1.25	1.54
	Vanadium (V) (mg/kg)	22.3	37.1	42.8	39.9	45.2
	Zinc (Zn) (mg/kg)	15.5	25.8	29.1	28.4	33.1
	Zirconium (Zr) (mg/kg)	4.7	8.5	9.1	8.4	11.0
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-6	L2365825-7	L2365825-8	L2365825-9	L2365825-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	03-OCT-19	04-OCT-19	04-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	16:30	15:45	16:20	10:40	11:10
	Client ID	SNE-8	SE-9	SE-10	SW-9	SW-10
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	58.8	35.4	34.6	46.6	40.7
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.163	0.076	0.080	0.096	0.075
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	366	241	240	320	240
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.39	0.717	0.759	0.824	0.630
	Vanadium (V) (mg/kg)	41.7	17.9	17.8	21.4	14.9
	Zinc (Zn) (mg/kg)	30.5	13.9	14.8	15.7	11.4
	Zirconium (Zr) (mg/kg)	10.3	4.7	5.1	6.6	5.6
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	0.0063	<0.0050	<0.0050
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-11	L2365825-12	L2365825-13	L2365825-14	L2365825-15
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	12:00	12:30	13:10	13:55	14:30
	Client ID	SNW-9	SNW-10	SNE-9	SNE-10	SNE-11
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	69.2	61.3	67.8	63.5	65.2
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.154	0.142	0.174	0.178	0.179
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	316	333	392	360	376
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.45	1.08	1.32	1.31	1.39
	Vanadium (V) (mg/kg)	34.9	38.6	47.1	43.7	47.3
	Zinc (Zn) (mg/kg)	26.6	25.9	33.7	31.1	33.6
	Zirconium (Zr) (mg/kg)	10.5	7.6	10.6	9.9	10.5
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
	Benzene (mg/kg)	<0.0050	<0.0050	<0.0050	0.0059	0.0057
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Bromoform (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloroform (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Styrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2365825-16 Sediment 05-OCT-19 15:00 SE-11	L2365825-17 Sediment 06-OCT-19 11:15 SW-11	L2365825-18 Sediment 06-OCT-19 11:35 SW-12		
Grouping	**Analyte**					
SOIL						
Metals	Strontium (Sr) (mg/kg)	53.7	28.6	32.9		
	Sulfur (S) (mg/kg)	<1000	<1000	<1000		
	Thallium (Tl) (mg/kg)	0.117	0.052	0.056		
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
	Titanium (Ti) (mg/kg)	301	181	192		
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50		
	Uranium (U) (mg/kg)	1.09	0.475	0.534		
	Vanadium (V) (mg/kg)	28.3	10.8	12.1		
	Zinc (Zn) (mg/kg)	20.4	8.5	9.0		
	Zirconium (Zr) (mg/kg)	6.0	4.3	4.9		
Volatile Organic Compounds	VOC Sample Container	Field MeOH	Field MeOH	Field MeOH		
	Benzene (mg/kg)	0.0079	<0.0050	<0.0050		
	Bromodichloromethane (mg/kg)	<0.050	<0.050	<0.050		
	Bromoform (mg/kg)	<0.050	<0.050	<0.050		
	Carbon Tetrachloride (mg/kg)	<0.050	<0.050	<0.050		
	Chlorobenzene (mg/kg)	<0.050	<0.050	<0.050		
	Dibromochloromethane (mg/kg)	<0.050	<0.050	<0.050		
	Chloroethane (mg/kg)	<0.10	<0.10	<0.10		
	Chloroform (mg/kg)	<0.10	<0.10	<0.10		
	Chloromethane (mg/kg)	<0.10	<0.10	<0.10		
	1,2-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050		
	1,3-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050		
	1,4-Dichlorobenzene (mg/kg)	<0.050	<0.050	<0.050		
	1,1-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050		
	1,2-Dichloroethane (mg/kg)	<0.050	<0.050	<0.050		
	1,1-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050		
	cis-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050		
	trans-1,2-Dichloroethylene (mg/kg)	<0.050	<0.050	<0.050		
	Dichloromethane (mg/kg)	<0.30	<0.30	<0.30		
	1,2-Dichloropropane (mg/kg)	<0.050	<0.050	<0.050		
	cis-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050		
	trans-1,3-Dichloropropylene (mg/kg)	<0.050	<0.050	<0.050		
	1,3-Dichloropropene (cis & trans) (mg/kg)	<0.10	<0.10	<0.10		
	Ethylbenzene (mg/kg)	<0.015	<0.015	<0.015		
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20	<0.20	<0.20		
	Styrene (mg/kg)	<0.050	<0.050	<0.050		
	1,1,1,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2365825-1 Sediment 03-OCT-19 10:00 SNE-3	L2365825-2 Sediment 03-OCT-19 11:30 SNE-4	L2365825-3 Sediment 03-OCT-19 13:50 SNE-5	L2365825-4 Sediment 03-OCT-19 15:30 SNE-6	L2365825-5 Sediment 03-OCT-19 16:01 SNE-7
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	77.6	89.5	74.3	83.8	79.7
	Surrogate: 1,4-Difluorobenzene (SS) (%)	70.4	102.7	84.0	94.9	77.5
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	83.5	93.4	90.3	83.8	86.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0088
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-6	L2365825-7	L2365825-8	L2365825-9	L2365825-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	03-OCT-19	04-OCT-19	04-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	16:30	15:45	16:20	10:40	11:10
	Client ID	SNE-8	SE-9	SE-10	SW-9	SW-10
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	83.3	80.2	89.1	76.6	78.7
	Surrogate: 1,4-Difluorobenzene (SS) (%)	72.5	93.1	102.6	82.9	88.4
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	90.6	90.1	90.5	87.5	90.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	0.0076	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2365825-11	L2365825-12	L2365825-13	L2365825-14	L2365825-15
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	12:00	12:30	13:10	13:55	14:30
	Client ID	SNW-9	SNW-10	SNE-9	SNE-10	SNE-11
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Toluene (mg/kg)	<0.050	<0.050	<0.050	0.078	0.090
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Xylenes (mg/kg)	<0.075	<0.075	<0.075	<0.075	<0.075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	79.8	84.4	82.2	73.3	79.8
	Surrogate: 1,4-Difluorobenzene (SS) (%)	55.7 SURR-ND	82.3	94.7	78.5	74.8
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200	<200	<200
	EPH19-32 (mg/kg)	<200	<200	<200	<200	<200
	LEPH (mg/kg)	<200	<200	<200	<200	<200
	HEPH (mg/kg)	<200	<200	<200	<200	<200
	F1 (C6-C10) (mg/kg)	<10	<10	<10	<10	<10
	Surrogate: 2-Bromobenzotrifluoride (%)	89.6	86.8	90.1	93.9	87.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.015	<0.015
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2365825-16 Sediment 05-OCT-19 15:00 SE-11	L2365825-17 Sediment 06-OCT-19 11:15 SW-11	L2365825-18 Sediment 06-OCT-19 11:35 SW-12		
Grouping	**Analyte**					
SOIL						
Volatile Organic Compounds	1,1,2,2-Tetrachloroethane (mg/kg)	<0.050	<0.050	<0.050		
	Tetrachloroethylene (mg/kg)	<0.050	<0.050	<0.050		
	Toluene (mg/kg)	0.091	<0.050	<0.050		
	1,1,1-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050		
	1,1,2-Trichloroethane (mg/kg)	<0.050	<0.050	<0.050		
	Trichloroethylene (mg/kg)	<0.010	<0.010	<0.010		
	Trichlorofluoromethane (mg/kg)	<0.10	<0.10	<0.10		
	Vinyl Chloride (mg/kg)	<0.10	<0.10	<0.10		
	ortho-Xylene (mg/kg)	<0.050	<0.050	<0.050		
	meta- & para-Xylene (mg/kg)	<0.050	<0.050	<0.050		
	Xylenes (mg/kg)	<0.075	<0.075	<0.075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)	77.3	71.9	76.0		
	Surrogate: 1,4-Difluorobenzene (SS) (%)	78.8	82.2	82.8		
Hydrocarbons	EPH10-19 (mg/kg)	<200	<200	<200		
	EPH19-32 (mg/kg)	<200	<200	<200		
	LEPH (mg/kg)	<200	<200	<200		
	HEPH (mg/kg)	<200	<200	<200		
	F1 (C6-C10) (mg/kg)	<10	<10	<10		
	Surrogate: 2-Bromobenzotrifluoride (%)	87.4	89.6	93.4		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040		
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015		
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Chrysene (mg/kg)	<0.010	<0.010	<0.010		
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Fluorene (mg/kg)	<0.010	<0.010	<0.010		
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010		
	1-Methylnaphthalene (mg/kg)	<0.050	<0.050	<0.050		
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L2365825-1 Sediment 03-OCT-19 10:00 SNE-3	L2365825-2 Sediment 03-OCT-19 11:30 SNE-4	L2365825-3 Sediment 03-OCT-19 13:50 SNE-5	L2365825-4 Sediment 03-OCT-19 15:30 SNE-6	L2365825-5 Sediment 03-OCT-19 16:01 SNE-7
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	95.3	104.4	97.7	92.8	95.9
	Surrogate: Naphthalene d8 (%)	96.3	107.2	103.4	95.5	97.9
	Surrogate: Phenanthrene d10 (%)	96.2	107.3	101.7	94.7	98.1
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-6	L2365825-7	L2365825-8	L2365825-9	L2365825-10
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	03-OCT-19	04-OCT-19	04-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	16:30	15:45	16:20	10:40	11:10
	Client ID	SNE-8	SE-9	SE-10	SW-9	SW-10
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	106.0	96.8	98.3	93.9	107.8
	Surrogate: Naphthalene d8 (%)	108.9	99.2	100.5	97.7	108.9
	Surrogate: Phenanthrene d10 (%)	108.5	98.1	99.4	96.2	109.1
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-11	L2365825-12	L2365825-13	L2365825-14	L2365825-15
	Description	Sediment	Sediment	Sediment	Sediment	Sediment
	Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
	Sampled Time	12:00	12:30	13:10	13:55	14:30
	Client ID	SNW-9	SNW-10	SNE-9	SNE-10	SNE-11
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Chrysene d12 (%)	96.5	96.5	95.3	100.0	99.9
	Surrogate: Naphthalene d8 (%)	102.2	101.9	100.2	104.8	105.5
	Surrogate: Phenanthrene d10 (%)	99.7	99.3	98.3	102.8	103.8
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2365825-16	L2365825-17	L2365825-18		
	Description	Sediment	Sediment	Sediment		
	Sampled Date	05-OCT-19	06-OCT-19	06-OCT-19		
	Sampled Time	15:00	11:15	11:35		
	Client ID	SE-11	SW-11	SW-12		
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Naphthalene (mg/kg)	<0.010	<0.010	<0.010		
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010		
	Pyrene (mg/kg)	<0.010	<0.010	<0.010		
	Quinoline (mg/kg)	<0.050	<0.050	<0.050		
	Surrogate: Chrysene d12 (%)	90.3	95.2	99.2		
	Surrogate: Naphthalene d8 (%)	93.9	104.8	103.4		
	Surrogate: Phenanthrene d10 (%)	92.7	103.3	102.3		
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020		
	IACR (CCME)	<0.15	<0.15	<0.15		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-HSFID-VA	Soil	CCME F1 by headspace GCMS	CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LEPH/HEPH-CALC-VA	Soil	LEPHs and HEPHs	BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

MOISTURE-VA	Soil	Moisture content	CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Reference Information

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

VOC-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-L-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Soil	VOC7 and/or VOC Surrogates for Soils	EPA 5035A/5021A/8260C
XYLENES-CALC-VA	Soil	Sum of Xylene Isomer Concentrations	EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-560006 17-766304

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road, Second Floor
Victoria BC V8Z 6T8

Contact: Phil Rouget

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4881786								
WG3195420-1 DUP		**L2365825-10**						
Inorganic Carbon		1.82	1.98		%	8.0	20	24-OCT-19
WG3195420-4 IRM		**08-109_SOIL**						
Inorganic Carbon			97.3		%		80-120	24-OCT-19
WG3195420-2 LCS		**0.5**						
Inorganic Carbon			105.0		%		80-120	24-OCT-19
WG3195420-3 MB								
Inorganic Carbon			<0.050		%		0.05	24-OCT-19
C-TOT-LECO-SK	**Soil**							
Batch R4879974								
WG3195388-1 DUP		**L2365825-10**						
Total Carbon by Combustion		4.31	4.64		%	7.6	20	22-OCT-19
WG3195388-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			99.7		%		80-120	22-OCT-19
WG3195388-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			102.4		%		90-110	22-OCT-19
WG3195388-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	22-OCT-19
EPH-TUMB-FID-VA	**Soil**							
Batch R4874381								
WG3193535-3 DUP		**L2365825-7**						
EPH10-19		<200	<200	RPD-NA	mg/kg	N/A	40	21-OCT-19
EPH19-32		<200	<200	RPD-NA	mg/kg	N/A	40	21-OCT-19
WG3193535-4 IRM		**ALS PHC RM3**						
EPH10-19			99.5		%		70-130	18-OCT-19
EPH19-32			95.5		%		70-130	18-OCT-19
WG3193535-2 LCS								
EPH10-19			99.8		%		70-130	18-OCT-19
EPH19-32			102.9		%		70-130	18-OCT-19
WG3193535-1 MB								
EPH10-19			<200		mg/kg		200	18-OCT-19
EPH19-32			<200		mg/kg		200	18-OCT-19
Surrogate: 2-Bromobenzotrifluoride			81.5		%		60-140	18-OCT-19
F1-HSFID-VA	**Soil**							

ALS Environmental

Quality Control Report

Workorder: L2365825   Report Date: 24-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-HSFID-VA	**Soil**							
Batch R4855049								
WG3196812-3 DUP		**L2365825-13**						
F1 (C6-C10)		<10	<10	RPD-NA	mg/kg	N/A	40	23-OCT-19
WG3196812-2 LCS								
F1 (C6-C10)			107.1		%		70-130	23-OCT-19
WG3196812-1 MB								
F1 (C6-C10)			<10		mg/kg		10	23-OCT-19
Batch R4881406								
WG3197608-2 LCS								
F1 (C6-C10)			104.0		%		70-130	24-OCT-19
WG3197608-1 MB								
F1 (C6-C10)			<10		mg/kg		10	24-OCT-19
HG-200.2-CVAF-VA	**Soil**							
Batch R4873683								
WG3193550-4 CRM		**VA-CANMET-TILL2**						
Mercury (Hg)			111.1		%		70-130	18-OCT-19
WG3193550-2 DUP		**L2365825-3**						
Mercury (Hg)		0.0197	0.0196		mg/kg	0.1	40	18-OCT-19
WG3193550-3 LCS								
Mercury (Hg)			110.5		%		80-120	18-OCT-19
WG3193550-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	18-OCT-19
MET-200.2-CCMS-VA	**Soil**							
Batch R4875008								
WG3193550-4 CRM		**VA-CANMET-TILL2**						
Aluminum (Al)			108.0		%		70-130	18-OCT-19
Antimony (Sb)			112.7		%		70-130	18-OCT-19
Arsenic (As)			115.7		%		70-130	18-OCT-19
Barium (Ba)			105.1		%		70-130	18-OCT-19
Beryllium (Be)			114.7		%		70-130	18-OCT-19
Bismuth (Bi)			115.9		%		70-130	18-OCT-19
Cadmium (Cd)			109.4		%		70-130	18-OCT-19
Calcium (Ca)			117.8		%		70-130	18-OCT-19
Copper (Cu)			107.3		%		70-130	18-OCT-19
Iron (Fe)			112.0		%		70-130	18-OCT-19
Lead (Pb)			108.2		%		70-130	18-OCT-19
Lithium (Li)			123.4		%		70-130	18-OCT-19
Magnesium (Mg)			105.3		%		70-130	18-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4875008								
WG3193550-4 CRM		**VA-CANMET-TILL2**						
Manganese (Mn)			100.5		%		70-130	18-OCT-19
Molybdenum (Mo)			113.8		%		70-130	18-OCT-19
Nickel (Ni)			115.5		%		70-130	18-OCT-19
Phosphorus (P)			111.1		%		70-130	18-OCT-19
Potassium (K)			104.1		%		70-130	18-OCT-19
Selenium (Se)			0.38		mg/kg		0.15-0.55	18-OCT-19
Silver (Ag)			0.29		mg/kg		0.16-0.36	18-OCT-19
Sodium (Na)			108.8		%		70-130	18-OCT-19
Strontium (Sr)			109.5		%		70-130	18-OCT-19
Thallium (Tl)			108.4		%		70-130	18-OCT-19
Tin (Sn)			2.5		mg/kg		0.2-4.2	18-OCT-19
Titanium (Ti)			115.8		%		70-130	18-OCT-19
Tungsten (W)			1.99		mg/kg		1-2	18-OCT-19
Uranium (U)			112.6		%		70-130	18-OCT-19
Vanadium (V)			112.9		%		70-130	18-OCT-19
Zinc (Zn)			110.9		%		70-130	18-OCT-19
WG3193550-2 DUP		**L2365825-3**						
Aluminum (Al)		10900	10500		mg/kg	2.9	40	18-OCT-19
Antimony (Sb)		0.21	0.22		mg/kg	1.6	30	18-OCT-19
Arsenic (As)		12.4	13.1		mg/kg	6.0	30	18-OCT-19
Barium (Ba)		29.8	28.2		mg/kg	5.7	40	18-OCT-19
Beryllium (Be)		0.69	0.65		mg/kg	5.7	30	18-OCT-19
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	18-OCT-19
Boron (B)		74.3	74.6		mg/kg	0.4	30	18-OCT-19
Cadmium (Cd)		0.117	0.129		mg/kg	9.9	30	18-OCT-19
Calcium (Ca)		90500	89700		mg/kg	0.9	30	18-OCT-19
Chromium (Cr)		29.3	29.1		mg/kg	0.7	30	18-OCT-19
Cobalt (Co)		5.32	5.37		mg/kg	1.0	30	18-OCT-19
Copper (Cu)		11.9	11.8		mg/kg	0.8	30	18-OCT-19
Iron (Fe)		19800	19800		mg/kg	0.1	30	18-OCT-19
Lead (Pb)		9.57	9.68		mg/kg	1.2	40	18-OCT-19
Lithium (Li)		49.9	48.9		mg/kg	2.1	30	18-OCT-19
Magnesium (Mg)		44800	44200		mg/kg	1.3	30	18-OCT-19
Manganese (Mn)		194	193		mg/kg	0.8	30	18-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4875008								
WG3193550-2 DUP		**L2365825-3**						
Molybdenum (Mo)		0.50	0.51		mg/kg	2.1	40	18-OCT-19
Nickel (Ni)		16.8	16.8		mg/kg	0.3	30	18-OCT-19
Phosphorus (P)		922	944		mg/kg	2.3	30	18-OCT-19
Potassium (K)		4370	4420		mg/kg	1.2	40	18-OCT-19
Selenium (Se)		0.31	0.32		mg/kg	3.0	30	18-OCT-19
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	18-OCT-19
Sodium (Na)		6530	6490		mg/kg	0.7	40	18-OCT-19
Strontium (Sr)		73.8	69.8		mg/kg	5.6	40	18-OCT-19
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	18-OCT-19
Thallium (Tl)		0.170	0.171		mg/kg	0.6	30	18-OCT-19
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	18-OCT-19
Titanium (Ti)		358	352		mg/kg	1.8	40	18-OCT-19
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	18-OCT-19
Uranium (U)		1.32	1.33		mg/kg	0.4	30	18-OCT-19
Vanadium (V)		42.8	42.4		mg/kg	0.8	30	18-OCT-19
Zinc (Zn)		29.1	29.0		mg/kg	0.4	30	18-OCT-19
Zirconium (Zr)		9.1	9.1		mg/kg	0.3	30	18-OCT-19
WG3193550-3 LCS								
Aluminum (Al)			105.1		%		80-120	18-OCT-19
Antimony (Sb)			99.1		%		80-120	18-OCT-19
Arsenic (As)			101.8		%		80-120	18-OCT-19
Barium (Ba)			102.9		%		80-120	18-OCT-19
Beryllium (Be)			107.8		%		80-120	18-OCT-19
Bismuth (Bi)			90.9		%		80-120	18-OCT-19
Boron (B)			104.8		%		80-120	18-OCT-19
Cadmium (Cd)			100.5		%		80-120	18-OCT-19
Calcium (Ca)			107.8		%		80-120	18-OCT-19
Chromium (Cr)			101.0		%		80-120	18-OCT-19
Cobalt (Co)			99.3		%		80-120	18-OCT-19
Copper (Cu)			97.1		%		80-120	18-OCT-19
Iron (Fe)			112.0		%		80-120	18-OCT-19
Lead (Pb)			95.3		%		80-120	18-OCT-19
Lithium (Li)			108.4		%		80-120	18-OCT-19
Magnesium (Mg)			101.9		%		80-120	18-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4875008								
WG3193550-3 LCS								
Manganese (Mn)			98.0		%		80-120	18-OCT-19
Molybdenum (Mo)			100.5		%		80-120	18-OCT-19
Nickel (Ni)			103.0		%		80-120	18-OCT-19
Phosphorus (P)			106.0		%		80-120	18-OCT-19
Potassium (K)			98.0		%		80-120	18-OCT-19
Selenium (Se)			99.6		%		80-120	18-OCT-19
Silver (Ag)			98.2		%		80-120	18-OCT-19
Sodium (Na)			106.3		%		80-120	18-OCT-19
Strontium (Sr)			100.6		%		80-120	18-OCT-19
Sulfur (S)			101.1		%		80-120	18-OCT-19
Thallium (Tl)			94.9		%		80-120	18-OCT-19
Tin (Sn)			98.5		%		80-120	18-OCT-19
Titanium (Ti)			101.2		%		80-120	18-OCT-19
Tungsten (W)			106.1		%		80-120	18-OCT-19
Uranium (U)			106.8		%		80-120	18-OCT-19
Vanadium (V)			104.0		%		80-120	18-OCT-19
Zinc (Zn)			101.2		%		80-120	18-OCT-19
Zirconium (Zr)			103.5		%		70-130	18-OCT-19
WG3193550-1 MB								
Aluminum (Al)			<50		mg/kg		50	18-OCT-19
Antimony (Sb)			<0.10		mg/kg		0.1	18-OCT-19
Arsenic (As)			<0.10		mg/kg		0.1	18-OCT-19
Barium (Ba)			<0.50		mg/kg		0.5	18-OCT-19
Beryllium (Be)			<0.10		mg/kg		0.1	18-OCT-19
Bismuth (Bi)			<0.20		mg/kg		0.2	18-OCT-19
Boron (B)			<5.0		mg/kg		5	18-OCT-19
Cadmium (Cd)			<0.020		mg/kg		0.02	18-OCT-19
Calcium (Ca)			<50		mg/kg		50	18-OCT-19
Chromium (Cr)			<0.50		mg/kg		0.5	18-OCT-19
Cobalt (Co)			<0.10		mg/kg		0.1	18-OCT-19
Copper (Cu)			<0.50		mg/kg		0.5	18-OCT-19
Iron (Fe)			<50		mg/kg		50	18-OCT-19
Lead (Pb)			<0.50		mg/kg		0.5	18-OCT-19
Lithium (Li)			<2.0		mg/kg		2	18-OCT-19

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4875008								
WG3193550-1 MB								
Magnesium (Mg)			<20		mg/kg		20	18-OCT-19
Manganese (Mn)			<1.0		mg/kg		1	18-OCT-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	18-OCT-19
Nickel (Ni)			<0.50		mg/kg		0.5	18-OCT-19
Phosphorus (P)			<50		mg/kg		50	18-OCT-19
Potassium (K)			<100		mg/kg		100	18-OCT-19
Selenium (Se)			<0.20		mg/kg		0.2	18-OCT-19
Silver (Ag)			<0.10		mg/kg		0.1	18-OCT-19
Sodium (Na)			<50		mg/kg		50	18-OCT-19
Strontium (Sr)			<0.50		mg/kg		0.5	18-OCT-19
Sulfur (S)			<1000		mg/kg		1000	18-OCT-19
Thallium (Tl)			<0.050		mg/kg		0.05	18-OCT-19
Tin (Sn)			<2.0		mg/kg		2	18-OCT-19
Titanium (Ti)			<1.0		mg/kg		1	18-OCT-19
Tungsten (W)			<0.50		mg/kg		0.5	18-OCT-19
Uranium (U)			<0.050		mg/kg		0.05	18-OCT-19
Vanadium (V)			<0.20		mg/kg		0.2	18-OCT-19
Zinc (Zn)			<2.0		mg/kg		2	18-OCT-19
Zirconium (Zr)			<1.0		mg/kg		1	18-OCT-19
MOISTURE-VA	**Soil**							
Batch R4873575								
WG3193557-3 DUP		**L2365825-2**						
Moisture		32.1	31.6		%	1.6	20	17-OCT-19
WG3193557-2 LCS								
Moisture			99.3		%		90-110	17-OCT-19
WG3193557-1 MB								
Moisture			<0.25		%		0.25	17-OCT-19
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4868997								
WG3193535-3 DUP		**L2365825-7**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	24-OCT-19
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	24-OCT-19
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	24-OCT-19
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4868997								
WG3193535-3 DUP		**L2365825-7**						
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	24-OCT-19
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
1-Methylnaphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	24-OCT-19
2-Methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	24-OCT-19
Quinoline		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	24-OCT-19
WG3193535-5 IRM		**ALS PAH RM2**						
Acenaphthene			103.5		%		60-130	24-OCT-19
Acenaphthylene			112.4		%		60-130	24-OCT-19
Anthracene			114.6		%		60-130	24-OCT-19
Benz(a)anthracene			99.1		%		60-130	24-OCT-19
Benzo(a)pyrene			89.4		%		60-130	24-OCT-19
Benzo(b&j)fluoranthene			94.7		%		60-130	24-OCT-19
Benzo(g,h,i)perylene			95.3		%		60-130	24-OCT-19
Benzo(k)fluoranthene			91.6		%		60-130	24-OCT-19
Chrysene			105.4		%		60-130	24-OCT-19
Dibenz(a,h)anthracene			100.3		%		60-130	24-OCT-19
Fluoranthene			108.5		%		60-130	24-OCT-19
Fluorene			106.5		%		60-130	24-OCT-19
Indeno(1,2,3-c,d)pyrene			95.5		%		60-130	24-OCT-19
1-Methylnaphthalene			105.3		%		60-130	24-OCT-19
2-Methylnaphthalene			102.9		%		60-130	24-OCT-19
Naphthalene			104.7		%		50-130	24-OCT-19
Phenanthrene			103.0		%		60-130	24-OCT-19
Pyrene			107.3		%		60-130	24-OCT-19
WG3193535-2 LCS								
Acenaphthene			121.6		%		60-130	24-OCT-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4868997								
WG3193535-2 LCS								
Acenaphthylene			118.1		%		60-130	24-OCT-19
Anthracene			119.6		%		60-130	24-OCT-19
Benz(a)anthracene			128.0		%		60-130	24-OCT-19
Benzo(a)pyrene			116.1		%		60-130	24-OCT-19
Benzo(b&j)fluoranthene			122.6		%		60-130	24-OCT-19
Benzo(g,h,i)perylene			115.7		%		60-130	24-OCT-19
Benzo(k)fluoranthene			122.9		%		60-130	24-OCT-19
Chrysene			127.7		%		60-130	24-OCT-19
Dibenz(a,h)anthracene			117.8		%		60-130	24-OCT-19
Fluoranthene			128.1		%		60-130	24-OCT-19
Fluorene			119.9		%		60-130	24-OCT-19
Indeno(1,2,3-c,d)pyrene			117.1		%		60-130	24-OCT-19
1-Methylnaphthalene			119.1		%		60-130	24-OCT-19
2-Methylnaphthalene			121.3		%		60-130	24-OCT-19
Naphthalene			118.0		%		50-130	24-OCT-19
Phenanthrene			120.9		%		60-130	24-OCT-19
Pyrene			127.5		%		60-130	24-OCT-19
Quinoline			120.7		%		60-130	24-OCT-19
WG3193535-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	24-OCT-19
Acenaphthylene			<0.0050		mg/kg		0.005	24-OCT-19
Anthracene			<0.0040		mg/kg		0.004	24-OCT-19
Benz(a)anthracene			<0.010		mg/kg		0.01	24-OCT-19
Benzo(a)pyrene			<0.010		mg/kg		0.01	24-OCT-19
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	24-OCT-19
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	24-OCT-19
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	24-OCT-19
Chrysene			<0.010		mg/kg		0.01	24-OCT-19
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	24-OCT-19
Fluoranthene			<0.010		mg/kg		0.01	24-OCT-19
Fluorene			<0.010		mg/kg		0.01	24-OCT-19
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	24-OCT-19
1-Methylnaphthalene			<0.050		mg/kg		0.05	24-OCT-19
2-Methylnaphthalene			<0.010		mg/kg		0.01	24-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R4868997								
WG3193535-1 MB								
Naphthalene			<0.010		mg/kg		0.01	24-OCT-19
Phenanthrene			<0.010		mg/kg		0.01	24-OCT-19
Pyrene			<0.010		mg/kg		0.01	24-OCT-19
Quinoline			<0.050		mg/kg		0.05	24-OCT-19
Surrogate: Naphthalene d8			101.7		%		50-130	24-OCT-19
Surrogate: Phenanthrene d10			99.3		%		60-130	24-OCT-19
Surrogate: Chrysene d12			95.2		%		60-130	24-OCT-19
PH-1:2-VA	**Soil**							
Batch R4877606								
WG3193550-2 DUP		**L2365825-3**						
pH (1:2 soil:water)		8.09	8.08	J	pH	0.01	0.2	21-OCT-19
PSA-PIPET+GRAVEL-SK	**Soil**							
Batch R4881115								
WG3196623-1 DUP		**L2365825-8**						
% Gravel (>2mm)		14.1	14.1	J	%	0.0	5	23-OCT-19
% Sand (2.0mm - 0.063mm)		59.9	59.0	J	%	0.9	5	23-OCT-19
% Silt (0.063mm - 4um)		20.1	21.4	J	%	1.3	5	23-OCT-19
% Clay (<4um)		5.8	5.5	J	%	0.3	5	23-OCT-19
WG3196623-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.063mm)			44.7		%		39.1-49.1	23-OCT-19
% Silt (0.063mm - 4um)			37.2		%		32.5-42.5	23-OCT-19
% Clay (<4um)			18.1		%		13.4-23.4	23-OCT-19
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196812-3 DUP		**L2365825-13**						
Bromodichloromethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Bromoform		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Carbon Tetrachloride		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Chlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Dibromochloromethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Chloroethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	22-OCT-19
Chloroform		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	22-OCT-19
Chloromethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196812-3 DUP		**L2365825-13**						
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Dichloromethane		<0.30	<0.30	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
cis-1,3-Dichloropropylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
trans-1,3-Dichloropropylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Tetrachloroethylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	22-OCT-19
Trichloroethylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	22-OCT-19
Trichlorofluoromethane		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	22-OCT-19
Vinyl Chloride		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	22-OCT-19
WG3196812-2 LCS								
Bromodichloromethane			81.4		%		70-130	22-OCT-19
Bromoform			83.0		%		70-130	22-OCT-19
Carbon Tetrachloride			100.2		%		70-130	22-OCT-19
Chlorobenzene			92.6		%		70-130	22-OCT-19
Dibromochloromethane			89.8		%		70-130	22-OCT-19
Chloroethane			87.8		%		60-140	22-OCT-19
Chloroform			90.0		%		70-130	22-OCT-19
Chloromethane			104.1		%		60-140	22-OCT-19
1,2-Dichlorobenzene			96.3		%		70-130	22-OCT-19
1,3-Dichlorobenzene			95.0		%		70-130	22-OCT-19
1,4-Dichlorobenzene			96.8		%		70-140	22-OCT-19
1,1-Dichloroethane			88.6		%		70-130	22-OCT-19
1,2-Dichloroethane			76.0		%		70-130	22-OCT-19
1,1-Dichloroethylene			91.5		%		70-130	22-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196812-2 LCS								
cis-1,2-Dichloroethylene			79.1		%		70-130	22-OCT-19
trans-1,2-Dichloroethylene			87.0		%		70-130	22-OCT-19
Dichloromethane			82.2		%		60-140	22-OCT-19
1,2-Dichloropropane			88.8		%		70-130	22-OCT-19
cis-1,3-Dichloropropylene			88.8		%		70-130	22-OCT-19
trans-1,3-Dichloropropylene			75.0		%		70-130	22-OCT-19
1,1,1,2-Tetrachloroethane			90.0		%		70-130	22-OCT-19
1,1,2,2-Tetrachloroethane			78.2		%		70-130	22-OCT-19
Tetrachloroethylene			106.0		%		70-130	22-OCT-19
1,1,1-Trichloroethane			99.9		%		70-130	22-OCT-19
1,1,2-Trichloroethane			74.6		%		70-130	22-OCT-19
Trichloroethylene			95.5		%		70-130	22-OCT-19
Trichlorofluoromethane			120.2		%		60-140	22-OCT-19
Vinyl Chloride			107.9		%		60-140	22-OCT-19
WG3196812-1 MB								
Bromodichloromethane			<0.050		mg/kg		0.05	22-OCT-19
Bromoform			<0.050		mg/kg		0.05	22-OCT-19
Carbon Tetrachloride			<0.050		mg/kg		0.05	22-OCT-19
Chlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
Dibromochloromethane			<0.050		mg/kg		0.05	22-OCT-19
Chloroethane			<0.10		mg/kg		0.1	22-OCT-19
Chloroform			<0.10		mg/kg		0.1	22-OCT-19
Chloromethane			<0.10		mg/kg		0.1	22-OCT-19
1,2-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,3-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,4-Dichlorobenzene			<0.050		mg/kg		0.05	22-OCT-19
1,1-Dichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,2-Dichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
cis-1,2-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
trans-1,2-Dichloroethylene			<0.050		mg/kg		0.05	22-OCT-19
Dichloromethane			<0.30		mg/kg		0.3	22-OCT-19
1,2-Dichloropropane			<0.050		mg/kg		0.05	22-OCT-19
cis-1,3-Dichloropropylene			<0.050		mg/kg		0.05	22-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4851265								
WG3196812-1 MB								
trans-1,3-Dichloropropylene			<0.050		mg/kg		0.05	22-OCT-19
1,1,1,2-Tetrachloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	22-OCT-19
Tetrachloroethylene			<0.050		mg/kg		0.05	22-OCT-19
1,1,1-Trichloroethane			<0.050		mg/kg		0.05	22-OCT-19
1,1,2-Trichloroethane			<0.050		mg/kg		0.05	22-OCT-19
Trichloroethylene			<0.010		mg/kg		0.01	22-OCT-19
Trichlorofluoromethane			<0.10		mg/kg		0.1	22-OCT-19
Vinyl Chloride			<0.10		mg/kg		0.1	22-OCT-19
Batch R4881627								
WG3197608-2 LCS								
Bromodichloromethane			88.3		%		70-130	24-OCT-19
Bromoform			83.4		%		70-130	24-OCT-19
Carbon Tetrachloride			95.6		%		70-130	24-OCT-19
Chlorobenzene			99.5		%		70-130	24-OCT-19
Dibromochloromethane			88.6		%		70-130	24-OCT-19
Chloroethane			95.4		%		60-140	24-OCT-19
Chloroform			92.0		%		70-130	24-OCT-19
Chloromethane			117.6		%		60-140	24-OCT-19
1,2-Dichlorobenzene			111.4		%		70-130	24-OCT-19
1,3-Dichlorobenzene			95.6		%		70-130	24-OCT-19
1,4-Dichlorobenzene			112.4		%		70-140	24-OCT-19
1,1-Dichloroethane			94.4		%		70-130	24-OCT-19
1,2-Dichloroethane			88.0		%		70-130	24-OCT-19
1,1-Dichloroethylene			96.8		%		70-130	24-OCT-19
cis-1,2-Dichloroethylene			99.2		%		70-130	24-OCT-19
trans-1,2-Dichloroethylene			95.1		%		70-130	24-OCT-19
Dichloromethane			91.0		%		60-140	24-OCT-19
1,2-Dichloropropane			91.6		%		70-130	24-OCT-19
cis-1,3-Dichloropropylene			88.1		%		70-130	24-OCT-19
trans-1,3-Dichloropropylene			94.1		%		70-130	24-OCT-19
1,1,1,2-Tetrachloroethane			94.0		%		70-130	24-OCT-19
1,1,2,2-Tetrachloroethane			93.4		%		70-130	24-OCT-19
Tetrachloroethylene			104.5		%		70-130	24-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Soil**							
Batch R4881627								
WG3197608-2 LCS								
1,1,1-Trichloroethane			99.5		%		70-130	24-OCT-19
1,1,2-Trichloroethane			78.4		%		70-130	24-OCT-19
Trichloroethylene			98.2		%		70-130	24-OCT-19
Trichlorofluoromethane			113.2		%		60-140	24-OCT-19
Vinyl Chloride			108.1		%		60-140	24-OCT-19
WG3197608-1 MB								
Bromodichloromethane			<0.050		mg/kg		0.05	24-OCT-19
Bromoform			<0.050		mg/kg		0.05	24-OCT-19
Carbon Tetrachloride			<0.050		mg/kg		0.05	24-OCT-19
Chlorobenzene			<0.050		mg/kg		0.05	24-OCT-19
Dibromochloromethane			<0.050		mg/kg		0.05	24-OCT-19
Chloroethane			<0.10		mg/kg		0.1	24-OCT-19
Chloroform			<0.10		mg/kg		0.1	24-OCT-19
Chloromethane			<0.10		mg/kg		0.1	24-OCT-19
1,2-Dichlorobenzene			<0.050		mg/kg		0.05	24-OCT-19
1,3-Dichlorobenzene			<0.050		mg/kg		0.05	24-OCT-19
1,4-Dichlorobenzene			<0.050		mg/kg		0.05	24-OCT-19
1,1-Dichloroethane			<0.050		mg/kg		0.05	24-OCT-19
1,2-Dichloroethane			<0.050		mg/kg		0.05	24-OCT-19
1,1-Dichloroethylene			<0.050		mg/kg		0.05	24-OCT-19
cis-1,2-Dichloroethylene			<0.050		mg/kg		0.05	24-OCT-19
trans-1,2-Dichloroethylene			<0.050		mg/kg		0.05	24-OCT-19
Dichloromethane			<0.30		mg/kg		0.3	24-OCT-19
1,2-Dichloropropane			<0.050		mg/kg		0.05	24-OCT-19
cis-1,3-Dichloropropylene			<0.050		mg/kg		0.05	24-OCT-19
trans-1,3-Dichloropropylene			<0.050		mg/kg		0.05	24-OCT-19
1,1,1,2-Tetrachloroethane			<0.050		mg/kg		0.05	24-OCT-19
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	24-OCT-19
Tetrachloroethylene			<0.050		mg/kg		0.05	24-OCT-19
1,1,1-Trichloroethane			<0.050		mg/kg		0.05	24-OCT-19
1,1,2-Trichloroethane			<0.050		mg/kg		0.05	24-OCT-19
Trichloroethylene			<0.010		mg/kg		0.01	24-OCT-19
Trichlorofluoromethane			<0.10		mg/kg		0.1	24-OCT-19
Vinyl Chloride			<0.10		mg/kg		0.1	24-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC7-L-HSMS-VA	**Soil**							
Batch R4851265								
WG3196812-3 DUP		**L2365825-13**						
Benzene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	40	22-OCT-19
Ethylbenzene		<0.015	<0.015	RPD-NA	mg/kg	N/A	40	22-OCT-19
Methyl t-butyl ether (MTBE)		<0.20	<0.20	RPD-NA	mg/kg	N/A	40	22-OCT-19
Styrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	22-OCT-19
Toluene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	22-OCT-19
meta- & para-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	22-OCT-19
ortho-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	22-OCT-19
WG3196812-2 LCS								
Benzene			89.4		%		70-130	22-OCT-19
Ethylbenzene			116.1		%		70-130	22-OCT-19
Methyl t-butyl ether (MTBE)			95.5		%		70-130	22-OCT-19
Styrene			86.9		%		70-130	22-OCT-19
Toluene			91.4		%		70-130	22-OCT-19
meta- & para-Xylene			98.9		%		70-130	22-OCT-19
ortho-Xylene			97.0		%		70-130	22-OCT-19
WG3196812-1 MB								
Benzene			<0.0050		mg/kg		0.005	22-OCT-19
Ethylbenzene			<0.015		mg/kg		0.015	22-OCT-19
Methyl t-butyl ether (MTBE)			<0.20		mg/kg		0.2	22-OCT-19
Styrene			<0.050		mg/kg		0.05	22-OCT-19
Toluene			<0.050		mg/kg		0.05	22-OCT-19
meta- & para-Xylene			<0.050		mg/kg		0.05	22-OCT-19
ortho-Xylene			<0.050		mg/kg		0.05	22-OCT-19
Batch R4881627								
WG3197608-2 LCS								
Benzene			95.5		%		70-130	24-OCT-19
Ethylbenzene			106.0		%		70-130	24-OCT-19
Methyl t-butyl ether (MTBE)			94.7		%		70-130	24-OCT-19
Styrene			92.3		%		70-130	24-OCT-19
Toluene			102.2		%		70-130	24-OCT-19
meta- & para-Xylene			101.9		%		70-130	24-OCT-19
ortho-Xylene			97.2		%		70-130	24-OCT-19
WG3197608-1 MB								
Benzene			<0.0050		mg/kg		0.005	24-OCT-19
Ethylbenzene			<0.015		mg/kg		0.015	24-OCT-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC7-L-HSMS-VA	**Soil**							
Batch R4881627								
WG3197608-1 MB								
Methyl t-butyl ether (MTBE)			<0.20		mg/kg		0.2	24-OCT-19
Styrene			<0.050		mg/kg		0.05	24-OCT-19
Toluene			<0.050		mg/kg		0.05	24-OCT-19
meta- & para-Xylene			<0.050		mg/kg		0.05	24-OCT-19
ortho-Xylene			<0.050		mg/kg		0.05	24-OCT-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

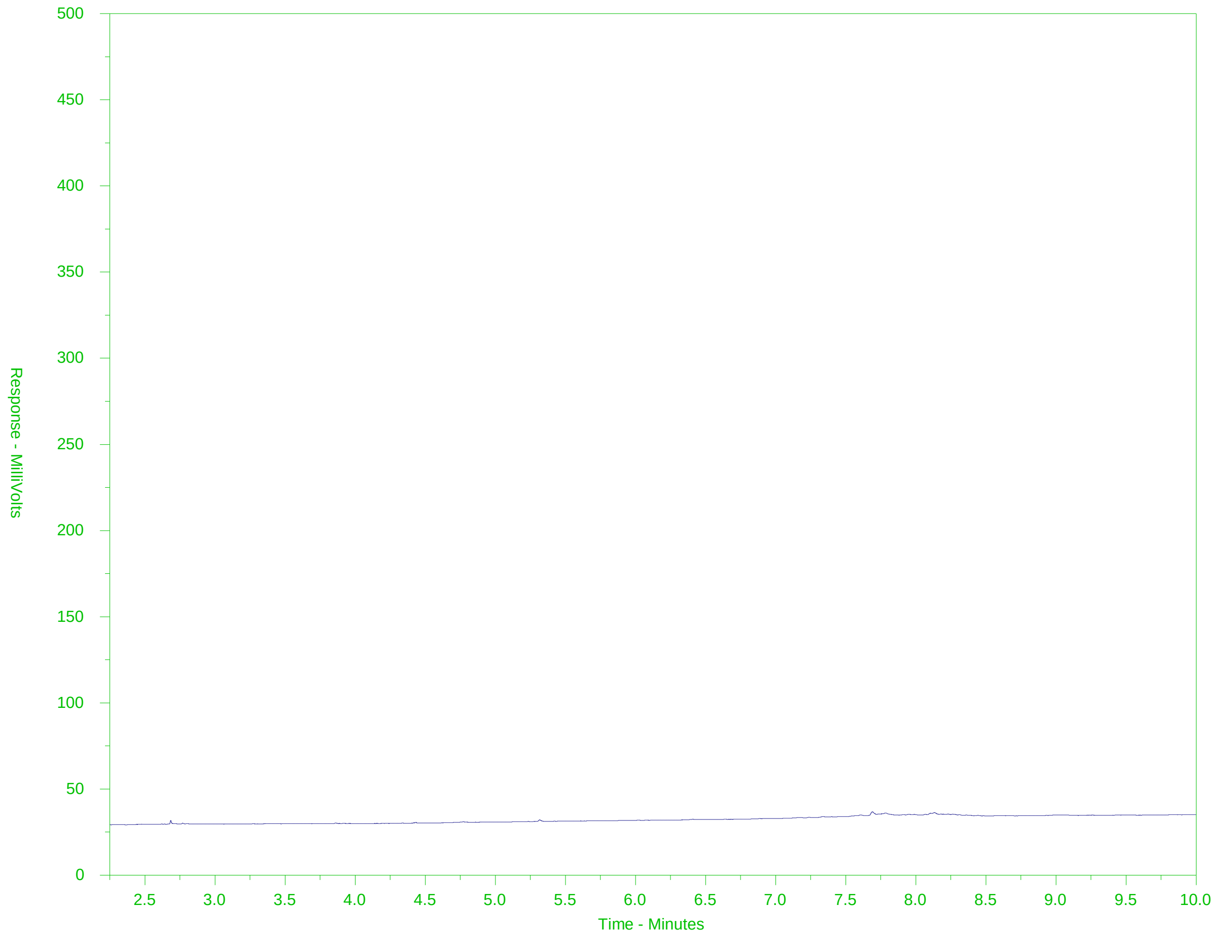
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-1
Client Sample ID: SNE-3



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

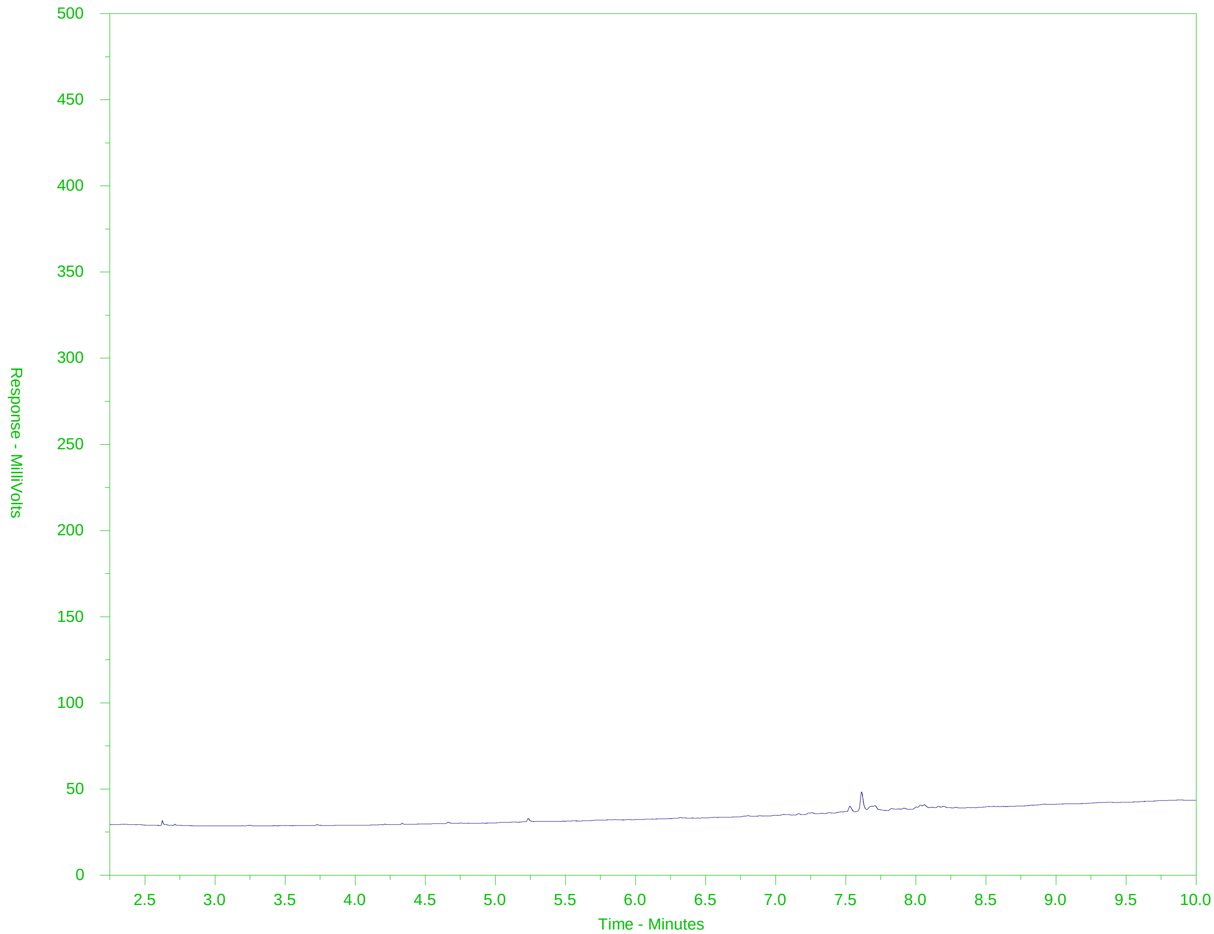
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-2
Client Sample ID: SNE-4



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

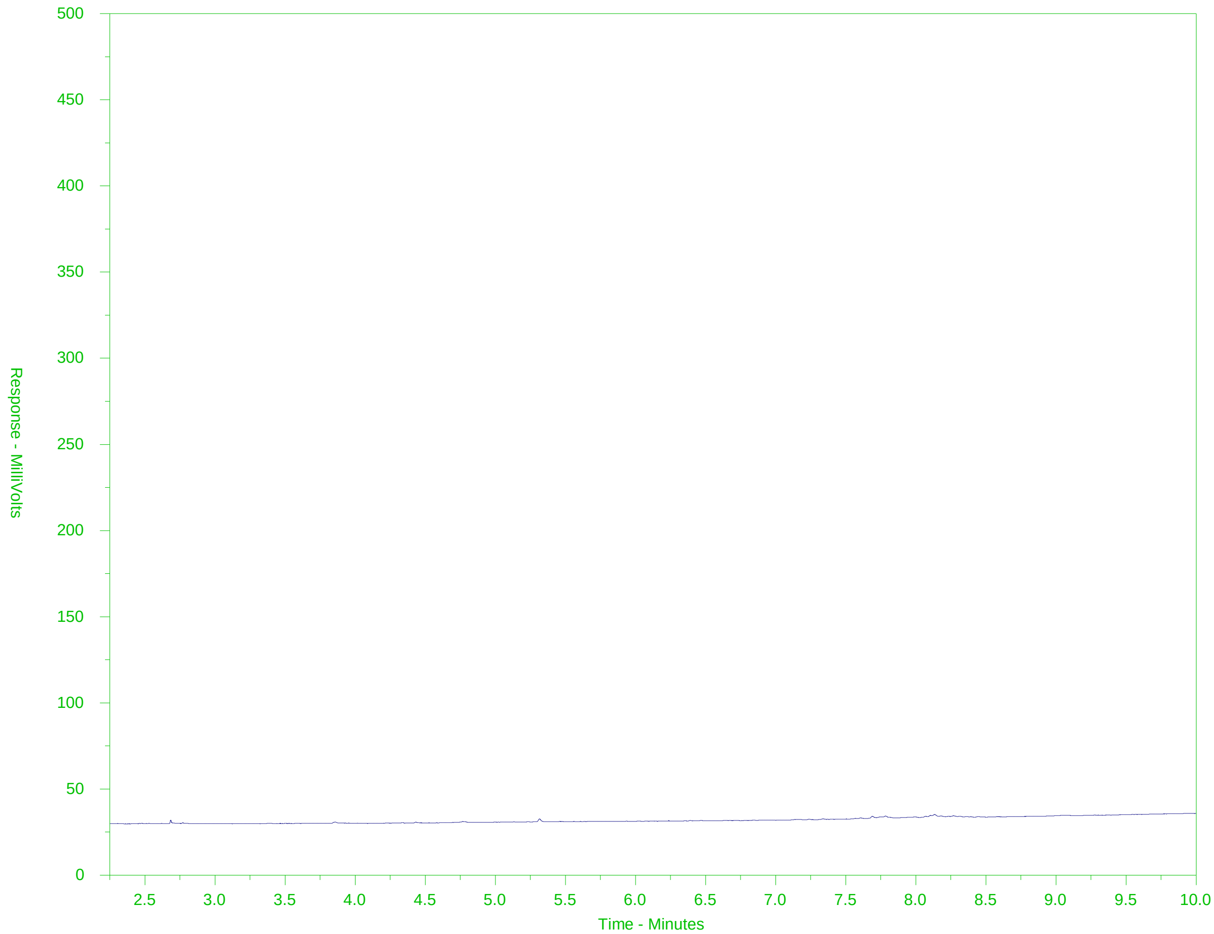
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-3
Client Sample ID: SNE-5



← EPH10-19 →		← EPH19-32 →
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

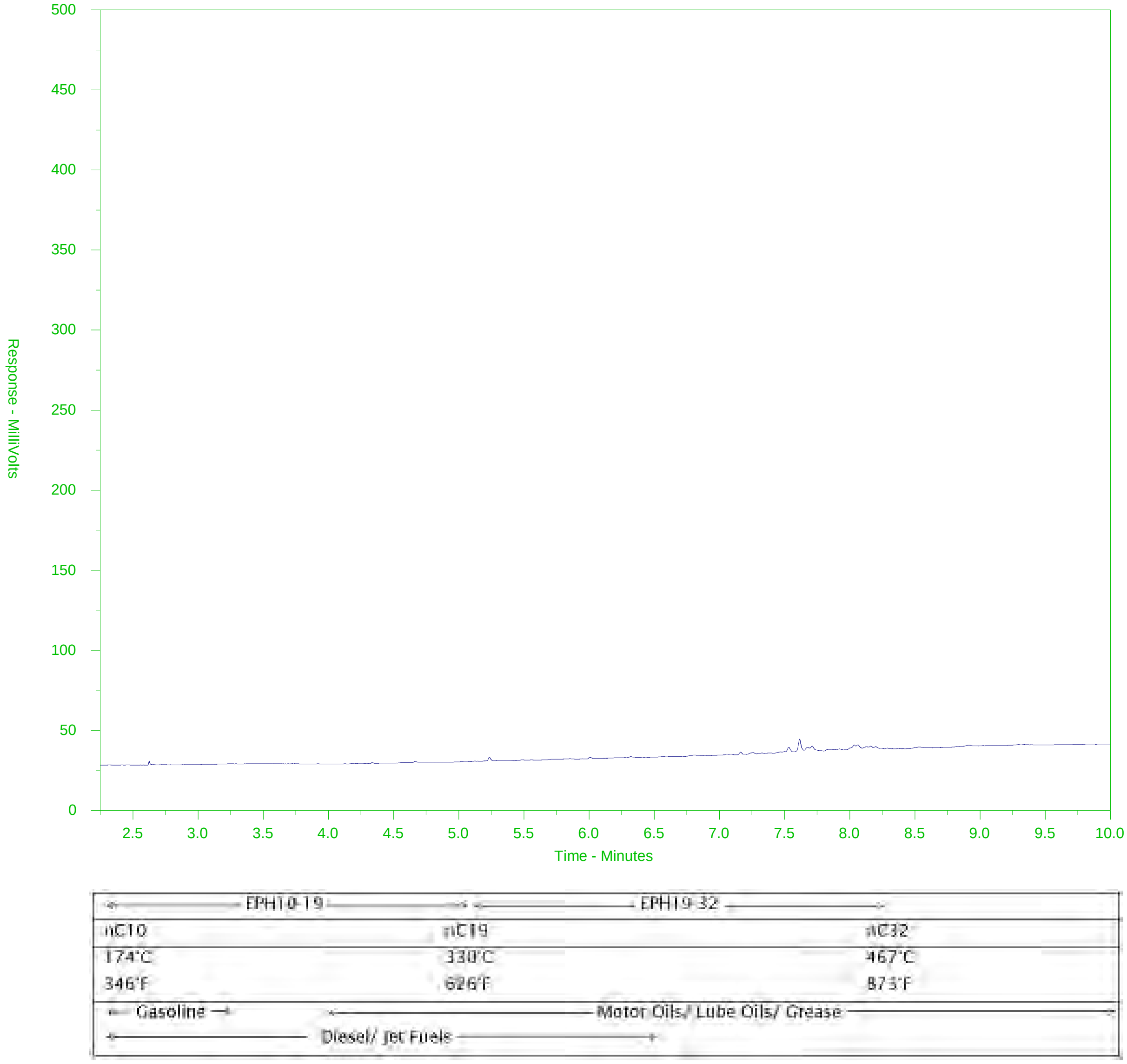
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-4
Client Sample ID: SNE-6



The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

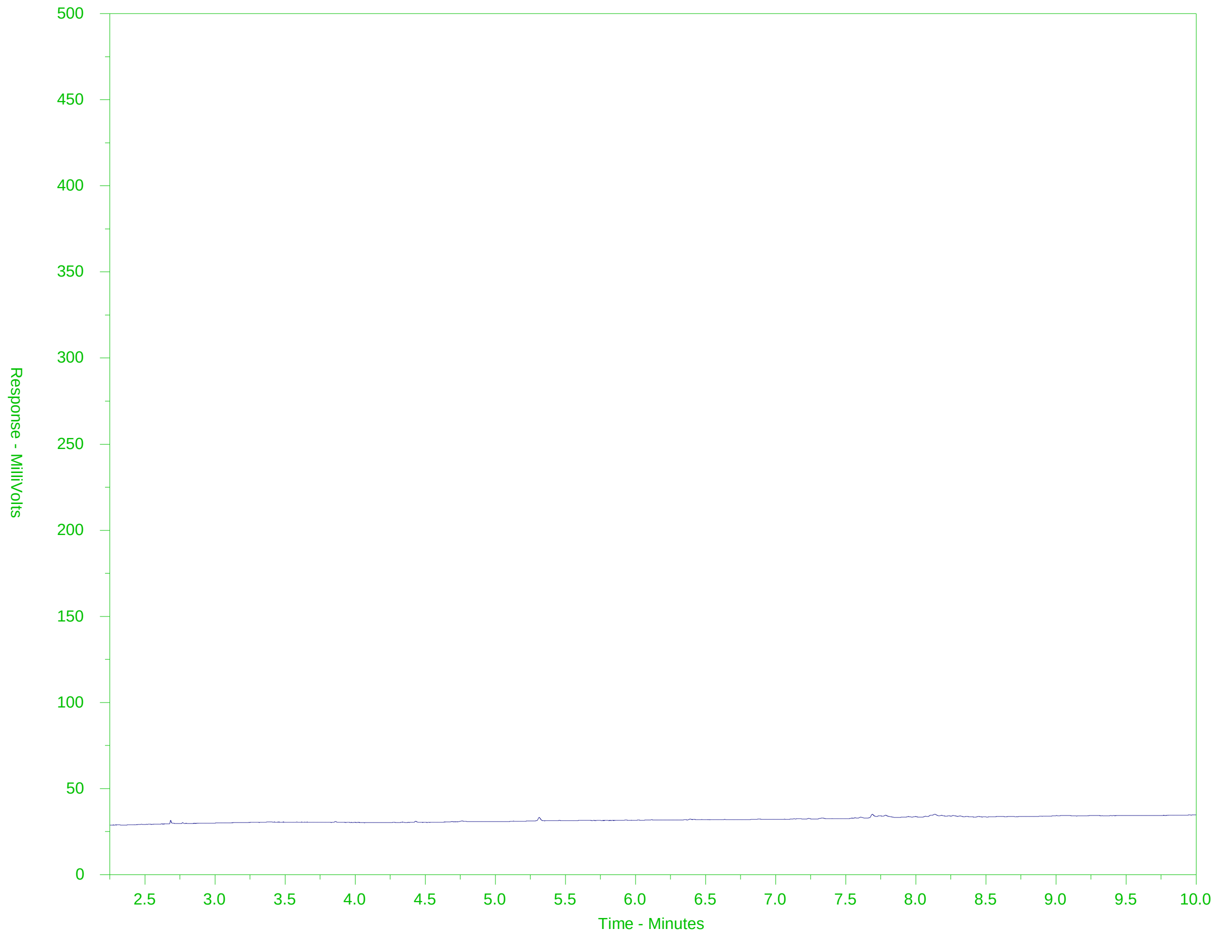
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

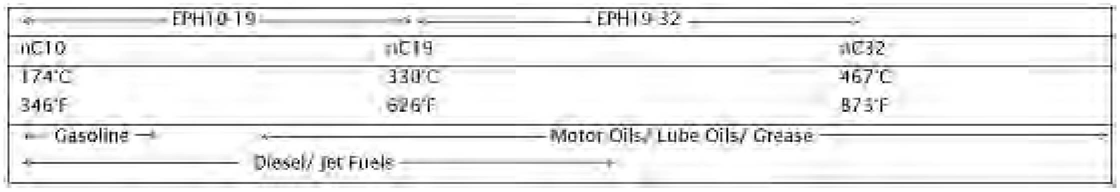
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-5
Client Sample ID: SNE-7





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

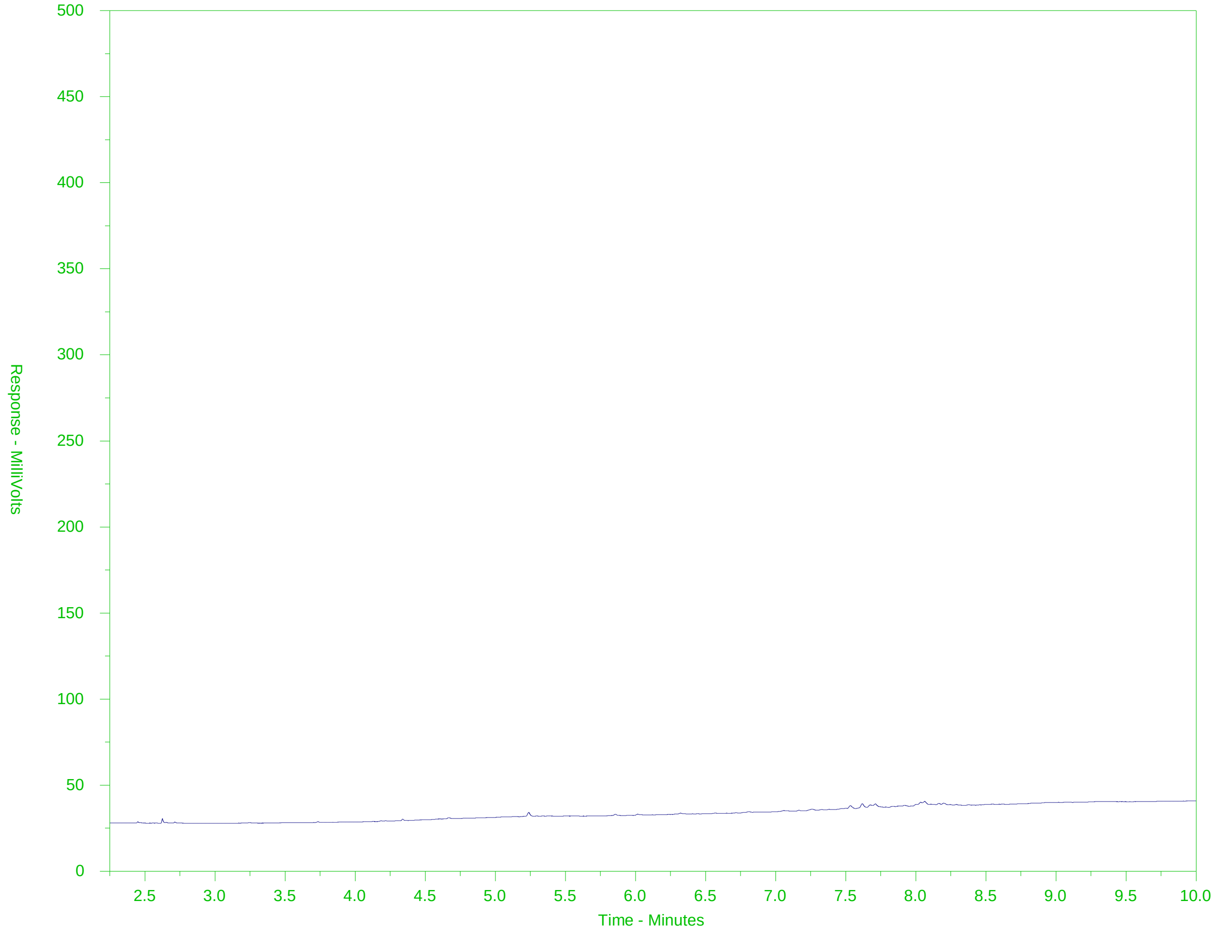
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-6
Client Sample ID: SNE-8



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

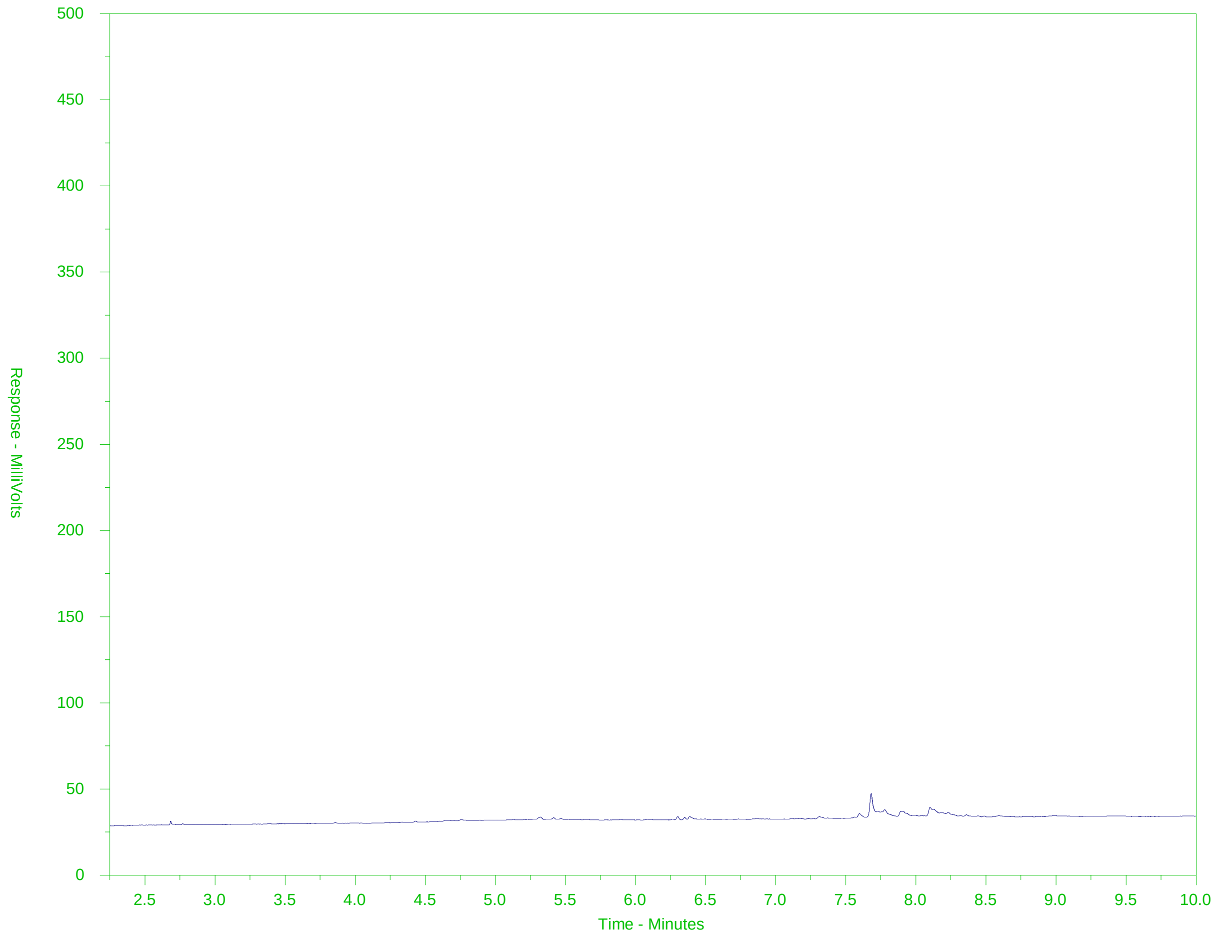
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

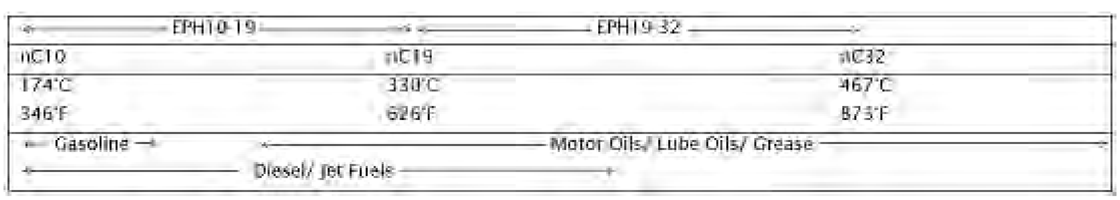
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-7
Client Sample ID: SE-9





The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

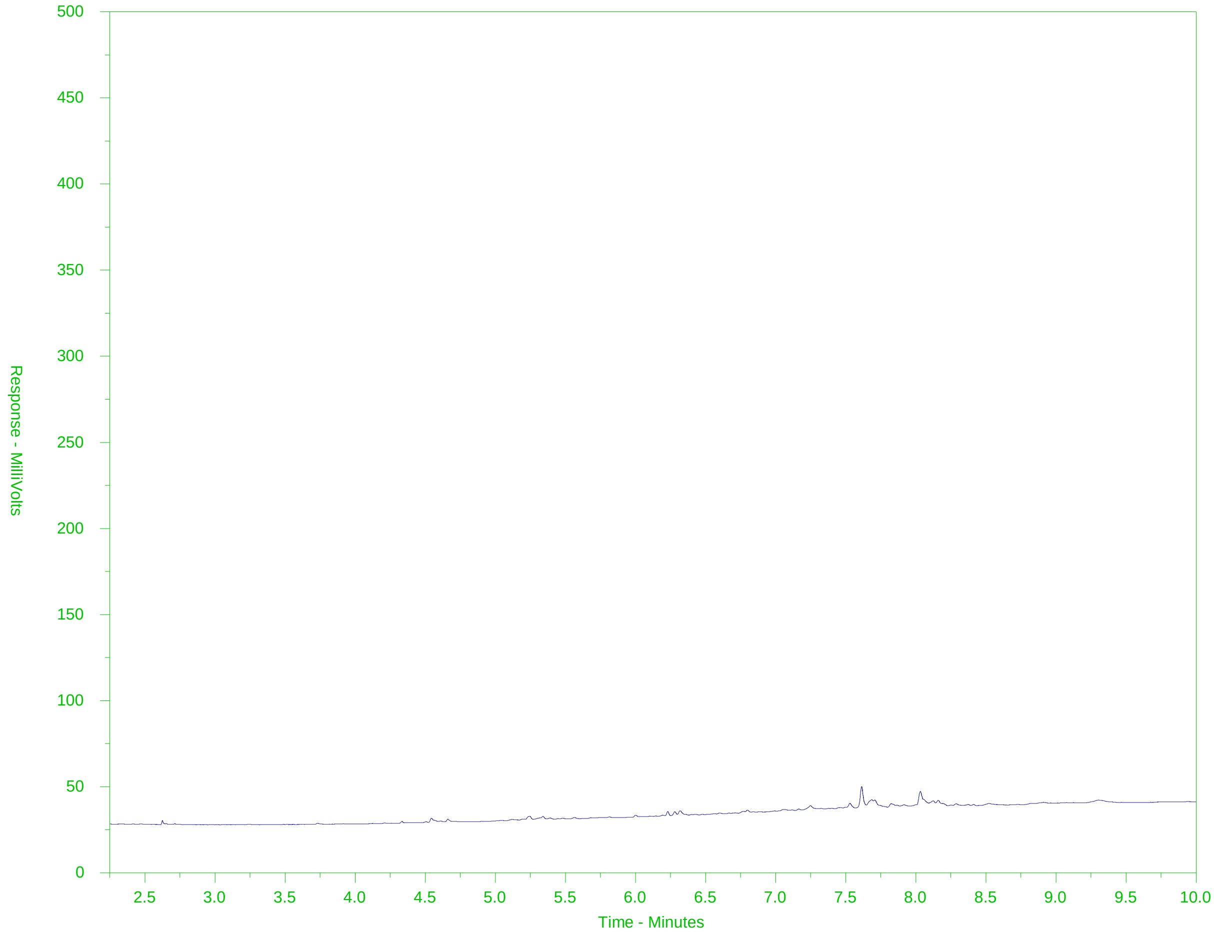
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: WG3193535-3#L2365825-7

Client Sample ID: SE-9



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

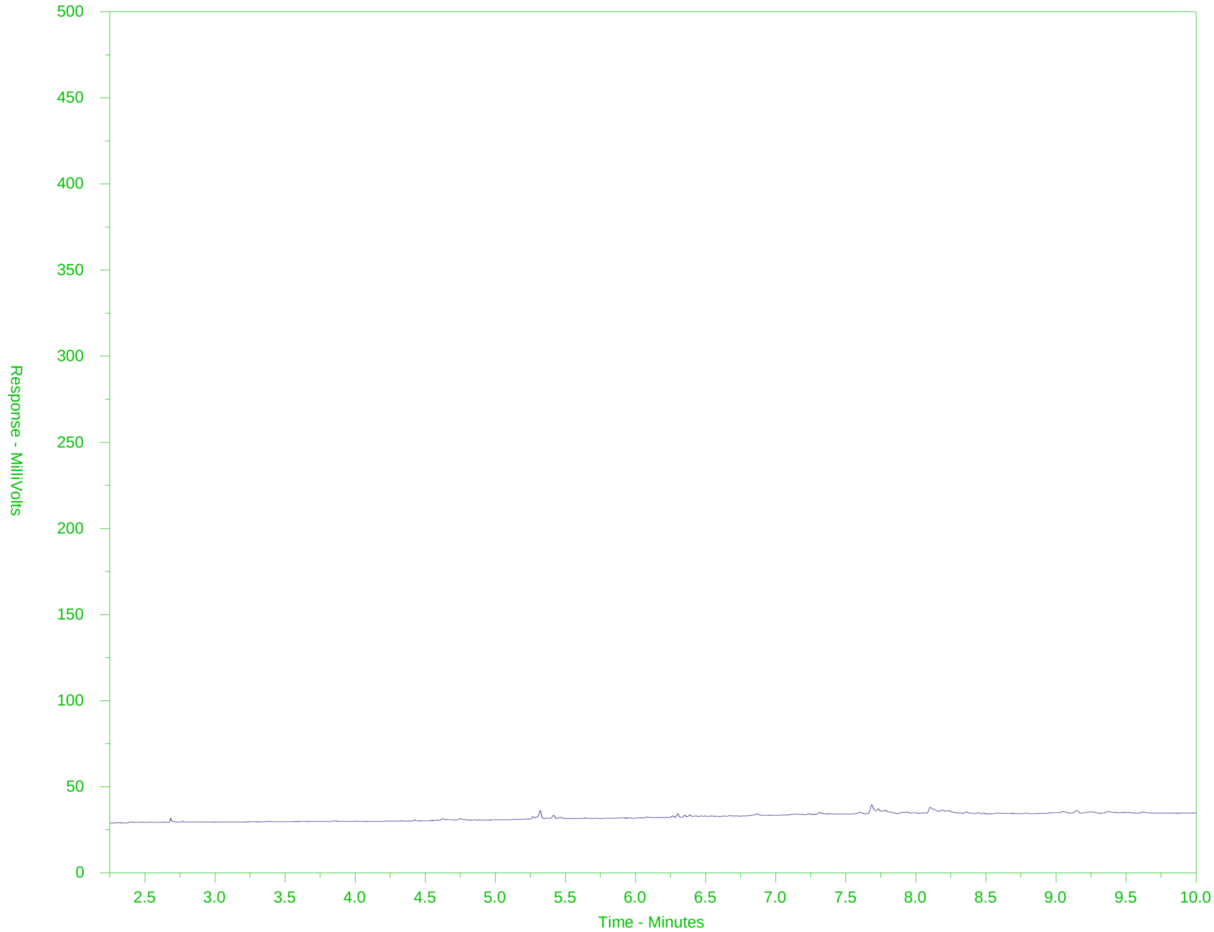
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-8
Client Sample ID: SE-10



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

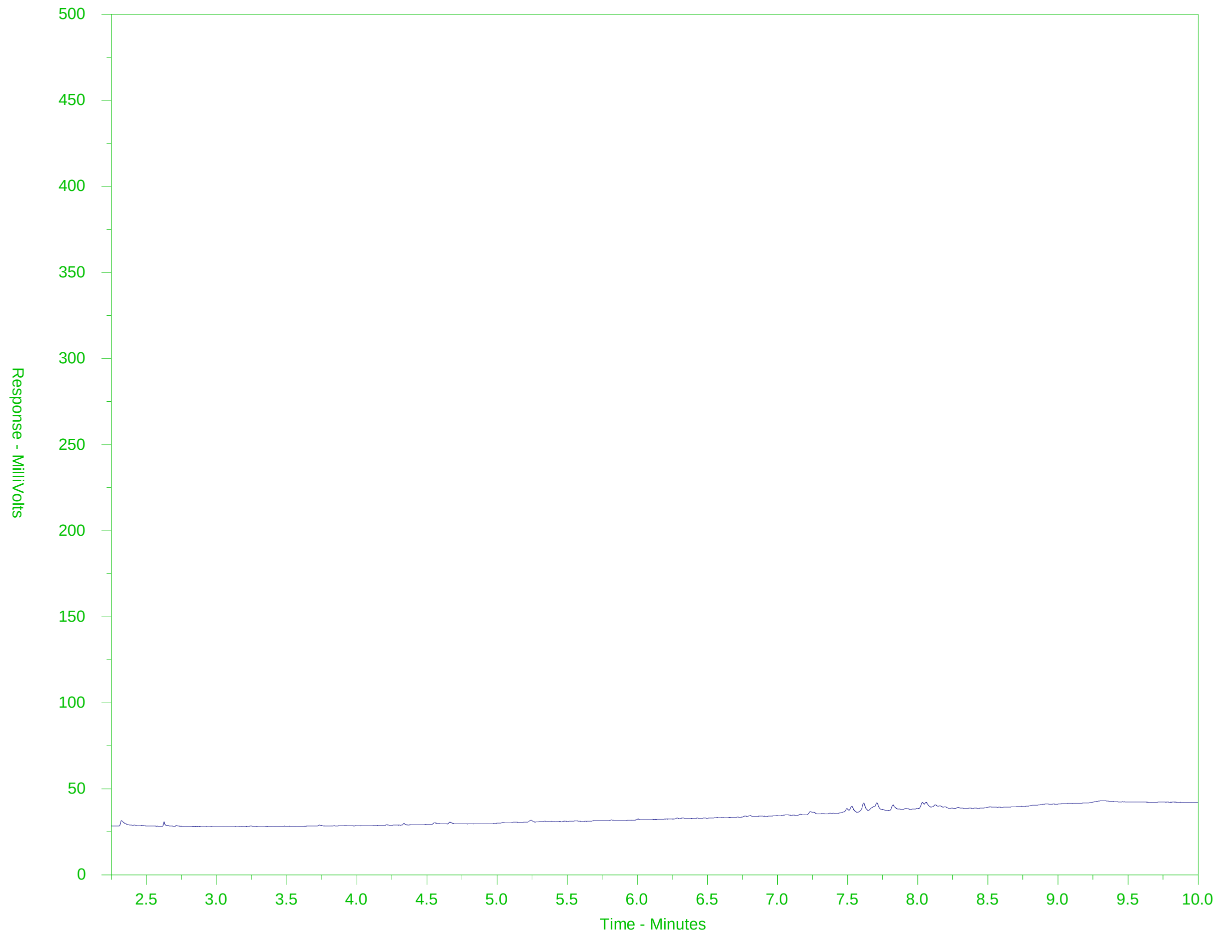
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-9
Client Sample ID: SW-9



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

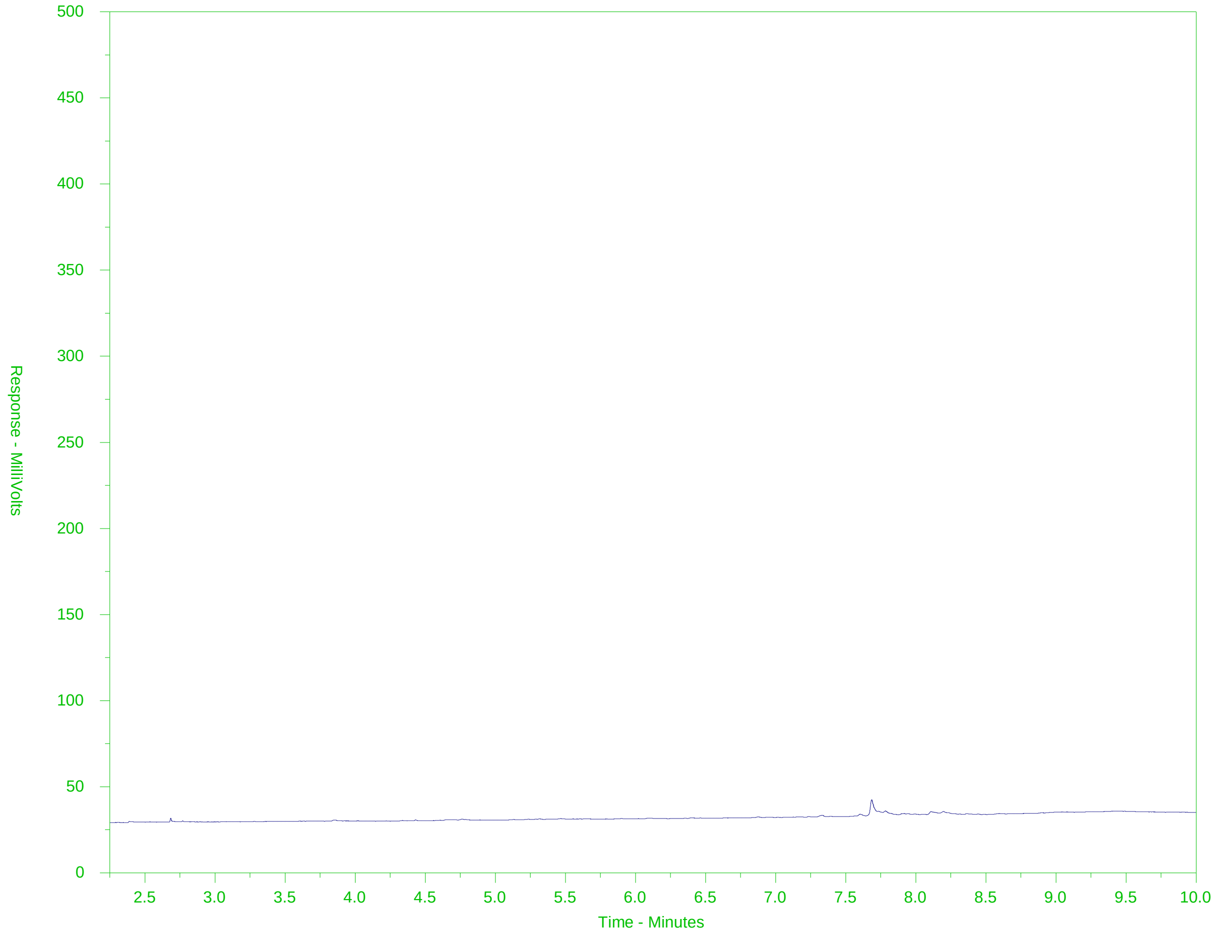
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-10
Client Sample ID: SW-10



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

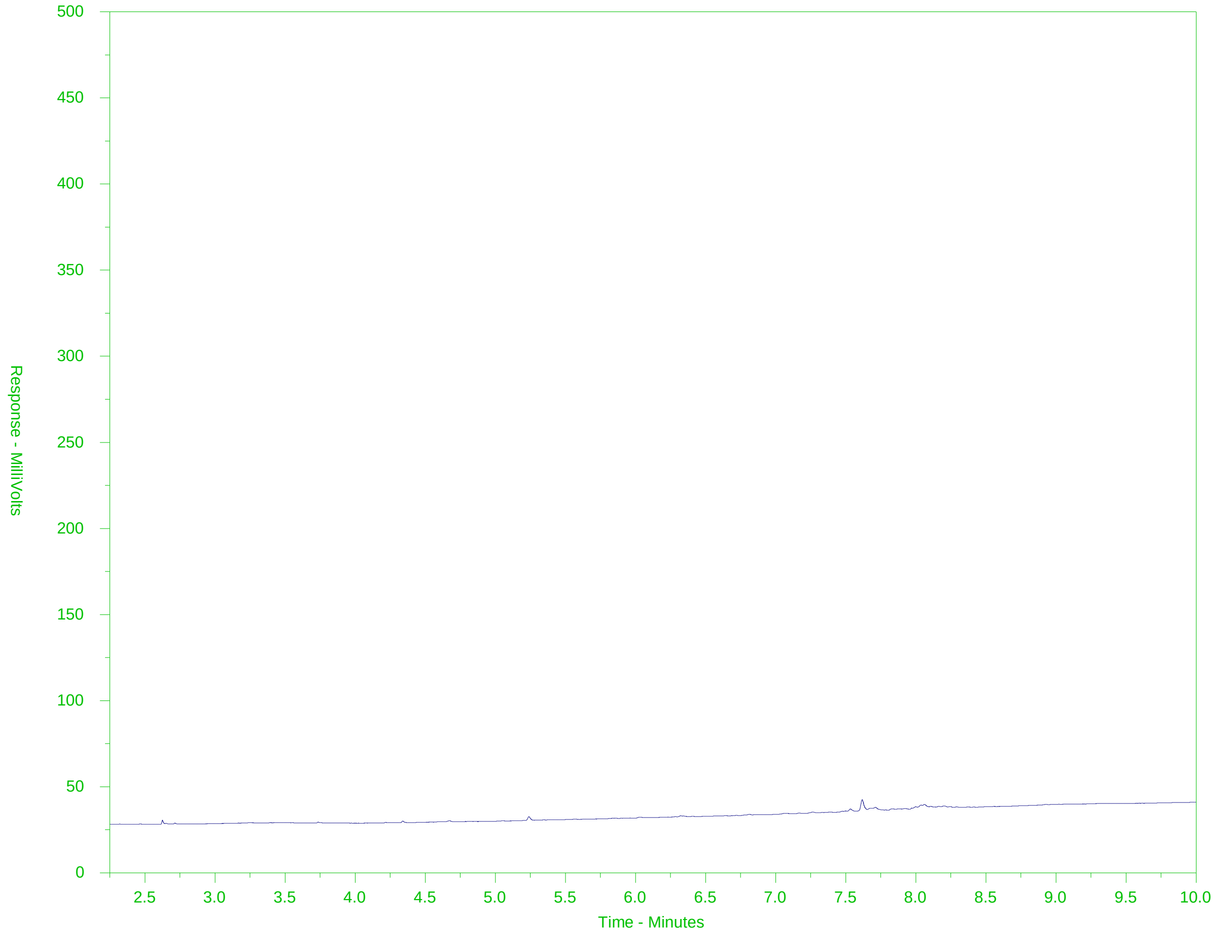
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-11
Client Sample ID: SNW-9



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

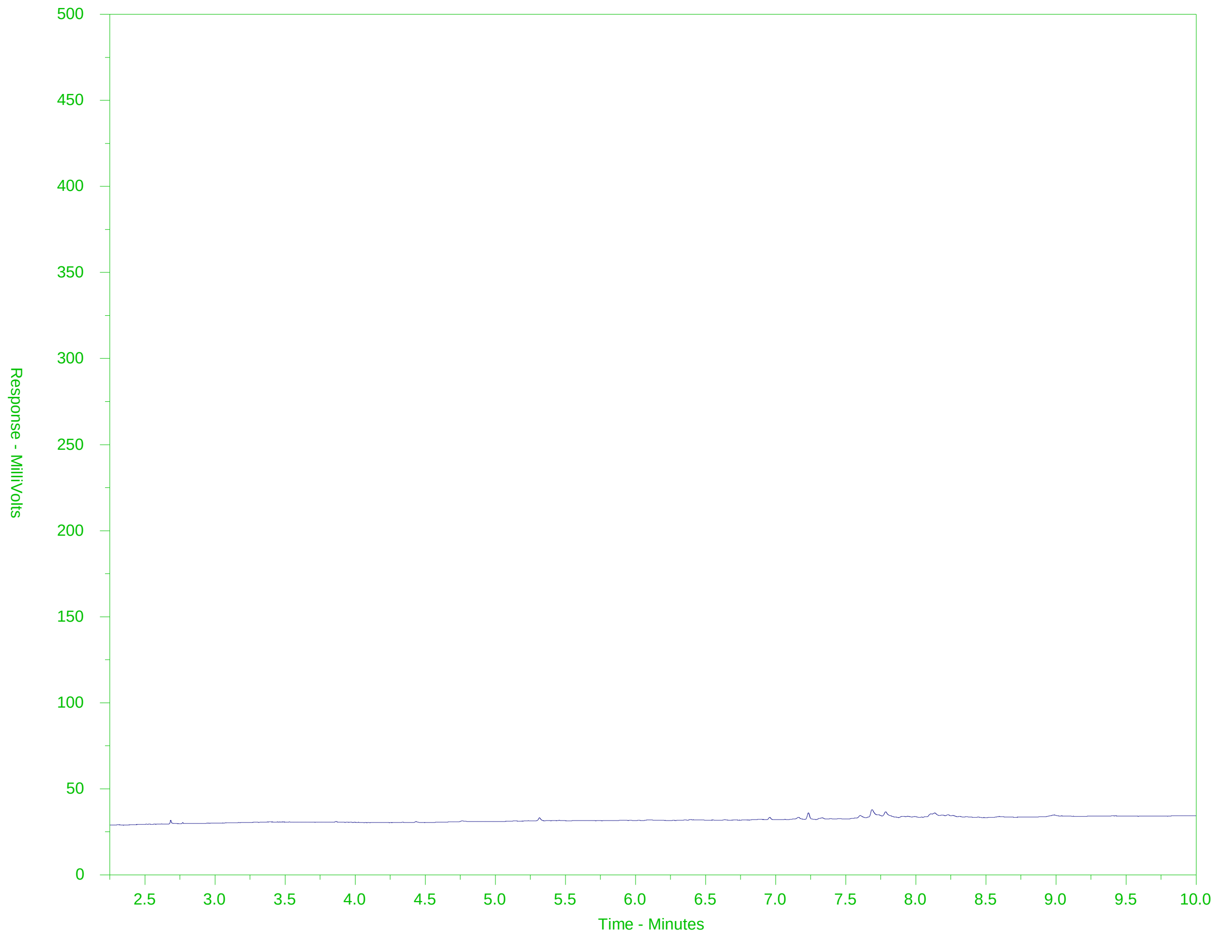
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-12
Client Sample ID: SNW-10



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

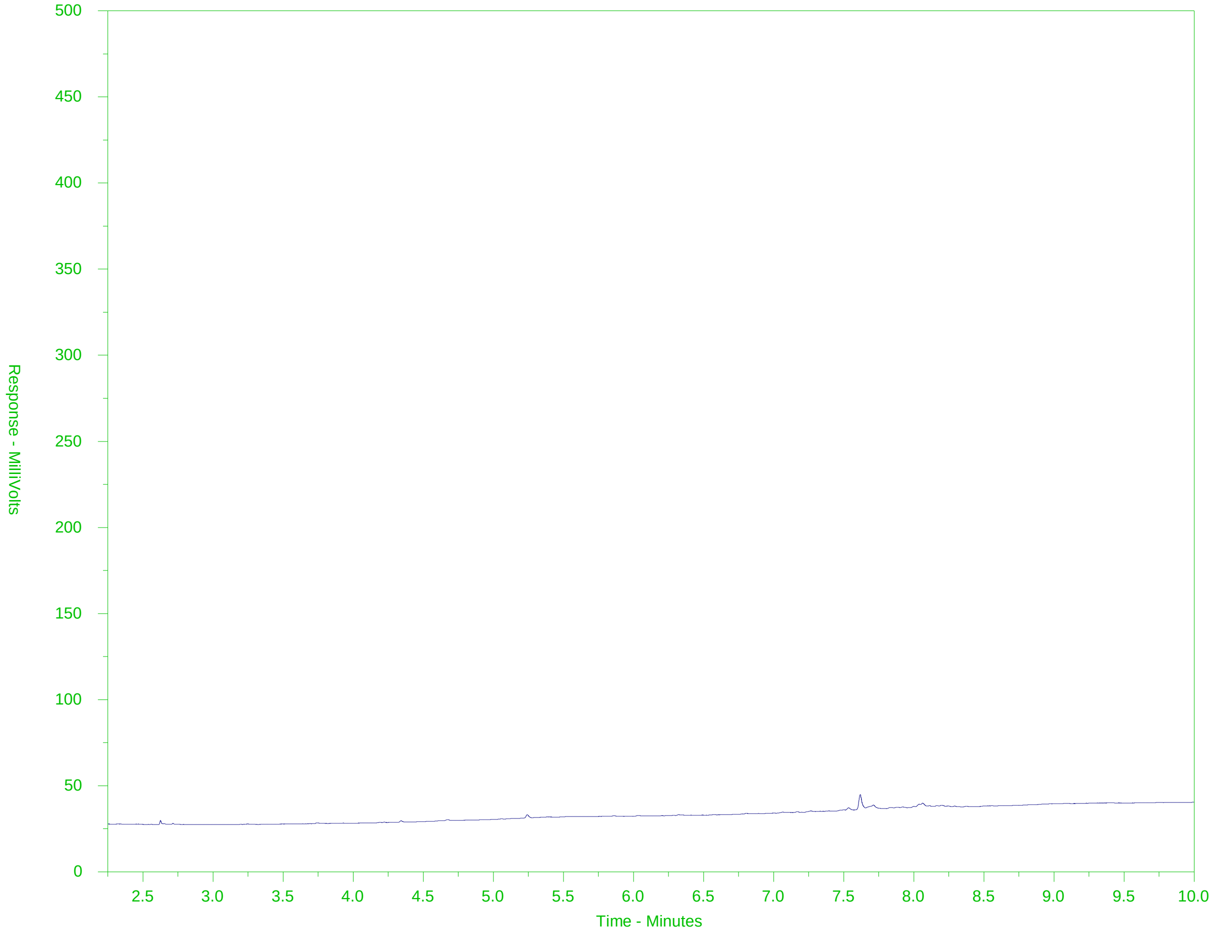
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-13
Client Sample ID: SNE-9



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

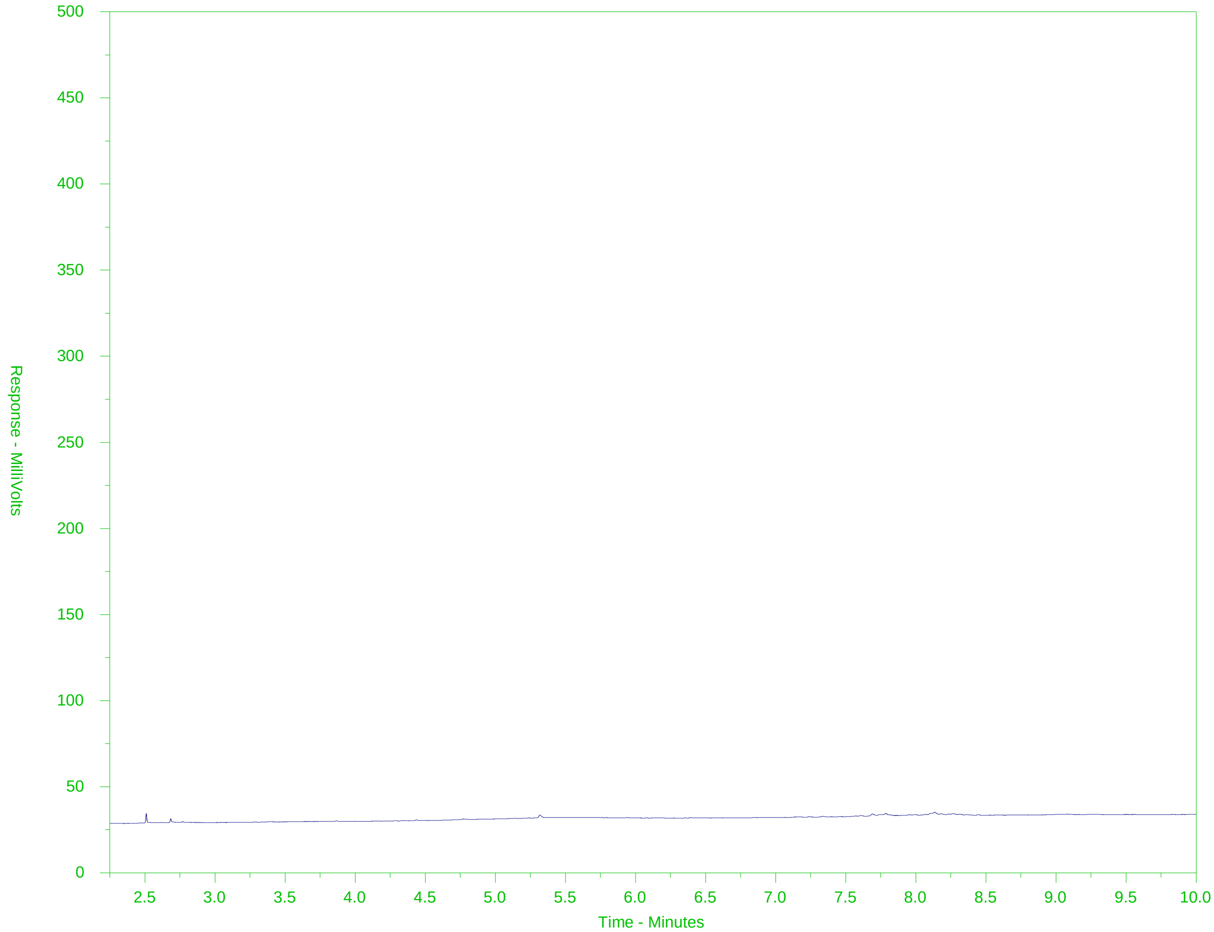
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-14
Client Sample ID: SNE-10



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

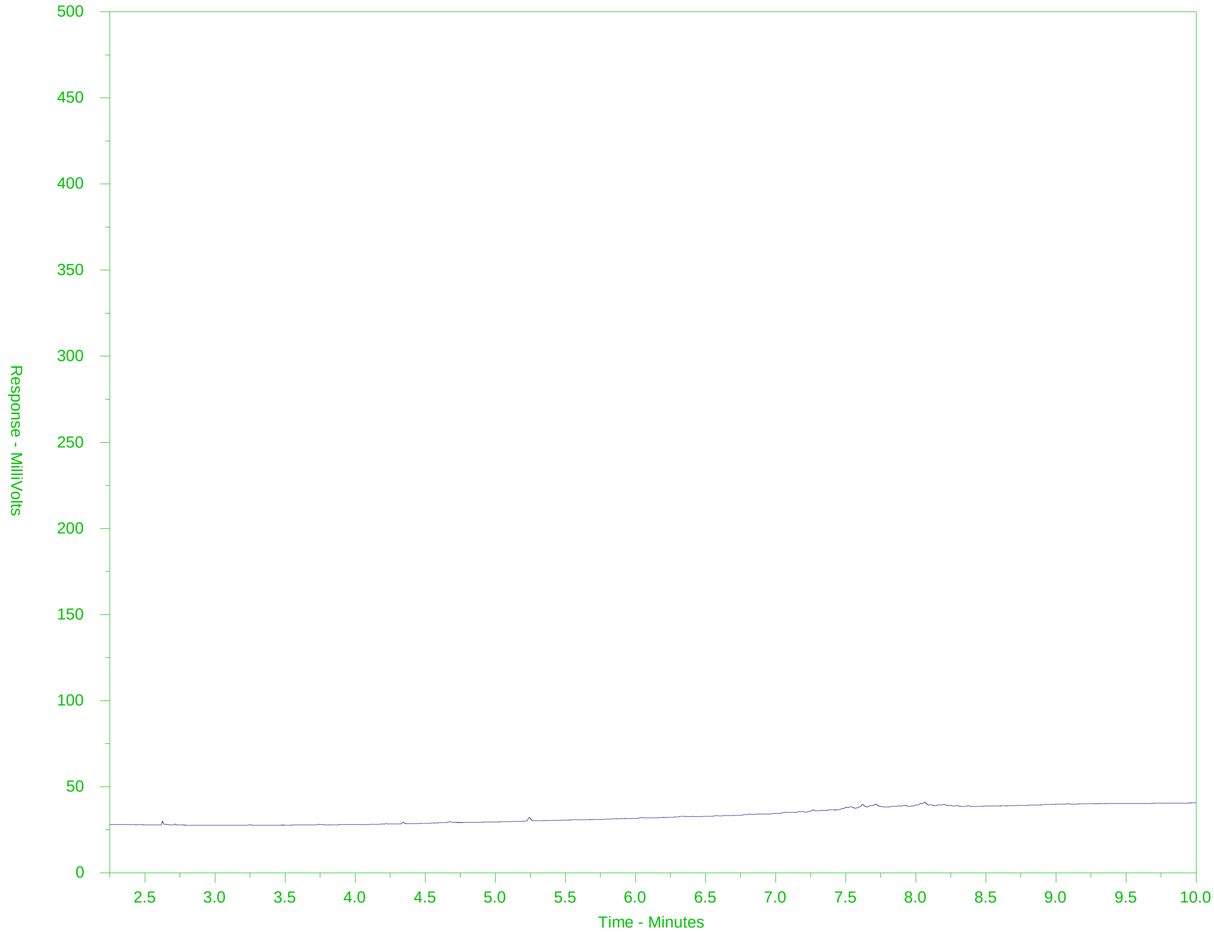
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-15
Client Sample ID: SNE-11



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

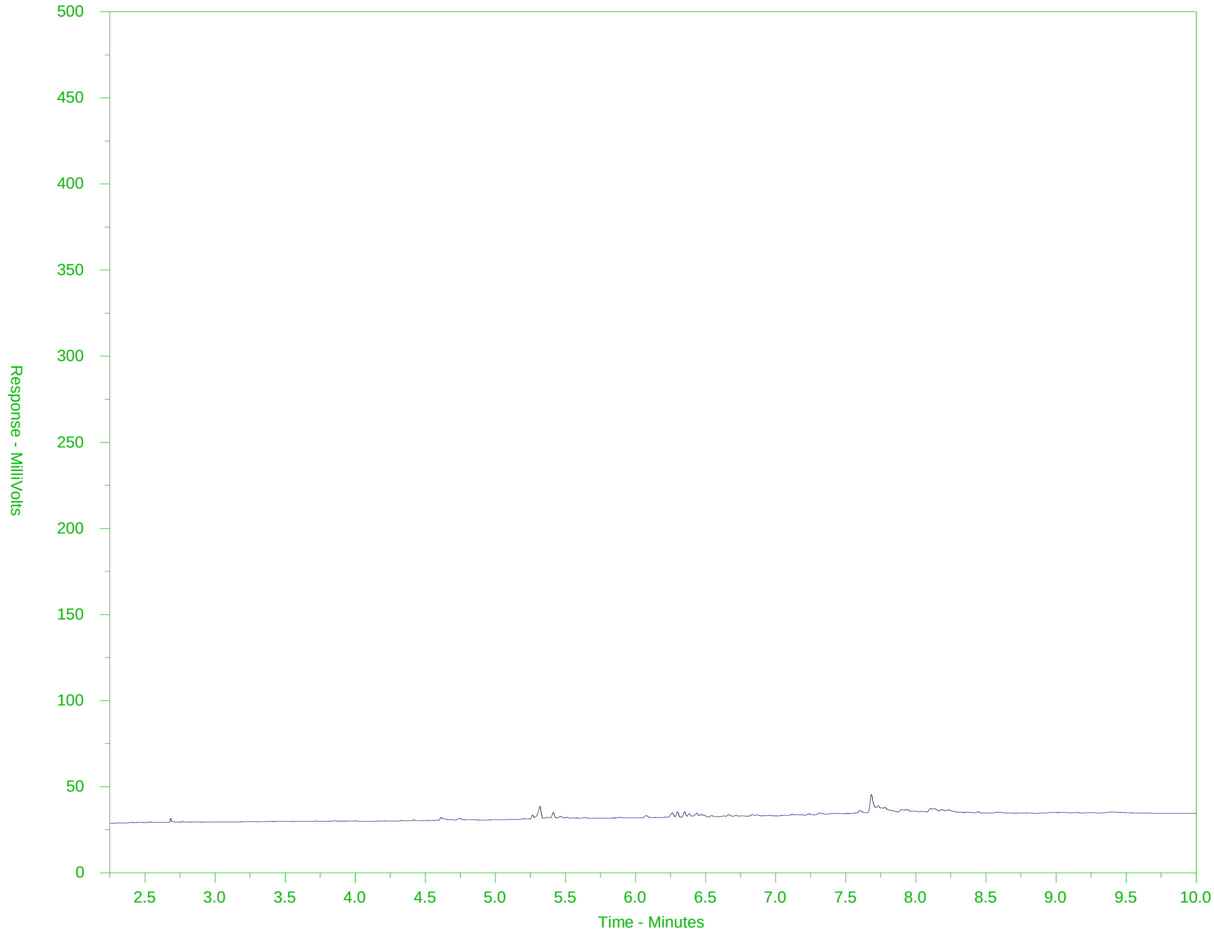
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-16
Client Sample ID: SE-11



EPH10-19		EPH19-32
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

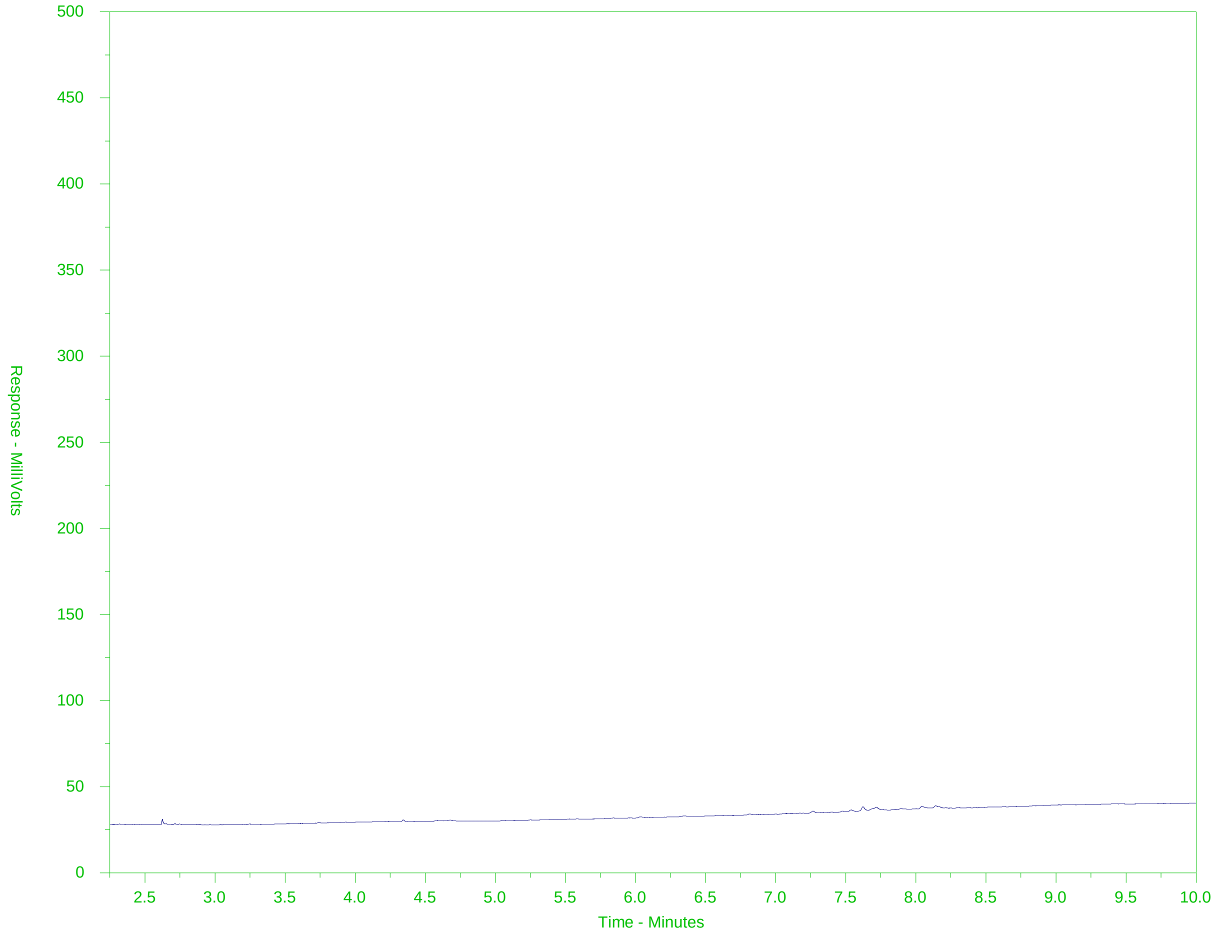
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-17
Client Sample ID: SW-11



← EPH10-19 →	← EPH19-32 →	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

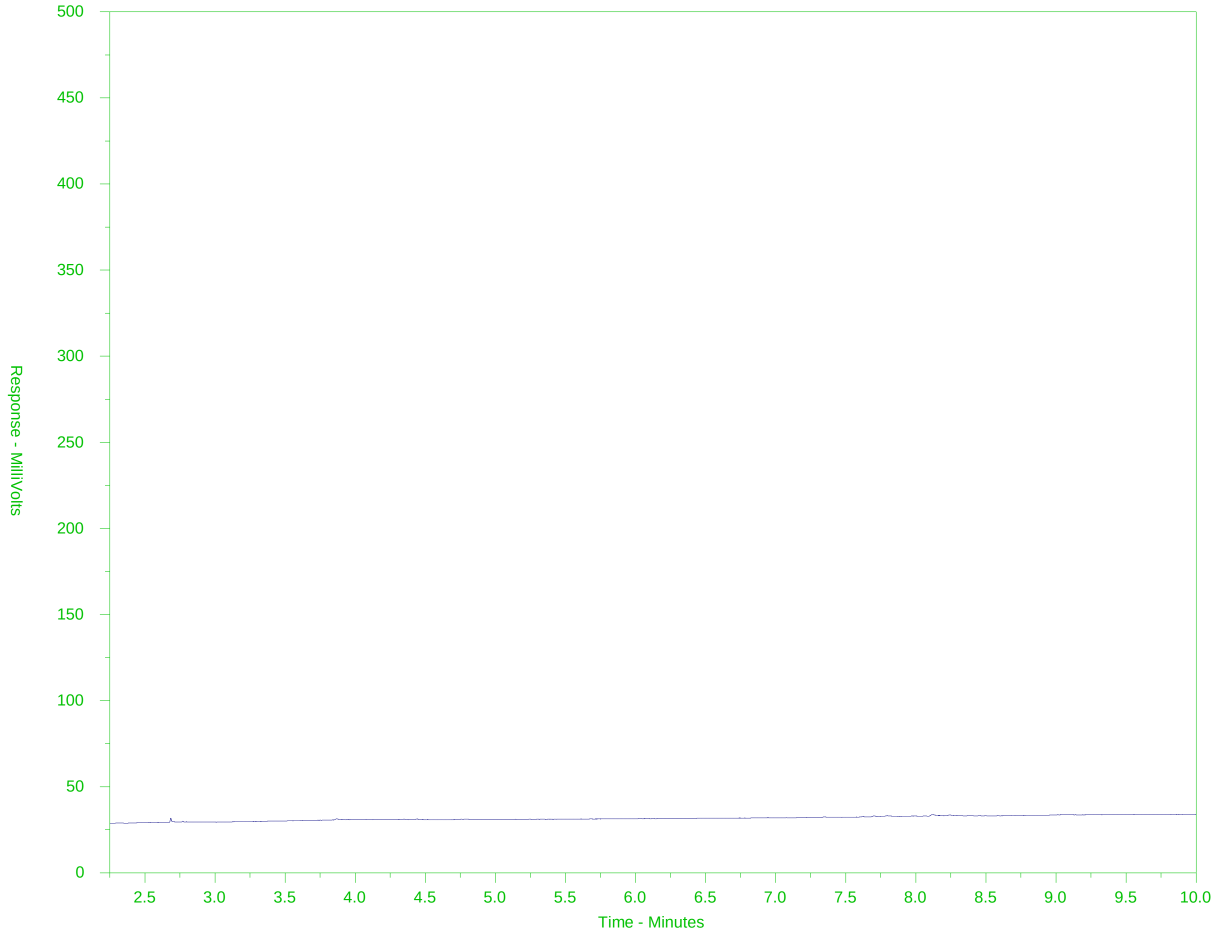
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2365825-18
Client Sample ID: SW-12



EPH10-19	EPH19-32	
nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
Gasoline	Motor Oils/ Lube Oils/ Grease	
Diesel/ Jet Fuels		

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2365825-COFC

COC Number: 17 - 766304

Page 1 of 2

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	PHIL ROUGET
Phone:	250 888 1100
	Company address below will appear on the final report
Street:	2nd Floor 3795 Carey Rd.
City/Province:	Victoria B.C.
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: PRouget@golder.com

Email 2: Patricia_Tomliens@golder.com

Email 3: cbylenga@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Victor_Kim@Golder.com

Email 2: Krista_Joyce@Golder.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #: 1663724/24000

PO / AFE:

LSD:

ALS Lab Work Order # (lab use only):

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact:

Sampler: Christine Bylenga, Trish Tomliens

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Moisture and pH	Extractable Metals	TOC and TIC	Hydrocarbons (EPH, LEPH, HEPH)	PAH	Particle Size	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	SNE-3	03 OCT 19	10:00	SEDIMENT	4	X	X	X	X	X	X		
	SNE-4	03 OCT 19	11:30	SEDIMENT	4	X	X	X	X	X	X		
	SNE-5	03 OCT 19	13:50	SEDIMENT	4	X	X	X	X	X	X		
	SNE-6	03 OCT 19	15:30	SEDIMENT	4	X	X	X	X	X	X		
	SNE-7	03 OCT 19	16:01	SEDIMENT	4	X	X	X	X	X	X		
	SNE-8	03 OCT 19	16:30	SEDIMENT	4	X	X	X	X	X	X		
	SE-9	04 Oct 19	15:45	SEDIMENT	4	X	X	X	X	X	X		
	SE-10	04 Oct 19	16:20	SEDIMENT	4	X	X	X	X	X	X		
	SW-9	05 Oct 19	10:40	SEDIMENT	4	X	X	X	X	X	X		
	SW-10	05 Oct 19	11:10	SEDIMENT	4	X	X	X	X	X	X		
	SNW-9	05 Oct 19	12:00	SEDIMENT	4	X	X	X	X	X	X		
	SNW-10	05 Oct 19	12:30	SEDIMENT	4	X	X	X	X	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C:

FINAL COOLER TEMPERATURES °C: 14, 16, 16 C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Christine Bylenga	Date: 7 October 2019	Time: 1600	Received by:	Date:	Time:	Received by: JH	Date: 16 Oct 19	Time: 9:40 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2365825-COFC

COC Number: 15 - 560006

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Phil Rouget
Phone:	250 888 1100
	Company address below will appear on the final report
Street:	2nd floor 3795 Carey Rd.
City/Province:	Victoria B.C.
Postal Code:	V8Z 6T8
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: PRouget@golder.com
Email 2: Patricia_tomliens@golder.com
Email 3: Cbylenga@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Victor_Kim@golder.com
Email 2: Krista_Joyce@golder.com

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ 3 day [P3] ☐ 2 day [P2] ☐
EMERGENCY: 1 Business day [E1] ☐ Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information	
ALS Account # / Quote #:	
Job #:	1663724 / 24000
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler: Christine Bylenga, Trish Tomliens

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Moisture and pH	Extractable Metals	TOC and TIC	Hydrocarbons (EPH, LEPH, HEPH)	PAH	Particle size	Number of Containers
	SNE-9	05 Oct 19	13:10	SEDIMENT	X	X	X	X	X	X	4
	SNE-10	05 Oct 19	13:55	SEDIMENT	X	X	X	X	X	X	4
	SNE-11	05 Oct 19	14:30	SEDIMENT	X	X	X	X	X	X	4
	SE-11	05 Oct 19	15:00	SEDIMENT	X	X	X	X	X	X	4
	SW-11	06 Oct 19	11:15	SEDIMENT	X	X	X	X	X	X	4
	SW-12	06 OCT 19	11:35	SEDIMENT	X	X	X	X	X	X	4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C:
FINAL COOLER TEMPERATURES °C: 14, 16, 16C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Christine Bylenga	Date: 7 October 2019	Time: 1600	Received by:	Date:	Time:	Received by: JG	Date: 16 Oct 19	Time: 9:40AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY   OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Parameter	Lowest Detection Limit	Units	CCME ISQG	CCME PEL	BC MOE Lower SWQG	BC MOE Upper SWQG	BC MOE Approved	NOAA Sediment Benchmarks T_{20}	NOAA TEL	NOAA ERL	NOAA T_{50}	NOAA PEL	NOAA ERM	NOAA AET
Physical Properties														
Moisture	0.25	%	-	-	-	-	-	-	-	-	-	-	-	-
pH (1:2 soil:water)	0.10	pH	-	-	-	-	-	-	-	-	-	-	-	-
% Gravel (>2mm)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-
% Sand (2.0mm - 0.063mm)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-
% Silt (0.063mm - 4um)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-
% Clay (<4um)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-
Texture			-	-	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon (Soil)														
Inorganic Carbon	0.050	%	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	0.050	%	-	-	-	-	-	-	-	-	-	-	-	-
Metals														
Aluminum (Al)	50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	18000.00
Antimony (Sb)	0.10	mg/kg	-	-	-	-	-	0.63	-	-	2.40	-	-	9.30
Arsenic (As)	0.10	mg/kg	**7.24**	41.6	7.24	42	-	**7.40**	7.24	8.20	20.00	41.60	70.00	35.00
Barium (Ba)	0.50	mg/kg	-	-	-	-	-	-	130.10	-	-	-	-	48.00
Beryllium (Be)	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Bismuth (Bi)	0.20	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Boron (B)	5.0	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd)	0.020	mg/kg	0.7	4.2	0.7	4.2	-	0.38	0.68	1.20	1.40	4.21	9.60	3.00
Calcium (Ca)	50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chromium (Cr)	0.50	mg/kg	52.3	160	52.3	160	-	49.00	52.30	81.00	141.00	160.00	370.00	62.00
Cobalt (Co)	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	10.00
Copper (Cu)	0.50	mg/kg	18.7	108	18.7	108	-	32.00	18.70	34.00	94.00	108.00	270.00	390.00
Iron (Fe)	50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	220000.00
Lead (Pb)	0.50	mg/kg	30.2	112	30.2	112	-	30.00	30.24	46.70	94.00	112.00	218.00	400.00
Lithium (Li)	2.0	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium (Mg)	20	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (Mn)	1.0	mg/kg	-	-	-	-	-	-	-	-	-	-	-	260.00
Mercury (Hg)	0.0050	mg/kg	0.13	0.7	0.13	0.7	-	0.14	0.13	0.15	0.48	0.70	0.71	0.41
Molybdenum (Mo)	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Nickel (Ni)	0.50	mg/kg	-	-	30	50	-	**15.00**	15.90	20.90	47.00	42.80	51.60	110.00
Phosphorus (P)	50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Potassium (K)	100	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Selenium (Se)	0.20	mg/kg	-	-	-	-	2[a]	-	-	-	-	-	-	1.00
Silver (Ag)	0.10	mg/kg	-	-	1	2.2	-	0.23	0.73	1.00	1.10	1.77	3.70	3.10
Sodium (Na)	50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Strontium (Sr)	0.50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Sulfur (S)	1000	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Thallium (Tl)	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Tin (Sn)	2.0	mg/kg	-	-	-	-	-	-	0.05	-	-	-	-	3.40
Titanium (Ti)	1.0	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Tungsten (W)	0.50	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Uranium (U)	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium (V)	0.20	mg/kg	-	-	-	-	-	-	-	-	-	-	-	57.00
Zinc (Zn)	2.0	mg/kg	124	271	124	271	-	94.00	124.00	150.00	245.00	271.00	410.00	410.00
Zirconium (Zr)	1.0	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Volatile Organic Compounds (Soil)														
VOC Sample Container			-	-	-	-	-	-	-	-	-	-	-	-
Benzene	0.0050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Bromodichloromethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Bromoform	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Tetrachloride	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chlorobenzene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Dibromochloromethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chloroethane	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chloroform	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichlorobenzene	0.050	mg/kg	-	-	0.023	-	-	-	-	-	-	-	-	0.01
1,3-Dichlorobenzene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	
1,4-Dichlorobenzene	0.050	mg/kg	-	-	0.031	0.09	-	-	-	-	-	-	-	0.11
1,1-Dichloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
trans-1,2-Dichloroethylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Dichloromethane	0.30	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dichloropropane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
cis-1,3-Dichloropropylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
trans-1,3-Dichloropropylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,3-Dichloropropene (cis & trans)	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.015	mg/kg	-	-	-	-	-	-	-	-	-	-	-	0.00
Methyl t-butyl ether (MTBE)	0.20	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Tetrachloroethylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	0.06
Toluene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethylene	0.010	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Trichlorofluoromethane	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride	0.10	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
ortho-Xylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
meta- & para-Xylene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes	0.075	mg/kg	-	-	-	-	-	-	-	-	-	-	-	0.00
4-Bromofluorobenzene (SS)		%	-	-	-	-	-	-	-	-	-	-	-	-
1,4-Difluorobenzene (SS)		%	-	-	-	-	-	-	-	-	-	-	-	-
Hydrocarbons (Soil)														
EPH10-19	200	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
EPH19-32	200	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
LEPH	200	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
HEPH	200	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride		%	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (Soil)														
Acenaphthene	0.0050	mg/kg	**0.00671**	0.0889	0.00671	0.0889	0.15[b]	0.019	0.007	0.016	0.116	0.089	0.500	0.130
Acenaphthylene	0.0050	mg/kg	0.00587	0.128	0.00587	0.128	-	0.014	0.006	0.044	0.140	0.128	0.640	0.071
Anthracene	0.0040	mg/kg	0.0469	0.245	0.0469	0.245	-	0.034	0.047	0.085	0.290	0.245	1.100	0.280
Benz(a)anthracene	0.010	mg/kg	0.0748	0.693	0.0748	0.693	-	0.061	0.075	0.261	0.466	0.693	1.600	0.960
Benzo(a)pyrene	0.010	mg/kg	0.0888	0.763	0.0888	0.763	0.06[b]	0.069	0.089	0.430	0.520	0.763	1.600	1.100
Benzo(b&j)fluoranthene	0.010	mg/kg	-	-	-	-	-	0.130	-	-	1.107	-	-	1.800
Benzo(b+j+k)fluoranthene	0.015	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	0.010	mg/kg	-	-	0.31	0.78	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	0.010	mg/kg	-	-	2.3	4.5	-	0.070	-	-	0.537	-	-	1.800
Chrysene	0.010	mg/kg	0.108	0.846	0.108	0.846	0.2[b]	0.082	0.108	0.384	0.650	0.846	2.800	0.950
Dibenz(a,h)anthracene	0.0050	mg/kg	**0.00622**	0.135	0.00622	0.135	-	0.019	0.006	0.063	0.113	0.135	0.260	0.230
Fluoranthene	0.010	mg/kg	0.113	1.494	0.113	1.494	-	0.119	0.113	0.600	1.034	1.494	5.100	1.300
Fluorene	0.010	mg/kg	0.0212	0.144	0.0212	0.144	0.2[b]	0.019	0.021	0.019	0.114	0.144	0.540	0.120
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	-	-	0.34	0.88	-	0.068	-	-	0.488	-	-	0.600
1-Methylnaphthalene	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	0.010	mg/kg	0.0202	0.201	0.02	0.202	-	0.021	0.020	0.070	0.128	0.201	0.670	0.064
Naphthalene	0.010	mg/kg	0.0346	0.391	0.0346	0.391	0.01[b]	0.030	0.035	0.160	0.217	0.391	2.100	0.230
Phenanthrene	0.010	mg/kg	0.0867	0.544	0.0867	0.544	-	0.068	0.087	0.240	0.455	0.544	1.500	0.660
Pyrene	0.010	mg/kg	0.153	1.398	0.153	1.398	-	0.125	0.153	0.665	0.932	1.398	2.600	2.400
Quinoline	0.050	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene d10		%	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene d12		%	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene d8		%	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene d10		%	-	-	-	-	-	-	-	-	-	-	-	-
B(a)P Total Potency Equivalent	0.020	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
IACR (CCME)	0.15	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-

Sample ID	SE18-1	SE18-2	SE-1	SE-2	SE-3	SE-4	SE-5	SE-6	SE-7	SE-8	DUPA
Date Sampled	21-Sep-2019	21-Sep-2019	21-Sep-2019	22-Sep-2019	22-Sep-2019	22-Sep-2019	23-Sep-2019	24-Sep-2019	24-Sep-2019	24-Sep-2019	24-Sep-2019
Laboratory Sample ID	L2355484-1	L2355484-2	L2355484-3	L2355484-4	L2355484-5	L2355484-6	L2355484-7	L2355484-8	L2355484-9	L2355484-10	L2355484-11
Parameter	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Properties											
Moisture	17.7	16.9	27.9	14.2	25.3	16.4	30.1	26.7	26.4	33.3	27.7
pH (1:2 soil:water)	8.39	8.35	8.15	8.43	8.23	8.46	8.11	8.12	8.10	8.03	8.13
% Gravel (>2mm)	6.0	15.2	23.9	12.4	11.9	6.8	15.3	14.1	12.0	12.6	14.0
% Sand (2.0mm - 0.063mm)	85.0	66.5	45.4	83.5	55.7	81.1	38.4	48.0	56.0	58.7	54.1
% Silt (0.063mm - 4um)	7.0	14.3	24.3	2.8	25.6	9.1	35.8	29.0	21.0	25.6	25.2
% Clay (<4um)	2.0	3.9	6.4	1.3	6.8	3.1	10.0	9.0	6.9	7.4	6.6
Texture	Sand	Loamy sand	Sandy loam	Sand	Sandy loam	Sand	Loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Organic / Inorganic Carbon (Soil)											
Inorganic Carbon	0.88	1.42	1.48	0.87	1.66	1.08	1.71	1.83	1.74	1.44	1.82
Total Organic Carbon	0.36	0.87	2.32	0.42	1.5	0.61	2.43	1.71	1.26	1.48	1.58
Metals											
Aluminum (Al)	1520	3190	4570	1160	4730	2270	5890	5090	4440	4150	4630
Antimony (Sb)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic (As)	1.02	2.70	3.78	0.67	3.89	1.79	4.21	4.02	4.72	4.41	4.13
Barium (Ba)	4.9	10.5	15.1	4.0	14.4	6.6	15.3	14.1	12.0	12.6	14.0
Beryllium (Be)	<0.10	0.22	0.28	<0.10	0.26	0.18	0.35	0.31	0.27	0.25	0.29
Bismuth (Bi)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	10.3	20.4	32.0	8.9	31.5	15.3	38.0	35.1	28.2	27.7	31.3
Cadmium (Cd)	<0.020	0.02	0.05	<0.020	0.03	<0.020	0.05	0.04	0.03	0.03	0.05
Calcium (Ca)	23500	42100	59700	21700	52700	31700	60600	55200	43600	41100	60600
Chromium (Cr)	6.5	12.0	15.4	3.9	14.9	8.1	18.7	16.1	14.3	13.9	15.5
Cobalt (Co)	0.99	2.09	2.69	0.73	2.60	1.47	3.11	2.73	2.58	2.56	2.79
Copper (Cu)	1.9	3.9	5.8	1.2	5.2	2.7	6.7	5.7	5.0	5.5	6.0
Iron (Fe)	6170	9090	11600	3040	10600	5810	11700	10600	9910	9850	10100
Lead (Pb)	1.51	3.01	4.68	1.32	4.53	2.22	5.45	5.02	4.29	4.39	4.88
Lithium (Li)	6.4	14.3	21.6	6.0	19.9	9.8	24.5	21.5	18.3	17.2	20.5
Magnesium (Mg)	12400	21700	30400	12500	29500	15900	35900	30100	25600	23300	31500
Manganese (Mn)	45	87	117	37	114	60	125	113	104	106	117
Mercury (Hg)	<0.0050	0.0069	0.0100	<0.0050	0.0113	<0.0050	0.0122	0.0124	0.0102	0.0109	0.0129
Molybdenum (Mo)	0.18	0.30	0.69	0.32	0.39	0.27	0.45	0.38	0.32	0.41	0.62
Nickel (Ni)	3.27	6.65	8.88	2.22	8.23	4.46	10.30	8.87	8.49	8.20	9.18
Phosphorus (P)	163	301	408	145	425	197	439	441	390	448	460
Potassium (K)	670	1410	1950	500	2050	1000	2450	2120	1800	1740	1960
Selenium (Se)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	1600	2110	4290	1180	3970	2010	4630	3970	3810	4700	4700
Strontium (Sr)	15.2	27.5	50.2	12.3	38.5	22.5	39.2	38.7	34.4	36.3	57.3
Sulfur (S)	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	<0.050	0.064	0.087	<0.050	0.085	<0.050	0.101	0.087	0.075	0.078	0.083
Tin (Sn)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	88	193	237	78	231	124	252	232	195	217	216
Tungsten (W)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.33	0.54	1.07	0.41	0.84	0.57	0.99	0.77	0.66	0.78	0.80
Vanadium (V)	6.0	12.8	18.7	4.9	18.3	8.9	22.3	20.2	18.3	17.4	20.2
Zinc (Zn)	5.2	9.8	16.3	4.3	14.5	6.6	16.9	14.8	13.9	13.4	14.7
Zirconium (Zr)	2.0	3.5	4.6	1.9	4.6	2.9	5.1	4.8	4.1	3.3	4.0
Volatile Organic Compounds (Soil)											
VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
Benzene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0107	<0.0050	<0.0050	<0.0050
Bromodichloromethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bromoform	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Carbon Tetrachloride	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibromochloromethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloroethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroform	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloromethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,2-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,2-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dichloromethane	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2-Dichloropropane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,3-Dichloropropylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,3-Dichloropropylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichloropropene (cis & trans)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylbenzene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Methyl t-butyl ether (MTBE)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Styrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1,2-Tetrachloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2,2-Tetrachloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tetrachloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.103	<0.050	<0.050	<0.050
1,1,1-Trichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2-Trichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trichloroethylene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Trichlorofluoromethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vinyl Chloride	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ortho-Xylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
4-Bromofluorobenzene (SS)	82.4	74.6	77.2	78.2	80.1	93.4	86.3	99.6	96.1	88.4	75.4
1,4-Difluorobenzene (SS)	92.6	84.9	78.9	73.5	91	100.6	87.3	111.8	102.6	80.6	83.3
Hydrocarbons (Soil)											
EPH10-19	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
EPH19-32	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
LEPH	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
HEPH	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
2-Bromobenzotrifluoride	89	86.1	88.4	90.9	89.2	85.8	84.9	90.7	84.6	90.3	88.5
Polycyclic Aromatic Hydrocarbons (Soil)											
Acenaphthene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	0.01	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	<0.010	<0.010	<0.010	<0.010	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene d10											
Chrysene d12	101.5	111.2	113.8	111.6	102.3	108.9	92	108.2	105.1	105.1	112.3
Naphthalene d8	101.7	112.6	111.4	115.2	107.1	109.1	103.7	112.6	105.9	108.7	112.9
Phenanthrene d10	102.9	114.6	114	116.2	107	110.5	104.8	111.1	106.5	109.3	113.8
B(a)P Total Potency Equivalent	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15

Sample ID	SE-9	SE-10	SE-11	SW-1	DUP B	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7
Date Sampled	4-Oct-2019	4-Oct-2019	5-Oct-2019	27-Sep-2019	27-Sep-2019	27-Sep-2019	27-Sep-2019	27-Sep-2019	27-Sep-2019	28-Sep-2019	28-Sep-2019
Laboratory Sample ID	L2365825-7	L2365825-8	L2365825-16	L2359868-1	L2359868-2	L2359868-3	L2359868-4	L2359868-5	L2359868-6	L2359868-7	L2359868-8
Parameter	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Properties											
Moisture	25.7	29.6	32.1	16.4	15.8	22.6	26.3	24.6	28.5	24.1	28.4
pH (1:2 soil:water)	8.19	8.24	8.24	8.48	8.49	8.29	8.00	8.19	7.96	7.92	8.29
% Gravel (>2mm)	17.7	14.1	9.7	6.7	4.8	2.5	6.1	6.7	6.0	2.3	4.4
% Sand (2.0mm - 0.063mm)	57.8	59.9	37.2	82.9	86.5	83.0	57.3	56.6	53.4	54.0	53.3
% Silt (0.063mm - 4um)	19.3	20.1	41.0	8.1	6.6	11.2	29.5	29.2	32.3	33.6	33.9
% Clay (<4um)	5.2	[illegible]	12.1	2.3	2.1	3.3	7.1	7.5	8.4	8.1	8.3
Texture	Sandy loam	Sandy loam	Loam	Sand	Sand	and / Loamy sa	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Organic / Inorganic Carbon (Soil)											
Inorganic Carbon	1.50	1.74	2.40	1.02	0.82	0.95	1.69	1.66	1.65	1.54	1.67
Total Organic Carbon	1.78	1.52	2.23	0.85	1.19	1.27	2.89	2.53	3.04	3.08	3.26
Metals											
Aluminum (Al)	4500	4750	7440	1840	1710	2570	4490	5040	5020	5110	5530
Antimony (Sb)	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11
Arsenic (As)	5.37	4.08	5.13	1.76	1.84	2.60	3.90	4.45	5.57	6.29	4.86
Barium (Ba)	11.9	12.6	19.2	7.1	5.4	9.3	15.3	16.8	16.4	19.3	19.4
Beryllium (Be)	0.30	0.29	0.45	0.12	0.12	0.17	0.28	0.31	0.33	0.31	0.33
Bismuth (Bi)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	32.6	33.3	52.9	10.8	11.0	16.0	29.1	32.7	35.2	34.8	35.2
Cadmium (Cd)	0.03	0.03	0.06	<0.020	<0.020	<0.020	0.02	0.03	0.03	0.03	0.03
Calcium (Ca)	46500	45500	67400	26200	26000	36100	62700	66000	68400	71500	73800
Chromium (Cr)	13.8	15.1	22.8	7.0	7.0	10.2	16.5	17.6	18.1	19.1	20.1
Cobalt (Co)	2.67	2.66	3.61	1.23	1.20	1.72	2.82	3.05	2.97	3.15	3.29
Copper (Cu)	5.1	5.7	8.0	2.4	2.3	3.2	5.4	5.7	5.7	6.1	6.9
Iron (Fe)	10600	9760	12800	6750	6970	8500	12300	13300	13300	13300	13300
Lead (Pb)	4.33	4.63	6.86	1.75	1.71	2.35	4.51	4.24	4.38	4.36	4.58
Lithium (Li)	18.7	19.5	31.4	7.5	7.4	11.1	19.9	21.8	23.0	23.3	23.7
Magnesium (Mg)	22500	22100	36000	13600	13600	20700	32900	37600	37400	40200	42900
Manganese (Mn)	125	103	134	56	60	80	124	134	135	146	144
Mercury (Hg)	0.0097	0.0101	0.0152	<0.0050	<0.0050	<0.0050	0.0087	0.0087	0.0097	0.0097	0.0121
Molybdenum (Mo)	0.30	0.31	0.49	0.14	0.15	0.20	0.34	0.34	0.31	0.36	0.37
Nickel (Ni)	7.84	8.35	12.40	3.91	3.82	5.30	9.14	9.48	9.69	10.10	10.60
Phosphorus (P)	540	452	535	204	219	340	438	431	559	684	588
Potassium (K)	1780	1880	3040	820	790	1240	2020	2240	2310	2340	2560
Selenium (Se)	<0.20	<0.20	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	3900	4470	6060	2110	1530	2300	3370	3920	4800	3550	4670
Strontium (Sr)	35.4	34.6	53.7	18.6	17.4	23.8	38.0	41.0	44.4	45.8	50.8
Sulfur (S)	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.076	0.080	0.117	<0.050	<0.050	0.053	0.092	0.088	0.093	0.089	0.105
Tin (Sn)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	241	240	301	119	111	172	280	264	264	290	287
Tungsten (W)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.72	0.76	1.09	0.31	0.35	0.45	0.72	0.69	0.72	0.77	0.76
Vanadium (V)	17.9	17.8	28.3	7.6	7.5	10.4	17.6	19.5	19.5	19.7	23.5
Zinc (Zn)	13.9	14.8	20.4	8.2	6.3	8.9	13.8	14.1	14.0	13.9	15.0
Zirconium (Zr)	4.7	5.1	6.0	1.9	2.4	2.9	4.5	4.8	4.9	5.4	5.5
Volatile Organic Compounds (Soil)											
VOC Sample Container	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
Benzene	<0.0050	0.0063	0.0079	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromodichloromethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bromoform	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Carbon Tetrachloride	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibromochloromethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloroethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroform	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloromethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-Dichlorobenzene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,2-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,2-Dichloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dichloromethane	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2-Dichloropropane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,3-Dichloropropylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,3-Dichloropropylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichloropropene (cis & trans)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylbenzene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Methyl t-butyl ether (MTBE)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Styrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1,2-Tetrachloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2,2-Tetrachloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tetrachloroethylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene	<0.050	<0.050	0.091	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1-Trichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2-Trichloroethane	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trichloroethylene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Trichlorofluoromethane	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vinyl Chloride	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ortho-Xylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
4-Bromofluorobenzene (SS)	80.2	89.1	77.3	93	78.6	97.3	86.4	78.3	88.9	81.8	83.1
1,4-Difluorobenzene (SS)	93.1	102.6	78.8	75.6	90.9	96.4	87.4	91.5	66.1	73.4	73.4
Hydrocarbons (Soil)											
EPH10-19	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
EPH19-32	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
LEPH	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
HEPH	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
2-Bromobenzotrifluoride	90.1	90.5	87.4	93.9	85	90.4	91.6	92.1	87.2	86	94.7
Polycyclic Aromatic Hydrocarbons (Soil)											
Acenaphthene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene d10											
Chrysene d12	96.8	98.3	90.3	101.4	110	94	109.8	102.8	104.2	100.6	111.9
Naphthalene d8	99.2	100.5	93.9	109.7	114.8	102.6	111.2	100.9	108.3	103.2	109.6
Phenanthrene d10	98.1	99.4	92.7	112.4	115.2	105.7	114.9	101.9	110	108	113.1
B(a)P Total Potency Equivalent	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15

Notes:

Values	Greater then CCME ISQG guideline
Values	Greater then CCME PEL guideline
Values	Greater then BC MOE working lower SWQG
Values	Greater then NOAA Sediment Benchmarks T_{50} guideline
Values	Greater then NOAA Sediment Benchmarks TEL guideline
Values	Greater then NOAA Sediment Benchmarks ERL

mg/kg - milligram per kilogram, NA - not available, pH - scale of acidity, % - percentage, "-" - no value; mm = millimetre; um = micrometre; PEL = probable effect level; ISQG = interim sediment quality guideline; CCME = Canadian Council of Ministers of the Environment; NOAA = National Oceanic and Atmospheric; TEL = threshold effec level; ERL = Effects Range Low; ERM = effects range medium; Administrat[a]Selenium - BC Alert concentration; [b] PAHs - BC concentrations at 1% TOC

Appendix C-3: Table 1. Sediment Screening Table

Sample ID			SW-8	SW-9	SW-10	SW-11	SW-12	SNW-1	SNW-2	DUP-C	SNW-3	SNW-4	SNW-5	SNW-6	SNW-7	SNW-8
Date Sampled			28-Sep-2019	5-Oct-2019	5-Oct-2019	6-Oct-2019	6-Oct-2019	28-Sep-2019	30-Sep-2019	30-Sep-2019	30-Sep-2019	1-Oct-2019	1-Oct-2019	2-Oct-2019	2-Oct-2019	2-Oct-2019
Laboratory Sample ID			L2359868-9	L2365825-9	L2365825-10	L2365825-17	L2365825-18	L2359868-10	L2360531-1	L2360531-2	L2360531-3	L2360531-4	L2360531-5	L2360531-9	L2360531-10	L2360531-11
Parameter	Lowest Detection Limit	Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Properties																
Moisture	0.25	%	27.4	27.3	25.4	22.3	21.8	23.4	26.3	24.4	28.9	29.4	31.6	27.5	31.5	33.2
pH (1:2 soil:water)	0.10	pH	8.10	8.28	8.25	8.74	8.63	8.33	8.37	8.35	8.29	8.23	8.26	8.34	8.26	8.26
% Gravel (>2mm)	1.0	%	3.4	3.0	1.0	<1.0	1.9	5.8	8.0	13.4	9.1	11.7	9.7	6.2	5.0	7.1
% Sand (2.0mm - 0.063mm)	1.0	%	50.8	54.4	66.9	81.3	77.0	55.7	39.3	40.3	38.6	28.4	32.7	39.2	37.8	31.1
% Silt (0.063mm - 4um)	1.0	%	37.9	36.9	28.2	15.1	18.2	30.7	40.4	35.6	40.4	45.1	41.9	37.6	39.7	42.6
% Clay (<4um)	1.0	%	7.9	5.7	3.9	2.8	2.9	7.7	12.3	10.7	11.8	14.8	15.7	17.1	17.4	19.1
Texture		-	Sandy loam	Sandy loam	Sandy loam	Loamy sand	Loamy sand	Sandy loam	Loam	Loam	Loam	Silt loam	Silt loam	Loam	Loam	Silt loam
Organic / Inorganic Carbon (Soil)																
Inorganic Carbon	0.050	%	1.53	2.12	1.82	1.81	1.88	1.80	2.07	1.80	2.13	2.40	2.27	2.35	2.42	2.66
Total Organic Carbon	0.050	%	3.76	2.9	2.49	1.45	1.42	2.65	2.58	2.81	3.1	3.1	2.8	2.42	2.4	2.7
Metals																
Aluminum (Al)	50	mg/kg	5700	5650	4190	2900	3110	4460	5970	5770	6170	7160	7430	6690	8640	7820
Antimony (Sb)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	0.12	0.12	0.14	0.14	0.17	0.19	0.13
Arsenic (As)	0.10	mg/kg	4.01	4.25	3.94	1.51	1.54	3.67	4.76	4.39	**7.72**	5.48	6.99	6.32	***9.11***	7.13
Barium (Ba)	0.50	mg/kg	19.7	18.3	12.5	9.0	10.2	13.1	17.9	17.1	17.9	19.8	23.4	19.6	24.6	20.6
Beryllium (Be)	0.10	mg/kg	0.34	0.38	0.28	0.19	0.21	0.28	0.35	0.37	0.39	0.45	0.48	0.40	0.54	0.45
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	5.0	mg/kg	35.3	40.6	31.7	22.2	24.1	29.6	37.4	39.2	45.0	45.8	50.1	45.0	58.0	53.1
Cadmium (Cd)	0.020	mg/kg	0.03	0.02	<0.020	<0.020	<0.020	0.03	0.09	0.08	0.06	0.09	0.08	0.09	0.12	0.08
Calcium (Ca)	50	mg/kg	76100	90900	74100	56000	68100	59600	74900	76500	83200	77200	80500	75500	90500	91900
Chromium (Cr)	0.50	mg/kg	21.6	21.1	16.0	10.9	12.7	15.0	20.6	19.1	19.8	22.4	23.0	20.1	25.3	22.4
Cobalt (Co)	0.10	mg/kg	3.51	3.57	2.86	2.04	2.18	2.65	3.73	3.53	3.53	4.06	4.19	3.77	4.70	4.26
Copper (Cu)	0.50	mg/kg	7.1	7.3	5.4	3.8	4.2	5.8	8.3	8.0	7.8	9.3	9.5	9.2	10.5	9.3
Iron (Fe)	50	mg/kg	12300	14000	12900	9860	9960	12300	12700	11900	13300	13600	14200	12500	16800	13900
Lead (Pb)	0.50	mg/kg	4.58	4.60	3.49	2.50	2.75	4.07	5.98	5.79	6.08	7.17	7.30	6.80	8.23	7.04
Lithium (Li)	2.0	mg/kg	25.7	32.2	23.0	16.2	19.2	19.1	26.4	27.0	29.2	33.4	35.5	30.4	40.3	32.3
Magnesium (Mg)	20	mg/kg	46300	45100	37200	26500	33800	33100	46100	41000	43400	45000	42700	36800	47300	42000
Manganese (Mn)	1.0	mg/kg	143	153	136	93	108	129	155	142	160	154	164	137	199	165
Mercury (Hg)	0.0050	mg/kg	0.0108	0.0093	0.0068	<0.0050	<0.0050	0.0092	0.0109	0.0128	0.0126	0.0130	0.0140	0.0128	0.0146	0.0137
Molybdenum (Mo)	0.10	mg/kg	0.34	0.36	0.29	0.28	0.28	0.29	0.34	0.35	0.37	0.36	0.37	0.38	0.46	0.37
Nickel (Ni)	0.50	mg/kg	11.60	11.00	8.21	5.80	6.46	8.41	11.70	11.10	11.50	12.90	13.50	12.00	14.60	13.00
Phosphorus (P)	50	mg/kg	470	494	493	254	277	378	514	456	608	502	522	508	647	470
Potassium (K)	100	mg/kg	2620	2410	1830	1330	1340	1900	2530	2460	2730	3000	3120	2740	3570	3140
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	<0.20	0.22	0.20	0.26	0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	50	mg/kg	3990	4100	4480	3400	2020	3340	4730	4470	5010	4910	5220	4570	6530	5040
Strontium (Sr)	0.50	mg/kg	45.9	46.6	40.7	28.6	32.9	35.9	48.7	52.2	57.1	51.0	57.2	52.7	66.3	60.4
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.050	mg/kg	0.100	0.096	0.075	0.052	0.056	0.074	0.117	0.107	0.105	0.132	0.128	0.117	0.137	0.116
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	327	320	240	181	192	216	250	239	255	273	274	245	343	260
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.050	mg/kg	0.76	0.82	0.63	0.48	0.53	0.70	0.93	0.94	0.90	1.05	0.96	1.00	1.07	0.90
Vanadium (V)	0.20	mg/kg	22.6	21.4	14.9	10.8	12.1	17.2	25.4	23.8	25.1	29.2	31.1	28.2	37.2	31.1
Zinc (Zn)	2.0	mg/kg	14.9	15.7	11.4	8.5	9.0	12.5	18.1	17.4	18.1	21.0	21.5	21.0	24.9	20.4
Zirconium (Zr)	1.0	mg/kg	6.7	6.6	5.6	4.3	4.9	5.1	6.5	6.7	6.5	7.3	7.8	6.9	8.5	7.2
Volatile Organic Compounds (Soil)																
VOC Sample Container		-	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH								
Benzene	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050								
Bromodichloromethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Bromoform	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Carbon Tetrachloride	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Chlorobenzene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Dibromochloromethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Chloroethane	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
Chloroform	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
Chloromethane	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
1,2-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,3-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,4-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1-Dichloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,2-Dichloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1-Dichloroethylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
cis-1,2-Dichloroethylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
trans-1,2-Dichloroethylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Dichloromethane	0.30	mg/kg	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30								
1,2-Dichloropropane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
cis-1,3-Dichloropropylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
trans-1,3-Dichloropropylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,3-Dichloropropene (cis & trans	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
Ethylbenzene	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015								
Methyl t-butyl ether (MTBE	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20								
Styrene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1,1,2-Tetrachloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1,2,2-Tetrachloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Tetrachloroethylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Toluene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1,1-Trichloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
1,1,2-Trichloroethane	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Trichloroethylene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010								
Trichlorofluoromethane	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
Vinyl Chloride	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10								
ortho-Xylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
meta- & para-Xylene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050								
Xylenes	0.075	mg/kg	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075								
4-Bromofluorobenzene (SS		%	78.5	76.6	78.7	71.9	76	83.7								
1,4-Difluorobenzene (SS)		%	88.3	82.9	88.4	82.2	82.8	71.7								
Hydrocarbons (Soil)																
EPH10-19	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
EPH19-32	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
LEPH	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
HEPH	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
2-Bromobenzotrifluoride		%	95.4	87.5	90.6	89.6	93.4	91.1	87.5	90.7	90.5	90.9	88.1	91.1	88	93.1
Polycyclic Aromatic Hydrocarbons (Soil)																
Acenaphthene	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.028	<0.010	<0.010
Benzo(b&j)fluoranthene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.032	<0.010	<0.010
Benzo(b+j+k)fluoranthene	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.047	<0.015	<0.015
Benzo(g,h,i)perylene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.051	<0.010	<0.010
Benzo(k)fluoranthene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010	<0.010
Chrysene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0070	<0.0050	<0.0050	<0.0050	<0.0050	**0.0098**	<0.0050	<0.0050
Fluoranthene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.038	<0.010	<0.010
1-Methylnaphthalene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene d10		%														
Chrysene d12		%	110.9	93.9	107.8	95.2	99.2	103.3	71.4	73.9	71.1	69.6	69.7	71.2	69.9	95.9
Naphthalene d8		%	108	97.7	108.9	104.8	103.4	101.1	91	91.6	90.8	88.5	89.5	90.3	90.3	93.6
Phenanthrene d10		%	113	96.2	109.1	103.3	102.3	108.5	88.2	92.8	92.2	88.2	90.7	89.7	89.1	97.8
B(a)P Total Potency Equivalen	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.047	<0.020	<0.020
IACR (CCME)	0.15	mg/kg	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.45	<0.15	<0.15

Sample ID			SNW-9	SNW-10	SNE-1	SNE-2	DUP-D	SNE-3	SNE-4	SNE-5	SNE-6	SNE-7	SNE-8	SNE-9	SNE-10	SNE-11
Date Sampled			5-Oct-2019	5-Oct-2019	1-Oct-2019	1-Oct-2019	1-Oct-2019	3-Oct-2019	3-Oct-2019	3-Oct-2019	3-Oct-2019	3-Oct-2019	3-Oct-2019	5-Oct-2019	5-Oct-2019	5-Oct-2019
Laboratory Sample ID			L2365825-11	L2365825-12	L2360531-6	L2360531-7	L2360531-8	L2365825-1	L2365825-2	L2365825-3	L2365825-4	L2365825-5	L2365825-6	L2365825-13	L2365825-14	L2365825-15
Parameter	Lowest Detection Limit	Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Properties																
Moisture	0.25	%	31.5	28.2	17.5	30.1	28.9	22.5	32.1	34.2	34.1	36	34.8	37.6	36.5	35.8
pH (1:2 soil:water)	0.10	pH	8.20	7.92	8.53	7.30	7.82	8.14	8.11	8.09	8.12	8.11	8.09	8.06	8.14	8.17
% Gravel (>2mm)	1.0	%	10.6	24.7	11.4	10.1	13.9	33.2	9.5	5.4	8.3	1.6	2.9	4.0	5.6	5.3
% Sand (2.0mm - 0.063mm)	1.0	%	22.8	29.5	64.2	39.2	38.8	34.6	30.8	22.7	23.7	21.1	21.1	15.8	21.7	26.7
% Silt (0.063mm - 4um)	1.0	%	45.6	31.2	18.8	38.5	36.6	24.8	43.4	49.4	47.8	53.3	53.0	54.7	49.5	46.3
% Clay (<4um)	1.0	%	21.0	14.5	5.6	12.2	10.7	7.4	16.2	22.5	20.2	24.0	22.9	25.4	23.2	21.7
Texture		-	Silt loam	Loam	Sandy loam	Loam	Loam	am / Sandy lo	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon (Soil)																
Inorganic Carbon	0.050	%	3.10	3.05	1.24	2.48	2.00	2.43	2.40	2.90	2.82	2.93	2.56	3.15	3.11	3.65
Total Organic Carbon	0.050	%	2.7	1.9	1.69	2.9	2.73	1.64	2.48	2.4	1.76	2.3	2.7	2.2	2.1	1.4
Metals																
Aluminum (Al)	50	mg/kg	9530	8890	3440	5890	5610	5400	8960	10900	9620	12000	10900	12100	11200	12100
Antimony (Sb)	0.10	mg/kg	0.17	0.19	<0.10	0.11	0.11	0.10	0.16	0.21	0.20	0.23	0.20	0.25	0.23	0.23
Arsenic (As)	0.10	mg/kg	5.65	***10.10***	2.40	6.27	6.04	6.54	***8.46***	***12.40***	***11.00***	***8.23***	**7.39**	***10.20***	***8.97***	***11.00***
Barium (Ba)	0.50	mg/kg	23.9	24.1	11.1	18.5	16.4	15.8	25.2	29.8	27.1	30.1	28.5	33.4	31.6	32.4
Beryllium (Be)	0.10	mg/kg	0.63	0.55	0.20	0.36	0.37	0.34	0.58	0.69	0.64	0.73	0.69	0.73	0.69	0.71
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	5.0	mg/kg	66.2	61.6	22.5	40.3	38.0	38.6	62.0	74.3	68.7	77.6	70.9	77.3	73.8	78.7
Cadmium (Cd)	0.020	mg/kg	0.13	0.09	0.05	0.12	0.06	0.06	0.07	0.12	0.10	0.13	0.10	0.10	0.10	0.12
Calcium (Ca)	50	mg/kg	103000	88300	41900	67600	64500	75700	87200	90500	90600	92400	86900	90600	89100	89400
Chromium (Cr)	0.50	mg/kg	27.4	25.5	11.2	18.1	17.6	16.8	26.3	29.3	28.4	32.7	30.8	33.8	31.1	33.3
Cobalt (Co)	0.10	mg/kg	5.03	4.73	1.87	3.40	3.37	3.17	4.87	5.32	5.30	5.82	5.52	6.15	5.63	6.02
Copper (Cu)	0.50	mg/kg	11.2	10.3	4.2	7.3	7.0	6.5	10.3	11.9	11.7	13.2	12.3	13.6	12.9	13.5
Iron (Fe)	50	mg/kg	15300	16500	7460	12200	11900	11500	17000	19800	18400	19500	18500	20700	19100	20600
Lead (Pb)	0.50	mg/kg	8.75	8.05	3.59	5.73	5.76	5.23	8.34	9.57	9.60	10.30	9.66	10.20	10.10	10.40
Lithium (Li)	2.0	mg/kg	48.7	42.9	14.3	25.4	25.6	26.8	43.2	49.9	47.2	54.0	52.1	52.5	49.5	52.7
Magnesium (Mg)	20	mg/kg	44500	38600	24500	37800	35500	35100	46600	44800	45300	46600	44600	47500	44500	44400
Manganese (Mn)	1.0	mg/kg	178	193	82	155	151	143	194	194	207	196	191	230	208	220
Mercury (Hg)	0.0050	mg/kg	0.0146	0.0181	0.0074	0.0116	0.0121	0.0122	0.0166	0.0197	0.0214	0.0199	0.0192	0.0221	0.0207	0.0215
Molybdenum (Mo)	0.10	mg/kg	0.49	0.45	0.26	0.35	0.36	0.33	0.41	0.50	0.61	0.50	0.46	0.54	0.52	0.54
Nickel (Ni)	0.50	mg/kg	**15.80**	14.90	6.12	10.50	10.50	9.66	15.00	**16.80**	**16.70**	**18.60**	**17.40**	**19.00**	**17.70**	**18.90**
Phosphorus (P)	50	mg/kg	470	627	323	489	460	477	626	922	679	613	585	767	603	645
Potassium (K)	100	mg/kg	3780	3520	1510	2570	2360	2190	3590	4370	3770	4510	4410	4640	4400	4730
Selenium (Se)	0.20	mg/kg	0.27	0.28	<0.20	0.21	<0.20	<0.20	0.30	0.31	0.33	0.32	0.32	0.34	0.33	0.35
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	50	mg/kg	5430	5960	2540	5720	4520	3860	5850	6530	6470	6430	6350	8240	6500	7680
Strontium (Sr)	0.50	mg/kg	69.2	61.3	29.8	57.3	47.7	47.1	59.0	73.8	64.1	61.3	58.8	67.8	63.5	65.2
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.050	mg/kg	0.154	0.142	0.059	0.106	0.098	0.089	0.143	0.170	0.160	0.185	0.163	0.174	0.178	0.179
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	316	333	160	234	228	219	338	358	334	391	366	392	360	376
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.050	mg/kg	1.45	1.08	0.60	0.77	0.77	0.73	1.07	1.32	1.25	1.54	1.39	1.32	1.31	1.39
Vanadium (V)	0.20	mg/kg	34.9	38.6	13.5	24.3	23.6	22.3	37.1	42.8	39.9	45.2	41.7	47.1	43.7	47.3
Zinc (Zn)	2.0	mg/kg	26.6	25.9	10.1	19.3	17.6	15.5	25.8	29.1	28.4	33.1	30.5	33.7	31.1	33.6
Zirconium (Zr)	1.0	mg/kg	10.5	7.6	4.4	5.7	5.5	4.7	8.5	9.1	8.4	11.0	10.3	10.6	9.9	10.5
Volatile Organic Compounds (Soil)																
VOC Sample Container		-	Field MeOH	Field MeOH				Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH	Field MeOH
Benzene	0.0050	mg/kg	<0.0050	<0.0050				<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	0.0057
Bromodichloromethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Bromoform	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Carbon Tetrachloride	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlorobenzene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibromochloromethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloroethane	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroform	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloromethane	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-Dichlorobenzene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-Dichloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-Dichloroethylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,2-Dichloroethylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,2-Dichloroethylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dichloromethane	0.30	mg/kg	<0.30	<0.30				<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2-Dichloropropane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
cis-1,3-Dichloropropylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
trans-1,3-Dichloropropylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-Dichloropropene (cis & trans	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethylbenzene	0.015	mg/kg	<0.015	<0.015				<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Methyl t-butyl ether (MTBE	0.20	mg/kg	<0.20	<0.20				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Styrene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1,2-Tetrachloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2,2-Tetrachloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tetrachloroethylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.078	0.09
1,1,1-Trichloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2-Trichloroethane	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Trichloroethylene	0.010	mg/kg	<0.010	<0.010				<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Trichlorofluoromethane	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vinyl Chloride	0.10	mg/kg	<0.10	<0.10				<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ortho-Xylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	<0.050	<0.050				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes	0.075	mg/kg	<0.075	<0.075				<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
4-Bromofluorobenzene (SS		%	79.8	84.4				77.6	89.5	74.3	83.8	79.7	83.3	82.2	73.3	79.8
1,4-Difluorobenzene (SS)		%	55.7	82.3				70.4	102.7	84	94.9	77.5	72.5	94.7	78.5	74.8
Hydrocarbons (Soil)																
EPH10-19	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
EPH19-32	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
LEPH	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
HEPH	200	mg/kg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
2-Bromobenzotrifluoride		%	89.6	86.8	92.5	88	98.4	83.5	93.4	90.3	83.8	86.6	90.6	90.1	93.9	87.6
Polycyclic Aromatic Hydrocarbons (Soil)																
Acenaphthene	0.0050	mg/kg	<0.0050	<0.0050	**0.013**	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	<0.0040	<0.0040	0.008	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.010	mg/kg	<0.010	<0.010	0.031	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.010	mg/kg	<0.010	<0.010	0.033	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	0.010	mg/kg	<0.010	<0.010	0.048	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	0.015	mg/kg	<0.015	<0.015	0.069	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	0.010	mg/kg	<0.010	<0.010	0.04	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	0.010	mg/kg	<0.010	<0.010	0.022	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.010	mg/kg	<0.010	<0.010	0.041	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	mg/kg	<0.0050	<0.0050	**0.0177**	<0.0070	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	**0.0088**	**0.0076**	<0.0050	<0.0050	<0.0050
Fluoranthene	0.010	mg/kg	<0.010	<0.010	0.05	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.010	mg/kg	<0.010	<0.010	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	<0.010	<0.010	0.034	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1-Methylnaphthalene	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.010	mg/kg	<0.010	<0.010	0.043	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	0.010	mg/kg	<0.010	<0.010	0.042	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Quinoline	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthene d10		%														
Chrysene d12		%	96.5	96.5	74.2	76.7	102.6	95.3	104.4	97.7	92.8	95.9	106	95.3	100	99.9
Naphthalene d8		%	102.2	101.9	90.3	97.6	101.9	96.3	107.2	103.4	95.5	97.9	108.9	100.2	104.8	105.5
Phenanthrene d10		%	99.7	99.3	90.8	96.3	72.7	96.2	107.3	101.7	94.7	98.1	108.5	98.3	102.8	103.8
B(a)P Total Potency Equivalen	0.020	mg/kg	<0.020	<0.020	0.065	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
IACR (CCME)	0.15	mg/kg	<0.15	<0.15	0.73	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15

Notes:

Values	Greater then CCME ISQG
Values	Greater then CCME PEL g
Values	Greater then BC MOE wor
Values	Greater then NOAA Sedim
Values	Greater then NOAA Sedim
Values	Greater then NOAA Sedim

mg/kg - milligram per kilogram, NA - not available, pH - scale of acidity, % - percentage, "-" - no value; mm = r

Appendix C-3: Table 2. RPD Table

Golder Sample ID		DUP A	SE-6	Calculated RPD%	DUP B	SW-1	Calculated RPD%	DUP-C	SNW-2	Calculated RPD%	DUP-D	SNE-2	Calculated RPD%
Sample Matrix		SED	SED		SED	SED		SED	SED		SED	SED	
Sampling Date		24-Sep-19	24-Sep-19		27-Sep-19	27-Sep-19		30-Sep-19	30-Sep-19		1-Oct-19	1-Oct-19	
Physical Parameters and Nutrients													
Clay Content	%	6.6	9.0	31	2.1	2.3	n/c	10.7	12.3	14	10.7	12.2	13
Inorganic carbon as calcium carbonate equivalent	%	15.1	15.3	1	6.84	8.52	22.0	15.0	17.2	14	16.6	20.7	22
Moisture, Percent	%	27.7	26.7	4	15.8	16.4	4.0	24.4	26.3	7	28.9	30.1	4
Sieve - #10 (>2.00mm)	%	14.0	14.0	0	4.8	6.7	33.0	13.4	8.0	**50**	13.9	10.1	32
Total Carbon	%	3.40	3.54	4	2.01	1.87	7.0	4.61	4.65	1	4.73	5.39	13
Total Inorganic Carbon	%	1.82	1.83	1	0.821	1.02	22.0	1.80	2.07	14	2.00	2.48	21
Total Metals													
Aluminum	mg/kg	4630	5090	9	1710	1840	7.0	5770	5970	3	5610	5890	5
Antimony	mg/kg	0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	0.12	0.13	n/c	0.11	0.11	n/c
Arsenic	mg/kg	4.13	4.02	3	1.84	1.76	4.0	4.39	4.76	8	6.04	6.27	4
Barium	mg/kg	14.0	14.1	1	5.39	7.12	28.0	17.1	17.9	5	16.4	18.5	12
Beryllium	mg/kg	0.29	0.31	n/c	0.12	0.12	n/c	0.37	0.35	n/c	0.37	0.36	n/c
Bismuth	mg/kg	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c
Boron	mg/kg	31.3	35.1	11	11.0	10.8	n/c	39.2	37.4	5	38.0	40.3	6
Cadmium	mg/kg	0.046	0.043	n/c	< 0.020	< 0.020	n/c	0.083	0.093	n/c	0.055	0.119	**74**
Calcium	mg/kg	60600	55200	9	26000	26200	1.0	76500	74900	2	64500	67600	5
Chromium	mg/kg	15.5	16.1	4	7.02	7.03	0.0	19.1	20.6	8	17.6	18.1	3
Cobalt	mg/kg	2.79	2.73	2	1.20	1.23	2.0	3.53	3.73	6	3.37	3.40	1
Copper	mg/kg	6.02	5.69	6	2.27	2.35	n/c	8.00	8.32	4	6.99	7.26	4
Iron	mg/kg	10100	10600	5	6970	6750	3.0	11900	12700	7	11900	12200	2
Lead	mg/kg	4.88	5.02	3	1.71	1.75	n/c	5.79	5.98	3	5.76	5.73	1
Lithium	mg/kg	20.5	21.5	5	7.4	7.5	n/c	27.0	26.4	2	25.6	25.4	1
Magnesium	mg/kg	31500	30100	5	13600	13600	0.0	41000	46100	12	35500	37800	6
Manganese	mg/kg	117	113	3	59.9	56.3	6.0	142	155	9	151	155	3
Mercury	mg/kg	0.0129	0.0124	n/c	< 0.0050	< 0.0050	n/c	0.0128	0.0109	n/c	0.0121	0.0116	n/c
Molybdenum	mg/kg	0.62	0.38	48	0.15	0.14	n/c	0.35	0.34	n/c	0.36	0.35	n/c
Nickel	mg/kg	9.18	8.87	3	3.82	3.91	2.0	11.1	11.7	5	10.5	10.5	0
pH	pH units	8.13	8.12	0	8.49	8.48	0.0	8.35	8.37	0	7.82	7.30	7
Phosphorus	mg/kg	460	441	4	219	204	n/c	456	514	12	460	489	6
Potassium	mg/kg	1960	2120	8	790	820	4.0	2460	2530	3	2360	2570	9
Selenium	mg/kg	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	0.21	n/c
Silver	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Sodium	mg/kg	4700	3970	17	1530	2110	32.0	4470	4730	6	4520	5720	23
Strontium	mg/kg	57.3	38.7	39	17.4	18.6	7.0	52.2	48.7	7	47.7	57.3	18
Sulphur (H2S)	mg/kg	< 1000	< 1000	n/c	< 1000	< 1000	n/c	< 1000	< 1000	n/c	< 1000	< 1000	n/c
Thallium	mg/kg	0.083	0.087	n/c	< 0.050	< 0.050	n/c	0.107	0.117	n/c	0.098	0.106	n/c
Tin	mg/kg	< 2.0	< 2.0	n/c	< 2.0	< 2.0	n/c	< 2.0	< 2.0	n/c	< 2.0	< 2.0	n/c
Titanium	mg/kg	216	232	7	111	119	7.0	239	250	4	228	234	3
Tungsten	mg/kg	< 0.50	< 0.50	n/c	< 0.50	< 0.50	n/c	< 0.50	< 0.50	n/c	< 0.50	< 0.50	n/c
Uranium	mg/kg	0.798	0.771	3	0.353	0.314	12.0	0.937	0.926	1	0.774	0.770	1
Vanadium	mg/kg	20.2	20.2	0	7.54	7.57	0.0	23.8	25.4	7	23.6	24.3	3
Zinc	mg/kg	14.7	14.8	1	6.3	8.2	n/c	17.4	18.1	4	17.6	19.3	9
Zirconium	mg/kg	4.0	4.8	n/c	2.4	1.9	n/c	6.7	6.5	3	5.5	5.7	4

Appendix C-3: Table 2. RPD Table

Golder Sample ID		DUP A	SE-6	Calculated RPD%	DUP B	SW-1	Calculated RPD%	DUP-C	SNW-2	Calculated RPD%	DUP-D	SNE-2	Calculated RPD%
Sample Matrix		SED	SED		SED	SED		SED	SED		SED	SED	
Sampling Date		24-Sep-19	24-Sep-19		27-Sep-19	27-Sep-19		30-Sep-19	30-Sep-19		1-Oct-19	1-Oct-19	
Polycyclic Aromatic Hydrocarbons (PAHs)													
1-Methylnaphthalene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
2-methylnaphthalene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Acenaphthene	mg/kg	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c
Acenaphthylene	mg/kg	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c
Anthracene	mg/kg	< 0.0040	< 0.0040	n/c	< 0.0040	< 0.0040	n/c	< 0.0040	< 0.0040	n/c	< 0.0040	< 0.0040	n/c
Benz(a)anthracene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Benzo(a)pyrene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Benzo(a)pyrene Total Potency Equivalence (TPE)	mg/kg	< 0.020	< 0.020	n/c	< 0.020	< 0.020	n/c	< 0.020	< 0.020	n/c	< 0.020	< 0.020	n/c
Benzo(b,j) fluoranthene	mg/kg	< 0.010	0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Benzo(b,j,k)fluoranthene	mg/kg	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c
Benzo(g,h,i)perylene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Benzo(k)fluoranthene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Chrysene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Dibenz(a,h)anthracene	mg/kg	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0070	n/c	< 0.0050	< 0.0070	n/c
EPH (C10-C19)	mg/kg	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c
EPH (C19-C32)	mg/kg	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c
Fluoranthene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Fluorene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
HEPH (C19-C32) Less PAHs	mg/kg	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Index of Additive Cancer Risk (IACR)	none	< 0.15	< 0.15	n/c	< 0.15	< 0.15	n/c	< 0.15	< 0.15	n/c	< 0.15	< 0.15	n/c
LEPH (C10-C19) Less PAHs	mg/kg	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c	< 200	< 200	n/c
Naphthalene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Petroleum Hydrocarbons - F1 (C6-C10)	mg/kg	< 10	< 10	n/c	< 10	< 10	n/c	< 10	< 10	n/c	< 10	< 10	n/c
Phenanthrene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Pyrene	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Quinoline	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Total Organic Carbon	%	1.58	1.71	n/c	1.19	0.85	n/c	2.81	2.58	n/c	2.73	2.9	n/c

Appendix C-3: Table 2. RPD Table

Golder Sample ID		DUP A	SE-6	Calculated RPD%	DUP B	SW-1	Calculated RPD%	DUP-C	SNW-2	Calculated RPD%	DUP-D	SNE-2	Calculated RPD%
Sample Matrix		SED	SED		SED	SED		SED	SED		SED	SED	
Sampling Date		24-Sep-19	24-Sep-19		27-Sep-19	27-Sep-19		30-Sep-19	30-Sep-19		1-Oct-19	1-Oct-19	
VOCs & BTEX													
1,1,1,2-tetrachloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,1,1-trichloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,1,2,2-tetrachloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,1,2-trichloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,1-dichloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,1-dichloroethene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.070	< 0.050	n/c
1,2-dichlorobenzene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,2-dichloroethane	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,2-dichloroethylene (Cis) (1,2-dichloroethene)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,2-dichloroethylene (Trans) (1,2-dichloroethene)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,2-dichloropropane (Propylene Dichloride)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,3-dichlorobenzene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,3-dichloropropene (Cis)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,3-dichloropropene (Trans)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
1,3-dichloropropene, Total	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
1,4-dichlorobenzene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Benzene	mg/kg	< 0.0050	0.0107	n/c	< 0.0050	< 0.0050	n/c	< 0.0050	< 0.0050	n/c	< 0.0070	0.0107	n/c
Bromodichloromethane (BDCM)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Bromoform (Tribromomethane)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Carbon Tetrachloride	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Chlorobenzene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Chloroethane	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Chloroform	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Chloromethane	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Dibromochloromethane (DBCM)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Dichloromethane (DCM) (Methylene Chloride)	mg/kg	< 0.30	< 0.30	n/c	< 0.30	< 0.30	n/c	< 0.30	< 0.30	n/c	< 0.30	< 0.30	n/c
Ethylbenzene	mg/kg	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c	< 0.015	< 0.015	n/c
m,p-Xylenes	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Methyl tert-Butyl Ether	mg/kg	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c	< 0.20	< 0.20	n/c
o-Xylene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Styrene	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Tetrachloroethylene (PCE/PERC)	mg/kg	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c
Toluene	mg/kg	< 0.050	0.103	n/c	< 0.050	< 0.050	n/c	< 0.050	< 0.050	n/c	< 0.050	0.057	n/c
Trichloroethylene (TCE)	mg/kg	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c	< 0.010	< 0.010	n/c
Trichlorofluoromethane (Freon 11)	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Vinyl Chloride (Chloroethene)	mg/kg	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c	< 0.10	< 0.10	n/c
Xylenes, Total	mg/kg	< 0.075	< 0.075	n/c	< 0.075	< 0.075	n/c	< 0.075	< 0.075	n/c	< 0.075	< 0.075	n/c

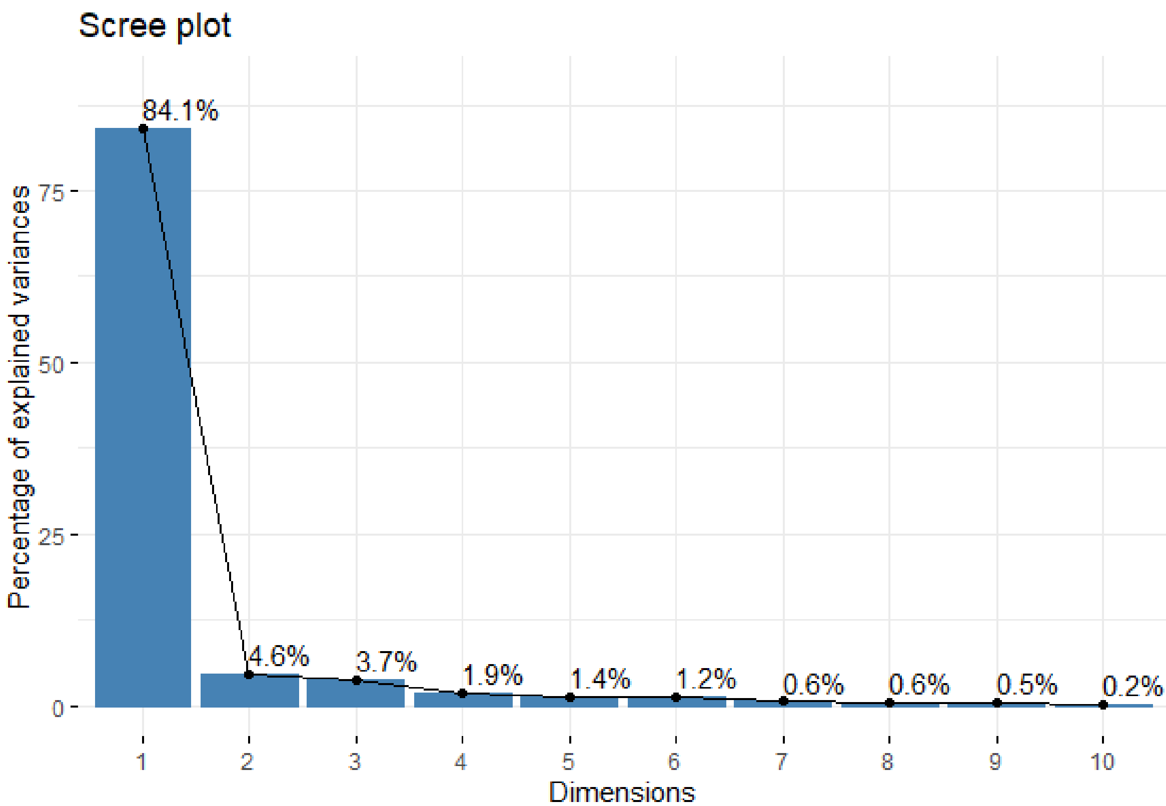
Notes: mg/kg = milligrams per kilogram; < = less than; n/c = not calculable; RPD = relative percent difference; % = percentage; mm = millimetres; VOC = Volitile organic compounds; BTEX = benzene, toluene, ethylbenzene and xylene; PAH = plolycyclic aromatic hydrocarbons; SED = sediment

Appendix C-4: Spearman Rank Correlation Analysis Results

Spearman Correlation Matrix	SE	SNE	SNW	SW
Critical value	0.618	0.618	0.648	0.587
n	11	11	10	12
	DISTANCE	DISTANCE	DISTANCE	DISTANCE
ALUMINUM__AL_	0.391	**0.918**	**0.939**	0.231
ANTIMONY__SB_	0.5	**0.883**	**0.773**	0.044
ARSENIC__AS_	**0.818**	0.615	0.648	-0.175
BARIUM__BA_	0.128	**0.918**	**0.851**	0.133
BERYLLIUM__BE_	0.527	**0.837**	**0.881**	0.25
BORON__B_	0.5	**0.845**	**0.924**	0.28
CADMIUM__CD_	0.137	0.468	0.395	-0.153
CALCIUM__CA_	0.173	0.606	**0.818**	0.538
CHROMIUM__CR_	0.264	**0.918**	**0.821**	0.238
COBALT__CO_	0.336	**0.918**	**0.927**	0.287
COPPER__CU_	0.291	**0.918**	**0.855**	0.294
IRON__FE_	0.156	**0.733**	**0.77**	0.189
LEAD__PB_	0.291	**0.927**	**0.818**	0.193
LITHIUM__LI_	0.182	**0.827**	**0.855**	0.354
MAGNESIUM__MG_	0.1	0.415	-0.018	0.343
MANGANESE__MN_	0.282	**0.861**	**0.77**	0.343
MERCURY__HG_	0.383	**0.873**	**0.906**	0.014
MOLYBDENUM__MO_	-0.15	**0.795**	**0.853**	0.141
NICKEL__NI_	0.227	**0.918**	**0.891**	0.238
PHOSPHORUS__P_	**0.809**	0.509	0.219	0.098
POTASSIUM__K_	0.227	**0.918**	**0.903**	0.224
SELENIUM__SE_	0.337	**0.929**	**0.851**	.
SODIUM__NA_	0.487	**0.827**	**0.758**	0.182
STRONTIUM__SR_	0.118	**0.664**	**0.879**	0.273
THALLIUM__TL_	0.196	**0.864**	**0.711**	0.119
TITANIUM__TI_	0.518	**0.845**	**0.721**	0.207
URANIUM__U_	0.118	**0.781**	**0.745**	0.21
VANADIUM__V_	0.191	**0.909**	**0.9**	0.214
ZINC__ZN_	0.256	**0.918**	**0.841**	0.147
ZIRCONIUM__ZR_	0.571	**0.827**	**0.754**	0.557

Notes: n = number of samples; SE = East Transect; SNE = Northeast Transect; SNW = Northwest Transect; SW = West Transect.

APPENDIX C-5
Principal Component Analysis



APPENDIX C-5
Principal Component Analysis

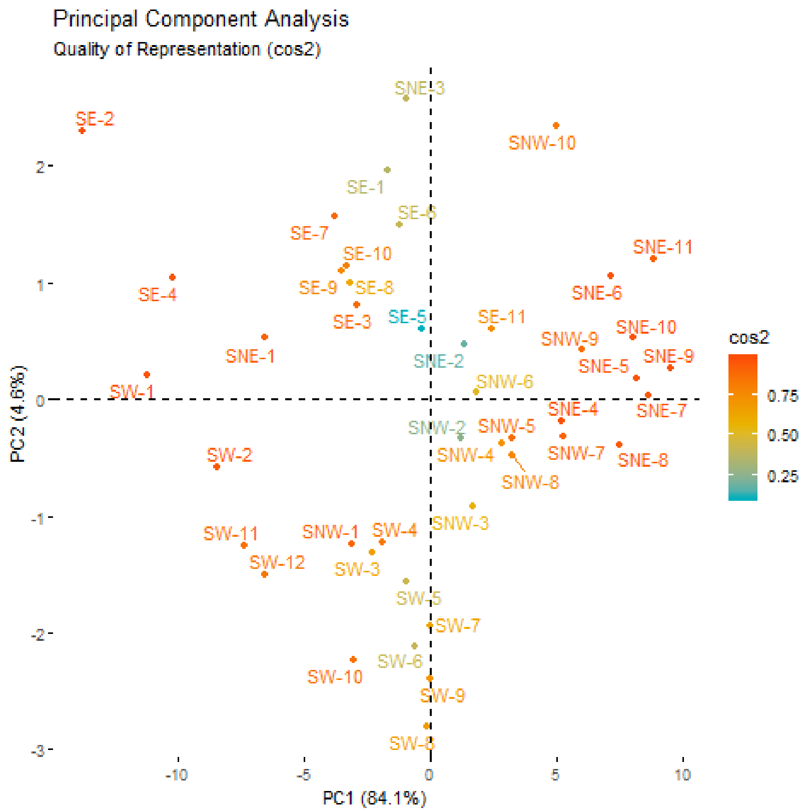
EigenvaluesError! Not a valid link.Correlations between variables and principal components (Loadings) Error! Not a valid link.

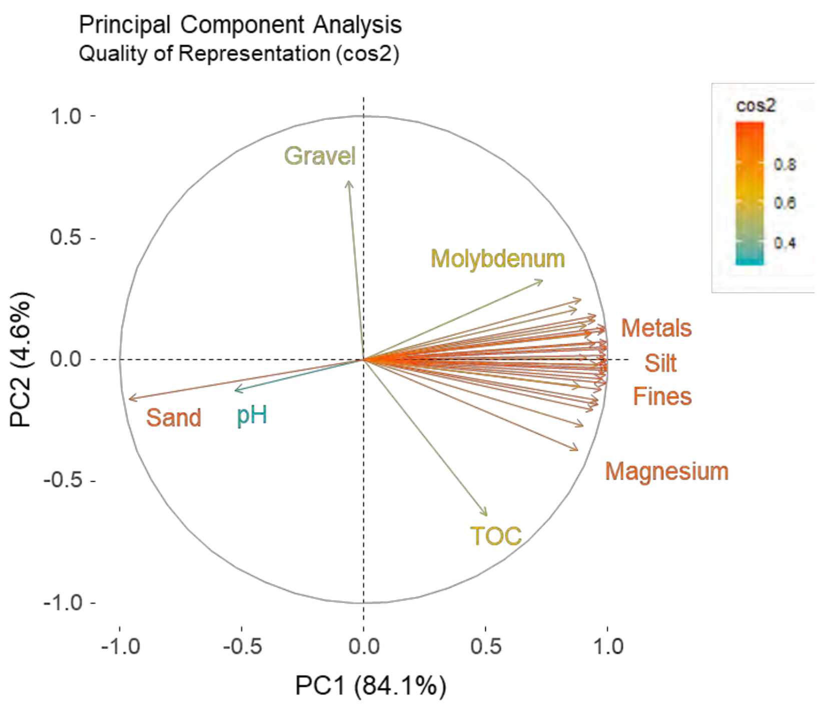
Variable Coordinates (Scores) Error! Not a valid link.

Description of Correlations between Variables and Dimension 1 Error! Not a valid link.

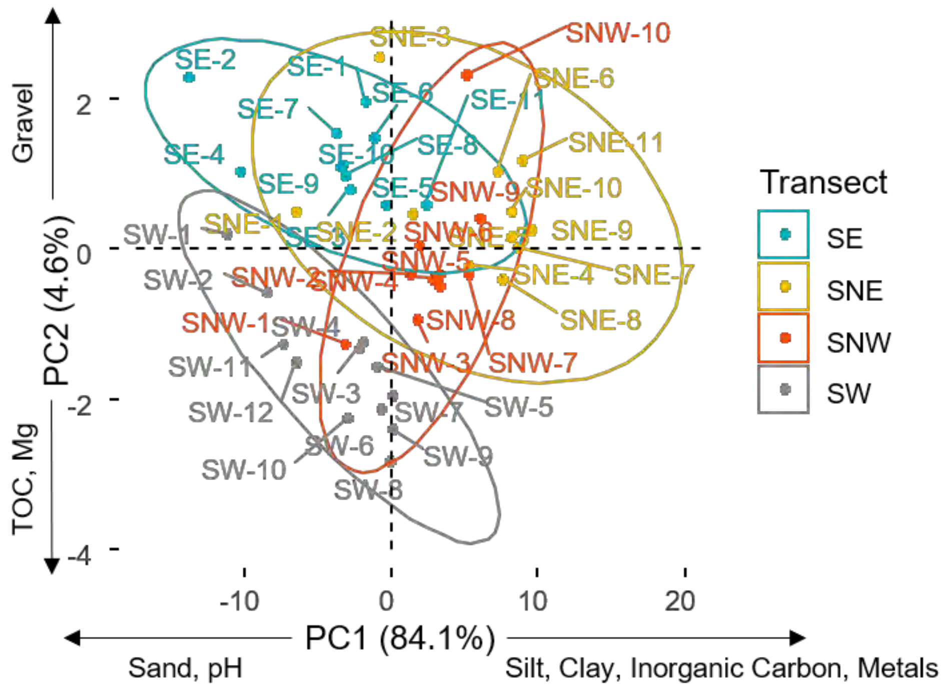
APPENDIX C-5
Principal Component Analysis

Quality of Representation of Individuals and Variables





Principal Component Analysis - Scatter Plot



APPENDIX D

Belt Transect Underwater Video Data

Appendix D
2019 MEEMP Belt Transect Underwater Video Data

Transect	Belt Transect Location		Video Collection Date	HD Video File Name	SD Video File Name	Video Analysis Start	Video Analysis End	Depth Range (m)	Substrate (Percent Cover)	Macroflora (Percent Cover)	Epifauna (Count)	Comments
	UTM Coordinates											
	Easting	Northing										
TP01			22-Aug-19	TP01 hd.MOV	TP01 sd.AVI	9:53:04	10:04:20	8.1-10.3	Fine (96%) Shell debris (1%) Mixed cobbles (3%)	Not classifiable (20%) Chlorophyta (5%) Brown algae (1%) Red algae (1%)	Brittle star Tunicate Clam siphon holes (75) Sculpin Bivalvia indet. Sea urchin Scallop Ctenophore	Belt was moved, epifauna is only presence/ absence
TP02			22-Aug-19	TP02 hd.MOV	TP02 sd.AVI	12:46:24	12:59:20	8.4-10.8	Fine (100%)	Chlorophyta (5%) Brown algae (15%)	Brittle star Tunicate Clam siphon holes (350) Sculpin Bivalvia indet. Sea urchin Scallop Jellyfish indet. Feather worm	Belt was moved, epifauna is only presence/ absence
TP03			22-Aug-19	TP03 hd.MOV	TP03 sd.AVI	14:08:11	14:17:01	10.8-12.5	Fine (97%) Shell debris (3%)	Not classifiable (5%) Chlorophyta (1%) Brown algae (30%) Red algae (1%) Encrusting coraline algae (1%)	Brittle star Tunicate Clam siphon holes (150) Sculpin Bivalvia indet. Sea urchin Scallop Cone worm Copepod	Belt was moved, epifauna is only presence/ absence
TP04			22-Aug-19	TP04 hd.MOV	TP04 sd.AVI	15:18:39	15:30:42	10.1-11	Fine (91%) Shell debris (6%) Mixed cobbles (3%)	Not classifiable (55%) Chlorophyta (1%) Brown algae (10%) Red algae (1%)	Brittle star (9) Tunicate (11) Clam siphon holes (125) Bivalvia indet. (5) Sea urchin (9) Hydromedusae (1) Sea spider (1)	
TP05			24-Aug-19	TP05 hd.MOV	TP05 sd.AVI	8:58:48	9:08:53	10-11.8	Fine (96%) Shell debris (3%) Mixed cobbles (1%)	Not classifiable (25%) Chlorophyta (1%) Brown algae (1%) Red algae (5%)	Brittle star (11) Tunicate (2) Clam siphon holes (75) Bivalvia indet. (3) Sea urchin (36) Scallop (3)	
TP06			25-Aug-19	TP06 - no good hd.MOV	TP06 - no good sd.AVI	12:25:27	12:27:05	12.2-12.7	Fine (100%)	Not classifiable (100%)	Brittle star Bivalvia indet.	Belt was moved, epifauna is only presence/ absence
TP07			25-Aug-19	TP07_redo hd.MOV	TP07_redo sd.AVI	12:43:40	12:53:18	9.1-10.6	Fine (81%) Shell debris (3%) Mixed cobbles (16%)	Not classifiable (55%) Laminaria sp. (5%) Brown algae (10%) Encrusting coraline algae (1%)	Brittle star (3) Tunicate (6) Clam siphon holes (50) Bivalvia indet. (9) Sea urchin (11) Sea angel (6) Jellyfish indet. (1) Gastropod (1)	
TP08			24-Aug-19	TP08 hd.MOV	TP08 sd.AVI	11:06:08	11:22:00	9-10.6	Fine (98%) Shell debris (1%) Mixed cobbles (1%)	Not classifiable (10%) Chlorophyta (1%) Brown algae (2%) Red algae (1%)	Brittle star (12) Tunicate (6) Clam siphon holes (75) Sculpin (2) Bivalvia indet. (11) Sea urchin (1) Scallop (6)	
TP09			25-Aug-19	TP09 hd.MOV	TP09 sd.AVI	10:48:06	10:54:45	9.6-11.9	Fine (65%) Shell debris (2%) Mixed cobbles (33%)	Not classifiable (50%) Chlorophyta (1%) Brown algae (2%) Red algae (1%) Encrusting coraline algae (15%)	Brittle star (11) Tunicate (3) Clam siphon holes (75) Bivalvia indet. (6) Sea urchin (9) Sea angel (2) Scallop (2) Limpet (1) Gastropod (2)	Belt was moved, epifauna is only presence/ absence
TP10			25-Aug-19	TP10 hd.MOV	TP010 sd.AVI	11:43:17	11:57:29	6.2-8.7	Fine (98%) Shell debris (1%) Mixed cobbles (1%)	Not classifiable (80%) Laminaria sp. (1%) Brown algae (2%)	Brittle star (1) Tunicate (4) Clam siphon holes (25) Bivalvia indet. (11) Scallop (2) Shrimp (1) Cone worm (11)	Belt was moved, epifauna is only presence/ absence

APPENDIX E

Benthic Infauna Data

biologica

Marine Benthic Enumeration and Identification Methods
Client: Golder
Project: Baffinlands Iron Mine 2019
Protocol: EEM

Sample Inventory

Sample arrival: 1-Oct-2019
Number of samples: 32
Number of jars: 89
Screen size: 500 µm
Biologica project number: 19-072

The chain of custody documents were checked and approved with the client. Samples were transferred from formalin into 70% ethanol, and stained with Rose Bengal to aid in sorting. Each sample was provided a unique identification number and placed in the queue for analysis.

Table 1. Summary of benthic samples processed for Baffinlands Iron Mine, 2019.

Client Sample ID	Date Sampled	Biologica Sample ID	# of Jars	Sampler	Field Split	Final Split	Organisms Counted
BE-1	22-Sep-19	mb19-072-001	9	Van Veen	Whole	1/8	446
						1/2	175
BE-2	22-Sep-19	mb19-072-002	4	Ponar	Whole	1/4	163
						Whole	14
BE-3	23-Sep-19	mb19-072-003	3	Ponar	Whole	1/4	671
						Whole	103
BE-4	23-Sep-19	mb19-072-004	4	Ponar	Whole	1/4	438
						Whole	97
BE-5	24-Sep-19	mb19-072-005	3	Ponar	Whole	1/4	578
						Whole	67
BE-6	24-Sep-19	mb19-072-006	3	Ponar	Whole	1/4	585
						Whole	152
BE-7	24-Sep-19	mb19-072-007	4	Ponar	Whole	1/4	424
						Whole	103
BE-8	25-Sep-19	mb19-072-008	2	Ponar	Whole	1/4	758
						Whole	77
BW-1	27-Sep-19	mb19-072-009	4	Ponar	Whole	1/4	280
						Whole	179
BW-2	27-Sep-19	mb19-072-010	1	Ponar	Whole	1/4	353
						Whole	115
BW-3	27-Sep-19	mb19-072-011	1	Ponar	Whole	1/4	874
						Whole	74
BW-4	27-Sep-19	mb19-072-012	2	Ponar	Whole	1/4	985
						Whole	86

Client Sample ID	Date Sampled	Biologica Sample ID	# of Jars	Sampler	Field Split	Final Split	Organisms Counted
BW-5	28-Sep-19	mb19-072-013	3	Ponar	Whole	1/4	377
						Whole	93
BW-6	28-Sep-19	mb19-072-014	3	Ponar	Whole	1/4	759
						Whole	58
BW-7	28-Sep-19	mb19-072-015	4	Ponar	Whole	1/4	899
						Whole	168
BW-8	28-Sep-19	mb19-072-016	2	Ponar	Whole	1/4	388
						Whole	57
BNW-1	29-Sep-19	mb19-072-017	2	Ponar	Whole	1/4	214
						Whole	37
BNW-2	30-Sep-19	mb19-072-018	2	Ponar	Whole	1/4	345
						Whole	62
BNW-3	1-Oct-19	mb19-072-019	3	Ponar	Whole	1/4	276
						Whole	98
BNW-4	1-Oct-19	mb19-072-020	3	Ponar	Whole	1/4	276
						Whole	40
BNW-5	2-Oct-19	mb19-072-021	2	Van Veen	1/2	1/2	41
						1/8	131
BNW-6	3-Oct-19	mb19-072-022	3	Van Veen	1/2	1/2	71
						1/8	209
BNW-7	3-Oct-19	mb19-072-023	3	Van Veen	1/2	1/2	128
						1/8	114
BNW-8	3-Oct-19	mb19-072-024	2	Van Veen	1/2	1/2	63
						1/8	107
BNE-1	2-Oct-19	mb19-072-025	3	Ponar	Whole	1/4	286
						Whole	75
BNE-2	2-Oct-19	mb19-072-026	3	Ponar	Whole	1/4	243
						Whole	43
BNE-3	4-Oct-19	mb19-072-027	2	Van Veen	1/2	1/2	27
						1/8	253
BNE-4	4-Oct-19	mb19-072-028	2	Van Veen	1/2	1/2	29
						1/8	175
BNE-5	4-Oct-19	mb19-072-029	2	Van Veen	1/2	1/2	67
						1/8	230
BNE-6	5-Oct-19	mb19-072-030	2	Van Veen	1/2	1/2	91
						1/8	139
BNE-7	5-Oct-19	mb19-072-031	1	Van Veen	1/2	1/2	19
						1/8	28
BNE-8	5-Oct-19	mb19-072-032	2	Van Veen	1/2	1/2	59
						1/8	281

Sample Processing

Sorting and Subsampling:

All samples were sorted using dissecting microscopes at 10-40x magnification by trained personnel. Microscopic sorting is the only way to ensure >90% of organisms are removed from the debris, which is required by EEM (Environment Canada; Environmental Effects Monitoring) guidelines for marine benthic analyses.

Due to the large volumes and high abundances in the samples, Biologica personnel developed a subsampling strategy that would maximize the detection of large and rare individuals while accurately enumerated smaller organisms. The samples were first sorted whole, with all large organisms (>1.0 cm) removed from the sample. The abundances of these large organisms should be comparable to historical estimates (SEM Ltd., 2016) as are the organisms visible to the naked eye without a microscope. Biologica subsampled the remaining debris to ensure all smaller individuals were examined and identified. This smaller fraction was subsampled to a ¼ split as recommended by EEM (Environment Canada; Environmental Effects Monitoring) guidelines.

Subsampling was done with a Caton tray (Caton, 1991). After the whole sort for large/rare taxa, the remaining sample was spread evenly over a Caton grid, and sequential random quadrats were selected and sorted until the minimum ¼ split was reached.

In addition, all large debris in the sample was checked microscopically, including rocks and other large debris. To minimize potential sorter bias, samples were distributed among technicians such that no person sorted all the replicates of a given sample.

Sorting QA/QC:

To ensure sorting efficiency was >95%, whole and/or partial sub-samples were re-sorted. Sorting efficiency was calculated using the following equation (where total count = final total number of organisms in sample):

Sorting efficiency = [1−(# of organisms in spotcheck or resort / total organisms)] x 100
*Total organisms includes the original count and the number found from the resort

Sorting efficiency QA/QC was performed on 50% of samples. 25% of the debris was re-sorted for the selected samples. All samples checked must meet or exceed 95% sorting efficiency. Any samples falling below 95% sorting efficiency were re-sorted in their entirety, and additional checks were undertaken as necessary. Refer to Table 2 for sorting efficiency results.

Table 2. Summary of sorting QA/QC results for Baffinlands Iron Mine, 2019.

Client Sample ID	Biologica Sample ID	Sorting Efficiency QC Spotchecks
BE-1	mb19-072-001	
BE-2	mb19-072-002	100.00%
BE-3	mb19-072-003	
BE-4	mb19-072-004	
BE-5	mb19-072-005	

Client Sample ID	Biologica Sample ID	Sorting Efficiency QC Spotchecks
BE-6	mb19-072-006	98.90%
BE-7	mb19-072-007	
BE-8	mb19-072-008	100.00%
BW-1	mb19-072-009	100.00%
BW-2	mb19-072-010	98.50%
BW-3	mb19-072-011	100.00%
BW-4	mb19-072-012	
BW-5	mb19-072-013	
BW-6	mb19-072-014	
BW-7	mb19-072-015	
BW-8	mb19-072-016	95.10%
BNW-1	mb19-072-017	100.00%
BNW-2	mb19-072-018	
BNW-3	mb19-072-019	
BNW-4	mb19-072-020	95.00%
BNW-5	mb19-072-021	100.00%
BNW-6	mb19-072-022	
BNW-7	mb19-072-023	96.40%
BNW-8	mb19-072-024	
BNE-1	mb19-072-025	100.00%
BNE-2	mb19-072-026	100.00%
BNE-3	mb19-072-027	100.00%
BNE-4	mb19-072-028	
BNE-5	mb19-072-029	95.95%
BNE-6	mb19-072-030	100.00%
BNE-7	mb19-072-031	
BNE-8	mb19-072-032	
Average:		**98.74%**

Identification and Invasive species detection:

All organisms were identified using a combination of dissecting (10–40x) and compound microscopes (100–1000x) and standard taxonomic keys (see methodological and taxonomic references) to the lowest practicable level (species whenever possible). All specimens were archived in air-tight glass vials with glycerin and 70% ethanol for long-term storage. Taxonomic data were recorded in Biologica's custom database.

During the identification process, taxonomists recorded if the identified taxa were beyond their recorded range and/or potentially introduced (originating from another location) or invasive (both introduced and appearing to proliferate with possible detrimental effects to the ecosystem and/or industry). Within the constraints of available literature and historical data, no taxa observed were identified as invasive taxa. One individual matched the description of *Sosane wireni* (polychaete), however this is out of its geographical range. The identification has been left as *Sosane sp. nr. wireni* and will be sent for verification. Two taxa have also had a correction to their identification *Nereimyra aphroditoides*, previously identified as *Nereimyra* *punctata*, and *Streptospinigera niuqtuut*, previously identified as *Syllides longocirratus*, (both polychaetes) which will be sent for verification.

Data Management and Analysis

All data were recorded in Biologica's custom database. Total abundances were extrapolated for samples split in the field to represent the abundance from the whole sample. Organism densities were calculated by dividing the total organism abundance (extrapolated if the sample was split) using a square area of a Ponar grab (0.05 m^2) or the area of a Van Veen grab (0.1 m^2), multiplied by the number of composite grabs.

Results were provided to the Golder project manager in Excel spreadsheets via email.

Selected Methodological and Taxonomic References

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Appendix E-2: Benthic Infauna Raw data and QA/QC

Table 1: Raw Abundance Data of Benthic Infaunal Taxa for Four Transects Extending from Milne Port, 2019

Major Taxon	Order	Family/Subfamily	Genus / Species	BE-1 Van veen	BE-2 Ponar	BE-3 Ponar	BE-4 Ponar	BE-5 Ponar	BE-6 Ponar	BE-7 Ponar	BE-8 Ponar	BW-1 Ponar	BW-2 Ponar	BW-3 Ponar	BW-4 Ponar	BW-5 Ponar	BW-6 Ponar	BW-7 Ponar	BW-8 Ponar	BNW-1 Ponar	BNW-2 Ponar	BNW-3 Ponar	BNW-4 Ponar	BNW-5 Van veen	BNW-6 Van veen	BNW-7 Van veen	BNW-8 Van veen	BNE-1 Ponar	BNE-2 Ponar	BNE-3 Van veen	BNE-4 Van veen	BNE-5 Van veen	BNE-6 Van veen	BNE-7 Van veen	BNE-8 Van veen
Calcarea	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Anthozoa	Actiniaria	Edwardsiidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
Hydrozoa	-	-	-	2	0	2	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Anthoathecata	-	-	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leptothecata	Lafoeidae	*Lafoea* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
	Limnomedusae	Monobrachiidae	*Monobrachium parasitum*	0	0	0	0	0	0	0	9	0	0	4	2	0	3	1	0	0	4	4	0	2	2	0	6	3	1	0	12	0	0	0	20
Gymnolaemata	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	4	0	0	16
	Cheilostomatida	-	-	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	8	0	0	0	0	2	0	0	0
		Calloporidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	8	0	0	0
		Escharellidae	*Escharella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	0	8	4	0	8	16
Stenolaemata	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
	Cyclostomatida	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8	8	0	8	0	0	0	0	0	8	0	0
		Crisiidae	*Crisia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	8	0	0	0
		Oncousoeciidae	*Oncousoecia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
		Tubuliporidae	*Tubulipora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
Nemertea	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Hoplonemertea	-	-	-	0	0	4	8	0	5	8	20	4	8	16	16	4	0	0	0	0	0	0	0	0	24	0	0	0	0	24	8	0	24	0	16
	Monostilifera	Tetrastemmatidae	*Tetrastemma* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	4	0	0	0	0	16	0	8
Palaeonemertea	-	Tubulanidae	*Tubulanus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	1	0	0	0	0	0	0	0	0	0	0	0	0
	Archinemertea	Cephalotrichidae	*Cephalothrix* sp.	0	0	0	0	0	4	4	0	20	12	0	12	4	0	0	0	0	8	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Pilidiophora	Heteronemertea	-	-	0	0	0	0	4	0	0	0	0	0	0	0	4	0	4	0	0	0	0	4	8	0	0	0	0	0	0	0	0	0	0	0
		Lineidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	2	0	8	0	0
			Cerebratulus sp.	0	0	4	4	4	5	4	12	4	12	8	4	8	2	3	5	4	0	0	0	0	0	0	0	0	0	0	24	0	8	0	16
			Lineus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Clitellata	Rhynchobdellida	Piscicolidae	-	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Enchytraeida	Enchytraeidae	-	0	156	16	32	0	4	24	4	0	0	0	4	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polychaeta	-	Capitellidae	-	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Capitella capitata complex	8	4	8	8	0	0	0	0	8	0	0	4	4	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Mediomastus sp.	120	4	4	80	28	32	28	52	24	28	44	52	8	68	400	24	0	16	0	8	8	24	0	8	0	0	40	32	24	8	0	16
			Notomastus latericeus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	22	6	16	30	0	1	8	24	22	34	44	56
		Cossuridae	*Cossura longocirrata*	72	0	72	20	40	12	36	72	0	12	20	80	48	120	108	48	24	88	32	8	16	0	8	0	12	92	8	0	16	24	8	8
		Maldanidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	16	0	8	0	0	8
		Euclymeninae	-	0	0	4	0	0	4	0	0	0	0	0	0	4	0	0	4	0	16	0	0	0	16	0	8	4	4	16	8	8	8	0	8
			Clymenura polaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	8	0	0	0	0
			Clymenura sp.	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Microclymene sp.	0	0	0	0	4	0	0	0	0	0	8	8	8	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	8	0	0
			Praxillella gracilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	8	0	0	8	0	0	0	8	0	0	8	0
			Praxillella praetermissa	0	0	0	0	0	8	0	0	0	0	0	8	0	0	0	0	4	4	0	0	0	16	0	0	0	0	24	0	0	0	0	0
		Maldaninae	*Maldane sarsi*	8	0	44	0	40	90	4	0	4	40	40	45	52	0	0	0	4	16	17	20	16	10	80	50	0	1	72	64	90	40	40	84
		Nicomachinae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0
			Nicomache sp.	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Petaloproctus sp.	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Petaloproctus tenuis	0	0	0	0	5	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	0	0	40
		Rhodininae	*Rhodine loveni*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
		Ophelininae	*Ophelina* sp.	0	0	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0
			Ophelina acuminata	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ophelina cylindricaudata	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	24	16	0	0	0	0	0	0	0	0	0	0
			Ophelia limacina	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Orbiniidae	-	0	0	0	0	0	0	0	0	0	12	20	0	0	20	0	0	4	8	4	0	0	0	0	0	40	0	0	0	0	8	0	0
		Orbiniinae	*Scoloplos armiger*	0	0	15	1	8	0	0	1	13	0	16	0	0	4	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Scoloplos sp.	48	0	12	0	16	12	0	16	16	0	0	0	0	100	12	12	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
			Leitoscoloplos acutus	0	0	0	17	1	0	13	8	0	16	0	24	12	0	0	0	4	8	8	4	0	56	26	8	0	4	16	32	48	24	2	48
		Paraonidae	-	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	24	16	0	4	0	0	0	0	0	0	8
			Aricidea sp.	0	0	0	4	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	4	24	0	0	0	0	0	0	0	0	0	0	8
			Aricidea (Acmira) catherinae	16	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Aricidea (Strelzovia) antennata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
			Aricidea hartmanae	0	0	4	0	0	0	0	0	0	0	0	0	12	0	12	0	8	12	8	8	0	24	24	0	12	48	40	16	8	16	0	40

Major Taxon	Order	Family/Subfamily	Genus / Species	BE-1 Van veen	BE-2 Ponar	BE-3 Ponar	BE-4 Ponar	BE-5 Ponar	BE-6 Ponar	BE-7 Ponar	BE-8 Ponar	BW-1 Ponar	BW-2 Ponar	BW-3 Ponar	BW-4 Ponar	BW-5 Ponar	BW-6 Ponar	BW-7 Ponar	BW-8 Ponar	BNW-1 Ponar	BNW-2 Ponar	BNW-3 Ponar	BNW-4 Ponar	BNW-5 Van veen	BNW-6 Van veen	BNW-7 Van veen	BNW-8 Van veen	BNE-1 Ponar	BNE-2 Ponar	BNE-3 Van veen	BNE-4 Van veen	BNE-5 Van veen	BNE-6 Van veen	BNE-7 Van veen	BNE-8 Van veen
			Aricidea minuta	0	0	28	28	20	48	4	36	8	4	60	28	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Aricidea nolani	8	0	4	0	8	12	4	0	4	0	0	12	0	12	8	0	8	0	0	0	0	8	0	0	0	16	0	8	40	0	0	16
		Scalibregmatidae	*Polyphysia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
			Scalibregma inflatum	48	0	24	0	41	6	24	80	8	20	72	116	28	44	29	8	8	4	0	0	0	8	0	0	4	4	8	8	8	0	0	0
	Eunicida	Dorvilleidae	*Parougia caeca*	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	8	0	8
		Lumbrineridae	-	0	0	0	0	4	8	16	16	0	0	8	32	0	0	0	0	0	28	48	40	72	64	72	48	20	16	24	40	64	24	0	80
			Scoletoma sp.	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Scoletoma fragilis	2	0	12	1	4	1	5	8	4	1	0	1	2	4	4	1	12	8	46	70	80	128	56	48	32	48	128	136	296	188	32	520
			Scoletoma impatiens	32	0	48	32	84	32	36	52	24	0	76	60	24	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Hyalinoeciinae	*Nothria conchylega*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	50	13	56	126	192	114	0	4	62	60	74	168	14	98
	Phyllodocida	Glyceridae	*Glycera* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	8	0	0	0	0
			Glycera capitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	2	0	0	0	0	0	0	0	0	0	0
		Hesionidae	-	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
			Nereimyra aphroditoides	32	20	253	96	116	12	100	64	92	32	52	32	16	196	156	72	40	0	4	12	0	0	0	0	0	4	0	0	0	0	0	0
		Nephtyidae	*Aglaophamus malmgreni*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	10	4	4	2	2
			Micronephthys cornuta	16	0	72	8	68	32	40	88	21	40	68	104	68	72	8	0	16	64	96	136	264	296	32	88	88	104	72	40	210	32	8	128
			Nephtys sp.	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
			Nephtys ciliata	2	0	2	1	0	0	1	1	1	0	0	0	0	0	0	1	0	6	1	1	0	0	0	0	0	1	0	0	2	0	0	0
			Nephtys paradoxa	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nereididae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nereidinae	*Nereis zonata*	18	0	7	4	2	0	9	2	1	12	24	1	11	12	15	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
		Pholoidae	*Pholoe* sp.	224	0	20	5	16	0	4	0	4	0	8	0	0	528	356	108	4	40	0	0	96	32	16	0	144	52	8	24	80	40	0	32
			Pholoe minuta	704	4	160	72	84	81	42	217	204	108	292	220	76	132	352	156	4	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0
			Pholoe tecta	1,480	68	748	528	400	192	292	788	60	128	892	720	317	668	1,654	604	68	64	104	116	0	40	0	128	64	0	224	120	176	144	0	120
		Eteoninae	*Eteone* sp.	0	0	0	4	4	0	4	0	0	4	8	0	0	4	4	0	0	8	24	12	32	8	0	24	4	0	0	0	8	0	0	16
			Eteone barbata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Eteone flava	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			Eteone longa complex	0	0	6	0	0	5	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	8	16	0	4	0	8	0	0	8	0	8
			Eumida sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
		Phyllodocinae	*Phyllodoce* sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Phyllodoce groenlandica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		Polynoinae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	4	0	8	2	0	4	4	0	0	0	0	0	8
			Gattyana cirrhosa	2	0	2	0	0	1	8	9	1	6	13	5	4	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
			Harmothoe sp.	0	0	4	0	0	0	0	0	0	0	8	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Harmothoe imbricata	16	4	16	0	4	8	17	4	0	0	4	4	0	12	12	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Harmothoe rarispina	0	0	0	0	0	0	4	0	0	0	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sphaerodoridae	*Sphaerodoropsis biserialis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	16	16	8	8	0	8	0	0	0	0	0	0	0	0
			Sphaerodoropsis minutum	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Anoplosyllinae	*Streptospinigera niuqtuut*	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	8
		Eusyllinae	*Pionosyllis compacta*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
		Exogoninae	*Exogone naidina*	0	0	24	8	20	97	32	80	0	0	4	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	8	0	0	0	8
	Sabellida	Fabriciidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Pseudofabricia sp. nr. *aberrans*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	64	24	32	0	0	72
		Oweniidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
			Galathowenia oculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	28	4	4	8	0	16	8	0	0	152	96	24	32	0	24
			Myriochele heeri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12	4	15	2	0	0	0	0	0	40	42	8	0	0	8
			Owenia fusiformis	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	11	17	11	5	10	2	0	0	4	0	8	0	0	12	0	0
		Sabellidae	-	0	0	0	4	0	4	0	0	0	4	8	0	4	12	0	4	0	0	0	4	0	0	8	0	1	0	0	0	0	0	0	0
			Sabellidae sp. 3	0	0	0	0	8	0	0	0	0	0	4	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	8	0	8	0	0
			Sabellidae sp. 4	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	0	8
			Dialychone sp. 1	0	0	4	0	16	0	4	0	0	4	0	8	20	0	0	0	8	0	0	0	0	0	0	0	0	0	8	0	0	0	0	16
		Sabellinae	*Euchone* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
			Euchone analis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Euchone incolor	0	0	48	0	76	124	24	60	20	32	100	164	16	0	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8
			Euchone rubrocincta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
		Serpulidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Major Taxon	Order	Family/Subfamily	Genus / Species	BE-1 Van veen	BE-2 Ponar	BE-3 Ponar	BE-4 Ponar	BE-5 Ponar	BE-6 Ponar	BE-7 Ponar	BE-8 Ponar	BW-1 Ponar	BW-2 Ponar	BW-3 Ponar	BW-4 Ponar	BW-5 Ponar	BW-6 Ponar	BW-7 Ponar	BW-8 Ponar	BNW-1 Ponar	BNW-2 Ponar	BNW-3 Ponar	BNW-4 Ponar	BNW-5 Van veen	BNW-6 Van veen	BNW-7 Van veen	BNW-8 Van veen	BNE-1 Ponar	BNE-2 Ponar	BNE-3 Van veen	BNE-4 Van veen	BNE-5 Van veen	BNE-6 Van veen	BNE-7 Van veen	BNE-8 Van veen
	Sedentaria	Ampharetidae	*Ampharete borealis*	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spionida	Apistobranchidae	*Apistobranchus* sp.	0	0	12	0	0	8	4	4	4	8	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Spionidae	-	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Dipolydora caulleryi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
			Dipolydora quadrilobata	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Dipolydora socialis	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Laonice cirrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	10	12	4	0	0	0	0	2	0	0	2
			Marenzelleria viridis	0	8	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Prionospio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	24	68	0	0	0	0	16	0
			Prionospio steenstrupi	0	0	4	8	20	4	0	4	0	20	8	8	8	0	0	4	88	141	60	28	8	72	40	0	0	0	72	32	56	48	0	112
			Pygospio elegans	0	0	0	8	0	0	0	8	12	8	44	4	4	4	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
			Spio filicornis	8	0	0	4	0	0	0	0	8	0	0	16	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Terebellida	Ampharetidae	-	0	0	0	0	0	0	4	0	8	8	0	8	4	0	0	0	4	0	0	4	0	0	0	16	0	0	0	8	0	0	0	0
			Amphicteis sundevalli	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ampharetinae	*Ampharete* sp.	0	0	8	12	20	20	12	20	0	4	4	4	4	0	12	8	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0
			Lysippe labiata	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	24
			Sosane sp. nr. *wireni*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
		Melinninae	*Melinna elisabethae*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6	6	13	2	38	36	26	3	6	78	50	4	8	0	0
		Cirratulidae	*Aphelochaeta* sp.	0	0	56	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	16	8	0	0	0	0	0	40	8	0	16
			-	48	0	24	136	28	48	33	48	28	16	52	88	20	8	4	0	28	88	36	28	24	32	24	56	48	12	56	24	48	24	16	160
			Chaetozone sp.	8	0	0	68	12	8	12	84	56	100	64	60	16	32	0	12	48	101	80	12	24	16	56	0	88	52	56	96	120	48	8	96
			Chaetozone bathyala	32	0	169	52	149	76	136	96	116	106	136	204	36	84	28	24	68	32	16	12	8	8	0	0	40	20	8	16	0	0	0	0
			Chaetozone pigmentata	8	0	16	8	12	4	40	8	4	12	32	12	20	8	0	0	4	0	0	0	0	0	2	16	0	0	8	0	16	8	0	32
			Chaetozone setosa complex	0	0	24	16	16	32	16	12	36	40	16	8	8	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Tharyx sp.	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Flabelligeridae	*Diplocirrus hirsutus*	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	8	0	0
			Flabelligera affinis	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pectinariidae	*Cistenides granulata*	156	1	7	28	3	31	10	9	61	41	28	12	9	68	48	20	0	2	0	0	0	0	0	0	0	0	0	0	8	0	0	0
		Terebellidae	-	0	0	0	0	0	0	4	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
			Neoamphitrite affinis	0	0	0	0	0	0	6	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Polycirrinae	*Polycirrus* sp. complex	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10	0	0	0	0	24	16	8	0	24
			Polycirrus medusa	0	0	0	0	0	0	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	0	0	0	0	0
		Terebellinae	*Lanassa* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0
			Lanassa venusta venusta	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Laphania boecki	0	0	0	4	8	4	0	8	4	4	0	8	0	0	8	0	4	0	0	0	0	0	8	0	0	0	8	8	0	0	0	0
			Leaena abranchiata	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Pista maculata	2	0	9	1	6	0	6	3	2	4	5	5	1	20	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Trichobranchidae	*Terebellides* sp.	0	0	18	4	15	16	8	68	4	1	8	16	12	8	16	0	4	0	0	4	8	8	0	16	1	0	8	0	0	0	0	0
			Terebellides stroemii	0	0	2	0	0	0	0	1	0	0	0	6	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	-	-	-	24	0	0	0	0	0	0	4	0	0	0	0	8	0	0	0	0	8	0	4	0	0	0	0	0	0	0	0	0	0	0	0
	Cephalaspidea	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	8	0	0	0	4	0	0	0	0	0	0
		Cylichnidae	-	0	0	0	0	0	0	0	0	0	8	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Cylichna sp.	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
			Cylichna alba	0	0	0	0	0	0	0	0	0	0	0	8	0	4	4	0	0	0	0	20	24	0	0	0	0	0	8	0	0	8	0	0
			Cylichnoides occultus	0	0	8	0	4	0	0	4	0	0	4	0	4	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
		Philininae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0
		Tornatinidae	*Acteocina* sp.	48	0	0	0	8	20	8	8	4	0	8	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Littorinimorpha	Capulidae	*Ariadnaria borealis*	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Naticidae	-	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Euspira pallida	0	0	0	0	0	0	0	1	1	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0
		Rissoidae	-	16	0	0	16	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Boreocingula castanea	0	0	4	4	0	8	4	0	0	8	8	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Major Taxon	Order	Family/Subfamily	Genus / Species	BE-1	BE-2	BE-3	BE-4	BE-5	BE-6	BE-7	BE-8	BW-1	BW-2	BW-3	BW-4	BW-5	BW-6	BW-7	BW-8	BNW-1	BNW-2	BNW-3	BNW-4	BNW-5	BNW-6	BNW-7	BNW-8	BNE-1	BNE-2	BNE-3	BNE-4	BNE-5	BNE-6	BNE-7	BNE-8
				Van veen	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Van veen	Van veen
	Neogastropoda	Buccinidae	-	0	0	0	0	0	0	0	8	0	0	0	0	4	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
			Buccinum ciliatum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Buccinum hydrophanum	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Admetinae	*Admete viridula*	16	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Mangeliidae	-	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Trochida	Margaritidae	*Margarites* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	8
			Margarites groenlandicus	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Margarites helicinus	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	-	Lepetidae	*Lepeta caeca*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	13	4	8	26	34	8	7	0	8	16	0	8	0	0
Bivalvia	-	-	-	0	0	0	12	0	0	0	4	4	0	4	16	8	12	12	0	0	0	8	4	8	0	0	8	4	0	8	8	0	16	0	0
	-	Periplomatidae	*Periploma aleuticum*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
	Adapedonta	Hiatellidae	*Hiatella arctica*	86	0	13	25	10	11	8	8	31	5	16	21	24	8	98	15	4	0	0	1	0	0	0	0	0	0	0	8	0	0	0	0
	Anomalodesmata	Lyonsiidae	*Lyonsia arenosa*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thraciidae	*Thracia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	8	0	0	0	0	0
			Thracia myopsis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	Arcida	Arcidae	*Bathyarca glacialis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	8	0	0	2	0	0	3	0	4	12	2	0	0
	Cardiida	Cardiidae	-	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ciliatocardium ciliatum	2	0	0	0	0	0	0	0	3	4	0	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Serripes groenlandicus	2	0	0	8	0	2	2	8	2	2	8	8	1	9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Tellinidae	-	0	0	12	12	20	36	0	48	12	4	48	49	16	12	0	0	12	0	20	28	24	8	0	32	0	4	0	16	8	0	0	0
			Limecola balthica	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Macoma calcarea	0	0	3	0	10	7	3	1	2	4	0	13	3	19	1	0	2	6	10	3	6	2	6	10	10	6	16	16	10	4	0	14
			Macoma moesta	0	3	2	3	2	1	0	5	3	2	4	6	5	0	0	0	0	7	0	0	0	2	0	0	1	1	2	0	0	0	0	0
	Carditida	Astartidae	*Astarte* sp.	0	0	0	28	16	16	16	32	0	44	48	52	16	8	0	0	4	8	0	0	0	0	0	2	8	4	24	8	0	0	0	0
			Astarte borealis	90	0	54	34	15	66	28	31	38	10	32	67	20	31	9	0	3	0	0	0	0	0	2	8	1	0	0	0	0	4	0	0
			Astarte montagui	102	0	58	81	47	74	59	99	131	31	76	151	68	7	1	0	16	9	2	5	2	24	10	2	23	19	48	10	2	0	0	0
	Lucinida	Thyasiridae	-	0	0	4	4	0	4	8	12	12	20	40	36	4	0	0	0	8	4	0	4	8	0	8	0	0	0	0	0	0	0	0	0
			Axinopsida sp.	0	0	0	0	0	0	0	32	0	12	8	0	0	12	0	0	0	12	20	8	24	0	8	8	0	24	16	32	48	8	0	16
			Axinopsida serricata	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Thyasira sp.	16	0	8	0	8	16	8	36	4	8	24	16	12	0	0	0	8	8	4	12	16	8	8	0	8	16	0	8	0	0	0	0
	Myida	Myidae	*Mya* sp.	0	0	4	0	0	8	0	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Mya truncata	46	0	6	1	0	26	4	22	9	21	8	14	7	9	13	3	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	Mytilida	Mytilidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	308	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
			Musculus sp.	0	0	0	0	0	0	0	0	0	4	0	0	0	20	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Musculus discors	10	0	0	0	0	0	1	0	0	0	0	0	0	0	4	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Musculus niger	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nuculanida	-	-	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nuculanidae	*Nuculana* sp.	0	0	0	8	8	20	4	20	4	16	0	16	16	24	12	0	4	4	16	0	0	16	8	0	4	4	16	0	0	0	0	0
			Nuculana minuta	24	0	9	28	16	9	3	31	12	17	4	8	3	46	14	0	4	0	4	0	0	0	0	0	4	0	0	0	0	0	0	0
			Nuculana pernula	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	1	5	0	0	0	2	0	0	4	4	0	0	0	0	0	0
		Yoldiidae	*Portlandia arctica*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
			Yoldiella frigida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	20	16	32	0	8	0	0	24	0	16	32	0	32
			Yoldiella intermedia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	24	8	0	8	0	0	4	0	0	0	0	0	0
			-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	24	0	24	0	12	12	0	8	0	0	0	0
	Nuculida	Nuculidae	*Ennucula tenuis*	0	0	0	1	6	1	10	9	5	14	8	21	4	25	0	0	8	53	80	40	16	26	32	24	36	29	72	40	64	16	16	48
	Pectinida	Pectinidae	*Chlamys islandica*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Propeamussiidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	4	8	0	0	0	0	0
			Similipecten greenlandicus	0	0	2	0	0	0	0	0	9	23	0	0	6	0	0	0	15	1	1	11	0	0	0	2	14	1	0	0	0	0	0	0
Caudofoveata	Chaetodermatida	Chaetodermatidae	*Chaetoderma* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	1	0	4	8	24	16	1	0	0	0	56	16	0	8
Scaphopoda	Gadilida	Gadilidae	*Gadilidae indet.*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	8
			Siphonodentalium lobatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Arachnida	-	-	-	8	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda	Myodocopida	Philomedidae	*Philomedes* sp.	80	0	160	100	308	96	96	192	64	240	604	657	224	292	40	4	96	304	224	144	16	248	104	56	156	136	328	8	0	0	0	24
	Podocopida	Cytheridae	-	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	8	0	4	0	8	8	0	0	32	0	0	0	0	0	0	0
Malacostraca	Amphipoda	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
			-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Acanthonotozomatidae	*Acanthonotozoma inflatum*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Ampeliscidae	*Ampelisca* sp.	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ampelisca eschrichtii	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

				BE-1	BE-2	BE-3	BE-4	BE-5	BE-6	BE-7	BE-8	BW-1	BW-2	BW-3	BW-4	BW-5	BW-6	BW-7	BW-8	BNW-1	BNW-2	BNW-3	BNW-4	BNW-5	BNW-6	BNW-7	BNW-8	BNE-1	BNE-2	BNE-3	BNE-4	BNE-5	BNE-6	BNE-7	BNE-8
Major Taxon	**Order**	**Family/Subfamily**	**Genus / Species**	Van veen	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Van veen	Van veen
			Byblis sp.	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	0	0	0	0	0	0	0
			Haploops tubicola	0	0	1	0	4	12	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0
		Dexaminidae	*Atylus carinatus*	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
		Corophiidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stenothoyidae	*Monocorophium* sp.	0	4	0	4	0	0	0	0	0	4	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
		Dexaminidae	*Guernea nordenskioldi*	80	0	201	56	176	168	112	184	4	20	152	224	100	80	20	0	16	0	0	4	0	32	8	0	4	0	0	0	0	0	0	0
		Lysianassidae	-	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
		Oedicerotidae	*Aceroides latipes*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	8
			Arrhis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
			Monoculodes sp.	8	0	4	20	16	24	4	0	0	16	12	20	8	36	4	12	0	0	4	24	0	16	0	0	12	0	0	8	8	8	0	0
			Monoculopsis longicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
			Monoculopsis sp.	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			-	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
			Paroediceros lynceus	0	28	21	0	0	0	1	0	5	4	0	0	0	8	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
			Rostroculodes sp.	0	8	0	4	0	5	0	0	0	8	8	0	0	0	4	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
		Pontogeneiidae	*Pontoporeia femorata*	32	0	33	0	33	25	67	0	0	0	0	0	0	40	32	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Pontoporeiidae	*Monoporeia affinis*	0	324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Stenothoidae	*Metopa* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	12	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
		Tryphosidae	-	0	4	0	0	0	32	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	24	4	0	0
			Hippomedon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0
			Orchomene sp.	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Orchomenella sp.	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Orchomenella minuta	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Uristidae	*Anonyx* sp.	0	0	12	0	0	0	0	0	0	0	8	4	0	0	0	4	12	0	0	0	0	0	0	0	4	0	0	0	0	0	6	0
			Anonyx laticoxae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Anonyx nugax	2	0	4	3	1	5	0	0	21	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Onisimus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	0	0	64	0	0	0	0	0	0	0	0	0	0
	Cumacea	Diastylidae	-	0	0	4	4	0	12	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Brachydiastylis resima	0	0	4	0	148	452	96	44	0	0	12	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8	0	0
			Diastylis sp.	0	0	8	0	8	0	28	8	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
			Diastylis goodsiri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	6	2	0	0	0	0	4	4	2	0	0	0	0
			Diastylis rathkei	8	0	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
			Diastylis scorpioides	24	0	12	4	8	13	0	44	4	8	0	36	4	8	8	0	8	4	0	0	0	8	0	0	24	4	0	0	0	8	0	0
			Diastylis spinulosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	8	0	0	0	0	2	0	16	0
		Lampropidae	*Lamprops fuscatus*	24	0	4	16	0	8	0	16	0	16	36	0	8	28	16	24	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
		Leuconidae	-	0	0	4	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Eudorella sp.	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
			Eudorella emarginata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
			Eudorella truncatula	0	0	4	0	0	24	0	8	0	0	8	36	4	0	0	0	8	0	0	4	0	0	0	8	8	0	0	0	0	0	0	0
			Leucon sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	4	8	0	0	8	0	0	0	0	0	0	0	0	0
			Leucon nasica	8	0	28	8	4	16	24	12	0	0	20	44	28	44	4	0	0	0	0	0	0	0	0	0	0	0	0	8	16	0	0	0
			Leucon nasicoides	0	0	20	0	0	8	8	4	0	8	24	20	28	8	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
		Nannastacidae	*Campylaspis rubicunda*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0
	Decapoda	Crangonidae	*Sabinea septemcarinata*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Thoridae	*Lebbeus* sp.	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Lebbeus sp. *nr. polaris*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Isopoda	Gnathiidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	8
			Gnathia sp.	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	8	0	0	0	0	0	8	0	0	0	0
	Tanaidacea	-	-	0	0	0	0	4	0	0	0	0	0	0	1	0	12	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Akanthophoreidae	*Akanthophoreus* sp.	0	0	20	8	32	84	29	8	0	0	16	0	8	0	0	0	0	0	4	0	8	8	0	0	0	4	8	0	8	0	0	16
		Pseudotanaidae	*Pseudotanais* sp.	0	0	12	0	16	24	12	32	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0
		Sphyrapodidae	*Pseudosphyrapus anomalus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	88	0	0	0	0	0	0	128	124	0	0	0	0	0	0
		Typhlotanaidae	*Typhlotanais* sp.	0	0	0	0	0	0	4	12	0	0	0	44	0	0	0	0	0	8	0	16	0	0	0	0	0	0	0	0	0	0	0	0
Hexanauplia	Sessilia	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
	Cyclopoida	-	-	0	0	0	0	0	8	0	4	4	0	0	0	8	4	104	4	12	0	16	8	0	0	0	0	0	0	8	0	0	0	0	0
	Harpacticoida	-	-	0	0	0	0	0	0	0	20	0	0	0	0	0	8	16	8	0	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0
Pycnogonida	Pantopoda	Nymphonidae	*Nymphon hirtipes*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Major Taxon	Order	Family/Subfamily	Genus / Species	BE-1	BE-2	BE-3	BE-4	BE-5	BE-6	BE-7	BE-8	BW-1	BW-2	BW-3	BW-4	BW-5	BW-6	BW-7	BW-8	BNW-1	BNW-2	BNW-3	BNW-4	BNW-5	BNW-6	BNW-7	BNW-8	BNE-1	BNE-2	BNE-3	BNE-4	BNE-5	BNE-6	BNE-7	BNE-8
				Van veen	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Ponar	Ponar	Van veen	Van veen	Van veen	Van veen	Van veen	Van veen
Echinoidea	Camarodonta	Strongylocentrotidae	*Strongylocentrotus* sp.	0	0	0	0	0	0	0	0	0	1	1	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Strongylocentrotus droebachiensis	2	0	1	2	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holothuroidea	Apodida	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12	0	0	0	0	0	0	0	0	0	0	0	0
		Myriotrochidae	*Myriotrochus rinkii*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	24	8	0	0	4	0	0	0	0	0	0	0
	Dendrochirotida	Psolidae	*Psolus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Molpadida	Eupyrgidae	*Eupyrgus scaber*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Ophiuroidea	-	-	-	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0
	Ophiurida	Ophiopyrgidae	*Ophiopleura borealis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
			-	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	16	0	0	0	0	0	0	8	0	0
			Ophiocten affinis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Ophiura sp.	12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	32	0	0	0
			Ophiura sarsii	0	0	0	4	0	0	0	1	3	1	4	3	2	0	3	0	0	0	1	2	0	0	0	0	0	4	2	0	2	0	0	0
			Ophiura robusta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	0	0	0	18	4	4	0	16	32	24	6	0	8
Priapulida	-	-	-	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Priapulomorpha	Priapulidae	*Priapulus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
Sipunculidea	Golfingiida	Golfingiidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Golfingia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0	0	0	0	2	0	0	0	0
			Nephasoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	8	0	0	0	0	16	0	0	0	0	8
Ascidiacea	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Aplousobranchia	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	26	0	0
	Phlebobranchia	Ascidiidae	*Ascidia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Stolidobranchia	Molgulidae	*Molgula* sp.	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0
		Pyuridae	*Boltenia echinata*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Styelidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Polycarpa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Actinopyergii	Perciformes	Zoarcidae	-	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisces-Actinopterygii	Scorpaeniformes	Cottidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes: - = no value; sp. = species

Table 2: Presence/Absence of Benthic Infaunal Taxa for Four Transects Extending from Milne Port, 2019

Major Taxon	Order	Family/Subfamily	Taxon	BE	BW	BNW	BNE
Calcarea	-	-	-	-	-	-	X
Anthozoa	Actiniaria	Edwardsiidae	-	-	-	-	X
Hydrozoa	-	-	-	X	-	-	-
	Anthoathecata	-	-	X	-	-	-
	Leptothecata	Lafoeidae	Lafoea sp.	-	-	-	X
	Limnomedusae	Monobrachiidae	Monobrachium parasitum	X	X	X	X
Gymnolaemata	-	-	-	-	-	X	X
	Cheilostomatida	-	-	-	-	X	X
		Calloporidae	-	-	-	X	X
		Escharellidae	Escharella sp.	-	-	X	X
Stenolaemata	-	-	-	-	-	-	X
	Cyclostomatida	-	-	-	-	X	X
		Crisiidae	Crisia sp.	-	-	-	X
		Oncousoeciidae	Oncousoecia sp.	-	-	-	X
		Tubuliporidae	Tubulipora sp.	-	-	-	X
Nemertea	-	-	-	-	-	-	X
Hoplonemertea	-	-	-	-	X	X	X
	Monostilifera	Tetrastemmatidae	Tetrastemma sp.	-	X	X	X
Palaeonemertea	-	Tubulanidae	Tubulanus sp.	-	-	X	-
	Archinemertea	Cephalotrichidae	Cephalothrix sp.	X	X	X	-
Pilidiophora	Heteronemertea	-	-	X	X	X	X
		Lineidae	-	X	X	X	X
			Cerebratulus sp.	X	X	X	X
			Lineus sp.	-	-	X	-
Clitellata	Rhynchobdellida	Piscicolidae	-	-	X	-	-
	Enchytraeida	Enchytraeidae	-	X	X	-	-
Polychaeta	-	Capitellidae	-	X	X	-	-
			Capitella capitata complex	X	X	-	-
			Mediomastus sp.	X	X	X	X
			Notomastus latericeus	-	-	X	X
		Cossuridae	Cossura longocirrata	X	X	X	X
		Maldanidae	-	-	-	X	X
		Euclymeninae	-	-	-	X	X
			Clymenura polaris	-	-	-	X
			Clymenura sp.	-	X	-	-
			Microclymene sp.	X	X	X	X
			Praxillella gracilis	-	-	X	X
			Praxillella praetermissa	X	X	X	X
		Maldaninae	Maldane sarsi	X	X	X	X
		Nicomachinae	-	-	-	X	X
			Nicomache sp.	X	-	-	-
			Petaloproctus sp.	-	X	-	-
			Petaloproctus tenuis	X	X	-	X
		Rhodininae	Rhodine loveni	-	-	-	X
		Ophelininae	Ophelina sp.	X	X	X	-
			Ophelina acuminata	X	-	-	-
			Ophelina cylindricaudata	X	-	X	-
			Ophelia limacina	-	X	-	-
		Orbiniidae	-	X	X	X	X
		Orbiniinae	Scoloplos armiger	X	X	X	-
			Scoloplos sp.	X	X	X	-
			Leitoscoloplos acutus	X	X	X	X
		Paraonidae	-	X	-	-	-
			Aricidea sp.	-	-	X	-
			Aricidea (Acmira) catherinae	X	-	-	-
			Aricidea (Strelzovia) antennata	-	-	X	-
			Aricidea hartmanae	X	X	X	X
			Aricidea minuta	X	X	-	-
			Aricidea nolani	X	X	X	X
		Scalibregmatidae	Polyphysia sp.	-	-	-	X
			Scalibregma inflatum	X	X	X	X
	Eunicida	Dorvilleidae	Parougia caeca	-	X	-	X
		Lumbrineridae	-	X	X	X	X

Major Taxon	Order	Family/Subfamily	Taxon	BE	BW	BNW	BNE
			Scoletoma sp.	-	X	-	-
			Scoletoma fragilis	X	X	X	X
			Scoletoma impatiens	X	X	-	-
		Hyalinoeciinae	Nothria conchylega	-	-	X	X
	Phyllodocida	Glyceridae	Glycera sp.	-	-	-	X
			Glycera capitata	-	-	X	-
		Hesionidae	-	X	-	-	X
			Nereimyra aphroditoides	X	X	X	X
		Nephtyidae	Aglaophamus malmgreni	-	-	X	X
			Micronephthys cornuta	X	X	X	X
			Nephtys sp.	-	X	X	-
			Nephtys ciliata	X	X	X	X
			Nephtys paradoxa	X	-	-	-
		Nereididae	-	-	-	-	-
		Nereidinae	Nereis zonata	X	X	-	X
		Pholoidae	Pholoe sp.	-	-	X	X
			Pholoe minuta	X	X	X	X
			Pholoe tecta	X	X	X	X
		Eteoninae	Eteone sp.	X	X	X	X
			Eteone barbata	-	X	-	-
			Eteone flava	-	-	-	X
			Eteone longa complex	X	X	X	X
			Eumida sp.	-	-	X	-
		Phyllodocinae	Phyllodoce sp.	-	X	-	-
			Phyllodoce groenlandica	-	-	X	-
		Polynoinae	-	X	X	X	X
			Gattyana cirrhosa	X	X	X	-
			Harmothoe sp.	X	X	-	-
			Harmothoe imbricata	X	X	-	-
			Harmothoe rarispina	X	X	-	-
		Sphaerodoridae	Sphaerodoropsis biserialis	-	-	X	-
			Sphaerodoropsis minutum	-	X	-	-
		Anoplosyllinae	Streptospinigera niuqtuut	X	X	X	X
		Eusyllinae	Pionosyllis compacta	-	-	-	X
		Exogoninae	Exogone naidina	X	X	X	X
	Sabellida	Fabriciidae	-	-	-	X	-
			Pseudofabricia sp. nr. aberrans	-	-	X	X
		Oweniidae	-	-	-	X	X
			Galathowenia oculata	-	-	X	X
			Myriochele heeri	-	-	X	X
			Owenia fusiformis	X	-	X	X
		Sabellidae	-	X	X	X	X
			Sabellidae sp. 3	X	X	X	X
			Sabellidae sp. 4	-	-	-	X
			Dialychone sp. 1	X	X	X	X
		Sabellinae	Euchone sp.	-	-	-	X
			Euchone analis	X	X	X	-
			Euchone incolor	X	X	X	X
			Euchone rubrocincta	-	-	X	-
		Serpulidae	-	-	-	-	X
	Sedentaria	Ampharetidae	Ampharete borealis	X	-	-	-
	Spionida	Apistobranchidae	Apistobranchus sp.	X	X	-	-
		Spionidae	-	-	-	-	X
			Dipolydora caulleryi	-	-	-	X
			Dipolydora quadrilobata	X	X	-	-
			Dipolydora socialis	X	-	-	-
			Laonice cirrata	-	-	X	X
			Marenzelleria viridis	X	X	-	-
			Prionospio sp.	-	-	-	X
			Prionospio steenstrupi	X	X	X	X
			Pygospio elegans	X	X	-	X
			Spio filicornis	X	X	-	-
	Terebellida	Ampharetidae	-	X	-	-	-
			Amphicteis sundevalli	X	-	-	-
		Ampharetinae	Ampharete sp.	X	X	X	-

Major Taxon	Order	Family/Subfamily	Taxon	BE	BW	BNW	BNE
			Lysippe labiata	X	-	X	X
			Sosane sp. nr. wireni	-	-	-	X
		Melinninae	Melinna elisabethae	-	-	X	X
		Cirratulidae	Aphelochaeta sp.	X	X	X	X
			-	X	X	X	X
			Chaetozone sp.	-	X	X	X
			Chaetozone bathyala	X	X	-	X
			Chaetozone pigmentata	X	X	X	X
			Chaetozone setosa complex	X	X	X	-
			Tharyx sp.	X	-	-	-
		Flabelligeridae	Diplocirrus hirsutus	X	-	X	X
			Flabelligera affinis	X	-	-	-
		Pectinariidae	Cistenides granulata	X	X	X	X
		Terebellidae	-	X	X	-	-
			Neoamphitrite affinis	X	X	-	-
		Polycirrinae	Polycirrus sp. complex	X	-	X	X
			Polycirrus medusa	X	X	-	X
		Terebellinae	Lanassa sp.	-	-	-	-
			Lanassa venusta venusta	-	-	-	-
			Laphania boecki	X	X	X	X
			Leaena abranchiata	X	-	-	-
			Pista maculata	X	X	-	-
		Trichobranchidae	Terebellides sp.	X	X	X	X
			Terebellides stroemii	-	X	-	-
Gastropoda	-	-	-	-	X	X	X
	Cephalaspidea	-	-	-	X	X	X
		Cylichnidae	-	-	X	X	X
			Cylichna sp.	X	-	-	X
			Cylichna alba	-	X	X	X
			Cylichnoides occultus	X	X	-	X
		Philininae	-	-	X	X	X
		Tornatinidae	Acteocina sp.	X	X	-	-
	Littorinimorpha	Capulidae	Ariadnaria borealis	X	-	-	-
		Naticidae	-	X	-	-	-
			Euspira pallida	X	X	X	X
		Rissoidae	-	X	X	-	-
			Boreocingula castanea	X	X	-	-
	Neogastropoda	Buccinidae	-	X	X	X	-
			Buccinum ciliatum	-	X	-	-
			Buccinum hydrophanum	X	-	-	-
		Admetinae	Admete viridula	X	-	-	-
		Mangeliidae	-	-	X	-	-
	Trochida	Margaritidae	Margarites sp.	-	-	-	X
			Margarites groenlandicus	-	X	-	-
			Margarites helicinus	X	X	-	-
	-	Lepetidae	Lepeta caeca	X	-	X	X
Bivalvia	-	-	-	X	X	X	X
		Periplomatidae	Periploma aleuticum	-	-	-	-
	Adapedonta	Hiatellidae	Hiatella arctica	X	X	X	X
	Anomalodesmata	Lyonsiidae	Lyonsia arenosa	-	X	-	-
		Thraciidae	Thracia sp.	-	-	X	X
			Thracia myopsis	-	-	-	X
	Arcida	Arcidae	Bathyarca glacialis	-	-	X	X
	Cardiida	Cardiidae	-	-	-	X	X
			Ciliatocardium ciliatum	X	X	-	-
			Serripes groenlandicus	X	X	-	-
		Tellinidae	-	-	-	X	X
			Limecola balthica	X	-	-	-
			Macoma calcarea	X	X	X	X
			Macoma moesta	X	X	X	X
	Carditida	Astartidae	Astarte sp.	-	-	-	-
			Astarte borealis	X	X	X	X
			Astarte montagui	X	X	X	X
	Lucinida	Thyasiridae	-	X	-	-	-
			Axinopsida sp.	X	X	X	X

Major Taxon	Order	Family/Subfamily	Taxon	BE	BW	BNW	BNE
			Axinopsida serricata	X	-	-	-
			Thyasira sp.	X	-	X	X
	Myida	Myidae	Mya sp.	-	-	-	-
			Mya truncata	X	X	X	X
	Mytilida	Mytilidae	-	-	X	-	-
			Musculus sp.	-	X	-	-
			Musculus discors	X	X	-	-
			Musculus niger	-	X	-	-
	Nuculanida	-	-	X	X	X	X
		Nuculanidae	Nuculana sp.	-	-	X	X
			Nuculana minuta	X	X	X	X
			Nuculana pernula	X	X	X	X
		Yoldiidae	Portlandia arctica	-	-	X	-
			Yoldiella frigida	-	-	X	X
			Yoldiella intermedia	-	-	X	X
			-	-	-	X	-
	Nuculida	Nuculidae	Ennucula tenuis	X	X	X	X
	Pectinida	Pectinidae	Chlamys islandica	X	-	-	-
		Propeamussiidae	-	-	-	X	X
			Similipecten greenlandicus	X	X	X	X
Caudofoveata	Chaetodermatida	Chaetodermatidae	Chaetoderma sp.	-	-	X	X
Scaphopoda	Gadilida	Gadilidae	Gadilidae indet.	-	-	X	X
			Siphonodentalium lobatum	-	-	X	-
Arachnida	-	-	-	X	X	-	-
Ostracoda	Myodocopida	Philomedidae	Philomedes sp.	X	X	X	X
	Podocopida	Cytheridae	-	-	X	X	X
Malacostraca	Amphipoda	-	-	-	X	X	-
			-	-	X	X	-
		Acanthonotozomatidae	Acanthonotozoma inflatum	-	X	X	-
		Ampeliscidae	Ampelisca sp.	-	-	-	-
			Ampelisca eschrichtii	X	-	-	-
			Byblis sp.	X	-	X	X
			Haploops tubicola	X	-	-	X
		Dexaminidae	Atylus carinatus	X	-	-	X
		Corophiidae	-	-	X	X	-
		Stenothoyidae	Monocorophium sp.	X	X	-	X
		Dexaminidae	Guernea nordenskioldi	X	X	X	X
		Lysianassidae	-	-	X	-	X
		Oedicerotidae	Aceroides latipes	-	-	-	X
			Arrhis sp.	-	-	-	X
			Monoculodes sp.	X	X	X	X
			Monoculopsis longicornis	-	-	-	X
			Monoculopsis sp.	-	X	-	-
			-	-	-	-	X
			Paroediceros lynceus	X	X	X	X
			Rostroculodes sp.	X	X	X	-
		Pontogeneiidae	Pontoporeia femorata	X	X	-	-
		Pontoporeiidae	Monoporeia affinis	X	-	-	-
		Stenothoidae	Metopa sp.	-	X	X	-
		Tryphosidae	-	-	-	X	-
			Hippomedon sp.	-	-	X	-
			Orchomene sp.	X	-	-	-
			Orchomenella sp.	X	-	-	-
			Orchomenella minuta	X	-	-	-
		Uristidae	Anonyx sp.	-	X	X	X
			Anonyx laticoxae	-	X	-	-
			Anonyx nugax	X	X	-	-
			Onisimus sp.	-	-	X	-
	Cumacea	Diastylidae	-	X	X	-	X
			Brachydiastylis resima	X	X	-	X
			Diastylis sp.	-	-	-	-
			Diastylis goodsiri	-	-	X	X
			Diastylis rathkei	X	X	-	X
			Diastylis scorpioides	X	X	X	X
			Diastylis spinulosa	-	-	X	X

Major Taxon	Order	Family/Subfamily	Taxon	BE	BW	BNW	BNE
		Lampropidae	Lamprops fuscatus	X	X	-	X
		Leuconidae	-	-	-	X	-
			Eudorella sp.	X	-	-	X
			Eudorella emarginata	-	-	X	-
			Eudorella truncatula	X	X	X	X
			Leucon sp.	-	-	X	-
			Leucon nasica	X	X	-	X
			Leucon nasicoides	X	X	-	X
		Nannastacidae	Campylaspis rubicunda	-	-	X	X
	Decapoda	Crangonidae	Sabinea septemcarinata	-	-	X	-
		Thoridae	Lebbeus sp.	X	-	-	-
			Lebbeus sp. nr. polaris	-	-	-	-
	Isopoda	Gnathiidae	-	X	X	X	X
			Gnathia sp.	X	X	X	X
	Tanaidacea	-	-	X	X	X	X
		Akanthophoreidae	Akanthophoreus sp.	X	X	X	X
		Pseudotanaidae	Pseudotanais sp.	X	X	-	X
		Sphyrapodidae	Pseudosphyrapus anomalus	-	-	X	X
		Typhlotanaidae	Typhlotanais sp.	X	X	X	-
Hexanauplia	Sessilia	-	-	-	-	X	X
	Cyclopoida	-	-	X	X	X	X
	Harpacticoida	-	-	X	X	X	X
Pycnogonida	Pantopoda	Nymphonidae	Nymphon hirtipes	-	-	-	X
Echinoidea	Camarodonta	Strongylocentrotidae	Strongylocentrotus sp.	-	X	-	-
			Strongylocentrotus droebachiensis	X	X	-	-
Holothuroidea	Apodida	-	-	-	X	X	X
		Myriotrochidae	Myriotrochus rinkii	-	X	X	X
	Dendrochirotida	Psolidae	Psolus sp.	-	-	X	-
	Molpadida	Eupyrgidae	Eupyrgus scaber	-	-	X	X
Ophiuroidea	-	-	-	-	-	-	X
	Ophiurida	Ophiopyrgidae	Ophiopleura borealis	-	-	-	X
			-	-	-	-	X
			Ophiocten affinis	X	-	-	-
			Ophiura sp.	X	-	-	-
			Ophiura sarsii	X	X	X	X
			Ophiura robusta	-	-	X	X
Priapulida	-	-	-	-	-	X	-
	Priapulomorpha	Priapulidae	Priapulus sp.	-	-	X	-
Sipunculidea	Golfingiida	Golfingiidae	-	-	-	X	X
			Golfingia sp.	-	-	X	X
			Nephasoma sp.	-	-	X	X
Ascidiacea	-	-	-	-	-	-	X
	Aplousobranchia	-	-	-	-	-	X
	Phlebobranchia	Ascidiidae	Ascidia sp.	-	X	-	-
	Stolidobranchia	Molgulidae	Molgula sp.	X	-	-	X
		Pyuridae	Boltenia echinata	X	-	-	-
		Styelidae	-	-	X	-	-
			Polycarpa sp.	-	X	-	-

Notes; - = no value; sp. = species

Table 3: Summary Statistics and Endpoints of Benthic Infauna from Four Transects Extending from Milne Port Area, 2019

Area and Waterbody	Station	Total Density (org/m^2)	Richness (taxa/station)	Simpson's Diversity Index	Simpson's Evenness Index
BE	BE-1	13068	53	0.815	0.095
	BE-2	4441	17	0.694	0.192
	BE-3	18588	72	0.900	0.119
	BE-4	12332	64	0.896	0.132
	BE-5	15865	69	0.932	0.189
	BE-6	16614	75	0.942	0.205
	BE-7	11999	78	0.947	0.222
	BE-8	20729	70	0.914	0.144
Mean		14,205	62	0.880	0.162
Median		14,467	70	0.907	0.166
Minimum		4,441	17	0.694	0.095
Maximum		20,729	78	0.947	0.222
Count		8	8	8	8
SD		5,005	20	0.086	0.046
SE		1,769	7	0.030	0.016
BW	BW-1	8,665	57	0.938	0.249
	BW-2	10,184	69	0.946	0.241
	BW-3	23,804	69	0.894	0.118
	BW-4	26,842	76	0.924	0.156
	BW-5	10,680	65	0.926	0.166
	BW-6	21,107	60	0.907	0.151
	BW-7	25,093	60	0.773	0.066
	BW-8	10,731	38	0.804	0.113
Mean		17,138	62	0.889	0.157
Median		15,919	63	0.916	0.153
Minimum		8,665	38	0.773	0.066
Maximum		26,842	76	0.946	0.249
Count		8	8	8	8
SD		7,751	11	0.065	0.063
SE		2,740	4	0.023	0.022
BNW	BNW-1	5,959	64	0.954	0.303
	BNW-2	9,617	53	0.921	0.208
	BNW-3	8,020	57	0.931	0.226
	BNW-4	7,636	67	0.947	0.250
	BNW-5	3,772	46	0.919	0.243
	BNW-6	6,056	55	0.935	0.241
	BNW-7	3,899	45	0.943	0.343
	BNW-8	3,281	43	0.941	0.371
Mean		6,030	54	0.936	0.273

Median		6,008	54	0.938	0.246
Minimum		3,281	43	0.919	0.208
Maximum		9,617	67	0.954	0.371
Count		8	8	8	8
SD		2,287	9	0.012	0.059
SE		809	3	0.004	0.021
BNE	**BNE-1**	8,136	60	0.937	0.237
	BNE-2	6,779	50	0.931	0.263
	BNE-3	6,932	53	0.941	0.299
	BNE-4	4,868	59	0.962	0.414
	BNE-5	6,585	54	0.941	0.283
	BNE-6	4,321	54	0.939	0.281
	BNE-7	876	19	0.909	0.578
	BNE-8	7,894	60	0.929	0.213
Mean		5,799	51	0.936	0.321
Median		6,682	54	0.938	0.282
Minimum		876	19	0.909	0.213
Maximum		8,136	60	0.962	0.578
Count		8	8	8	8
SD		2,390	13	0.015	0.120
SE		845	5	0.005	0.042

Notes: org/m^2 = organism per meter squared; SD = standard deviation; SE = standard error

APPENDIX F

Shellfish Tissue Chemical Analysis and Weight and Length Data

Table 1: Tissue Metal Outliers Removed from Statistical Analysis of *Hiatella arctica* , 2018 and 2019

Sample Identification	Year	Metal	ncentration Val	Reasoning
L2156762-5	2018	Cadmium	2.49	Data points have a narrow spread with the outliers 3 times larger than median value.
			1.79	
L2156762-19	2018	Tin	0.352	Data points have a narrow spread with the outliers 4 times larger than median value.
BE-4 SA19-072-063	2019	Tin	0.529	Outlier is 4 times larger than median value. Remaining values clustered in closer proximity to outer whiskers.
BW-6 SA19-072-117	2019	Titanium	4.59	Outlier 25 units below median value.
BNW-1 SA19-072-128	2019	Aluminium	2370	Outlier 2 times larger than median value.
		Antimony	0.0424	Outlier over 2 times larger than median value.

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475878, 08475881

Attention: Christine Bylenga

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Report Date: 2020/01/20
Report #: R2835276
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A5916
Received: 2019/12/10, 08:10

Sample Matrix: Tissue
Samples Received: 80

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS - Tissue Plug Wet Wt	40	2020/01/07	2020/01/16	BBY WI-00033	Auto Calc
Elements by ICPMS - Tissue Plug Wet Wt	35	2020/01/08	2020/01/16	BBY WI-00033	Auto Calc
Elements by ICPMS - Tissue Plug Wet Wt	5	2020/01/08	2020/01/17	BBY WI-00033	Auto Calc
Moisture in Tissue - Freeze Drying	40	2020/01/07	2020/01/09	BBY7SOP-00021	BCMOE BCLM Aug 2014
Moisture in Tissue - Freeze Drying	40	2020/01/08	2020/01/10	BBY7SOP-00021	BCMOE BCLM Aug 2014

Remarks:

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Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
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Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475878, 08475881

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Report Date: 2020/01/20
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Version: 1 - Final

CERTIFICATE OF ANALYSIS

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Email: Gail.Pedersen@bvlabs.com
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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0727	XC0728	XC0729	XC0730		
Sampling Date		2019/09/22	2019/09/22	2019/09/22	2019/09/22		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-1 SA19-072-053**	**BE-1 SA19-072-054**	**BE-1 SA19-072-055**	**BE-1 SA19-072-056**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	387	1130	1040	526	0.50	9732352
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0089	0.0180	0.0179	0.0168	0.0020	9732352
Total (Wet Wt) Arsenic (As)	mg/kg	1.65	2.34	3.10	1.80	0.0050	9732352
Total (Wet Wt) Barium (Ba)	mg/kg	3.95	7.42	6.26	3.32	0.010	9732352
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0224	0.0620	0.0567	0.0274	0.0020	9732352
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0067	0.0143	0.0130	0.0106	0.0013	9732352
Total (Wet Wt) Boron (B)	mg/kg	14.4	14.5	13.7	7.57	0.20	9732352
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.277	0.425	0.732	0.555	0.0013	9732352
Total (Wet Wt) Calcium (Ca)	mg/kg	2980	7850	7700	3990	4.0	9732352
Total (Wet Wt) Chromium (Cr)	mg/kg	1.04	2.76	2.57	1.38	0.025	9732352
Total (Wet Wt) Cobalt (Co)	mg/kg	0.291	0.914	0.888	0.995	0.0013	9732352
Total (Wet Wt) Copper (Cu)	mg/kg	1.54	2.24	3.91	1.83	0.013	9732352
Total (Wet Wt) Iron (Fe)	mg/kg	671	2020	2250	835	0.25	9732352
Total (Wet Wt) Lead (Pb)	mg/kg	0.447	1.52	1.36	1.73	0.0013	9732352
Total (Wet Wt) Magnesium (Mg)	mg/kg	1990	4630	4300	2320	0.40	9732352
Total (Wet Wt) Manganese (Mn)	mg/kg	14.3	58.1	72.3	88.2	0.010	9732352
Total (Wet Wt) Mercury (Hg)	mg/kg	0.026	0.025	0.028	0.034	0.013	9732352
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.198	0.823	0.361	0.224	0.0080	9732352
Total (Wet Wt) Nickel (Ni)	mg/kg	0.906	2.00	1.82	1.35	0.010	9732352
Total (Wet Wt) Phosphorus (P)	mg/kg	2750	1220	1450	1370	2.0	9732352
Total (Wet Wt) Potassium (K)	mg/kg	1040	1210	1010	1120	2.5	9732352
Total (Wet Wt) Selenium (Se)	mg/kg	1.66	1.60	1.59	1.39	0.010	9732352
Total (Wet Wt) Silver (Ag)	mg/kg	0.0019	0.0040	0.0055	0.0033	0.0013	9732352
Total (Wet Wt) Sodium (Na)	mg/kg	4320	4320	3970	3650	2.5	9732352
Total (Wet Wt) Strontium (Sr)	mg/kg	10.1	14.0	16.3	12.0	0.013	9732352
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00925	0.0215	0.0208	0.0139	0.00040	9732352
Total (Wet Wt) Tin (Sn)	mg/kg	0.024	0.098	0.060	0.029	0.020	9732352
Total (Wet Wt) Titanium (Ti)	mg/kg	13.7	34.5	34.6	17.9	0.13	9732352
Total (Wet Wt) Uranium (U)	mg/kg	0.116	0.254	0.260	0.138	0.00040	9732352
Total (Wet Wt) Vanadium (V)	mg/kg	1.34	3.85	3.80	2.38	0.020	9732352
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	12.6	16.5	15.3	0.20	9732352

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0731	XC0732	XC0733	XC0734		
Sampling Date		2019/09/22	2019/09/23	2019/09/23	2019/09/23		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-1 SA19-072-057**	**BE-3 SA19-072-058**	**BE-3 SA19-072-059**	**BE-3 SA19-072-060**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	1060	726	487	1580	0.50	9732352
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0228	0.0115	0.0140	0.0198	0.0020	9732352
Total (Wet Wt) Arsenic (As)	mg/kg	5.31	1.59	3.24	2.97	0.0050	9732352
Total (Wet Wt) Barium (Ba)	mg/kg	6.02	5.57	20.3	9.58	0.010	9732352
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0610	0.0391	0.0301	0.0868	0.0020	9732352
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0176	0.0089	0.0081	0.0171	0.0013	9732352
Total (Wet Wt) Boron (B)	mg/kg	16.7	7.39	6.43	11.5	0.20	9732352
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.755	0.472	0.572	0.353	0.0013	9732352
Total (Wet Wt) Calcium (Ca)	mg/kg	7300	5440	3990	15700	4.0	9732352
Total (Wet Wt) Chromium (Cr)	mg/kg	2.67	1.92	1.48	4.53	0.025	9732352
Total (Wet Wt) Cobalt (Co)	mg/kg	1.26	0.559	1.18	1.04	0.0013	9732352
Total (Wet Wt) Copper (Cu)	mg/kg	2.36	1.98	1.83	2.25	0.013	9732352
Total (Wet Wt) Iron (Fe)	mg/kg	3490	1320	1000	3060	0.25	9732352
Total (Wet Wt) Lead (Pb)	mg/kg	1.61	0.994	1.10	1.76	0.0013	9732352
Total (Wet Wt) Magnesium (Mg)	mg/kg	3980	3090	2430	8120	0.40	9732352
Total (Wet Wt) Manganese (Mn)	mg/kg	109	32.6	147	63.2	0.010	9732352
Total (Wet Wt) Mercury (Hg)	mg/kg	0.034	0.021	0.078	0.015	0.013	9732352
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.524	0.243	0.293	0.241	0.0080	9732352
Total (Wet Wt) Nickel (Ni)	mg/kg	2.13	1.56	1.78	2.62	0.010	9732352
Total (Wet Wt) Phosphorus (P)	mg/kg	1300	1170	960	1020	2.0	9732352
Total (Wet Wt) Potassium (K)	mg/kg	970	1020	910	1400	2.5	9732352
Total (Wet Wt) Selenium (Se)	mg/kg	1.45	1.21	1.61	1.18	0.010	9732352
Total (Wet Wt) Silver (Ag)	mg/kg	0.0045	0.0032	0.0032	0.0043	0.0013	9732352
Total (Wet Wt) Sodium (Na)	mg/kg	3870	4370	4590	3060	2.5	9732352
Total (Wet Wt) Strontium (Sr)	mg/kg	21.7	14.2	15.1	17.2	0.013	9732352
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0246	0.0154	0.0177	0.0316	0.00040	9732352
Total (Wet Wt) Tin (Sn)	mg/kg	0.070	0.054	0.030	0.122	0.020	9732352
Total (Wet Wt) Titanium (Ti)	mg/kg	34.5	26.5	17.0	71.7	0.13	9732352
Total (Wet Wt) Uranium (U)	mg/kg	0.292	0.384	0.211	0.313	0.00040	9732352
Total (Wet Wt) Vanadium (V)	mg/kg	4.99	2.51	2.51	5.26	0.020	9732352
Total (Wet Wt) Zinc (Zn)	mg/kg	15.7	12.8	13.9	13.9	0.20	9732352
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0735	XC0736	XC0737	XC0738		
Sampling Date		2019/09/23	2019/09/23	2019/09/23	2019/09/23		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-3 SA19-072-061**	**BE-3 SA19-072-062**	**BE-4 SA19-072-063**	**BE-4 SA19-072-064**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	696	1460	1620	1380	0.50	9732352
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0120	0.0239	0.0229	0.0195	0.0020	9732352
Total (Wet Wt) Arsenic (As)	mg/kg	2.67	2.75	5.61	3.45	0.0050	9732352
Total (Wet Wt) Barium (Ba)	mg/kg	21.1	15.7	19.6	12.0	0.010	9732352
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0399	0.0787	0.0915	0.0779	0.0020	9732352
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0117	0.0157	0.0197	0.0158	0.0013	9732352
Total (Wet Wt) Boron (B)	mg/kg	7.61	13.7	13.8	11.7	0.20	9732352
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.897	0.396	0.677	0.958	0.0013	9732352
Total (Wet Wt) Calcium (Ca)	mg/kg	11100	9750	16000	9200	4.0	9732352
Total (Wet Wt) Chromium (Cr)	mg/kg	1.85	3.85	4.46	3.47	0.025	9732352
Total (Wet Wt) Cobalt (Co)	mg/kg	0.871	1.58	1.93	1.51	0.0013	9732352
Total (Wet Wt) Copper (Cu)	mg/kg	1.74	2.96	3.00	2.54	0.013	9732352
Total (Wet Wt) Iron (Fe)	mg/kg	1330	2680	4010	3100	0.25	9732352
Total (Wet Wt) Lead (Pb)	mg/kg	0.997	2.07	1.99	1.79	0.0013	9732352
Total (Wet Wt) Magnesium (Mg)	mg/kg	3410	5440	6250	4720	0.40	9732352
Total (Wet Wt) Manganese (Mn)	mg/kg	75.1	136	207	135	0.010	9732352
Total (Wet Wt) Mercury (Hg)	mg/kg	0.052	0.032	0.024	0.021	0.013	9732352
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.302	0.485	0.480	0.372	0.0080	9732352
Total (Wet Wt) Nickel (Ni)	mg/kg	1.72	3.15	3.25	2.59	0.010	9732352
Total (Wet Wt) Phosphorus (P)	mg/kg	960	1020	1750	1320	2.0	9732352
Total (Wet Wt) Potassium (K)	mg/kg	1060	1450	1460	1470	2.5	9732352
Total (Wet Wt) Selenium (Se)	mg/kg	1.57	1.40	1.29	1.13	0.010	9732352
Total (Wet Wt) Silver (Ag)	mg/kg	0.0027	0.0064	0.0065	0.0062	0.0013	9732352
Total (Wet Wt) Sodium (Na)	mg/kg	4760	4110	3730	4470	2.5	9732352
Total (Wet Wt) Strontium (Sr)	mg/kg	89.9	20.8	56.0	22.3	0.013	9732352
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0163	0.0329	0.0329	0.0321	0.00040	9732352
Total (Wet Wt) Tin (Sn)	mg/kg	0.040	0.094	0.529	0.083	0.020	9732352
Total (Wet Wt) Titanium (Ti)	mg/kg	23.5	51.6	49.8	49.0	0.13	9732352
Total (Wet Wt) Uranium (U)	mg/kg	0.241	0.318	0.435	0.327	0.00040	9732352
Total (Wet Wt) Vanadium (V)	mg/kg	2.81	5.64	6.42	5.15	0.020	9732352
Total (Wet Wt) Zinc (Zn)	mg/kg	15.6	12.4	14.0	14.2	0.20	9732352
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0739	XC0740	XC0741	XC0742		
Sampling Date		2019/09/23	2019/09/23	2019/09/23	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-4 SA19-072-065**	**BE-4 SA19-072-066**	**BE-4 SA19-072-067**	**BE-5 SA19-072-068**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	887	1170	1130	1510	0.50	9732352
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0158	0.0163	0.0159	0.0197	0.0020	9732352
Total (Wet Wt) Arsenic (As)	mg/kg	3.78	2.92	3.71	2.54	0.0050	9732352
Total (Wet Wt) Barium (Ba)	mg/kg	11.5	10.6	23.9	8.12	0.010	9732352
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0520	0.0616	0.0661	0.0802	0.0020	9732352
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0111	0.0136	0.0137	0.0146	0.0013	9732352
Total (Wet Wt) Boron (B)	mg/kg	9.73	11.0	9.95	11.9	0.20	9732352
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.262	0.156	1.27	0.310	0.0013	9732352
Total (Wet Wt) Calcium (Ca)	mg/kg	6280	8800	8610	11000	4.0	9732352
Total (Wet Wt) Chromium (Cr)	mg/kg	2.44	3.16	3.09	3.71	0.025	9732352
Total (Wet Wt) Cobalt (Co)	mg/kg	1.29	1.07	0.925	0.998	0.0013	9732352
Total (Wet Wt) Copper (Cu)	mg/kg	1.87	2.14	2.21	2.23	0.013	9732352
Total (Wet Wt) Iron (Fe)	mg/kg	2200	2380	2640	2680	0.25	9732352
Total (Wet Wt) Lead (Pb)	mg/kg	1.18	1.27	1.35	1.50	0.0013	9732352
Total (Wet Wt) Magnesium (Mg)	mg/kg	3410	4850	4790	5960	0.40	9732352
Total (Wet Wt) Manganese (Mn)	mg/kg	141	105	60.8	101	0.010	9732352
Total (Wet Wt) Mercury (Hg)	mg/kg	0.039	0.030	0.027	0.024	0.013	9732352
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.400	0.721	0.425	0.305	0.0080	9732352
Total (Wet Wt) Nickel (Ni)	mg/kg	2.11	2.15	2.07	2.33	0.010	9732352
Total (Wet Wt) Phosphorus (P)	mg/kg	935	1610	961	1500	2.0	9732352
Total (Wet Wt) Potassium (K)	mg/kg	1160	1550	1150	1360	2.5	9732352
Total (Wet Wt) Selenium (Se)	mg/kg	1.39	1.42	1.18	1.15	0.010	9732352
Total (Wet Wt) Silver (Ag)	mg/kg	0.0036	0.0039	0.0122	0.0050	0.0013	9732352
Total (Wet Wt) Sodium (Na)	mg/kg	4730	4020	4190	4260	2.5	9732352
Total (Wet Wt) Strontium (Sr)	mg/kg	18.6	16.8	18.3	16.9	0.013	9732352
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0204	0.0219	0.0223	0.0249	0.00040	9732352
Total (Wet Wt) Tin (Sn)	mg/kg	0.091	0.132	0.091	0.077	0.020	9732352
Total (Wet Wt) Titanium (Ti)	mg/kg	29.0	38.0	39.2	45.4	0.13	9732352
Total (Wet Wt) Uranium (U)	mg/kg	0.268	0.288	0.431	0.228	0.00040	9732352
Total (Wet Wt) Vanadium (V)	mg/kg	3.75	4.36	4.40	4.80	0.020	9732352
Total (Wet Wt) Zinc (Zn)	mg/kg	11.7	9.72	11.9	13.8	0.20	9732352
RDL = Reportable Detection Limit							

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BUREAU VERITAS

BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0743	XC0744	XC0745	XC0746		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-5 SA19-072-069**	**BE-5 SA19-072-070**	**BE-5 SA19-072-071**	**BE-5 SA19-072-072**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	742	1060	1630	900	0.50	9732352
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0163	0.0270	0.0219	0.0155	0.0020	9732352
Total (Wet Wt) Arsenic (As)	mg/kg	3.44	3.15	2.22	1.67	0.0050	9732352
Total (Wet Wt) Barium (Ba)	mg/kg	12.4	32.7	11.0	5.05	0.010	9732352
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0425	0.0569	0.0837	0.0473	0.0020	9732352
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0097	0.0125	0.0163	0.0104	0.0013	9732352
Total (Wet Wt) Boron (B)	mg/kg	8.03	10.1	12.9	8.67	0.20	9732352
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.413	0.163	0.372	0.403	0.0013	9732352
Total (Wet Wt) Calcium (Ca)	mg/kg	5120	5920	14500	5570	4.0	9732352
Total (Wet Wt) Chromium (Cr)	mg/kg	2.00	2.78	4.46	2.34	0.025	9732352
Total (Wet Wt) Cobalt (Co)	mg/kg	1.17	2.43	0.950	0.975	0.0013	9732352
Total (Wet Wt) Copper (Cu)	mg/kg	1.79	2.04	2.32	1.83	0.013	9732352
Total (Wet Wt) Iron (Fe)	mg/kg	1330	2220	2790	1570	0.25	9732352
Total (Wet Wt) Lead (Pb)	mg/kg	1.19	1.99	1.55	1.56	0.0013	9732352
Total (Wet Wt) Magnesium (Mg)	mg/kg	3150	3690	7860	3720	0.40	9732352
Total (Wet Wt) Manganese (Mn)	mg/kg	140	388	54.5	96.3	0.010	9732352
Total (Wet Wt) Mercury (Hg)	mg/kg	0.046	0.034	0.026	0.025	0.013	9732352
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.426	0.492	0.511	0.254	0.0080	9732352
Total (Wet Wt) Nickel (Ni)	mg/kg	1.88	2.49	2.70	1.76	0.010	9732352
Total (Wet Wt) Phosphorus (P)	mg/kg	1070	972	1970	954	2.0	9732352
Total (Wet Wt) Potassium (K)	mg/kg	1100	1170	1350	1010	2.5	9732352
Total (Wet Wt) Selenium (Se)	mg/kg	1.30	1.23	1.07	0.898	0.010	9732352
Total (Wet Wt) Silver (Ag)	mg/kg	0.0029	0.0051	0.0049	0.0035	0.0013	9732352
Total (Wet Wt) Sodium (Na)	mg/kg	4640	4930	3530	4810	2.5	9732352
Total (Wet Wt) Strontium (Sr)	mg/kg	14.9	17.8	29.7	13.8	0.013	9732352
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0201	0.0294	0.0293	0.0187	0.00040	9732352
Total (Wet Wt) Tin (Sn)	mg/kg	0.042	0.059	0.100	0.051	0.020	9732352
Total (Wet Wt) Titanium (Ti)	mg/kg	26.3	35.0	58.3	31.1	0.13	9732352
Total (Wet Wt) Uranium (U)	mg/kg	0.164	0.177	0.269	0.131	0.00040	9732352
Total (Wet Wt) Vanadium (V)	mg/kg	3.17	4.79	5.30	3.42	0.020	9732352
Total (Wet Wt) Zinc (Zn)	mg/kg	14.0	11.2	13.8	11.9	0.20	9732352
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0747	XC0748	XC0749	XC0750		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-6 SA19-072-073**	**BE-6 SA19-072-074**	**BE-6 SA19-072-075**	**BE-6 SA19-072-076**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	572	901	1030	711	0.50	9732907
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0137	0.0169	0.0157	0.0206	0.0020	9732907
Total (Wet Wt) Arsenic (As)	mg/kg	2.94	2.10	3.01	3.92	0.0050	9732907
Total (Wet Wt) Barium (Ba)	mg/kg	10.9	6.83	7.49	11.5	0.010	9732907
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0317	0.0475	0.0551	0.0396	0.0020	9732907
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0092	0.0122	0.0121	0.0095	0.0013	9732907
Total (Wet Wt) Boron (B)	mg/kg	7.39	8.35	8.98	7.93	0.20	9732907
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.689	0.502	0.449	0.209	0.0013	9732907
Total (Wet Wt) Calcium (Ca)	mg/kg	4340	5850	7730	4830	4.0	9732907
Total (Wet Wt) Chromium (Cr)	mg/kg	1.71	2.40	2.69	1.93	0.025	9732907
Total (Wet Wt) Cobalt (Co)	mg/kg	1.02	0.781	0.714	2.02	0.0013	9732907
Total (Wet Wt) Copper (Cu)	mg/kg	1.87	2.18	1.89	1.96	0.013	9732907
Total (Wet Wt) Iron (Fe)	mg/kg	1220	1620	1840	1940	0.25	9732907
Total (Wet Wt) Lead (Pb)	mg/kg	0.997	1.68	1.14	1.40	0.0013	9732907
Total (Wet Wt) Magnesium (Mg)	mg/kg	2560	3490	4430	3050	0.40	9732907
Total (Wet Wt) Manganese (Mn)	mg/kg	98.2	70.9	44.5	283	0.010	9732907
Total (Wet Wt) Mercury (Hg)	mg/kg	0.059	0.021	0.044	0.045	0.013	9732907
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.267	0.183	0.212	0.402	0.0080	9732907
Total (Wet Wt) Nickel (Ni)	mg/kg	1.75	1.90	2.04	1.99	0.010	9732907
Total (Wet Wt) Phosphorus (P)	mg/kg	1130	2400	1090	2030	2.0	9732907
Total (Wet Wt) Potassium (K)	mg/kg	1090	1550	1370	1410	2.5	9732907
Total (Wet Wt) Selenium (Se)	mg/kg	1.80	1.06	1.36	1.46	0.010	9732907
Total (Wet Wt) Silver (Ag)	mg/kg	0.0054	0.0043	0.0043	0.0028	0.0013	9732907
Total (Wet Wt) Sodium (Na)	mg/kg	4580	4000	4210	3940	2.5	9732907
Total (Wet Wt) Strontium (Sr)	mg/kg	18.0	14.0	15.4	18.8	0.013	9732907
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0160	0.0227	0.0201	0.0184	0.00040	9732907
Total (Wet Wt) Tin (Sn)	mg/kg	0.037	0.050	0.056	0.044	0.020	9732907
Total (Wet Wt) Titanium (Ti)	mg/kg	22.1	32.9	36.4	25.2	0.13	9732907
Total (Wet Wt) Uranium (U)	mg/kg	0.200	0.146	0.184	0.176	0.00040	9732907
Total (Wet Wt) Vanadium (V)	mg/kg	2.91	3.60	3.73	4.04	0.020	9732907
Total (Wet Wt) Zinc (Zn)	mg/kg	16.3	11.6	13.9	9.74	0.20	9732907

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0751	XC0752	XC0753	XC0754		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-6 SA19-072-077**	**BE-7 SA19-072-078**	**BE-7 SA19-072-079**	**BE-7 SA19-072-080**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	910	623	1020	532	0.50	9732907
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0161	0.0113	0.0256	0.0107	0.0020	9732907
Total (Wet Wt) Arsenic (As)	mg/kg	1.86	1.81	4.13	1.83	0.0050	9732907
Total (Wet Wt) Barium (Ba)	mg/kg	7.64	3.92	24.0	4.34	0.010	9732907
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0498	0.0345	0.0566	0.0297	0.0020	9732907
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0104	0.0072	0.0108	0.0069	0.0013	9732907
Total (Wet Wt) Boron (B)	mg/kg	8.35	6.23	8.87	5.42	0.20	9732907
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.461	0.374	1.19	0.598	0.0013	9732907
Total (Wet Wt) Calcium (Ca)	mg/kg	6450	4370	10400	3920	4.0	9732907
Total (Wet Wt) Chromium (Cr)	mg/kg	2.44	1.67	2.55	1.47	0.025	9732907
Total (Wet Wt) Cobalt (Co)	mg/kg	0.963	0.506	1.83	0.377	0.0013	9732907
Total (Wet Wt) Copper (Cu)	mg/kg	1.81	1.54	2.10	2.12	0.013	9732907
Total (Wet Wt) Iron (Fe)	mg/kg	1700	1250	2510	1090	0.25	9732907
Total (Wet Wt) Lead (Pb)	mg/kg	1.39	0.732	1.46	0.654	0.0013	9732907
Total (Wet Wt) Magnesium (Mg)	mg/kg	3920	2950	6070	2520	0.40	9732907
Total (Wet Wt) Manganese (Mn)	mg/kg	97.1	38.5	294	26.2	0.010	9732907
Total (Wet Wt) Mercury (Hg)	mg/kg	0.022	0.020	0.022	0.021	0.013	9732907
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.440	0.212	0.420	0.400	0.0080	9732907
Total (Wet Wt) Nickel (Ni)	mg/kg	1.76	1.24	2.63	1.26	0.010	9732907
Total (Wet Wt) Phosphorus (P)	mg/kg	1270	1440	1990	2100	2.0	9732907
Total (Wet Wt) Potassium (K)	mg/kg	1270	1610	1410	1320	2.5	9732907
Total (Wet Wt) Selenium (Se)	mg/kg	0.913	1.23	1.45	1.59	0.010	9732907
Total (Wet Wt) Silver (Ag)	mg/kg	0.0040	0.0035	0.0045	0.0054	0.0013	9732907
Total (Wet Wt) Sodium (Na)	mg/kg	4320	4790	4190	4630	2.5	9732907
Total (Wet Wt) Strontium (Sr)	mg/kg	14.0	9.86	29.6	9.97	0.013	9732907
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0161	0.0119	0.0260	0.0112	0.00040	9732907
Total (Wet Wt) Tin (Sn)	mg/kg	0.054	0.040	0.093	0.037	0.020	9732907
Total (Wet Wt) Titanium (Ti)	mg/kg	32.5	23.7	35.2	20.9	0.13	9732907
Total (Wet Wt) Uranium (U)	mg/kg	0.153	0.0964	0.202	0.113	0.00040	9732907
Total (Wet Wt) Vanadium (V)	mg/kg	3.52	2.44	4.56	1.86	0.020	9732907
Total (Wet Wt) Zinc (Zn)	mg/kg	13.5	12.8	11.2	14.5	0.20	9732907
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0755	XC0756	XC0757	XC0758		
Sampling Date		2019/09/24	2019/09/24	2019/09/25	2019/09/25		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-7 SA19-072-081**	**BE-7 SA19-072-082**	**BE-8 SA19-072-083**	**BE-8 SA19-072-084**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	587	681	952	550	0.50	9732907
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0113	0.0279	0.0161	0.0106	0.0020	9732907
Total (Wet Wt) Arsenic (As)	mg/kg	2.37	5.54	3.30	1.56	0.0050	9732907
Total (Wet Wt) Barium (Ba)	mg/kg	4.72	11.3	21.0	3.54	0.010	9732907
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0317	0.0407	0.0498	0.0283	0.0020	9732907
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0075	0.0085	0.0103	0.0063	0.0013	9732907
Total (Wet Wt) Boron (B)	mg/kg	6.23	8.71	9.17	5.64	0.20	9732907
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.223	0.419	0.351	0.333	0.0013	9732907
Total (Wet Wt) Calcium (Ca)	mg/kg	4250	4960	6390	3100	4.0	9732907
Total (Wet Wt) Chromium (Cr)	mg/kg	1.56	1.81	2.52	1.39	0.025	9732907
Total (Wet Wt) Cobalt (Co)	mg/kg	0.470	2.59	0.779	0.343	0.0013	9732907
Total (Wet Wt) Copper (Cu)	mg/kg	1.79	1.80	1.98	1.42	0.013	9732907
Total (Wet Wt) Iron (Fe)	mg/kg	1430	3120	1870	998	0.25	9732907
Total (Wet Wt) Lead (Pb)	mg/kg	0.707	0.933	1.05	0.579	0.0013	9732907
Total (Wet Wt) Magnesium (Mg)	mg/kg	2490	2820	3940	2290	0.40	9732907
Total (Wet Wt) Manganese (Mn)	mg/kg	39.1	575	52.3	17.3	0.010	9732907
Total (Wet Wt) Mercury (Hg)	mg/kg	0.023	0.047	0.037	0.021	0.013	9732907
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.237	0.735	0.836	0.158	0.0080	9732907
Total (Wet Wt) Nickel (Ni)	mg/kg	1.20	1.93	1.85	1.05	0.010	9732907
Total (Wet Wt) Phosphorus (P)	mg/kg	2450	1380	2060	1370	2.0	9732907
Total (Wet Wt) Potassium (K)	mg/kg	1360	871	1410	1250	2.5	9732907
Total (Wet Wt) Selenium (Se)	mg/kg	1.48	1.27	1.51	1.27	0.010	9732907
Total (Wet Wt) Silver (Ag)	mg/kg	0.0033	0.0028	0.0046	0.0023	0.0013	9732907
Total (Wet Wt) Sodium (Na)	mg/kg	4500	4870	5020	5170	2.5	9732907
Total (Wet Wt) Strontium (Sr)	mg/kg	13.2	32.3	15.3	9.87	0.013	9732907
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0118	0.0211	0.0192	0.0102	0.00040	9732907
Total (Wet Wt) Tin (Sn)	mg/kg	0.035	0.074	0.056	0.033	0.020	9732907
Total (Wet Wt) Titanium (Ti)	mg/kg	20.6	23.4	34.6	19.7	0.13	9732907
Total (Wet Wt) Uranium (U)	mg/kg	0.109	0.169	0.173	0.0982	0.00040	9732907
Total (Wet Wt) Vanadium (V)	mg/kg	2.31	4.06	3.65	1.91	0.020	9732907
Total (Wet Wt) Zinc (Zn)	mg/kg	9.50	15.5	12.0	12.9	0.20	9732907

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0759	XC0760	XC0761	XC0762		
Sampling Date		2019/09/25	2019/09/25	2019/09/25	2019/09/27		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-8 SA19-072-085**	**BE-8 SA19-072-086**	**BE-8 SA19-072-087**	**BW-1 SA19-072-088**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	1110	1010	768	483	0.50	9732907
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0173	0.0177	0.0163	0.0119	0.0020	9732907
Total (Wet Wt) Arsenic (As)	mg/kg	2.43	3.85	3.43	2.28	0.0050	9732907
Total (Wet Wt) Barium (Ba)	mg/kg	8.22	7.89	28.6	4.23	0.010	9732907
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0579	0.0546	0.0442	0.0277	0.0020	9732907
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0125	0.0116	0.0093	0.0076	0.0013	9732907
Total (Wet Wt) Boron (B)	mg/kg	8.98	9.70	7.98	7.19	0.20	9732907
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.690	0.418	0.492	0.448	0.0013	9732907
Total (Wet Wt) Calcium (Ca)	mg/kg	5970	6400	5610	4100	4.0	9732907
Total (Wet Wt) Chromium (Cr)	mg/kg	2.77	2.82	2.26	1.29	0.025	9732907
Total (Wet Wt) Cobalt (Co)	mg/kg	1.16 (1)	0.902	0.909	0.555	0.0013	9732907
Total (Wet Wt) Copper (Cu)	mg/kg	2.27	1.87	1.78	2.29	0.013	9732907
Total (Wet Wt) Iron (Fe)	mg/kg	2120	2000	1670	1820	0.25	9732907
Total (Wet Wt) Lead (Pb)	mg/kg	1.38	1.20	0.947	0.689	0.0013	9732907
Total (Wet Wt) Magnesium (Mg)	mg/kg	3690	3750	3690	2230	0.40	9732907
Total (Wet Wt) Manganese (Mn)	mg/kg	113 (1)	73.8	87.3	50.3	0.010	9732907
Total (Wet Wt) Mercury (Hg)	mg/kg	0.036	0.044	0.049	0.025	0.013	9732907
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.299	0.272	0.370	0.252	0.0080	9732907
Total (Wet Wt) Nickel (Ni)	mg/kg	2.03	2.04	2.02	1.37	0.010	9732907
Total (Wet Wt) Phosphorus (P)	mg/kg	899	832	1160	1510	2.0	9732907
Total (Wet Wt) Potassium (K)	mg/kg	880	1170	1220	1020	2.5	9732907
Total (Wet Wt) Selenium (Se)	mg/kg	1.12	1.61	1.75	1.19	0.010	9732907
Total (Wet Wt) Silver (Ag)	mg/kg	0.0036	0.0039	0.0034	0.0033	0.0013	9732907
Total (Wet Wt) Sodium (Na)	mg/kg	4510	5210	5060	5660	2.5	9732907
Total (Wet Wt) Strontium (Sr)	mg/kg	16.1	19.7	15.3	14.8	0.013	9732907
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0201	0.0191	0.0163	0.0110	0.00040	9732907
Total (Wet Wt) Tin (Sn)	mg/kg	0.061	0.062	0.084	0.039	0.020	9732907
Total (Wet Wt) Titanium (Ti)	mg/kg	39.3	34.2	28.4	15.8	0.13	9732907
Total (Wet Wt) Uranium (U)	mg/kg	0.200	0.237	0.211	0.129	0.00040	9732907
Total (Wet Wt) Vanadium (V)	mg/kg	3.91	4.01	3.41	2.30	0.020	9732907
Total (Wet Wt) Zinc (Zn)	mg/kg	14.9	11.0	12.9	15.9	0.20	9732907

RDL = Reportable Detection Limit

(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0763	XC0764	XC0765	XC0766		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BW-1 SA19-072-089**	**BW-1 SA19-072-090**	**BW-1 SA19-072-091**	**BW-1 SA19-072-092**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	875	420	419	1190	0.50	9732907
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0139	0.0091	0.0097	0.0196	0.0020	9732907
Total (Wet Wt) Arsenic (As)	mg/kg	1.86	1.87	1.91	2.51	0.0050	9732907
Total (Wet Wt) Barium (Ba)	mg/kg	7.69	4.35	6.95	7.29	0.010	9732907
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0488	0.0224	0.0236	0.0637	0.0020	9732907
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0111	0.0066	0.0063	0.0137	0.0013	9732907
Total (Wet Wt) Boron (B)	mg/kg	8.54	6.20	5.77	10.9	0.20	9732907
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.326	0.530	0.384	0.425	0.0013	9732907
Total (Wet Wt) Calcium (Ca)	mg/kg	7800	2770	3580	8520	4.0	9732907
Total (Wet Wt) Chromium (Cr)	mg/kg	2.54	1.13	1.28	3.44	0.025	9732907
Total (Wet Wt) Cobalt (Co)	mg/kg	0.867	0.580	0.665	1.11	0.0013	9732907
Total (Wet Wt) Copper (Cu)	mg/kg	2.24	2.35	1.88	3.02	0.013	9732907
Total (Wet Wt) Iron (Fe)	mg/kg	2640	1310	1460	3580	0.25	9732907
Total (Wet Wt) Lead (Pb)	mg/kg	1.09	0.596	0.628	1.43	0.0013	9732907
Total (Wet Wt) Magnesium (Mg)	mg/kg	4490	1980	2290	4880	0.40	9732907
Total (Wet Wt) Manganese (Mn)	mg/kg	64.5	69.3	67.4	92.5	0.010	9732907
Total (Wet Wt) Mercury (Hg)	mg/kg	0.021	0.026	0.027	0.026	0.013	9732907
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.248	0.230	0.270	0.286	0.0080	9732907
Total (Wet Wt) Nickel (Ni)	mg/kg	1.92	1.15	1.25	2.76	0.010	9732907
Total (Wet Wt) Phosphorus (P)	mg/kg	1420	2730	1230	825	2.0	9732907
Total (Wet Wt) Potassium (K)	mg/kg	1100	1420	1200	1090	2.5	9732907
Total (Wet Wt) Selenium (Se)	mg/kg	1.21	1.72	1.72	1.08	0.010	9732907
Total (Wet Wt) Silver (Ag)	mg/kg	0.0037	0.0035	0.0027	0.0050	0.0013	9732907
Total (Wet Wt) Sodium (Na)	mg/kg	5310	5300	5450	5530	2.5	9732907
Total (Wet Wt) Strontium (Sr)	mg/kg	15.8	10.5	11.8	18.0	0.013	9732907
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0202	0.00933	0.0106	0.0250	0.00040	9732907
Total (Wet Wt) Tin (Sn)	mg/kg	0.107	0.081	0.042	0.115	0.020	9732907
Total (Wet Wt) Titanium (Ti)	mg/kg	30.6	13.8	14.6	38.6	0.13	9732907
Total (Wet Wt) Uranium (U)	mg/kg	0.250	0.108	0.112	0.227	0.00040	9732907
Total (Wet Wt) Vanadium (V)	mg/kg	3.46	1.97	1.85	4.72	0.020	9732907
Total (Wet Wt) Zinc (Zn)	mg/kg	12.6	13.3	15.5	13.5	0.20	9732907

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0767	XC0768	XC0779	XC0780		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475878	08475878	08475881	08475881		
	UNITS	**BW-2 SA19-072-093**	**BW-2 SA19-072-094**	**BW-2 SA19-072-095**	**BW-2 SA19-072-096**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	608	858	599	831	0.50	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0129	0.0150	0.0125	0.0166	0.0020	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	2.41	2.08	2.23	2.58	0.0050	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	18.2	5.16	10.7	6.18	0.010	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0343	0.0464	0.0347	0.0443	0.0020	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0081	0.0114	0.0085	0.0103	0.0013	9732998
Total (Wet Wt) Boron (B)	mg/kg	6.54	7.74	6.35	8.49	0.20	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.304	0.386	0.535	0.355	0.0013	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	4060	7340	4130	6000	4.0	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	2.19	2.46	2.14	2.45	0.025	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	0.873	0.571	0.611	1.19	0.0013	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.18	2.48	1.87	2.44	0.013	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	1630	2530	1800	2460	0.25	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	0.893	0.916	0.705	1.25	0.0013	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	2500	3240	2650	3480	0.40	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	84.9	31.5	42.8	129	0.010	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.032	0.018	0.030	0.029	0.013	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.292	0.206	0.226	0.292	0.0080	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	1.78	1.74	1.60	1.99	0.010	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	1170	1490	928	1240	2.0	9732998
Total (Wet Wt) Potassium (K)	mg/kg	1030	1690	1050	1820	2.5	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.62	1.27	1.48	1.60	0.010	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0095	0.0056	0.0036	0.0043	0.0013	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	5600	4780	5210	4200	2.5	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	15.4	23.9	14.0	11.9	0.013	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0184	0.0169	0.0116	0.0244	0.00040	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.130	0.059	0.045	0.052	0.020	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	25.8	34.0	21.7	36.1	0.13	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.168	0.152	0.200	0.162	0.00040	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	2.57	3.18	2.59	3.58	0.020	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	12.8	13.3	11.4	15.8	0.20	9732998
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0781	XC0782	XC0783	XC0784		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-2 SA19-072-097**	**BW-3 SA19-072-098**	**BW-3 SA19-072-099**	**BW-3 SA19-072-100**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	999	1350	661	1070	0.50	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0213	0.0224	0.0151	0.0185	0.0020	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	2.92	2.66	3.30	2.76	0.0050	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	4.48	7.21	24.4	7.82	0.010	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0536	0.0747	0.0398	0.0594	0.0020	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0131	0.0167	0.0091	0.0129	0.0013	9732998
Total (Wet Wt) Boron (B)	mg/kg	9.39	10.6	6.73	9.02	0.20	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.466	0.392	0.537	0.480	0.0013	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	7090	9650	5100	7540	4.0	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	2.98	4.01	2.26	3.18	0.025	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	1.28	0.927	0.590	0.914	0.0013	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.62	2.93	1.49	2.80	0.013	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	3880	3530	1850	2940	0.25	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	1.43	1.46	0.645	1.24	0.0013	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	3640	5200	3030	4170	0.40	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	108	50.9	28.2	85.7	0.010	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.017	0.020	0.078	0.023	0.013	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.293	0.621	0.350	0.273	0.0080	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	2.39	2.58	2.04	2.06	0.010	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	758	3160	728	1460	2.0	9732998
Total (Wet Wt) Potassium (K)	mg/kg	913	1950	920	1630	2.5	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.12	1.55	1.91	1.52	0.010	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0078	0.0062	0.0037	0.0124	0.0013	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	4830	3620	4950	3620	2.5	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	20.7	14.5	13.6	13.3	0.013	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0197	0.0267	0.0182	0.0225	0.00040	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.075	0.088	0.041	0.073	0.020	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	36.3	50.7	26.6	43.2	0.13	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.220	0.220	0.240	0.192	0.00040	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	4.62	5.05	2.98	4.10	0.020	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	11.5	13.7	13.8	16.4	0.20	9732998

RDL = Reportable Detection Limit

BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0785	XC0786	XC0787	XC0788		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-3 SA19-072-101**	**BW-3 SA19-072-102**	**BW-4 SA19-072-103**	**BW-4 SA19-072-104**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	844	906	723	960	0.50	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0137	0.0165	0.0189	0.0200	0.0020	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	2.00	1.94	2.89	4.12	0.0050	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	6.40	7.70	8.85	19.5	0.010	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0443	0.0499	0.0399	0.0559	0.0020	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0105	0.0104	0.0099	0.0133	0.0013	9732998
Total (Wet Wt) Boron (B)	mg/kg	7.07	7.91	8.24	8.96	0.20	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.546	0.704	0.493	0.424	0.0013	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	6450	6880	5890	6010	4.0	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	2.41	2.69	2.21	2.94	0.025	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	0.557	0.719	1.80	1.64	0.0013	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.22	2.09	2.39	2.44	0.013	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	2190	2650	1970	2800	0.25	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	0.869	1.04	1.15	1.43	0.0013	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	3570	3870	3640	3580	0.40	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	30.5	51.9	244	217	0.010	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.019	0.019	0.032	0.070	0.013	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	1.27	0.214	0.382	0.606	0.0080	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	1.73	1.89	2.41	2.41	0.010	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	1300	2440	2270	1330	2.0	9732998
Total (Wet Wt) Potassium (K)	mg/kg	1530	1680	1290	1200	2.5	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.55	1.29	1.55	1.40	0.010	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0060	0.0056	0.0054	0.0134	0.0013	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	3900	3920	5260	5030	2.5	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	11.6	13.4	15.1	19.5	0.013	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0167	0.0184	0.0234	0.0276	0.00040	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.055	0.055	0.066	0.061	0.020	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	35.0	36.4	28.2	35.9	0.13	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.162	0.148	0.137	0.210	0.00040	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	2.98	3.57	3.65	4.39	0.020	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	15.0	14.6	14.9	15.3	0.20	9732998
RDL = Reportable Detection Limit							

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BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0789	XC0790	XC0791	XC0792		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-4 SA19-072-105**	**BW-4 SA19-072-106**	**BW-4 SA19-072-107**	**BW-5 SA19-072-108**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	850	909	991	1310	0.50	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0190	0.0180	0.0268	0.0316	0.0020	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	2.79	2.97	5.15	6.23	0.0050	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	13.9	14.7	8.15	12.7	0.010	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0497	0.0532	0.0550	0.0745	0.0020	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0108	0.0127	0.0136	0.0159	0.0013	9732998
Total (Wet Wt) Boron (B)	mg/kg	8.34	9.06	10.3	14.2	0.20	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.286	0.378	0.374	0.289	0.0013	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	6430	7650	9260	11600	4.0	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	2.86	2.89	3.10	3.97	0.025	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	1.74	1.15	2.94	3.86	0.0013	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.10	2.37	2.52	3.00	0.013	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	2440	2250	3470	4200	0.25	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	1.33	1.19	1.72	2.14	0.0013	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	3990	4450	5130	5270	0.40	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	237	117	456	634	0.010	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.060	0.048	0.036	0.031	0.013	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.290	0.343	0.533	0.710	0.0080	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	2.61	2.36	3.06	3.89	0.010	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	778	1070	1180	904	2.0	9732998
Total (Wet Wt) Potassium (K)	mg/kg	1090	1520	1360	1020	2.5	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.12	1.68	1.29	0.984	0.010	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0048	0.0050	0.0050	0.0074	0.0013	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	5010	4520	5010	3790	2.5	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	15.7	15.1	22.1	51.2	0.013	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0302	0.0234	0.0636	0.0621	0.00040	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.053	0.077	0.063	0.153	0.020	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	33.4	36.3	38.7	50.0	0.13	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.217	0.181	0.182	0.254	0.00040	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	4.22	4.30	5.75	7.54	0.020	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	11.8	14.2	10.4	12.0	0.20	9732998
RDL = Reportable Detection Limit							

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BUREAU VERITAS

BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0793	XC0794	XC0795	XC0796		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-5 SA19-072-109**	**BW-5 SA19-072-110**	**BW-5 SA19-072-111**	**BW-5 SA19-072-112**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	974	743	1060	883	0.50	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0234	0.0207	0.0262 (1)	0.0226	0.0020	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	3.68	3.33	3.95	3.61	0.0050	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	8.96	17.6	10.3 (1)	12.5	0.010	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0531	0.0419	0.0655	0.0501	0.0020	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0125	0.0107	0.0137	0.0135	0.0013	9732998
Total (Wet Wt) Boron (B)	mg/kg	8.83	7.41	10.8	8.41	0.20	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.444	0.251	0.473	0.394	0.0013	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	9340	27000	11100	6520	4.0	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	3.15	2.43	3.31	2.73	0.025	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	2.46	1.92	2.69 (1)	2.66	0.0013	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.32	2.23	2.67	3.16	0.013	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	3230	2160	3110	2220	0.25	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	1.60	1.36	1.75	2.06	0.0013	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	4990	4000	5360	3690	0.40	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	414	301	392 (1)	319	0.010	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.033	0.060	0.035	0.062	0.013	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.580	0.473	0.553	0.429	0.0080	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	2.75	2.48	3.06	3.22	0.010	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	1090	705	1180	1540	2.0	9732998
Total (Wet Wt) Potassium (K)	mg/kg	1390	923	1590	1120	2.5	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.07	1.24	1.12	1.11	0.010	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0072	0.0046	0.0048	0.0050	0.0013	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	4140	4100	3340	2590	2.5	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	20.4	32.2	21.6	14.6	0.013	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0386	0.0285	0.0511	0.0258	0.00040	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.064	0.043	0.069	0.059	0.020	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	40.0	29.9	43.6	33.1	0.13	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.194	0.202	0.221	0.230	0.00040	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	5.12	4.00	5.87	4.54	0.020	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	9.50	8.61	13.7	14.2	0.20	9732998

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0797	XC0798	XC0799	XC0800		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-6 SA19-072-113**	**BW-6 SA19-072-114**	**BW-6 SA19-072-115**	**BW-6 SA19-072-116**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	1090	770	1380	543	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0259	0.0158	0.0217	0.0120	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	6.31	3.15	3.78	2.82	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	10.9	9.18	11.8	15.8	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0605	0.0457	0.0732	0.0324	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0132	0.0112	0.0160	0.0077	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	10.8	7.47	8.83	5.02	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.315	0.415	0.415	0.845	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	11100	8160	9590	5350	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	3.64	2.50	3.94	1.85	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	2.28	1.16	2.21	0.834	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	3.05	2.22	2.67	2.02	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	4690	2490	4030	1580	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	1.32	0.989	1.76	0.763	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	4880	4260	5180	3180	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	343	121	232	92.6	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.038	0.037	0.028	0.034	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.544	0.620	0.288	0.558	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	3.05	2.07	2.95	1.49	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1140	1130	1460	1210	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	1070	1080	1030	1130	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.19	2.01	0.738	1.43	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0050	0.0037	0.0042	0.0159	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3290	3810	1830	3230	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	45.0	24.9	22.6	10.6	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0292	0.0191	0.0321	0.0138	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.068	0.044	0.099	0.037	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	45.6	29.9	60.5	25.2	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.238	0.170	0.287	0.140	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	6.14	3.77	6.26	2.62	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	11.4	11.8	12.2	17.3	0.20	9734320
RDL = Reportable Detection Limit							

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0801	XC0802	XC0803	XC0804		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-6 SA19-072-117**	**BW-7 SA19-072-118**	**BW-7 SA19-072-119**	**BW-7 SA19-072-120**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	109	413	1100	565	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0043	0.0226	0.0208	0.0117	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.68	3.06	3.09	3.01	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	17.3	8.17	7.18	15.0	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0072	0.0270	0.0594	0.0336	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0032	0.0085	0.0136	0.0080	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	3.06	4.97	10.4	5.98	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.503	0.320	0.610	0.977	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	1390	4940	11500	6010	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	0.405	1.55	3.72	1.93	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	0.326	1.76	0.911	0.704	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	1.90	2.00	2.24	2.13	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	374	1590	3310	1740	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	0.150	0.951	1.16	0.679	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	1190	2490	5930	3200	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	19.3	288	65.8	59.5	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.037	0.036	0.032	0.033	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.165	0.323	0.215	0.272	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	0.743	1.89	2.51	1.57	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1360	1080	928	1260	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	998	1000	878	1250	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.84	1.68	1.07	1.56	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0091	0.0030	0.0049	0.0085	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3770	2640	3270	3620	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	7.44	15.0	28.2	14.9	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00370	0.0166	0.0230	0.0143	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	0.025	0.096	0.033	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	4.59	17.9	46.8	23.1	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.0901	0.148	0.232	0.168	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	0.834	3.34	5.05	2.85	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	19.2	13.9	13.2	19.1	0.20	9734320

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0805	XC0806	XC0807	XC0808		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-7 SA19-072-121**	**BW-7 SA19-072-122**	**BW-8 SA19-072-123**	**BW-8 SA19-072-124**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	732	916	634	1280	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0138	0.0184	0.0105	0.0217	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.50	2.85	1.70	2.53	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	4.68	17.3	3.49	5.10	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0437	0.0528	0.0378	0.0689	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0106	0.0118	0.0104	0.0150	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	6.45	8.00	5.64	9.99	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.467	0.766	0.459	0.345	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	8180	10100	7260	12500	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	2.49	3.05	2.17	4.19	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	0.642	1.21	0.574	1.16	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	1.93	2.11	2.31	2.80	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	1970	2730	1570	3120	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	0.877	1.18	0.877	1.40	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	4520	5580	4150	6580	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	45.5	116	26.8	79.5	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.028	0.020	0.015	0.019	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.185	0.291	0.203	0.260	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	1.68	2.23	1.57	2.66	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1100	976	2760	1990	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	1110	1140	1410	1600	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.59	1.24	1.12	1.43	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0026	0.0053	0.0061	0.0106	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3240	4060	3300	2620	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	13.6	18.2	10.5	17.9	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0159	0.0215	0.0150	0.0288	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.045	0.054	0.044	0.078	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	29.7	37.1	26.0	53.4	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.147	0.193	0.124	0.212	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	3.24 (1)	4.39	2.72	5.40	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	13.4	12.2	13.6	14.8	0.20	9734320

RDL = Reportable Detection Limit

(1) Matrix spike failed for (Vanadium), suspected matrix interference.

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0809	XC0810	XC0811	XC0812		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/29		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-8 SA19-072-125**	**BW-8 SA19-072-126**	**BW-8 SA19-072-127**	**BNW-1 SA19-072-128**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	973	1290	673	2370	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0187	0.0177	0.0162	0.0424	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.41	2.17	2.46	2.11	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	4.81	5.39	7.90	10.0	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0557	0.0730	0.0400	0.146	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0149	0.0172	0.0121	0.0248	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	7.98	10.0	6.44	16.4	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.487	0.448	0.783	0.435	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	9710	21300	6690	22600	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	3.46	4.44	2.30	7.34	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	1.48	1.05	1.12	1.29	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	2.57	2.94	2.97	4.49	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	2850	3340	1760	7000	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	1.56	1.47	1.05	2.29	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	5630	8410	3870	11600	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	118	57.4	106	47.3	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.030	0.019	0.023	0.025	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.291	0.212	0.270	0.242	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	2.29	2.70	1.78	4.26	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1140	1170	1590	981	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	1410	1540	1450	1270	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.27	1.49	1.84	1.37	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0219	0.0063	0.0127	0.0169	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3340	2840	3190	2340	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	13.7	80.1	12.4	21.3	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0221	0.0280	0.0232	0.0465	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.060	0.079	0.043	0.151	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	42.2	58.2	30.2	109	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.207	0.263	0.151	0.369	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	5.03	5.40	3.64	7.15	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	12.3	17.2	19.5	0.20	9734320

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0813	XC0814	XC0815		
Sampling Date		2019/09/29	2019/10/02	2019/10/04		
COC Number		08475881	08475881	08475881		
	UNITS	**BNW-1 SA19-072-129**	**BNE-1 SA19-072-130**	**BNE-4 SA19-072-131**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	1290	686	474	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0241	0.0316	0.0119	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.05	3.03	2.15	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	9.87	19.0	4.20	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0734	0.0436	0.0268	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0169	0.0153	0.0074	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	9.37	6.97	5.30	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.787	0.916	0.695	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	10200	8330	5920	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	3.68	2.30	1.47	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	0.787	3.96	0.461	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	4.18	2.97	2.42	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	3700	2220	1190	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	1.60	3.42	0.774	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	4380	2980	2630	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	37.7	560	36.4	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.030	0.033	0.036	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.242	0.501	0.134	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	2.82	3.33	1.60	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1400	1070	2660	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	1140	1190	1410	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.87	1.19	1.87	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0150	0.0060	0.0055	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3160	1680	4810	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	20.4	22.7	18.7	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0248	0.0511	0.0128	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.069	0.071	0.035	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	51.9	27.4	19.1	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.227	0.193	0.0941	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	4.32	5.27	2.26	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	20.9	15.0	14.8	0.20	9734320
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0816		
Sampling Date		2019/10/04		
COC Number		08475881		
	UNITS	**BNE-5 SA19-072-132**	**RDL**	**QC Batch**
Total Metals by ICPMS				
Total (Wet Wt) Aluminum (Al)	mg/kg	828	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0199	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.49	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	5.53	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0475	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0116	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	7.91	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.725	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	8390	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	2.55	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	0.802	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	2.39	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	1750	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	1.05	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	4320	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	49.1	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.048	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.182	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	2.04	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	881	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	969	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.72	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0063	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	4710	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	18.9	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0233	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.060	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	32.2	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.191	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	3.71	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	15.0	0.20	9734320
RDL = Reportable Detection Limit				

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0727	XC0728	XC0729	XC0730		
Sampling Date		2019/09/22	2019/09/22	2019/09/22	2019/09/22		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-1 SA19-072-053**	**BE-1 SA19-072-054**	**BE-1 SA19-072-055**	**BE-1 SA19-072-056**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	79	77	75	81	0.30	9727621
RDL = Reportable Detection Limit							

BV Labs ID		XC0731	XC0732	XC0733	XC0734		
Sampling Date		2019/09/22	2019/09/23	2019/09/23	2019/09/23		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-1 SA19-072-057**	**BE-3 SA19-072-058**	**BE-3 SA19-072-059**	**BE-3 SA19-072-060**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	77	84	84	55	0.30	9727621
RDL = Reportable Detection Limit							

BV Labs ID		XC0735	XC0736	XC0737	XC0738		
Sampling Date		2019/09/23	2019/09/23	2019/09/23	2019/09/23		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-3 SA19-072-061**	**BE-3 SA19-072-062**	**BE-4 SA19-072-063**	**BE-4 SA19-072-064**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	80	73	73	74	0.30	9727621
RDL = Reportable Detection Limit							

BV Labs ID		XC0739	XC0740	XC0741	XC0742		
Sampling Date		2019/09/23	2019/09/23	2019/09/23	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-4 SA19-072-065**	**BE-4 SA19-072-066**	**BE-4 SA19-072-067**	**BE-5 SA19-072-068**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	81	75	73	73	0.30	9727621
RDL = Reportable Detection Limit							

BV Labs ID		XC0743	XC0744	XC0745	XC0746		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-5 SA19-072-069**	**BE-5 SA19-072-070**	**BE-5 SA19-072-071**	**BE-5 SA19-072-072**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	81	80	63	82	0.30	9727621
RDL = Reportable Detection Limit							

BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0747	XC0748	XC0749	XC0750		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-6 SA19-072-073**	**BE-6 SA19-072-074**	**BE-6 SA19-072-075**	**BE-6 SA19-072-076**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	82	78	79	77	0.30	9727655
RDL = Reportable Detection Limit							

BV Labs ID		XC0751	XC0752	XC0753	XC0754		
Sampling Date		2019/09/24	2019/09/24	2019/09/24	2019/09/24		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-6 SA19-072-077**	**BE-7 SA19-072-078**	**BE-7 SA19-072-079**	**BE-7 SA19-072-080**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	79	79	75	81	0.30	9727655
RDL = Reportable Detection Limit							

BV Labs ID		XC0755	XC0756	XC0757	XC0758		
Sampling Date		2019/09/24	2019/09/24	2019/09/25	2019/09/25		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-7 SA19-072-081**	**BE-7 SA19-072-082**	**BE-8 SA19-072-083**	**BE-8 SA19-072-084**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	79	81	74	82	0.30	9727655
RDL = Reportable Detection Limit							

BV Labs ID		XC0759	XC0760	XC0761	XC0762		
Sampling Date		2019/09/25	2019/09/25	2019/09/25	2019/09/27		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BE-8 SA19-072-085**	**BE-8 SA19-072-086**	**BE-8 SA19-072-087**	**BW-1 SA19-072-088**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	82	78	78	82	0.30	9727655
RDL = Reportable Detection Limit							

BV Labs ID		XC0763	XC0764	XC0765	XC0766		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475878	08475878	08475878	08475878		
	UNITS	**BW-1 SA19-072-089**	**BW-1 SA19-072-090**	**BW-1 SA19-072-091**	**BW-1 SA19-072-092**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	80	80	75	0.30	9727655
RDL = Reportable Detection Limit							

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BV Labs Job #: B9A5916
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0767	XC0768	XC0779	XC0780		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475878	08475878	08475881	08475881		
	UNITS	**BW-2 SA19-072-093**	**BW-2 SA19-072-094**	**BW-2 SA19-072-095**	**BW-2 SA19-072-096**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	78	77	82	72	0.30	9728895
RDL = Reportable Detection Limit							

BV Labs ID		XC0781	XC0782	XC0783	XC0784		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-2 SA19-072-097**	**BW-3 SA19-072-098**	**BW-3 SA19-072-099**	**BW-3 SA19-072-100**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	78	72	83	73	0.30	9728895
RDL = Reportable Detection Limit							

BV Labs ID		XC0785	XC0786	XC0787	XC0788		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/27		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-3 SA19-072-101**	**BW-3 SA19-072-102**	**BW-4 SA19-072-103**	**BW-4 SA19-072-104**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	78	76	80	86	0.30	9728895
RDL = Reportable Detection Limit							

BV Labs ID		XC0789	XC0790	XC0791	XC0792		
Sampling Date		2019/09/27	2019/09/27	2019/09/27	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-4 SA19-072-105**	**BW-4 SA19-072-106**	**BW-4 SA19-072-107**	**BW-5 SA19-072-108**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	80	77	78	80	0.30	9728895
RDL = Reportable Detection Limit							

BV Labs ID		XC0793	XC0794	XC0795	XC0796		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-5 SA19-072-109**	**BW-5 SA19-072-110**	**BW-5 SA19-072-111**	**BW-5 SA19-072-112**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	85	80	75	77	0.30	9728895
RDL = Reportable Detection Limit							

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PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0797	XC0798	XC0799	XC0800		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-6 SA19-072-113**	**BW-6 SA19-072-114**	**BW-6 SA19-072-115**	**BW-6 SA19-072-116**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	78	67	77	0.30	9729051

RDL = Reportable Detection Limit

BV Labs ID		XC0801	XC0802	XC0803	XC0804		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-6 SA19-072-117**	**BW-7 SA19-072-118**	**BW-7 SA19-072-119**	**BW-7 SA19-072-120**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	81	81	76	78	0.30	9729051

RDL = Reportable Detection Limit

BV Labs ID		XC0805	XC0806	XC0807	XC0808		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/28		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-7 SA19-072-121**	**BW-7 SA19-072-122**	**BW-8 SA19-072-123**	**BW-8 SA19-072-124**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	77	77	76	68	0.30	9729051

RDL = Reportable Detection Limit

BV Labs ID		XC0809	XC0810	XC0811	XC0812		
Sampling Date		2019/09/28	2019/09/28	2019/09/28	2019/09/29		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BW-8 SA19-072-125**	**BW-8 SA19-072-126**	**BW-8 SA19-072-127**	**BNW-1 SA19-072-128**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	75	66	72	57	0.30	9729051

RDL = Reportable Detection Limit

BV Labs ID		XC0813	XC0814	XC0815	XC0816		
Sampling Date		2019/09/29	2019/10/02	2019/10/04	2019/10/04		
COC Number		08475881	08475881	08475881	08475881		
	UNITS	**BNW-1 SA19-072-129**	**BNE-1 SA19-072-130**	**BNE-4 SA19-072-131**	**BNE-5 SA19-072-132**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	69	75	75	75	0.30	9729051

RDL = Reportable Detection Limit

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE) Comments

Sample XC0727 [BE-1 SA19-072-053] Elements by ICPMS - Tissue Plug Wet Wt: Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.

Results relate only to the items tested.

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9727621	Moisture	2020/01/09					1.6 (1)	20		
9727655	Moisture	2020/01/09					1.2 (2)	20		
9728895	Moisture	2020/01/10					1.6 (3)	20		
9729051	Moisture	2020/01/10					0.65 (4)	20		
9732352	Total (Wet Wt) Aluminum (Al)	2020/01/16	113	80 - 120	<0.50	mg/kg	84 (6,1)	40		
9732352	Total (Wet Wt) Antimony (Sb)	2020/01/16	98	80 - 120	<0.0020	mg/kg	112 (6,1)	40	98	75 - 125
9732352	Total (Wet Wt) Arsenic (As)	2020/01/16	93	80 - 120	<0.0050	mg/kg	44 (6,1)	40	95	75 - 125
9732352	Total (Wet Wt) Barium (Ba)	2020/01/16	101	80 - 120	<0.010	mg/kg	10 (1)	40		
9732352	Total (Wet Wt) Beryllium (Be)	2020/01/16	98	80 - 120	<0.0020	mg/kg	88 (6,1)	40		
9732352	Total (Wet Wt) Bismuth (Bi)	2020/01/16	105	80 - 120	<0.0013	mg/kg	77 (6,1)	40		
9732352	Total (Wet Wt) Boron (B)	2020/01/16	101	80 - 120	<0.20	mg/kg	40 (1)	40		
9732352	Total (Wet Wt) Cadmium (Cd)	2020/01/16	95	80 - 120	<0.0013	mg/kg	6.7 (1)	40	92	75 - 125
9732352	Total (Wet Wt) Calcium (Ca)	2020/01/16	107	80 - 120	<4.0	mg/kg	62 (6,1)	60	115	75 - 125
9732352	Total (Wet Wt) Chromium (Cr)	2020/01/16	94	80 - 120	<0.025	mg/kg	79 (6,1)	40		
9732352	Total (Wet Wt) Cobalt (Co)	2020/01/16	95	80 - 120	<0.0013	mg/kg	148 (6,1)	40	90	75 - 125
9732352	Total (Wet Wt) Copper (Cu)	2020/01/16	94	80 - 120	<0.013	mg/kg	44 (6,1)	40	93	75 - 125
9732352	Total (Wet Wt) Iron (Fe)	2020/01/16	104	80 - 120	<0.25	mg/kg	100 (6,1)	40	99	75 - 125
9732352	Total (Wet Wt) Lead (Pb)	2020/01/16	104	80 - 120	<0.0013	mg/kg	129 (6,1)	40	108	75 - 125
9732352	Total (Wet Wt) Magnesium (Mg)	2020/01/16	104	80 - 120	<0.40	mg/kg	52 (6,1)	40		
9732352	Total (Wet Wt) Manganese (Mn)	2020/01/16	98	80 - 120	<0.010	mg/kg	179 (6,1)	40	97	75 - 125
9732352	Total (Wet Wt) Mercury (Hg)	2020/01/16	101	80 - 120	<0.013	mg/kg	30 (1)	40	86	75 - 125
9732352	Total (Wet Wt) Molybdenum (Mo)	2020/01/16	104	80 - 120	<0.0080	mg/kg	70 (6,1)	40	95	75 - 125
9732352	Total (Wet Wt) Nickel (Ni)	2020/01/16	95	80 - 120	<0.010	mg/kg	85 (6,1)	40		
9732352	Total (Wet Wt) Phosphorus (P)	2020/01/16	93	80 - 120	<2.0	mg/kg	74 (6,1)	40	99	75 - 125
9732352	Total (Wet Wt) Potassium (K)	2020/01/16	102	80 - 120	<2.5	mg/kg	20 (1)	40	104	75 - 125
9732352	Total (Wet Wt) Selenium (Se)	2020/01/16	93	80 - 120	<0.010	mg/kg	24 (1)	40	93	75 - 125
9732352	Total (Wet Wt) Silver (Ag)	2020/01/16	62 (7)	80 - 120	<0.0013	mg/kg	NC (1)	40	72 (5)	75 - 125
9732352	Total (Wet Wt) Sodium (Na)	2020/01/16	101	80 - 120	<2.5	mg/kg	3.0 (1)	40	107	75 - 125
9732352	Total (Wet Wt) Strontium (Sr)	2020/01/16	98	80 - 120	<0.013	mg/kg	47 (1)	60	110	75 - 125
9732352	Total (Wet Wt) Thallium (Tl)	2020/01/16	106	80 - 120	<0.00040	mg/kg	101 (6,1)	40	96	75 - 125
9732352	Total (Wet Wt) Tin (Sn)	2020/01/16	101	80 - 120	<0.020	mg/kg	99 (6,1)	40	98	75 - 125
9732352	Total (Wet Wt) Titanium (Ti)	2020/01/16	94	80 - 120	<0.13	mg/kg	75 (6,1)	40		
9732352	Total (Wet Wt) Uranium (U)	2020/01/16	106	80 - 120	<0.00040	mg/kg	54 (6,1)	40	106	75 - 125

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			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9732352	Total (Wet Wt) Vanadium (V)	2020/01/16	91	80 - 120	<0.020	mg/kg	106 (6,1)	40	56 (6)	75 - 125
9732352	Total (Wet Wt) Zinc (Zn)	2020/01/16	88	80 - 120	<0.20	mg/kg	1.9 (1)	40	92	75 - 125
9732907	Total (Wet Wt) Aluminum (Al)	2020/01/16	105	80 - 120	<0.50	mg/kg	37 (2)	40		
9732907	Total (Wet Wt) Antimony (Sb)	2020/01/16	103	80 - 120	<0.0020	mg/kg	19 (2)	40	123	75 - 125
9732907	Total (Wet Wt) Arsenic (As)	2020/01/16	99	80 - 120	<0.0050	mg/kg	13 (2)	40	95	75 - 125
9732907	Total (Wet Wt) Barium (Ba)	2020/01/16	103	80 - 120	<0.010	mg/kg	34 (2)	40		
9732907	Total (Wet Wt) Beryllium (Be)	2020/01/16	91	80 - 120	<0.0020	mg/kg	34 (2)	40		
9732907	Total (Wet Wt) Bismuth (Bi)	2020/01/16	106	80 - 120	<0.0013	mg/kg	15 (2)	40		
9732907	Total (Wet Wt) Boron (B)	2020/01/16	95	80 - 120	<0.20	mg/kg	15 (2)	40		
9732907	Total (Wet Wt) Cadmium (Cd)	2020/01/16	97	80 - 120	<0.0013	mg/kg	11 (2)	40	93	75 - 125
9732907	Total (Wet Wt) Calcium (Ca)	2020/01/16	104	80 - 120	<4.0	mg/kg	13 (2)	60	98	75 - 125
9732907	Total (Wet Wt) Chromium (Cr)	2020/01/16	99	80 - 120	<0.025	mg/kg	29 (2)	40		
9732907	Total (Wet Wt) Cobalt (Co)	2020/01/16	99	80 - 120	<0.0013	mg/kg	67 (6,2)	40	90	75 - 125
9732907	Total (Wet Wt) Copper (Cu)	2020/01/16	100	80 - 120	<0.013	mg/kg	15 (2)	40	94	75 - 125
9732907	Total (Wet Wt) Iron (Fe)	2020/01/16	110	80 - 120	<0.25	mg/kg	1.2 (2)	40	99	75 - 125
9732907	Total (Wet Wt) Lead (Pb)	2020/01/16	105	80 - 120	<0.0013	mg/kg	16 (2)	40	85	75 - 125
9732907	Total (Wet Wt) Magnesium (Mg)	2020/01/16	108	80 - 120	<0.40	mg/kg	23 (2)	40		
9732907	Total (Wet Wt) Manganese (Mn)	2020/01/16	101	80 - 120	<0.010	mg/kg	97 (6,2)	40	95	75 - 125
9732907	Total (Wet Wt) Mercury (Hg)	2020/01/16	103	80 - 120	<0.013	mg/kg	1.5 (2)	40	89	75 - 125
9732907	Total (Wet Wt) Molybdenum (Mo)	2020/01/16	101	80 - 120	<0.0080	mg/kg	24 (2)	40	97	75 - 125
9732907	Total (Wet Wt) Nickel (Ni)	2020/01/16	100	80 - 120	<0.010	mg/kg	7.8 (2)	40		
9732907	Total (Wet Wt) Phosphorus (P)	2020/01/16	95	80 - 120	<2.0	mg/kg	2.0 (2)	40	96	75 - 125
9732907	Total (Wet Wt) Potassium (K)	2020/01/16	108	80 - 120	<2.5	mg/kg	4.9 (2)	40	106	75 - 125
9732907	Total (Wet Wt) Selenium (Se)	2020/01/16	96	80 - 120	<0.010	mg/kg	19 (2)	40	92	75 - 125
9732907	Total (Wet Wt) Silver (Ag)	2020/01/16	66 (6)	80 - 120	<0.0013	mg/kg	7.7 (2)	40	77	75 - 125
9732907	Total (Wet Wt) Sodium (Na)	2020/01/16	104	80 - 120	<2.5	mg/kg	8.6 (2)	40	107	75 - 125
9732907	Total (Wet Wt) Strontium (Sr)	2020/01/16	100	80 - 120	<0.013	mg/kg	27 (2)	60	97	75 - 125
9732907	Total (Wet Wt) Thallium (Tl)	2020/01/16	107	80 - 120	<0.00040	mg/kg	1.7 (2)	40	98	75 - 125
9732907	Total (Wet Wt) Tin (Sn)	2020/01/16	104	80 - 120	<0.020	mg/kg	0.049 (2)	40	93	75 - 125
9732907	Total (Wet Wt) Titanium (Ti)	2020/01/16	95	80 - 120	<0.13	mg/kg	23 (2)	40		
9732907	Total (Wet Wt) Uranium (U)	2020/01/16	108	80 - 120	<0.00040	mg/kg	36 (2)	40	103	75 - 125
9732907	Total (Wet Wt) Vanadium (V)	2020/01/16	95	80 - 120	<0.020	mg/kg	1.4 (2)	40	54 (5)	75 - 125
9732907	Total (Wet Wt) Zinc (Zn)	2020/01/16	114	80 - 120	<0.20	mg/kg	18 (2)	40	95	75 - 125

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9732998	Total (Wet Wt) Aluminum (Al)	2020/01/16	98	80 - 120	<0.50	mg/kg	6.0 (3)	40		
9732998	Total (Wet Wt) Antimony (Sb)	2020/01/16	97	80 - 120	<0.0020	mg/kg	75 (6,3)	40	106	75 - 125
9732998	Total (Wet Wt) Arsenic (As)	2020/01/16	95	80 - 120	<0.0050	mg/kg	4.5 (3)	40	88	75 - 125
9732998	Total (Wet Wt) Barium (Ba)	2020/01/16	100	80 - 120	<0.010	mg/kg	53 (6,3)	40		
9732998	Total (Wet Wt) Beryllium (Be)	2020/01/16	87	80 - 120	<0.0020	mg/kg	12 (3)	40		
9732998	Total (Wet Wt) Bismuth (Bi)	2020/01/16	103	80 - 120	<0.0013	mg/kg	2.2 (3)	40		
9732998	Total (Wet Wt) Boron (B)	2020/01/16	90	80 - 120	<0.20	mg/kg	12 (3)	40		
9732998	Total (Wet Wt) Cadmium (Cd)	2020/01/16	95	80 - 120	<0.0013	mg/kg	9.1 (3)	40	87	75 - 125
9732998	Total (Wet Wt) Calcium (Ca)	2020/01/16	103	80 - 120	<4.0	mg/kg	18 (3)	60	97	75 - 125
9732998	Total (Wet Wt) Chromium (Cr)	2020/01/16	98	80 - 120	<0.025	mg/kg	6.9 (3)	40		
9732998	Total (Wet Wt) Cobalt (Co)	2020/01/16	99	80 - 120	<0.0013	mg/kg	41 (6,3)	40	85	75 - 125
9732998	Total (Wet Wt) Copper (Cu)	2020/01/16	99	80 - 120	<0.013	mg/kg	12 (3)	40	91	75 - 125
9732998	Total (Wet Wt) Iron (Fe)	2020/01/16	111	80 - 120	<0.25	mg/kg	14 (3)	40	98	75 - 125
9732998	Total (Wet Wt) Lead (Pb)	2020/01/16	101	80 - 120	<0.0013	mg/kg	25 (3)	40	380 (5)	75 - 125
9732998	Total (Wet Wt) Magnesium (Mg)	2020/01/16	104	80 - 120	<0.40	mg/kg	19 (3)	40		
9732998	Total (Wet Wt) Manganese (Mn)	2020/01/16	100	80 - 120	<0.010	mg/kg	46 (6,3)	40	91	75 - 125
9732998	Total (Wet Wt) Mercury (Hg)	2020/01/16	99	80 - 120	<0.013	mg/kg	10 (3)	40	83	75 - 125
9732998	Total (Wet Wt) Molybdenum (Mo)	2020/01/16	99	80 - 120	<0.0080	mg/kg	23 (3)	40	90	75 - 125
9732998	Total (Wet Wt) Nickel (Ni)	2020/01/16	99	80 - 120	<0.010	mg/kg	20 (3)	40		
9732998	Total (Wet Wt) Phosphorus (P)	2020/01/16	92	80 - 120	<2.0	mg/kg	16 (3)	40	92	75 - 125
9732998	Total (Wet Wt) Potassium (K)	2020/01/16	105	80 - 120	<2.5	mg/kg	4.1 (3)	40	99	75 - 125
9732998	Total (Wet Wt) Selenium (Se)	2020/01/16	93	80 - 120	<0.010	mg/kg	24 (3)	40	89	75 - 125
9732998	Total (Wet Wt) Silver (Ag)	2020/01/16	91	80 - 120	<0.0013	mg/kg	30 (3)	40	85	75 - 125
9732998	Total (Wet Wt) Sodium (Na)	2020/01/16	103	80 - 120	<2.5	mg/kg	10 (3)	40	100	75 - 125
9732998	Total (Wet Wt) Strontium (Sr)	2020/01/16	95	80 - 120	<0.013	mg/kg	46 (3)	60	91	75 - 125
9732998	Total (Wet Wt) Thallium (Tl)	2020/01/16	103	80 - 120	<0.00040	mg/kg	31 (3)	40	89	75 - 125
9732998	Total (Wet Wt) Tin (Sn)	2020/01/16	99	80 - 120	<0.020	mg/kg	10 (3)	40	84	75 - 125
9732998	Total (Wet Wt) Titanium (Ti)	2020/01/16	99	80 - 120	<0.13	mg/kg	15 (3)	40		
9732998	Total (Wet Wt) Uranium (U)	2020/01/16	103	80 - 120	<0.00040	mg/kg	6.0 (3)	40	96	75 - 125
9732998	Total (Wet Wt) Vanadium (V)	2020/01/16	96	80 - 120	<0.020	mg/kg	21 (3)	40	69 (5)	75 - 125
9732998	Total (Wet Wt) Zinc (Zn)	2020/01/16	95	80 - 120	<0.20	mg/kg	5.1 (3)	40	91	75 - 125
9734320	Total (Wet Wt) Aluminum (Al)	2020/01/16	103	80 - 120	<0.50	mg/kg	22 (4)	40		
9734320	Total (Wet Wt) Antimony (Sb)	2020/01/16	102	80 - 120	<0.0020	mg/kg	14 (4)	40	95	75 - 125

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9734320	Total (Wet Wt) Arsenic (As)	2020/01/16	97	80 - 120	<0.0050	mg/kg	2.6 (4)	40	89	75 - 125
9734320	Total (Wet Wt) Barium (Ba)	2020/01/16	106	80 - 120	<0.010	mg/kg	5.2 (4)	40		
9734320	Total (Wet Wt) Beryllium (Be)	2020/01/16	93	80 - 120	<0.0020	mg/kg	17 (4)	40		
9734320	Total (Wet Wt) Bismuth (Bi)	2020/01/16	106	80 - 120	<0.0013	mg/kg	2.4 (4)	40		
9734320	Total (Wet Wt) Boron (B)	2020/01/16	99	80 - 120	<0.20	mg/kg	12 (4)	40		
9734320	Total (Wet Wt) Cadmium (Cd)	2020/01/16	99	80 - 120	<0.0013	mg/kg	2.8 (4)	40	89	75 - 125
9734320	Total (Wet Wt) Calcium (Ca)	2020/01/16	101	80 - 120	<4.0	mg/kg	0.16 (4)	60	92	75 - 125
9734320	Total (Wet Wt) Chromium (Cr)	2020/01/16	97	80 - 120	<0.025	mg/kg	14 (4)	40		
9734320	Total (Wet Wt) Cobalt (Co)	2020/01/16	98	80 - 120	<0.0013	mg/kg	23 (4)	40	89	75 - 125
9734320	Total (Wet Wt) Copper (Cu)	2020/01/16	97	80 - 120	<0.013	mg/kg	11 (4)	40	93	75 - 125
9734320	Total (Wet Wt) Iron (Fe)	2020/01/16	111	80 - 120	<0.25	mg/kg	6.4 (4)	40	97	75 - 125
9734320	Total (Wet Wt) Lead (Pb)	2020/01/16	106	80 - 120	<0.0013	mg/kg	14 (4)	40	78	75 - 125
9734320	Total (Wet Wt) Magnesium (Mg)	2020/01/16	105	80 - 120	<0.40	mg/kg	1.1 (4)	40		
9734320	Total (Wet Wt) Manganese (Mn)	2020/01/16	99	80 - 120	<0.010	mg/kg	22 (4)	40	93	75 - 125
9734320	Total (Wet Wt) Mercury (Hg)	2020/01/16	104	80 - 120	<0.013	mg/kg	13 (4)	40	83	75 - 125
9734320	Total (Wet Wt) Molybdenum (Mo)	2020/01/16	101	80 - 120	<0.0080	mg/kg	3.5 (4)	40	97	75 - 125
9734320	Total (Wet Wt) Nickel (Ni)	2020/01/16	99	80 - 120	<0.010	mg/kg	17 (4)	40		
9734320	Total (Wet Wt) Phosphorus (P)	2020/01/16	93	80 - 120	<2.0	mg/kg	1.3 (4)	40	93	75 - 125
9734320	Total (Wet Wt) Potassium (K)	2020/01/16	103	80 - 120	<2.5	mg/kg	12 (4)	40	99	75 - 125
9734320	Total (Wet Wt) Selenium (Se)	2020/01/16	95	80 - 120	<0.010	mg/kg	0.54 (4)	40	87	75 - 125
9734320	Total (Wet Wt) Silver (Ag)	2020/01/16	72 (9)	80 - 120	<0.0013	mg/kg	32 (4)	40	86	75 - 125
9734320	Total (Wet Wt) Sodium (Na)	2020/01/16	99	80 - 120	<2.5	mg/kg	9.7 (4)	40	101	75 - 125
9734320	Total (Wet Wt) Strontium (Sr)	2020/01/16	99	80 - 120	<0.013	mg/kg	5.7 (4)	60	90	75 - 125
9734320	Total (Wet Wt) Thallium (Tl)	2020/01/16	109	80 - 120	<0.00040	mg/kg	23 (4)	40	90	75 - 125
9734320	Total (Wet Wt) Tin (Sn)	2020/01/16	104	80 - 120	<0.020	mg/kg	17 (4)	40	84	75 - 125
9734320	Total (Wet Wt) Titanium (Ti)	2020/01/16	96	80 - 120	<0.13	mg/kg	17 (4)	40		
9734320	Total (Wet Wt) Uranium (U)	2020/01/16	110	80 - 120	<0.00040	mg/kg	9.7 (4)	40	98	75 - 125
9734320	Total (Wet Wt) Vanadium (V)	2020/01/16	96	80 - 120	<0.020	mg/kg	16 (4)	40	66 (6)	75 - 125

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9734320	Total (Wet Wt) Zinc (Zn)	2020/01/16	97	80 - 120	<0.20	mg/kg	5.8 (4)	40	93	75 - 125

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Duplicate Parent ID [XC0727-01]

(2) Duplicate Parent ID [XC0759-01]

(3) Duplicate Parent ID [XC0795-01]

(4) Duplicate Parent ID [XC0805-01]

(5) Reference outside acceptance criteria - re-analysis yields similar results.

(6) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(7) Blank Spike outside acceptance criteria - re-analysis yields similar results.

(8) Duplicate Parent ID

(9) Blank Spike for (Silver) outside acceptance criteria (10% of analytes failure allowed).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Rob Reinert, B.Sc., Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

08475881

Client:	Golder - Baffinlands (Hiatella)
Project:	sa19-072

Client Sample ID	Sample Date	Replicate	Biologica Sample ID	# of Org.
BW-2	27-Sep-19	3	sa19-072-095	1
BW-2	27-Sep-19	4	sa19-072-096	1
BW-2	27-Sep-19	5	sa19-072-097	1
BW-3	27-Sep-19	1	sa19-072-098	1
BW-3	27-Sep-19	2	sa19-072-099	1
BW-3	27-Sep-19	3	sa19-072-100	1
BW-3	27-Sep-19	4	sa19-072-101	1
BW-3	27-Sep-19	5	sa19-072-102	1
BW-4	27-Sep-19	1	sa19-072-103	1
BW-4	27-Sep-19	2	sa19-072-104	1
BW-4	27-Sep-19	3	sa19-072-105	1
BW-4	27-Sep-19	4	sa19-072-106	1
BW-4	27-Sep-19	5	sa19-072-107	1
BW-5	28-Sep-19	1	sa19-072-108	1
BW-5	28-Sep-19	2	sa19-072-109	1
BW-5	28-Sep-19	3	sa19-072-110	1
BW-5	28-Sep-19	4	sa19-072-111	1
BW-5	28-Sep-19	5	sa19-072-112	1
BW-6	28-Sep-19	1	sa19-072-113	1
BW-6	28-Sep-19	2	sa19-072-114	1
BW-6	28-Sep-19	3	sa19-072-115	1
BW-6	28-Sep-19	4	sa19-072-116	1
BW-6	28-Sep-19	5	sa19-072-117	1
BW-7	28-Sep-19	1	sa19-072-118	1
BW-7	28-Sep-19	2	sa19-072-119	1
BW-7	28-Sep-19	3	sa19-072-120	1
BW-7	28-Sep-19	4	sa19-072-121	1
BW-7	28-Sep-19	5	sa19-072-122	1
BW-8	28-Sep-19	1	sa19-072-123	1
BW-8	28-Sep-19	2	sa19-072-124	1
BW-8	28-Sep-19	3	sa19-072-125	1
BW-8	28-Sep-19	4	sa19-072-126	1
BW-8	28-Sep-19	5	sa19-072-127	1
BNW-1	29-Sep-19	1	sa19-072-128	1
BNW-1	29-Sep-19	2	sa19-072-129	1
BNE-1	2-Oct-19	3	sa19-072-130	1
BNE-4	4-Oct-19	4	sa19-072-131	1
BNE-5	4-Oct-19	5	sa19-072-132	1

KEVIN Ulch 2019/10/10 08:10
Temp: 3, 4, 4

B9A5916_COC

1352

E:\Golder\2019\19-072 Baffinlands\19-072 Golder-Baffinlands Sample Inventory (Bureau Veritas)

biologica

08475878

B9A5916_COC

Client:	Golder - Baffinlands (Hiatella)
Project:	sa19-072

Client Sample ID	Sample Date	Replicate	Biologica Sample ID	# of Org.
BE-1	22-Sep-19	1	sa19-072-053	1
BE-1	22-Sep-19	2	sa19-072-054	1
BE-1	22-Sep-19	3	sa19-072-055	1
BE-1	22-Sep-19	4	sa19-072-056	1
BE-1	22-Sep-19	5	sa19-072-057	1
BE-3	23-Sep-19	1	sa19-072-058	1
BE-3	23-Sep-19	2	sa19-072-059	1
BE-3	23-Sep-19	3	sa19-072-060	1
BE-3	23-Sep-19	4	sa19-072-061	1
BE-3	23-Sep-19	5	sa19-072-062	1
BE-4	23-Sep-19	1	sa19-072-063	1
BE-4	23-Sep-19	2	sa19-072-064	1
BE-4	23-Sep-19	3	sa19-072-065	1
BE-4	23-Sep-19	4	sa19-072-066	1
BE-4	23-Sep-19	5	sa19-072-067	1
BE-5	24-Sep-19	1	sa19-072-068	1
BE-5	24-Sep-19	2	sa19-072-069	1
BE-5	24-Sep-19	3	sa19-072-070	1
BE-5	24-Sep-19	4	sa19-072-071	1
BE-5	24-Sep-19	5	sa19-072-072	1
BE-6	24-Sep-19	1	sa19-072-073	1
BE-6	24-Sep-19	2	sa19-072-074	1
BE-6	24-Sep-19	3	sa19-072-075	1
BE-6	24-Sep-19	4	sa19-072-076	1
BE-6	24-Sep-19	5	sa19-072-077	1
BE-7	24-Sep-19	1	sa19-072-078	1
BE-7	24-Sep-19	2	sa19-072-079	1
BE-7	24-Sep-19	3	sa19-072-080	1
BE-7	24-Sep-19	4	sa19-072-081	1
BE-7	24-Sep-19	5	sa19-072-082	1
BE-8	25-Sep-19	1	sa19-072-083	1
BE-8	25-Sep-19	2	sa19-072-084	1
BE-8	25-Sep-19	3	sa19-072-085	1
BE-8	25-Sep-19	4	sa19-072-086	1
BE-8	25-Sep-19	5	sa19-072-087	1
BW-1	27-Sep-19	1	sa19-072-088	1
BW-1	27-Sep-19	2	sa19-072-089	1
BW-1	27-Sep-19	3	sa19-072-090	1
BW-1	27-Sep-19	4	sa19-072-091	1
BW-1	27-Sep-19	5	sa19-072-092	1
BW-2	27-Sep-19	1	sa19-072-093	1
BW-2	27-Sep-19	2	sa19-072-094	1

E:\Golder\2019\19-072 Baffinlands\19-072 Golder-Baffinlands Sample Inventory (Bureau Veritas)

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200 Burnaby, BC PC: V5M 0C4	Address:	PC:	Project #:	Golder Project # 1663724-24000 Task 03	Rush TAT (Surcharges will be applied) Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
1	sa19-072-053	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
2	sa19-072-054	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
3	sa19-072-055	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
4	sa19-072-056	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
5	sa19-072-057	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
6	sa19-072-058	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
7	sa19-072-059	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
8	sa19-072-060	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
9	sa19-072-061	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
10	sa19-072-062	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
11	sa19-072-063	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
12	sa19-072-064	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
13	sa19-072-065	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
14	sa19-072-066	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
15	sa19-072-067	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
16	sa19-072-068	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
17	sa19-072-069	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
18	sa19-072-070	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
19	sa19-072-071	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
20	sa19-072-072	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information
Company: Golder Associates Ltd.
Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200, Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

Report Information (if differs from invoice)
Company: Golder Associates Ltd.
Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
Seal Present			
Seal Intact			Temp
Cooling Media			
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
21	sa19-072-073	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
22	sa19-072-074	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
23	sa19-072-075	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
24	sa19-072-076	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
25	sa19-072-077	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
26	sa19-072-078	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
27	sa19-072-079	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
28	sa19-072-080	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
29	sa19-072-081	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
30	sa19-072-082	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
31	sa19-072-083	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
32	sa19-072-084	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
33	sa19-072-085	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
34	sa19-072-086	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
35	sa19-072-087	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
36	sa19-072-088	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
37	sa19-072-089	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
38	sa19-072-090	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
39	sa19-072-091	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
40	sa19-072-092	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jerry Thomson, Biologica	2019/12/13					

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
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CHAIN OF CUSTODY RECORD

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Contact Name: Christine Bylenga
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Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
41	sa19-072-093	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
42	sa19-072-094	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
43	sa19-072-095	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
44	sa19-072-096	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
45	sa19-072-097	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
46	sa19-072-098	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
47	sa19-072-099	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
48	sa19-072-100	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
49	sa19-072-101	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
50	sa19-072-102	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
51	sa19-072-103	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
52	sa19-072-104	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
53	sa19-072-105	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
54	sa19-072-106	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
55	sa19-072-107	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
56	sa19-072-108	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
57	sa19-072-109	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
58	sa19-072-110	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
59	sa19-072-111	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
60	sa19-072-112	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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Copies:

Report Information (if differs from invoice)
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Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
61	sa19-072-113	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
62	sa19-072-114	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
63	sa19-072-115	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
64	sa19-072-116	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
65	sa19-072-117	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
66	sa19-072-118	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
67	sa19-072-119	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
68	sa19-072-120	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
69	sa19-072-121	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
70	sa19-072-122	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
71	sa19-072-123	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
72	sa19-072-124	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
73	sa19-072-125	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
74	sa19-072-126	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
75	sa19-072-127	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
76	sa19-072-128	2019-09-29	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
77	sa19-072-129	2019-09-29	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
78	sa19-072-130	2019-10-02	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
79	sa19-072-131	2019-10-04	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
80	sa19-072-132	2019-10-04	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jerry Thomson, Biologica	2019/12/13					

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information
Company: Golder Associates Ltd.
Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200
Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

Report Information (if differs from invoice)
Company: Golder Associates Ltd.
Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
1	sa19-072-053	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
2	sa19-072-054	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
3	sa19-072-055	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
4	sa19-072-056	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
5	sa19-072-057	2019-09-22	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
6	sa19-072-058	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
7	sa19-072-059	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
8	sa19-072-060	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
9	sa19-072-061	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
10	sa19-072-062	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
11	sa19-072-063	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
12	sa19-072-064	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
13	sa19-072-065	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
14	sa19-072-066	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
15	sa19-072-067	2019-09-23	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
16	sa19-072-068	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
17	sa19-072-069	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
18	sa19-072-070	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
19	sa19-072-071	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
20	sa19-072-072	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

COC-1020BL

BBY FCD-00077/1

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information
Company: Golder Associates Ltd.
Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200, Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

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Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
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1 Day ☐ 3-4 Days
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Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
Seal Present			
Seal Intact			Temp
Cooling Media			
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
21	sa19-072-073	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
22	sa19-072-074	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
23	sa19-072-075	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
24	sa19-072-076	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
25	sa19-072-077	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
26	sa19-072-078	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
27	sa19-072-079	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
28	sa19-072-080	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
29	sa19-072-081	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
30	sa19-072-082	2019-09-24	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
31	sa19-072-083	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
32	sa19-072-084	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
33	sa19-072-085	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
34	sa19-072-086	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
35	sa19-072-087	2019-09-25	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
36	sa19-072-088	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
37	sa19-072-089	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
38	sa19-072-090	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
39	sa19-072-091	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
40	sa19-072-092	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

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[signature] Jerry Thomson, Biologica	2019/12/13					

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Contact Name: Christine Bylenga
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PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
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Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
41	sa19-072-093	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
42	sa19-072-094	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
43	sa19-072-095	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
44	sa19-072-096	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
45	sa19-072-097	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
46	sa19-072-098	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
47	sa19-072-099	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
48	sa19-072-100	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
49	sa19-072-101	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
50	sa19-072-102	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
51	sa19-072-103	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
52	sa19-072-104	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
53	sa19-072-105	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
54	sa19-072-106	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
55	sa19-072-107	2019-09-27	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
56	sa19-072-108	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
57	sa19-072-109	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
58	sa19-072-110	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
59	sa19-072-111	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
60	sa19-072-112	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

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[signature] Jenny Thomson, Biologica	2019/12/13					

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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria

- ☐ BC CSR
- ☐ YK CSR
- ☐ CCME
- ☐ Drinking Water
- ☐ BC Water Quality
- ☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
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62	sa19-072-114	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
63	sa19-072-115	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
64	sa19-072-116	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
65	sa19-072-117	2019-09-28	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
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79	sa19-072-131	2019-10-04	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight
80	sa19-072-132	2019-10-04	n/a	Tissue	1	x		*Hiatella* tissue; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jerry Thomson, Biologica	2019/12/13					

biologica

Shell aging for Hiatella arctica for Golder Baffinlands Iron Mine 2019.

Client	Project	Client Sample ID	Date Sample	Sampler	Biologica Sample ID	Taxa	Age	Comments
Golder	Baffinlands	BE-1	22-Sep-19	Van Veen	sa19-072-053	Hiatella arctica	14	
Golder	Baffinlands	BE-1	22-Sep-19	Van Veen	sa19-072-054	Hiatella arctica	23	
Golder	Baffinlands	BE-1	22-Sep-19	Van Veen	sa19-072-055	Hiatella arctica	13	
Golder	Baffinlands	BE-1	22-Sep-19	Van Veen	sa19-072-056	Hiatella arctica	29	
Golder	Baffinlands	BE-1	22-Sep-19	Van Veen	sa19-072-057	Hiatella arctica	16	
Golder	Baffinlands	BE-3	23-Sep-19	Ponar	sa19-072-058	Hiatella arctica	58	
Golder	Baffinlands	BE-3	23-Sep-19	Ponar	sa19-072-059	Hiatella arctica	54	
Golder	Baffinlands	BE-3	23-Sep-19	Ponar	sa19-072-060	Hiatella arctica	10	
Golder	Baffinlands	BE-3	23-Sep-19	Ponar	sa19-072-061	Hiatella arctica	47	
Golder	Baffinlands	BE-3	23-Sep-19	Ponar	sa19-072-062	Hiatella arctica	24	
Golder	Baffinlands	BE-4	23-Sep-19	Ponar	sa19-072-063	Hiatella arctica	18	
Golder	Baffinlands	BE-4	23-Sep-19	Ponar	sa19-072-064	Hiatella arctica	16	
Golder	Baffinlands	BE-4	23-Sep-19	Ponar	sa19-072-065	Hiatella arctica	40	
Golder	Baffinlands	BE-4	23-Sep-19	Ponar	sa19-072-066	Hiatella arctica	31	
Golder	Baffinlands	BE-4	23-Sep-19	Ponar	sa19-072-067	Hiatella arctica	51	
Golder	Baffinlands	BE-5	24-Sep-19	Ponar	sa19-072-068	Hiatella arctica	8	
Golder	Baffinlands	BE-5	24-Sep-19	Ponar	sa19-072-069	Hiatella arctica	31	
Golder	Baffinlands	BE-5	24-Sep-19	Ponar	sa19-072-070	Hiatella arctica	31	
Golder	Baffinlands	BE-5	24-Sep-19	Ponar	sa19-072-071	Hiatella arctica	20	
Golder	Baffinlands	BE-5	24-Sep-19	Ponar	sa19-072-072	Hiatella arctica	27	
Golder	Baffinlands	BE-6	24-Sep-19	Ponar	sa19-072-073	Hiatella arctica	35	
Golder	Baffinlands	BE-6	24-Sep-19	Ponar	sa19-072-074	Hiatella arctica	18	
Golder	Baffinlands	BE-6	24-Sep-19	Ponar	sa19-072-075	Hiatella arctica	26	
Golder	Baffinlands	BE-6	24-Sep-19	Ponar	sa19-072-076	Hiatella arctica	52	
Golder	Baffinlands	BE-6	24-Sep-19	Ponar	sa19-072-077	Hiatella arctica	14	
Golder	Baffinlands	BE-7	24-Sep-19	Ponar	sa19-072-078	Hiatella arctica	15	
Golder	Baffinlands	BE-7	24-Sep-19	Ponar	sa19-072-079	Hiatella arctica	40	
Golder	Baffinlands	BE-7	24-Sep-19	Ponar	sa19-072-080	Hiatella arctica	9	
Golder	Baffinlands	BE-7	24-Sep-19	Ponar	sa19-072-081	Hiatella arctica	13	
Golder	Baffinlands	BE-7	24-Sep-19	Ponar	sa19-072-082	Hiatella arctica	39	
Golder	Baffinlands	BE-8	25-Sep-19	Ponar	sa19-072-083	Hiatella arctica	37	
Golder	Baffinlands	BE-8	25-Sep-19	Ponar	sa19-072-084	Hiatella arctica	13	
Golder	Baffinlands	BE-8	25-Sep-19	Ponar	sa19-072-085	Hiatella arctica	13	
Golder	Baffinlands	BE-8	25-Sep-19	Ponar	sa19-072-086	Hiatella arctica	49	
Golder	Baffinlands	BE-8	25-Sep-19	Ponar	sa19-072-087	Hiatella arctica	56	
Golder	Baffinlands	BW-1	27-Sep-19	Ponar	sa19-072-088	Hiatella arctica	20	
Golder	Baffinlands	BW-1	27-Sep-19	Ponar	sa19-072-089	Hiatella arctica	28	
Golder	Baffinlands	BW-1	27-Sep-19	Ponar	sa19-072-090	Hiatella arctica	14	
Golder	Baffinlands	BW-1	27-Sep-19	Ponar	sa19-072-091	Hiatella arctica	22	
Golder	Baffinlands	BW-1	27-Sep-19	Ponar	sa19-072-092	Hiatella arctica	55	
Golder	Baffinlands	BW-2	27-Sep-19	Ponar	sa19-072-093	Hiatella arctica	23	
Golder	Baffinlands	BW-2	27-Sep-19	Ponar	sa19-072-094	Hiatella arctica	7	
Golder	Baffinlands	BW-2	27-Sep-19	Ponar	sa19-072-095	Hiatella arctica	30	
Golder	Baffinlands	BW-2	27-Sep-19	Ponar	sa19-072-096	Hiatella arctica	17	
Golder	Baffinlands	BW-2	27-Sep-19	Ponar	sa19-072-097	Hiatella arctica	25	
Golder	Baffinlands	BW-3	27-Sep-19	Ponar	sa19-072-098	Hiatella arctica	9	
Golder	Baffinlands	BW-3	27-Sep-19	Ponar	sa19-072-099	Hiatella arctica	45	
Golder	Baffinlands	BW-3	27-Sep-19	Ponar	sa19-072-100	Hiatella arctica	12	
Golder	Baffinlands	BW-3	27-Sep-19	Ponar	sa19-072-101	Hiatella arctica	n/a	Unable to age, shell broken at hinge.
Golder	Baffinlands	BW-3	27-Sep-19	Ponar	sa19-072-102	Hiatella arctica	11	
Golder	Baffinlands	BW-4	27-Sep-19	Ponar	sa19-072-103	Hiatella arctica	26	
Golder	Baffinlands	BW-4	27-Sep-19	Ponar	sa19-072-104	Hiatella arctica	46	
Golder	Baffinlands	BW-4	27-Sep-19	Ponar	sa19-072-105	Hiatella arctica	69	
Golder	Baffinlands	BW-4	27-Sep-19	Ponar	sa19-072-106	Hiatella arctica	30	
Golder	Baffinlands	BW-4	27-Sep-19	Ponar	sa19-072-107	Hiatella arctica	43	
Golder	Baffinlands	BW-5	28-Sep-19	Ponar	sa19-072-108	Hiatella arctica	50	
Golder	Baffinlands	BW-5	28-Sep-19	Ponar	sa19-072-109	Hiatella arctica	38	
Golder	Baffinlands	BW-5	28-Sep-19	Ponar	sa19-072-110	Hiatella arctica	39	
Golder	Baffinlands	BW-5	28-Sep-19	Ponar	sa19-072-111	Hiatella arctica	51	
Golder	Baffinlands	BW-5	28-Sep-19	Ponar	sa19-072-112	Hiatella arctica	42	
Golder	Baffinlands	BW-6	28-Sep-19	Ponar	sa19-072-113	Hiatella arctica	31	
Golder	Baffinlands	BW-6	28-Sep-19	Ponar	sa19-072-114	Hiatella arctica	29	
Golder	Baffinlands	BW-6	28-Sep-19	Ponar	sa19-072-115	Hiatella arctica	35	
Golder	Baffinlands	BW-6	28-Sep-19	Ponar	sa19-072-116	Hiatella arctica	21	
Golder	Baffinlands	BW-6	28-Sep-19	Ponar	sa19-072-117	Hiatella arctica	21	
Golder	Baffinlands	BW-7	28-Sep-19	Ponar	sa19-072-118	Hiatella arctica	27	
Golder	Baffinlands	BW-7	28-Sep-19	Ponar	sa19-072-119	Hiatella arctica	16	
Golder	Baffinlands	BW-7	28-Sep-19	Ponar	sa19-072-120	Hiatella arctica	17	
Golder	Baffinlands	BW-7	28-Sep-19	Ponar	sa19-072-121	Hiatella arctica	24	
Golder	Baffinlands	BW-7	28-Sep-19	Ponar	sa19-072-122	Hiatella arctica	22	
Golder	Baffinlands	BW-8	28-Sep-19	Ponar	sa19-072-123	Hiatella arctica	11	
Golder	Baffinlands	BW-8	28-Sep-19	Ponar	sa19-072-124	Hiatella arctica	n/a	Unable to age, shell broken at hinge.
Golder	Baffinlands	BW-8	28-Sep-19	Ponar	sa19-072-125	Hiatella arctica	18	
Golder	Baffinlands	BW-8	28-Sep-19	Ponar	sa19-072-126	Hiatella arctica	11	
Golder	Baffinlands	BW-8	28-Sep-19	Ponar	sa19-072-127	Hiatella arctica	10	
Golder	Baffinlands	BNW-1	29-Sep-19	Ponar	sa19-072-128	Hiatella arctica	n/a	Unable to age, shell too small to cut (~1.0 cm, <100mg).
Golder	Baffinlands	BNW-1	29-Sep-19	Ponar	sa19-072-129	Hiatella arctica	n/a	Unable to age, shell too small to cut (~1.4 cm, <100mg).
Golder	Baffinlands	BNE-1	2-Oct-19	Ponar	sa19-072-130	Hiatella arctica	59	
Golder	Baffinlands	BNE-4	4-Oct-19	Van Veen	sa19-072-131	Hiatella arctica	11	
Golder	Baffinlands	BNE-5	4-Oct-19	Van Veen	sa19-072-132	Hiatella arctica	34	

Shell Age Determination Methods
Client: Golder
Project: Baffinlands Iron Mine

Sample Inventory

Sample arrival: October 10, 2019
Number of samples: 80
Biologica project number: 19-072

Table 1. Summary of sites and median age of *Hiatella arctica* for Golder Baffinlands Iron Mine 2019.

Client Site	# of Shells	Median Age	Average Age	# of Shells Aged
BE-1	5	16	19.00	5
BE-3	5	47	38.60	5
BE-4	5	31	31.20	5
BE-5	5	27	23.40	5
BE-6	5	26	29.00	5
BE-7	5	15	23.20	5
BE-8	5	37	33.60	5
BNE-1	1	59	59.00	1
BNE-4	1	11	11.00	1
BNE-5	1	34	34.00	1
BNW-1	2	n/a	n/a	0
BW-1	5	22	27.80	5
BW-2	5	23	20.40	4
BW-3	5	12	19.25	5
BW-4	5	43	42.80	5
BW-5	5	42	44.00	5
BW-6	5	29	27.40	5
BW-7	5	22	21.20	5
BW-8	5	11	12.50	4
Total:	**80**			**76**
Average:		**28.17**	**28.74**	

Sample Processing

Cutting: The right valve of each shell was sectioned through the umbo-rim axis using a lapidary saw with a diamond-impregnated saw blade. When the right valve was broken or unavailable, the left valve used instead. In some cases the umbo was missing or broken for both valves; these shells were not aged.

Grinding: Once cut, the valves were polished using progressively finer sandpaper; starting with an 800 grit to smooth the edges, and continuing down to a 1500 grit to polish off any lines that could have arisen from cutting and grinding.

Etching: The valves were etched in a solution of 1% hydrochloric acid for 1 minute to remove calcium carbonate deposits that could hinder the ability to obtain clear peels of the growth lines, then rinsed with tap water and dried.

Acetate Peel: Replicating acetate sheets (125 µm x 150 mm x 100 mm) were cut into approximately 5 mm squares. Acetate peels were then produced by placing a drop of acetone on the cut acetate, and lightly pressing it against the umbo. After allowing the acetate to dry completely (1-3 minutes), it was gently peeled off and mounted onto a slide. Unclear peels were repeated. If a clear peel could not be obtained after three attempts, valves were re-polished and the grinding and etching processes was repeated before attempting additional peels.

Age Analysis: Acetate peels were examined using a dissecting microscope (10–40x magnification). All distinct, continuous growth lines were counted to determine the age of the shell (Richardson and Runham, 1979). Pictures were taken using a Zeiss imaging system.

Data

All data were recorded in Biologica's custom database. Data and photographs were provided to the Golder project manager in Excel spreadsheets via email.

References

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Anwar, N.A., Richardson, C.A., and Seed, R. 1990. Age Determination, Growth Rate and Population Structure of the Horse Mussel *Modiolus modiolus*. Journal of Marine Biological Association of the UK 70: 441-457.

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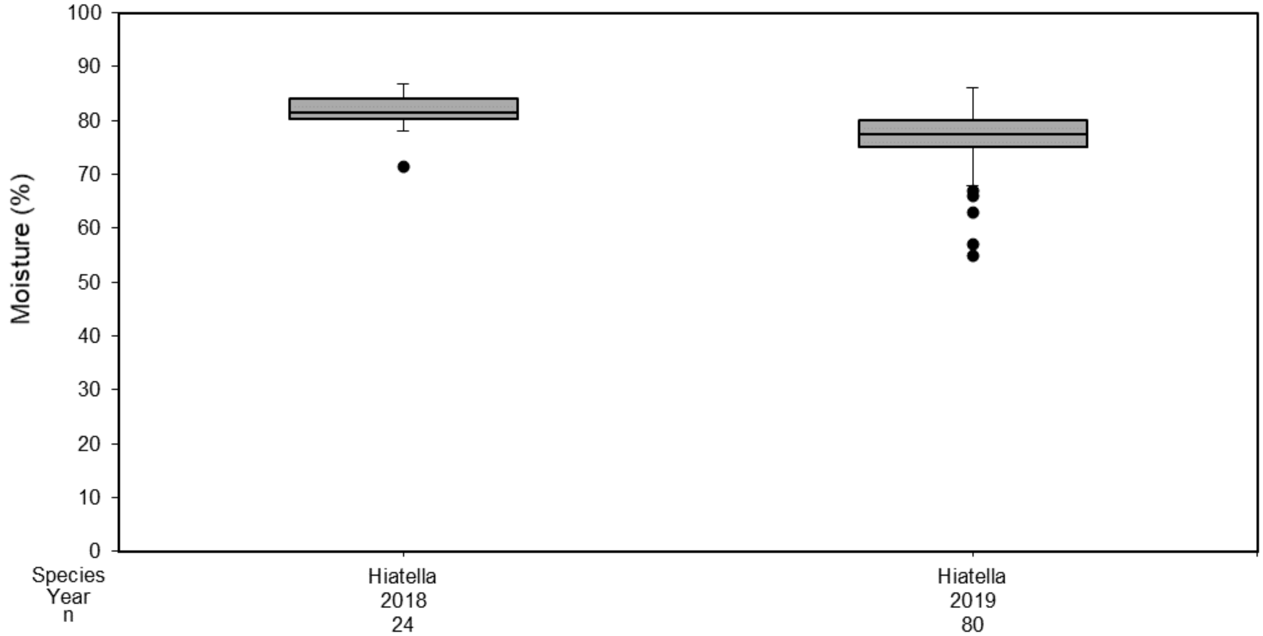
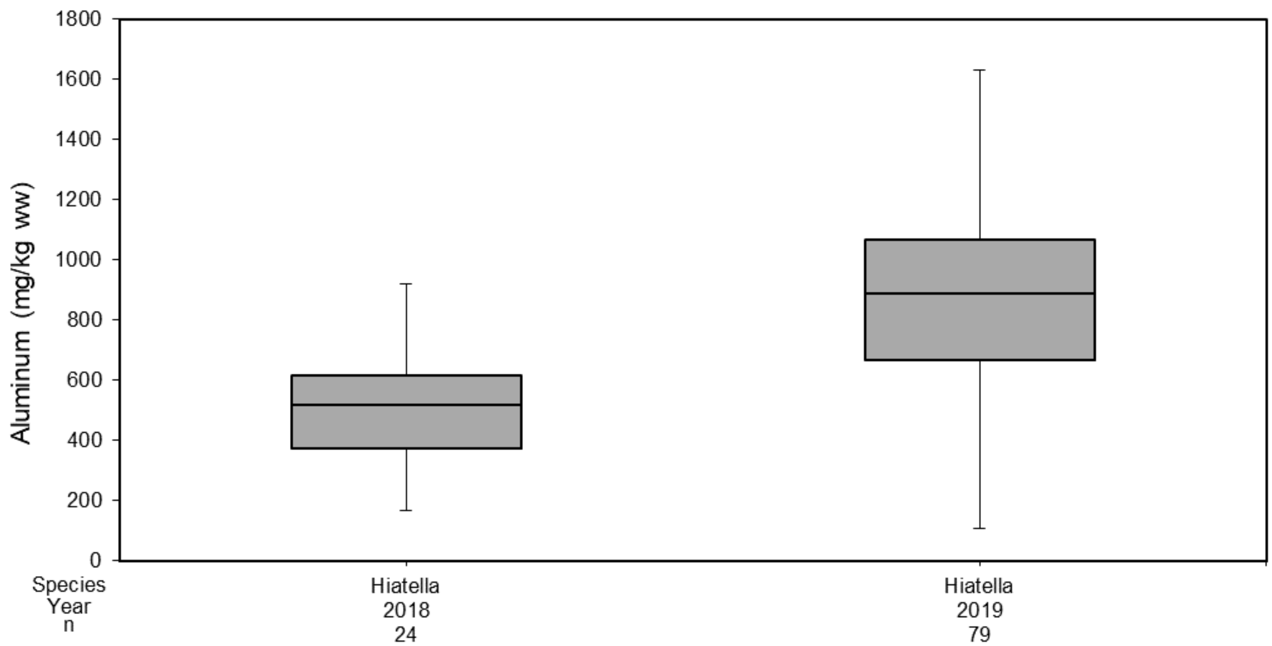
BoxPlots



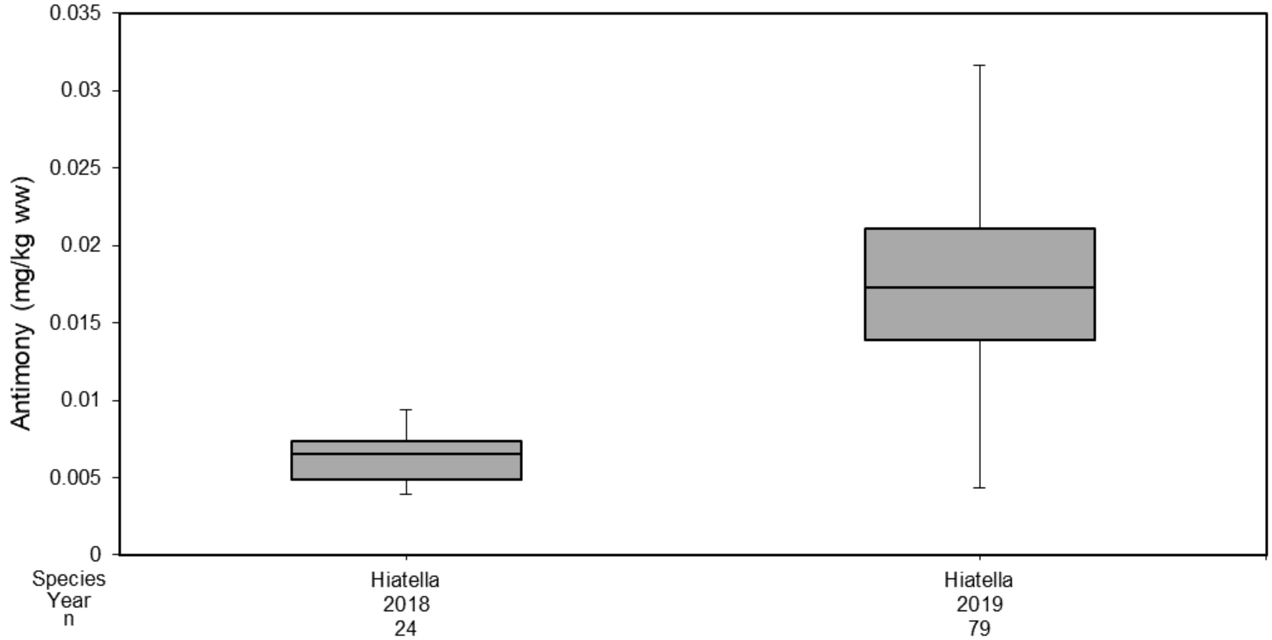
Note: % = percent; n = sample size.

Figure F-5.1: Percent Moisture of as *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



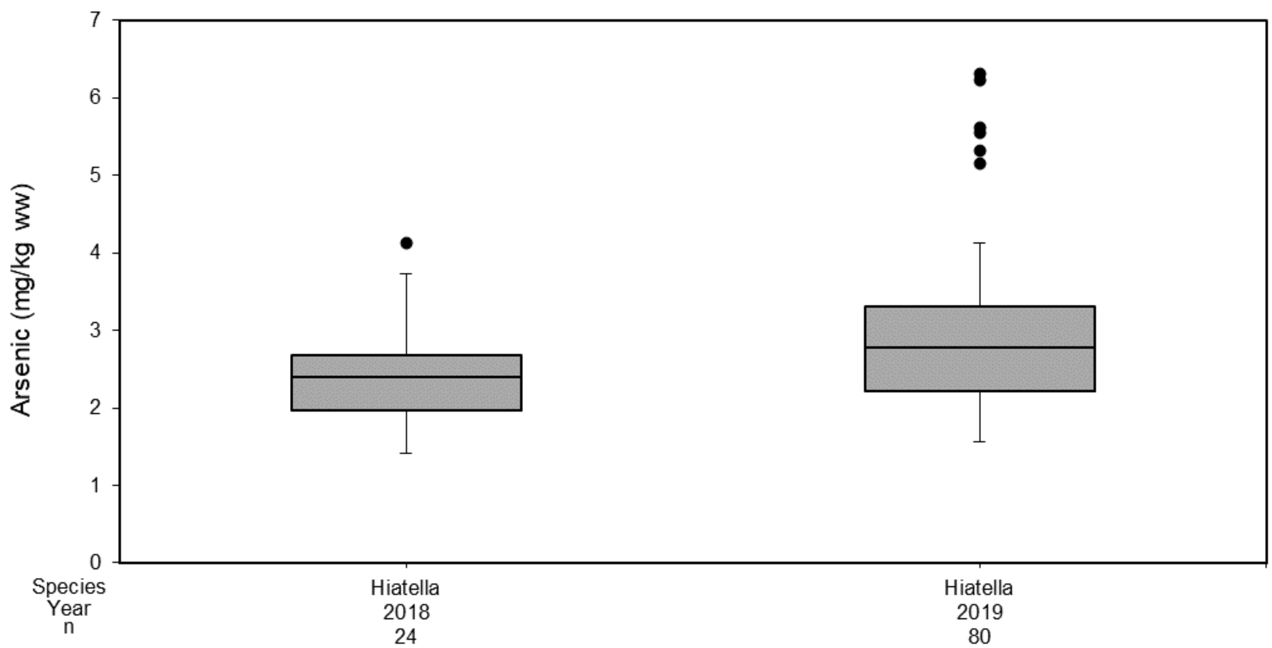
Note: Horizontal line indicates detection limit. One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 2370); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.2: Aluminum Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



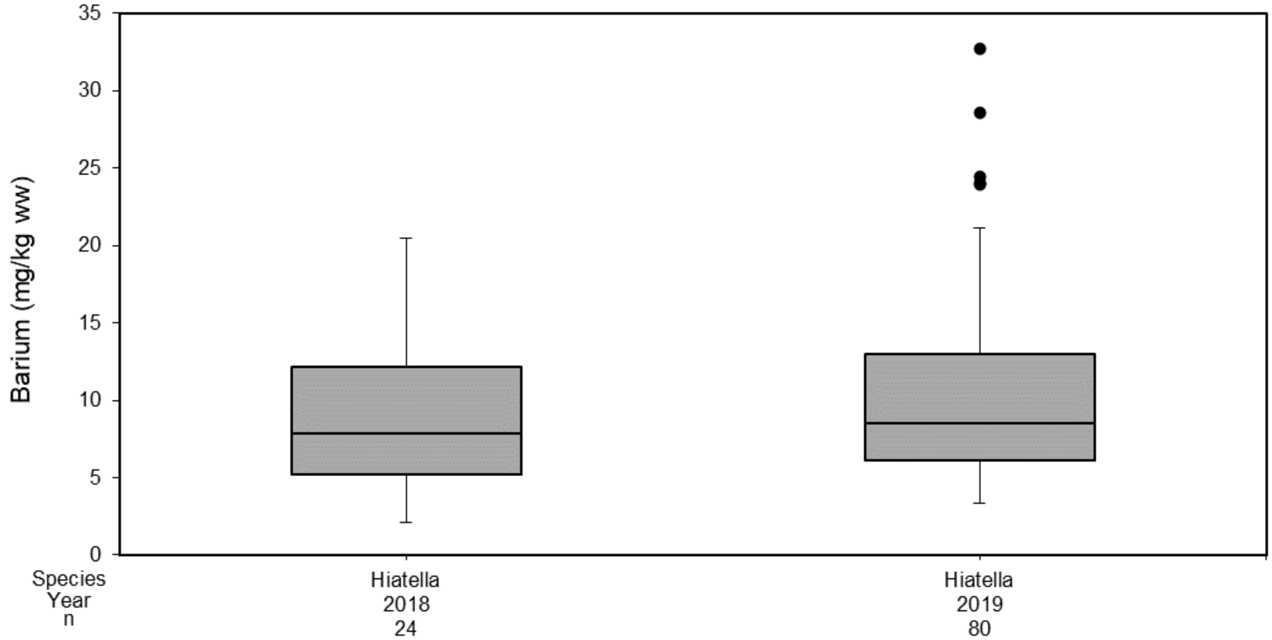
Note: One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 0.0424); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.3: Antimony Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



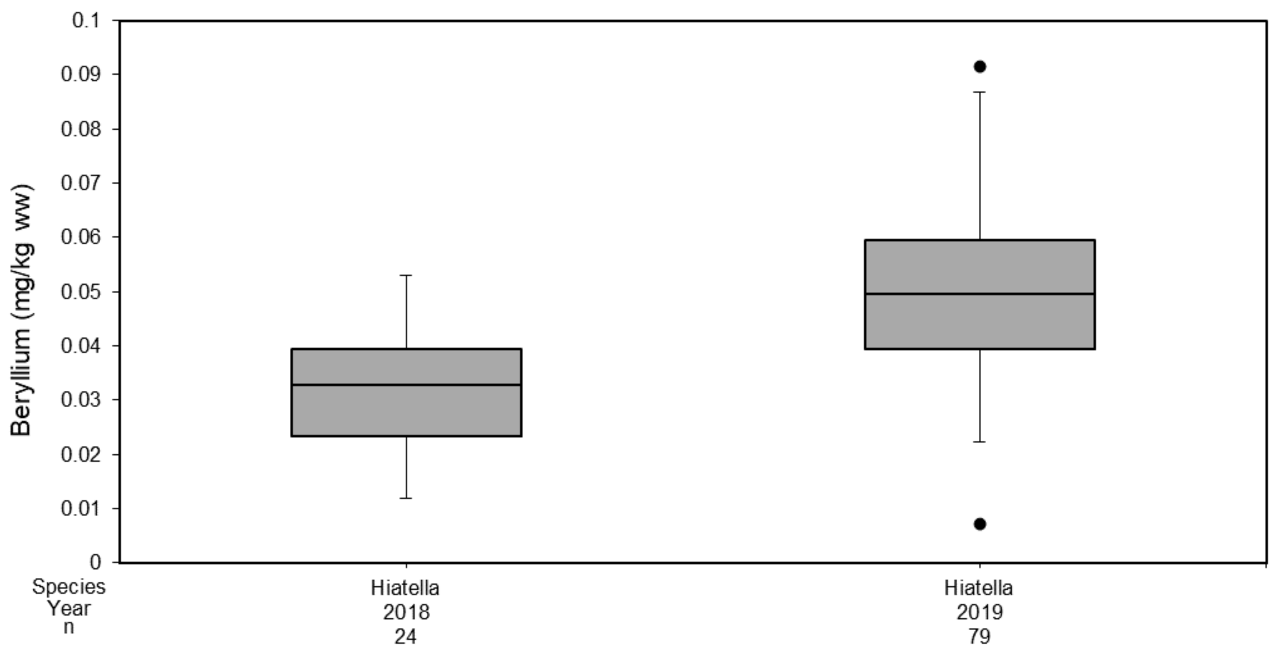
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.4: Arsenic Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



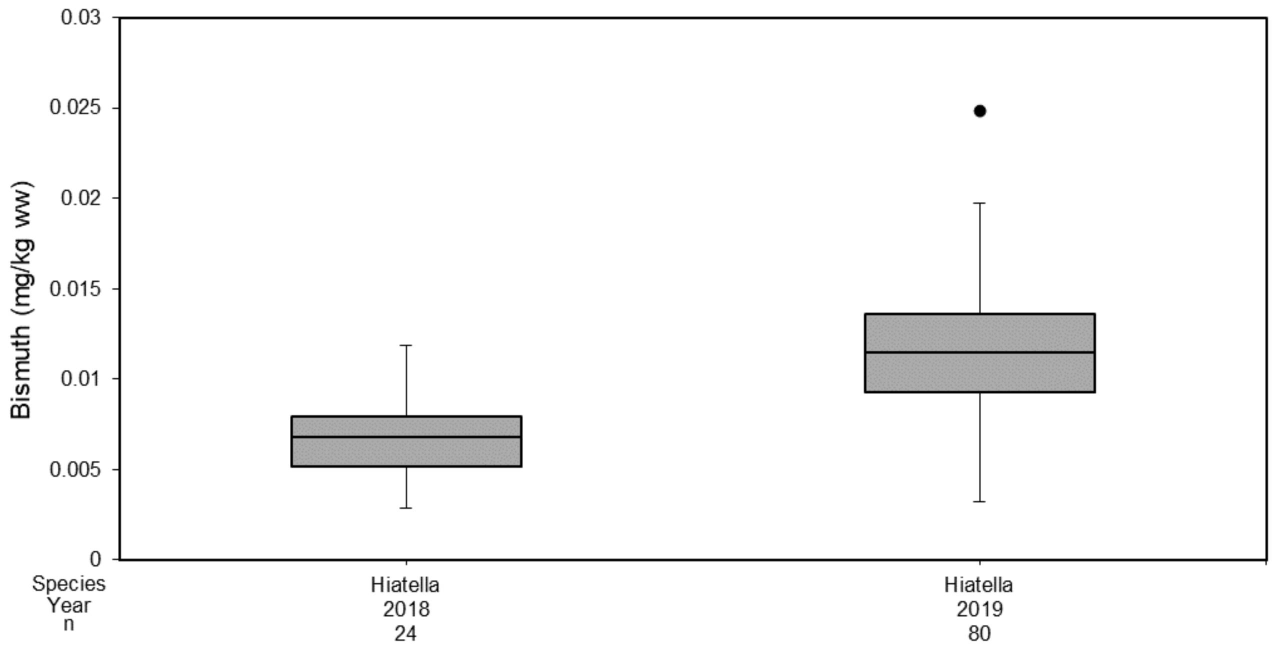
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5: Barium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



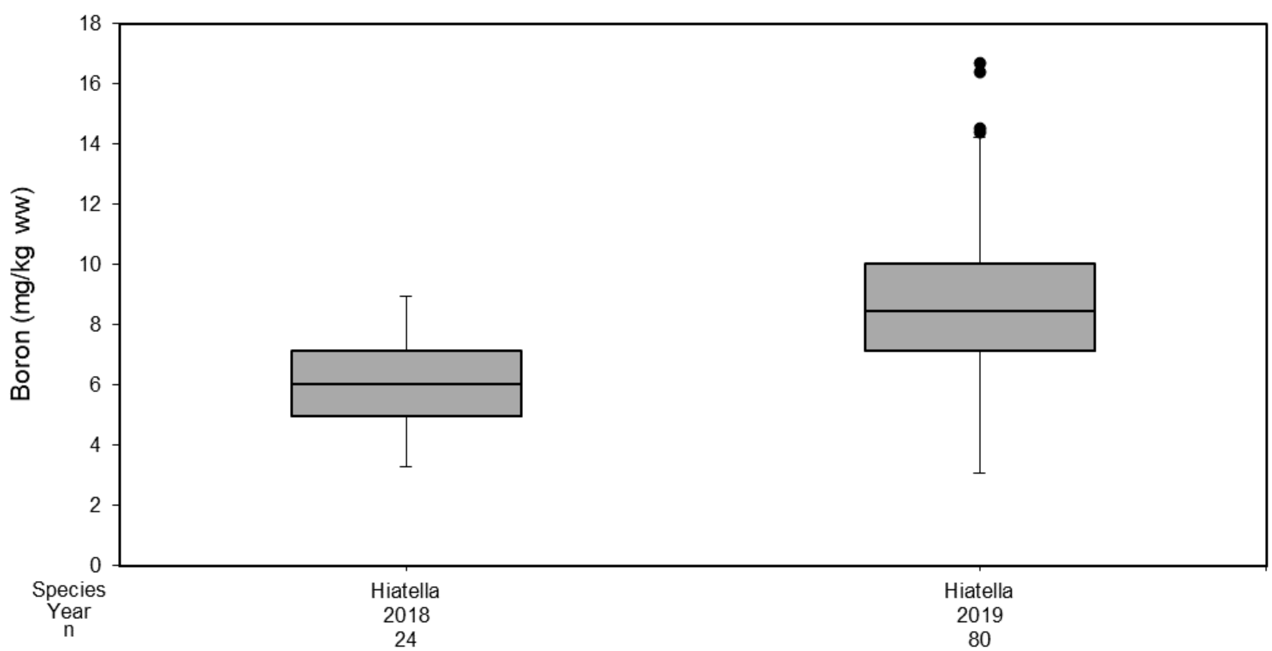
Note: One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 0.146); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.6: Beryllium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



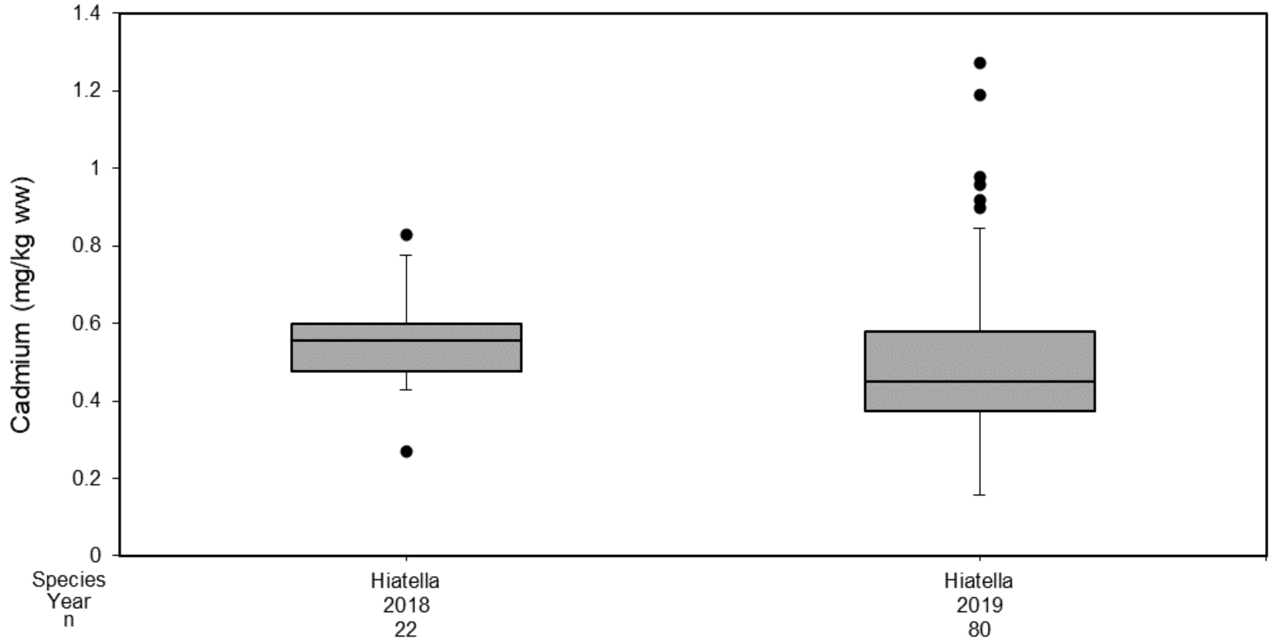
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.7: Bismuth Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



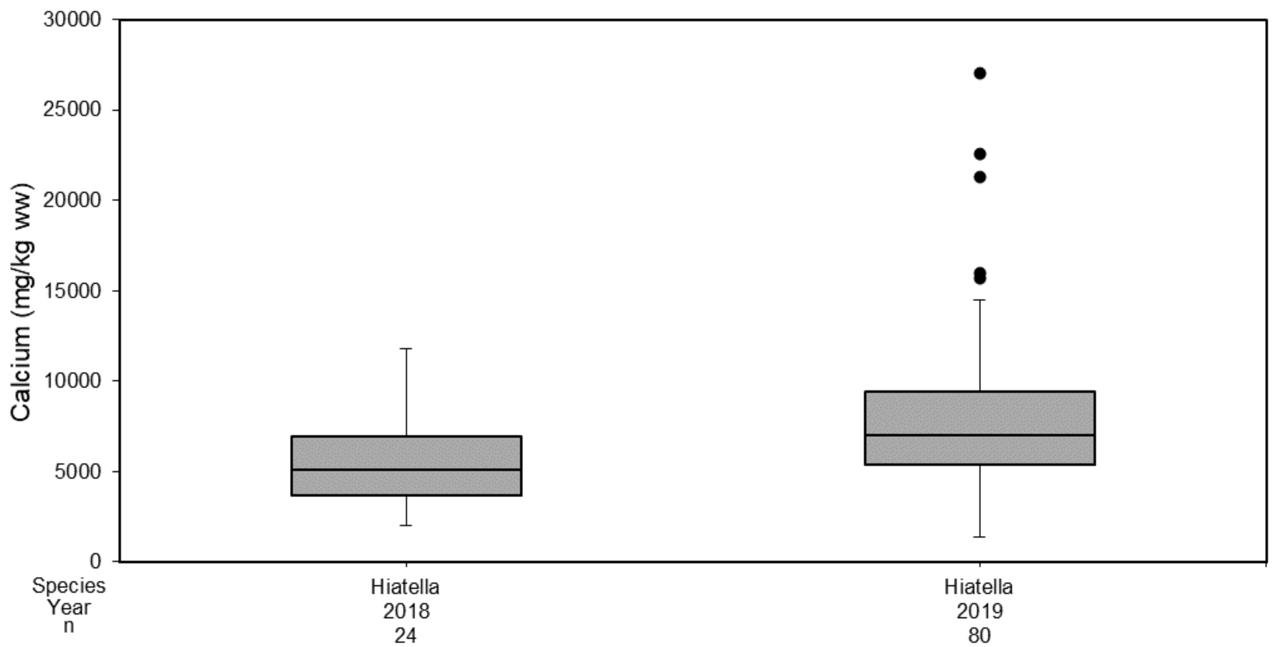
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.8: Boron Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



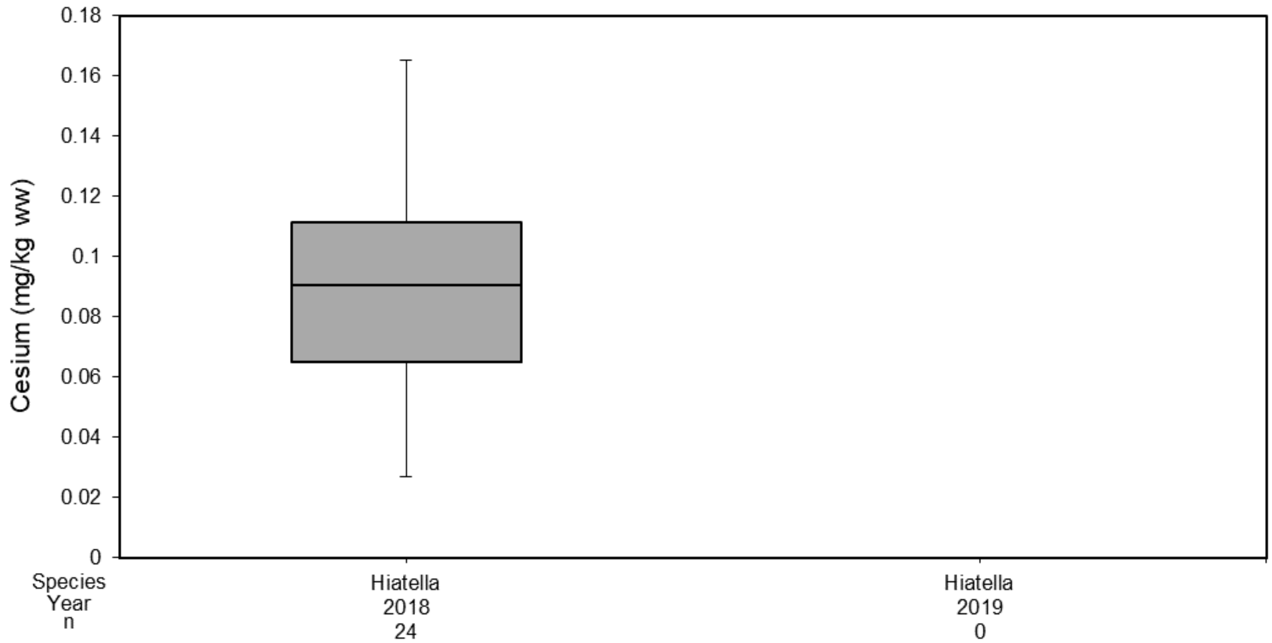
Note: Two statistical outliers removed from the 2018 dataset to aid in data visualization (Sample L2156762-5, values 1.79 and 2.49); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.9: Cadmium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



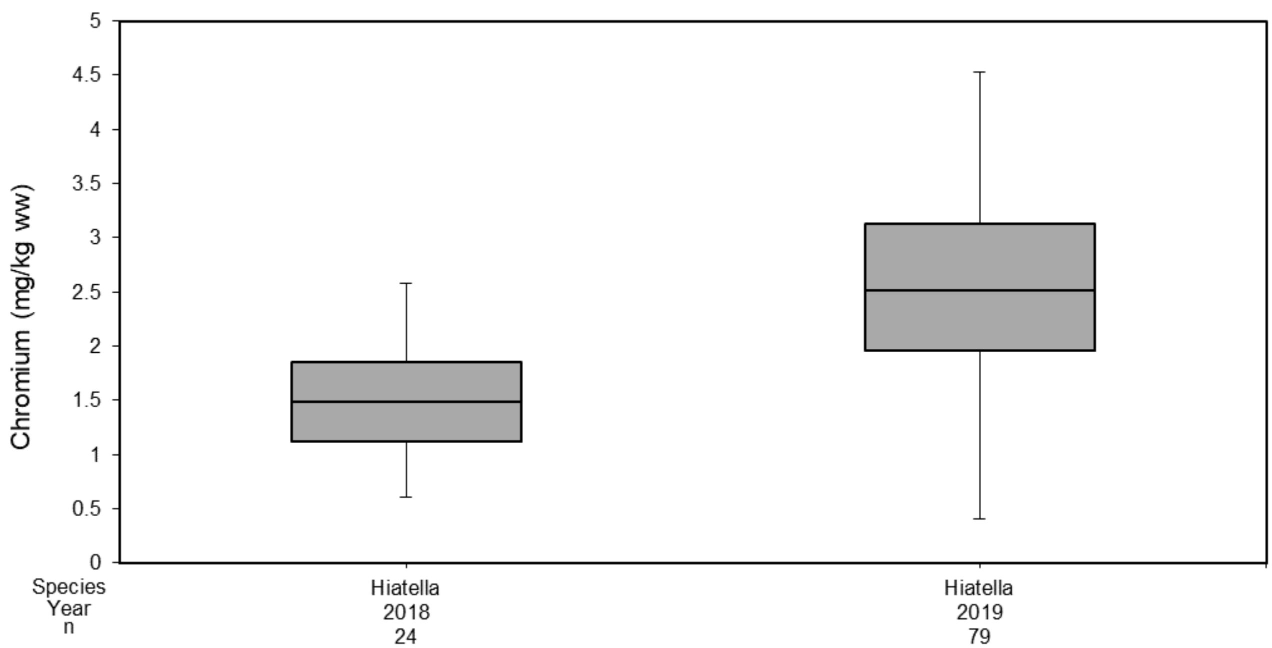
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.10: Calcium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



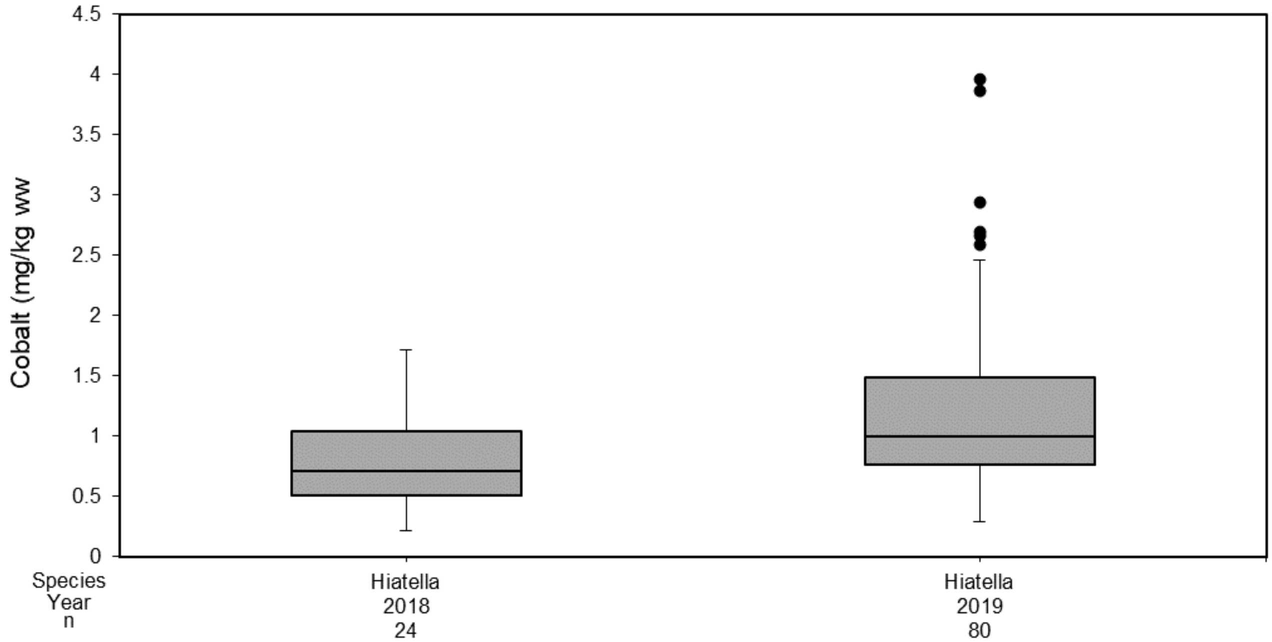
Note: Cesium was not measured in 2019; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.11: Cesium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018



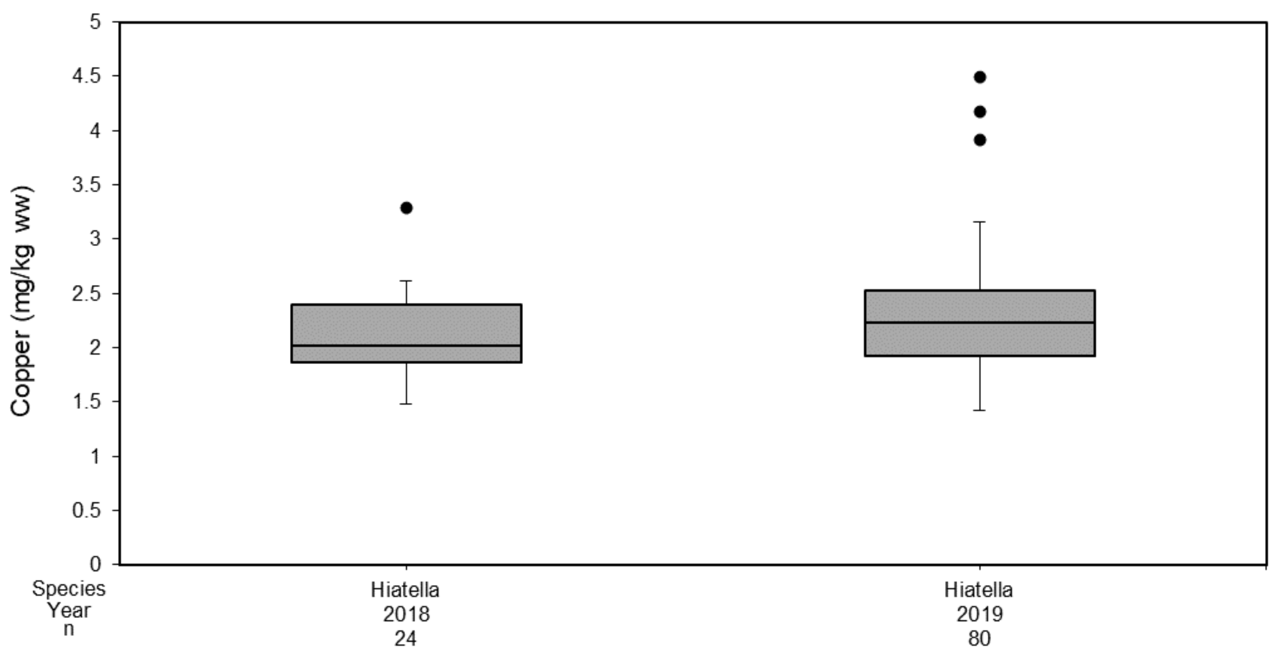
Note: One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 7.34); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.12: Chromium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



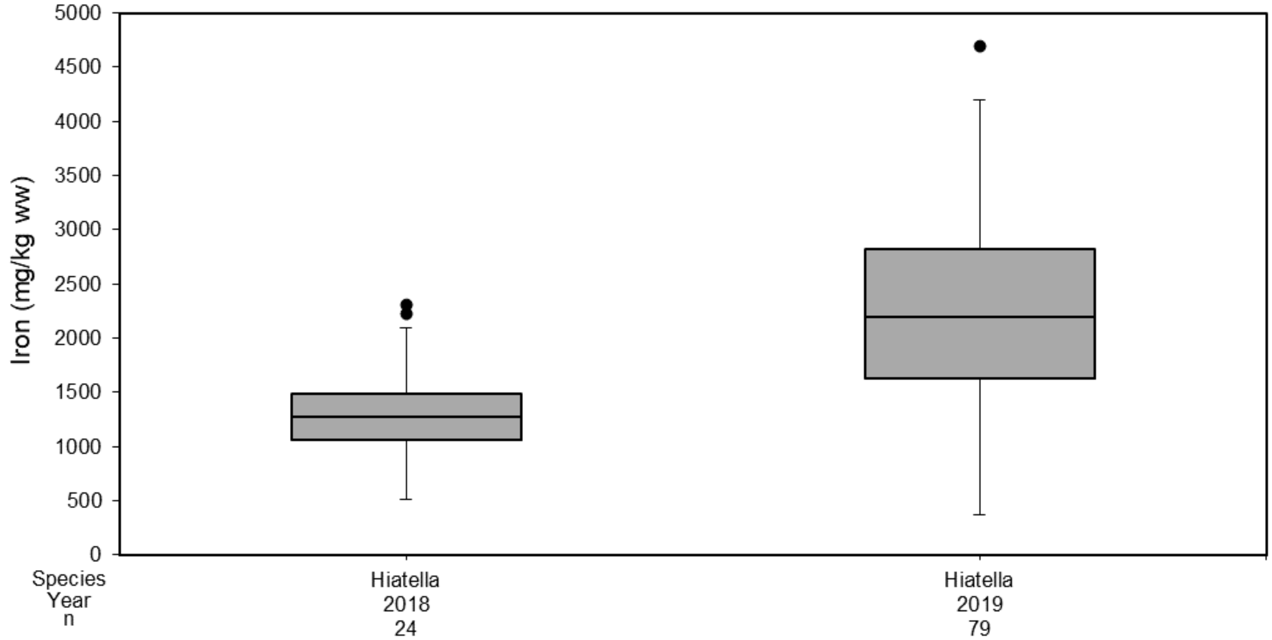
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.13: Cobalt Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



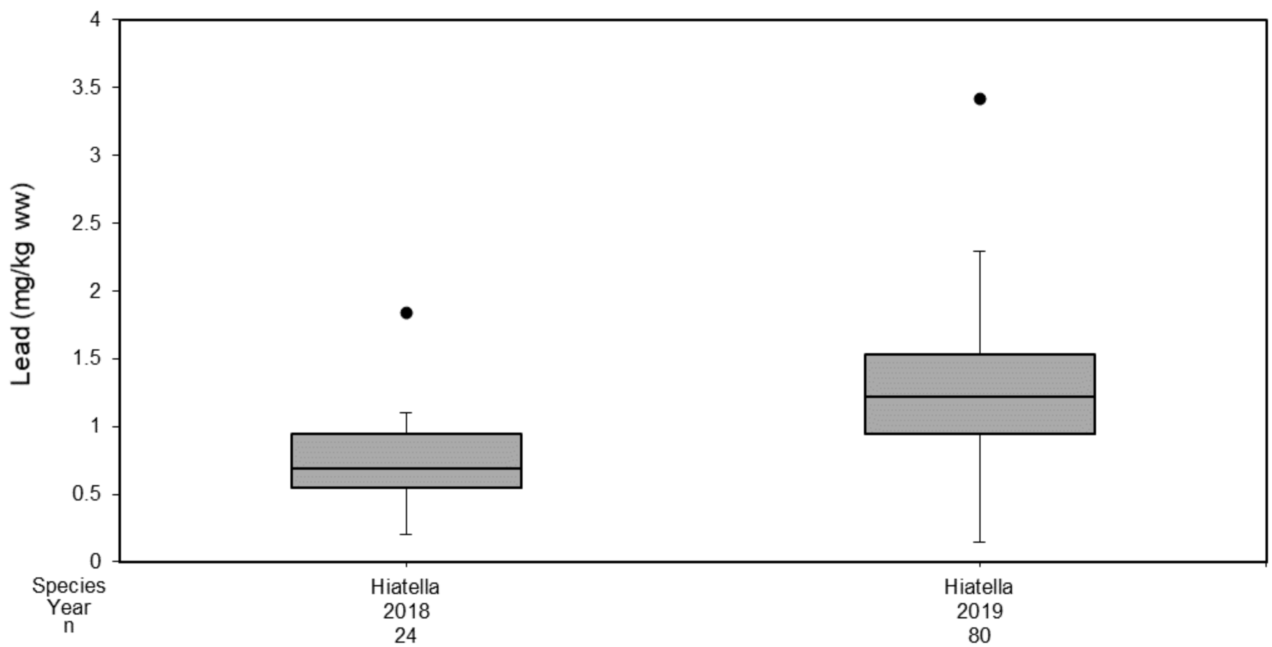
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.14: Copper Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



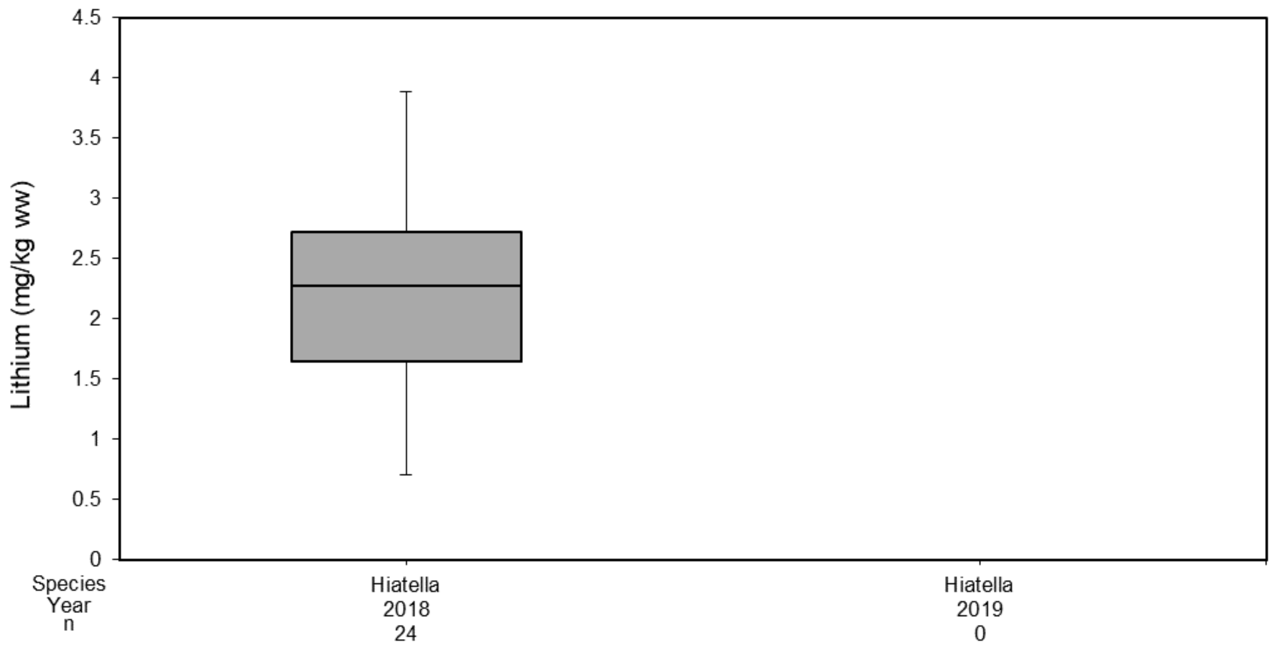
Note: One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 7000); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.15: Iron Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



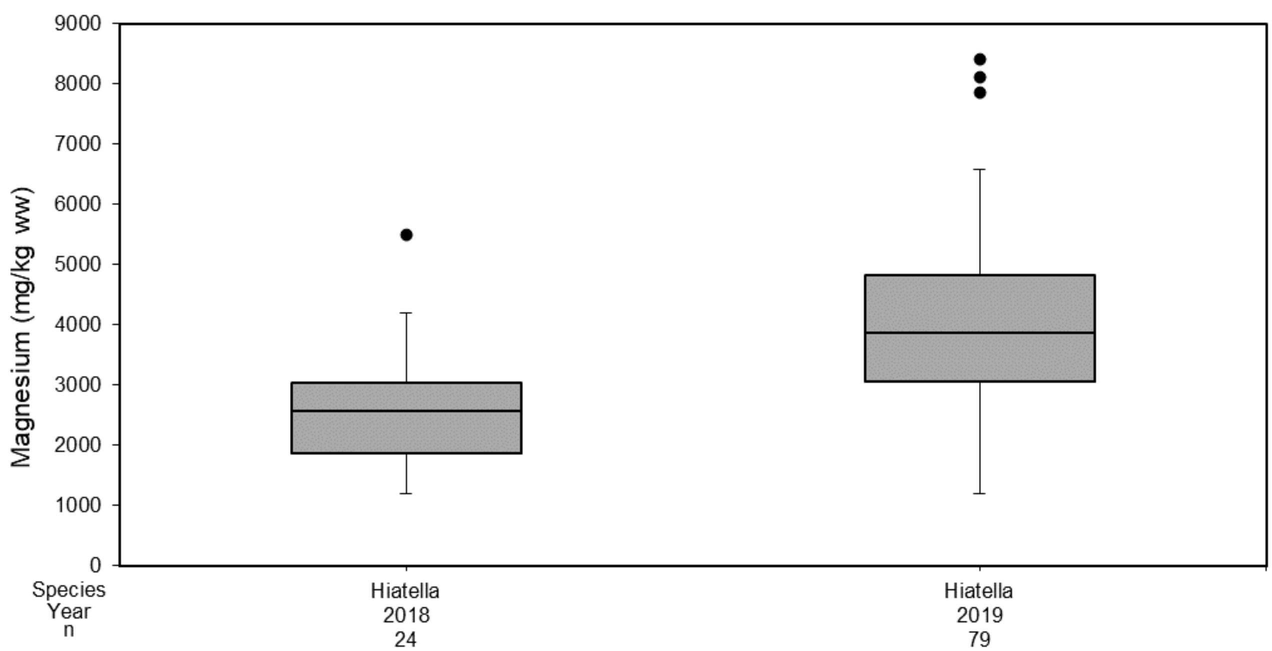
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.16: Lead Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



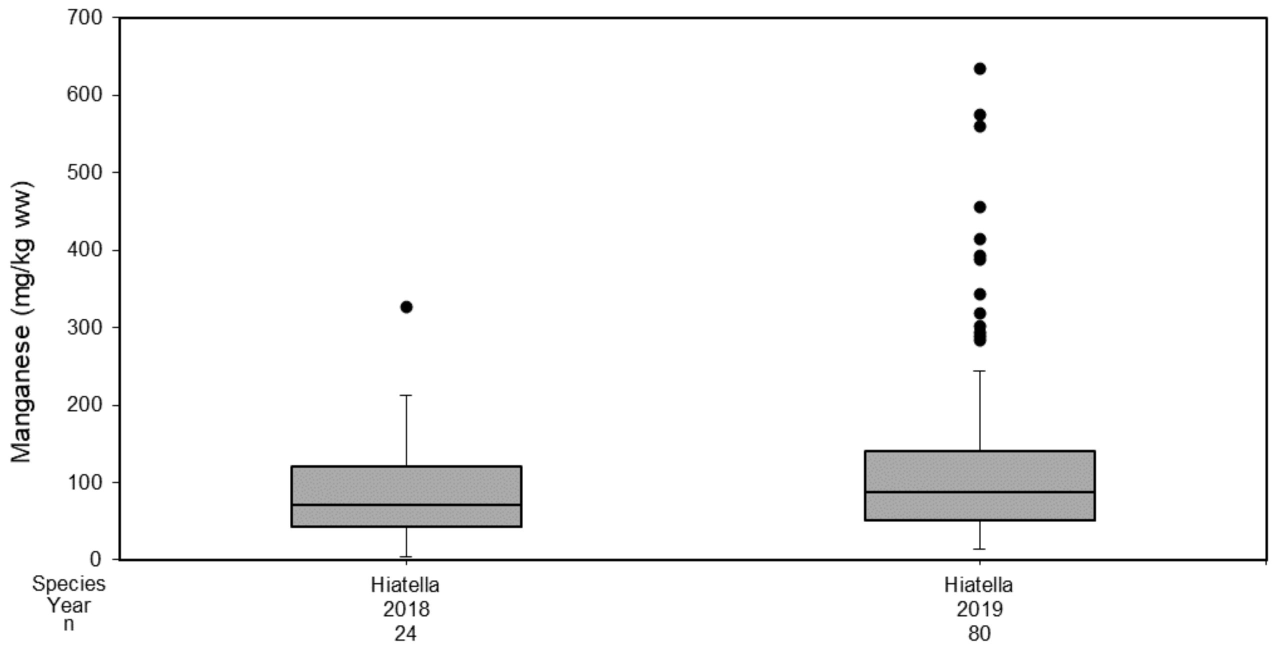
Note: Lithium was not measured in 2019; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.17: Lithium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018



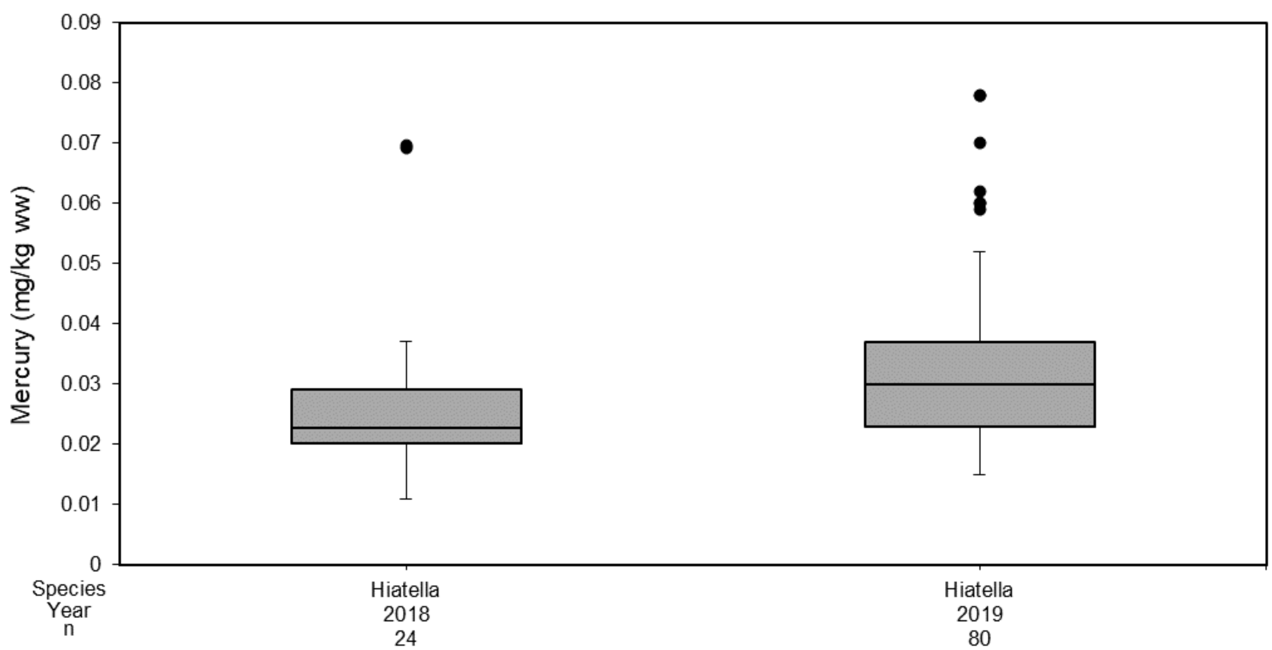
Note: One statistical outlier removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 11600); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.18: Magnesium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



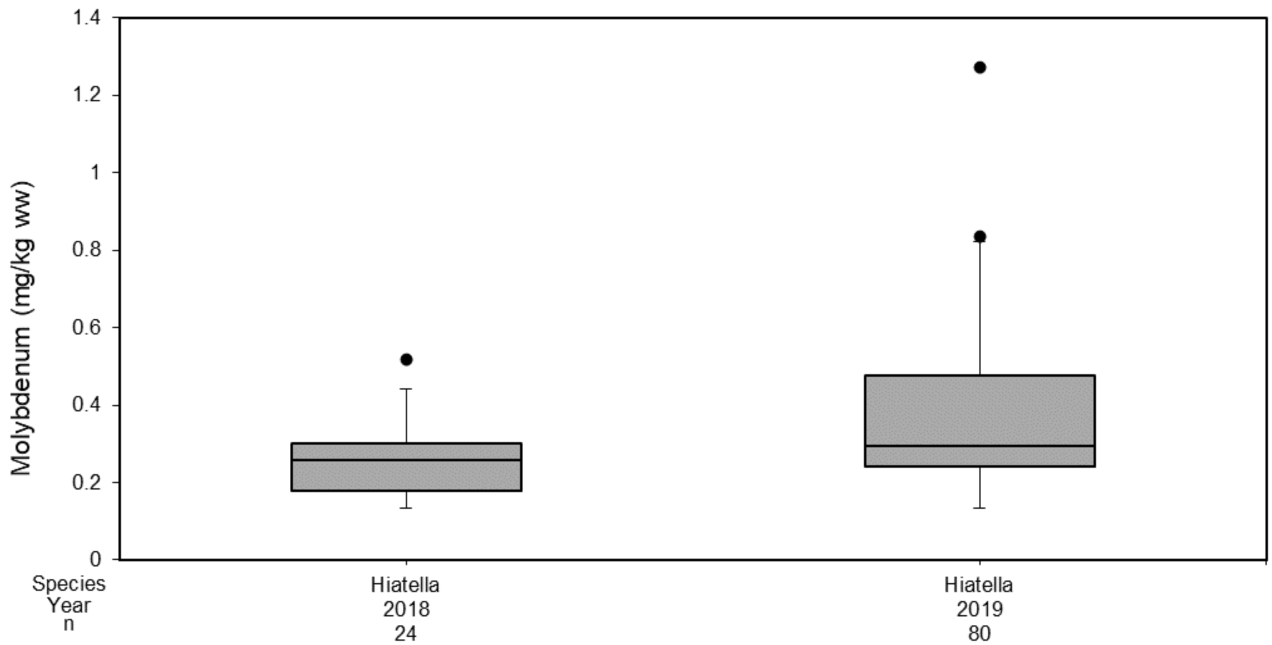
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.19: Manganese Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



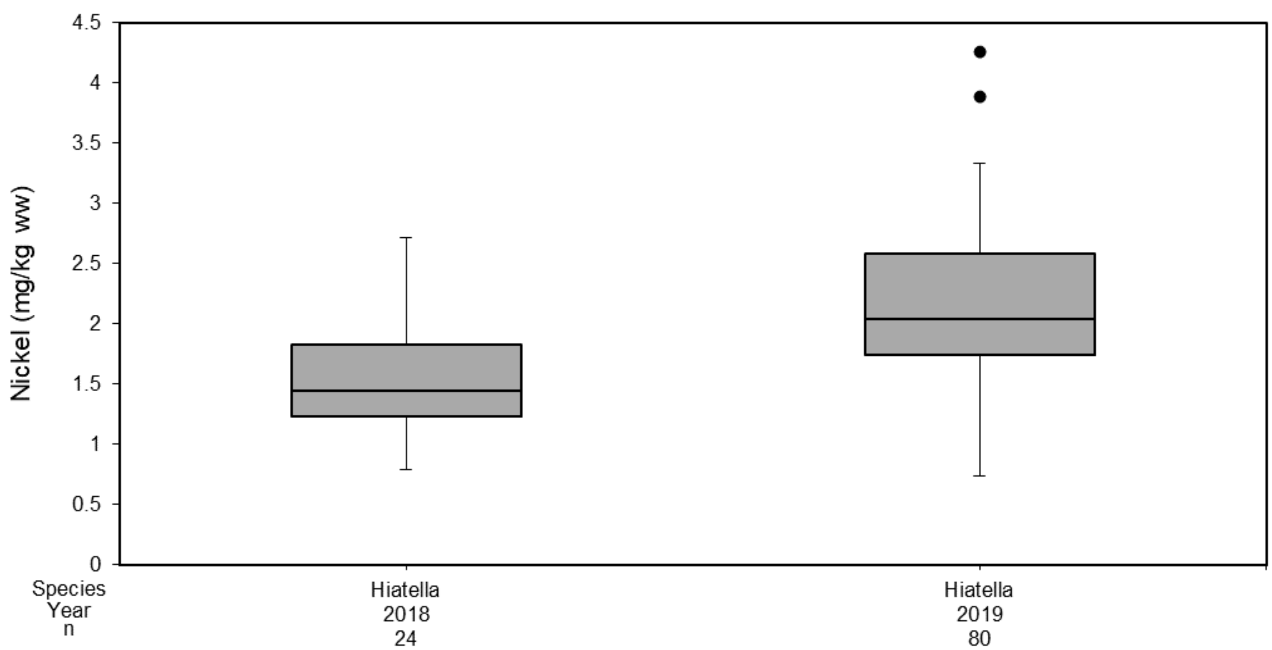
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.20: Mercury Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



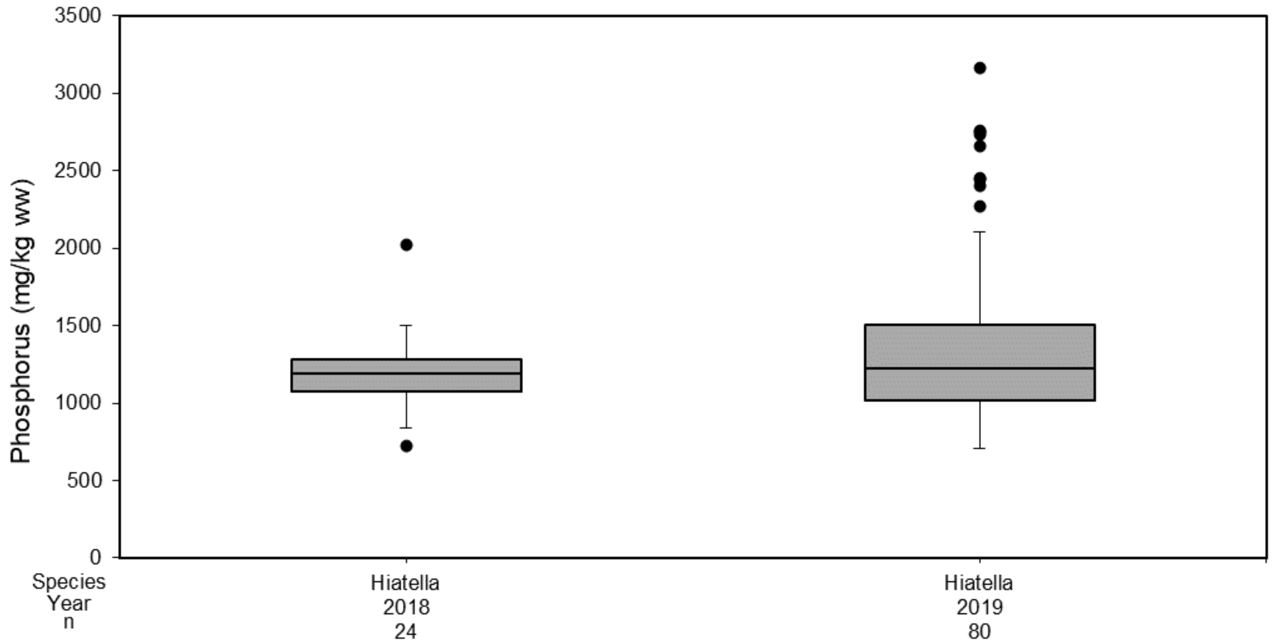
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.21: Molybdenum Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



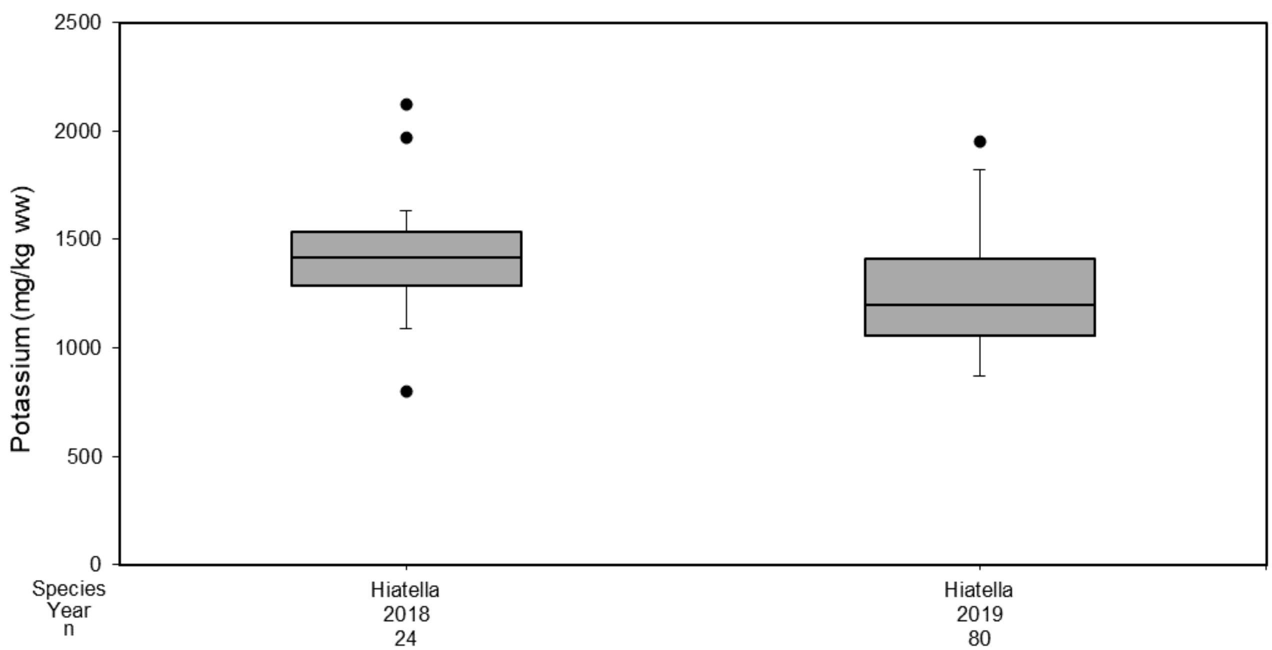
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.22: Nickel Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



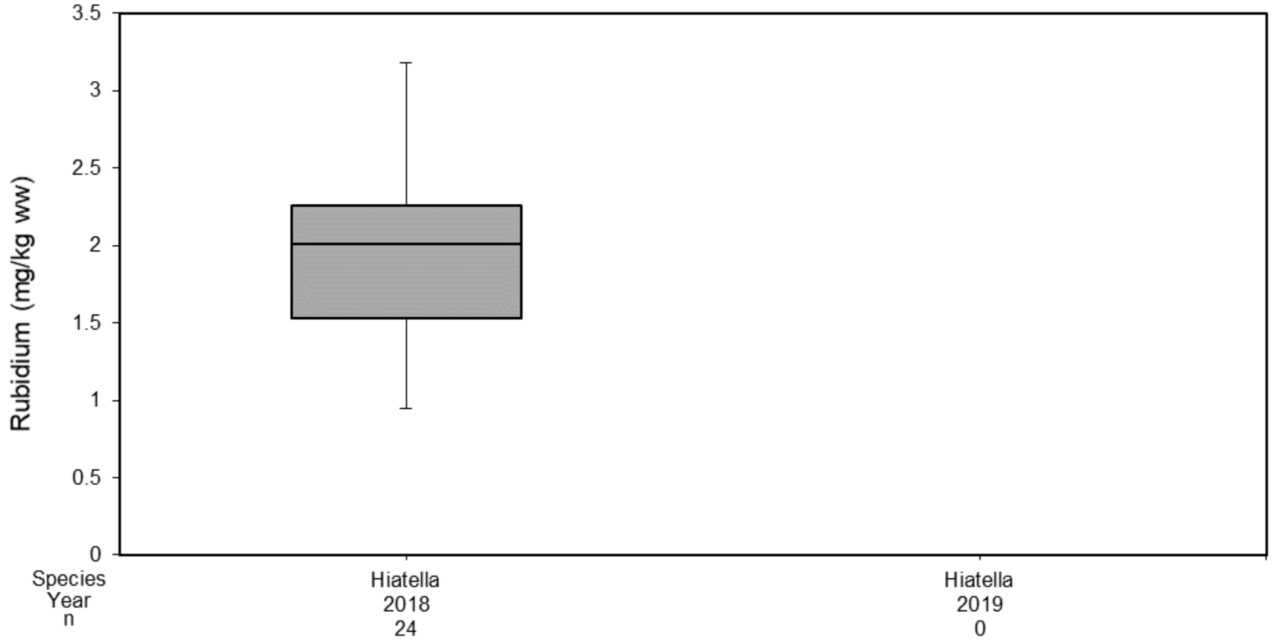
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.23: Phosphorus Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



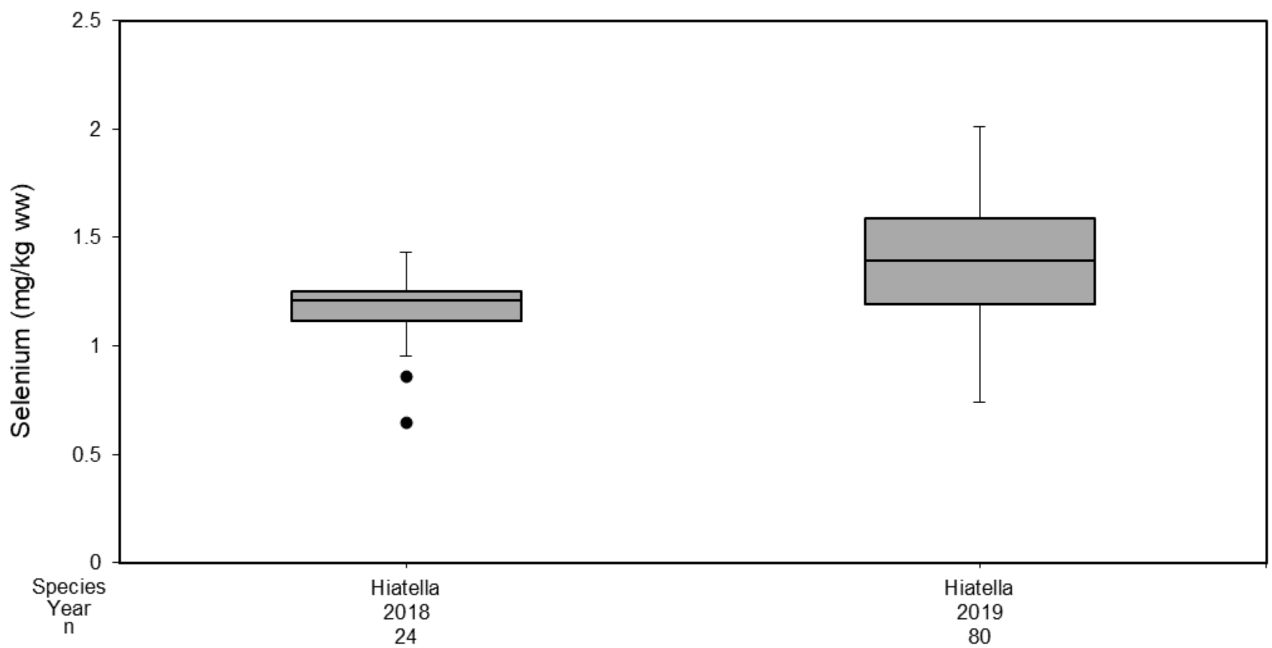
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.24: Potassium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



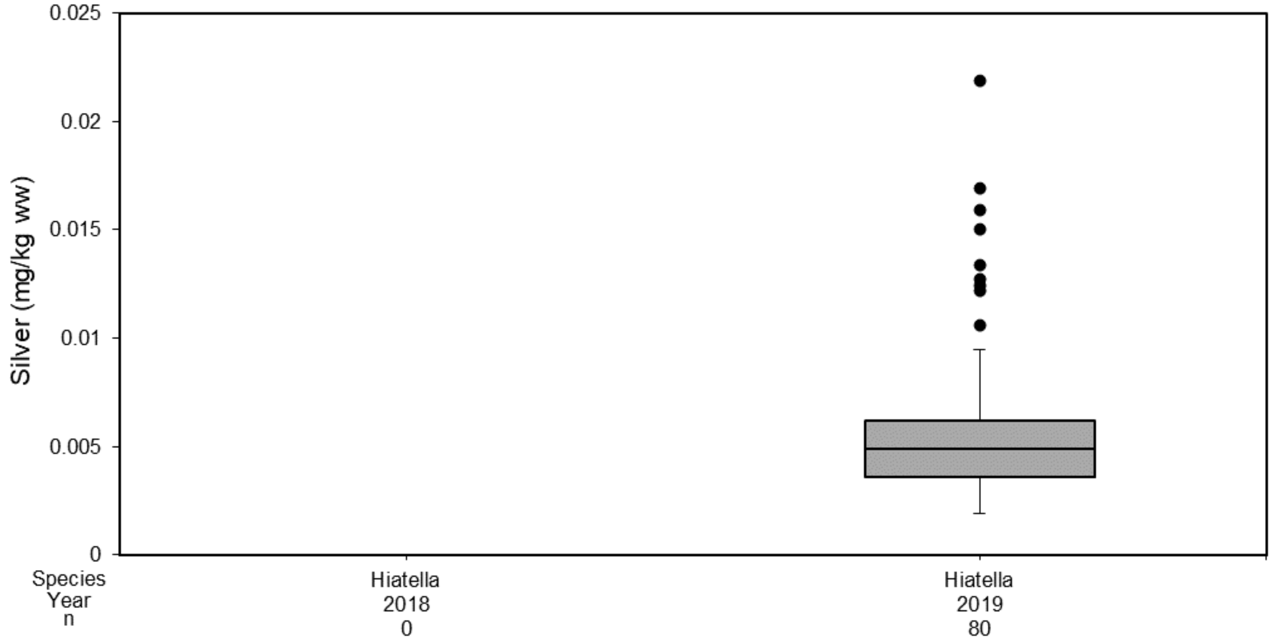
Note: Rubidium was not measured in 2019; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.25: Rubidium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018



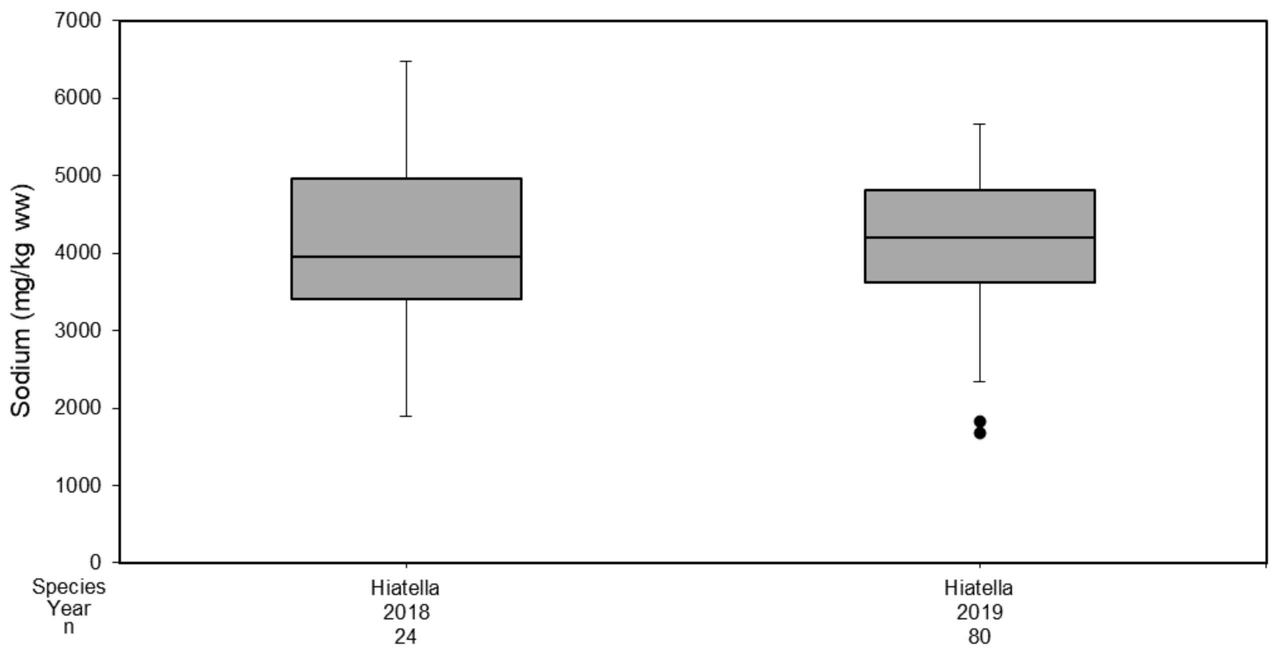
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.26: Selenium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



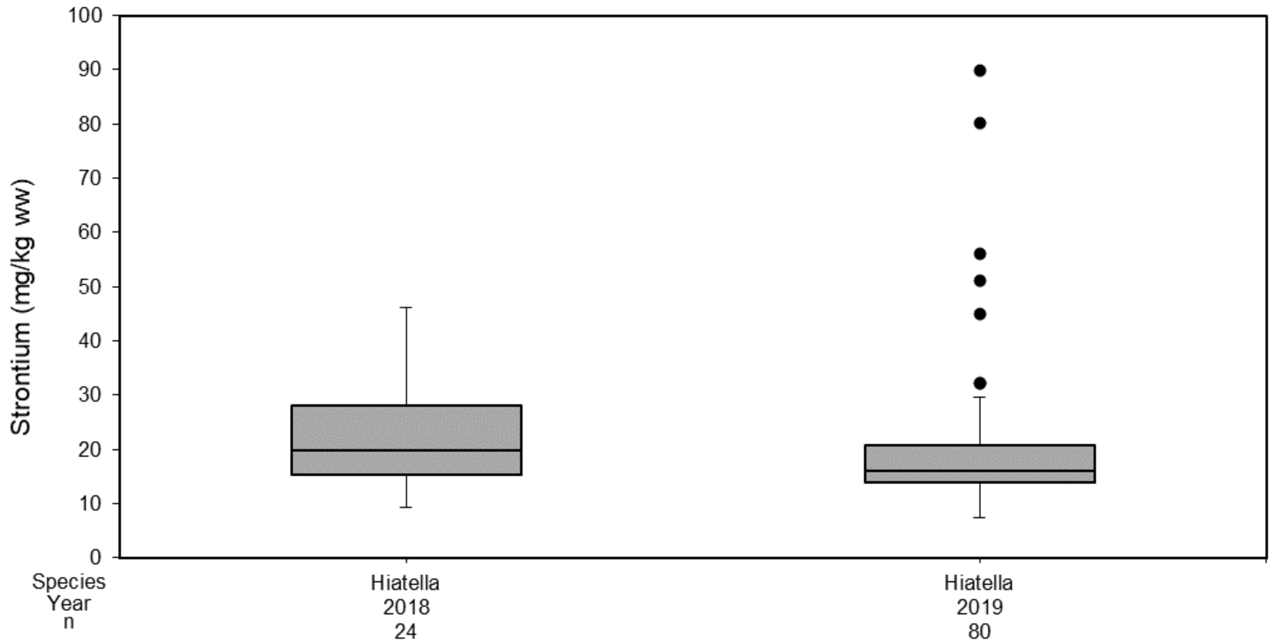
Note: Silver was not measured in 2018; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.27: Silver Concentration of *Hiatella arctica* Collected in Milne Port Area, 2019



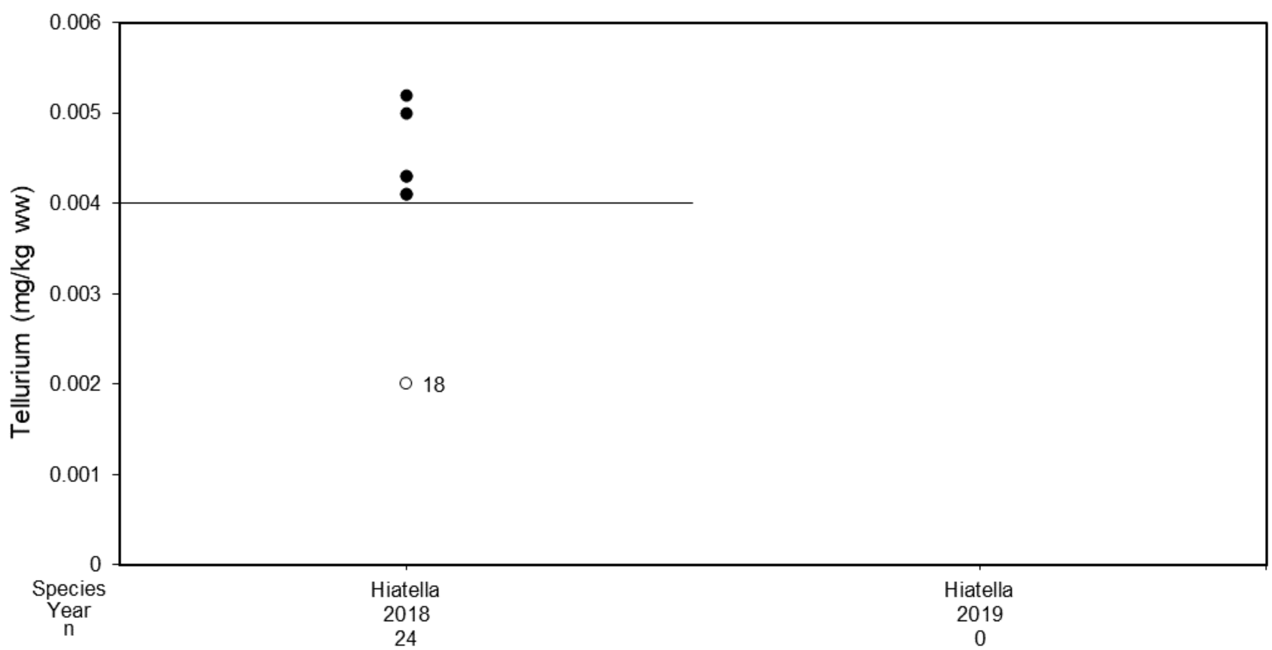
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.28: Sodium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



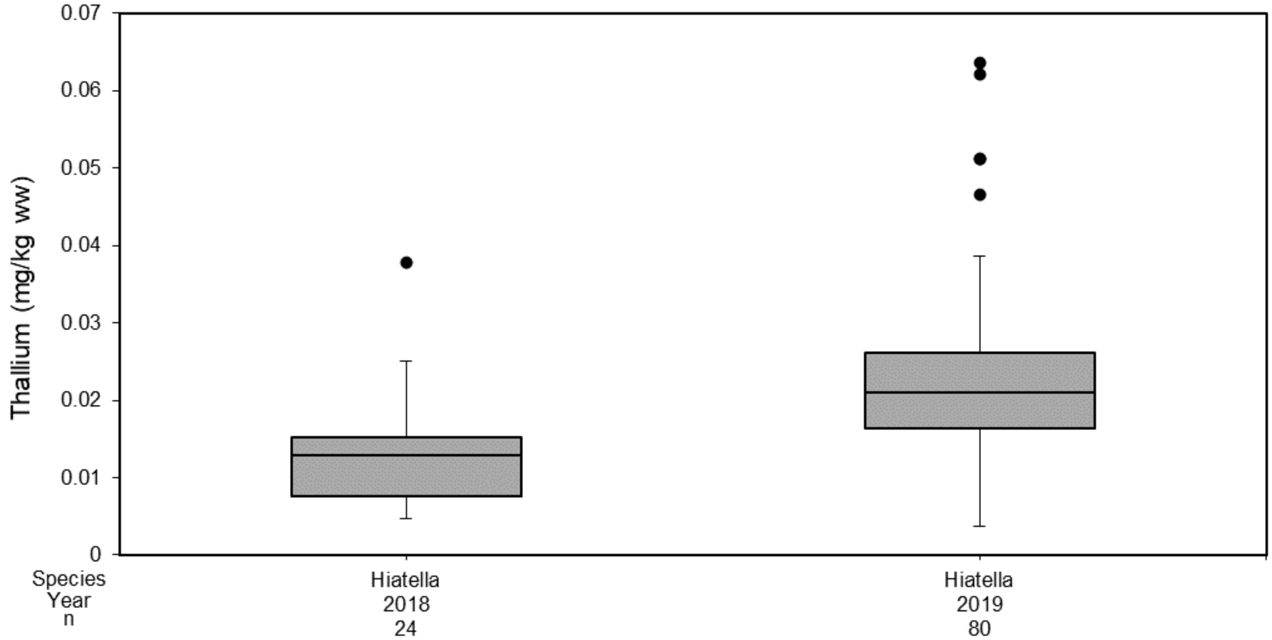
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.29: Strontium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



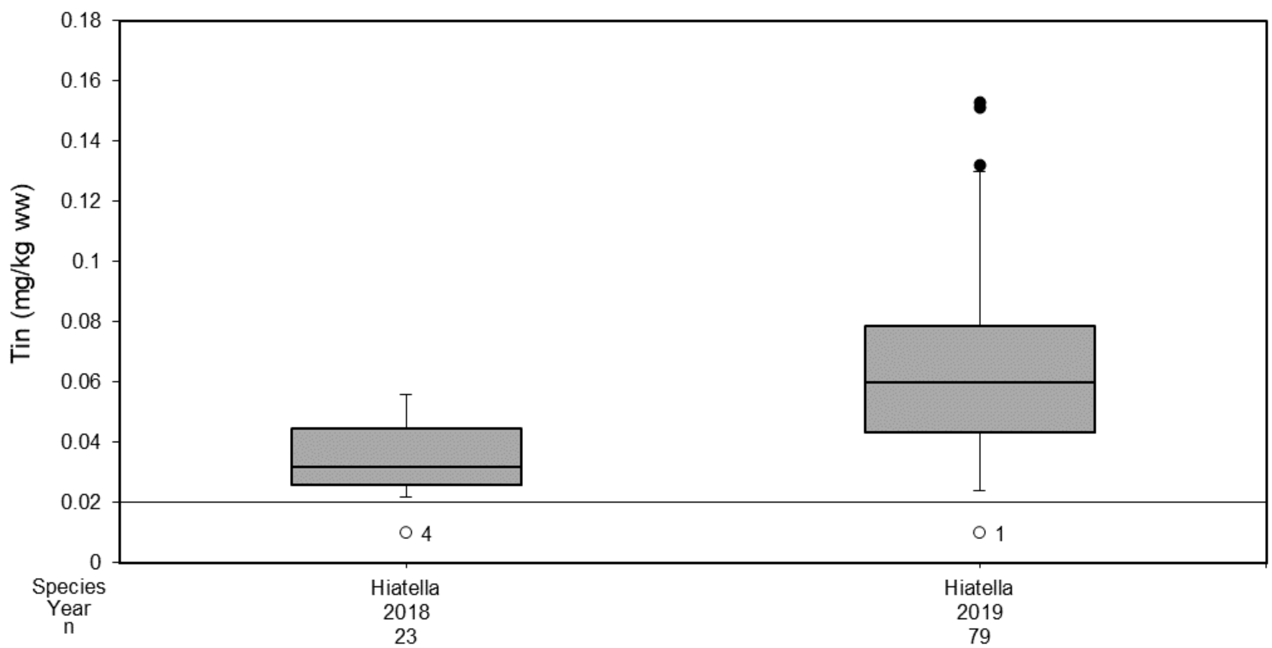
Note: Tellurium was not measured in 2018. Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.30: Tellurium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2019



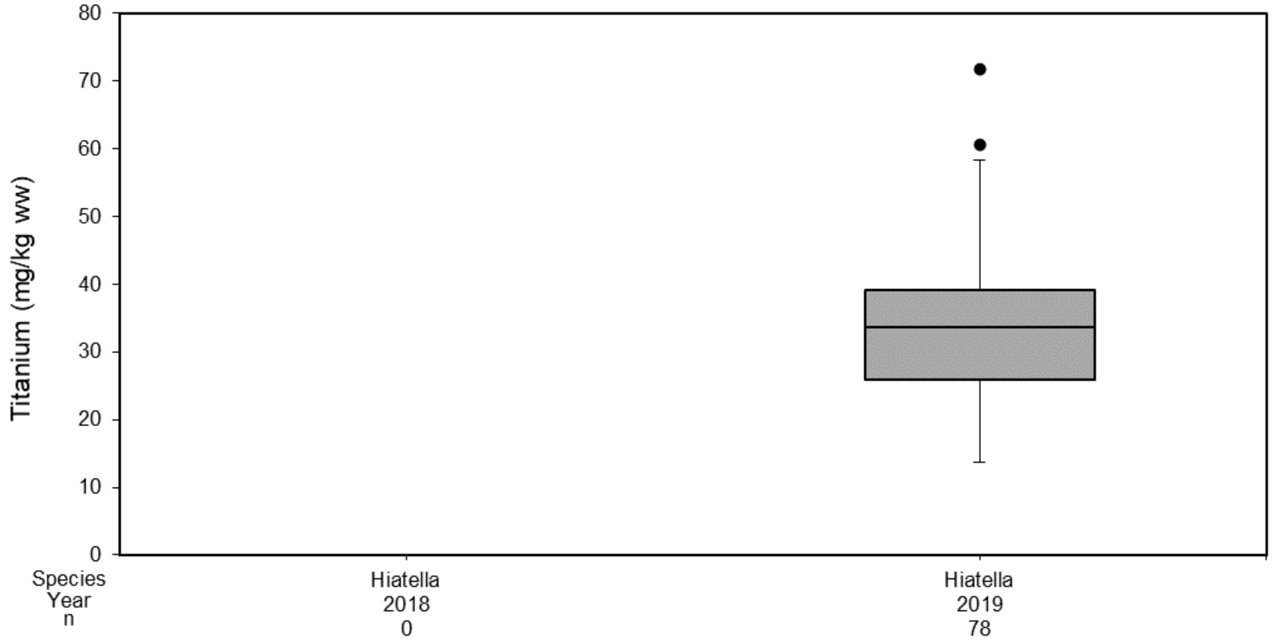
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.31: Thallium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



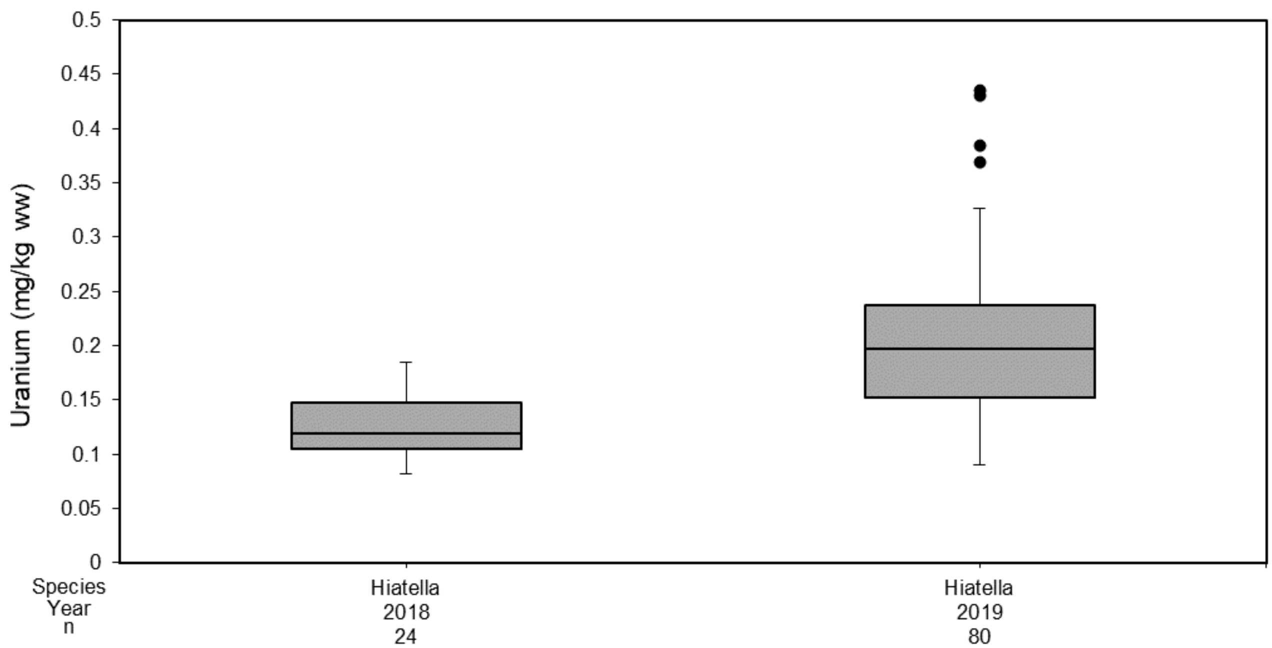
Note: Horizontal line indicates detection limit. One statistical outlier was removed from each of the 2018 and 2019 datasets to aid in data visualization (Sample L2156762-19, value 0.352, and Sample SA19-072-063, value 0.529); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.32: Tin Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



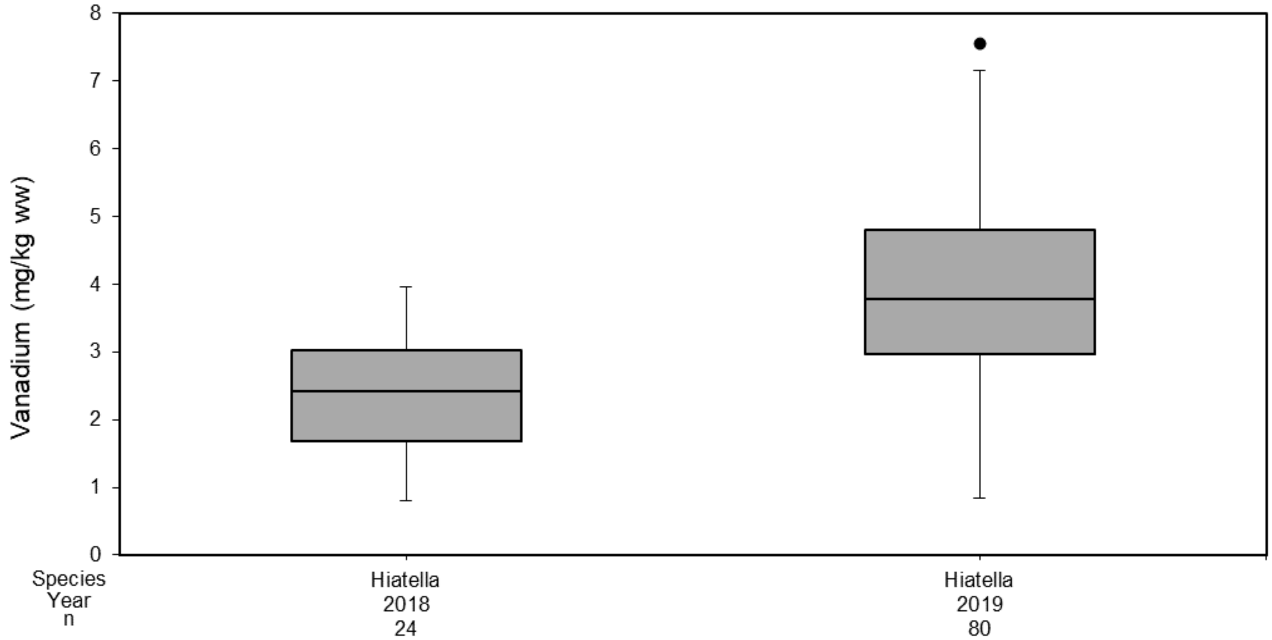
Note: Titanium was not measured in 2018. Two statistical outliers removed from the 2019 dataset to aid in data visualization (Sample SA19-072-128, value 109, and Sample SA19-072-117, value 4.59); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.33: Titanium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2019



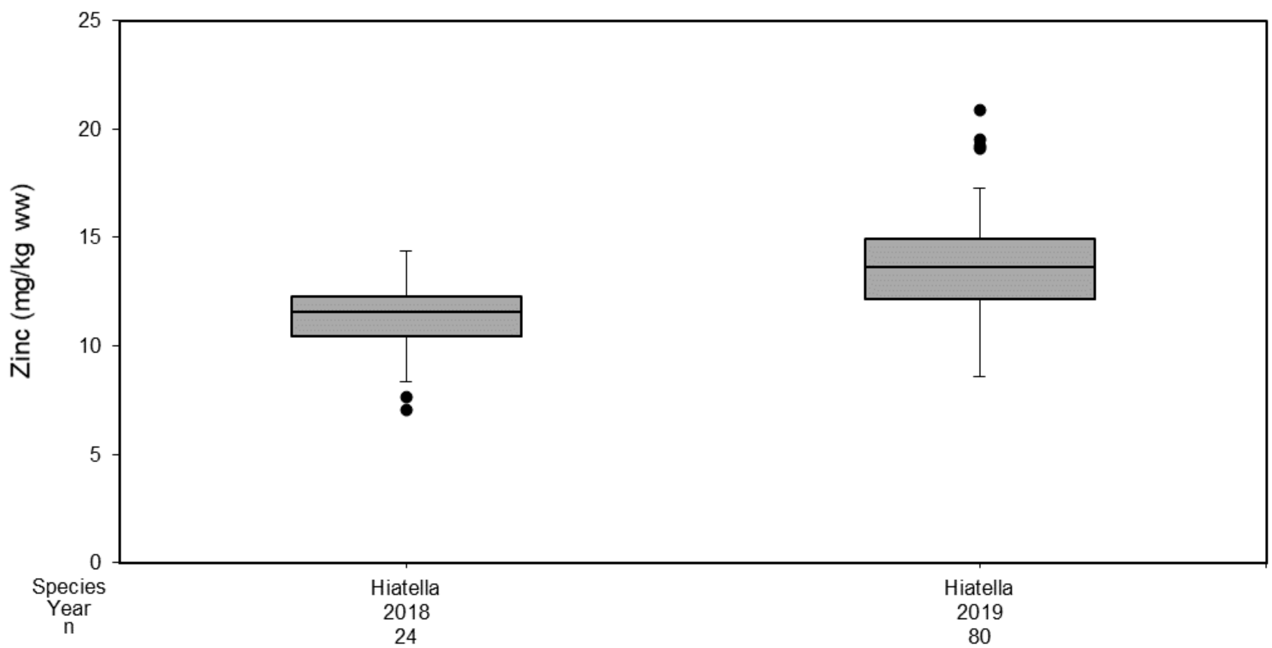
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.34: Uranium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



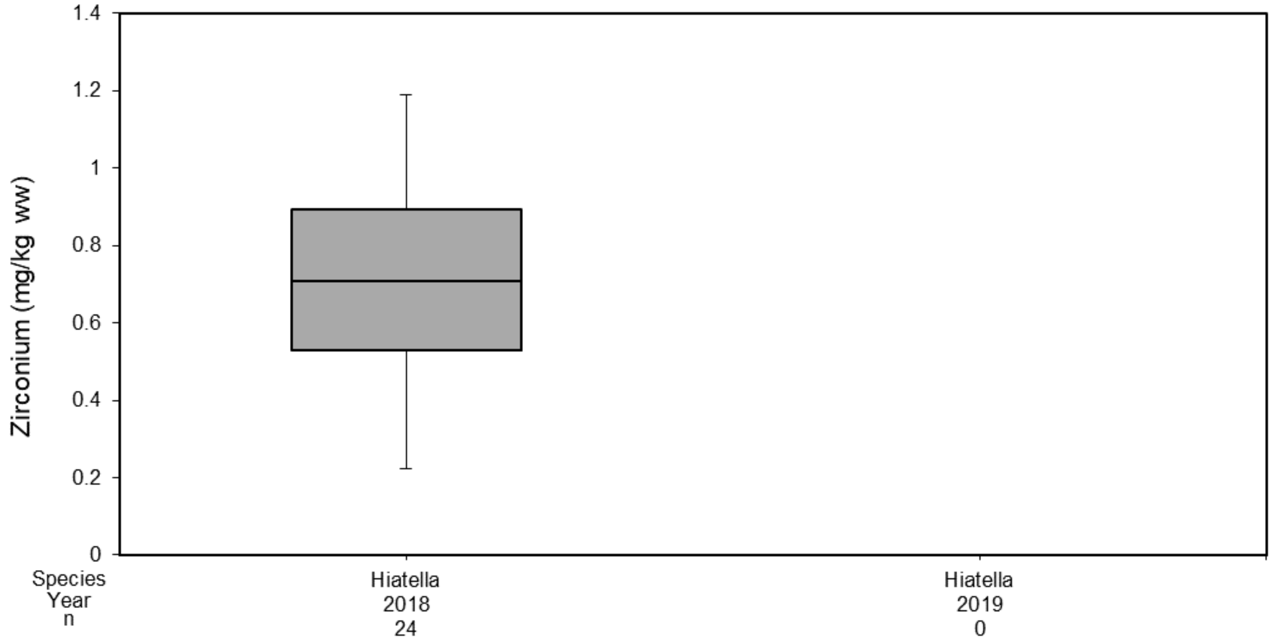
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.35: Vanadium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.36: Zinc Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018 and 2019



Note: Zirconium was not measured in 2019; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure F-5.37: Zirconium Concentration of *Hiatella arctica* Collected in Milne Port Area, 2018

GOLDER ASSOCIATES LTD
BV Labs Job Number: B9A5916 Client Project #: 1663724-24000 TASK 03
Report Date: 2020/01/20

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0727	XC0728	XC0729	XC0730	XC0731	XC0732	XC0733	XC0734	XC0735	XC0736	XC0737	XC0738	XC0739
Sampling Date		2019-09-22	2019-09-22	2019-09-22	2019-09-22	2019-09-22	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23
COC Number		08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878
	UNITS	**BE-1 SA19-072-053**	**BE-1 SA19-072-054**	**BE-1 SA19-072-055**	**BE-1 SA19-072-056**	**BE-1 SA19-072-057**	**BE-3 SA19-072-058**	**BE-3 SA19-072-059**	**BE-3 SA19-072-060**	**BE-3 SA19-072-061**	**BE-3 SA19-072-062**	**BE-4 SA19-072-063**	**BE-4 SA19-072-064**	**BE-4 SA19-072-065**
Total Metals by ICPMS														
Total (Wet Wt) Aluminum (Al)	mg/kg	387	1130	1040	526	1060	726	487	1580	696	1460	1620	1380	887
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0089	0.0180	0.0179	0.0168	0.0228	0.0115	0.0140	0.0198	0.0120	0.0239	0.0229	0.0195	0.0158
Total (Wet Wt) Arsenic (As)	mg/kg	1.65	2.34	3.10	1.80	5.31	1.59	3.24	2.97	2.67	2.75	5.61	3.45	3.78
Total (Wet Wt) Barium (Ba)	mg/kg	3.95	7.42	6.26	3.32	6.02	5.57	20.3	9.58	21.1	15.7	19.6	12.0	11.5
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0224	0.0620	0.0567	0.0274	0.0610	0.0391	0.0301	0.0868	0.0399	0.0787	0.0915	0.0779	0.0520
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0067	0.0143	0.0130	0.0106	0.0176	0.0089	0.0081	0.0171	0.0117	0.0157	0.0197	0.0158	0.0111
Total (Wet Wt) Boron (B)	mg/kg	14.4	14.5	13.7	7.57	16.7	7.39	6.43	11.5	7.61	13.7	13.8	11.7	9.73
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.277	0.425	0.732	0.555	0.755	0.472	0.572	0.353	0.897	0.396	0.677	0.958	0.262
Total (Wet Wt) Calcium (Ca)	mg/kg	2980	7850	7700	3990	7300	5440	3990	15700	11100	9750	16000	9200	6280
Total (Wet Wt) Chromium (Cr)	mg/kg	1.04	2.76	2.57	1.38	2.67	1.92	1.48	4.53	1.85	3.85	4.46	3.47	2.44
Total (Wet Wt) Cobalt (Co)	mg/kg	0.291	0.914	0.888	0.995	1.26	0.559	1.18	1.04	0.871	1.58	1.93	1.51	1.29
Total (Wet Wt) Copper (Cu)	mg/kg	1.54	2.24	3.91	1.83	2.36	1.98	1.83	2.25	1.74	2.96	3.00	2.54	1.87
Total (Wet Wt) Iron (Fe)	mg/kg	671	2020	2250	835	3490	1320	1000	3060	1330	2680	4010	3100	2200
Total (Wet Wt) Lead (Pb)	mg/kg	0.447	1.52	1.36	1.73	1.61	0.994	1.10	1.76	0.997	2.07	1.99	1.79	1.18
Total (Wet Wt) Magnesium (Mg)	mg/kg	1990	4630	4300	2320	3980	3090	2430	8120	3410	5440	6250	4720	3410
Total (Wet Wt) Manganese (Mn)	mg/kg	14.3	58.1	72.3	88.2	109	32.6	147	63.2	75.1	136	207	135	141
Total (Wet Wt) Mercury (Hg)	mg/kg	0.026	0.025	0.028	0.034	0.034	0.021	0.078	0.015	0.052	0.032	0.024	0.021	0.039
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.198	0.823	0.361	0.224	0.524	0.243	0.293	0.241	0.302	0.485	0.480	0.372	0.400
Total (Wet Wt) Nickel (Ni)	mg/kg	0.906	2.00	1.82	1.35	2.13	1.56	1.78	2.62	1.72	3.15	3.25	2.59	2.11
Total (Wet Wt) Phosphorus (P)	mg/kg	2750	1220	1450	1370	1300	1170	960	1020	960	1020	1750	1320	935
Total (Wet Wt) Potassium (K)	mg/kg	1040	1210	1010	1120	970	1020	910	1400	1060	1450	1460	1470	1160
Total (Wet Wt) Selenium (Se)	mg/kg	1.66	1.60	1.59	1.39	1.45	1.21	1.61	1.18	1.57	1.40	1.29	1.13	1.39
Total (Wet Wt) Silver (Ag)	mg/kg	0.0019	0.0040	0.0055	0.0033	0.0045	0.0032	0.0032	0.0043	0.0027	0.0064	0.0065	0.0062	0.0036
Total (Wet Wt) Sodium (Na)	mg/kg	4320	4320	3970	3650	3870	4370	4590	3060	4760	4110	3730	4470	4730
Total (Wet Wt) Strontium (Sr)	mg/kg	10.1	14.0	16.3	12.0	21.7	14.2	15.1	17.2	89.9	20.8	56.0	22.3	18.6
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00925	0.0215	0.0208	0.0139	0.0246	0.0154	0.0177	0.0316	0.0163	0.0329	0.0329	0.0321	0.0204
Total (Wet Wt) Tin (Sn)	mg/kg	0.024	0.098	0.060	0.029	0.070	0.054	0.030	0.122	0.040	0.094	0.529	0.083	0.091
Total (Wet Wt) Titanium (Ti)	mg/kg	13.7	34.5	34.6	17.9	34.5	26.5	17.0	71.7	23.5	51.6	49.8	49.0	29.0
Total (Wet Wt) Uranium (U)	mg/kg	0.116	0.254	0.260	0.138	0.292	0.384	0.211	0.313	0.241	0.318	0.435	0.327	0.268
Total (Wet Wt) Vanadium (V)	mg/kg	1.34	3.85	3.80	2.38	4.99	2.51	2.51	5.26	2.81	5.64	6.42	5.15	3.75
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	12.6	16.5	15.3	15.7	12.8	13.9	13.9	15.6	12.4	14.0	14.2	11.7

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results
(2) Matrix spike failed for (Vanadium), suspected matrix interference

Results relate only to the items tested.

BV Labs ID		XC0740	XC0741	XC0742	XC0743	XC0744	XC0745	XC0746		XC0747	XC0748	XC0749	XC0750	XC0751
Sampling Date		2019-09-23	2019-09-23	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24		2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24
COC Number		08475878	08475878	08475878	08475878	08475878	08475878	08475878		08475878	08475878	08475878	08475878	08475878
	UNITS	**BE-4 SA19-072-066**	**BE-4 SA19-072-067**	**BE-5 SA19-072-068**	**BE-5 SA19-072-069**	**BE-5 SA19-072-070**	**BE-5 SA19-072-071**	**BE-5 SA19-072-072**	**QC Batch**	**BE-6 SA19-072-073**	**BE-6 SA19-072-074**	**BE-6 SA19-072-075**	**BE-6 SA19-072-076**	**BE-6 SA19-072-077**
Total Metals by ICPMS														
Total (Wet Wt) Aluminum (Al)	mg/kg	1170	1130	1510	742	1060	1630	900	9732352	572	901	1030	711	910
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0163	0.0159	0.0197	0.0163	0.0270	0.0219	0.0155	9732352	0.0137	0.0169	0.0157	0.0206	0.0161
Total (Wet Wt) Arsenic (As)	mg/kg	2.92	3.71	2.54	3.44	3.15	2.22	1.67	9732352	2.94	2.10	3.01	3.92	1.86
Total (Wet Wt) Barium (Ba)	mg/kg	10.6	23.9	8.12	12.4	32.7	11.0	5.05	9732352	10.9	6.83	7.49	11.5	7.64
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0616	0.0661	0.0802	0.0425	0.0569	0.0837	0.0473	9732352	0.0317	0.0475	0.0551	0.0396	0.0498
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0136	0.0137	0.0146	0.0097	0.0125	0.0163	0.0104	9732352	0.0092	0.0122	0.0121	0.0095	0.0104
Total (Wet Wt) Boron (B)	mg/kg	11.0	9.95	11.9	8.03	10.1	12.9	8.67	9732352	7.39	8.35	8.98	7.93	8.35
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.156	1.27	0.310	0.413	0.163	0.372	0.403	9732352	0.689	0.502	0.449	0.209	0.461
Total (Wet Wt) Calcium (Ca)	mg/kg	8800	8610	11000	5120	5920	14500	5570	9732352	4340	5850	7730	4830	6450
Total (Wet Wt) Chromium (Cr)	mg/kg	3.16	3.09	3.71	2.00	2.78	4.46	2.34	9732352	1.71	2.40	2.69	1.93	2.44
Total (Wet Wt) Cobalt (Co)	mg/kg	1.07	0.925	0.998	1.17	2.43	0.950	0.975	9732352	1.02	0.781	0.714	2.02	0.963
Total (Wet Wt) Copper (Cu)	mg/kg	2.14	2.21	2.23	1.79	2.04	2.32	1.83	9732352	1.87	2.18	1.89	1.96	1.81
Total (Wet Wt) Iron (Fe)	mg/kg	2380	2640	2680	1330	2220	2790	1570	9732352	1220	1620	1840	1940	1700
Total (Wet Wt) Lead (Pb)	mg/kg	1.27	1.35	1.50	1.19	1.99	1.55	1.56	9732352	0.997	1.68	1.14	1.40	1.39
Total (Wet Wt) Magnesium (Mg)	mg/kg	4850	4790	5960	3150	3690	7860	3720	9732352	2560	3490	4430	3050	3920
Total (Wet Wt) Manganese (Mn)	mg/kg	105	60.8	101	140	388	54.5	96.3	9732352	98.2	70.9	44.5	283	97.1
Total (Wet Wt) Mercury (Hg)	mg/kg	0.030	0.027	0.024	0.046	0.034	0.026	0.025	9732352	0.059	0.021	0.044	0.045	0.022
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.721	0.425	0.305	0.426	0.492	0.511	0.254	9732352	0.267	0.183	0.212	0.402	0.440
Total (Wet Wt) Nickel (Ni)	mg/kg	2.15	2.07	2.33	1.88	2.49	2.70	1.76	9732352	1.75	1.90	2.04	1.99	1.76
Total (Wet Wt) Phosphorus (P)	mg/kg	1610	961	1500	1070	972	1970	954	9732352	1130	2400	1090	2030	1270
Total (Wet Wt) Potassium (K)	mg/kg	1550	1150	1360	1100	1170	1350	1010	9732352	1090	1550	1370	1410	1270
Total (Wet Wt) Selenium (Se)	mg/kg	1.42	1.18	1.15	1.30	1.23	1.07	0.898	9732352	1.80	1.06	1.36	1.46	0.913
Total (Wet Wt) Silver (Ag)	mg/kg	0.0039	0.0122	0.0050	0.0029	0.0051	0.0049	0.0035	9732352	0.0054	0.0043	0.0043	0.0028	0.0040
Total (Wet Wt) Sodium (Na)	mg/kg	4020	4190	4260	4640	4930	3530	4810	9732352	4580	4000	4210	3940	4320
Total (Wet Wt) Strontium (Sr)	mg/kg	16.8	18.3	16.9	14.9	17.8	29.7	13.8	9732352	18.0	14.0	15.4	18.8	14.0
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0219	0.0223	0.0249	0.0201	0.0294	0.0293	0.0187	9732352	0.0160	0.0227	0.0201	0.0184	0.0161
Total (Wet Wt) Tin (Sn)	mg/kg	0.132	0.091	0.077	0.042	0.059	0.100	0.051	9732352	0.037	0.050	0.056	0.044	0.054
Total (Wet Wt) Titanium (Ti)	mg/kg	38.0	39.2	45.4	26.3	35.0	58.3	31.1	9732352	22.1	32.9	36.4	25.2	32.5
Total (Wet Wt) Uranium (U)	mg/kg	0.288	0.431	0.228	0.164	0.177	0.269	0.131	9732352	0.200	0.146	0.184	0.176	0.153
Total (Wet Wt) Vanadium (V)	mg/kg	4.36	4.40	4.80	3.17	4.79	5.30	3.42	9732352	2.91	3.60	3.73	4.04	3.52
Total (Wet Wt) Zinc (Zn)	mg/kg	9.72	11.9	13.8	14.0	11.2	13.8	11.9	9732352	16.3	11.6	13.9	9.74	13.5

BV Labs ID		XC0752	XC0753	XC0754	XC0755	XC0756	XC0757	XC0758	XC0759	XC0760	XC0761	XC0762	XC0763
Sampling Date		2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-25	2019-09-25	2019-09-25	2019-09-25	2019-09-25	2019-09-27	2019-09-27
COC Number		08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878
	UNITS	**BE-7 SA19-072-078**	**BE-7 SA19-072-079**	**BE-7 SA19-072-080**	**BE-7 SA19-072-081**	**BE-7 SA19-072-082**	**BE-8 SA19-072-083**	**BE-8 SA19-072-084**	**BE-8 SA19-072-085**	**BE-8 SA19-072-086**	**BE-8 SA19-072-087**	**BW-1 SA19-072-088**	**BW-1 SA19-072-089**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	623	1020	532	587	681	952	550	1110	1010	768	483	875
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0113	0.0256	0.0107	0.0113	0.0279	0.0161	0.0106	0.0173	0.0177	0.0163	0.0119	0.0139
Total (Wet Wt) Arsenic (As)	mg/kg	1.81	4.13	1.83	2.37	5.54	3.30	1.56	2.43	3.85	3.43	2.28	1.86
Total (Wet Wt) Barium (Ba)	mg/kg	3.92	24.0	4.34	4.72	11.3	21.0	3.54	8.22	7.89	28.6	4.23	7.69
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0345	0.0566	0.0297	0.0317	0.0407	0.0498	0.0283	0.0579	0.0546	0.0442	0.0277	0.0488
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0072	0.0108	0.0069	0.0075	0.0085	0.0103	0.0063	0.0125	0.0116	0.0093	0.0076	0.0111
Total (Wet Wt) Boron (B)	mg/kg	6.23	8.87	5.42	6.23	8.71	9.17	5.64	8.98	9.70	7.98	7.19	8.54
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.374	1.19	0.598	0.223	0.419	0.351	0.333	0.690	0.418	0.492	0.448	0.326
Total (Wet Wt) Calcium (Ca)	mg/kg	4370	10400	3920	4250	4960	6390	3100	5970	6400	5610	4100	7800
Total (Wet Wt) Chromium (Cr)	mg/kg	1.67	2.55	1.47	1.56	1.81	2.52	1.39	2.77	2.82	2.26	1.29	2.54
Total (Wet Wt) Cobalt (Co)	mg/kg	0.506	1.83	0.377	0.470	2.59	0.779	0.343	1.16 (1)	0.902	0.909	0.555	0.867
Total (Wet Wt) Copper (Cu)	mg/kg	1.54	2.10	2.12	1.79	1.80	1.98	1.42	2.27	1.87	1.78	2.29	2.24
Total (Wet Wt) Iron (Fe)	mg/kg	1250	2510	1090	1430	3120	1870	998	2120	2000	1670	1820	2640
Total (Wet Wt) Lead (Pb)	mg/kg	0.732	1.46	0.654	0.707	0.933	1.05	0.579	1.38	1.20	0.947	0.689	1.09
Total (Wet Wt) Magnesium (Mg)	mg/kg	2950	6070	2520	2490	2820	3940	2290	3690	3750	3690	2230	4490
Total (Wet Wt) Manganese (Mn)	mg/kg	38.5	294	26.2	39.1	575	52.3	17.3	113 (1)	73.8	87.3	50.3	64.5
Total (Wet Wt) Mercury (Hg)	mg/kg	0.020	0.022	0.021	0.023	0.047	0.037	0.021	0.036	0.044	0.049	0.025	0.021
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.212	0.420	0.400	0.237	0.735	0.836	0.158	0.299	0.272	0.370	0.252	0.248
Total (Wet Wt) Nickel (Ni)	mg/kg	1.24	2.63	1.26	1.20	1.93	1.85	1.05	2.03	2.04	2.02	1.37	1.92
Total (Wet Wt) Phosphorus (P)	mg/kg	1440	1990	2100	2450	1380	2060	1370	899	832	1160	1510	1420
Total (Wet Wt) Potassium (K)	mg/kg	1610	1410	1320	1360	871	1410	1250	880	1170	1220	1020	1100
Total (Wet Wt) Selenium (Se)	mg/kg	1.23	1.45	1.59	1.48	1.27	1.51	1.27	1.12	1.61	1.75	1.19	1.21
Total (Wet Wt) Silver (Ag)	mg/kg	0.0035	0.0045	0.0054	0.0033	0.0028	0.0046	0.0023	0.0036	0.0039	0.0034	0.0033	0.0037
Total (Wet Wt) Sodium (Na)	mg/kg	4790	4190	4630	4500	4870	5020	5170	4510	5210	5060	5660	5310
Total (Wet Wt) Strontium (Sr)	mg/kg	9.86	29.6	9.97	13.2	32.3	15.3	9.87	16.1	19.7	15.3	14.8	15.8
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0119	0.0260	0.0112	0.0118	0.0211	0.0192	0.0102	0.0201	0.0191	0.0163	0.0110	0.0202
Total (Wet Wt) Tin (Sn)	mg/kg	0.040	0.093	0.037	0.035	0.074	0.056	0.033	0.061	0.062	0.084	0.039	0.107
Total (Wet Wt) Titanium (Ti)	mg/kg	23.7	35.2	20.9	20.6	23.4	34.6	19.7	39.3	34.2	28.4	15.8	30.6
Total (Wet Wt) Uranium (U)	mg/kg	0.0964	0.202	0.113	0.109	0.169	0.173	0.0982	0.200	0.237	0.211	0.129	0.250
Total (Wet Wt) Vanadium (V)	mg/kg	2.44	4.56	1.86	2.31	4.06	3.65	1.91	3.91	4.01	3.41	2.30	3.46
Total (Wet Wt) Zinc (Zn)	mg/kg	12.8	11.2	14.5	9.50	15.5	12.0	12.9	14.9	11.0	12.9	15.9	12.6

BV Labs ID		XC0764	XC0765	XC0766		XC0767	XC0768	XC0779	XC0780	XC0781	XC0782	XC0783	XC0784
Sampling Date		2019-09-27	2019-09-27	2019-09-27		2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27
COC Number		08475878	08475878	08475878		08475878	08475878	08475881	08475881	08475881	08475881	08475881	08475881
	UNITS	**BW-1 SA19-072-090**	**BW-1 SA19-072-091**	**BW-1 SA19-072-092**	**QC Batch**	**BW-2 SA19-072-093**	**BW-2 SA19-072-094**	**BW-2 SA19-072-095**	**BW-2 SA19-072-096**	**BW-2 SA19-072-097**	**BW-3 SA19-072-098**	**BW-3 SA19-072-099**	**BW-3 SA19-072-100**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	420	419	1190	9732907	608	858	599	831	999	1350	661	1070
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0091	0.0097	0.0196	9732907	0.0129	0.0150	0.0125	0.0166	0.0213	0.0224	0.0151	0.0185
Total (Wet Wt) Arsenic (As)	mg/kg	1.87	1.91	2.51	9732907	2.41	2.08	2.23	2.58	2.92	2.66	3.30	2.76
Total (Wet Wt) Barium (Ba)	mg/kg	4.35	6.95	7.29	9732907	18.2	5.16	10.7	6.18	4.48	7.21	24.4	7.82
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0224	0.0236	0.0637	9732907	0.0343	0.0464	0.0347	0.0443	0.0536	0.0747	0.0398	0.0594
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0066	0.0063	0.0137	9732907	0.0081	0.0114	0.0085	0.0103	0.0131	0.0167	0.0091	0.0129
Total (Wet Wt) Boron (B)	mg/kg	6.20	5.77	10.9	9732907	6.54	7.74	6.35	8.49	9.39	10.6	6.73	9.02
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.530	0.384	0.425	9732907	0.304	0.386	0.535	0.355	0.466	0.392	0.537	0.480
Total (Wet Wt) Calcium (Ca)	mg/kg	2770	3580	8520	9732907	4060	7340	4130	6000	7090	9650	5100	7540
Total (Wet Wt) Chromium (Cr)	mg/kg	1.13	1.28	3.44	9732907	2.19	2.46	2.14	2.45	2.98	4.01	2.26	3.18
Total (Wet Wt) Cobalt (Co)	mg/kg	0.580	0.665	1.11	9732907	0.873	0.571	0.611	1.19	1.28	0.927	0.590	0.914
Total (Wet Wt) Copper (Cu)	mg/kg	2.35	1.88	3.02	9732907	2.18	2.48	1.87	2.44	2.62	2.93	1.49	2.80
Total (Wet Wt) Iron (Fe)	mg/kg	1310	1460	3580	9732907	1630	2530	1800	2460	3880	3530	1850	2940
Total (Wet Wt) Lead (Pb)	mg/kg	0.596	0.628	1.43	9732907	0.893	0.916	0.705	1.25	1.43	1.46	0.645	1.24
Total (Wet Wt) Magnesium (Mg)	mg/kg	1980	2290	4880	9732907	2500	3240	2650	3480	3640	5200	3030	4170
Total (Wet Wt) Manganese (Mn)	mg/kg	69.3	67.4	92.5	9732907	84.9	31.5	42.8	129	108	50.9	28.2	85.7
Total (Wet Wt) Mercury (Hg)	mg/kg	0.026	0.027	0.026	9732907	0.032	0.018	0.030	0.029	0.017	0.020	0.078	0.023
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.230	0.270	0.286	9732907	0.292	0.206	0.226	0.292	0.293	0.621	0.350	0.273
Total (Wet Wt) Nickel (Ni)	mg/kg	1.15	1.25	2.76	9732907	1.78	1.74	1.60	1.99	2.39	2.58	2.04	2.06
Total (Wet Wt) Phosphorus (P)	mg/kg	2730	1230	825	9732907	1170	1490	928	1240	758	3160	728	1460
Total (Wet Wt) Potassium (K)	mg/kg	1420	1200	1090	9732907	1030	1690	1050	1820	913	1950	920	1630
Total (Wet Wt) Selenium (Se)	mg/kg	1.72	1.72	1.08	9732907	1.62	1.27	1.48	1.60	1.12	1.55	1.91	1.52
Total (Wet Wt) Silver (Ag)	mg/kg	0.0035	0.0027	0.0050	9732907	0.0095	0.0056	0.0036	0.0043	0.0078	0.0062	0.0037	0.0124
Total (Wet Wt) Sodium (Na)	mg/kg	5300	5450	5530	9732907	5600	4780	5210	4200	4830	3620	4950	3620
Total (Wet Wt) Strontium (Sr)	mg/kg	10.5	11.8	18.0	9732907	15.4	23.9	14.0	11.9	20.7	14.5	13.6	13.3
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00933	0.0106	0.0250	9732907	0.0184	0.0169	0.0116	0.0244	0.0197	0.0267	0.0182	0.0225
Total (Wet Wt) Tin (Sn)	mg/kg	0.081	0.042	0.115	9732907	0.130	0.059	0.045	0.052	0.075	0.088	0.041	0.073
Total (Wet Wt) Titanium (Ti)	mg/kg	13.8	14.6	38.6	9732907	25.8	34.0	21.7	36.1	36.3	50.7	26.6	43.2
Total (Wet Wt) Uranium (U)	mg/kg	0.108	0.112	0.227	9732907	0.168	0.152	0.200	0.162	0.220	0.220	0.240	0.192
Total (Wet Wt) Vanadium (V)	mg/kg	1.97	1.85	4.72	9732907	2.57	3.18	2.59	3.58	4.62	5.05	2.98	4.10
Total (Wet Wt) Zinc (Zn)	mg/kg	13.3	15.5	13.5	9732907	12.8	13.3	11.4	15.8	11.5	13.7	13.8	16.4

BV Labs ID		XC0785	XC0786	XC0787	XC0788	XC0789	XC0790	XC0791	XC0792	XC0793	XC0794	XC0795	XC0796	
Sampling Date		2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	
COC Number		08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	
	UNITS	**BW-3 SA19-072-101**	**BW-3 SA19-072-102**	**BW-4 SA19-072-103**	**BW-4 SA19-072-104**	**BW-4 SA19-072-105**	**BW-4 SA19-072-106**	**BW-4 SA19-072-107**	**BW-5 SA19-072-108**	**BW-5 SA19-072-109**	**BW-5 SA19-072-110**	**BW-5 SA19-072-111**	**BW-5 SA19-072-112**	**QC Batch**
Total Metals by ICPMS														
Total (Wet Wt) Aluminum (Al)	mg/kg	844	906	723	960	850	909	991	1310	974	743	1060	883	9732998
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0137	0.0165	0.0189	0.0200	0.0190	0.0180	0.0268	0.0316	0.0234	0.0207	0.0262 (1)	0.0226	9732998
Total (Wet Wt) Arsenic (As)	mg/kg	2.00	1.94	2.89	4.12	2.79	2.97	5.15	6.23	3.68	3.33	3.95	3.61	9732998
Total (Wet Wt) Barium (Ba)	mg/kg	6.40	7.70	8.85	19.5	13.9	14.7	8.15	12.7	8.96	17.6	10.3 (1)	12.5	9732998
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0443	0.0499	0.0399	0.0559	0.0497	0.0532	0.0550	0.0745	0.0531	0.0419	0.0655	0.0501	9732998
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0105	0.0104	0.0099	0.0133	0.0108	0.0127	0.0136	0.0159	0.0125	0.0107	0.0137	0.0135	9732998
Total (Wet Wt) Boron (B)	mg/kg	7.07	7.91	8.24	8.96	8.34	9.06	10.3	14.2	8.83	7.41	10.8	8.41	9732998
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.546	0.704	0.493	0.424	0.286	0.378	0.374	0.289	0.444	0.251	0.473	0.394	9732998
Total (Wet Wt) Calcium (Ca)	mg/kg	6450	6880	5890	6010	6430	7650	9260	11600	9340	27000	11100	6520	9732998
Total (Wet Wt) Chromium (Cr)	mg/kg	2.41	2.69	2.21	2.94	2.86	2.89	3.10	3.97	3.15	2.43	3.31	2.73	9732998
Total (Wet Wt) Cobalt (Co)	mg/kg	0.557	0.719	1.80	1.64	1.74	1.15	2.94	3.86	2.46	1.92	2.69 (1)	2.66	9732998
Total (Wet Wt) Copper (Cu)	mg/kg	2.22	2.09	2.39	2.44	2.10	2.37	2.52	3.00	2.32	2.23	2.67	3.16	9732998
Total (Wet Wt) Iron (Fe)	mg/kg	2190	2650	1970	2800	2440	2250	3470	4200	3230	2160	3110	2220	9732998
Total (Wet Wt) Lead (Pb)	mg/kg	0.869	1.04	1.15	1.43	1.33	1.19	1.72	2.14	1.60	1.36	1.75	2.06	9732998
Total (Wet Wt) Magnesium (Mg)	mg/kg	3570	3870	3640	3580	3990	4450	5130	5270	4990	4000	5360	3690	9732998
Total (Wet Wt) Manganese (Mn)	mg/kg	30.5	51.9	244	217	237	117	456	634	414	301	392 (1)	319	9732998
Total (Wet Wt) Mercury (Hg)	mg/kg	0.019	0.019	0.032	0.070	0.060	0.048	0.036	0.031	0.033	0.060	0.035	0.062	9732998
Total (Wet Wt) Molybdenum (Mo)	mg/kg	1.27	0.214	0.382	0.606	0.290	0.343	0.533	0.710	0.580	0.473	0.553	0.429	9732998
Total (Wet Wt) Nickel (Ni)	mg/kg	1.73	1.89	2.41	2.41	2.61	2.36	3.06	3.89	2.75	2.48	3.06	3.22	9732998
Total (Wet Wt) Phosphorus (P)	mg/kg	1300	2440	2270	1330	778	1070	1180	904	1090	705	1180	1540	9732998
Total (Wet Wt) Potassium (K)	mg/kg	1530	1680	1290	1200	1090	1520	1360	1020	1390	923	1590	1120	9732998
Total (Wet Wt) Selenium (Se)	mg/kg	1.55	1.29	1.55	1.40	1.12	1.68	1.29	0.984	1.07	1.24	1.12	1.11	9732998
Total (Wet Wt) Silver (Ag)	mg/kg	0.0060	0.0056	0.0054	0.0134	0.0048	0.0050	0.0050	0.0074	0.0072	0.0046	0.0048	0.0050	9732998
Total (Wet Wt) Sodium (Na)	mg/kg	3900	3920	5260	5030	5010	4520	5010	3790	4140	4100	3340	2590	9732998
Total (Wet Wt) Strontium (Sr)	mg/kg	11.6	13.4	15.1	19.5	15.7	15.1	22.1	51.2	20.4	32.2	21.6	14.6	9732998
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0167	0.0184	0.0234	0.0276	0.0302	0.0234	0.0636	0.0621	0.0386	0.0285	0.0511	0.0258	9732998
Total (Wet Wt) Tin (Sn)	mg/kg	0.055	0.055	0.066	0.061	0.053	0.077	0.063	0.153	0.064	0.043	0.069	0.059	9732998
Total (Wet Wt) Titanium (Ti)	mg/kg	35.0	36.4	28.2	35.9	33.4	36.3	38.7	50.0	40.0	29.9	43.6	33.1	9732998
Total (Wet Wt) Uranium (U)	mg/kg	0.162	0.148	0.137	0.210	0.217	0.181	0.182	0.254	0.194	0.202	0.221	0.230	9732998
Total (Wet Wt) Vanadium (V)	mg/kg	2.98	3.57	3.65	4.39	4.22	4.30	5.75	7.54	5.12	4.00	5.87	4.54	9732998
Total (Wet Wt) Zinc (Zn)	mg/kg	15.0	14.6	14.9	15.3	11.8	14.2	10.4	12.0	9.50	8.61	13.7	14.2	9732998

BV Labs ID		XC0797	XC0798	XC0799	XC0800	XC0801	XC0802	XC0803	XC0804	XC0805	XC0806	XC0807	XC0808
Sampling Date		2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28
COC Number		08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881
	UNITS	**BW-6 SA19-072-113**	**BW-6 SA19-072-114**	**BW-6 SA19-072-115**	**BW-6 SA19-072-116**	**BW-6 SA19-072-117**	**BW-7 SA19-072-118**	**BW-7 SA19-072-119**	**BW-7 SA19-072-120**	**BW-7 SA19-072-121**	**BW-7 SA19-072-122**	**BW-8 SA19-072-123**	**BW-8 SA19-072-124**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	1090	770	1380	543	109	413	1100	565	732	916	634	1280
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0259	0.0158	0.0217	0.0120	0.0043	0.0226	0.0208	0.0117	0.0138	0.0184	0.0105	0.0217
Total (Wet Wt) Arsenic (As)	mg/kg	6.31	3.15	3.78	2.82	2.68	3.06	3.09	3.01	2.50	2.85	1.70	2.53
Total (Wet Wt) Barium (Ba)	mg/kg	10.9	9.18	11.8	15.8	17.3	8.17	7.18	15.0	4.68	17.3	3.49	5.10
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0605	0.0457	0.0732	0.0324	0.0072	0.0270	0.0594	0.0336	0.0437	0.0528	0.0378	0.0689
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0132	0.0112	0.0160	0.0077	0.0032	0.0085	0.0136	0.0080	0.0106	0.0118	0.0104	0.0150
Total (Wet Wt) Boron (B)	mg/kg	10.8	7.47	8.83	5.02	3.06	4.97	10.4	5.98	6.45	8.00	5.64	9.99
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.315	0.415	0.415	0.845	0.503	0.320	0.610	0.977	0.467	0.766	0.459	0.345
Total (Wet Wt) Calcium (Ca)	mg/kg	11100	8160	9590	5350	1390	4940	11500	6010	8180	10100	7260	12500
Total (Wet Wt) Chromium (Cr)	mg/kg	3.64	2.50	3.94	1.85	0.405	1.55	3.72	1.93	2.49	3.05	2.17	4.19
Total (Wet Wt) Cobalt (Co)	mg/kg	2.28	1.16	2.21	0.834	0.326	1.76	0.911	0.704	0.642	1.21	0.574	1.16
Total (Wet Wt) Copper (Cu)	mg/kg	3.05	2.22	2.67	2.02	1.90	2.00	2.24	2.13	1.93	2.11	2.31	2.80
Total (Wet Wt) Iron (Fe)	mg/kg	4690	2490	4030	1580	374	1590	3310	1740	1970	2730	1570	3120
Total (Wet Wt) Lead (Pb)	mg/kg	1.32	0.989	1.76	0.763	0.150	0.951	1.16	0.679	0.877	1.18	0.877	1.40
Total (Wet Wt) Magnesium (Mg)	mg/kg	4880	4260	5180	3180	1190	2490	5930	3200	4520	5580	4150	6580
Total (Wet Wt) Manganese (Mn)	mg/kg	343	121	232	92.6	19.3	288	65.8	59.5	45.5	116	26.8	79.5
Total (Wet Wt) Mercury (Hg)	mg/kg	0.038	0.037	0.028	0.034	0.037	0.036	0.032	0.033	0.028	0.020	0.015	0.019
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.544	0.620	0.288	0.558	0.165	0.323	0.215	0.272	0.185	0.291	0.203	0.260
Total (Wet Wt) Nickel (Ni)	mg/kg	3.05	2.07	2.95	1.49	0.743	1.89	2.51	1.57	1.68	2.23	1.57	2.66
Total (Wet Wt) Phosphorus (P)	mg/kg	1140	1130	1460	1210	1360	1080	928	1260	1100	976	2760	1990
Total (Wet Wt) Potassium (K)	mg/kg	1070	1080	1030	1130	998	1000	878	1250	1110	1140	1410	1600
Total (Wet Wt) Selenium (Se)	mg/kg	1.19	2.01	0.738	1.43	1.84	1.68	1.07	1.56	1.59	1.24	1.12	1.43
Total (Wet Wt) Silver (Ag)	mg/kg	0.0050	0.0037	0.0042	0.0159	0.0091	0.0030	0.0049	0.0085	0.0026	0.0053	0.0061	0.0106
Total (Wet Wt) Sodium (Na)	mg/kg	3290	3810	1830	3230	3770	2640	3270	3620	3240	4060	3300	2620
Total (Wet Wt) Strontium (Sr)	mg/kg	45.0	24.9	22.6	10.6	7.44	15.0	28.2	14.9	13.6	18.2	10.5	17.9
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0292	0.0191	0.0321	0.0138	0.00370	0.0166	0.0230	0.0143	0.0159	0.0215	0.0150	0.0288
Total (Wet Wt) Tin (Sn)	mg/kg	0.068	0.044	0.099	0.037	<0.020	0.025	0.096	0.033	0.045	0.054	0.044	0.078
Total (Wet Wt) Titanium (Ti)	mg/kg	45.6	29.9	60.5	25.2	4.59	17.9	46.8	23.1	29.7	37.1	26.0	53.4
Total (Wet Wt) Uranium (U)	mg/kg	0.238	0.170	0.287	0.140	0.0901	0.148	0.232	0.168	0.147	0.193	0.124	0.212
Total (Wet Wt) Vanadium (V)	mg/kg	6.14	3.77	6.26	2.62	0.834	3.34	5.05	2.85	3.24 (2)	4.39	2.72	5.40
Total (Wet Wt) Zinc (Zn)	mg/kg	11.4	11.8	12.2	17.3	19.2	13.9	13.2	19.1	13.4	12.2	13.6	14.8

BV Labs ID		XC0809	XC0810	XC0811	XC0812	XC0813	XC0814	XC0815	XC0816		
Sampling Date		2019-09-28	2019-09-28	2019-09-28	2019-09-29	2019-09-29	2019-10-02	2019-10-04	2019-10-04		
COC Number		08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881		
	UNITS	**BW-8 SA19-072-125**	**BW-8 SA19-072-126**	**BW-8 SA19-072-127**	**BNW-1 SA19-072-128**	**BNW-1 SA19-072-129**	**BNE-1 SA19-072-130**	**BNE-4 SA19-072-131**	**BNE-5 SA19-072-132**	**RDL**	**QC Batch**
Total Metals by ICPMS											
Total (Wet Wt) Aluminum (Al)	mg/kg	973	1290	673	2370	1290	686	474	828	0.50	9734320
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0187	0.0177	0.0162	0.0424	0.0241	0.0316	0.0119	0.0199	0.0020	9734320
Total (Wet Wt) Arsenic (As)	mg/kg	2.41	2.17	2.46	2.11	2.05	3.03	2.15	2.49	0.0050	9734320
Total (Wet Wt) Barium (Ba)	mg/kg	4.81	5.39	7.90	10.0	9.87	19.0	4.20	5.53	0.010	9734320
Total (Wet Wt) Beryllium (Be)	mg/kg	0.0557	0.0730	0.0400	0.146	0.0734	0.0436	0.0268	0.0475	0.0020	9734320
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0149	0.0172	0.0121	0.0248	0.0169	0.0153	0.0074	0.0116	0.0013	9734320
Total (Wet Wt) Boron (B)	mg/kg	7.98	10.0	6.44	16.4	9.37	6.97	5.30	7.91	0.20	9734320
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.487	0.448	0.783	0.435	0.787	0.916	0.695	0.725	0.0013	9734320
Total (Wet Wt) Calcium (Ca)	mg/kg	9710	21300	6690	22600	10200	8330	5920	8390	4.0	9734320
Total (Wet Wt) Chromium (Cr)	mg/kg	3.46	4.44	2.30	7.34	3.68	2.30	1.47	2.55	0.025	9734320
Total (Wet Wt) Cobalt (Co)	mg/kg	1.48	1.05	1.12	1.29	0.787	3.96	0.461	0.802	0.0013	9734320
Total (Wet Wt) Copper (Cu)	mg/kg	2.57	2.94	2.97	4.49	4.18	2.97	2.42	2.39	0.013	9734320
Total (Wet Wt) Iron (Fe)	mg/kg	2850	3340	1760	7000	3700	2220	1190	1750	0.25	9734320
Total (Wet Wt) Lead (Pb)	mg/kg	1.56	1.47	1.05	2.29	1.60	3.42	0.774	1.05	0.0013	9734320
Total (Wet Wt) Magnesium (Mg)	mg/kg	5630	8410	3870	11600	4380	2980	2630	4320	0.40	9734320
Total (Wet Wt) Manganese (Mn)	mg/kg	118	57.4	106	47.3	37.7	560	36.4	49.1	0.010	9734320
Total (Wet Wt) Mercury (Hg)	mg/kg	0.030	0.019	0.023	0.025	0.030	0.033	0.036	0.048	0.013	9734320
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.291	0.212	0.270	0.242	0.242	0.501	0.134	0.182	0.0080	9734320
Total (Wet Wt) Nickel (Ni)	mg/kg	2.29	2.70	1.78	4.26	2.82	3.33	1.60	2.04	0.010	9734320
Total (Wet Wt) Phosphorus (P)	mg/kg	1140	1170	1590	981	1400	1070	2660	881	2.0	9734320
Total (Wet Wt) Potassium (K)	mg/kg	1410	1540	1450	1270	1140	1190	1410	969	2.5	9734320
Total (Wet Wt) Selenium (Se)	mg/kg	1.27	1.49	1.84	1.37	1.87	1.19	1.87	1.72	0.010	9734320
Total (Wet Wt) Silver (Ag)	mg/kg	0.0219	0.0063	0.0127	0.0169	0.0150	0.0060	0.0055	0.0063	0.0013	9734320
Total (Wet Wt) Sodium (Na)	mg/kg	3340	2840	3190	2340	3160	1680	4810	4710	2.5	9734320
Total (Wet Wt) Strontium (Sr)	mg/kg	13.7	80.1	12.4	21.3	20.4	22.7	18.7	18.9	0.013	9734320
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0221	0.0280	0.0232	0.0465	0.0248	0.0511	0.0128	0.0233	0.00040	9734320
Total (Wet Wt) Tin (Sn)	mg/kg	0.060	0.079	0.043	0.151	0.069	0.071	0.035	0.060	0.020	9734320
Total (Wet Wt) Titanium (Ti)	mg/kg	42.2	58.2	30.2	109	51.9	27.4	19.1	32.2	0.13	9734320
Total (Wet Wt) Uranium (U)	mg/kg	0.207	0.263	0.151	0.369	0.227	0.193	0.0941	0.191	0.00040	9734320
Total (Wet Wt) Vanadium (V)	mg/kg	5.03	5.40	3.64	7.15	4.32	5.27	2.26	3.71	0.020	9734320
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	12.3	17.2	19.5	20.9	15.0	14.8	15.0	0.20	9734320

GOLDER ASSOCIATES LTD

BV Labs Job Number: B9A5916
Client Project #: 1663724-24000 TASK 03
Report Date: 2020/01/20

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0727	XC0728	XC0729	XC0730	XC0731	XC0732	XC0733	XC0734	XC0735	XC0736	XC0737
Sampling Date		2019-09-22	2019-09-22	2019-09-22	2019-09-22	2019-09-22	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-23
COC Number		08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878
	UNITS	**BE-1 SA19-072-053**	**BE-1 SA19-072-054**	**BE-1 SA19-072-055**	**BE-1 SA19-072-056**	**BE-1 SA19-072-057**	**BE-3 SA19-072-058**	**BE-3 SA19-072-059**	**BE-3 SA19-072-060**	**BE-3 SA19-072-061**	**BE-3 SA19-072-062**	**BE-4 SA19-072-063**
Physical Properties												
Moisture	%	79	77	75	81	77	84	84	55	80	73	73

RDL = Reportable Detection Limit

Results relate only to the items tested.

XC0738	XC0739	XC0740	XC0741	XC0742	XC0743	XC0744	XC0745	XC0746		XC0747	XC0748	XC0749
2019-09-23	2019-09-23	2019-09-23	2019-09-23	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24		2019-09-24	2019-09-24	2019-09-24
08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878		08475878	08475878	08475878
BE-4 SA19-072-064	**BE-4 SA19-072-065**	**BE-4 SA19-072-066**	**BE-4 SA19-072-067**	**BE-5 SA19-072-068**	**BE-5 SA19-072-069**	**BE-5 SA19-072-070**	**BE-5 SA19-072-071**	**BE-5 SA19-072-072**	**QC Batch**	**BE-6 SA19-072-073**	**BE-6 SA19-072-074**	**BE-6 SA19-072-075**
74	81	75	73	73	81	80	63	82	9727621	82	78	79

XC0750	XC0751	XC0752	XC0753	XC0754	XC0755	XC0756	XC0757	XC0758	XC0759	XC0760	XC0761
2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-24	2019-09-25	2019-09-25	2019-09-25	2019-09-25	2019-09-25
08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878	08475878
BE-6 SA19-072-076	**BE-6 SA19-072-077**	**BE-7 SA19-072-078**	**BE-7 SA19-072-079**	**BE-7 SA19-072-080**	**BE-7 SA19-072-081**	**BE-7 SA19-072-082**	**BE-8 SA19-072-083**	**BE-8 SA19-072-084**	**BE-8 SA19-072-085**	**BE-8 SA19-072-086**	**BE-8 SA19-072-087**
77	79	79	75	81	79	81	74	82	82	78	78

XC0762	XC0763	XC0764	XC0765	XC0766		XC0767	XC0768	XC0779	XC0780	XC0781	XC0782
2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27		2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27
08475878	08475878	08475878	08475878	08475878		08475878	08475878	08475881	08475881	08475881	08475881
BW-1 SA19-072-088	**BW-1 SA19-072-089**	**BW-1 SA19-072-090**	**BW-1 SA19-072-091**	**BW-1 SA19-072-092**	**QC Batch**	**BW-2 SA19-072-093**	**BW-2 SA19-072-094**	**BW-2 SA19-072-095**	**BW-2 SA19-072-096**	**BW-2 SA19-072-097**	**BW-3 SA19-072-098**
82	76	80	80	75	9727655	78	77	82	72	78	72

XC0783	XC0784	XC0785	XC0786	XC0787	XC0788	XC0789	XC0790	XC0791	XC0792	XC0793	XC0794
2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-27	2019-09-28	2019-09-28	2019-09-28
08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881
BW-3 SA19-072-099	**BW-3 SA19-072-100**	**BW-3 SA19-072-101**	**BW-3 SA19-072-102**	**BW-4 SA19-072-103**	**BW-4 SA19-072-104**	**BW-4 SA19-072-105**	**BW-4 SA19-072-106**	**BW-4 SA19-072-107**	**BW-5 SA19-072-108**	**BW-5 SA19-072-109**	**BW-5 SA19-072-110**
83	73	78	76	80	86	80	77	78	80	85	80

XC0795	XC0796		XC0797	XC0798	XC0799	XC0800	XC0801	XC0802	XC0803	XC0804	XC0805
2019-09-28	2019-09-28		2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28
08475881	08475881		08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881
BW-5 SA19-072-111	**BW-5 SA19-072-112**	**QC Batch**	**BW-6 SA19-072-113**	**BW-6 SA19-072-114**	**BW-6 SA19-072-115**	**BW-6 SA19-072-116**	**BW-6 SA19-072-117**	**BW-7 SA19-072-118**	**BW-7 SA19-072-119**	**BW-7 SA19-072-120**	**BW-7 SA19-072-121**
75	77	9728895	76	78	67	77	81	81	76	78	77

XC0806	XC0807	XC0808	XC0809	XC0810	XC0811	XC0812	XC0813	XC0814	XC0815	XC0816		
2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-28	2019-09-29	2019-09-29	2019-10-02	2019-10-04	2019-10-04		
08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881	08475881		
BW-7 SA19-072-122	**BW-8 SA19-072-123**	**BW-8 SA19-072-124**	**BW-8 SA19-072-125**	**BW-8 SA19-072-126**	**BW-8 SA19-072-127**	**BNW-1 SA19-072-128**	**BNW-1 SA19-072-129**	**BNE-1 SA19-072-130**	**BNE-4 SA19-072-131**	**BNE-5 SA19-072-132**	**RDL**	**QC Batch**
77	76	68	75	66	72	57	69	75	75	75	0.30	9729051

APPENDIX G

Fish Catch and Analysis Data

Licence #: S-19/20-1033-NU

Philippe Rouget
3795 Carey Road 2nd floor
Victoria, BC, CA V8Z 6T8

Dear Philippe Rouget,

Enclosed is your Licence to Fish for Scientific Purposes issued pursuant to Section 52 of the Fishery (General) Regulations.

Failure to comply with any of the conditions specified on the attached licence may result in a contravention of the Fishery (General) Regulations.

Please be advised that this licence only permits those activities stated on your licence. Any other activity may require approval under the Fisheries Act or other legislation. It is the Project Authority's responsibility to obtain any other approvals.

Please ensure that you include the licence number and project title in any future correspondence and that you complete the Summary Harvest Report upon completion of activities under this licence.

Yours truly,

Jenna Kayakjuak
License Delivery Officer
Northern Operations
Central and Arctic Region
Fisheries and Oceans Canada

Date

Enclosure

LICENCE TO FISH FOR SCIENTIFIC PURPOSES

S-19/20-1033-NU

Pursuant to Section 52 of the Fishery (General) Regulations, the Minister of Fisheries and Oceans hereby authorizes the individual(s) listed below to fish for scientific purposes, subject to the conditions specified.

Project Authority: Philippe Rouget — Golder Associates Ltd.
3795 Carey Road 2nd floor
Victoria, BC, CA V8Z 6T8

Other Personnel: John Sherrin; Daniel Vicente; Arman Ospan; Amy Cardinal; Christine Bylenga; David Hurley; Patricia Tomliens; Benjamin Widdowson; Additional field staff from Pond Inlet area will be hired, names to be determined. These individuals will be under the supervision of the above staff.

Objectives: Baffinland 2019 Marine Ecological Effects Monitoring Program and Marine Habitat Offset Monitoring Program

The Project objectives are to conduct sampling to adhere to the terms and conditions of Baffinland to operate the Mary River Mine and Port Facility in Milne Inlet including:
1. To assess the effectiveness of fish offsetting measures in relation to the construction of the Milne ore dock.
2. To collect marine data for the Marine Ecological Effects Monitoring Program and Marine Habitat Offset Monitoring Program regulatory requirements.

CONDITIONS

Specified Conditions:

Sampling will be conducted from Milne Inlet (Baffinland's Port Facility) to Ragged Island (Mouth of Tremblay Sound)

Samples may also be captured using Fukui traps. Dead samples will be only taken from incidental mortalities, no fish will be killed for sampling purposes.

Waters:

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Sculpin, Fourhorn

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Sculpin, Shorthorn

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Sculpin, Ribbed

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Sculpin, Arctic Staghorn

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Spiny Lumpsucker

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Sand Lance

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Cod, Greenland

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Cod, Arctic

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging
Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Arctic Char (Searun)

Gear: 10 MM Mesh Gillnets and Larger
Fyke Nets
Jigging

Species:

Gear: Minnow Trap
Otter Trawl
Seine
Trolling

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			500	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Gastropods/Shellfish

Gear: Ponar dredge
Van Veen Grab

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
			200	100				

Water Body: Milne Inlet
Point A: 72° 20' N, 80° 30' W

Species: Benthos

Gear: Ponar dredge
Van Veen Grab

Total Weight	Weight Live	Weight Dead	Number Alive	Number Dead	Number Tows	Number Sets	Hours	Minutes
300.00								

Fishing Period: July 15, 2019 to September 30, 2019

A copy of this licence must be available at the study site and produced at the request of a fishery officer.

Live fish may not be retained unless specified in the conditions of this licence.

The licence holder shall immediately cease fishing when the total fish killed or live sampled reaches any of the maximums set for any of the species listed.

Transportation:

Other approvals/permits may be necessary to collect or transport certain species, such as Marine Mammal Transportation Permits. For marine mammal parts, products and derivatives a Marine Mammal Transportation Licence is required for domestic transport and, for international transport a Canadian CITES Export Permit is also required.

Disposal of Fish Caught:

Fish not required for the purpose of dead sampling and/or retention MUST be returned to the water at the site of capture. Retained fish may be made available to the nearest settlement for domestic consumption or sold commercially within the Territory. Any dead fish for commercial sale beyond the Territory in which it was caught requires authorization under the Fish Inspection Regulations. Disposal of any fish remains must be in accordance with local land use regulations.

Report on Activities:

The Project Authority will submit to the License Delivery Officer, Department of Fisheries and Oceans, within one month of the expiry date, a report stating:
i) whether or not the field work was conducted; and if conducted
ii) waterbody location, fishing coordinates, gear types used at each coordinate, numbers or amount of fish (by species) collected and/or marked and the date or period of collection.

A Summary Harvest Report template is provided by the License Delivery Officer at time of issuance of this licence .

The Project Authority also will provide a copy of any published or public access documents which result from the project . Information supplied will be used for population management purposes by the Department of Fisheries and Oceans and becomes part of the public record.

All documents should be sent to:

Fisheries and Oceans Canada
Northern Operations
Central and Arctic Region
P.O. Box 358
Iqaluit, NU X0A 0H0

Attention: License Delivery Officer

Telephone: (867) 979-8005
Fax: (867) 979-8039
E-mail: XCNA-NT-NUpermit@dfo-mpo.gc.ca

Notification of Commencement:

Prior to the commencement of fishing the Project Authority will contact:

Fisheries and Oceans Canada
Northern Operations
Central and Arctic Region
P.O. Box 358
Iqaluit, NU X0A 0H0

Attention: License Delivery Officer

Telephone: (867) 979-8005
Fax: (867) 979-8039
E-mail: XCNA-NT-NUpermit@dfo-mpo.gc.ca

Larry Dow
Director, Northern Operations
Central and Arctic Region
Fisheries and Oceans Canada

Date

For the Minister of Fisheries and Oceans.

Pursuant to Section 52 of the Fishery (General) Regulations.

Canada

Date: September 4th 2019

To: Phillipe Rouget, Golder Associates Ltd.

Subject: Animal Use Protocol - Letter of Approval

Dear Phillipe,

Your 2019 Animal Use Protocol (AUP), number FWI-ACC-2019-42, entitled “Baffinland 2019 Marine Ecological Effects Monitoring Program and Marine Habitat Offset Monitoring Program” has been reviewed and approved by the Freshwater Institute Animal Care Committee.

Keep this signed letter of approval as well as the signed AUP application form for your records. Please be advised that should there be a need to revise the protocol you are requested to contact the Freshwater Institute Animal Care Committee and obtain approval prior to proceeding.

The Canadian Council on Animal Care requires post approval monitoring of Animal Use Protocols (AUP). The Freshwater Institute Animal Care Committee will be randomly choosing AUPs and asking for photographs or video that shows the handling or interaction of animals for these projects.

In addition, you are required to submit a brief report within 30 days of completion of the project outlining the unexpected changes to the protocol, the number of animals used and any unanticipated results or mortalities. The report form is attached in your approval email.

Feel free to contact me if you have any questions or concerns.

Sincerely,

Michelle Wetton-Salo

Michelle Wetton-Salo

Chair Person of FWI-ACC

Freshwater Institute Animal Care Committee
Arctic & Aquatic Research
Central & Arctic / Région du Centre et de l’Arctique
Fisheries and Oceans Canada / Pêches et Océans Canada
501 University Crescent
Winnipeg, Manitoba R3T 2N6
Phone:204-983-5238
xca-fwisl-acc@dfo-mpo.gc.ca

Canada

APPROVAL BY ANIMAL CARE COMMITTEE MEMBERS

Signatures of ACC Members

Andrew Chapelsky

Marc Brandson

Dr. Charlene Berkvens D.V.M., D.V.Sc.

Chantelle Sawatzky

Kerry Wautier

Travis Durhack

Brent Young

Interim Approval ☐ **Final Approval** ☒

APPROVAL BY THE FWI ANIMAL CARE COMMITTEE IS FOR THE PERIOD STATED ON YOUR ANIMAL USE PROTOCOL.

Nunavummi Qaujisaqtulirijikkut / Nunavut Research Institute
Box 1720, Iqaluit, NU X0A 0H0 phone:(867) 979-7279 fax: (867) 979-7109 e-mail: mosha.cote@arcticcollege.ca

SCIENTIFIC RESEARCH LICENSE

LICENSE # 02 010 19R-M

ISSUED TO: Megan-Lorde Hoyle
Baffinland Iron Mines Corporation
2275 Upper Middle Road East, Suite 300
Oakville, Ontario
L6H 0C3 Canada

TEAM MEMBERS: W. Bowden, C. Devereaux, P. Lepage, A. Rees, M. Clarke, L. Doetzel, K. Beckmann, B. Pagagz, V. Latam, A. Ospan, J. Sherrin

AFFILIATION: Baffinland Iron Mines Corporation

TITLE: Mary River Project

OBJECTIVES OF RESEARCH:
Data collection and analysis for environmental monitoring and management of the Mary River project to assess Project impacts in relation to the approved environmental impact assessment;Compliance to NIRB Certificate No. 005, Amended Type "A" Water License 2AM-MRY1325 and further baseline and operating conditions analysis for future permitting.

TERMS & CONDITIONS:
The holder of the licence will be bound by the terms and conditions of the Nunavut Impact Review Board Screening Decision Report and the Department of Culture & Heritage archaeological sites terms and conditions. These terms and conditions will form part of this licence.

DATA COLLECTION IN NU:
DATES: January 21, 2019-December 31, 2019
LOCATION: Steensby Port,Mary River,Milne Port/Road

Scientific Research License 02 010 19R-M expires on December 31, 2019
Issued at Iqaluit, NU on January 21, 2019

Mary Ellen Thomas
Science Advisor

Capture Method	Site	Date	Species*	Length (mm)	Weight (g)	Sex	Stage
	AN01	26-Jul-19	-	-	-	-	-
	AN02	24-Aug-19	-	-	-	-	-
	AN03	24-Aug-19	-	-	-	-	-
	AN04	25-Aug-19	-	-	-	-	-
	AN05	26-Aug-19	-	-	-	-	-
	AN06	27-Aug-19	-	-	-	-	-
Angling	AN07	27-Aug-19	SHSC	171	70	U	U
	FT01	22-Aug-19	-	-	-	-	-
	FT02	22-Aug-19	-	-	-	-	-
	FT03	22-Aug-19	FHSC	280	200	U	U
	FT04	22-Aug-19	-	-	-	-	-
	FT05	22-Aug-19	-	-	-	-	-
	FT06	22-Aug-19	FHSC	199	70	U	U
	FT07	24-Aug-19	-	-	-	-	-
	FT08	24-Aug-19	-	-	-	-	-
	FT09	24-Aug-19	-	-	-	-	-
	FT10	24-Aug-19	FHSC	160	28	U	U
	FT11	24-Aug-19	FHSC	235	120	U	U
	FT11	24-Aug-19	FHSC	180	47	U	U
	FT11	24-Aug-19	FHSC	161	31	U	U
	FT11	24-Aug-19	FHSC	211	90	U	U
	FT12	24-Aug-19	-	-	-	-	-
	FT13	27-Aug-19	-	-	-	-	-
	FT14	27-Aug-19	-	-	-	-	-
	FT15	27-Aug-19	NRSL	168	20	U	U
	FT16	27-Aug-19	SHSC	185	49	U	U
	FT17	27-Aug-19	FHSC	170	42	U	U
Fukui Trap	FT18	27-Aug-19	-	-	-	-	-
	GN01	27-Jul-19	ARCH	346	396	U	A
	GN01	27-Jul-19	ARCH	576	2322	U	A
	GN01	27-Jul-19	ARCH	505	1503	U	A
	GN01	27-Jul-19	ARCH	465	1140	U	A
	GN01	27-Jul-19	SHSC	230	106	U	A
	GN01	27-Jul-19	ARCH	560	1997	U	A
	GN01	27-Jul-19	ARCH	411	630	U	A
	GN01	27-Jul-19	ARCH	465	1231	U	A
	GN01	27-Jul-19	ARCH	600	2824	U	A
	GN01	27-Jul-19	ARCH	520	1857	U	A
	GN01	27-Jul-19	ARCH	286	182	U	A
	GN01	27-Jul-19	SHSC	140	36	U	A
	GN01	27-Jul-19	FHSC	208	92	U	A
	GN02	27-Jul-19	SHSC	167	37	U	U
	GN02	27-Jul-19	SHSC	126	17.5	U	U
	GN02	27-Jul-19	SHSC	200	61	U	A
	GN02	27-Jul-19	SHSC	113	12	U	U
	GN02	27-Jul-19	ARCH	126	19.5	U	J
	GN02	27-Jul-19	SHSC	115	14	U	U
	GN02	27-Jul-19	ARCH	463	1157	U	A
	GN02	27-Jul-19	FHSC	193	58.5	U	A
	GN03	27-Jul-19	FHSC	187	55.5	U	A
	GN03	27-Jul-19	FHSC	187	53	U	A
	GN03	27-Jul-19	SHSC	128	26	U	A
	GN03	27-Jul-19	FHSC	220	99	U	A
	GN03	27-Jul-19	SHSC	175	83	U	A
	GN03	27-Jul-19	SHSC	231	232	U	A
	GN03	27-Jul-19	SHSC	160	285	U	A
	GN03	27-Jul-19	FHSC	211	68	U	A
	GN03	27-Jul-19	FHSC	186	68	U	A
	GN03	27-Jul-19	FHSC	177	52	U	A
	GN03	27-Jul-19	ARCH	840	6809	U	A
	GN03	27-Jul-19	ARCH	395	678	U	A
	GN03	27-Jul-19	ARCH	448	948	U	A
	GN03	27-Jul-19	ARCH	580	2583	U	A
	GN03	27-Jul-19	ARCH	585	2175	U	A
	GN04	27-Jul-19	FHSC	255	166	U	A
	GN04	27-Jul-19	SHSC	405	832	U	A
	GN04	27-Jul-19	SHSC	287	313	U	A
	GN05	28-Jul-19	ARCH	445	986	U	A
	GN05	28-Jul-19	ARCH	415	777	U	A
	GN05	28-Jul-19	ARCH	490	1276	U	A
	GN05	28-Jul-19	ARCH	385	670	U	A
	GN05	28-Jul-19	ARCH	530	1757	U	A
	GN05	28-Jul-19	ARCH	452	1050	U	A
	GN05	28-Jul-19	ARCH	538	1703	U	A
	GN05	28-Jul-19	ARCH	381	645	U	A
	GN05	28-Jul-19	ARCH	558	2118	U	A
	GN05	28-Jul-19	ARCH	126	19.5	U	A

Capture Method	Site	Date	Species*	Length (mm)	Weight (g)	Sex	Stage
	GN05	28-Jul-19	FHSC	230	139	U	A
	GN05	28-Jul-19	FHSC	191	73	U	A
	GN05	28-Jul-19	FHSC	198	68	U	A
	GN05	28-Jul-19	FHSC	208	83	U	A
	GN05	28-Jul-19	FHSC	252	192	U	A
	GN05	28-Jul-19	ARCH	529	1650	U	A
	GN05	28-Jul-19	ARCH	273	210	U	A
	GN05	28-Jul-19	ARCH	770	4500	U	A
	GN05	28-Jul-19	ARCH	400	920	U	A
	GN05	28-Jul-19	ARCH	393	560	M	A
	GN05	28-Jul-19	ARCH	419	830	U	A
	GN05	28-Jul-19	ARCH	513	1880	U	A
	GN05	28-Jul-19	ARCH	435	1010	U	A
	GN05	28-Jul-19	ARCH	573	2230	U	A
	GN05	28-Jul-19	ARCH	464	1310	U	A
	GN05	28-Jul-19	ARCH	455	1220	U	A
	GN05	28-Jul-19	ARCH	429	960	U	A
	GN05	28-Jul-19	FHSC	214	130	U	A
	GN05	28-Jul-19	ARCH	460	1181	U	A
	GN05	28-Jul-19	ARCH	497	1363	U	A
	GN05	28-Jul-19	ARCH	300	249	U	A
	GN05	28-Jul-19	SHSC	160	33	U	U
	GN05	28-Jul-19	SHSC	163	30	U	U
	GN05	28-Jul-19	ARCH	547	1947	U	A
	GN05	28-Jul-19	FHSC	256	120	U	A
	GN05	28-Jul-19	FHSC	237	116	U	A
	GN05	28-Jul-19	FHSC	185	54	U	A
	GN05	28-Jul-19	ARCH	264	239	U	U
	GN05	28-Jul-19	ARCH	300	258	U	U
	GN05	28-Jul-19	ARCH	375	628	U	A
	GN05	28-Jul-19	ARCH	310	308	U	U
	GN05	28-Jul-19	ARCH	289	208	U	U
	GN05	28-Jul-19	FHSC	235	135	U	A
	GN05	28-Jul-19	FHSC	240	130	U	A
	GN05	28-Jul-19	FHSC	227	118	U	A
	GN05	28-Jul-19	FHSC	296	258	U	A
	GN05	28-Jul-19	ARCH	375	486	U	U
	GN05	28-Jul-19	ARCH	430	953	U	A
	GN05	28-Jul-19	ARCH	362	417	U	A
	GN05	28-Jul-19	ARCH	345	419	U	A
	GN05	28-Jul-19	ARCH	353	514	U	A
	GN05	28-Jul-19	FHSC	270	180	U	A
	GN05	28-Jul-19	FHSC	278	244	U	A
	GN05	28-Jul-19	FHSC	253	144	U	A
	GN05	28-Jul-19	FHSC	240	128	U	A
	GN05	28-Jul-19	ARCH	550	1933	U	A
	GN05	28-Jul-19	ARCH	430	552	U	A
	GN05	28-Jul-19	FHSC	245	187	U	A
	GN05	28-Jul-19	FHSC	280	234	U	A
	GN05	28-Jul-19	FHSC	248	182	U	A
	GN05	28-Jul-19	FHSC	238	142	U	A
	GN05	28-Jul-19	FHSC	241	132	U	A
	GN05	28-Jul-19	FHSC	260	189	U	A
	GN05	28-Jul-19	FHSC	265	239	U	A
	GN05	28-Jul-19	FHSC	263	253	U	A
	GN05	28-Jul-19	FHSC	258	251	U	A
	GN05	28-Jul-19	FHSC	285	230	U	A
	GN05	28-Jul-19	FHSC	270	194	U	A
	GN05	28-Jul-19	ARCH	555	1928	U	A
	GN05	28-Jul-19	ARCH	456	1133	U	A
	GN05	28-Jul-19	ARCH	535	1859	U	A
	GN05	28-Jul-19	ARCH	440	1112	U	A
	GN05	28-Jul-19	ARCH	510	1465	U	A
	GN05	28-Jul-19	ARCH	435	929	U	A
	GN05	28-Jul-19	FHSC	205	78	U	A
	GN05	28-Jul-19	FHSC	150	30	U	U
	GN05	28-Jul-19	FHSC	142	33	U	U
	GN06	28-Jul-19	ARCH	128	19	U	J
	GN06	28-Jul-19	ARCH	515	1640	U	A
	GN06	28-Jul-19	ARCH	426	1125	U	A
	GN06	28-Jul-19	ARCH	441	1000	U	A
	GN06	28-Jul-19	ARCH	510	1870	U	A
	GN06	28-Jul-19	ARCH	626	1920	U	A
	GN06	28-Jul-19	ARCH	611	3100	U	A
	GN06	28-Jul-19	ARCH	371	600	U	A
	GN06	28-Jul-19	FHSC	243	130	U	A

Capture Method	Site	Date	Species*	Length (mm)	Weight (g)	Sex	Stage
	GN06	28-Jul-19	FHSC	257	175	U	A
	GN06	28-Jul-19	FHSC	242	160	U	A
	GN07	28-Jul-19	ARCH	293	222	U	A
	GN07	28-Jul-19	ARCH	363	355	U	A
	GN07	28-Jul-19	ARCH	500	1420	U	A
	GN07	28-Jul-19	ARCH	350	410	U	A
	GN07	28-Jul-19	ARCH	585	2175	U	A
	GN07	28-Jul-19	ARCH	295	211	U	U
	GN07	28-Jul-19	ARCH	425	827	U	A
	GN07	28-Jul-19	SHSC	215	94	U	A
	GN07	28-Jul-19	FHSC	195	49	U	A
	GN07	28-Jul-19	ARCH	601	2516	U	A
	GN07	28-Jul-19	ARCH	585	2281	U	A
	GN07	28-Jul-19	ARCH	570	2118	U	A
	GN07	28-Jul-19	ARCH	425	910	U	A
	GN07	28-Jul-19	ARCH	330	365	U	A
	GN07	28-Jul-19	FHSC	255	154	U	A
	GN07	28-Jul-19	FHSC	205	75	U	A
	GN07	28-Jul-19	FHSC	195	87	U	A
	GN07	28-Jul-19	FHSC	250	170	U	A
	GN07	28-Jul-19	FHSC	210	78	U	A
	GN07	28-Jul-19	FHSC	235	123	U	A
	GN07	28-Jul-19	FHSC	235	111	U	A
	GN07	28-Jul-19	ARCH	527	1510	U	A
	GN07	28-Jul-19	ARCH	395	607	U	A
	GN07	28-Jul-19	ARCH	360	505	U	A
	GN07	28-Jul-19	ARCH	345	460	U	A
	GN07	28-Jul-19	ARCH	731	3842	U	A
	GN07	28-Jul-19	ARCH	634	2573	U	A
	GN07	28-Jul-19	ARCH	475	1276	U	A
	GN07	28-Jul-19	ARCH	440	1079	U	A
	GN08	22-Aug-19	ARCH	431	960	U	U
	GN08	22-Aug-19	ARCH	390	614	U	U
	GN08	22-Aug-19	ARCH	373	277	U	U
	GN08	22-Aug-19	FHSC	279	246	U	U
	GN08	22-Aug-19	FHSC	191	59	U	U
	GN08	22-Aug-19	FHSC	240	220	U	U
	GN08	22-Aug-19	FHSC	221	173	U	U
	GN08	22-Aug-19	FHSC	194	100	U	U
	GN08	22-Aug-19	FHSC	165	39	U	U
	GN08	22-Aug-19	SHSC	146	24	U	U
	GN08	22-Aug-19	FHSC	153	28	U	U
	GN08	22-Aug-19	FHSC	187	50	U	U
	GN08	22-Aug-19	FHSC	194	59	U	U
	GN08	22-Aug-19	FHSC	152	25	U	U
	GN08	22-Aug-19	SHSC	114	10	U	U
	GN08	22-Aug-19	SHSC	129	18	U	U
	GN08	22-Aug-19	SHSC	160	31	U	U
	GN08	22-Aug-19	SHSC	151	26	U	U
	GN08	22-Aug-19	SHSC	191	65	U	U
	GN08	22-Aug-19	FHSC	152	29	U	U
	GN08	22-Aug-19	SHSC	115	12	U	U
	GN08	22-Aug-19	SHSC	166	33	U	U
	GN08	22-Aug-19	FHSC	221	100	U	U
	GN08	22-Aug-19	SHSC	230	163	U	U
	GN08	22-Aug-19	FHSC	171	37	U	U
	GN08	22-Aug-19	FHSC	166	40	U	U
	GN08	22-Aug-19	FHSC	196	52	U	U
	GN08	22-Aug-19	FHSC	195	55	U	U
	GN08	22-Aug-19	SHSC	146	24	U	U
	GN08	22-Aug-19	FHSC	174	42	U	U
	GN08	22-Aug-19	FHSC	160	29	U	U
	GN08	22-Aug-19	SHSC	121	14	U	U
	GN08	22-Aug-19	FHSC	193	58	U	U
	GN08	22-Aug-19	SHSC	149	26	U	U
	GN08	22-Aug-19	FHSC	171	41	U	U
	GN08	22-Aug-19	SHSC	149	25	U	U
	GN08	22-Aug-19	FHSC	164	39	U	U
	GN08	22-Aug-19	FHSC	157	31	U	U
	GN09	22-Aug-19	ARCH	321	351	U	U
	GN09	22-Aug-19	ARCH	332	438	U	U
	GN09	22-Aug-19	FHSC	186	135	U	U
	GN09	22-Aug-19	SHSC	206	85	U	U
	GN09	22-Aug-19	SHSC	175	46	U	U
	GN09	22-Aug-19	ARCH	386	785	U	U
	GN09	22-Aug-19	ARCH	356	562	U	U

Capture Method	Site	Date	Species*	Length (mm)	Weight (g)	Sex	Stage
	GN09	22-Aug-19	FHSC	210	166	U	U
	GN09	22-Aug-19	SHSC	170	44	U	U
	GN09	22-Aug-19	SHSC	158	32	U	U
	GN09	22-Aug-19	SHSC	167	39	U	U
	GN09	22-Aug-19	SHSC	146	25	U	U
	GN09	22-Aug-19	FHSC	155	27	U	U
	GN09	22-Aug-19	SHSC	126	16	U	U
	GN09	22-Aug-19	SHSC	146	26	U	U
	GN09	22-Aug-19	FHSC	182	46	U	U
	GN09	22-Aug-19	SHSC	95	10	U	U
	GN10	26-Aug-19	-	-	-	-	-
	GN11	27-Aug-19	ARCH	570	1540	U	A
	GN12	27-Aug-19	SHSC	295	350	U	A
	GN12	27-Aug-19	SHSC	236	200	U	A
	GN12	27-Aug-19	SHSC	220	150	U	A
	GN12	27-Aug-19	SHSC	255	200	U	A
	GN12	27-Aug-19	FHSC	266	200	U	A
	GN12	27-Aug-19	SHSC	295	300	U	A
	GN12	27-Aug-19	SHSC	213	120	U	A
	GN12	27-Aug-19	SHSC	340	550	U	A
	GN12	27-Aug-19	SHSC	298	350	U	A
	GN12	27-Aug-19	SHSC	274	230	U	A
	GN12	27-Aug-19	SHSC	181	90	U	A
	GN13	27-Aug-19	SHSC	124	17	U	U
	GN14	28-Aug-19	FHSC	165	38	U	U
	GN14	28-Aug-19	SHSC	149	25	U	U
	GN14	28-Aug-19	ARCH	211	80	U	J
	GN14	28-Aug-19	SHSC	153	29	U	U
	GN14	28-Aug-19	ARCH	232	85	U	J
	GN14	28-Aug-19	FHSC	284	250	U	A
	GN14	28-Aug-19	FHSC	195	65	U	A
	GN14	28-Aug-19	FHSC	200	80	U	A
	GN14	28-Aug-19	SHSC	215	85	U	A
	GN14	28-Aug-19	SHSC	157	36	U	U
	GN14	28-Aug-19	SHSC	155	29	U	U
	GN14	28-Aug-19	FHSC	165	48	U	U
	GN14	28-Aug-19	SHSC	162	35	U	U
	GN14	28-Aug-19	SHSC	173	48	U	U
	GN15	28-Aug-19	-	-	-	-	-
	GN16	28-Aug-19	-	-	-	-	-
	GN17	28-Aug-19	FHSC	153	28	U	U
	GN18	29-Aug-19	FHSC	270	250	U	A
	GN18	29-Aug-19	FHSC	235	150	U	A
	GN19	29-Aug-19	FHSC	310	310	U	A
	GN20	29-Aug-19	FHSC	215	100	U	A
	GN20	29-Aug-19	FHSC	205	100	U	A
	GN20	29-Aug-19	FHSC	295	250	U	A
	GN20	29-Aug-19	ARCH	670	3650	U	A
	GN20	29-Aug-19	ARCH	455	1100	U	A
	GN20	29-Aug-19	ARCH	450	950	U	A
	GN20	29-Aug-19	ARCH	390	650	U	U
	GN20	29-Aug-19	ARCH	232	125	U	J
	GN20	29-Aug-19	FHSC	283	210	U	A
Gill Net	GN20	29-Aug-19	FHSC	208	125	U	U
	FN01	28-Aug-19	FHSC	173	45	U	U
	FN01	28-Aug-19	SHSC	180	52	U	U
	FN01	28-Aug-19	FHSC	203	100	U	U
	FN01	28-Aug-19	SHSC	165	40	U	U
	FN02	28-Aug-19	SHSC	170	50	U	U
	FN02	28-Aug-19	FHSC	225	100	U	U
	FN02	28-Aug-19	ARCH	215	75	U	J
	FN02	28-Aug-19	SHSC	250	160	U	U
	FN02	28-Aug-19	SHSC	263	190	U	U
	FN02	28-Aug-19	FHSC	280	200	U	U
	FN02	28-Aug-19	FHSC	300	260	U	U
Hoop Net	FN02	28-Aug-19	FHSC	218	125	U	U
	SN01	30-Aug-19	NNST	38	1	U	U
	SN02	30-Aug-19	SHSC	90	6	U	U
	SN03	30-Aug-19	SHSC	90	6	U	U
Seine Net	SN03	30-Aug-19	SHSC	56	2	U	U

Notes
[1] Fish species codes: ARCH = Arctic Char, FHSC = Fourhorn Sculpin, NNST = Ninespine Stickleback, NRSL = Northern Sandlance, SHSC = Shorthorn Sculpin
[2] A = Adult, F = Fry, J = Juvenile, M = Male, F = Female, U = Unknown, (-) = No Data

Fish Stomach Enumeration and Identification Methods
Client: Golder
Project: Baffinlands Iron Mine
Fish: Arctic Char & Sculpin

Sample Inventory

Sample arrival: September 11, 2019
Number of samples: 47
Biologica project number: ms19-072

Upon arrival, the samples were examined and double-checked against the chain of custody to ensure (1) all samples were accounted for, (2) each sample had the appropriate number of jars as indicated on the COC. Any discrepancies were reported to the client and were resolved before further sample handling. Samples were then assigned a unique identification number.

Table 1. Summary of Arctic Char fish stomachs processed for Golder Baffinlands Iron Mine 2019.

Client Sample #	Replicate	Date Sampled	Biologica Sample #	Full stomach weight (g)	% Stomach Fullness	% Material Digested
Arctic Char						
GN-01-1	1	27-Jul-19	ms19-072-133	34.57204	100	75
GN-01-3	1	27-Jul-19	ms19-072-134	27.55345	75	75
GN-01-2	1	27-Jul-19	ms19-072-135	53.31670	75	75
GN-03-3	1	27-Jul-19	ms19-072-136	40.31685	50	100
GN-03-2	1	27-Jul-19	ms19-072-137	71.18360	75	75
GN-03-1	1	27-Jul-19	ms19-072-138	113.32270	25	100
GN-03-4	1	27-Jul-19	ms19-072-139	36.49636	25	75
GN-05-P1	1	29-Jul-19	ms19-072-140	14.37853	50	100
GN-05-P3	1	29-Jul-19	ms19-072-141	7.82763	75	75
GN-05-P3	2	29-Jul-19	ms19-072-142	12.10605	25	75
GN-05-P3	3	29-Jul-19	ms19-072-143	7.04164	75	100
GN-05-P3	4	29-Jul-19	ms19-072-144	4.88235	50	100
GN-05-P3	5	29-Jul-19	ms19-072-145	12.33321	100	75
GN-05-P3	6	29-Jul-19	ms19-072-146	42.44031	75	75
GN-05-P5	1	29-Jul-19	ms19-072-147	13.34223	25	100
GN-05-P5	2	29-Jul-19	ms19-072-148	35.96325	50	100
GN-05-P2	1	29-Jul-19	ms19-072-149	7.17212	25	100
GN-05-P2	2	29-Jul-19	ms19-072-150	35.94012	25	100
GN-05-P4	1	29-Jul-19	ms19-072-151	10.36973	50	75
GN-05-P4	2	29-Jul-19	ms19-072-152	13.81427	75	75
GN-05-P4	3	29-Jul-19	ms19-072-153	15.53505	75	75
GN-05-P4	4	29-Jul-19	ms19-072-154	16.01738	75	75
GN-05-P4	5	29-Jul-19	ms19-072-155	12.80647	50	75

Client Sample #	Replicate	Date Sampled	Biologica Sample #	Full stomach weight (g)	% Stomach Fullness	% Material Digested
Arctic Char						
GN7-P1	1	29-Jul-19	ms19-072-156	5.73530	25	100
GN7-P1	2	29-Jul-19	ms19-072-157	6.50647	50	100
GN7-P2	1	29-Jul-19	ms19-072-158	12.20159	75	75
GN7-P2	2	29-Jul-19	ms19-072-159	18.90706	10	100
GN7-P3	1	29-Jul-19	ms19-072-160	24.43285	10	100
GN7-P3	2	29-Jul-19	ms19-072-161	15.04595	50	100
GN7-P3	3	29-Jul-19	ms19-072-162	11.75664	75	75
GN-06-P6	1	29-Jul-19	ms19-072-163	12.64318	25	100
GN-06-P6	2	29-Jul-19	ms19-072-164	19.85306	25	100
GN-06-P6	3	29-Jul-19	ms19-072-165	17.00457	50	100
GN-06-P6	4	29-Jul-19	ms19-072-166	10.57426	25	100
GN-06-P6	5	29-Jul-19	ms19-072-167	27.22673	10	100
GN-06-P6	6	29-Jul-19	ms19-072-168	21.78035	75	100
GN7-P6	1	29-Jul-19	ms19-072-169	15.10566	50	100
GN7-P6	2	29-Jul-19	ms19-072-170	8.27075	10	100
GN7-P6	3	29-Jul-19	ms19-072-171	38.35374	25	100
GN7-P6	4	29-Jul-19	ms19-072-172	85.52230	75	100
GN7-P5	1	29-Jul-19	ms19-072-173	10.92164	50	75
GN7-P5	2	29-Jul-19	ms19-072-174	12.79103	50	75
GN7-P5	3	29-Jul-19	ms19-072-175	15.37553	75	75
GN7-P5	4	29-Jul-19	ms19-072-176	22.24027	25	75
GN-09-ARCH-6	1	22-Aug-19	ms19-072-177	18.74315	50	50
GN-09-ARCH-7	1	22-Aug-19	ms19-072-178	8.79311	25	75
FN02-ARCH	1	2-Sep-19	ms19-072-179	1.21928	25	100
Sculpin						
GN-04-1	1	27-Jul-19	ms19-072-180	31.02716	100	100
GN-05-P2	1	29-Jul-19	ms19-072-181	1.06743	10	100
GN-05-P2	2	29-Jul-19	ms19-072-182	1.23672	50	100
GN-05-P2	3	29-Jul-19	ms19-072-183	0.99279	25	100
GN-05-P2	4	29-Jul-19	ms19-072-184	1.80745	10	100
GN-05-P2	5	29-Jul-19	ms19-072-185	0.62064	25	100
GN-05-P3	1	29-Jul-19	ms19-072-186	1.07541	10	100
GN-05-P3	2	29-Jul-19	ms19-072-187	4.72812	50	100
GN-05-P3	3	29-Jul-19	ms19-072-188	6.05015	50	100
GN-05-P4	1	29-Jul-19	ms19-072-189	5.15213	50	100
GN-05-P4	2	29-Jul-19	ms19-072-190	4.64104	50	100
GN-05-P4	3	29-Jul-19	ms19-072-191	4.39078	25	100
GN-05-P4	4	29-Jul-19	ms19-072-192	9.22304	25	100
GN-05-P5	1	29-Jul-19	ms19-072-193	4.02854	75	100
GN-05-P5	2	29-Jul-19	ms19-072-194	5.06874	25	100
GN-05-P5	3	29-Jul-19	ms19-072-195	7.19542	50	100
GN-05-P5	4	29-Jul-19	ms19-072-196	10.92732	75	100
GN7-P3	1	29-Jul-19	ms19-072-197	2.04642	25	100

Client Sample #	Replicate	Date Sampled	Biologica Sample #	Full stomach weight (g)	% Stomach Fullness	% Material Digested
Arctic Char						
GN7-P3	2	29-Jul-19	ms19-072-198	2.86437	50	100
GN-06-P6	1	29-Jul-19	ms19-072-199	8.48821	50	100
GN-06-P6	2	29-Jul-19	ms19-072-200	5.28043	75	100
GN-06-P6	3	29-Jul-19	ms19-072-201	8.29789	50	100
GN-06-P6	4	29-Jul-19	ms19-072-202	16.28544	100	75
GN-06-P6	5	29-Jul-19	ms19-072-203	17.16044	100	75
GN-06-P6	6	29-Jul-19	ms19-072-204	13.0239	100	75
GN-06-P6	7	29-Jul-19	ms19-072-205	5.64533	75	50
GN-06-P6	8	29-Jul-19	ms19-072-206	8.96506	25	100
GN-06-P6	9	29-Jul-19	ms19-072-207	19.32707	100	100
GN-06-P6	10	29-Jul-19	ms19-072-208	3.89511	25	100
GN-06-P6	11	29-Jul-19	ms19-072-209	7.56401	25	100

Sample Processing

Before dissection and identification, the percent fullness and percent digestion of each stomach was recorded based on the professional judgement of the taxonomist(s). For each new project, if multiple taxonomists are involved, they must agree on the categorization for the first 30 stomachs to ensure consistency of reporting.

The stomach contents were dissected out and weighed as per the following protocol:

1. Intestines were removed just anterior to the pyloric caecae and discarded. The esophagus was included with the stomach.

2. A longitudinal incision was made with a scalpel or scissors, avoiding damage to the contents, to reveal the food bolus. At this time stomach fullness was determined and the corresponding code for the degree of fullness is recorded (Table 2). Fullness was estimated by considering two factors: the degree of distention of the stomach, and the weight of the bolus relative to the size of the fish. Comparing stomach fullness estimates between analysts helps to develop consistency amongst analysts.

Table 2. Stomach fullness categories.

0	Empty
10	Trace of prey
25	Trace -25% full
50	25-50% full
75	50-75% full
100	75-100% full (distended)

3. Percent digestion was determined based on the following categories. This ranking was given before the bolus was dissected based on observable condition of the prey organisms (Table 3).

Table 3. Percent digestion of stomach contents.

0	All material is undigested, only whole organisms visible
0-10	Trace only; few posterior-most prey items are digested
25	10-25% digested. Posterior-most 25% digested and more than half of the organisms are whole
50	25-50% digested; approximately half of the organisms are whole
75	50-75% digested, less than half of organisms are whole
100	All material is digested, no whole organisms visible

4. Excess moisture was blotted from the food bolus with paper towel, avoiding excessive pressure on the food bolus. Material that was obviously composed of parasites, stomach lining, rocks, or any other non-prey is removed. (These items were not included in the stomach weight, but were noted in the comments).

5. The bolus was dissected, working anterior-posterior, and its identifiable components weighed to the nearest 0.01mg nearest 0.0001g. Prey items were identified to the lowest practicable taxonomic level (species when possible). Digested and unidentifiable material were categorized (e.g. Unidentified parts, digested tissue, non-food, etc.). Each identifiable unit (taxon or category) was placed in small drops of water on petri dish to prevent desiccation during the identification process.

6. All prey categories (taxa and unidentifiable categories) were blotted and weighed to the nearest 0.01mg of wet weight.

Data

Results were provided to the Golder project manager in Excel spreadsheets via email.

References

Brey T. 2012. Virtual Handbook on Population Dynamics. http://www.thomasbrey.de/science/virtualhandbook/navlog/index.html. Accessed November 2016.

Waters TF. 1977. Secondary production in inland waters. Adv. Ecol. Res. 10: 91–164.

Wetzel RG, Likens GE. 1978. Limnological Analyses. 3rd ed. Springer: 429p.

Ricciardi A, Bouret E. 1998. Weight-to-weight conversion factors for marine benthic macroinvertebrates. Mar. Ecol. Prog. Ser. 163: 245–251.

Fish Tissue Analysis Methods
Client: Golder
Project: Baffinlands Iron Mine

Sample Inventory

Sample arrival: September 11, 2019
Number of samples: 77
Biologica project number: ms19-072

Upon arrival, the samples were examined and double-checked against the chain of custody to ensure all samples were accounted for. Any discrepancies were reported to the client and were resolved before further sample handling. Samples were then assigned a unique identification number.

Table 1. Summary of fish stomachs processed for Golder Baffinlands Iron Mine 2019.

Client Sample #	Date Sampled	Replicate	Biologica Sample #	Fish Fork Length (cm)	Fish Weight (kg)	Otolith Age (years)
GN-01-1	27-Jul-19	1	19-072-133	44.7	1.0100	10
GN-01-3	27-Jul-19	1	19-072-134	33.5	0.7000	13
GN-01-2	27-Jul-19	1	19-072-135	49.7	1.5400	13
GN-03-3	27-Jul-19	1	19-072-136	55.6	27.7300	13
GN-03-2	27-Jul-19	1	19-072-137	58.7	2.7100	12
GN-03-1	27-Jul-19	1	19-072-138	78.7	6.4800	17
GN-03-4	27-Jul-19	1	19-072-139	57.0	2.2700	11
GN-05-P1	29-Jul-19	1	19-072-140	43.4	1.1700	10
GN-05-P3	29-Jul-19	1	19-072-141	28.6	0.1900	9
GN-05-P3	29-Jul-19	2	19-072-142	36.7	0.6100	12
GN-05-P3	29-Jul-19	3	19-072-143	30.7	0.2400	14
GN-05-P3	29-Jul-19	4	19-072-144	24.8	0.2200	6
GN-05-P3	29-Jul-19	5	19-072-145	32.2	0.3100	12
GN-05-P3	29-Jul-19	6	19-072-146	54.3	1.7100	15
GN-05-P5	29-Jul-19	1	19-072-147	37.6	0.5600	18
GN-05-P5	29-Jul-19	2	19-072-148	67.3	2.0900	16
GN-05-P2	29-Jul-19	1	19-072-149	29.5	0.2400	12
GN-05-P2	29-Jul-19	2	19-072-150	42.6	1.4000	15
GN-05-P4	29-Jul-19	1	19-072-151	33.3	0.4300	14
GN-05-P4	29-Jul-19	2	19-072-152	35.2	0.4700	13
GN-05-P4	29-Jul-19	3	19-072-153	40.4	0.8400	7
GN-05-P4	29-Jul-19	4	19-072-154	35.4	0.4600	11
GN-05-P4	29-Jul-19	5	19-072-155	31.4	0.3800	11
GN7-P1	29-Jul-19	1	19-072-156	26.9	0.2300	11
GN7-P1	29-Jul-19	2	19-072-157	33.2	0.3700	12
GN7-P2	29-Jul-19	1	19-072-158	35.2	0.4200	12

Client Sample #	Date Sampled	Replicate	Biologica Sample #	Fish Fork Length (cm)	Fish Weight (kg)	Otolith Age (years)
GN7-P2	29-Jul-19	2	19-072-159	50.1	1.4400	13
GN7-P3	29-Jul-19	1	19-072-160	51.5	2.3200	16
GN7-P3	29-Jul-19	2	19-072-161	39.4	0.8600	10
GN7-P3	29-Jul-19	3	19-072-162	26.6	0.1900	n/a
GN-06-P6	29-Jul-19	1	19-072-163	36.2	0.8100	10
GN-06-P6	29-Jul-19	2	19-072-164	54.2	1.4900	9
GN-06-P6	29-Jul-19	3	19-072-165	37.0	0.8900	9
GN-06-P6	29-Jul-19	4	19-072-166	48.2	1.0700	8
GN-06-P6	29-Jul-19	5	19-072-167	52.3	1.7200	12
GN-06-P6	29-Jul-19	6	19-072-168	56.5	1.8600	15
GN7-P6	29-Jul-19	1	19-072-169	43.0	0.9600	8
GN7-P6	29-Jul-19	2	19-072-170	45.1	1.0700	13
GN7-P6	29-Jul-19	3	19-072-171	60.5	2.2700	12
GN7-P6	29-Jul-19	4	19-072-172	72.6	3.4300	19
GN7-P5	29-Jul-19	1	19-072-173	32.2	0.4500	11
GN7-P5	29-Jul-19	2	19-072-174	35.2	0.5000	13
GN7-P5	29-Jul-19	3	19-072-175	35.6	0.6100	10
GN7-P5	29-Jul-19	4	19-072-176	55.7	1.5400	14
FN02-ARCH	2-Sep-19	1	19-072-177	38.1	0.7800	13
GN-09-ARCH-7	22-Aug-19	1	19-072-178	34.5	0.4900	12
GN-09-ARCH-6	22-Aug-19	1	19-072-179	20.8	0.1100	4
GN-04-1	27-Jul-19	1	19-072-180	27.9	0.2300	7
GN-05-P2	29-Jul-19	1	19-072-181	15.3	0.0020	4
GN-05-P2	29-Jul-19	2	19-072-182	15.6	0.0024	4
GN-05-P2	29-Jul-19	3	19-072-183	16.0	0.0026	4
GN-05-P2	29-Jul-19	4	19-072-184	28.0	0.0070	7
GN-05-P2	29-Jul-19	5	19-072-185	14.4	0.0019	5
GN-05-P3	29-Jul-19	1	19-072-186	17.3	0.0047	5
GN-05-P3	29-Jul-19	2	19-072-187	24.5	0.0118	6
GN-05-P3	29-Jul-19	3	19-072-188	25.6	0.1200	7
GN-05-P4	29-Jul-19	1	19-072-189	22.2	0.1000	6
GN-05-P4	29-Jul-19	2	19-072-190	23.8	0.1100	7
GN-05-P4	29-Jul-19	3	19-072-191	24.2	0.1300	7
GN-05-P4	29-Jul-19	4	19-072-192	28.3	0.2300	8
GN-05-P5	29-Jul-19	1	19-072-193	24.6	0.1100	7
GN-05-P5	29-Jul-19	2	19-072-194	25.7	0.1400	6
GN-05-P5	29-Jul-19	3	19-072-195	26.0	0.1800	6
GN-05-P5	29-Jul-19	4	19-072-196	28.1	0.1900	8
GN7-P3	29-Jul-19	1	19-072-197	19.7	0.0052	5
GN7-P3	29-Jul-19	2	19-072-198	22.0	0.0093	5
GN-06-P6	29-Jul-19	1	19-072-199	26.8	0.0168	6
GN-06-P6	29-Jul-19	2	19-072-200	24.3	0.0119	6
GN-06-P6	29-Jul-19	3	19-072-201	26.3	0.0151	6
GN-06-P6	29-Jul-19	4	19-072-202	29.0	0.0185	7

Client Sample #	Date Sampled	Replicate	Biologica Sample #	Fish Fork Length (cm)	Fish Weight (kg)	Otolith Age (years)
GN-06-P6	29-Jul-19	5	19-072-203	27.3	0.0200	7
GN-06-P6	29-Jul-19	6	19-072-204	26.7	0.0196	7
GN-06-P6	29-Jul-19	7	19-072-205	24.1	0.1325	6
GN-06-P6	29-Jul-19	8	19-072-206	25.4	0.0173	7
GN-06-P6	29-Jul-19	9	19-072-207	24.8	0.0205	6
GN-06-P6	29-Jul-19	10	19-072-208	24.4	0.0113	6
GN-06-P6	29-Jul-19	11	19-072-209	24.3	0.0163	6

Sample Processing

Latex gloves were worn when handling the fish samples, and changed between each sample to avoid potential contamination. All fish were weighed and the fork length measured.

Tissue Collection:

The fish samples were examined for any lesions or tumors, and none were noted, and the sex of the fish was determined. The internal organs (e.g. stomachs, intestines, gonads, etc.) and heads were removed with a knife. To avoid contamination different dissecting trays were used and the knife was rinsed with distilled water and dried in between samples. After tissue removal the tissue samples were rinsed with distilled water, wrapped in clean, food grade aluminum foil (with the dull side in contact with the fish), and placed in clean, pre-labelled food grade plastic bags. Samples were placed back in the freezer as quickly as possible, and delivered to Maxxam Analytics in a cooler with icepacks for analysis.

Otoliths:

After tissue dissection otoliths were dissected. Otoliths were removed, rinsed and stored in water. Otoliths were mounted and polished as necessary and then aged by viewing the number of annuli through a compound microscope.

Fish Stomachs:

Fish stomachs were removed and preserved in 10% Formalin.

Sample Processing and Data Analysis

Tissue sample processing was performed at the Maxxam Analytics' laboratory in Victoria, BC. Results were provided to the Golder project manager in Excel spreadsheets via email.

References

Kasich, J., Taylor, G. M., & Scott, J.N. 2012. Fish Tissue Collection Manual. Cooperative Fish Tissue Monitoring Program. US EPA. Ohio.

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Vol 1: Fish Sampling and Analysis. 3rd edition. 2000. Office of Water. US EPA. Washington.

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Abbreviations & Definitions

Worksheets:

1. Abbreviations & Definitions	
2. Data Long-Fish Stomachs	Abundance and biomass data for fish stomach contents.

Abundance Data:

Benthic	Organisms found in the sediment of aquatic habitats
Epibenthic	Organisms found onand in the surface sediment including some sub-surface layers
Non-Food	Items not considered food, organic and inorganic (not weighed)
Parasite	Parasitic organism found in host
Planktonic	Organisms found in the water column
Semi-Terrestrial	Organisms found in both aquatic and terrestrial environments
Surface dweller	Organisms found on the surface of the water/may dive in to the water as well
Terrestrial	Terrestrial organisms
Undetermined	Digested tissue or fragments that are unidentifiable and therefore, unable to determine whether it is benthic or planktonic
A	Adult
Int	Intermediate - has adult features but not of typical reproductive size
J	Juvenile
L	Larvae
N	Nymph
P	Pupa
Col	Colony
Deut	Deutonymph

Major Taxonomic Groups:

EPT	Ephemeroptera, Plecoptera, Trichoptera
Miscellaneous	
AMPH	Amphibia
BRYO	Bryozoa
CNHY	Cnidaria Hydrozoa
CNXX	Cnidaria
NTEA	Nemertea
PIXX	Pisces
PLTY	Platyhelminthes
PORI	Porifera
ROTI	Rotifera
TARD	Tardigrada
EGGS	Invertebrate eggs
Annelida	
ANHI	Annelida Hirudinea
ANOL	Annelida Oligochaeta
ANXX	Annelida
Arthropoda	
CHAR	Chelicerata Arachnida
CHXX	Chelicerata
CRAM	Crustacea Amphipoda
CRCL	Crustacea Cladocera
CRCO	Crustacea Copepoda
CRCU	Crustacea Cumacea
CRIS	Crustacea Isopoda
CRMY	Crustacea Mysidacea
CROS	Crustacea Ostracoda
CRXX	Crustacea
Insecta	
INCM	Insecta Collembola
INCO	Insecta Coleoptera
INDI	Insecta Diptera
INEP	Insecta Ephemeroptera
INHM	Insecta Hemiptera
INHY	Insecta Hymenoptera
INLE	Insecta Lepidoptera
INMG	Insecta Megaloptera
INOD	Insecta Odonata
INPL	Insecta Plecoptera
INTR	Insecta Tricoptera
INXX	Insecta
Mollusca	
MOBI	Mollusca Bivalvia
MOGA	Mollusca Gastropoda
MOXX	Mollusca

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Abundance and biomass data for fish stomach contents for Golder Baffinlands Fish, 2019.

Client	Project	Year	Sample Type	Fish	Biologica Sample ID	Client Sample ID	Replicate	Date Sampled	% Fullness	% Digested	Full Stomach Weight (g)	Source	GroupCode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Stage	Total Abundance	Total Wet Weight (g)	WW/Individual (g)	Total Taxa	Comments
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-133	GN-01-1	1	27-Jul-19	100	75	34.57204	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	568	2.13116	0.00375	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-133	GN-01-1	1	27-Jul-19	100	75	34.57204	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	A/parts	12	0.17584	0.01465	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-133	GN-01-1	1	27-Jul-19	100	75	34.57204	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	8.78852	8.78852		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-133	GN-01-1	1	27-Jul-19	100	75	34.57204	Non-food	Non-food							Barnacle test		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-133	GN-01-1	1	27-Jul-19	100	75	34.57204	Non-food	Non-food							Wood fragment		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-134	GN-01-3	1	27-Jul-19	75	75	27.55345	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	456	13.05944	0.02864	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-134	GN-01-3	1	27-Jul-19	75	75	27.55345	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Uristidae	Onisimus sp.	A	1	0.02034	0.02034	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-134	GN-01-3	1	27-Jul-19	75	75	27.55345	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	18	0.00859	0.00048	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-134	GN-01-3	1	27-Jul-19	75	75	27.55345	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	A/parts	3	0.01803	0.00601	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-135	GN-01-2	1	27-Jul-19	75	75	53.31670	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	756	14.92500	0.01974	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-135	GN-01-2	1	27-Jul-19	75	75	53.31670	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	J	1	0.00176	0.00176	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-135	GN-01-2	1	27-Jul-19	75	75	53.31670	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	2	0.00875	0.00438	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-135	GN-01-2	1	27-Jul-19	75	75	53.31670	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	A/parts	2	0.08748	0.04374	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-135	GN-01-2	1	27-Jul-19	75	75	53.31670	Undetermined	XXXX							Unidentified tissue		n/a	2.86605	2.86605		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-136	GN-03-3	1	27-Jul-19	50	100	40.31685	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	40	0.75764	0.01894	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-136	GN-03-3	1	27-Jul-19	50	100	40.31685	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	2	0.00763	0.00382	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-136	GN-03-3	1	27-Jul-19	50	100	40.31685	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	5.53317	5.53317		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-136	GN-03-3	1	27-Jul-19	50	100	40.31685	Undetermined	XXXX							Unidentified tissue		n/a	0.31807	0.31807		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-137	GN-03-2	1	27-Jul-19	75	75	71.18360	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	184	2.76568	0.01503	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-137	GN-03-2	1	27-Jul-19	75	75	71.18360	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	1,064	4.38904	0.00413	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-137	GN-03-2	1	27-Jul-19	75	75	71.18360	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	A/parts	4	0.02406	0.00602	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-137	GN-03-2	1	27-Jul-19	75	75	71.18360	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	16.84328	16.84328		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-138	GN-03-1	1	27-Jul-19	25	100	113.32270	Planktonic	PIXX	Chordata	Vertebrata	Pisces-Actinopterygii				Pisces indet.	A/parts	8	10.33285	1.29161	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-139	GN-03-4	1	27-Jul-19	25	75	36.49636	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus sp.	A/parts	14	0.03848	0.00275	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-139	GN-03-4	1	27-Jul-19	25	75	36.49636	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	A	1	0.09331	0.09331	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-139	GN-03-4	1	27-Jul-19	25	75	36.49636	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.40895	0.40895		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-139	GN-03-4	1	27-Jul-19	25	75	36.49636	Undetermined	XXXX							Unidentified tissue		n/a	4.67034	4.67034		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-140	GN-05-P1	1	29-Jul-19	50	100	14.37853	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	Parts	n/a	0.14566	0.14566	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-140	GN-05-P1	1	29-Jul-19	50	100	14.37853	Undetermined	XXXX							Unidentified tissue		n/a	2.69237	2.69237		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-141	GN-05-P3	1	29-Jul-19	75	75	7.82763	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A	2	0.04158	0.02079	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-141	GN-05-P3	1	29-Jul-19	75	75	7.82763	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	J	1	0.00291	0.00291	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-141	GN-05-P3	1	29-Jul-19	75	75	7.82763	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	J	1	0.01893	0.01893	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-141	GN-05-P3	1	29-Jul-19	75	75	7.82763	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	3.80470	3.80470		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-141	GN-05-P3	1	29-Jul-19	75	75	7.82763	Undetermined	XXXX							Unidentified tissue		n/a	0.65531	0.65531		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-142	GN-05-P3	2	29-Jul-19	25	75	12.10605	Undetermined	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	Parts	n/a	0.05398	0.05398		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-142	GN-05-P3	2	29-Jul-19	25	75	12.10605	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	Int/parts	2	0.05654	0.02827	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-142	GN-05-P3	2	29-Jul-19	25	75	12.10605	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	6	0.03305	0.00551	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-142	GN-05-P3	2	29-Jul-19	25	75	12.10605	Undetermined	XXXX							Unidentified tissue		n/a	3.83475	3.83475		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-143	GN-05-P3	3	29-Jul-19	75	100	7.04164	Undetermined	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	Parts	n/a	2.24722	2.24722	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-143	GN-05-P3	3	29-Jul-19	75	100	7.04164	Planktonic	PIXX	Chordata	Vertebrata	Pisces-Actinopterygii				Pisces indet.	Parts	n/a	0.01807	0.01807	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-144	GN-05-P3	4	29-Jul-19	50	100	4.88235	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	3	0.03907	0.01302	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-144	GN-05-P3	4	29-Jul-19	50	100	4.88235	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	1.46832	1.46832		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-144	GN-05-P3	4	29-Jul-19	50	100	4.88235	Undetermined	XXXX							Unidentified tissue		n/a	0.89369	0.89369		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-145	GN-05-P3	5	29-Jul-19	100	75	12.33321	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	12	0.19689	0.01641	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-145	GN-05-P3	5	29-Jul-19	100	75	12.33321	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	Int/parts	2	0.02244	0.01122	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-145	GN-05-P3	5	29-Jul-19	100	75	12.33321	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	J/parts	1	0.00083	0.00083	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-145	GN-05-P3	5	29-Jul-19	100	75	12.33321	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	4.54107	4.54107		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-145	GN-05-P3	5	29-Jul-19	100	75	12.33321	Undetermined	XXXX							Unidentified tissue		n/a	1.07442	1.07442		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-146	GN-05-P3	6	29-Jul-19	75	75	42.44031	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	15	0.56815	0.03788	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-146	GN-05-P3	6	29-Jul-19	75	75	42.44031	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	16	0.12487	0.00780	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-146	GN-05-P3	6	29-Jul-19	75	75	42.44031	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	A/parts	18	0.60562	0.03365	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-146	GN-05-P3	6	29-Jul-19	75	75	42.44031	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	9.75421	9.75421		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-146	GN-05-P3	6	29-Jul-19	75	75	42.44031	Undetermined	XXXX							Unidentified tissue		n/a	4.74231	4.74231		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-147	GN-05-P5	1	29-Jul-19	25	100	13.34223	Undetermined	XXXX							Unidentified tissue		n/a	3.05695	3.05695	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-148	GN-05-P5	2	29-Jul-19	50	100	35.96325	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	1	0.02007	0.02007	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-148	GN-05-P5	2	29-Jul-19	50	100	35.96325	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	A/parts	5	0.17872	0.03574	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-148	GN-05-P5	2	29-Jul-19	50	100	35.96325	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	7.76227	7.76227		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-149	GN-05-P2	1	29-Jul-19	25	100	7.17212	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	1.97753	1.97753	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-149	GN-05-P2	1	29-Jul-19	25	100	7.17212	Undetermined	XXXX							Unidentified tissue		n/a	1.29338	1.29338		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-150	GN-05-P2	2	29-Jul-19	25	100	35.94012	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	2.24621	2.24621	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-150	GN-05-P2	2	29-Jul-19	25	100	35.94012	Undetermined	XXXX							Unidentified tissue		n/a	1.38265	1.38265		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-151	GN-05-P4	1	29-Jul-19	50	75	10.36973	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	2	0.04119	0.02060	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-151	GN-05-P4	1	29-Jul-19	50	75	10.36973	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	21	0.03744	0.00178	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-151	GN-05-P4	1	29-Jul-19	50	75	10.36973	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	3.15432	3.15432		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-151	GN-05-P4	1	29-Jul-19	50	75	10.36973	Undetermined	XXXX							Unidentified tissue		n/a	0.43128	0.43128		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-152	GN-05-P4	2	29-Jul-19	75	75	13.81427	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Gammaridae	Gammarus sp.	Int/parts	2	0.03339	0.01670	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-152	GN-05-P4	2	29-Jul-19	75	75	13.81427	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	24	0.54735	0.02281	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-152	GN-05-P4	2	29-Jul-19	75	75	13.81427	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	3.25358	3.25358		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-152	GN-05-P4	2	29-Jul-19	75	75	13.81427	Undetermined	XXXX							Unidentified tissue		n/a	0.64921	0.64921		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-153	GN-05-P4	3	29-Jul-19	75	75	15.53505	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	7	0.12918	0.01845	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-153	GN-05-P4	3	29-Jul-19	75	75	15.53505	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	5.38417	5.38417	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-153	GN-05-P4	3	29-Jul-19	75	75	15.53505	Undetermined	XXXX							Unidentified tissue		n/a	0.20843	0.20843		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-154	GN-05-P4	4	29-Jul-19	75	75	16.01738	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	44	0.91761	0.02085	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-154	GN-05-P4	4	29-Jul-19	75	75	16.01738	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	4.85526	4.85526	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-154	GN-05-P4	4	29-Jul-19	75	75	16.01738	Undetermined	XXXX							Unidentified tissue		n/a	0.09006	0.09006		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-155	GN-05-P4	5	29-Jul-19	50	75	12.80647	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	4	0.09932	0.02483	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-155	GN-05-P4	5	29-Jul-19	50	75	12.80647	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	Parts	n/a	2.94728	2.94728	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-155	GN-05-P4	5	29-Jul-19	50	75	12.80647	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.54864	0.54864		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-155	GN-05-P4	5	29-Jul-19	50	75	12.80647	Undetermined	XXXX							Unidentified tissue		n/a	1.09321	1.09321		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-156	GN7-P1	1	29-Jul-19	25	100	5.73530	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	Parts	n/a	0.07625	0.07625	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-156	GN7-P1	1	29-Jul-19	25	100	5.73530	Undetermined	XXXX							Unidentified tissue		n/a	2.09528	2.09528		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-157	GN7-P1	2	29-Jul-19	50	100	6.50647	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	1.11213	1.11213	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-157	GN7-P1	2	29-Jul-19	50	100	6.50647	Undetermined	XXXX							Unidentified tissue		n/a	0.96469	0.96469		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-158	GN7-P2	1	29-Jul-19	75	75	12.20159	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	2	0.03417	0.01709	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-158	GN7-P2	1	29-Jul-19	75	75	12.20159	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	10	0.04088	0.00409	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-158	GN7-P2	1	29-Jul-19	75	75	12.20159	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	5.38770	5.38770		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-158	GN7-P2	1	29-Jul-19	75	75	12.20159	Undetermined	XXXX							Unidentified tissue		n/a	0.96537	0.96537		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-159	GN7-P2	2	29-Jul-19	10	100	18.90706	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	1.17211	1.17211	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-159	GN7-P2	2	29-Jul-19	10	100	18.90706	Undetermined	XXXX							Unidentified tissue		n/a	2.89159	2.89159		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-160	GN7-P3	1	29-Jul-19	10	100	24.43285	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.02852	0.02852	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-160	GN7-P3	1	29-Jul-19	10	100	24.43285	Undetermined	XXXX							Unidentified tissue		n/a	0.96855	0.96855		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-161	GN7-P3	2	29-Jul-19	50	100	15.04595	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	7	0.07445	0.01064	1	

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Abundance and biomass data for fish stomach contents for Golder Baffinlands Fish, 2019.

Client	Project	Year	Sample Type	Fish	Biologica Sample ID	Client Sample ID	Replicate	Date Sampled	% Fullness	% Digested	Full Stomach Weight (g)	Source	GroupCode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Stage	Total Abundance	Total Wet Weight (g)	WW/Individual (g)	Total Taxa	Comments
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-161	GN7-P3	2	29-Jul-19	50	100	15.04595	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	3	0.00603	0.00201	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-161	GN7-P3	2	29-Jul-19	50	100	15.04595	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	2.97142	2.97142		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-161	GN7-P3	2	29-Jul-19	50	100	15.04595	Undetermined	XXXX							Unidentified tissue		n/a	0.68234	0.68234		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-162	GN7-P3	3	29-Jul-19	75	75	11.75664	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	28	0.80013	0.02858	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-162	GN7-P3	3	29-Jul-19	75	75	11.75664	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Gammaroidea indet.	Int/parts	1	0.00235	0.00235	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-162	GN7-P3	3	29-Jul-19	75	75	11.75664	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	5.55034	5.55034		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-163	GN-06-P6	1	29-Jul-19	25	100	12.64318	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.00058	0.00058	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-163	GN-06-P6	1	29-Jul-19	25	100	12.64318	Undetermined	XXXX							Unidentified tissue		n/a	2.44262	2.44262		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-164	GN-06-P6	2	29-Jul-19	25	100	19.85306	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	4	0.02449	0.00612	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-164	GN-06-P6	2	29-Jul-19	25	100	19.85306	Undetermined	XXXX							Unidentified tissue		n/a	4.09707	4.09707		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-165	GN-06-P6	3	29-Jul-19	50	100	17.00457	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	1.57748	1.57748	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-165	GN-06-P6	3	29-Jul-19	50	100	17.00457	Planktonic	PIXX	Chordata	Vertebrata	Pisces-Actinopterygii				Pisces indet.	A/parts	1	1.08382	1.08382	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-165	GN-06-P6	3	29-Jul-19	50	100	17.00457	Undetermined	XXXX							Unidentified tissue		n/a	2.68173	2.68173		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-166	GN-06-P6	4	29-Jul-19	25	100	10.57426	Undetermined	XXXX							Unidentified tissue		n/a	1.51634	1.51634	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-167	GN-06-P6	5	29-Jul-19	10	100	27.22673	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	7	0.05873	0.00839	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-167	GN-06-P6	5	29-Jul-19	10	100	27.22673	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.70839	0.70839		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-167	GN-06-P6	5	29-Jul-19	10	100	27.22673	Undetermined	XXXX							Unidentified tissue		n/a	2.84142	2.84142		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-168	GN-06-P6	6	29-Jul-19	75	100	21.78035	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	Parts	n/a	0.07584	0.07584	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-168	GN-06-P6	6	29-Jul-19	75	100	21.78035	Undetermined	XXXX							Unidentified tissue		n/a	5.33196	5.33196		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-169	GN7-P6	1	29-Jul-19	50	100	15.10566	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	4	0.20712	0.05178	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-169	GN7-P6	1	29-Jul-19	50	100	15.10566	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	6	0.03152	0.00525	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-169	GN7-P6	1	29-Jul-19	50	100	15.10566	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	4.63227	4.63227		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-169	GN7-P6	1	29-Jul-19	50	100	15.10566	Undetermined	XXXX							Unidentified tissue		n/a	0.40491	0.40491		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-170	GN7-P6	2	29-Jul-19	10	100	8.27075	Undetermined	XXXX							Unidentified tissue		n/a	0.01772	0.01772	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-171	GN7-P6	3	29-Jul-19	25	100	38.35374	Undetermined	XXXX							Unidentified tissue		n/a	8.40677	8.40677	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-172	GN7-P6	4	29-Jul-19	75	100	85.52230	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Hyperiidea indet.	A/parts	8	0.38766	0.04846	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-172	GN7-P6	4	29-Jul-19	75	100	85.52230	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	Parts	n/a	0.19235	0.19235	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-172	GN7-P6	4	29-Jul-19	75	100	85.52230	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	4.56171	4.56171		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-172	GN7-P6	4	29-Jul-19	75	100	85.52230	Planktonic	MOGA							Gastropoda indet.	Parts	n/a	0.15704	0.15704	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-172	GN7-P6	4	29-Jul-19	75	100	85.52230	Undetermined	XXXX							Unidentified tissue		n/a	17.40552	17.40552		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-173	GN7-P5	1	29-Jul-19	50	75	10.92164	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	10	0.13267	0.01327	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-173	GN7-P5	1	29-Jul-19	50	75	10.92164	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.78431	0.78431		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-173	GN7-P5	1	29-Jul-19	50	75	10.92164	Undetermined	XXXX							Unidentified tissue		n/a	2.84577	2.84577		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	1	0.04558	0.04558	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida	Calanidae	Calanus glacialis	A	1	0.00690	0.00690	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	4	0.02018	0.00505		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	J/parts	1	0.00135	0.00135	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	2.75347	2.75347		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-174	GN7-P5	2	29-Jul-19	50	75	12.79103	Undetermined	XXXX							Unidentified tissue		n/a	2.55992	2.55992		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-175	GN7-P5	3	29-Jul-19	75	75	15.37553	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	9	0.00693	0.00077	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-175	GN7-P5	3	29-Jul-19	75	75	15.37553	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	2.14562	2.14562		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-175	GN7-P5	3	29-Jul-19	75	75	15.37553	Undetermined	XXXX							Unidentified tissue		n/a	3.58544	3.58544		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-176	GN7-P5	4	29-Jul-19	25	75	22.24027	Epibenthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Ampeliscidae indet.	A/parts	1	0.02491	0.02491	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-176	GN7-P5	4	29-Jul-19	25	75	22.24027	Planktonic	CRCO	Arthropoda	Crustacea	Maxillopoda	Copepoda	Calanoida		Calanoida indet.	A/parts	8	0.05277	0.00660	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-176	GN7-P5	4	29-Jul-19	25	75	22.24027	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.42342	0.42342		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-176	GN7-P5	4	29-Jul-19	25	75	22.24027	Undetermined	XXXX							Unidentified tissue		n/a	3.36639	3.36639		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	14	0.55137	0.03938	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Benthic	CRDE	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Decapoda		Caridea indet.	J	1	0.00776	0.00776	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida	Mysidae	Mysis sp.	A/parts	68	3.06003	0.04500	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.86594	0.86594		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Planktonic	PIXX	Chordata	Vertebrata	Pisces-Actinopterygii				Pisces indet.	Parts	n/a	0.04451	0.04451	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-177	GN-09-ARCH-6	1	22-Aug-19	50	50	18.74315	Undetermined	XXXX							Unidentified tissue		n/a	0.98115	0.98115		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-178	GN-09-ARCH-7	1	22-Aug-19	25	75	8.79311	Planktonic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto sp.	A/parts	1	0.02974	0.02974	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-178	GN-09-ARCH-7	1	22-Aug-19	25	75	8.79311	Planktonic	CRMY	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Mysida		Mysida indet.	A/parts	5	0.22846	0.04569	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-178	GN-09-ARCH-7	1	22-Aug-19	25	75	8.79311	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.28735	0.28735		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-178	GN-09-ARCH-7	1	22-Aug-19	25	75	8.79311	Planktonic	PIXX	Chordata	Vertebrata	Pisces-Actinopterygii				Pisces indet.	Parts	n/a	0.17076	0.17076	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-178	GN-09-ARCH-7	1	22-Aug-19	25	75	8.79311	Undetermined	XXXX							Unidentified tissue		n/a	1.33292	1.33292		
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-179	FN02-ARCH	1	2-Sep-19	25	100	1.21928	Planktonic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.00316	0.00316	1	
Golder	Baffinlands	2019	Fish Stomach	Arctic Char	ms19-072-179	FN02-ARCH	1	2-Sep-19	25	100	1.21928	Undetermined	XXXX							Unidentified tissue		n/a	0.23779	0.23779		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-180	GN-04-1	1	27-Jul-19	100	100	31.02716	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	A/parts	1	0.01081	0.01081	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-180	GN-04-1	1	27-Jul-19	100	100	31.02716	Undetermined	PIXX	Chordata	Vertebrata	Actinopterygii				Cottidae indet.	A/parts	1	12.55512	12.55512	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-180	GN-04-1	1	27-Jul-19	100	100	31.02716	Undetermined	PIXX	Chordata	Vertebrata	Pisces				Pisces indet.	Int/parts	2	6.47108	3.23554		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-180	GN-04-1	1	27-Jul-19	100	100	31.02716	Benthic	POER	Annelida		Polychaeta	Errantia	Phyllodocida	Nereididae	Nereididae indet.	Parts	n/a	0.07065	0.07065	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-180	GN-04-1	1	27-Jul-19	100	100	31.02716	Undetermined	XXXX							Unidentified tissue		n/a	3.66611	3.66611		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-181	GN-05-P2	1	29-Jul-19	10	100	1.06743	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-181	GN-05-P2	1	29-Jul-19	10	100	1.06743	Undetermined	XXXX							Unidentified tissue		n/a	0.14549	0.14549	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-182	GN-05-P2	2	29-Jul-19	50	100	1.23672	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	A/parts	2	0.03287	0.01644	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-182	GN-05-P2	2	29-Jul-19	50	100	1.23672	Non-food	Non-food							Plant material		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-182	GN-05-P2	2	29-Jul-19	50	100	1.23672	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-182	GN-05-P2	2	29-Jul-19	50	100	1.23672	Undetermined	XXXX							Unidentified tissue		n/a	0.43312	0.43312		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-183	GN-05-P2	3	29-Jul-19	25	100	0.99279	Undetermined	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	A/parts	n/a	0.00482	0.00482	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-183	GN-05-P2	3	29-Jul-19	25	100	0.99279	Non-food	Non-food							Plant material		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-183	GN-05-P2	3	29-Jul-19	25	100	0.99279	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-183	GN-05-P2	3	29-Jul-19	25	100	0.99279	Benthic	POXX	Annelida		Polychaeta				Polychaeta indet.	Parts	n/a	0.00028	0.00028	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-183	GN-05-P2	3	29-Jul-19	25	100	0.99279	Undetermined	XXXX							Unidentified tissue		n/a	0.14607	0.14607		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-184	GN-05-P2	4	29-Jul-19	10	100	1.80745	Undetermined	XXXX							Unidentified tissue		n/a	0.17331	0.17331	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-185	GN-05-P2	5	29-Jul-19	25	100	0.62064	Undetermined	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.00946	0.00946	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-185	GN-05-P2	5	29-Jul-19	25	100	0.62064	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-185	GN-05-P2	5	29-Jul-19	25	100	0.62064	Undetermined	XXXX							Unidentified tissue		n/a	0.06487	0.06487		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-186	GN-05-P3	1	29-Jul-19	10	100	1.07541	Undetermined	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.01382	0.01382	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-186	GN-05-P3	1	29-Jul-19	10	100	1.07541	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-186	GN-05-P3	1	29-Jul-19	10	100	1.07541	Undetermined	XXXX							Unidentified tissue		n/a	0.05123	0.05123		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-187	GN-05-P3	2	29-Jul-19	50	100	4.72812	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-187	GN-05-P3	2	29-Jul-19	50	100	4.72812	Undetermined	XXXX							Unidentified tissue		n/a	1.49855	1.49855	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-188	GN-05-P3	3	29-Jul-19	50	100	6.05015	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	Parts	5	1.58504	0.31701	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-188	GN-05-P3	3	29-Jul-19	50	100	6.05015	Non-food	Non-food							Filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-188	GN-05-P3	3	29-Jul-19	50	100	6.05015	Non-food	Non-food							Leaves		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-188	GN-05-P3	3	29-Jul-19	50	100	6.05015	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-188	GN-05-P3	3	29-Jul-19	50	100	6.05015	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	Parts	n/a	0.46605	0.46605	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-189	GN-05-P4	1	29-Jul-19	50	100	5.15213	Undetermined	XXXX							Unidentified tissue		n/a	1.04114	1.04114	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-190	GN-05-P4	2	29-Jul-19	50	100	4.64104	Non-food	Non-food							Filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-190	GN-05-P4	2	29-Jul-19	50	100	4.64104	Undetermined	XXXX							Unidentified tissue		n/a	0.95085	0.95085	1	

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Abundance and biomass data for fish stomach contents for Golder Baffinlands Fish, 2019.

Client	Project	Year	Sample Type	Fish	Biologica Sample ID	Client Sample ID	Replicate	Date Sampled	% Fullness	% Digested	Full Stomach Weight (g)	Source	GroupCode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxon	Stage	Total Abundance	Total Wet Weight (g)	WW/Individual (g)	Total Taxa	Comments
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-191	GN-05-P4	3	29-Jul-19	25	100	4.39078	Parasite	ACAN	Acanthocephala						Acanthocephala indet.	Int	1	0.00026	0.00026	1	Internal parasite
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-191	GN-05-P4	3	29-Jul-19	25	100	4.39078	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-191	GN-05-P4	3	29-Jul-19	25	100	4.39078	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	Parts	n/a	0.13083	0.13083	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-191	GN-05-P4	3	29-Jul-19	25	100	4.39078	Undetermined	XXXX							Unidentified tissue		n/a	0.69937	0.69937		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-192	GN-05-P4	4	29-Jul-19	25	100	9.22304	Non-food	Non-food							Filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-192	GN-05-P4	4	29-Jul-19	25	100	9.22304	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	A/parts	1	1.30306	1.30306	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-193	GN-05-P5	1	29-Jul-19	75	100	4.02854	Undetermined	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.24614	0.24614	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-193	GN-05-P5	1	29-Jul-19	75	100	4.02854	Undetermined	XXXX							Unidentified tissue		n/a	0.81636	0.81636		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-194	GN-05-P5	2	29-Jul-19	25	100	5.06874	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	A/parts	1	0.02477	0.02477	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-194	GN-05-P5	2	29-Jul-19	25	100	5.06874	Undetermined	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.04536	0.04536		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-194	GN-05-P5	2	29-Jul-19	25	100	5.06874	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-194	GN-05-P5	2	29-Jul-19	25	100	5.06874	Undetermined	XXXX							Unidentified tissue		n/a	1.19778	1.19778		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-195	GN-05-P5	3	29-Jul-19	50	100	7.19542	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Atylidae	Atylus sp.	A/parts	1	0.25553	0.25553	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-195	GN-05-P5	3	29-Jul-19	50	100	7.19542	Undetermined	XXXX							Unidentified tissue		n/a	0.85409	0.85409		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-196	GN-05-P5	4	29-Jul-19	75	100	10.92732	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Oedicerotidae indet.	A/parts	14	3.83215	0.27373	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-196	GN-05-P5	4	29-Jul-19	75	100	10.92732	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-196	GN-05-P5	4	29-Jul-19	75	100	10.92732	Undetermined	XXXX							Unidentified tissue		n/a	0.18179	0.18179		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-197	GN7-P3	1	29-Jul-19	25	100	2.04642	Undetermined	XXXX							Unidentified tissue		n/a	0.18276	0.18276	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-198	GN7-P3	2	29-Jul-19	50	100	2.86437	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	A/parts	6	0.21253	0.03542	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-198	GN7-P3	2	29-Jul-19	50	100	2.86437	Benthic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.41536	0.41536		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-198	GN7-P3	2	29-Jul-19	50	100	2.86437	Undetermined	XXXX							Unidentified tissue		n/a	0.00449	0.00449		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-199	GN-06-P6	1	29-Jul-19	50	100	8.48821	Undetermined	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.00539	0.00539	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-199	GN-06-P6	1	29-Jul-19	50	100	8.48821	Undetermined	XXXX							Unidentified tissue		n/a	1.76915	1.76915		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-200	GN-06-P6	2	29-Jul-19	75	100	5.28043	Benthic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.08525	0.08525	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-200	GN-06-P6	2	29-Jul-19	75	100	5.28043	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-200	GN-06-P6	2	29-Jul-19	75	100	5.28043	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	Parts	n/a	1.53216	1.53216	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-200	GN-06-P6	2	29-Jul-19	75	100	5.28043	Undetermined	XXXX							Unidentified tissue		n/a	0.07400	0.07400		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-201	GN-06-P6	3	29-Jul-19	50	100	8.29789	Benthic	CROS	Arthropoda	Crustacea	Ostracoda	Myodocopa	Myodocopida	Philomedidae	Philomedes sp.	A/parts	1	0.00393	0.00393	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-201	GN-06-P6	3	29-Jul-19	50	100	8.29789	Benthic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.00461	0.00461		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-201	GN-06-P6	3	29-Jul-19	50	100	8.29789	Benthic	POXX	Annelida		Polychaeta				Polychaeta indet.	Parts	n/a	0.00772	0.00772	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-201	GN-06-P6	3	29-Jul-19	50	100	8.29789	Undetermined	XXXX							Unidentified tissue		n/a	1.31556	1.31556		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-202	GN-06-P6	4	29-Jul-19	100	75	16.28544	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Oedicerotidae	Oedicerotidae indet.	A/parts	43	1.91407	0.04451	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-202	GN-06-P6	4	29-Jul-19	100	75	16.28544	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-202	GN-06-P6	4	29-Jul-19	100	75	16.28544	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	A/parts	1	0.10774	0.10774	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-202	GN-06-P6	4	29-Jul-19	100	75	16.28544	Undetermined	XXXX							Unidentified tissue		n/a	5.65735	5.65735		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-203	GN-06-P6	5	29-Jul-19	100	75	17.16044	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	A/parts	2	0.83582	0.41791	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-203	GN-06-P6	5	29-Jul-19	100	75	17.16044	Non-food	Non-food							filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-203	GN-06-P6	5	29-Jul-19	100	75	17.16044	Benthic	POXX	Annelida		Polychaeta				Polychaeta indet.	Parts	1	0.07451	0.07451	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-203	GN-06-P6	5	29-Jul-19	100	75	17.16044	Undetermined	XXXX							Unidentified egg	Egg	200	2.27167	0.01136		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-203	GN-06-P6	5	29-Jul-19	100	75	17.16044	Undetermined	XXXX							Unidentified tissue		n/a	4.10547	4.10547		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	Parts	1	0.37706	0.37706	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Benthic	MOBI	Mollusca		Bivalvia	Pteriomorphia	Mytilida	Mytilidae	Musculus discors	Int/parts	1	0.11282	0.11282	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Non-food	Non-food							Filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	Int/parts	1	0.10434	0.10434	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-204	GN-06-P6	6	29-Jul-19	100	75	13.02390	Undetermined	XXXX							Unidentified tissue		n/a	4.66308	4.66308		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Atylidae	Atylus sp.	A/parts	1	0.59672	0.59672	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Lysianassoidea indet.	A/parts	3	0.09211	0.03070	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Non-food	Non-food							Filamentous algae		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Non-food	Non-food							Wood fragment		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-205	GN-06-P6	7	29-Jul-19	75	50	5.64533	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	A/parts	1	1.11218	1.11218	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-206	GN-06-P6	8	29-Jul-19	25	100	8.96506	Undetermined	XXXX							Unidentified tissue		n/a	2.34227	2.34227		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	A/parts	1	0.14568	0.14568	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Non-food	Non-food							Leaves		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Non-food	Non-food							Polychaete tubes		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Non-food	Non-food							Sand		n/a	n/a	n/a		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Undetermined	PIXX	Chordata	Vertebrata	Pisces				Pisces indet.	Parts	n/a	2.77743	2.77743	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Benthic	POSE	Annelida		Polychaeta	Sedentaria	Terebellida	Pectinariidae	Pectinariidae indet.	A/parts	2	1.23016	0.61508	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-207	GN-06-P6	9	29-Jul-19	100	100	19.32707	Undetermined	XXXX							Unidentified tissue		n/a	4.65062	4.65062		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-208	GN-06-P6	10	29-Jul-19	25	100	3.89511	Benthic	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda		Amphipoda indet.	Parts	n/a	0.00641	0.00641	1	
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-208	GN-06-P6	10	29-Jul-19	25	100	3.89511	Benthic	CRXX	Arthropoda	Crustacea					Crustacea indet.	Parts	n/a	0.02940	0.02940		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-208	GN-06-P6	10	29-Jul-19	25	100	3.89511	Undetermined	XXXX							Unidentified tissue		n/a	1.02745	1.02745		
Golder	Baffinlands	2019	Fish Stomach	Sculpin	ms19-072-209	GN-06-P6	11	29-Jul-19	25	100	7.56401	Undetermined	XXXX							Unidentified tissue		n/a	1.24419	1.24419	1	

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Abbreviations & Definitions

Worksheets:

1. Abbreviations & Definitions	
2. Data Long-Whole Fish	Raw data from fish dissections and otolith aging.

Abundance Data:

Benthic	Organisms found in the sediment of aquatic habitats
Epibenthic	Organisms found onand in the surface sediment including some sub-surface layers
Non-Food	Items not considered food, organic and inorganic (not weighed)
Parasite	Parasitic organism found in host
Planktonic	Organisms found in the water column
Semi-Terrestrial	Organisms found in both aquatic and terrestrial environments
Surface dweller	Organisms found on the surface of the water/may dive in to the water as well
Terrestrial	Terrestrial organisms
Undetermined	Digested tissue or fragments that are unidentifiable and therefore, unable to determine whether it is benthic or planktonic
A	Adult
Int	Intermediate - has adult features but not of typical reproductive size
J	Juvenile
L	Larvae
N	Nymph
P	Pupa
Col	Colony
Deut	Deutonymph

Major Taxonomic Groups:

EPT	Ephemeroptera, Plecoptera, Trichoptera
Miscellaneous	
AMPH	Amphibia
BRYO	Bryozoa
CNHY	Cnidaria Hydrozoa
CNXX	Cnidaria
NTEA	Nemertea
PIXX	Pisces
PLTY	Platyhelminthes
PORI	Porifera
ROTI	Rotifera
TARD	Tardigrada
EGGS	Invertebrate eggs
Annelida	
ANHI	Annelida Hirudinea
ANOL	Annelida Oligochaeta
ANXX	Annelida
Arthropoda	

CHAR	Chelicerata Arachnida
CHXX	Chelicerata
CRAM	Crustacea Amphipoda
CRCL	Crustacea Cladocera
CRCO	Crustacea Copepoda
CRCU	Crustacea Cumacea
CRIS	Crustacea Isopoda
CRMY	Crustacea Mysidacea
CROS	Crustacea Ostracoda
CRXX	Crustacea
Insecta	
INCM	Insecta Collembola
INCO	Insecta Coleoptera
INDI	Insecta Diptera
INEP	Insecta Ephemeroptera
INHM	Insecta Hemiptera
INHY	Insecta Hymenoptera
INLE	Insecta Lepidoptera
INMG	Insecta Megaloptera
INOD	Insecta Odonata
INPL	Insecta Plecoptera
INTR	Insecta Tricoptera
INXX	Insecta
Mollusca	
MOBI	Mollusca Bivalvia
MOGA	Mollusca Gastropoda
MOXX	Mollusca

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Raw data from fish dissections and otolith aging for Golder Baffinlands Iron Mine, 2019.

				Corrected	sent in original data					Corrected	sent in original data								
Client	**Project**	**Year**	**Identification**	**Client Sample ID**	**Client Sample ID**	**Date Sampled**	**Replicate**	**Biologica Sample ID**	**Fork Length (cm)**	**Weight (kg)**	**Weight (kg)**	**Sex**	**Otolith Age (years)**	**Lesions**	**Tumors**	**Tissue Extracted for Metals**	**Stomach Dissected**	**Otoliths Removed**	**Fish Comment**
Golder	Baffinlands	2019	Arctic Char	GN-01-1		27-Jul-19	1	19-072-133	44.7	1.0100		Female	10	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-01-3		27-Jul-19	1	19-072-134	33.5	0.6173	0.7000	Male	13	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-01-2		27-Jul-19	1	19-072-135	49.7	1.5400		Male	13	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-03-3		27-Jul-19	1	19-072-136	55.6	1.9928	27.7300	Female	13	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-03-2		27-Jul-19	1	19-072-137	58.7	2.7100		Male	12	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-03-1		27-Jul-19	1	19-072-138	78.7	6.4800		Male	17	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	GN-03-4		27-Jul-19	1	19-072-139	57.0	2.2700		Male	11	n/a	n/a	Yes	Yes	L + R	Small gonads
Golder	Baffinlands	2019	Arctic Char	GN-05-P1		29-Jul-19	1	19-072-140	43.4	1.1700		Male	10	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	1	19-072-141	28.6	0.1900		Indeterminable	9	n/a	n/a	Yes	Yes	L	Skull crushed, intestine ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	2	19-072-142	36.7	0.6100		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Intestine ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	3	19-072-143	30.7	0.2400		Indeterminable	14	n/a	n/a	Yes	Yes	L + R	Skull crushed, intestine & internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	4	19-072-144	24.8	0.2200		Indeterminable	6	n/a	n/a	Yes	Yes	L	Body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	5	19-072-145	32.2	0.3100		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body crushed/torn
Golder	Baffinlands	2019	Arctic Char	GN-05-P3		29-Jul-19	6	19-072-146	54.3	1.7100		Female	15	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	GN-05-P5		29-Jul-19	1	19-072-147	37.6	0.5600		Indeterminable	18	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN-05-P5		29-Jul-19	2	19-072-148	67.3	2.0900		Female	16	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN-05-P2		29-Jul-19	1	19-072-149	29.5	0.2400		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P2		29-Jul-19	2	19-072-150	42.6	1.4000		Male	15	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN-05-P4		29-Jul-19	1	19-072-151	33.3	0.4300		Indeterminable	14	n/a	n/a	Yes	Yes	L + R	Intestine ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P4		29-Jul-19	2	19-072-152	35.2	0.4700		Indeterminable	13	n/a	n/a	Yes	Yes	L + R	Body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P4		29-Jul-19	3	19-072-153	40.4	0.8400		Male	7	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-05-P4		29-Jul-19	4	19-072-154	35.4	0.4600		Indeterminable	11	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, skull crushed
Golder	Baffinlands	2019	Arctic Char	GN-05-P4		29-Jul-19	5	19-072-155	31.4	0.3800		Indeterminable	11	n/a	n/a	Yes	Yes	L + R	Body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN7-P1		29-Jul-19	1	19-072-156	26.9	0.2300		Indeterminable	11	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, intestines ruptured
Golder	Baffinlands	2019	Arctic Char	GN7-P1		29-Jul-19	2	19-072-157	33.2	0.3700		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN7-P2		29-Jul-19	1	19-072-158	35.2	0.4200		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN7-P2		29-Jul-19	2	19-072-159	50.1	1.4400		Female	13	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN7-P3		29-Jul-19	1	19-072-160	51.5	2.3200		Female	16	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	GN7-P3		29-Jul-19	2	19-072-161	39.4	0.8600		Indeterminable	10	n/a	n/a	Yes	Yes	L + R	Internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN7-P3		29-Jul-19	3	19-072-162	26.6	0.1900		Indeterminable	n/a	n/a	n/a	Yes	Yes	n/a	Skull crushed, intestine & internal organs ruptured, unable to locate otoliths
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	1	19-072-163	36.2	0.8100		Indeterminable	10	n/a	n/a	Yes	Yes	L	Body crushed/bent, body wall torn, skull crushed, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	2	19-072-164	54.2	1.4900		Indeterminable	9	n/a	n/a	Yes	Yes	L + R	Body wall torn, internal organs ruptured
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	3	19-072-165	37.0	0.8900		Indeterminable	9	n/a	n/a	Yes	Yes	L + R	Skull crushed, stomach ruptured
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	4	19-072-166	48.2	1.0700		Indeterminable	8	n/a	n/a	Yes	Yes	L + R	Body crushed/bent, internal organs damaged
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	5	19-072-167	52.3	1.7200		Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN-06-P6		29-Jul-19	6	19-072-168	56.5	1.7600	1.8600	Indeterminable	15	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P6		29-Jul-19	1	19-072-169	43.0	0.9600		Male	8	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	GN7-P6		29-Jul-19	2	19-072-170	45.1	1.0700		Indeterminable	13	n/a	n/a	Yes	Yes	L + R	Intestine ruptured
Golder	Baffinlands	2019	Arctic Char	GN7-P6		29-Jul-19	3	19-072-171	60.5	2.4900	2.2700	Indeterminable	12	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P6		29-Jul-19	4	19-072-172	72.6	3.4300		Indeterminable	19	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P5		29-Jul-19	1	19-072-173	32.2	0.4500		Indeterminable	11	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P5		29-Jul-19	2	19-072-174	35.2	0.5000		Indeterminable	13	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P5		29-Jul-19	3	19-072-175	35.6	0.6100		Indeterminable	10	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN7-P5		29-Jul-19	4	19-072-176	55.7	1.5400		Indeterminable	14	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Arctic Char	GN-09-ARCH-6	FN02-ARCH	22-Aug-19	1	19-072-177	38.1	0.7800		Male	13	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	GN-09-ARCH-7		22-Aug-19	1	19-072-178	34.5	0.4900		Female	12	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Arctic Char	FN02-ARCH	GN-09-ARCH-6	2-Sep-19	1	19-072-179	20.8	0.1100		Immature	4	n/a	n/a	Yes	Yes	L + R	Gonads small (possibly male)
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-04-1		27-Jul-19	1	19-072-180	27.9	0.2300		Female	7	n/a	n/a	Yes	Yes	L + R	Intestine ruptured
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P2		29-Jul-19	1	19-072-181	15.3	0.0020		Indeterminable	4	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P2		29-Jul-19	2	19-072-182	15.6	0.0024		Indeterminable	4	n/a	n/a	Yes	Yes	L	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P2		29-Jul-19	3	19-072-183	16.0	0.0026		Indeterminable	4	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P2		29-Jul-19	4	19-072-184	28.0	0.0070		Male	7	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P2		29-Jul-19	5	19-072-185	14.4	0.0019		Indeterminable	5	n/a	n/a	Yes	Yes	L + R	Body crushed, internal organs damaged, unable to determine sex
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P3		29-Jul-19	1	19-072-186	17.3	0.0047		Male	5	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P3		29-Jul-19	2	19-072-187	24.5	0.0118		Female	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P3		29-Jul-19	3	19-072-188	25.6	0.1200		Female	7	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P4		29-Jul-19	1	19-072-189	22.2	0.1000		Female	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P4		29-Jul-19	2	19-072-190	23.8	0.1100		Female	7	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P4		29-Jul-19	3	19-072-191	24.2	0.1300		Indeterminable	7	n/a	n/a	Yes	Yes	L + R	Gonads discoloured, unable to determine sex
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P4		29-Jul-19	4	19-072-192	28.3	0.2300		Female	8	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P5		29-Jul-19	1	19-072-193	24.6	0.1100		Male	7	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P5		29-Jul-19	2	19-072-194	25.7	0.1400		Female	6	n/a	n/a	Yes	Yes	R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P5		29-Jul-19	3	19-072-195	26.0	0.1800		Female	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-05-P5		29-Jul-19	4	19-072-196	28.1	0.1900		Female	8	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN7-P3		29-Jul-19	1	19-072-197	19.7	0.0052		Female	5	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN7-P3		29-Jul-19	2	19-072-198	22.0	0.0093		Female	5	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	1	19-072-199	26.8	0.0168		Female	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	2	19-072-200	24.3	0.0119		Male	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	3	19-072-201	26.3	0.0151		Female	6	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	4	19-072-202	29.0	0.0185		Female	7	n/a	n/a	Yes	Yes	L + R	
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	5	19-072-203	27.3	0.0200		Female	7	n/a	n/a	Yes	Yes	L + R	Skull crushed, body wall torn, intestines ruptured
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	6	19-072-204	26.7	0.0196		Female	7	n/a	n/a	Yes	Yes	L + R	Body wall torn, stomach ruptured
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	7	19-072-205	24.1	0.1325		Male	6	n/a	n/a	Yes	Yes	L + R	Body wall torn, stomach ruptured
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	8	19-072-206	25.4	0.0173		Female	7	n/a	n/a	Yes	Yes	L + R	Body crushed/torn
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	9	19-072-207	24.8	0.0205		Female	6	n/a	n/a	Yes	Yes	L + R	Body crushed/torn
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	10	19-072-208	24.4	0.0113		Female	6	n/a	n/a	Yes	Yes	L + R	Body crushed/torn
Golder	Baffinlands	2019	Fourhorn Sculpin	GN-06-P6		29-Jul-19	11	19-072-209	24.3	0.0163		Male	6	n/a	n/a	Yes	Yes	L + R	Body crushed/torn

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475873

Attention: Christine Bylenga

GOLDER ASSOCIATES LTD
Suite 200 - 2920 Virtual Way
VANCOUVER, BC
Canada V5M 0C4

Report Date: 2020/01/20
Report #: R2835269
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A5897
Received: 2019/12/10, 08:10

Sample Matrix: Tissue
Samples Received: 30

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS - Tissue Plug Wet Wt	20	2020/01/07	2020/01/17	BBY WI-00033	Auto Calc
Elements by ICPMS - Tissue Plug Wet Wt	10	2020/01/09	2020/01/17	BBY WI-00033	Auto Calc
Moisture in Tissue - Freeze Drying	20	2020/01/07	2020/01/14	BBY7SOP-00021	BCMOE BCLM Aug 2014
Moisture in Tissue - Freeze Drying	10	2020/01/09	2020/01/14	BBY7SOP-00021	BCMOE BCLM Aug 2014

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475873

Attention: Christine Bylenga

GOLDER ASSOCIATES LTD
Suite 200 - 2920 Virtual Way
VANCOUVER, BC
Canada V5M 0C4

Report Date: 2020/01/20
Report #: R2835269
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A5897
Received: 2019/12/10, 08:10

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Gail Pedersen, Key Account Specialist
Email: Gail.Pedersen@bvlabs.com
Phone# (604) 734 7276
==
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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0600	XC0601	XC0602		
Sampling Date		2019/07/27	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-04-1 19-072-180**	**GN-05-P2 19-072-181**	**GN-05-P2 19-072-182**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.79	3.19	11.4	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0026	<0.0020	0.0021	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	6.63	0.520	0.513	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.042	0.201	0.400	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0013	<0.0013	0.0020	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	0.60	0.23	0.28	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0055	0.0471	0.0653	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	955	2230	2920	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	0.102	0.068	0.117	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0045	0.0101	0.0157	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.338	0.550	1.03	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	4.29	7.29	24.4	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0055	0.0300	0.0389	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	232	257	414	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.200	0.473	0.870	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.152	0.055	0.060	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	0.0091	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.053	0.033	0.042	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	2220	2450	2820	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	3360	2450	2210	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.636	0.344	0.428	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1030	1070	1260	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	3.80	11.6	16.7	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00049	0.00094	0.00164	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	1.41	0.233	0.168	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.28	0.41	0.66	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00045	0.00268	0.00454	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	12.2	14.7	14.7	0.20	9735287
RDL = Reportable Detection Limit						

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs Job #: B9A5897
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0603	XC0604	XC0605		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-05-P2 19-072-183**	**GN-05-P2 19-072-184**	**GN-05-P2 19-072-185**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	4.06	1.67	2.48	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	0.679	0.944	0.952	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.063	0.035	0.082	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0014	0.0020	<0.0013	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	0.34	0.21	<0.20	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.126	0.0621	0.0169	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	789	519	1370	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	0.031	0.053	<0.025	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0125	0.0129	0.0116	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.989	0.776	0.646	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	9.19	6.26	8.72	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0372	0.0212	0.0170	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	259	189	350	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.237	0.149	0.368	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.074	0.088	0.063	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	0.0089	<0.0080	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.036	0.028	0.019	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	2100	1900	2560	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	3170	3210	3200	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.556	0.434	0.452	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	0.0023	<0.0013	<0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1320	1330	1320	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	3.65	2.39	5.93	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00136	0.00125	0.00081	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.35	0.27	0.41	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00210	0.00091	0.00129	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	14.8	13.8	16.5	0.20	9735287
RDL = Reportable Detection Limit						

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0606	XC0607	XC0608		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-05-P3 19-072-186**	**GN-05-P3 19-072-187**	**GN-05-P3 19-072-188**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	2.61	1.15	1.00	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	0.796	1.38	2.03	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.284	0.223	0.172	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0016	0.0019	0.0020	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	0.25	0.22	<0.20	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0251	0.0514	0.0109	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	4290	4030	2470	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	0.041	<0.025	0.037	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0090	0.0102	0.0085	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.480	0.563	0.278	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	4.91	8.97	4.98	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0124	0.0069	0.0067	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	363	338	273	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.571	0.519	0.304	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.077	0.100	0.140	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	0.0124	<0.0080	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.017	0.025	0.014	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	4280	3870	3030	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	3640	3150	3240	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.391	0.565	0.473	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1180	1260	1010	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	21.3	21.5	15.5	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00227	0.00088	0.00105	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.69	0.65	0.46	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00328	0.00402	0.00260	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	17.2	19.8	15.3	0.20	9735287

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0609	XC0610	XC0611		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-05-P4 19-072-189**	**GN-05-P4 19-072-190**	**GN-05-P4 19-072-191**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	1.18	5.24	5.98	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	<0.0020	0.0020	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	1.79	1.52	1.23	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.097	0.170	0.197	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0034	0.0042	0.0030	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	0.22	<0.20	0.29	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0222	0.0169	0.0334	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	1460	3450	2800	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.025	<0.025	0.028	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0068	0.0155	0.0125	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.327	0.440	0.458	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	6.24	14.8	16.2	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0067	0.0116	0.0174	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	308	257	294	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.240	0.519	0.370	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.186	0.156	0.184	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	0.0085	<0.0080	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.015	0.044	0.040	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	2600	3380	3300	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	3120	2500	3090	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.533	0.609	0.605	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1160	1360	1150	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	11.1	23.7	22.8	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00178	0.00076	0.00086	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	0.024	<0.020	0.168	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.41	1.00	0.60	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00311	0.00621	0.00861	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	19.1	14.3	26.1	0.20	9735287
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0612	XC0613	XC0614		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-05-P4 19-072-192**	**GN-05-P5 19-072-193**	**GN-05-P5 19-072-194**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	3.80	1.36	2.51	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0021	0.0030	0.0023	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	2.20	1.97	2.71	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.137	0.108	0.042	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0033	0.0027	0.0052	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	0.22	0.24	0.24	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0998	0.0060	0.0115	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	1940	1860	578	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	0.030	0.025	0.028	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0143	0.0094	0.0102	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.744	0.364	0.438	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	12.3	5.81	5.78	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0172	0.0138	0.0136	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	257	242	281	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.277	0.356	0.195	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.276	0.094	0.180	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.042	0.054	0.031	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	2530	2520	1830	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	2640	2870	2910	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.604	0.403	0.562	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	0.0014	<0.0013	<0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1120	885	1490	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	13.8	11.4	3.54	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00080	0.00070	0.00074	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	0.178	0.199	0.104	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.44	0.40	0.33	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00415	0.00181	0.00093	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	22.3	14.6	15.0	0.20	9735287
RDL = Reportable Detection Limit						

BV Labs Job #: B9A5897
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0615	XC0616	XC0617	XC0618		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-05-P5 19-072-195**	**GN-05-P5 19-072-196**	**GN7-P3 19-072-197**	**GN7-P3 19-072-198**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	4.15	5.59	3.97	1.17	0.50	9735287
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0028	0.0023	0.0022	<0.0020	0.0020	9735287
Total (Wet Wt) Arsenic (As)	mg/kg	2.02	2.09	1.38	1.74	0.0050	9735287
Total (Wet Wt) Barium (Ba)	mg/kg	0.057	0.223	0.195	0.108	0.010	9735287
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	9735287
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0025	0.0039	0.0044	<0.0013	0.0013	9735287
Total (Wet Wt) Boron (B)	mg/kg	<0.20	0.24	<0.20	<0.20	0.20	9735287
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0259	0.0113	0.130	0.0240	0.0013	9735287
Total (Wet Wt) Calcium (Ca)	mg/kg	1250	3950	2260	1740	4.0	9735287
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.025	<0.025	0.035	<0.025	0.025	9735287
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0071	0.0097	0.0097	0.0054	0.0013	9735287
Total (Wet Wt) Copper (Cu)	mg/kg	0.371	0.566	0.499	0.293	0.013	9735287
Total (Wet Wt) Iron (Fe)	mg/kg	12.7	12.7	8.83	3.56	0.25	9735287
Total (Wet Wt) Lead (Pb)	mg/kg	0.0278	0.0262	0.0244	0.0067	0.0013	9735287
Total (Wet Wt) Magnesium (Mg)	mg/kg	254	288	307	272	0.40	9735287
Total (Wet Wt) Manganese (Mn)	mg/kg	0.249	0.408	0.479	0.294	0.010	9735287
Total (Wet Wt) Mercury (Hg)	mg/kg	0.178	0.180	0.107	0.087	0.013	9735287
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	<0.0080	0.0080	9735287
Total (Wet Wt) Nickel (Ni)	mg/kg	0.025	0.034	0.027	0.014	0.010	9735287
Total (Wet Wt) Phosphorus (P)	mg/kg	1840	3610	2690	2500	2.0	9735287
Total (Wet Wt) Potassium (K)	mg/kg	2430	2820	2960	2900	2.5	9735287
Total (Wet Wt) Selenium (Se)	mg/kg	0.515	0.526	0.381	0.403	0.010	9735287
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	<0.0013	0.0013	9735287
Total (Wet Wt) Sodium (Na)	mg/kg	1110	966	1050	1050	2.5	9735287
Total (Wet Wt) Strontium (Sr)	mg/kg	6.68	27.9	13.8	8.22	0.013	9735287
Total (Wet Wt) Thallium (Tl)	mg/kg	<0.00040	0.00088	0.00062	0.00046	0.00040	9735287
Total (Wet Wt) Tin (Sn)	mg/kg	0.076	0.079	0.021	<0.020	0.020	9735287
Total (Wet Wt) Titanium (Ti)	mg/kg	0.35	0.58	0.55	0.41	0.13	9735287
Total (Wet Wt) Uranium (U)	mg/kg	0.00170	0.00426	0.00777	0.00114	0.00040	9735287
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9735287
Total (Wet Wt) Zinc (Zn)	mg/kg	14.6	24.1	18.6	13.5	0.20	9735287

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0619		XC0620	XC0621		
Sampling Date		2019/07/29		2019/07/29	2019/07/29		
COC Number		08475873		08475873	08475873		
	UNITS	**GN-06-P6 19-072-199**	**QC Batch**	**GN-06-P6 19-072-200**	**GN-06-P6 19-072-201**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.75	9735287	1.30	2.03	0.50	9734293
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	9735287	0.0030	<0.0020	0.0020	9734293
Total (Wet Wt) Arsenic (As)	mg/kg	1.90	9735287	1.53	2.07	0.0050	9734293
Total (Wet Wt) Barium (Ba)	mg/kg	0.215	9735287	0.165	0.030	0.010	9734293
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	9735287	<0.0020	<0.0020	0.0020	9734293
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0034	9735287	0.0037	0.0030	0.0013	9734293
Total (Wet Wt) Boron (B)	mg/kg	0.21	9735287	0.27	0.24	0.20	9734293
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0138	9735287	0.0299	0.0236	0.0013	9734293
Total (Wet Wt) Calcium (Ca)	mg/kg	3370	9735287	3650	472	4.0	9734293
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.025	9735287	0.041	0.038	0.025	9734293
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0184	9735287	0.0142	0.0162	0.0013	9734293
Total (Wet Wt) Copper (Cu)	mg/kg	0.538	9735287	0.731	0.914	0.013	9734293
Total (Wet Wt) Iron (Fe)	mg/kg	9.18	9735287	9.32	12.8	0.25	9734293
Total (Wet Wt) Lead (Pb)	mg/kg	0.0112	9735287	0.0163	0.0138	0.0013	9734293
Total (Wet Wt) Magnesium (Mg)	mg/kg	268	9735287	298	220	0.40	9734293
Total (Wet Wt) Manganese (Mn)	mg/kg	0.453	9735287	0.471	0.180	0.010	9734293
Total (Wet Wt) Mercury (Hg)	mg/kg	0.204	9735287	0.159	0.173	0.013	9734293
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	9735287	<0.0080	<0.0080	0.0080	9734293
Total (Wet Wt) Nickel (Ni)	mg/kg	0.030	9735287	0.028	0.030	0.010	9734293
Total (Wet Wt) Phosphorus (P)	mg/kg	3200	9735287	3690	1750	2.0	9734293
Total (Wet Wt) Potassium (K)	mg/kg	2440	9735287	3000	2610	2.5	9734293
Total (Wet Wt) Selenium (Se)	mg/kg	0.594	9735287	0.456	0.602	0.010	9734293
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	9735287	<0.0013	<0.0013	0.0013	9734293
Total (Wet Wt) Sodium (Na)	mg/kg	1560	9735287	1640	1390	2.5	9734293
Total (Wet Wt) Strontium (Sr)	mg/kg	22.1	9735287	23.0	2.88	0.013	9734293
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00098	9735287	0.00071	0.00127	0.00040	9734293
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	9735287	0.063	0.028	0.020	9734293
Total (Wet Wt) Titanium (Ti)	mg/kg	0.51	9735287	0.59	0.30	0.13	9734293
Total (Wet Wt) Uranium (U)	mg/kg	0.00376	9735287	0.00504	0.00198	0.00040	9734293
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	9735287	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Zinc (Zn)	mg/kg	19.8	9735287	22.9	18.3	0.20	9734293
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0622	XC0623	XC0624		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-06-P6 19-072-202**	**GN-06-P6 19-072-203**	**GN-06-P6 19-072-204**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.97	1.80	0.86	0.50	9734293
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	<0.0020	0.0022	0.0020	9734293
Total (Wet Wt) Arsenic (As)	mg/kg	1.77	2.42	1.97	0.0050	9734293
Total (Wet Wt) Barium (Ba)	mg/kg	0.106	0.128	0.176	0.010	9734293
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9734293
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0041	0.0031	0.0023	0.0013	9734293
Total (Wet Wt) Boron (B)	mg/kg	0.24	0.23	0.21	0.20	9734293
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0856	0.0169	0.0395	0.0013	9734293
Total (Wet Wt) Calcium (Ca)	mg/kg	1670	2300	3180	4.0	9734293
Total (Wet Wt) Chromium (Cr)	mg/kg	0.044	0.073	0.163	0.025	9734293
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0137	0.0119	0.0146	0.0013	9734293
Total (Wet Wt) Copper (Cu)	mg/kg	0.749	0.470	0.529	0.013	9734293
Total (Wet Wt) Iron (Fe)	mg/kg	8.15	8.97	9.30	0.25	9734293
Total (Wet Wt) Lead (Pb)	mg/kg	0.0142	0.0544	0.0154	0.0013	9734293
Total (Wet Wt) Magnesium (Mg)	mg/kg	279	270	289	0.40	9734293
Total (Wet Wt) Manganese (Mn)	mg/kg	0.271	0.279	0.595	0.010	9734293
Total (Wet Wt) Mercury (Hg)	mg/kg	0.143	0.151	0.146	0.013	9734293
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	0.0080	9734293
Total (Wet Wt) Nickel (Ni)	mg/kg	0.029	0.024	0.027	0.010	9734293
Total (Wet Wt) Phosphorus (P)	mg/kg	2520	2850	3280	2.0	9734293
Total (Wet Wt) Potassium (K)	mg/kg	2900	2700	2460	2.5	9734293
Total (Wet Wt) Selenium (Se)	mg/kg	0.500	0.604	0.563	0.010	9734293
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	0.0013	9734293
Total (Wet Wt) Sodium (Na)	mg/kg	1290	1330	1370	2.5	9734293
Total (Wet Wt) Strontium (Sr)	mg/kg	11.9	14.1	21.2	0.013	9734293
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00132	0.00054	0.00052	0.00040	9734293
Total (Wet Wt) Tin (Sn)	mg/kg	0.033	0.030	0.025	0.020	9734293
Total (Wet Wt) Titanium (Ti)	mg/kg	0.41	0.50	0.50	0.13	9734293
Total (Wet Wt) Uranium (U)	mg/kg	0.00282	0.00466	0.0132	0.00040	9734293
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Zinc (Zn)	mg/kg	22.1	15.7	17.1	0.20	9734293
RDL = Reportable Detection Limit						

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0625	XC0626	XC0627		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873		
	UNITS	**GN-06-P6 19-072-205**	**GN-06-P6 19-072-206**	**GN-06-P6 19-072-207**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	2.95	7.64	1.05	0.50	9734293
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0024	0.0020	0.0021	0.0020	9734293
Total (Wet Wt) Arsenic (As)	mg/kg	1.68	1.81	2.32	0.0050	9734293
Total (Wet Wt) Barium (Ba)	mg/kg	0.256	0.056	0.153	0.010	9734293
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	9734293
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0026	0.0038	0.0031	0.0013	9734293
Total (Wet Wt) Boron (B)	mg/kg	0.32	0.26	0.25	0.20	9734293
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0343	0.0267	0.0092	0.0013	9734293
Total (Wet Wt) Calcium (Ca)	mg/kg	4230	793	2490	4.0	9734293
Total (Wet Wt) Chromium (Cr)	mg/kg	0.031	0.040	0.028	0.025	9734293
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0157	0.0144	0.0239	0.0013	9734293
Total (Wet Wt) Copper (Cu)	mg/kg	0.741	0.936	0.589	0.013	9734293
Total (Wet Wt) Iron (Fe)	mg/kg	17.4	17.5	10.1	0.25	9734293
Total (Wet Wt) Lead (Pb)	mg/kg	0.0335	0.0256	0.0100	0.0013	9734293
Total (Wet Wt) Magnesium (Mg)	mg/kg	312	238	265	0.40	9734293
Total (Wet Wt) Manganese (Mn)	mg/kg	0.472	0.318	0.255	0.010	9734293
Total (Wet Wt) Mercury (Hg)	mg/kg	0.150	0.194	0.184	0.013	9734293
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	0.0080	9734293
Total (Wet Wt) Nickel (Ni)	mg/kg	0.034	0.030	0.036	0.010	9734293
Total (Wet Wt) Phosphorus (P)	mg/kg	4020	2180	2940	2.0	9734293
Total (Wet Wt) Potassium (K)	mg/kg	2970	3090	2880	2.5	9734293
Total (Wet Wt) Selenium (Se)	mg/kg	0.481	0.523	0.544	0.010	9734293
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	0.0013	9734293
Total (Wet Wt) Sodium (Na)	mg/kg	1370	1270	1340	2.5	9734293
Total (Wet Wt) Strontium (Sr)	mg/kg	30.2	4.73	18.3	0.013	9734293
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00120	0.00108	0.00082	0.00040	9734293
Total (Wet Wt) Tin (Sn)	mg/kg	0.028	0.022	0.040	0.020	9734293
Total (Wet Wt) Titanium (Ti)	mg/kg	0.71	0.34	0.47	0.13	9734293
Total (Wet Wt) Uranium (U)	mg/kg	0.00807	0.00514	0.0201	0.00040	9734293
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Zinc (Zn)	mg/kg	26.7	22.8	16.3	0.20	9734293
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0628	XC0629		
Sampling Date		2019/07/29	2019/07/29		
COC Number		08475873	08475873		
	UNITS	**GN-06-P6 19-072-208**	**GN-06-P6 19-072-209**	**RDL**	**QC Batch**
Total Metals by ICPMS					
Total (Wet Wt) Aluminum (Al)	mg/kg	1.57	1.33	0.50	9734293
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	0.0026	0.0020	9734293
Total (Wet Wt) Arsenic (As)	mg/kg	1.22	2.10	0.0050	9734293
Total (Wet Wt) Barium (Ba)	mg/kg	0.050	0.204	0.010	9734293
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	0.0020	9734293
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0037	0.0019	0.0013	9734293
Total (Wet Wt) Boron (B)	mg/kg	<0.20	0.32	0.20	9734293
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0084	0.0206	0.0013	9734293
Total (Wet Wt) Calcium (Ca)	mg/kg	704	3300	4.0	9734293
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.025	0.044	0.025	9734293
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0160	0.0120	0.0013	9734293
Total (Wet Wt) Copper (Cu)	mg/kg	0.701	0.642	0.013	9734293
Total (Wet Wt) Iron (Fe)	mg/kg	7.64	8.97	0.25	9734293
Total (Wet Wt) Lead (Pb)	mg/kg	0.0070	0.0124	0.0013	9734293
Total (Wet Wt) Magnesium (Mg)	mg/kg	243	301	0.40	9734293
Total (Wet Wt) Manganese (Mn)	mg/kg	0.191	0.379	0.010	9734293
Total (Wet Wt) Mercury (Hg)	mg/kg	0.137	0.201	0.013	9734293
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	0.0080	9734293
Total (Wet Wt) Nickel (Ni)	mg/kg	0.028	0.033	0.010	9734293
Total (Wet Wt) Phosphorus (P)	mg/kg	1780	3270	2.0	9734293
Total (Wet Wt) Potassium (K)	mg/kg	2280	2600	2.5	9734293
Total (Wet Wt) Selenium (Se)	mg/kg	0.491	0.527	0.010	9734293
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	0.0013	9734293
Total (Wet Wt) Sodium (Na)	mg/kg	1490	1680	2.5	9734293
Total (Wet Wt) Strontium (Sr)	mg/kg	4.38	21.6	0.013	9734293
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00089	0.00062	0.00040	9734293
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Titanium (Ti)	mg/kg	0.27	0.54	0.13	9734293
Total (Wet Wt) Uranium (U)	mg/kg	0.00192	0.00555	0.00040	9734293
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Zinc (Zn)	mg/kg	16.3	20.5	0.20	9734293
RDL = Reportable Detection Limit					

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BV Labs Job #: B9A5897
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0600	XC0601	XC0602	XC0603		
Sampling Date		2019/07/27	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-04-1 19-072-180**	**GN-05-P2 19-072-181**	**GN-05-P2 19-072-182**	**GN-05-P2 19-072-183**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	75	83	85	79	0.30	9729707
RDL = Reportable Detection Limit							

BV Labs ID		XC0604	XC0605	XC0606	XC0607		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-05-P2 19-072-184**	**GN-05-P2 19-072-185**	**GN-05-P3 19-072-186**	**GN-05-P3 19-072-187**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	80	77	75	76	0.30	9729707
RDL = Reportable Detection Limit							

BV Labs ID		XC0608	XC0609	XC0610	XC0611		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-05-P3 19-072-188**	**GN-05-P4 19-072-189**	**GN-05-P4 19-072-190**	**GN-05-P4 19-072-191**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	78	77	74	77	0.30	9729707
RDL = Reportable Detection Limit							

BV Labs ID		XC0612	XC0613	XC0614	XC0615		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-05-P4 19-072-192**	**GN-05-P5 19-072-193**	**GN-05-P5 19-072-194**	**GN-05-P5 19-072-195**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	77	83	75	82	0.30	9729707
RDL = Reportable Detection Limit							

BV Labs ID		XC0616	XC0617	XC0618	XC0619		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-05-P5 19-072-196**	**GN7-P3 19-072-197**	**GN7-P3 19-072-198**	**GN-06-P6 19-072-199**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	77	77	76	0.30	9729707
RDL = Reportable Detection Limit							

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PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0620	XC0621	XC0622	XC0623		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-06-P6 19-072-200**	**GN-06-P6 19-072-201**	**GN-06-P6 19-072-202**	**GN-06-P6 19-072-203**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	76	77	74	0.30	9729720
RDL = Reportable Detection Limit							

BV Labs ID		XC0624	XC0625	XC0626	XC0627		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475873	08475873	08475873	08475873		
	UNITS	**GN-06-P6 19-072-204**	**GN-06-P6 19-072-205**	**GN-06-P6 19-072-206**	**GN-06-P6 19-072-207**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	75	74	75	76	0.30	9729720
RDL = Reportable Detection Limit							

BV Labs ID		XC0628	XC0629		
Sampling Date		2019/07/29	2019/07/29		
COC Number		08475873	08475873		
	UNITS	**GN-06-P6 19-072-208**	**GN-06-P6 19-072-209**	**RDL**	**QC Batch**
Physical Properties					
Moisture	%	77	79	0.30	9729720
RDL = Reportable Detection Limit					

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C

Results relate only to the items tested.

BV Labs Job #: B9A5897
Report Date: 2020/01/20

QUALITY ASSURANCE REPORT

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9729707	Moisture	2020/01/14					0.67 (1)	20		
9729720	Moisture	2020/01/14					1.9 (2)	20		
9734293	Total (Wet Wt) Aluminum (Al)	2020/01/17	97	80 - 120	<0.50	mg/kg	9.6 (2)	40		
9734293	Total (Wet Wt) Antimony (Sb)	2020/01/17	97	80 - 120	<0.0020	mg/kg	28 (2)	40	84	75 - 125
9734293	Total (Wet Wt) Arsenic (As)	2020/01/17	94	80 - 120	<0.0050	mg/kg	3.6 (2)	40	93	75 - 125
9734293	Total (Wet Wt) Barium (Ba)	2020/01/17	100	80 - 120	<0.010	mg/kg	41 (5,2)	40		
9734293	Total (Wet Wt) Beryllium (Be)	2020/01/17	83	80 - 120	<0.0020	mg/kg	NC (2)	40		
9734293	Total (Wet Wt) Bismuth (Bi)	2020/01/17	102	80 - 120	<0.0013	mg/kg	31 (2)	40		
9734293	Total (Wet Wt) Boron (B)	2020/01/17	84	80 - 120	<0.20	mg/kg	0.19 (2)	40		
9734293	Total (Wet Wt) Cadmium (Cd)	2020/01/17	94	80 - 120	<0.0013	mg/kg	3.5 (2)	40	92	75 - 125
9734293	Total (Wet Wt) Calcium (Ca)	2020/01/17	100	80 - 120	<4.0	mg/kg	6.1 (2)	60	99	75 - 125
9734293	Total (Wet Wt) Chromium (Cr)	2020/01/17	99	80 - 120	<0.025	mg/kg	17 (2)	40		
9734293	Total (Wet Wt) Cobalt (Co)	2020/01/17	99	80 - 120	<0.0013	mg/kg	11 (2)	40	92	75 - 125
9734293	Total (Wet Wt) Copper (Cu)	2020/01/17	100	80 - 120	<0.013	mg/kg	51 (5,2)	40	96	75 - 125
9734293	Total (Wet Wt) Iron (Fe)	2020/01/17	106	80 - 120	<0.25	mg/kg	8.2 (2)	40	102	75 - 125
9734293	Total (Wet Wt) Lead (Pb)	2020/01/17	101	80 - 120	<0.0013	mg/kg	20 (2)	40	123	75 - 125
9734293	Total (Wet Wt) Magnesium (Mg)	2020/01/17	102	80 - 120	<0.40	mg/kg	1.0 (2)	40		
9734293	Total (Wet Wt) Manganese (Mn)	2020/01/17	99	80 - 120	<0.010	mg/kg	2.2 (2)	40	94	75 - 125
9734293	Total (Wet Wt) Mercury (Hg)	2020/01/17	104	80 - 120	<0.013	mg/kg	8.0 (2)	40	85	75 - 125
9734293	Total (Wet Wt) Molybdenum (Mo)	2020/01/17	99	80 - 120	<0.0080	mg/kg	41 (5,2)	40	97	75 - 125
9734293	Total (Wet Wt) Nickel (Ni)	2020/01/17	99	80 - 120	<0.010	mg/kg	15 (2)	40		
9734293	Total (Wet Wt) Phosphorus (P)	2020/01/17	90	80 - 120	<2.0	mg/kg	7.8 (2)	40	98	75 - 125
9734293	Total (Wet Wt) Potassium (K)	2020/01/17	103	80 - 120	<2.5	mg/kg	0.086 (2)	40	104	75 - 125
9734293	Total (Wet Wt) Selenium (Se)	2020/01/17	91	80 - 120	<0.010	mg/kg	6.3 (2)	40	89	75 - 125
9734293	Total (Wet Wt) Silver (Ag)	2020/01/17	63 (4)	80 - 120	<0.0013	mg/kg	NC (2)	40	74 (3)	75 - 125
9734293	Total (Wet Wt) Sodium (Na)	2020/01/17	99	80 - 120	<2.5	mg/kg	0.22 (2)	40	104	75 - 125
9734293	Total (Wet Wt) Strontium (Sr)	2020/01/17	96	80 - 120	<0.013	mg/kg	1.3 (2)	60	97	75 - 125
9734293	Total (Wet Wt) Thallium (Tl)	2020/01/17	103	80 - 120	<0.00040	mg/kg	24 (2)	40	94	75 - 125
9734293	Total (Wet Wt) Tin (Sn)	2020/01/17	97	80 - 120	<0.020	mg/kg	28 (2)	40	130 (3)	75 - 125
9734293	Total (Wet Wt) Titanium (Ti)	2020/01/17	98	80 - 120	<0.13	mg/kg	16 (2)	40		
9734293	Total (Wet Wt) Uranium (U)	2020/01/17	103	80 - 120	<0.00040	mg/kg	7.2 (2)	40	102	75 - 125
9734293	Total (Wet Wt) Vanadium (V)	2020/01/17	93	80 - 120	<0.020	mg/kg	NC (2)	40	49 (3)	75 - 125
9734293	Total (Wet Wt) Zinc (Zn)	2020/01/17	95	80 - 120	<0.20	mg/kg	14 (2)	40	95	75 - 125

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			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9735287	Total (Wet Wt) Aluminum (Al)	2020/01/17	98	80 - 120	<0.50	mg/kg	11 (1)	40		
9735287	Total (Wet Wt) Antimony (Sb)	2020/01/17	100	80 - 120	<0.0020	mg/kg	7.3 (1)	40	90	75 - 125
9735287	Total (Wet Wt) Arsenic (As)	2020/01/17	97	80 - 120	<0.0050	mg/kg	1.6 (1)	40	98	75 - 125
9735287	Total (Wet Wt) Barium (Ba)	2020/01/17	102	80 - 120	<0.010	mg/kg	17 (1)	40		
9735287	Total (Wet Wt) Beryllium (Be)	2020/01/17	82	80 - 120	<0.0020	mg/kg	NC (1)	40		
9735287	Total (Wet Wt) Bismuth (Bi)	2020/01/17	101	80 - 120	<0.0013	mg/kg	NC (1)	40		
9735287	Total (Wet Wt) Boron (B)	2020/01/17	84	80 - 120	<0.20	mg/kg	6.4 (1)	40		
9735287	Total (Wet Wt) Cadmium (Cd)	2020/01/17	94	80 - 120	<0.0013	mg/kg	12 (1)	40	95	75 - 125
9735287	Total (Wet Wt) Calcium (Ca)	2020/01/17	102	80 - 120	<4.0	mg/kg	21 (1)	60	107	75 - 125
9735287	Total (Wet Wt) Chromium (Cr)	2020/01/17	98	80 - 120	<0.025	mg/kg	8.2 (1)	40		
9735287	Total (Wet Wt) Cobalt (Co)	2020/01/17	100	80 - 120	<0.0013	mg/kg	5.5 (1)	40	93	75 - 125
9735287	Total (Wet Wt) Copper (Cu)	2020/01/17	101	80 - 120	<0.013	mg/kg	18 (1)	40	99	75 - 125
9735287	Total (Wet Wt) Iron (Fe)	2020/01/17	109	80 - 120	<0.25	mg/kg	1.2 (1)	40	104	75 - 125
9735287	Total (Wet Wt) Lead (Pb)	2020/01/17	101	80 - 120	<0.0013	mg/kg	2.9 (1)	40	94	75 - 125
9735287	Total (Wet Wt) Magnesium (Mg)	2020/01/17	104	80 - 120	<0.40	mg/kg	2.8 (1)	40		
9735287	Total (Wet Wt) Manganese (Mn)	2020/01/17	101	80 - 120	<0.010	mg/kg	18 (1)	40	100	75 - 125
9735287	Total (Wet Wt) Mercury (Hg)	2020/01/17	99	80 - 120	<0.013	mg/kg	2.2 (1)	40	93	75 - 125
9735287	Total (Wet Wt) Molybdenum (Mo)	2020/01/17	97	80 - 120	<0.0080	mg/kg	NC (1)	40	98	75 - 125
9735287	Total (Wet Wt) Nickel (Ni)	2020/01/17	102	80 - 120	<0.010	mg/kg	4.7 (1)	40		
9735287	Total (Wet Wt) Phosphorus (P)	2020/01/17	92	80 - 120	<2.0	mg/kg	11 (1)	40	102	75 - 125
9735287	Total (Wet Wt) Potassium (K)	2020/01/17	106	80 - 120	<2.5	mg/kg	1.3 (1)	40	109	75 - 125
9735287	Total (Wet Wt) Selenium (Se)	2020/01/17	93	80 - 120	<0.010	mg/kg	7.9 (1)	40	97	75 - 125
9735287	Total (Wet Wt) Silver (Ag)	2020/01/17	65 (4)	80 - 120	<0.0013	mg/kg	NC (1)	40	77	75 - 125
9735287	Total (Wet Wt) Sodium (Na)	2020/01/17	100	80 - 120	<2.5	mg/kg	1.8 (1)	40	108	75 - 125
9735287	Total (Wet Wt) Strontium (Sr)	2020/01/17	97	80 - 120	<0.013	mg/kg	24 (1)	60	103	75 - 125
9735287	Total (Wet Wt) Thallium (Tl)	2020/01/17	104	80 - 120	<0.00040	mg/kg	6.3 (1)	40	96	75 - 125
9735287	Total (Wet Wt) Tin (Sn)	2020/01/17	101	80 - 120	<0.020	mg/kg	4.0 (1)	40	127 (3)	75 - 125
9735287	Total (Wet Wt) Titanium (Ti)	2020/01/17	94	80 - 120	<0.13	mg/kg	31 (1)	40		
9735287	Total (Wet Wt) Uranium (U)	2020/01/17	102	80 - 120	<0.00040	mg/kg	NC (1)	40	105	75 - 125
9735287	Total (Wet Wt) Vanadium (V)	2020/01/17	95	80 - 120	<0.020	mg/kg	NC (1)	40	52 (3)	75 - 125

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9735287	Total (Wet Wt) Zinc (Zn)	2020/01/17	94	80 - 120	<0.20	mg/kg	4.1 (1)	40	99	75 - 125

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Duplicate Parent ID [XC0600-01]

(2) Duplicate Parent ID

(3) Reference outside acceptance criteria - re-analysis yields similar results.

(4) Blank Spike outside acceptance criteria - re-analysis yields similar results.

(5) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

08475873

biologica

Client:	Golder - Baffinlands (Scuplins)
Project:	ms19-072

Client Sample ID	Sample Date	Replicate	Biologica Sample ID
GN-04-1	27-Jul-19	1	19-072-180
GN-05-P2	29-Jul-19	1	19-072-181
GN-05-P2	29-Jul-19	2	19-072-182
GN-05-P2	29-Jul-19	3	19-072-183
GN-05-P2	29-Jul-19	4	19-072-184
GN-05-P2	29-Jul-19	5	19-072-185
GN-05-P3	29-Jul-19	1	19-072-186
GN-05-P3	29-Jul-19	2	19-072-187
GN-05-P3	29-Jul-19	3	19-072-188
GN-05-P4	29-Jul-19	1	19-072-189
GN-05-P4	29-Jul-19	2	19-072-190
GN-05-P4	29-Jul-19	3	19-072-191
GN-05-P4	29-Jul-19	4	19-072-192
GN-05-P5	29-Jul-19	1	19-072-193
GN-05-P5	29-Jul-19	2	19-072-194
GN-05-P5	29-Jul-19	3	19-072-195
GN-05-P5	29-Jul-19	4	19-072-196
GN7-P3	29-Jul-19	1	19-072-197
GN7-P3	29-Jul-19	2	19-072-198
GN-06-P6	29-Jul-19	1	19-072-199
GN-06-P6	29-Jul-19	2	19-072-200
GN-06-P6	29-Jul-19	3	19-072-201
GN-06-P6	29-Jul-19	4	19-072-202
GN-06-P6	29-Jul-19	5	19-072-203
GN-06-P6	29-Jul-19	6	19-072-204
GN-06-P6	29-Jul-19	7	19-072-205
GN-06-P6	29-Jul-19	8	19-072-206
GN-06-P6	29-Jul-19	9	19-072-207
GN-06-P6	29-Jul-19	10	19-072-208
GN-06-P6	29-Jul-19	11	19-072-209

KEMW Chih 2019/12/10 08:10

Temp: 3, 4, 4

1352

B9A5897_COC

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
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CHAIN OF CUSTODY RECORD

Invoice Information
Company: Golder Associates Ltd.
Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200
Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

Report Information (if differs from invoice)
Company: Golder Associates Ltd.
Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis - fish tissue
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

#	Sample Identification (Double-Click Here to Add Rows.)	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
1	19-072-133	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
2	19-072-134	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
3	19-072-135	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
4	19-072-136	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
5	19-072-137	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
6	19-072-138	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
7	19-072-139	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
8	19-072-140	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
9	19-072-141	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
10	19-072-142	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
11	19-072-143	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
12	19-072-144	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
13	19-072-145	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
14	19-072-146	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
15	19-072-147	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
16	19-072-148	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
17	19-072-149	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
18	19-072-150	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
19	19-072-151	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
20	19-072-152	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	☐ Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	☐ 1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria

- ☐ BC CSR
- ☐ YK CSR
- ☐ CCME
- ☐ Drinking Water
- ☐ BC Water Quality
- ☐ Other

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
21	19-072-153	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
22	19-072-154	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
23	19-072-155	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
24	19-072-156	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
25	19-072-157	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
26	19-072-158	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
27	19-072-159	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
28	19-072-160	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
29	19-072-161	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
30	19-072-162	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
31	19-072-163	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
32	19-072-164	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
33	19-072-165	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
34	19-072-166	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
35	19-072-167	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
36	19-072-168	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
37	19-072-169	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
38	19-072-170	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
39	19-072-171	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
40	19-072-172	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
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CHAIN OF CUSTODY RECORD

Invoice Information
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Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200
Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

Report Information (if differs from invoice)
Company: Golder Associates Ltd.
Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
41	19-072-173	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
42	19-072-174	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
43	19-072-175	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
44	19-072-176	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
45	19-072-177	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
46	19-072-178	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
47	19-072-179	2019-09-02	n/a	Tissue	1	x		Arctic Char; metals by wet weight
48	19-072-180	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
49	19-072-181	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
50	19-072-182	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
51	19-072-183	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
52	19-072-184	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
53	19-072-185	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
54	19-072-186	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
55	19-072-187	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
56	19-072-188	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
57	19-072-189	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
58	19-072-190	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
59	19-072-191	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
60	19-072-192	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

COC-1020BL

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

#	Sample Identification (Double-Click Here to Add Rows.)	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
61	19-072-193	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
62	19-072-194	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
63	19-072-195	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
64	19-072-196	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
65	19-072-197	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
66	19-072-198	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
67	19-072-199	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
68	19-072-200	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
69	19-072-201	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
70	19-072-202	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
71	19-072-203	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
72	19-072-204	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
73	19-072-205	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
74	19-072-206	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
75	19-072-207	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
76	19-072-208	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
77	19-072-209	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475877

Attention: Christine Bylenga

GOLDER ASSOCIATES LTD
Suite 200 - 2920 Virtual Way
VANCOUVER, BC
Canada V5M 0C4

Report Date: 2020/01/20
Report #: R2835275
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A5905
Received: 2019/12/10, 08:10

Sample Matrix: Tissue
Samples Received: 47

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	47	2020/01/14	2020/01/17	BBY7SOP-00021 / BBY7SOP-00002	EPA 6020b R2 m
Moisture in Tissue	47	2020/01/15	2020/01/16	BBY8SOP-00017	BCMOE BCLM Dec2000 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1663724-24000 TASK 03
Your C.O.C. #: 08475877

Attention: Christine Bylenga

GOLDER ASSOCIATES LTD
Suite 200 - 2920 Virtual Way
VANCOUVER, BC
Canada V5M 0C4

Report Date: 2020/01/20
Report #: R2835275
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9A5905
Received: 2019/12/10, 08:10

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Gail Pedersen, Key Account Specialist
Email: Gail.Pedersen@bvlabs.com
Phone# (604) 734 7276
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BV Labs Job #: B9A5905
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0651	XC0652	XC0653	XC0654		
Sampling Date		2019/07/27	2019/07/27	2019/07/27	2019/07/27		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-01-1 19-072-133**	**GN-01-3 19-072-134**	**GN-01-2 19-072-135**	**GN-03-3 19-072-136**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.41	0.42	0.37	0.42	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.924	0.795	1.01	0.890	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	0.010	<0.010	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0019	0.0091	0.0038	0.0014	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	101 (1)	145	91.4	60.7	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	0.029	0.012	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0038	0.0042	0.0067	0.0037	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.343	0.321	0.739	0.437	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	2.62	3.11	5.96	3.63	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	<0.0010	<0.0010	0.0019	0.0010	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	296	322	277	282	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.089 (1)	0.102	0.111	0.079	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0470	0.0472	0.0345	0.0315	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.016	<0.010	0.020	0.015	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	3040	3200	2960	2920	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	4350	4720	4200	4060	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.369	0.379	0.364	0.339	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010 (2)	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	435	445	400	313	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.300 (1)	0.390	0.268	0.140	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00184	0.00294	0.00221	0.00195	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.520	0.574	0.506	0.483	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	5.71	5.68	6.96	5.07	0.040	9733297

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.
(2) Matrix Spike exceeds acceptance limits - Re-analysis yields similar results.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs Job #: B9A5905
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0655	XC0656	XC0657	XC0658		
Sampling Date		2019/07/27	2019/07/27	2019/07/27	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-03-2 19-072-137**	**GN-03-1 19-072-138**	**GN-03-4 19-072-139**	**GN-05-P1 19-072-140**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.25	0.20	0.54	2.50	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.855	2.85	0.826	0.970	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.010	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0019	0.0030	0.0026	0.0020	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	60.6	74.1	91.8	107	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	0.010	0.012	0.015	0.019	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0034	0.0026	0.0043	0.0050	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.338	0.320	0.425	0.345	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	2.46	3.27	4.17	7.45	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0027	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	258	282	283	280	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.083	0.072	0.082	0.120	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0389	0.0688	0.0500	0.0273	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.013	<0.010	<0.010	0.020	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	2750	2920	2980	2710	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	3890	4550	4270	3930	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.307	0.420	0.422	0.349	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	442	435	382	497	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.139	0.140	0.158	0.330	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00147	0.00176	0.00227	0.00156	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	0.021	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.464	0.516	0.508	0.484	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00047	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	4.53	4.63	4.69	6.12	0.040	9733297
RDL = Reportable Detection Limit							

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0659	XC0660	XC0661		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-05-P3 19-072-141**	**GN-05-P3 19-072-142**	**GN-05-P3 19-072-143**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.45	9.48	0.69	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.351	0.818	0.510	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	0.011	<0.010	0.017	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0071	0.0080	0.0053	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	196	121	173	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	0.019	0.019	0.013	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0047	0.0115	0.0026	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.519	0.507	0.384	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	6.29	20.6	3.96	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	0.0016	0.0013	0.0015	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	298	302	303	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.105	0.316	0.088	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.104	0.0672	0.0456	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.010	0.016	0.010	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	2890	3030	2630	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	3770	4430	3370	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.469	0.526	0.465	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	866	692	916	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.721	0.411	0.720	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00476	0.00444	0.00217	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.496	0.540	0.449	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00091	<0.00040	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	9.87	8.06	12.6	0.040	9733297

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0662	XC0663	XC0664		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-05-P3 19-072-144**	**GN-05-P3 19-072-145**	**GN-05-P3 19-072-146**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.79	0.77	0.32	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.615	0.531	0.682	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	0.021	0.012	<0.010	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0081	0.0215	0.0020	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	160	173	56.9	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	0.036	0.012	<0.010	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0064	0.0057	0.0035	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.560	0.394	0.392	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	5.46	4.35	2.88	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	0.0029	0.0021	0.0010	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	295	321	291	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.109	0.090	0.066	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0392	0.0646	0.0398	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.015	0.010	<0.010	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	2780	2870	2730	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	3470	3820	3680	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.387	0.467	0.345	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	839	787	600	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.675	0.661	0.224	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00284	0.00303	0.00201	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.475	0.500	0.473	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	0.00050	<0.00040	<0.00040	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	10.6	13.1	5.38	0.040	9733297
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0665	XC0666	XC0667		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-05-P5 19-072-147**	**GN-05-P5 19-072-148**	**GN-05-P2 19-072-149**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.70	0.34	0.52	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.605	0.869	0.602	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	0.010	<0.010	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0066	0.0014	0.0079	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	188	298	210	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	0.014	<0.010	0.034	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0043	0.0039	0.0051	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.417	0.365	0.390	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	8.72	2.79	3.80	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	0.0054	0.0013	0.0020	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	298	287	306	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.080	0.126	0.084	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0637	0.0411	0.0423	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.014	0.015	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	2620	2860	2670	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	3360	3750	3360	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.432	0.364	0.477	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	1160	452	1180	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.696	0.647	0.720	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00216	0.00186	0.00181	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.470	0.472	0.471	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	0.00044	<0.00040	<0.00040	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	10.2	5.16	11.0	0.040	9733297
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0668	XC0669	XC0670		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-05-P2 19-072-150**	**GN-05-P4 19-072-151**	**GN-05-P4 19-072-152**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.34	0.29	0.54	0.20	9733297
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Arsenic (As)	mg/kg	0.509	0.488	0.665	0.0040	9733297
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.010	9733297
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733297
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0027	0.0119	0.0235	0.0010	9733297
Total (Wet Wt) Calcium (Ca)	mg/kg	164	190	170	2.0	9733297
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.014	0.014	0.010	9733297
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0033	0.0057	0.0130	0.0013	9733297
Total (Wet Wt) Copper (Cu)	mg/kg	0.329	0.466	0.539	0.010	9733297
Total (Wet Wt) Iron (Fe)	mg/kg	2.30	5.65	5.08	0.25	9733297
Total (Wet Wt) Lead (Pb)	mg/kg	0.0016	0.0014	0.0022	0.0010	9733297
Total (Wet Wt) Magnesium (Mg)	mg/kg	314	314	286	0.40	9733297
Total (Wet Wt) Manganese (Mn)	mg/kg	0.090	0.099	0.105	0.010	9733297
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0843	0.0932	0.0767	0.0020	9733297
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733297
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.012	0.020	0.010	9733297
Total (Wet Wt) Phosphorus (P)	mg/kg	2900	2670	2760	2.0	9733297
Total (Wet Wt) Potassium (K)	mg/kg	4130	3440	3430	2.0	9733297
Total (Wet Wt) Selenium (Se)	mg/kg	0.638	0.491	0.519	0.010	9733297
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733297
Total (Wet Wt) Sodium (Na)	mg/kg	685	1110	873	2.0	9733297
Total (Wet Wt) Strontium (Sr)	mg/kg	0.348	0.719	0.557	0.010	9733297
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00305	0.00503	0.00345	0.00040	9733297
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Titanium (Ti)	mg/kg	0.494	0.453	0.471	0.020	9733297
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	9733297
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733297
Total (Wet Wt) Zinc (Zn)	mg/kg	5.34	7.28	13.0	0.040	9733297
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0671	XC0672	XC0673		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-05-P4 19-072-153**	**GN-05-P4 19-072-154**	**GN-05-P4 19-072-155**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.46	0.35	0.98	0.20	9733299
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Arsenic (As)	mg/kg	0.961	0.957	0.853	0.0040	9733299
Total (Wet Wt) Barium (Ba)	mg/kg	0.015	<0.010	0.013	0.010	9733299
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733299
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0123	0.0045	0.0093	0.0010	9733299
Total (Wet Wt) Calcium (Ca)	mg/kg	174	174	165	2.0	9733299
Total (Wet Wt) Chromium (Cr)	mg/kg	0.021	0.011	0.015	0.010	9733299
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0062	0.0069	0.0056	0.0013	9733299
Total (Wet Wt) Copper (Cu)	mg/kg	0.516	0.323	0.375	0.010	9733299
Total (Wet Wt) Iron (Fe)	mg/kg	4.95	5.10	5.00	0.25	9733299
Total (Wet Wt) Lead (Pb)	mg/kg	0.0018	0.0015	0.0031	0.0010	9733299
Total (Wet Wt) Magnesium (Mg)	mg/kg	257	301	299	0.40	9733299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.090	0.069	0.105	0.010	9733299
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0260	0.0913	0.0626	0.0020	9733299
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733299
Total (Wet Wt) Nickel (Ni)	mg/kg	0.017	<0.010	0.016	0.010	9733299
Total (Wet Wt) Phosphorus (P)	mg/kg	2490	2520	2720	2.0	9733299
Total (Wet Wt) Potassium (K)	mg/kg	2960	3570	3520	2.0	9733299
Total (Wet Wt) Selenium (Se)	mg/kg	0.373	0.305	0.558	0.010	9733299
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Sodium (Na)	mg/kg	722	1240	899	2.0	9733299
Total (Wet Wt) Strontium (Sr)	mg/kg	0.706	0.756	0.702	0.010	9733299
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00124	0.00363	0.00185	0.00040	9733299
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Titanium (Ti)	mg/kg	0.416	0.422	0.475	0.020	9733299
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	9733299
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Zinc (Zn)	mg/kg	7.51	12.2	12.0	0.040	9733299
RDL = Reportable Detection Limit						

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0674	XC0675	XC0676	XC0677		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P1 19-072-156**	**GN7-P1 19-072-157**	**GN7-P2 19-072-158**	**GN7-P2 19-072-159**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.73	0.32	0.55	0.60	0.20	9733299
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Arsenic (As)	mg/kg	0.558	0.329	0.500	0.840	0.0040	9733299
Total (Wet Wt) Barium (Ba)	mg/kg	0.016	0.024	<0.010	<0.010	0.010	9733299
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9733299
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0055	0.0045	0.0083	0.0055	0.0010	9733299
Total (Wet Wt) Calcium (Ca)	mg/kg	172	469	203	96.7	2.0	9733299
Total (Wet Wt) Chromium (Cr)	mg/kg	0.015	0.029	<0.010	0.017	0.010	9733299
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0035	0.0068	0.0098	0.0035	0.0013	9733299
Total (Wet Wt) Copper (Cu)	mg/kg	0.453	0.307	0.438	0.285	0.010	9733299
Total (Wet Wt) Iron (Fe)	mg/kg	4.50	5.60	5.08	2.92	0.25	9733299
Total (Wet Wt) Lead (Pb)	mg/kg	0.0033	0.0019	0.0030	0.0018	0.0010	9733299
Total (Wet Wt) Magnesium (Mg)	mg/kg	327	330	315	280	0.40	9733299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.102	0.122	0.098	0.090	0.010	9733299
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0410	0.126	0.0936	0.0294	0.0020	9733299
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	9733299
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.021	0.017	0.017	0.010	9733299
Total (Wet Wt) Phosphorus (P)	mg/kg	3020	2840	3030	2810	2.0	9733299
Total (Wet Wt) Potassium (K)	mg/kg	3960	3750	4030	4090	2.0	9733299
Total (Wet Wt) Selenium (Se)	mg/kg	0.443	0.229	0.524	0.316	0.010	9733299
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Sodium (Na)	mg/kg	862	1110	757	573	2.0	9733299
Total (Wet Wt) Strontium (Sr)	mg/kg	0.644	0.563	0.556	0.311	0.010	9733299
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00210	0.00600	0.00424	0.00165	0.00040	9733299
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Titanium (Ti)	mg/kg	0.517	0.474	0.514	0.518	0.020	9733299
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00044	<0.00040	<0.00040	0.00040	9733299
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	15.1	10.8	5.47	0.040	9733299

RDL = Reportable Detection Limit

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0678	XC0679	XC0680	XC0681		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P3 19-072-160**	**GN7-P3 19-072-161**	**GN7-P3 19-072-162**	**GN-06-P6 19-072-163**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.22	0.29	0.41	0.64	0.20	9733299
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Arsenic (As)	mg/kg	0.811	0.761	0.349	0.702	0.0040	9733299
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	0.010	0.014	0.017	0.010	9733299
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9733299
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0029	0.0057	0.0077	0.0080	0.0010	9733299
Total (Wet Wt) Calcium (Ca)	mg/kg	283	101	166	147	2.0	9733299
Total (Wet Wt) Chromium (Cr)	mg/kg	0.011	<0.010	0.016	0.012	0.010	9733299
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0030	0.0056	0.0047	0.0056	0.0013	9733299
Total (Wet Wt) Copper (Cu)	mg/kg	0.373	0.440	0.370	0.516	0.010	9733299
Total (Wet Wt) Iron (Fe)	mg/kg	3.06	3.82	4.00	4.87	0.25	9733299
Total (Wet Wt) Lead (Pb)	mg/kg	0.0012	0.0034	0.0022	0.0028	0.0010	9733299
Total (Wet Wt) Magnesium (Mg)	mg/kg	320	312	298	366	0.40	9733299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.105	0.092	0.086	0.123	0.010	9733299
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0386	0.0428	0.0789	0.0351	0.0020	9733299
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	9733299
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.020	0.011	0.016	0.010	9733299
Total (Wet Wt) Phosphorus (P)	mg/kg	3120	3020	2770	2670	2.0	9733299
Total (Wet Wt) Potassium (K)	mg/kg	4210	4350	3720	3580	2.0	9733299
Total (Wet Wt) Selenium (Se)	mg/kg	0.357	0.401	0.486	0.344	0.010	9733299
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Sodium (Na)	mg/kg	568	664	887	955	2.0	9733299
Total (Wet Wt) Strontium (Sr)	mg/kg	0.539	0.412	0.503	0.623	0.010	9733299
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00190	0.00226	0.00251	0.00183	0.00040	9733299
Total (Wet Wt) Tin (Sn)	mg/kg	0.023	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Titanium (Ti)	mg/kg	0.490	0.519	0.470	0.448	0.020	9733299
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00065	0.00040	9733299
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Zinc (Zn)	mg/kg	4.43	6.39	8.09	6.54	0.040	9733299
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0682	XC0683	XC0684		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-06-P6 19-072-164**	**GN-06-P6 19-072-165**	**GN-06-P6 19-072-166**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.32	0.30	0.31	0.20	9733299
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Arsenic (As)	mg/kg	1.01	0.456	0.811	0.0040	9733299
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.010	9733299
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733299
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0011	0.0047	0.0045	0.0010	9733299
Total (Wet Wt) Calcium (Ca)	mg/kg	139	104	96.7	2.0	9733299
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	0.010	9733299
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0067	0.0042	0.0034	0.0013	9733299
Total (Wet Wt) Copper (Cu)	mg/kg	0.318	0.423	0.359	0.010	9733299
Total (Wet Wt) Iron (Fe)	mg/kg	2.54	3.17	3.23	0.25	9733299
Total (Wet Wt) Lead (Pb)	mg/kg	0.0015	0.0017	0.0013	0.0010	9733299
Total (Wet Wt) Magnesium (Mg)	mg/kg	310	292	343	0.40	9733299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.094	0.081	0.085	0.010	9733299
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0307	0.0281	0.0265	0.0020	9733299
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733299
Total (Wet Wt) Nickel (Ni)	mg/kg	0.016	0.012	0.013	0.010	9733299
Total (Wet Wt) Phosphorus (P)	mg/kg	2640	2610	2910	2.0	9733299
Total (Wet Wt) Potassium (K)	mg/kg	3440	3490	4130	2.0	9733299
Total (Wet Wt) Selenium (Se)	mg/kg	0.350	0.325	0.339	0.010	9733299
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Sodium (Na)	mg/kg	966	578	739	2.0	9733299
Total (Wet Wt) Strontium (Sr)	mg/kg	0.580	0.351	0.304	0.010	9733299
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00173	0.00125	0.00201	0.00040	9733299
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Titanium (Ti)	mg/kg	0.450	0.435	0.486	0.020	9733299
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	9733299
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Zinc (Zn)	mg/kg	5.06	6.04	4.97	0.040	9733299
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0685	XC0686	XC0687	XC0688		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-06-P6 19-072-167**	**GN-06-P6 19-072-168**	**GN7-P6 19-072-169**	**GN7-P6 19-072-170**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.47	0.23	0.24	0.35	0.20	9733299
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Arsenic (As)	mg/kg	0.451	0.759	0.618	0.845	0.0040	9733299
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	<0.010	0.010	9733299
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9733299
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0014	0.0034	0.0015	0.0041	0.0010	9733299
Total (Wet Wt) Calcium (Ca)	mg/kg	97.7	64.2	78.6	133	2.0	9733299
Total (Wet Wt) Chromium (Cr)	mg/kg	0.043	0.011	<0.010	0.012	0.010	9733299
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0037	0.0030	0.0039	0.0049	0.0013	9733299
Total (Wet Wt) Copper (Cu)	mg/kg	0.400	0.342	0.394	0.486	0.010	9733299
Total (Wet Wt) Iron (Fe)	mg/kg	3.25	2.93	3.29	4.37	0.25	9733299
Total (Wet Wt) Lead (Pb)	mg/kg	0.0033	0.0014	<0.0010	0.0017	0.0010	9733299
Total (Wet Wt) Magnesium (Mg)	mg/kg	303	317	320	308	0.40	9733299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.086	0.073	0.096	0.098	0.010	9733299
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0329	0.0337	0.0265	0.0421	0.0020	9733299
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	9733299
Total (Wet Wt) Nickel (Ni)	mg/kg	0.014	0.018	0.012	0.020	0.010	9733299
Total (Wet Wt) Phosphorus (P)	mg/kg	2880	2900	2900	3170	2.0	9733299
Total (Wet Wt) Potassium (K)	mg/kg	4060	4110	4230	4420	2.0	9733299
Total (Wet Wt) Selenium (Se)	mg/kg	0.351	0.340	0.322	0.406	0.010	9733299
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9733299
Total (Wet Wt) Sodium (Na)	mg/kg	484	710	759	928	2.0	9733299
Total (Wet Wt) Strontium (Sr)	mg/kg	0.260	0.252	0.246	0.460	0.010	9733299
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00177	0.00162	0.00209	0.00200	0.00040	9733299
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	0.032	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Titanium (Ti)	mg/kg	0.490	0.487	0.494	0.568	0.020	9733299
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	9733299
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	9733299
Total (Wet Wt) Zinc (Zn)	mg/kg	5.30	5.16	5.32	7.53	0.040	9733299
RDL = Reportable Detection Limit							

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0689	XC0690		XC0691		
Sampling Date		2019/07/29	2019/07/29		2019/07/29		
COC Number		08475877	08475877		08475877		
	UNITS	**GN7-P6 19-072-171**	**GN7-P6 19-072-172**	**QC Batch**	**GN7-P5 19-072-173**	**RDL**	**QC Batch**
Total Metals by ICPMS							
Total (Wet Wt) Aluminum (Al)	mg/kg	0.48	0.34	9733299	0.34	0.20	9733502
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	9733299	<0.0010	0.0010	9733502
Total (Wet Wt) Arsenic (As)	mg/kg	1.24	1.13	9733299	0.826	0.0040	9733502
Total (Wet Wt) Barium (Ba)	mg/kg	0.022	<0.010	9733299	<0.010	0.010	9733502
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	9733299	<0.0010	0.0010	9733502
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	9733299	<0.0010	0.0010	9733502
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	9733299	<0.20	0.20	9733502
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0052	0.0028	9733299	0.0112	0.0010	9733502
Total (Wet Wt) Calcium (Ca)	mg/kg	791 (1)	88.7	9733299	143	2.0	9733502
Total (Wet Wt) Chromium (Cr)	mg/kg	0.017	0.025	9733299	0.010	0.010	9733502
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0030	0.0033	9733299	0.0053	0.0013	9733502
Total (Wet Wt) Copper (Cu)	mg/kg	0.514	0.388	9733299	0.317	0.010	9733502
Total (Wet Wt) Iron (Fe)	mg/kg	3.75	4.06	9733299	3.80	0.25	9733502
Total (Wet Wt) Lead (Pb)	mg/kg	0.0022	0.0015	9733299	0.0014	0.0010	9733502
Total (Wet Wt) Magnesium (Mg)	mg/kg	282	274	9733299	301	0.40	9733502
Total (Wet Wt) Manganese (Mn)	mg/kg	0.190 (1)	0.060	9733299	0.104	0.010	9733502
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0301	0.0530	9733299	0.0679	0.0020	9733502
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	9733299	<0.0040	0.0040	9733502
Total (Wet Wt) Nickel (Ni)	mg/kg	0.014	<0.010	9733299	<0.010	0.010	9733502
Total (Wet Wt) Phosphorus (P)	mg/kg	3300	2790	9733299	2970	2.0	9733502
Total (Wet Wt) Potassium (K)	mg/kg	4150	3940	9733299	4110	2.0	9733502
Total (Wet Wt) Selenium (Se)	mg/kg	0.357	0.450	9733299	0.375	0.010	9733502
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010 (2)	<0.0010	9733299	<0.0010	0.0010	9733502
Total (Wet Wt) Sodium (Na)	mg/kg	700	505	9733299	793	2.0	9733502
Total (Wet Wt) Strontium (Sr)	mg/kg	1.72 (1)	0.203	9733299	0.433	0.010	9733502
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00168	0.00196	9733299	0.00339	0.00040	9733502
Total (Wet Wt) Tin (Sn)	mg/kg	0.028	<0.020	9733299	<0.020	0.020	9733502
Total (Wet Wt) Titanium (Ti)	mg/kg	0.551	0.464	9733299	0.464	0.020	9733502
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	9733299	<0.00040	0.00040	9733502
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	9733299	<0.020	0.020	9733502
Total (Wet Wt) Zinc (Zn)	mg/kg	5.68	4.82	9733299	7.27	0.040	9733502

RDL = Reportable Detection Limit

(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.

(2) Matrix Spike exceeds acceptance limits - Re-analysis yields similar results.

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0692	XC0693	XC0694		
Sampling Date		2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877		
	UNITS	**GN7-P5 19-072-174**	**GN7-P5 19-072-175**	**GN7-P5 19-072-176**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.25	<0.20	0.49	0.20	9733502
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Arsenic (As)	mg/kg	0.945	0.795	0.721	0.0040	9733502
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.010	9733502
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733502
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0084	0.0052	0.0207	0.0010	9733502
Total (Wet Wt) Calcium (Ca)	mg/kg	211	123	102	2.0	9733502
Total (Wet Wt) Chromium (Cr)	mg/kg	0.011	0.022	<0.010	0.010	9733502
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0062	0.0042	0.0054	0.0013	9733502
Total (Wet Wt) Copper (Cu)	mg/kg	0.363	0.530	0.566	0.010	9733502
Total (Wet Wt) Iron (Fe)	mg/kg	3.03	3.70	5.12	0.25	9733502
Total (Wet Wt) Lead (Pb)	mg/kg	0.0021	0.0011	0.0013	0.0010	9733502
Total (Wet Wt) Magnesium (Mg)	mg/kg	303	292	286	0.40	9733502
Total (Wet Wt) Manganese (Mn)	mg/kg	0.118	0.096	0.091	0.010	9733502
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0552	0.0487	0.0362	0.0020	9733502
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733502
Total (Wet Wt) Nickel (Ni)	mg/kg	0.010	0.011	0.024	0.010	9733502
Total (Wet Wt) Phosphorus (P)	mg/kg	3020	2940	2920	2.0	9733502
Total (Wet Wt) Potassium (K)	mg/kg	4250	4270	4130	2.0	9733502
Total (Wet Wt) Selenium (Se)	mg/kg	0.535	0.400	0.368	0.010	9733502
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Sodium (Na)	mg/kg	675	581	516	2.0	9733502
Total (Wet Wt) Strontium (Sr)	mg/kg	0.467	0.307	0.396	0.010	9733502
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00233	0.00299	0.00232	0.00040	9733502
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733502
Total (Wet Wt) Titanium (Ti)	mg/kg	0.516	0.485	0.471	0.020	9733502
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	9733502
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733502
Total (Wet Wt) Zinc (Zn)	mg/kg	8.15	7.28	6.95	0.040	9733502
RDL = Reportable Detection Limit						

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0695	XC0696	XC0697		
Sampling Date		2019/08/22	2019/08/22	2019/09/02		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-09-ARCH-6 19-072-177**	**GN-09-ARCH-7 19-072-178**	**FN02-ARCH 19-072-179**	**RDL**	**QC Batch**
Total Metals by ICPMS						
Total (Wet Wt) Aluminum (Al)	mg/kg	0.45	<0.20	0.37	0.20	9733502
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Arsenic (As)	mg/kg	0.989	1.12	0.838	0.0040	9733502
Total (Wet Wt) Barium (Ba)	mg/kg	0.036	<0.010	<0.010	0.010	9733502
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	0.20	9733502
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0087	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Calcium (Ca)	mg/kg	208	161	205	2.0	9733502
Total (Wet Wt) Chromium (Cr)	mg/kg	0.013	0.012	0.018	0.010	9733502
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0029	0.0035	0.0024	0.0013	9733502
Total (Wet Wt) Copper (Cu)	mg/kg	0.311	0.401	0.442	0.010	9733502
Total (Wet Wt) Iron (Fe)	mg/kg	4.47	2.94	3.95	0.25	9733502
Total (Wet Wt) Lead (Pb)	mg/kg	0.0012	<0.0010	0.0027	0.0010	9733502
Total (Wet Wt) Magnesium (Mg)	mg/kg	333	343	345	0.40	9733502
Total (Wet Wt) Manganese (Mn)	mg/kg	0.088	0.084	0.111	0.010	9733502
Total (Wet Wt) Mercury (Hg)	mg/kg	0.102	0.0343	0.0322	0.0020	9733502
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	9733502
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	0.010	9733502
Total (Wet Wt) Phosphorus (P)	mg/kg	3190	3190	3010	2.0	9733502
Total (Wet Wt) Potassium (K)	mg/kg	4920	4890	4720	2.0	9733502
Total (Wet Wt) Selenium (Se)	mg/kg	0.325	0.380	0.355	0.010	9733502
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	0.0010	9733502
Total (Wet Wt) Sodium (Na)	mg/kg	534	475	717	2.0	9733502
Total (Wet Wt) Strontium (Sr)	mg/kg	0.306	0.416	0.582	0.010	9733502
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00229	0.00230	0.00249	0.00040	9733502
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	9733502
Total (Wet Wt) Titanium (Ti)	mg/kg	0.544	0.518	0.491	0.020	9733502
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	0.00040	9733502
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	0.020	9733502
Total (Wet Wt) Zinc (Zn)	mg/kg	8.67	6.51	8.21	0.040	9733502
RDL = Reportable Detection Limit						

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PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0651	XC0652	XC0653	XC0654		
Sampling Date		2019/07/27	2019/07/27	2019/07/27	2019/07/27		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-01-1 19-072-133**	**GN-01-3 19-072-134**	**GN-01-2 19-072-135**	**GN-03-3 19-072-136**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	69	73	66	61	0.30	9734692
RDL = Reportable Detection Limit							

BV Labs ID		XC0655	XC0656	XC0657	XC0658		
Sampling Date		2019/07/27	2019/07/27	2019/07/27	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-03-2 19-072-137**	**GN-03-1 19-072-138**	**GN-03-4 19-072-139**	**GN-05-P1 19-072-140**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	61	72	65	63	0.30	9734692
RDL = Reportable Detection Limit							

BV Labs ID		XC0659	XC0660	XC0661	XC0662		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-05-P3 19-072-141**	**GN-05-P3 19-072-142**	**GN-05-P3 19-072-143**	**GN-05-P3 19-072-144**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	72	75	73	0.30	9734692
RDL = Reportable Detection Limit							

BV Labs ID		XC0663	XC0664	XC0665	XC0666		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-05-P3 19-072-145**	**GN-05-P3 19-072-146**	**GN-05-P5 19-072-147**	**GN-05-P5 19-072-148**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	75	67	78	63	0.30	9734692
RDL = Reportable Detection Limit							

BV Labs ID		XC0667	XC0668	XC0669	XC0670		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-05-P2 19-072-149**	**GN-05-P2 19-072-150**	**GN-05-P4 19-072-151**	**GN-05-P4 19-072-152**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	76	71	76	70	0.30	9734692
RDL = Reportable Detection Limit							

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PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0671	XC0672	XC0673	XC0674		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-05-P4 19-072-153**	**GN-05-P4 19-072-154**	**GN-05-P4 19-072-155**	**GN7-P1 19-072-156**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	63	79	74	74	0.30	9734874
RDL = Reportable Detection Limit							

BV Labs ID		XC0675	XC0676	XC0677	XC0678		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P1 19-072-157**	**GN7-P2 19-072-158**	**GN7-P2 19-072-159**	**GN7-P3 19-072-160**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	79	73	68	71	0.30	9734874
RDL = Reportable Detection Limit							

BV Labs ID		XC0679	XC0680	XC0681	XC0682		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P3 19-072-161**	**GN7-P3 19-072-162**	**GN-06-P6 19-072-163**	**GN-06-P6 19-072-164**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	69	77	72	70	0.30	9734874
RDL = Reportable Detection Limit							

BV Labs ID		XC0683	XC0684	XC0685	XC0686		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN-06-P6 19-072-165**	**GN-06-P6 19-072-166**	**GN-06-P6 19-072-167**	**GN-06-P6 19-072-168**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	69	70	68	69	0.30	9734874
RDL = Reportable Detection Limit							

BV Labs ID		XC0687	XC0688	XC0689	XC0690		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P6 19-072-169**	**GN7-P6 19-072-170**	**GN7-P6 19-072-171**	**GN7-P6 19-072-172**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	72	68	66	63	0.30	9734874
RDL = Reportable Detection Limit							

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PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0691	XC0692	XC0693	XC0694		
Sampling Date		2019/07/29	2019/07/29	2019/07/29	2019/07/29		
COC Number		08475877	08475877	08475877	08475877		
	UNITS	**GN7-P5 19-072-173**	**GN7-P5 19-072-174**	**GN7-P5 19-072-175**	**GN7-P5 19-072-176**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	74	73	71	65	0.30	9734980

RDL = Reportable Detection Limit

BV Labs ID		XC0695	XC0696	XC0697		
Sampling Date		2019/08/22	2019/08/22	2019/09/02		
COC Number		08475877	08475877	08475877		
	UNITS	**GN-09-ARCH-6 19-072-177**	**GN-09-ARCH-7 19-072-178**	**FN02-ARCH 19-072-179**	**RDL**	**QC Batch**
Physical Properties						
Moisture	%	74	72	76	0.30	9734980

RDL = Reportable Detection Limit

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9733297	Total (Wet Wt) Aluminum (Al)	2020/01/17					<0.20	mg/kg	15 (7)	40	114	75 - 125
9733297	Total (Wet Wt) Antimony (Sb)	2020/01/17	97 (1)	75 - 125	103	75 - 125	<0.0010	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Arsenic (As)	2020/01/17	113 (1)	75 - 125	112	75 - 125	<0.0040	mg/kg	5.2 (7)	40	110	75 - 125
9733297	Total (Wet Wt) Barium (Ba)	2020/01/17	114 (1)	75 - 125	130 (4)	75 - 125	<0.010	mg/kg	0.50 (7)	40		
9733297	Total (Wet Wt) Beryllium (Be)	2020/01/17	99 (1)	75 - 125	109	75 - 125	<0.0010	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Bismuth (Bi)	2020/01/17					<0.0010	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Boron (B)	2020/01/17					<0.20	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Cadmium (Cd)	2020/01/17	97 (1)	75 - 125	110	75 - 125	<0.0010	mg/kg	22 (7)	40	100	75 - 125
9733297	Total (Wet Wt) Calcium (Ca)	2020/01/17					<2.0	mg/kg	91 (2,7)	60		
9733297	Total (Wet Wt) Chromium (Cr)	2020/01/17	93 (1)	75 - 125	112	75 - 125	<0.010	mg/kg	NC (7)	40	81	75 - 125
9733297	Total (Wet Wt) Cobalt (Co)	2020/01/17	90 (1)	75 - 125	110	75 - 125	<0.0013	mg/kg	3.1 (7)	40	96	75 - 125
9733297	Total (Wet Wt) Copper (Cu)	2020/01/17	92 (1)	75 - 125	111	75 - 125	<0.010	mg/kg	1.5 (7)	40	93	75 - 125
9733297	Total (Wet Wt) Iron (Fe)	2020/01/17					<0.25	mg/kg	10 (7)	40	101	75 - 125
9733297	Total (Wet Wt) Lead (Pb)	2020/01/17	100 (1)	75 - 125	122	75 - 125	<0.0010	mg/kg	9.5 (7)	40	57 (3)	75 - 125
9733297	Total (Wet Wt) Magnesium (Mg)	2020/01/17					<0.40	mg/kg	1.4 (7)	40		
9733297	Total (Wet Wt) Manganese (Mn)	2020/01/17	97 (1)	75 - 125	115	75 - 125	<0.010	mg/kg	50 (2,7)	40		
9733297	Total (Wet Wt) Mercury (Hg)	2020/01/17	91 (1)	75 - 125	100	75 - 125	<0.0020	mg/kg	0.28 (7)	40	97	75 - 125
9733297	Total (Wet Wt) Molybdenum (Mo)	2020/01/17	96 (1)	75 - 125	105	75 - 125	<0.0040	mg/kg	NC (7)	40	101	75 - 125
9733297	Total (Wet Wt) Nickel (Ni)	2020/01/17	90 (1)	75 - 125	113	75 - 125	<0.010	mg/kg	0.94 (7)	40	88	75 - 125
9733297	Total (Wet Wt) Phosphorus (P)	2020/01/17					<2.0	mg/kg	4.1 (7)	40	105	75 - 125
9733297	Total (Wet Wt) Potassium (K)	2020/01/17					<2.0	mg/kg	1.3 (7)	40		
9733297	Total (Wet Wt) Selenium (Se)	2020/01/17	110 (1)	75 - 125	113	75 - 125	<0.010	mg/kg	2.1 (7)	40	111	75 - 125
9733297	Total (Wet Wt) Silver (Ag)	2020/01/17	44 (2,1)	75 - 125	55 (4)	75 - 125	<0.0010	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Sodium (Na)	2020/01/17					<2.0	mg/kg	1.1 (7)	40	104	75 - 125
9733297	Total (Wet Wt) Strontium (Sr)	2020/01/17	115 (1)	75 - 125	117	75 - 125	<0.010	mg/kg	84 (2,7)	60		
9733297	Total (Wet Wt) Thallium (Tl)	2020/01/17	99 (1)	75 - 125	111	75 - 125	<0.00040	mg/kg	7.8 (7)	40		
9733297	Total (Wet Wt) Tin (Sn)	2020/01/17	92 (1)	75 - 125	105	75 - 125	<0.020	mg/kg	NC (7)	40	148 (3)	75 - 125
9733297	Total (Wet Wt) Titanium (Ti)	2020/01/17	91 (1)	75 - 125	104	75 - 125	<0.020	mg/kg	3.0 (7)	40		
9733297	Total (Wet Wt) Uranium (U)	2020/01/17	100 (1)	75 - 125	118	75 - 125	<0.00040	mg/kg	NC (7)	40	112	75 - 125
9733297	Total (Wet Wt) Vanadium (V)	2020/01/17	96 (1)	75 - 125	111	75 - 125	<0.020	mg/kg	NC (7)	40		
9733297	Total (Wet Wt) Zinc (Zn)	2020/01/17	NC (1)	75 - 125	130 (4)	75 - 125	0.217, RDL=0.040 (6)	mg/kg	5.4 (7)	40	96	75 - 125
9733299	Total (Wet Wt) Aluminum (Al)	2020/01/17					<0.20	mg/kg	NC (11)	40	99	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9733299	Total (Wet Wt) Antimony (Sb)	2020/01/17	105 (8)	75 - 125	102	75 - 125	<0.0010	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Arsenic (As)	2020/01/17	NC (8)	75 - 125	105	75 - 125	<0.0040	mg/kg	2.9 (11)	40	102	75 - 125
9733299	Total (Wet Wt) Barium (Ba)	2020/01/17	118 (8)	75 - 125	124	75 - 125	<0.010	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Beryllium (Be)	2020/01/17	102 (8)	75 - 125	102	75 - 125	<0.0010	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Bismuth (Bi)	2020/01/17					<0.0010	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Boron (B)	2020/01/17					<0.20	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Cadmium (Cd)	2020/01/17	105 (8)	75 - 125	105	75 - 125	<0.0010	mg/kg	26 (11)	40	97	75 - 125
9733299	Total (Wet Wt) Calcium (Ca)	2020/01/17					<2.0	mg/kg	122 (2,11)	60		
9733299	Total (Wet Wt) Chromium (Cr)	2020/01/17	100 (8)	75 - 125	109	75 - 125	<0.010	mg/kg	39 (11)	40	92	75 - 125
9733299	Total (Wet Wt) Cobalt (Co)	2020/01/17	99 (8)	75 - 125	107	75 - 125	<0.0013	mg/kg	3.7 (11)	40	89	75 - 125
9733299	Total (Wet Wt) Copper (Cu)	2020/01/17	81 (8)	75 - 125	109	75 - 125	<0.010	mg/kg	21 (11)	40	87	75 - 125
9733299	Total (Wet Wt) Iron (Fe)	2020/01/17					<0.25	mg/kg	26 (11)	40	95	75 - 125
9733299	Total (Wet Wt) Lead (Pb)	2020/01/17	107 (8)	75 - 125	118	75 - 125	<0.0010	mg/kg	20 (11)	40	53 (9)	75 - 125
9733299	Total (Wet Wt) Magnesium (Mg)	2020/01/17					<0.40	mg/kg	17 (11)	40		
9733299	Total (Wet Wt) Manganese (Mn)	2020/01/17	91 (8)	75 - 125	110	75 - 125	<0.010	mg/kg	58 (2,11)	40		
9733299	Total (Wet Wt) Mercury (Hg)	2020/01/17	97 (8)	75 - 125	103	75 - 125	<0.0020	mg/kg	2.9 (11)	40	93	75 - 125
9733299	Total (Wet Wt) Molybdenum (Mo)	2020/01/17	105 (8)	75 - 125	104	75 - 125	<0.0040	mg/kg	NC (11)	40	97	75 - 125
9733299	Total (Wet Wt) Nickel (Ni)	2020/01/17	97 (8)	75 - 125	110	75 - 125	<0.010	mg/kg	6.2 (11)	40	93	75 - 125
9733299	Total (Wet Wt) Phosphorus (P)	2020/01/17					<2.0	mg/kg	4.8 (11)	40	97	75 - 125
9733299	Total (Wet Wt) Potassium (K)	2020/01/17					<2.0	mg/kg	7.7 (11)	40		
9733299	Total (Wet Wt) Selenium (Se)	2020/01/17	110 (8)	75 - 125	105	75 - 125	<0.010	mg/kg	0.25 (11)	40	104	75 - 125
9733299	Total (Wet Wt) Silver (Ag)	2020/01/17	48 (2,8)	75 - 125	50 (4)	75 - 125	<0.0010	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Sodium (Na)	2020/01/17					<2.0	mg/kg	5.7 (11)	40	98	75 - 125
9733299	Total (Wet Wt) Strontium (Sr)	2020/01/17	NC (8)	75 - 125	107	75 - 125	<0.010	mg/kg	114 (2,11)	60		
9733299	Total (Wet Wt) Thallium (Tl)	2020/01/17	105 (8)	75 - 125	110	75 - 125	<0.00040	mg/kg	2.9 (11)	40		
9733299	Total (Wet Wt) Tin (Sn)	2020/01/17	101 (8)	75 - 125	103	75 - 125	<0.020	mg/kg	21 (11)	40	119	75 - 125
9733299	Total (Wet Wt) Titanium (Ti)	2020/01/17	95 (8)	75 - 125	103	75 - 125	<0.020	mg/kg	0.13 (11)	40		
9733299	Total (Wet Wt) Uranium (U)	2020/01/17	109 (8)	75 - 125	116	75 - 125	<0.00040	mg/kg	NC (11)	40	105	75 - 125
9733299	Total (Wet Wt) Vanadium (V)	2020/01/17	102 (8)	75 - 125	106	75 - 125	<0.020	mg/kg	NC (11)	40		
9733299	Total (Wet Wt) Zinc (Zn)	2020/01/17	NC (8)	75 - 125	112	75 - 125	0.215, RDL=0.040 (10)	mg/kg	2.9 (11)	40	89	75 - 125
9733502	Total (Wet Wt) Aluminum (Al)	2020/01/17					<0.20	mg/kg	30 (14)	40	97	75 - 125

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9733502	Total (Wet Wt) Antimony (Sb)	2020/01/17	106 (12)	75 - 125	101	75 - 125	<0.0010	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Arsenic (As)	2020/01/17	119 (12)	75 - 125	108	75 - 125	<0.0040	mg/kg	1.4 (14)	40	101	75 - 125
9733502	Total (Wet Wt) Barium (Ba)	2020/01/17	125 (12)	75 - 125	126 (4)	75 - 125	<0.010	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Beryllium (Be)	2020/01/17	104 (12)	75 - 125	104	75 - 125	<0.0010	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Bismuth (Bi)	2020/01/17					<0.0010	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Boron (B)	2020/01/17					<0.20	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Cadmium (Cd)	2020/01/17	109 (12)	75 - 125	109	75 - 125	<0.0010	mg/kg	19 (14)	40	97	75 - 125
9733502	Total (Wet Wt) Calcium (Ca)	2020/01/17					<2.0	mg/kg	5.0 (14)	60		
9733502	Total (Wet Wt) Chromium (Cr)	2020/01/17	105 (12)	75 - 125	112	75 - 125	<0.010	mg/kg	2.2 (14)	40	75	75 - 125
9733502	Total (Wet Wt) Cobalt (Co)	2020/01/17	104 (12)	75 - 125	112	75 - 125	<0.0013	mg/kg	7.9 (14)	40	92	75 - 125
9733502	Total (Wet Wt) Copper (Cu)	2020/01/17	100 (12)	75 - 125	113	75 - 125	<0.010	mg/kg	3.4 (14)	40	90	75 - 125
9733502	Total (Wet Wt) Iron (Fe)	2020/01/17					<0.25	mg/kg	5.9 (14)	40	97	75 - 125
9733502	Total (Wet Wt) Lead (Pb)	2020/01/17	111 (12)	75 - 125	123	75 - 125	<0.0010	mg/kg	17 (14)	40	54 (9)	75 - 125
9733502	Total (Wet Wt) Magnesium (Mg)	2020/01/17					<0.40	mg/kg	0.50 (14)	40		
9733502	Total (Wet Wt) Manganese (Mn)	2020/01/17	107 (12)	75 - 125	115	75 - 125	<0.010	mg/kg	11 (14)	40		
9733502	Total (Wet Wt) Mercury (Hg)	2020/01/17	NC (12)	75 - 125	102	75 - 125	<0.0020	mg/kg	2.9 (14)	40	96	75 - 125
9733502	Total (Wet Wt) Molybdenum (Mo)	2020/01/17	108 (12)	75 - 125	103	75 - 125	<0.0040	mg/kg	NC (14)	40	94	75 - 125
9733502	Total (Wet Wt) Nickel (Ni)	2020/01/17	104 (12)	75 - 125	114	75 - 125	<0.010	mg/kg	NC (14)	40	85	75 - 125
9733502	Total (Wet Wt) Phosphorus (P)	2020/01/17					<2.0	mg/kg	1.6 (14)	40	100	75 - 125
9733502	Total (Wet Wt) Potassium (K)	2020/01/17					<2.0	mg/kg	0.75 (14)	40		
9733502	Total (Wet Wt) Selenium (Se)	2020/01/17	119 (12)	75 - 125	107	75 - 125	<0.010	mg/kg	5.4 (14)	40	104	75 - 125
9733502	Total (Wet Wt) Silver (Ag)	2020/01/17	52 (13,12)	75 - 125	51 (4)	75 - 125	<0.0010	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Sodium (Na)	2020/01/17					<2.0	mg/kg	0.92 (14)	40	99	75 - 125
9733502	Total (Wet Wt) Strontium (Sr)	2020/01/17	104 (12)	75 - 125	110	75 - 125	<0.010	mg/kg	6.2 (14)	60		
9733502	Total (Wet Wt) Thallium (Tl)	2020/01/17	110 (12)	75 - 125	110	75 - 125	<0.00040	mg/kg	1.8 (14)	40		
9733502	Total (Wet Wt) Tin (Sn)	2020/01/17	102 (12)	75 - 125	102	75 - 125	<0.020	mg/kg	NC (14)	40	115	75 - 125
9733502	Total (Wet Wt) Titanium (Ti)	2020/01/17	100 (12)	75 - 125	102	75 - 125	<0.020	mg/kg	3.4 (14)	40		
9733502	Total (Wet Wt) Uranium (U)	2020/01/17	115 (12)	75 - 125	119	75 - 125	<0.00040	mg/kg	NC (14)	40	105	75 - 125
9733502	Total (Wet Wt) Vanadium (V)	2020/01/17	108 (12)	75 - 125	110	75 - 125	<0.020	mg/kg	NC (14)	40		
9733502	Total (Wet Wt) Zinc (Zn)	2020/01/17	NC (12)	75 - 125	118	75 - 125	0.064, RDL=0.040 (10)	mg/kg	11 (14)	40	93	75 - 125
9734692	Moisture	2020/01/16					<0.30	%	0.14 (15)	20		

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9734874	Moisture	2020/01/16					<0.30	%	1.3 (16)	20		
9734980	Moisture	2020/01/16					<0.30	%	0.61 (17)	20		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Matrix Spike Parent ID [XC0651-01]

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(3) Reference outside acceptance criteria - re-analysis yields similar results

(4) Blank Spike outside acceptance criteria - re-analysis yields similar results.

(5) Duplicate Parent ID

(6) Method Blank exceeds acceptance limits for Zn. Sample values for Zn are >10x the concentration of the method blank and the contamination is considered irrelevant

(7) Duplicate Parent ID [XC0651-01]

(8) Matrix Spike Parent ID [XC0689-01]

(9) Reference outside acceptance criteria - re-analysis yields similar results.

(10) Method Blank exceeds acceptance limits for Zn. Sample values for Zn are >10x the concentration of the method blank and the contamination is considered irrelevant.

(11) Duplicate Parent ID [XC0689-01]

(12) Matrix Spike Parent ID [XC0691-01]

(13) Matrix Spike exceeds acceptance limits - Re-analysis yields similar results.

(14) Duplicate Parent ID [XC0691-01]

(15) Duplicate Parent ID [XC0656-01]

(16) Duplicate Parent ID [XC0677-01]

(17) Duplicate Parent ID [XC0694-01]

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

biologica

08475877

Client:	Golder - Baffinlands (Char)
Project:	ms19-072

Client Sample ID	Sample Date	Replicate	Biologica Sample ID
GN-01-1	27-Jul-19	1	19-072-133
GN-01-3	27-Jul-19	1	19-072-134
GN-01-2	27-Jul-19	1	19-072-135
GN-03-3	27-Jul-19	1	19-072-136
GN-03-2	27-Jul-19	1	19-072-137
GN-03-1	27-Jul-19	1	19-072-138
GN-03-4	27-Jul-19	1	19-072-139
GN-05-P1	29-Jul-19	1	19-072-140
GN-05-P3	29-Jul-19	1	19-072-141
GN-05-P3	29-Jul-19	2	19-072-142
GN-05-P3	29-Jul-19	3	19-072-143
GN-05-P3	29-Jul-19	4	19-072-144
GN-05-P3	29-Jul-19	5	19-072-145
GN-05-P3	29-Jul-19	6	19-072-146
GN-05-P5	29-Jul-19	1	19-072-147
GN-05-P5	29-Jul-19	2	19-072-148
GN-05-P2	29-Jul-19	1	19-072-149
GN-05-P2	29-Jul-19	2	19-072-150
GN-05-P4	29-Jul-19	1	19-072-151
GN-05-P4	29-Jul-19	2	19-072-152
GN-05-P4	29-Jul-19	3	19-072-153
GN-05-P4	29-Jul-19	4	19-072-154
GN-05-P4	29-Jul-19	5	19-072-155
GN7-P1	29-Jul-19	1	19-072-156
GN7-P1	29-Jul-19	2	19-072-157
GN7-P2	29-Jul-19	1	19-072-158
GN7-P2	29-Jul-19	2	19-072-159
GN7-P3	29-Jul-19	1	19-072-160
GN7-P3	29-Jul-19	2	19-072-161
GN7-P3	29-Jul-19	3	19-072-162
GN-06-P6	29-Jul-19	1	19-072-163
GN-06-P6	29-Jul-19	2	19-072-164
GN-06-P6	29-Jul-19	3	19-072-165
GN-06-P6	29-Jul-19	4	19-072-166
GN-06-P6	29-Jul-19	5	19-072-167
GN-06-P6	29-Jul-19	6	19-072-168
GN7-P6	29-Jul-19	1	19-072-169
GN7-P6	29-Jul-19	2	19-072-170
GN7-P6	29-Jul-19	3	19-072-171
GN7-P6	29-Jul-19	4	19-072-172
GN7-P5	29-Jul-19	1	19-072-173
GN7-P5	29-Jul-19	2	19-072-174
GN7-P5	29-Jul-19	3	19-072-175
GN7-P5	29-Jul-19	4	19-072-176
GN-09-ARCH-6	22-Aug-19	1	19-072-177
GN-09-ARCH-7	22-Aug-19	1	19-072-178
FN02-ARCH	2-Sep-19	1	19-072-179

B9A5905_COC

KEM CHL
2019/12/10 08:10
Temp : 4, 4, 3

E:\Golder\2019\19-072 Baffinlands\19-072 Golder-Baffinlands Sample Inventory (Bureau Veritas)

1312

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information
Company: Golder Associates Ltd.
Contact Name: Philippe Rouget
Address: 2920 Virtual Way #200
Burnaby, BC PC: V5M 0C4
Phone/Fax: 1-250-881-7372
Email: Philippe_Rouget@golder.com
Copies:

Report Information (if differs from invoice)
Company: Golder Associates Ltd.
Contact Name: Christine Bylenga
Address:
PC:
Phone/Fax:
Email: Christine_Bylenga@golder.com
Copies:

Project Information
Quotation: Per Melissa McIntosh at Bureau Veritas
P.O. #/AFE#: Metals analysis - fish tissue
Project #: Golder Project # 1663724-24000 Task 03
Site Location: (Relinquished to Bureau Veritas by Biologica)
Site #:
Sampled By:

Turnaround Time (TAT) Required
5 - 7 Days Regular (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
Same Day ☐ 2 Days
1 Day ☐ 3-4 Days
Date Required:
Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria
☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
1	19-072-133	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
2	19-072-134	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
3	19-072-135	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
4	19-072-136	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
5	19-072-137	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
6	19-072-138	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
7	19-072-139	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
8	19-072-140	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
9	19-072-141	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
10	19-072-142	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
11	19-072-143	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
12	19-072-144	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
13	19-072-145	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
14	19-072-146	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
15	19-072-147	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
16	19-072-148	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
17	19-072-149	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
18	19-072-150	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
19	19-072-151	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
20	19-072-152	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	☐ Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	☐ 1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID	
Seal Present				
Seal Intact			Temp	
Cooling Media				
	YES	NO	Cooler ID	
Seal Present				
Seal Intact			Temp	
Cooling Media				
	YES	NO	Cooler ID	
Seal Present				
Seal Intact			Temp	
Cooling Media				

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
21	19-072-153	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
22	19-072-154	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
23	19-072-155	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
24	19-072-156	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
25	19-072-157	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
26	19-072-158	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
27	19-072-159	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
28	19-072-160	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
29	19-072-161	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
30	19-072-162	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
31	19-072-163	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
32	19-072-164	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
33	19-072-165	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
34	19-072-166	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
35	19-072-167	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
36	19-072-168	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
37	19-072-169	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
38	19-072-170	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
39	19-072-171	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
40	19-072-172	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

COC-1020BL

BBY FCD-00077/1

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
41	19-072-173	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
42	19-072-174	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
43	19-072-175	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
44	19-072-176	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
45	19-072-177	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
46	19-072-178	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
47	19-072-179	2019-09-02	n/a	Tissue	1	x		Arctic Char; metals by wet weight
48	19-072-180	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
49	19-072-181	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
50	19-072-182	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
51	19-072-183	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
52	19-072-184	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
53	19-072-185	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
54	19-072-186	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
55	19-072-187	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
56	19-072-188	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
57	19-072-189	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
58	19-072-190	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
59	19-072-191	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
60	19-072-192	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

COC-1020BL

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Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria
- ☐ BC CSR
- ☐ YK CSR
- ☐ CCME
- ☐ Drinking Water
- ☐ BC Water Quality
- ☐ Other

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
61	19-072-193	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
62	19-072-194	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
63	19-072-195	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
64	19-072-196	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
65	19-072-197	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
66	19-072-198	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
67	19-072-199	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
68	19-072-200	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
69	19-072-201	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
70	19-072-202	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
71	19-072-203	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
72	19-072-204	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
73	19-072-205	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
74	19-072-206	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
75	19-072-207	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
76	19-072-208	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
77	19-072-209	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis - fish tissue	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
1	19-072-133	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
2	19-072-134	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
3	19-072-135	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
4	19-072-136	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
5	19-072-137	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
6	19-072-138	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
7	19-072-139	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
8	19-072-140	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
9	19-072-141	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
10	19-072-142	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
11	19-072-143	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
12	19-072-144	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
13	19-072-145	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
14	19-072-146	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
15	19-072-147	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
16	19-072-148	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
17	19-072-149	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
18	19-072-150	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
19	19-072-151	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
20	19-072-152	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	☐ Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	☐ 1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

	YES	NO	Cooler ID			
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Analysis Requested | **Regulatory Criteria**

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
21	19-072-153	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
22	19-072-154	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
23	19-072-155	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
24	19-072-156	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
25	19-072-157	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
26	19-072-158	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
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28	19-072-160	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
29	19-072-161	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
30	19-072-162	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
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32	19-072-164	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
33	19-072-165	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
34	19-072-166	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
35	19-072-167	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
36	19-072-168	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
37	19-072-169	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
38	19-072-170	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
39	19-072-171	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
40	19-072-172	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

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CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
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Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Analysis Requested

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
41	19-072-173	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
42	19-072-174	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
43	19-072-175	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
44	19-072-176	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
45	19-072-177	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
46	19-072-178	2019-08-22	n/a	Tissue	1	x		Arctic Char; metals by wet weight
47	19-072-179	2019-09-02	n/a	Tissue	1	x		Arctic Char; metals by wet weight
48	19-072-180	2019-07-27	n/a	Tissue	1	x		Arctic Char; metals by wet weight
49	19-072-181	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
50	19-072-182	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
51	19-072-183	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
52	19-072-184	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
53	19-072-185	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
54	19-072-186	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
55	19-072-187	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
56	19-072-188	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
57	19-072-189	2019-07-29	n/a	Tissue	1	x		Arctic Char; metals by wet weight
58	19-072-190	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
59	19-072-191	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
60	19-072-192	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
Jerry Thomson, Biologica	2019/12/13					

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5 Toll Free (800) 665 8566
Victoria: 460 Tennyson Place, Unit 1, Victoria, BC V8Z 6S8 Toll Free (866) 385-6112
bvlabs.com

CHAIN OF CUSTODY RECORD

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company:	Golder Associates Ltd.	Company:	Golder Associates Ltd.	Quotation	Per Melissa McIntosh at Bureau Veritas	5 - 7 Days Regular (Most analyses)
Contact Name:	Philippe Rouget	Contact Name:	Christine Bylenga	P.O. #/AFE#:	Metals analysis	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2920 Virtual Way #200	Address:				Rush TAT (Surcharges will be applied)
	Burnaby, BC PC: V5M 0C4		PC:	Project #:	Golder Project # 1663724-24000 Task 03	Same Day ☐ 2 Days
Phone/Fax:	1-250-881-7372	Phone/Fax:		Site Location:	(Relinquished to Bureau Veritas by Biologica)	1 Day ☐ 3-4 Days
Email:	Philippe_Rouget@golder.com	Email:	Christine_Bylenga@golder.com	Site #:		Date Required:
Copies:		Copies:		Sampled By:		Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			
	YES	NO	Cooler ID
Seal Present			
Seal Intact			Temp
Cooling Media			

Depot Reception

Regulatory Criteria

☐ BC CSR
☐ YK CSR
☐ CCME
☐ Drinking Water
☐ BC Water Quality
☐ Other

Analysis Requested

#	Sample Identification	Date Sampled (yyyy/mm/dd)	Time Sampled (hh:mm)	Matrix	# of Containers	Total Metals	HOLD - DO NOT ANALYZE	Special Instructions
61	19-072-193	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
62	19-072-194	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
63	19-072-195	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
64	19-072-196	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
65	19-072-197	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
66	19-072-198	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
67	19-072-199	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
68	19-072-200	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
69	19-072-201	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
70	19-072-202	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
71	19-072-203	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
72	19-072-204	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
73	19-072-205	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
74	19-072-206	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
75	19-072-207	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
76	19-072-208	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight
77	19-072-209	2019-07-29	n/a	Tissue	1	x		Sculpin; metals by wet weight

Relinquished by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	Received by: (Signature/ Print)	Date (yyyy/mm/dd):	Time (hh:mm):	BV Job #
[signature] Jenny Thomson, Biologica	2019/12/13					

COC-1020BL

BBY FCD-00077/1

GOLDER ASSOCIATES LTD

BV Labs Job Number: B9A5905
Client Project #: 1663724-24000 TASK 03
Report Date: 2020/01/20

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0651	XC0652	XC0653	XC0654	XC0655	XC0656	XC0657	XC0658	XC0659	XC0660	XC0661	XC0662
Sampling Date		2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29
COC Number		08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877
	UNITS	**GN-01-1 19-072-133**	**GN-01-3 19-072-134**	**GN-01-2 19-072-135**	**GN-03-3 19-072-136**	**GN-03-2 19-072-137**	**GN-03-1 19-072-138**	**GN-03-4 19-072-139**	**GN-05-P1 19-072-140**	**GN-05-P3 19-072-141**	**GN-05-P3 19-072-142**	**GN-05-P3 19-072-143**	**GN-05-P3 19-072-144**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	0.41	0.42	0.37	0.42	0.25	0.20	0.54	2.50	0.45	9.48	0.69	0.79
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Arsenic (As)	mg/kg	0.924	0.795	1.01	0.890	0.855	2.85	0.826	0.970	0.351	0.818	0.510	0.615
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	0.010	0.011	<0.010	0.017	0.021
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0019	0.0091	0.0038	0.0014	0.0019	0.0030	0.0026	0.0020	0.0071	0.0080	0.0053	0.0081
Total (Wet Wt) Calcium (Ca)	mg/kg	101 (1)	145	91.4	60.7	60.6	74.1	91.8	107	196	121	173	160
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	0.029	0.012	0.010	0.012	0.015	0.019	0.019	0.019	0.013	0.036
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0038	0.0042	0.0067	0.0037	0.0034	0.0026	0.0043	0.0050	0.0047	0.0115	0.0026	0.0064
Total (Wet Wt) Copper (Cu)	mg/kg	0.343	0.321	0.739	0.437	0.338	0.320	0.425	0.345	0.519	0.507	0.384	0.560
Total (Wet Wt) Iron (Fe)	mg/kg	2.62	3.11	5.96	3.63	2.46	3.27	4.17	7.45	6.29	20.6	3.96	5.46
Total (Wet Wt) Lead (Pb)	mg/kg	<0.0010	<0.0010	0.0019	0.0010	<0.0010	<0.0010	<0.0010	0.0027	0.0016	0.0013	0.0015	0.0029
Total (Wet Wt) Magnesium (Mg)	mg/kg	296	322	277	282	258	282	283	280	298	302	303	295
Total (Wet Wt) Manganese (Mn)	mg/kg	0.089 (1)	0.102	0.111	0.079	0.083	0.072	0.082	0.120	0.105	0.316	0.088	0.109
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0470	0.0472	0.0345	0.0315	0.0389	0.0688	0.0500	0.0273	0.104	0.0672	0.0456	0.0392
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Total (Wet Wt) Nickel (Ni)	mg/kg	0.016	<0.010	0.020	0.015	0.013	<0.010	<0.010	0.020	0.010	0.016	0.010	0.015
Total (Wet Wt) Phosphorus (P)	mg/kg	3040	3200	2960	2920	2750	2920	2980	2710	2890	3030	2630	2780
Total (Wet Wt) Potassium (K)	mg/kg	4350	4720	4200	4060	3890	4550	4270	3930	3770	4430	3370	3470
Total (Wet Wt) Selenium (Se)	mg/kg	0.369	0.379	0.364	0.339	0.307	0.420	0.422	0.349	0.469	0.526	0.465	0.387
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010 (2)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Sodium (Na)	mg/kg	435	445	400	313	442	435	382	497	866	692	916	839
Total (Wet Wt) Strontium (Sr)	mg/kg	0.300 (1)	0.390	0.268	0.140	0.139	0.140	0.158	0.330	0.721	0.411	0.720	0.675
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00184	0.00294	0.00221	0.00195	0.00147	0.00176	0.00227	0.00156	0.00476	0.00444	0.00217	0.00284
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Titanium (Ti)	mg/kg	0.520	0.574	0.506	0.483	0.464	0.516	0.508	0.484	0.496	0.540	0.449	0.475
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00047	<0.00040	0.00091	<0.00040	0.00050
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	5.71	5.68	6.96	5.07	4.53	4.63	4.69	6.12	9.87	8.06	12.6	10.6

RDL = Reportable Detection Limit

(1) Duplicate RPD above control limit - Non-homogenous sample - Reanalysis yields similar results.

(2) Matrix Spike exceeds acceptance limits - Re-analysis yields similar results.

Results relate only to the items tested.

BV Labs ID		XC0663	XC0664	XC0665	XC0666	XC0667	XC0668	XC0669	XC0670		XC0671	XC0672	XC0673
Sampling Date		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		2019-07-29	2019-07-29	2019-07-29
COC Number		08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877		08475877	08475877	08475877
	UNITS	**GN-05-P3 19-072-145**	**GN-05-P3 19-072-146**	**GN-05-P5 19-072-147**	**GN-05-P5 19-072-148**	**GN-05-P2 19-072-149**	**GN-05-P2 19-072-150**	**GN-05-P4 19-072-151**	**GN-05-P4 19-072-152**	**QC Batch**	**GN-05-P4 19-072-153**	**GN-05-P4 19-072-154**	**GN-05-P4 19-072-155**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	0.77	0.32	0.70	0.34	0.52	0.34	0.29	0.54	9733297	0.46	0.35	0.98
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733297	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Arsenic (As)	mg/kg	0.531	0.682	0.605	0.869	0.602	0.509	0.488	0.665	9733297	0.961	0.957	0.853
Total (Wet Wt) Barium (Ba)	mg/kg	0.012	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	9733297	0.015	<0.010	0.013
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733297	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733297	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	9733297	<0.20	<0.20	<0.20
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0215	0.0020	0.0066	0.0014	0.0079	0.0027	0.0119	0.0235	9733297	0.0123	0.0045	0.0093
Total (Wet Wt) Calcium (Ca)	mg/kg	173	56.9	188	298	210	164	190	170	9733297	174	174	165
Total (Wet Wt) Chromium (Cr)	mg/kg	0.012	<0.010	0.014	<0.010	0.034	<0.010	0.014	0.014	9733297	0.021	0.011	0.015
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0057	0.0035	0.0043	0.0039	0.0051	0.0033	0.0057	0.0130	9733297	0.0062	0.0069	0.0056
Total (Wet Wt) Copper (Cu)	mg/kg	0.394	0.392	0.417	0.365	0.390	0.329	0.466	0.539	9733297	0.516	0.323	0.375
Total (Wet Wt) Iron (Fe)	mg/kg	4.35	2.88	8.72	2.79	3.80	2.30	5.65	5.08	9733297	4.95	5.10	5.00
Total (Wet Wt) Lead (Pb)	mg/kg	0.0021	0.0010	0.0054	0.0013	0.0020	0.0016	0.0014	0.0022	9733297	0.0018	0.0015	0.0031
Total (Wet Wt) Magnesium (Mg)	mg/kg	321	291	298	287	306	314	314	286	9733297	257	301	299
Total (Wet Wt) Manganese (Mn)	mg/kg	0.090	0.066	0.080	0.126	0.084	0.090	0.099	0.105	9733297	0.090	0.069	0.105
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0646	0.0398	0.0637	0.0411	0.0423	0.0843	0.0932	0.0767	9733297	0.0260	0.0913	0.0626
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	9733297	<0.0040	<0.0040	<0.0040
Total (Wet Wt) Nickel (Ni)	mg/kg	0.010	<0.010	0.012	0.014	0.015	0.012	0.012	0.020	9733297	0.017	<0.010	0.016
Total (Wet Wt) Phosphorus (P)	mg/kg	2870	2730	2620	2860	2670	2900	2670	2760	9733297	2490	2520	2720
Total (Wet Wt) Potassium (K)	mg/kg	3820	3680	3360	3750	3360	4130	3440	3430	9733297	2960	3570	3520
Total (Wet Wt) Selenium (Se)	mg/kg	0.467	0.345	0.432	0.364	0.477	0.638	0.491	0.519	9733297	0.373	0.305	0.558
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733297	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Sodium (Na)	mg/kg	787	600	1160	452	1180	685	1110	873	9733297	722	1240	899
Total (Wet Wt) Strontium (Sr)	mg/kg	0.661	0.224	0.696	0.647	0.720	0.348	0.719	0.557	9733297	0.706	0.756	0.702
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00303	0.00201	0.00216	0.00186	0.00181	0.00305	0.00503	0.00345	9733297	0.00124	0.00363	0.00185
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	9733297	<0.020	<0.020	<0.020
Total (Wet Wt) Titanium (Ti)	mg/kg	0.500	0.473	0.470	0.472	0.471	0.494	0.453	0.471	9733297	0.416	0.422	0.475
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	0.00044	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	9733297	<0.00040	<0.00040	<0.00040
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	9733297	<0.020	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	13.1	5.38	10.2	5.16	11.0	5.34	7.28	13.0	9733297	7.51	12.2	12.0

BV Labs ID		XC0674	XC0675	XC0676	XC0677	XC0678	XC0679	XC0680	XC0681	XC0682	XC0683	XC0684	XC0685
Sampling Date		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29
COC Number		08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877
	UNITS	**GN7-P1 19-072-156**	**GN7-P1 19-072-157**	**GN7-P2 19-072-158**	**GN7-P2 19-072-159**	**GN7-P3 19-072-160**	**GN7-P3 19-072-161**	**GN7-P3 19-072-162**	**GN-06-P6 19-072-163**	**GN-06-P6 19-072-164**	**GN-06-P6 19-072-165**	**GN-06-P6 19-072-166**	**GN-06-P6 19-072-167**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	0.73	0.32	0.55	0.60	0.22	0.29	0.41	0.64	0.32	0.30	0.31	0.47
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Arsenic (As)	mg/kg	0.558	0.329	0.500	0.840	0.811	0.761	0.349	0.702	1.01	0.456	0.811	0.451
Total (Wet Wt) Barium (Ba)	mg/kg	0.016	0.024	<0.010	<0.010	<0.010	0.010	0.014	0.017	<0.010	<0.010	<0.010	<0.010
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0055	0.0045	0.0083	0.0055	0.0029	0.0057	0.0077	0.0080	0.0011	0.0047	0.0045	0.0014
Total (Wet Wt) Calcium (Ca)	mg/kg	172	469	203	96.7	283	101	166	147	139	104	96.7	97.7
Total (Wet Wt) Chromium (Cr)	mg/kg	0.015	0.029	<0.010	0.017	0.011	<0.010	0.016	0.012	<0.010	<0.010	<0.010	0.043
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0035	0.0068	0.0098	0.0035	0.0030	0.0056	0.0047	0.0056	0.0067	0.0042	0.0034	0.0037
Total (Wet Wt) Copper (Cu)	mg/kg	0.453	0.307	0.438	0.285	0.373	0.440	0.370	0.516	0.318	0.423	0.359	0.400
Total (Wet Wt) Iron (Fe)	mg/kg	4.50	5.60	5.08	2.92	3.06	3.82	4.00	4.87	2.54	3.17	3.23	3.25
Total (Wet Wt) Lead (Pb)	mg/kg	0.0033	0.0019	0.0030	0.0018	0.0012	0.0034	0.0022	0.0028	0.0015	0.0017	0.0013	0.0033
Total (Wet Wt) Magnesium (Mg)	mg/kg	327	330	315	280	320	312	298	366	310	292	343	303
Total (Wet Wt) Manganese (Mn)	mg/kg	0.102	0.122	0.098	0.090	0.105	0.092	0.086	0.123	0.094	0.081	0.085	0.086
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0410	0.126	0.0936	0.0294	0.0386	0.0428	0.0789	0.0351	0.0307	0.0281	0.0265	0.0329
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.021	0.017	0.017	0.012	0.020	0.011	0.016	0.016	0.012	0.013	0.014
Total (Wet Wt) Phosphorus (P)	mg/kg	3020	2840	3030	2810	3120	3020	2770	2670	2640	2610	2910	2880
Total (Wet Wt) Potassium (K)	mg/kg	3960	3750	4030	4090	4210	4350	3720	3580	3440	3490	4130	4060
Total (Wet Wt) Selenium (Se)	mg/kg	0.443	0.229	0.524	0.316	0.357	0.401	0.486	0.344	0.350	0.325	0.339	0.351
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Sodium (Na)	mg/kg	862	1110	757	573	568	664	887	955	966	578	739	484
Total (Wet Wt) Strontium (Sr)	mg/kg	0.644	0.563	0.556	0.311	0.539	0.412	0.503	0.623	0.580	0.351	0.304	0.260
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00210	0.00600	0.00424	0.00165	0.00190	0.00226	0.00251	0.00183	0.00173	0.00125	0.00201	0.00177
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Titanium (Ti)	mg/kg	0.517	0.474	0.514	0.518	0.490	0.519	0.470	0.448	0.450	0.435	0.486	0.490
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00044	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00065	<0.00040	<0.00040	<0.00040	<0.00040
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	12.3	15.1	10.8	5.47	4.43	6.39	8.09	6.54	5.06	6.04	4.97	5.30

BV Labs ID		XC0686	XC0687	XC0688	XC0689	XC0690		XC0691	XC0692	XC0693	XC0694	XC0695	XC0696
Sampling Date		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-08-22	2019-08-22
COC Number		08475877	08475877	08475877	08475877	08475877		08475877	08475877	08475877	08475877	08475877	08475877
	UNITS	**GN-06-P6 19-072-168**	**GN7-P6 19-072-169**	**GN7-P6 19-072-170**	**GN7-P6 19-072-171**	**GN7-P6 19-072-172**	**QC Batch**	**GN7-P5 19-072-173**	**GN7-P5 19-072-174**	**GN7-P5 19-072-175**	**GN7-P5 19-072-176**	**GN-09-ARCH-6 19-072-177**	**GN-09-ARCH-7 19-072-178**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	0.23	0.24	0.35	0.48	0.34	9733299	0.34	0.25	<0.20	0.49	0.45	<0.20
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733299	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Arsenic (As)	mg/kg	0.759	0.618	0.845	1.24	1.13	9733299	0.826	0.945	0.795	0.721	0.989	1.12
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	<0.010	<0.010	0.022	<0.010	9733299	<0.010	<0.010	<0.010	<0.010	0.036	<0.010
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733299	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	9733299	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	9733299	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0034	0.0015	0.0041	0.0052	0.0028	9733299	0.0112	0.0084	0.0052	0.0207	0.0087	<0.0010
Total (Wet Wt) Calcium (Ca)	mg/kg	64.2	78.6	133	791 (1)	88.7	9733299	143	211	123	102	208	161
Total (Wet Wt) Chromium (Cr)	mg/kg	0.011	<0.010	0.012	0.017	0.025	9733299	0.010	0.011	0.022	<0.010	0.013	0.012
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0030	0.0039	0.0049	0.0030	0.0033	9733299	0.0053	0.0062	0.0042	0.0054	0.0029	0.0035
Total (Wet Wt) Copper (Cu)	mg/kg	0.342	0.394	0.486	0.514	0.388	9733299	0.317	0.363	0.530	0.566	0.311	0.401
Total (Wet Wt) Iron (Fe)	mg/kg	2.93	3.29	4.37	3.75	4.06	9733299	3.80	3.03	3.70	5.12	4.47	2.94
Total (Wet Wt) Lead (Pb)	mg/kg	0.0014	<0.0010	0.0017	0.0022	0.0015	9733299	0.0014	0.0021	0.0011	0.0013	0.0012	<0.0010
Total (Wet Wt) Magnesium (Mg)	mg/kg	317	320	308	282	274	9733299	301	303	292	286	333	343
Total (Wet Wt) Manganese (Mn)	mg/kg	0.073	0.096	0.098	0.190 (1)	0.060	9733299	0.104	0.118	0.096	0.091	0.088	0.084
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0337	0.0265	0.0421	0.0301	0.0530	9733299	0.0679	0.0552	0.0487	0.0362	0.102	0.0343
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	9733299	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Total (Wet Wt) Nickel (Ni)	mg/kg	0.018	0.012	0.020	0.014	<0.010	9733299	<0.010	0.010	0.011	0.024	<0.010	<0.010
Total (Wet Wt) Phosphorus (P)	mg/kg	2900	2900	3170	3300	2790	9733299	2970	3020	2940	2920	3190	3190
Total (Wet Wt) Potassium (K)	mg/kg	4110	4230	4420	4150	3940	9733299	4110	4250	4270	4130	4920	4890
Total (Wet Wt) Selenium (Se)	mg/kg	0.340	0.322	0.406	0.357	0.450	9733299	0.375	0.535	0.400	0.368	0.325	0.380
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010 (2)	<0.0010	9733299	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total (Wet Wt) Sodium (Na)	mg/kg	710	759	928	700	505	9733299	793	675	581	516	534	475
Total (Wet Wt) Strontium (Sr)	mg/kg	0.252	0.246	0.460	1.72 (1)	0.203	9733299	0.433	0.467	0.307	0.396	0.306	0.416
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00162	0.00209	0.00200	0.00168	0.00196	9733299	0.00339	0.00233	0.00299	0.00232	0.00229	0.00230
Total (Wet Wt) Tin (Sn)	mg/kg	0.032	<0.020	<0.020	0.028	<0.020	9733299	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Titanium (Ti)	mg/kg	0.487	0.494	0.568	0.551	0.464	9733299	0.464	0.516	0.485	0.471	0.544	0.518
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	9733299	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	9733299	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	5.16	5.32	7.53	5.68	4.82	9733299	7.27	8.15	7.28	6.95	8.67	6.51

BV Labs ID		XC0697		
Sampling Date		2019-09-02		
COC Number		08475877		
	UNITS	**FN02-ARCH 19-072-179**	**RDL**	**QC Batch**
Total Metals by ICPMS				
Total (Wet Wt) Aluminum (Al)	mg/kg	0.37	0.20	9733502
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	0.0010	9733502
Total (Wet Wt) Arsenic (As)	mg/kg	0.838	0.0040	9733502
Total (Wet Wt) Barium (Ba)	mg/kg	<0.010	0.010	9733502
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	0.0010	9733502
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	0.0010	9733502
Total (Wet Wt) Boron (B)	mg/kg	<0.20	0.20	9733502
Total (Wet Wt) Cadmium (Cd)	mg/kg	<0.0010	0.0010	9733502
Total (Wet Wt) Calcium (Ca)	mg/kg	205	2.0	9733502
Total (Wet Wt) Chromium (Cr)	mg/kg	0.018	0.010	9733502
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0024	0.0013	9733502
Total (Wet Wt) Copper (Cu)	mg/kg	0.442	0.010	9733502
Total (Wet Wt) Iron (Fe)	mg/kg	3.95	0.25	9733502
Total (Wet Wt) Lead (Pb)	mg/kg	0.0027	0.0010	9733502
Total (Wet Wt) Magnesium (Mg)	mg/kg	345	0.40	9733502
Total (Wet Wt) Manganese (Mn)	mg/kg	0.111	0.010	9733502
Total (Wet Wt) Mercury (Hg)	mg/kg	0.0322	0.0020	9733502
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	0.0040	9733502
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	0.010	9733502
Total (Wet Wt) Phosphorus (P)	mg/kg	3010	2.0	9733502
Total (Wet Wt) Potassium (K)	mg/kg	4720	2.0	9733502
Total (Wet Wt) Selenium (Se)	mg/kg	0.355	0.010	9733502
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	0.0010	9733502
Total (Wet Wt) Sodium (Na)	mg/kg	717	2.0	9733502
Total (Wet Wt) Strontium (Sr)	mg/kg	0.582	0.010	9733502
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00249	0.00040	9733502
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	0.020	9733502
Total (Wet Wt) Titanium (Ti)	mg/kg	0.491	0.020	9733502
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00040	9733502
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	0.020	9733502
Total (Wet Wt) Zinc (Zn)	mg/kg	8.21	0.040	9733502

BV Labs Job Number: B9A5905
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0651	XC0652	XC0653	XC0654	XC0655	XC0656	XC0657	XC0658	XC0659	XC0660
Sampling Date		2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-27	2019-07-29	2019-07-29	2019-07-29
COC Number		08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877
	UNITS	**GN-01-1 19-072-133**	**GN-01-3 19-072-134**	**GN-01-2 19-072-135**	**GN-03-3 19-072-136**	**GN-03-2 19-072-137**	**GN-03-1 19-072-138**	**GN-03-4 19-072-139**	**GN-05-P1 19-072-140**	**GN-05-P3 19-072-141**	**GN-05-P3 19-072-142**
Physical Properties											
Moisture	%	69	73	66	61	61	72	65	63	76	72

RDL = Reportable Detection Limit

Results relate only to the items tested.

XC0661	XC0662	XC0663	XC0664	XC0665	XC0666	XC0667	XC0668	XC0669	XC0670	
2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	
08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	
GN-05-P3 19-072-143	**GN-05-P3 19-072-144**	**GN-05-P3 19-072-145**	**GN-05-P3 19-072-146**	**GN-05-P5 19-072-147**	**GN-05-P5 19-072-148**	**GN-05-P2 19-072-149**	**GN-05-P2 19-072-150**	**GN-05-P4 19-072-151**	**GN-05-P4 19-072-152**	**QC Batch**
75	73	75	67	78	63	76	71	76	70	9734692

XC0671	XC0672	XC0673	XC0674	XC0675	XC0676	XC0677	XC0678	XC0679	XC0680	XC0681
2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29
08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877
GN-05-P4 19-072-153	**GN-05-P4 19-072-154**	**GN-05-P4 19-072-155**	**GN7-P1 19-072-156**	**GN7-P1 19-072-157**	**GN7-P2 19-072-158**	**GN7-P2 19-072-159**	**GN7-P3 19-072-160**	**GN7-P3 19-072-161**	**GN7-P3 19-072-162**	**GN-06-P6 19-072-163**
63	79	74	74	79	73	68	71	69	77	72

XC0682	XC0683	XC0684	XC0685	XC0686	XC0687	XC0688	XC0689	XC0690		XC0691
2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		2019-07-29
08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877	08475877		08475877
GN-06-P6 19-072-164	**GN-06-P6 19-072-165**	**GN-06-P6 19-072-166**	**GN-06-P6 19-072-167**	**GN-06-P6 19-072-168**	**GN7-P6 19-072-169**	**GN7-P6 19-072-170**	**GN7-P6 19-072-171**	**GN7-P6 19-072-172**	**QC Batch**	**GN7-P5 19-072-173**
70	69	70	68	69	72	68	66	63	9734874	74

XC0692	XC0693	XC0694	XC0695	XC0696	XC0697		
2019-07-29	2019-07-29	2019-07-29	2019-08-22	2019-08-22	2019-09-02		
08475877	08475877	08475877	08475877	08475877	08475877		
GN7-P5 19-072-174	**GN7-P5 19-072-175**	**GN7-P5 19-072-176**	**GN-09-ARCH-6 19-072-177**	**GN-09-ARCH-7 19-072-178**	**FN02-ARCH 19-072-179**	**RDL**	**QC Batch**
73	71	65	74	72	76	0.30	9734980

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

BV Labs ID		XC0600	XC0601	XC0602	XC0603	XC0604	XC0605	XC0606	XC0607	XC0608	XC0609	XC0610
Sampling Date		2019-07-27	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29
COC Number		08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873
	UNITS	**GN-04-1 19-072-180**	**GN-05-P2 19-072-181**	**GN-05-P2 19-072-182**	**GN-05-P2 19-072-183**	**GN-05-P2 19-072-184**	**GN-05-P2 19-072-185**	**GN-05-P3 19-072-186**	**GN-05-P3 19-072-187**	**GN-05-P3 19-072-188**	**GN-05-P4 19-072-189**	**GN-05-P4 19-072-190**
Total Metals by ICPMS												
Total (Wet Wt) Aluminum (Al)	mg/kg	0.79	3.19	11.4	4.06	1.67	2.48	2.61	1.15	1.00	1.18	5.24
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0026	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total (Wet Wt) Arsenic (As)	mg/kg	6.63	0.520	0.513	0.679	0.944	0.952	0.796	1.38	2.03	1.79	1.52
Total (Wet Wt) Barium (Ba)	mg/kg	0.042	0.201	0.400	0.063	0.035	0.082	0.284	0.223	0.172	0.097	0.170
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0013	<0.0013	0.0020	0.0014	0.0020	<0.0013	0.0016	0.0019	0.0020	0.0034	0.0042
Total (Wet Wt) Boron (B)	mg/kg	0.60	0.23	0.28	0.34	0.21	<0.20	0.25	0.22	<0.20	0.22	<0.20
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0055	0.0471	0.0653	0.126	0.0621	0.0169	0.0251	0.0514	0.0109	0.0222	0.0169
Total (Wet Wt) Calcium (Ca)	mg/kg	955	2230	2920	789	519	1370	4290	4030	2470	1460	3450
Total (Wet Wt) Chromium (Cr)	mg/kg	0.102	0.068	0.117	0.031	0.053	<0.025	0.041	<0.025	0.037	<0.025	<0.025
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0045	0.0101	0.0157	0.0125	0.0129	0.0116	0.0090	0.0102	0.0085	0.0068	0.0155
Total (Wet Wt) Copper (Cu)	mg/kg	0.338	0.550	1.03	0.989	0.776	0.646	0.480	0.563	0.278	0.327	0.440
Total (Wet Wt) Iron (Fe)	mg/kg	4.29	7.29	24.4	9.19	6.26	8.72	4.91	8.97	4.98	6.24	14.8
Total (Wet Wt) Lead (Pb)	mg/kg	0.0055	0.0300	0.0389	0.0372	0.0212	0.0170	0.0124	0.0069	0.0067	0.0067	0.0116
Total (Wet Wt) Magnesium (Mg)	mg/kg	232	257	414	259	189	350	363	338	273	308	257
Total (Wet Wt) Manganese (Mn)	mg/kg	0.200	0.473	0.870	0.237	0.149	0.368	0.571	0.519	0.304	0.240	0.519
Total (Wet Wt) Mercury (Hg)	mg/kg	0.152	0.055	0.060	0.074	0.088	0.063	0.077	0.100	0.140	0.186	0.156
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	0.0091	<0.0080	0.0089	<0.0080	<0.0080	0.0124	<0.0080	<0.0080	0.0085
Total (Wet Wt) Nickel (Ni)	mg/kg	0.053	0.033	0.042	0.036	0.028	0.019	0.017	0.025	0.014	0.015	0.044
Total (Wet Wt) Phosphorus (P)	mg/kg	2220	2450	2820	2100	1900	2560	4280	3870	3030	2600	3380
Total (Wet Wt) Potassium (K)	mg/kg	3360	2450	2210	3170	3210	3200	3640	3150	3240	3120	2500
Total (Wet Wt) Selenium (Se)	mg/kg	0.636	0.344	0.428	0.556	0.434	0.452	0.391	0.565	0.473	0.533	0.609
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	0.0013	0.0023	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Total (Wet Wt) Sodium (Na)	mg/kg	1030	1070	1260	1320	1330	1320	1180	1260	1010	1160	1360
Total (Wet Wt) Strontium (Sr)	mg/kg	3.80	11.6	16.7	3.65	2.39	5.93	21.3	21.5	15.5	11.1	23.7
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00049	0.00094	0.00164	0.00136	0.00125	0.00081	0.00227	0.00088	0.00105	0.00178	0.00076
Total (Wet Wt) Tin (Sn)	mg/kg	1.41	0.233	0.168	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.024	<0.020
Total (Wet Wt) Titanium (Ti)	mg/kg	0.28	0.41	0.66	0.35	0.27	0.41	0.69	0.65	0.46	0.41	1.00
Total (Wet Wt) Uranium (U)	mg/kg	0.00045	0.00268	0.00454	0.00210	0.00091	0.00129	0.00328	0.00402	0.00260	0.00311	0.00621
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	12.2	14.7	14.7	14.8	13.8	16.5	17.2	19.8	15.3	19.1	14.3

RDL = Reportable Detection Limit

Results relate only to the items tested.

BV Labs ID		XC0611	XC0612	XC0613	XC0614	XC0615	XC0616	XC0617	XC0618	XC0619		XC0620	XC0621
Sampling Date		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		2019-07-29	2019-07-29
COC Number		08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873		08475873	08475873
	UNITS	**GN-05-P4 19-072-191**	**GN-05-P4 19-072-192**	**GN-05-P5 19-072-193**	**GN-05-P5 19-072-194**	**GN-05-P5 19-072-195**	**GN-05-P5 19-072-196**	**GN7-P3 19-072-197**	**GN7-P3 19-072-198**	**GN-06-P6 19-072-199**	**QC Batch**	**GN-06-P6 19-072-200**	**GN-06-P6 19-072-201**
Total Metals by ICPMS													
Total (Wet Wt) Aluminum (Al)	mg/kg	5.98	3.80	1.36	2.51	4.15	5.59	3.97	1.17	0.75	9735287	1.30	2.03
Total (Wet Wt) Antimony (Sb)	mg/kg	0.0020	0.0021	0.0030	0.0023	0.0028	0.0023	0.0022	<0.0020	<0.0020	9735287	0.0030	<0.0020
Total (Wet Wt) Arsenic (As)	mg/kg	1.23	2.20	1.97	2.71	2.02	2.09	1.38	1.74	1.90	9735287	1.53	2.07
Total (Wet Wt) Barium (Ba)	mg/kg	0.197	0.137	0.108	0.042	0.057	0.223	0.195	0.108	0.215	9735287	0.165	0.030
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	9735287	<0.0020	<0.0020
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0030	0.0033	0.0027	0.0052	0.0025	0.0039	0.0044	<0.0013	0.0034	9735287	0.0037	0.0030
Total (Wet Wt) Boron (B)	mg/kg	0.29	0.22	0.24	0.24	<0.20	0.24	<0.20	<0.20	0.21	9735287	0.27	0.24
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0334	0.0998	0.0060	0.0115	0.0259	0.0113	0.130	0.0240	0.0138	9735287	0.0299	0.0236
Total (Wet Wt) Calcium (Ca)	mg/kg	2800	1940	1860	578	1250	3950	2260	1740	3370	9735287	3650	472
Total (Wet Wt) Chromium (Cr)	mg/kg	0.028	0.030	0.025	0.028	<0.025	<0.025	0.035	<0.025	<0.025	9735287	0.041	0.038
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0125	0.0143	0.0094	0.0102	0.0071	0.0097	0.0097	0.0054	0.0184	9735287	0.0142	0.0162
Total (Wet Wt) Copper (Cu)	mg/kg	0.458	0.744	0.364	0.438	0.371	0.566	0.499	0.293	0.538	9735287	0.731	0.914
Total (Wet Wt) Iron (Fe)	mg/kg	16.2	12.3	5.81	5.78	12.7	12.7	8.83	3.56	9.18	9735287	9.32	12.8
Total (Wet Wt) Lead (Pb)	mg/kg	0.0174	0.0172	0.0138	0.0136	0.0278	0.0262	0.0244	0.0067	0.0112	9735287	0.0163	0.0138
Total (Wet Wt) Magnesium (Mg)	mg/kg	294	257	242	281	254	288	307	272	268	9735287	298	220
Total (Wet Wt) Manganese (Mn)	mg/kg	0.370	0.277	0.356	0.195	0.249	0.408	0.479	0.294	0.453	9735287	0.471	0.180
Total (Wet Wt) Mercury (Hg)	mg/kg	0.184	0.276	0.094	0.180	0.178	0.180	0.107	0.087	0.204	9735287	0.159	0.173
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	9735287	<0.0080	<0.0080
Total (Wet Wt) Nickel (Ni)	mg/kg	0.040	0.042	0.054	0.031	0.025	0.034	0.027	0.014	0.030	9735287	0.028	0.030
Total (Wet Wt) Phosphorus (P)	mg/kg	3300	2530	2520	1830	1840	3610	2690	2500	3200	9735287	3690	1750
Total (Wet Wt) Potassium (K)	mg/kg	3090	2640	2870	2910	2430	2820	2960	2900	2440	9735287	3000	2610
Total (Wet Wt) Selenium (Se)	mg/kg	0.605	0.604	0.403	0.562	0.515	0.526	0.381	0.403	0.594	9735287	0.456	0.602
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	0.0014	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	9735287	<0.0013	<0.0013
Total (Wet Wt) Sodium (Na)	mg/kg	1150	1120	885	1490	1110	966	1050	1050	1560	9735287	1640	1390
Total (Wet Wt) Strontium (Sr)	mg/kg	22.8	13.8	11.4	3.54	6.68	27.9	13.8	8.22	22.1	9735287	23.0	2.88
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00086	0.00080	0.00070	0.00074	<0.00040	0.00088	0.00062	0.00046	0.00098	9735287	0.00071	0.00127
Total (Wet Wt) Tin (Sn)	mg/kg	0.168	0.178	0.199	0.104	0.076	0.079	0.021	<0.020	<0.020	9735287	0.063	0.028
Total (Wet Wt) Titanium (Ti)	mg/kg	0.60	0.44	0.40	0.33	0.35	0.58	0.55	0.41	0.51	9735287	0.59	0.30
Total (Wet Wt) Uranium (U)	mg/kg	0.00861	0.00415	0.00181	0.00093	0.00170	0.00426	0.00777	0.00114	0.00376	9735287	0.00504	0.00198
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	9735287	<0.020	<0.020
Total (Wet Wt) Zinc (Zn)	mg/kg	26.1	22.3	14.6	15.0	14.6	24.1	18.6	13.5	19.8	9735287	22.9	18.3

BV Labs ID		XC0622	XC0623	XC0624	XC0625	XC0626	XC0627	XC0628	XC0629		
Sampling Date		2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		
COC Number		08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873		
	UNITS	**GN-06-P6 19-072-202**	**GN-06-P6 19-072-203**	**GN-06-P6 19-072-204**	**GN-06-P6 19-072-205**	**GN-06-P6 19-072-206**	**GN-06-P6 19-072-207**	**GN-06-P6 19-072-208**	**GN-06-P6 19-072-209**	**RDL**	**QC Batch**
Total Metals by ICPMS											
Total (Wet Wt) Aluminum (Al)	mg/kg	0.97	1.80	0.86	2.95	7.64	1.05	1.57	1.33	0.50	9734293
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0020	<0.0020	0.0022	0.0024	0.0020	0.0021	<0.0020	0.0026	0.0020	9734293
Total (Wet Wt) Arsenic (As)	mg/kg	1.77	2.42	1.97	1.68	1.81	2.32	1.22	2.10	0.0050	9734293
Total (Wet Wt) Barium (Ba)	mg/kg	0.106	0.128	0.176	0.256	0.056	0.153	0.050	0.204	0.010	9734293
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	9734293
Total (Wet Wt) Bismuth (Bi)	mg/kg	0.0041	0.0031	0.0023	0.0026	0.0038	0.0031	0.0037	0.0019	0.0013	9734293
Total (Wet Wt) Boron (B)	mg/kg	0.24	0.23	0.21	0.32	0.26	0.25	<0.20	0.32	0.20	9734293
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0856	0.0169	0.0395	0.0343	0.0267	0.0092	0.0084	0.0206	0.0013	9734293
Total (Wet Wt) Calcium (Ca)	mg/kg	1670	2300	3180	4230	793	2490	704	3300	4.0	9734293
Total (Wet Wt) Chromium (Cr)	mg/kg	0.044	0.073	0.163	0.031	0.040	0.028	<0.025	0.044	0.025	9734293
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0137	0.0119	0.0146	0.0157	0.0144	0.0239	0.0160	0.0120	0.0013	9734293
Total (Wet Wt) Copper (Cu)	mg/kg	0.749	0.470	0.529	0.741	0.936	0.589	0.701	0.642	0.013	9734293
Total (Wet Wt) Iron (Fe)	mg/kg	8.15	8.97	9.30	17.4	17.5	10.1	7.64	8.97	0.25	9734293
Total (Wet Wt) Lead (Pb)	mg/kg	0.0142	0.0544	0.0154	0.0335	0.0256	0.0100	0.0070	0.0124	0.0013	9734293
Total (Wet Wt) Magnesium (Mg)	mg/kg	279	270	289	312	238	265	243	301	0.40	9734293
Total (Wet Wt) Manganese (Mn)	mg/kg	0.271	0.279	0.595	0.472	0.318	0.255	0.191	0.379	0.010	9734293
Total (Wet Wt) Mercury (Hg)	mg/kg	0.143	0.151	0.146	0.150	0.194	0.184	0.137	0.201	0.013	9734293
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	<0.0080	0.0080	9734293
Total (Wet Wt) Nickel (Ni)	mg/kg	0.029	0.024	0.027	0.034	0.030	0.036	0.028	0.033	0.010	9734293
Total (Wet Wt) Phosphorus (P)	mg/kg	2520	2850	3280	4020	2180	2940	1780	3270	2.0	9734293
Total (Wet Wt) Potassium (K)	mg/kg	2900	2700	2460	2970	3090	2880	2280	2600	2.5	9734293
Total (Wet Wt) Selenium (Se)	mg/kg	0.500	0.604	0.563	0.481	0.523	0.544	0.491	0.527	0.010	9734293
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	0.0013	9734293
Total (Wet Wt) Sodium (Na)	mg/kg	1290	1330	1370	1370	1270	1340	1490	1680	2.5	9734293
Total (Wet Wt) Strontium (Sr)	mg/kg	11.9	14.1	21.2	30.2	4.73	18.3	4.38	21.6	0.013	9734293
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00132	0.00054	0.00052	0.00120	0.00108	0.00082	0.00089	0.00062	0.00040	9734293
Total (Wet Wt) Tin (Sn)	mg/kg	0.033	0.030	0.025	0.028	0.022	0.040	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Titanium (Ti)	mg/kg	0.41	0.50	0.50	0.71	0.34	0.47	0.27	0.54	0.13	9734293
Total (Wet Wt) Uranium (U)	mg/kg	0.00282	0.00466	0.0132	0.00807	0.00514	0.0201	0.00192	0.00555	0.00040	9734293
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	9734293
Total (Wet Wt) Zinc (Zn)	mg/kg	22.1	15.7	17.1	26.7	22.8	16.3	16.3	20.5	0.20	9734293

BV Labs Job Number: B9A5897
Report Date: 2020/01/20

GOLDER ASSOCIATES LTD
Client Project #: 1663724-24000 TASK 03

PHYSICAL TESTING (TISSUE)

BV Labs ID		XC0600	XC0601	XC0602	XC0603	XC0604	XC0605	XC0606	XC0607	XC0608	XC0609
Sampling Date		2019-07-27	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29
COC Number		08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873
	UNITS	**GN-04-1 19-072-180**	**GN-05-P2 19-072-181**	**GN-05-P2 19-072-182**	**GN-05-P2 19-072-183**	**GN-05-P2 19-072-184**	**GN-05-P2 19-072-185**	**GN-05-P3 19-072-186**	**GN-05-P3 19-072-187**	**GN-05-P3 19-072-188**	**GN-05-P4 19-072-189**
Physical Properties											
Moisture	%	75	83	85	79	80	77	75	76	78	77

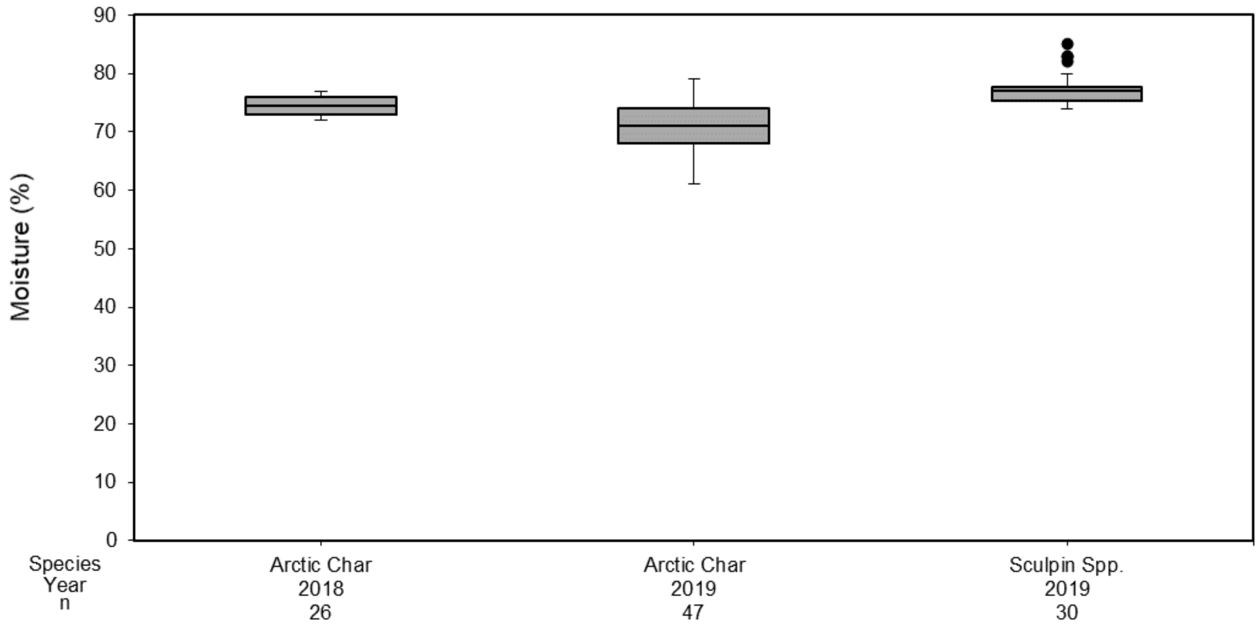
RDL = Reportable Detection Limit

Results relate only to the items tested.

XC0610	XC0611	XC0612	XC0613	XC0614	XC0615	XC0616	XC0617	XC0618	XC0619		XC0620
2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		2019-07-29
08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873		08475873
GN-05-P4 19-072-190	**GN-05-P4 19-072-191**	**GN-05-P4 19-072-192**	**GN-05-P5 19-072-193**	**GN-05-P5 19-072-194**	**GN-05-P5 19-072-195**	**GN-05-P5 19-072-196**	**GN7-P3 19-072-197**	**GN7-P3 19-072-198**	**GN-06-P6 19-072-199**	**QC Batch**	**GN-06-P6 19-072-200**
74	77	77	83	75	82	76	77	77	76	9729707	76

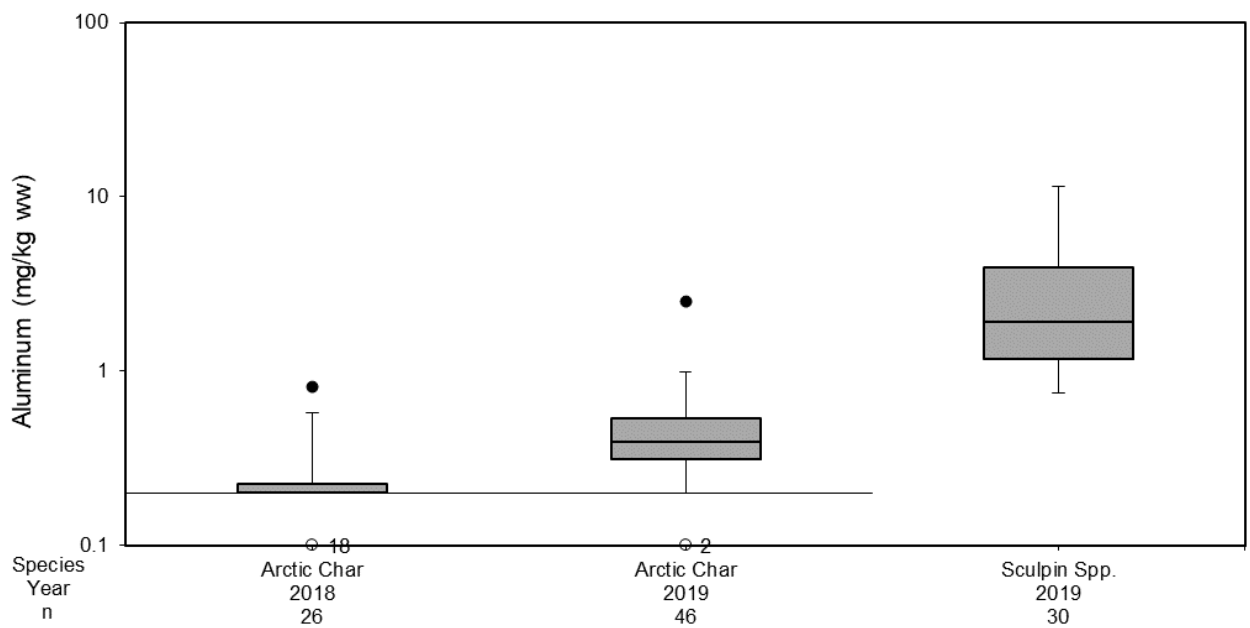
XC0621	XC0622	XC0623	XC0624	XC0625	XC0626	XC0627	XC0628	XC0629		
2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29	2019-07-29		
08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873	08475873		
GN-06-P6 19-072-201	**GN-06-P6 19-072-202**	**GN-06-P6 19-072-203**	**GN-06-P6 19-072-204**	**GN-06-P6 19-072-205**	**GN-06-P6 19-072-206**	**GN-06-P6 19-072-207**	**GN-06-P6 19-072-208**	**GN-06-P6 19-072-209**	**RDL**	**QC Batch**
76	77	74	75	74	75	76	77	79	0.30	9729720

Fish Box Plots



Note: % = percent; n = sample size.

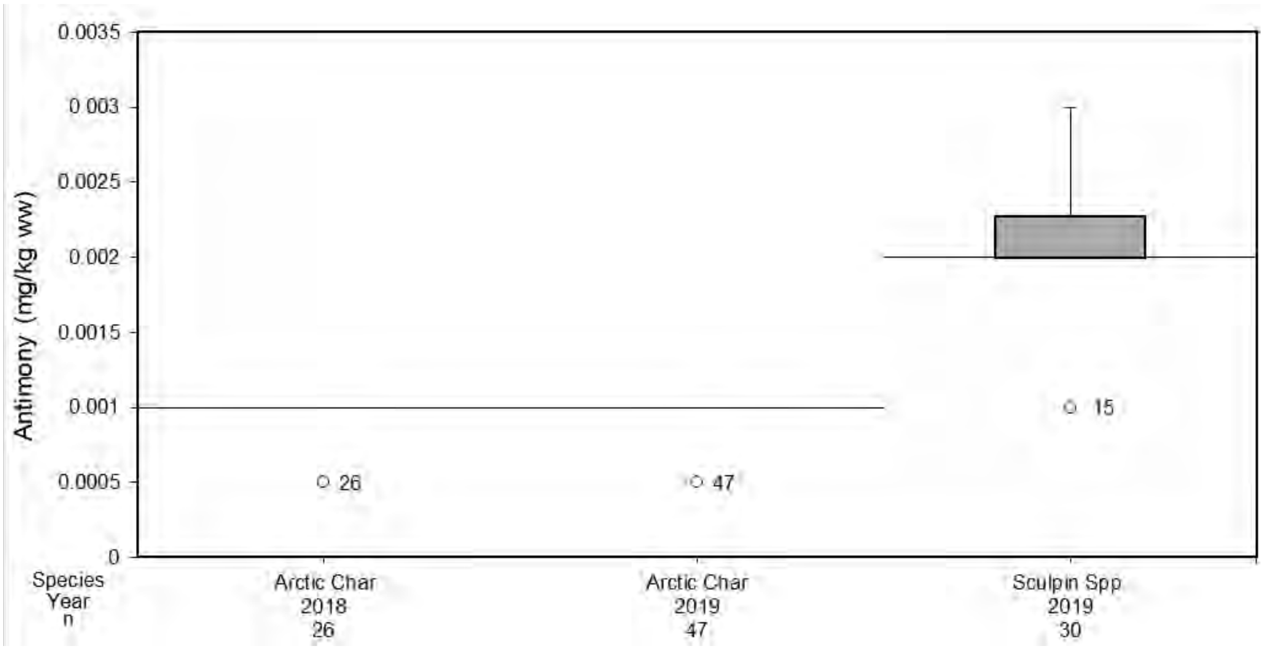
Figure G-4.1: Percent Moisture of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; One statistical outlier removed from the 2019 Arctic Char dataset to aid in data visualization (Sample 19-072-142 value of 9.48); mg/kg ww = milligram per kilogram wet weight; n = sample size.

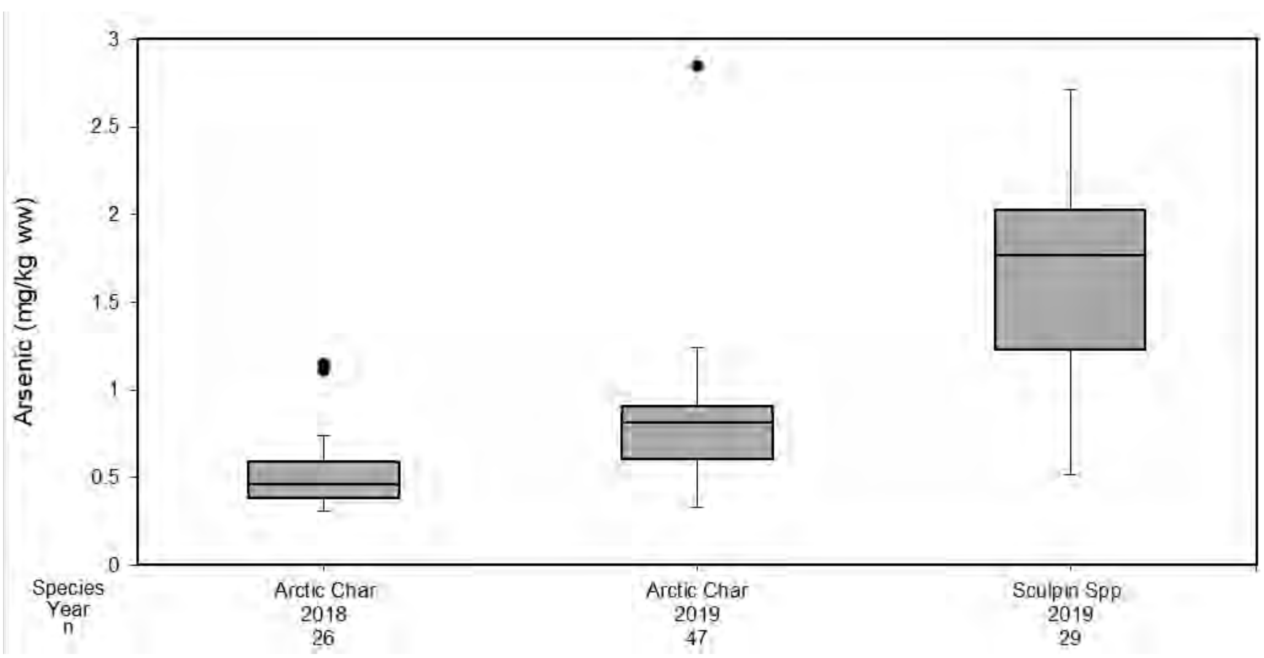
Figure G-4.2: Aluminum Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



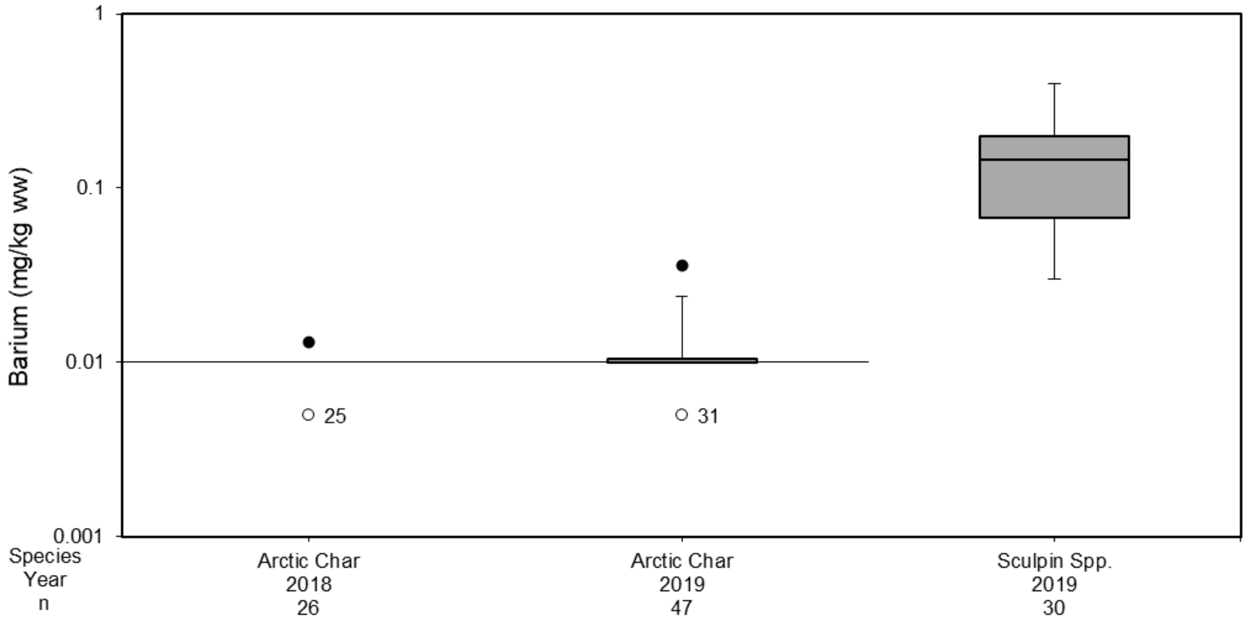
Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.3: Antimony Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



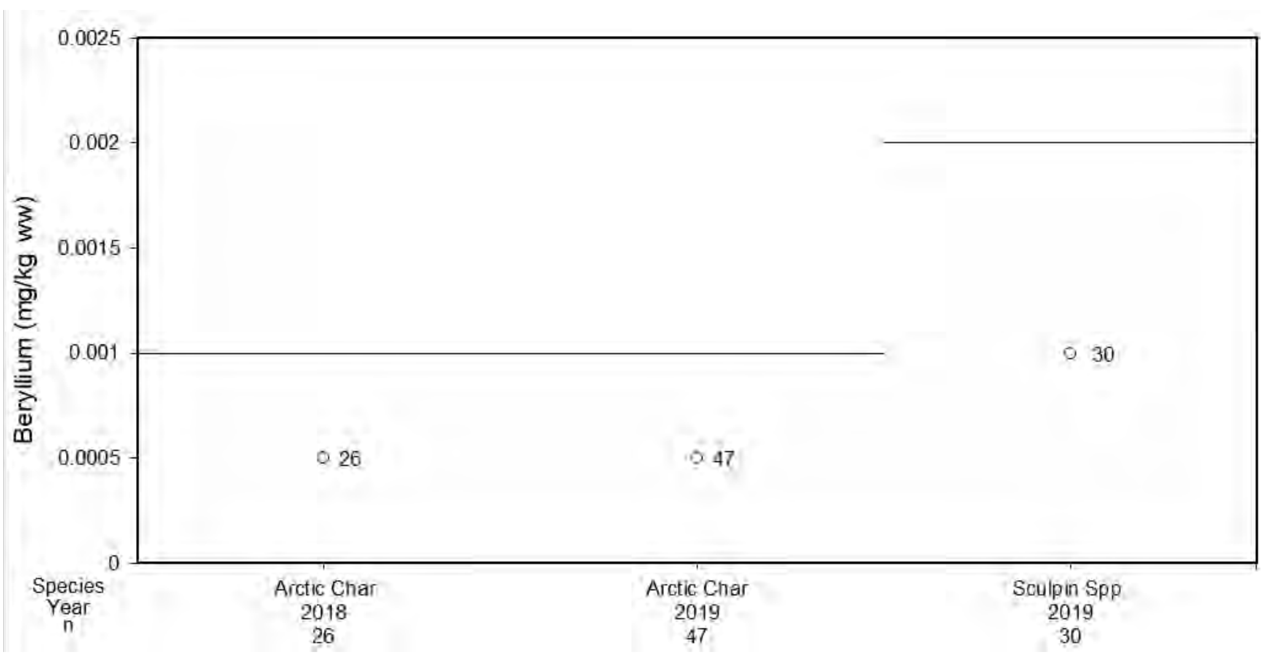
Note: One statistical outlier removed from the 2019 Sculpin Species dataset to aid in data visualization (Sample 19-072-142 value of 20.6); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.4: Arsenic Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



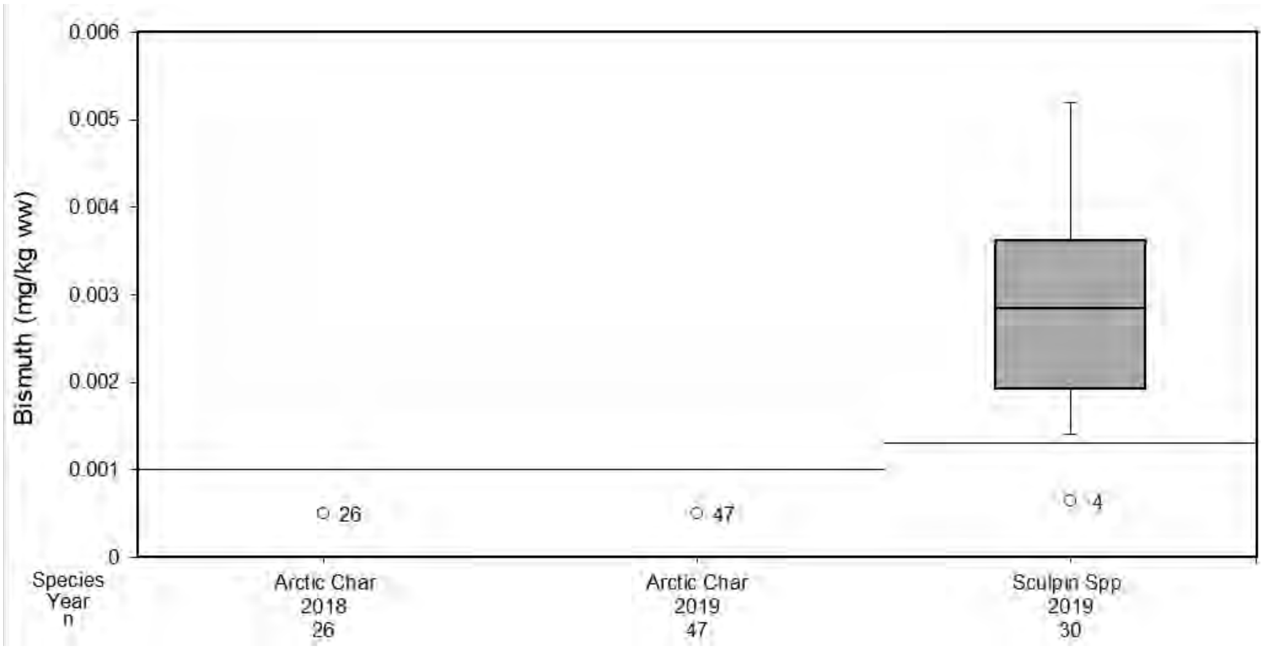
Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.5: Barium Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



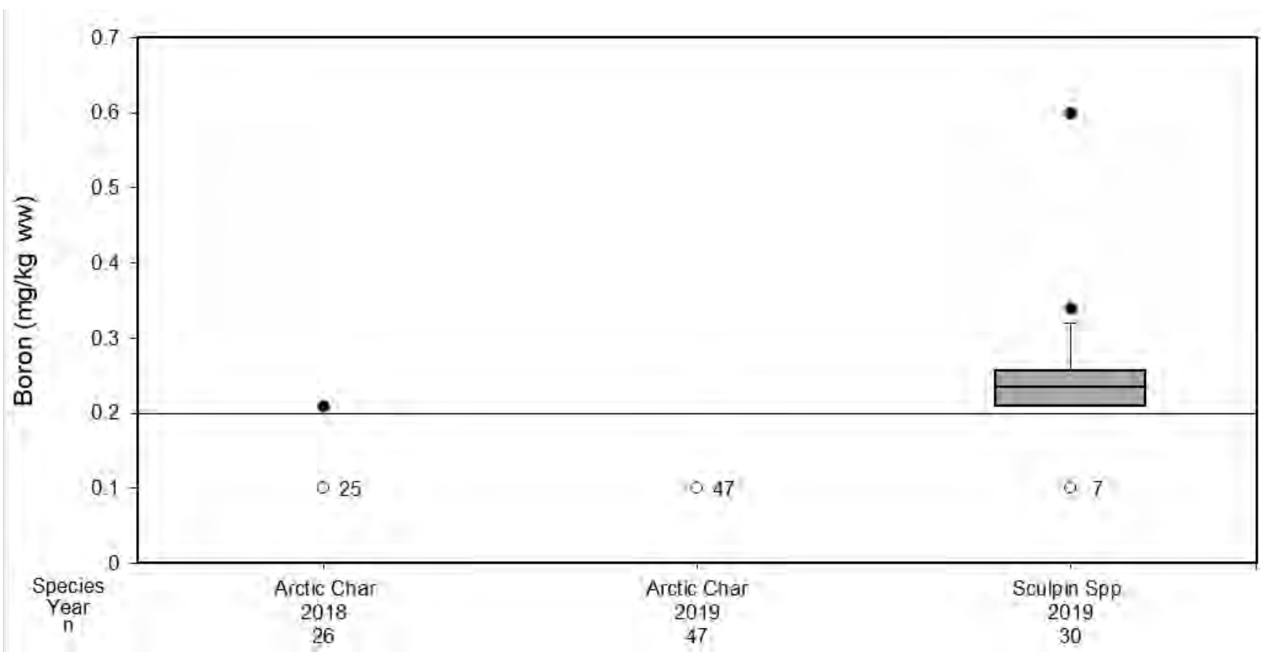
Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.6: Beryllium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



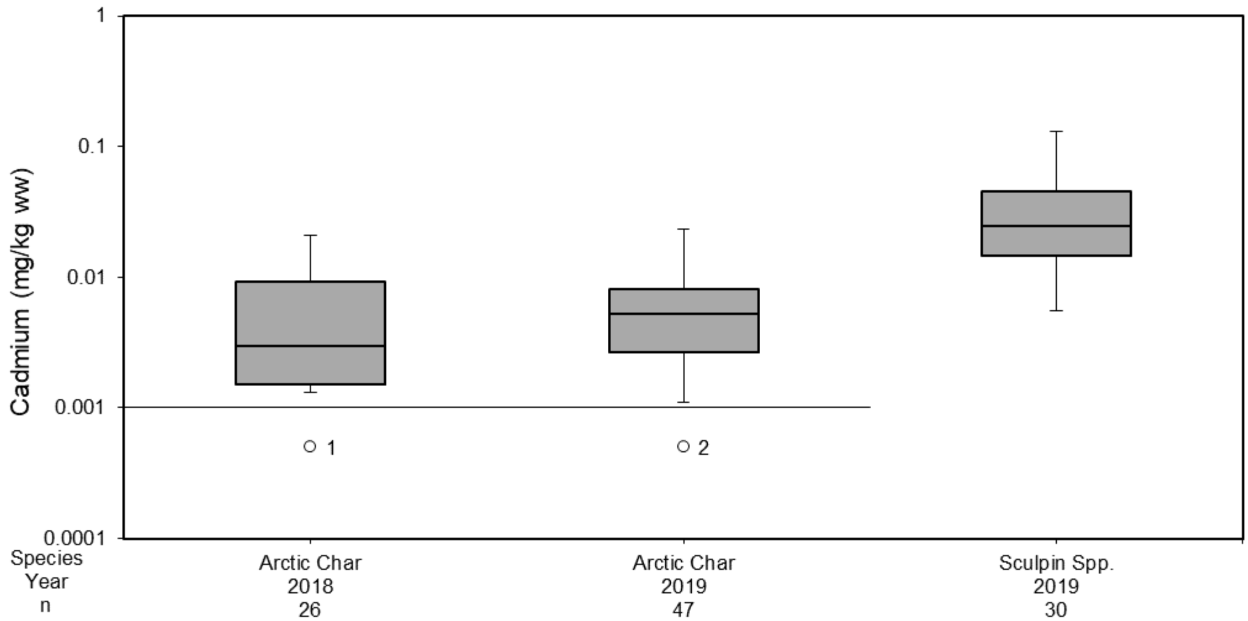
Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.7: Bismuth Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



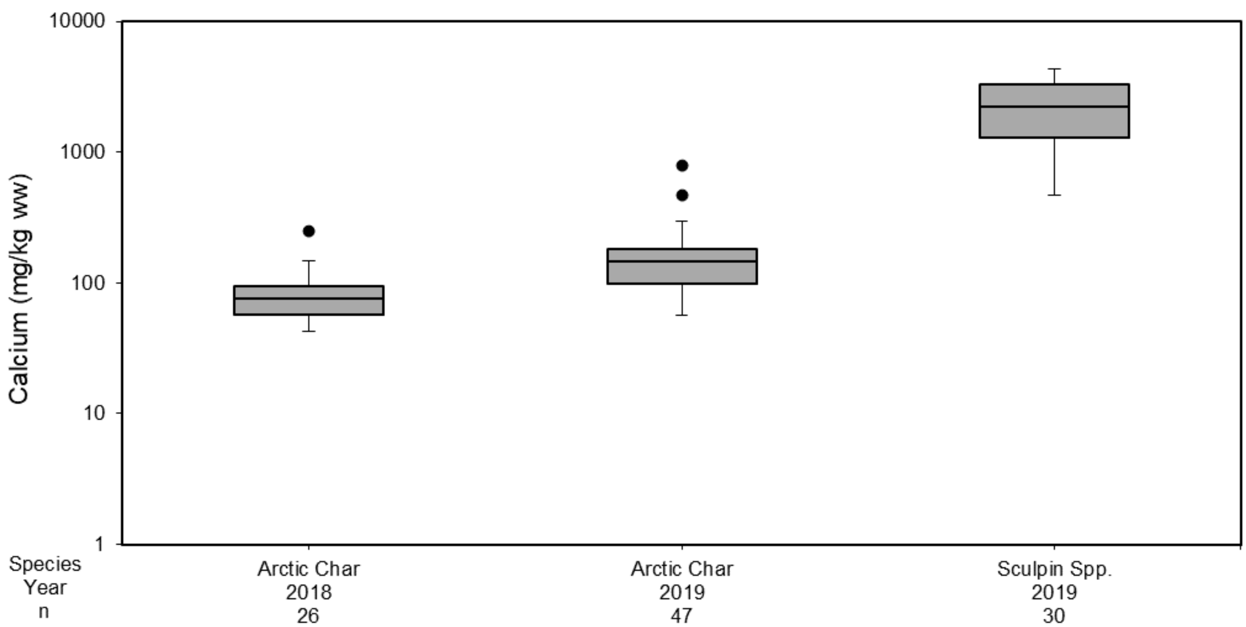
Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.8: Boron Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

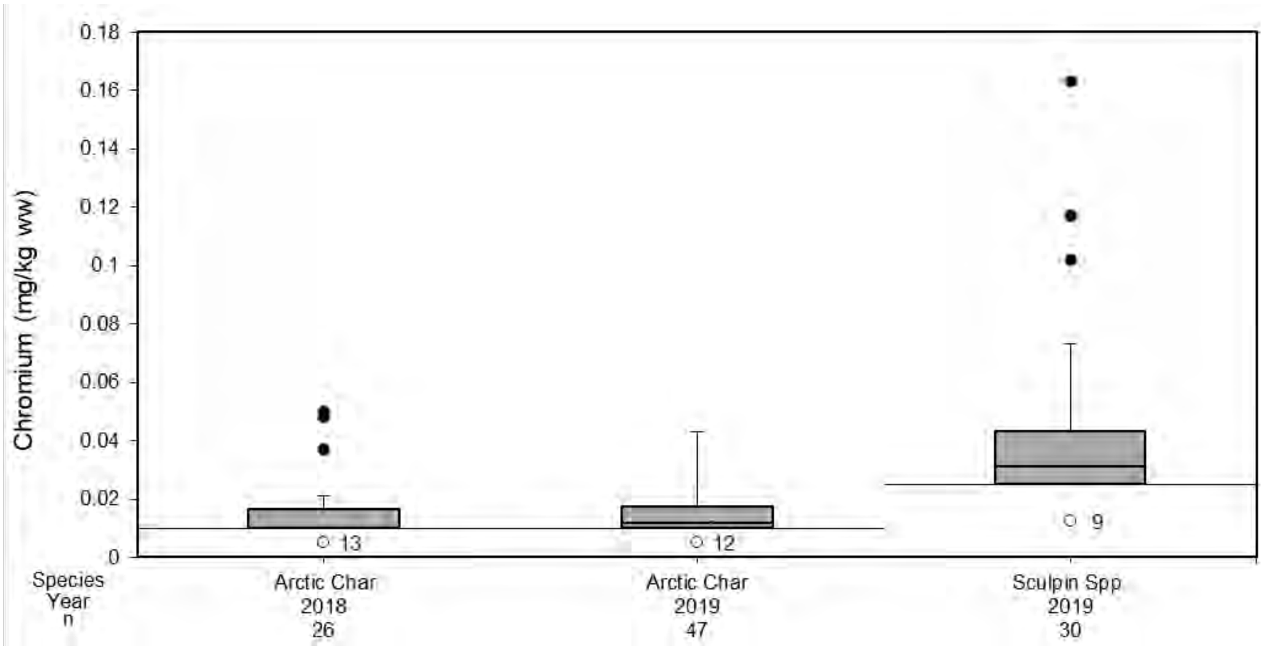
Figure G-4.9: Cadmium Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; mg/kg ww = milligram per kilogram wet weight; n = sample size.

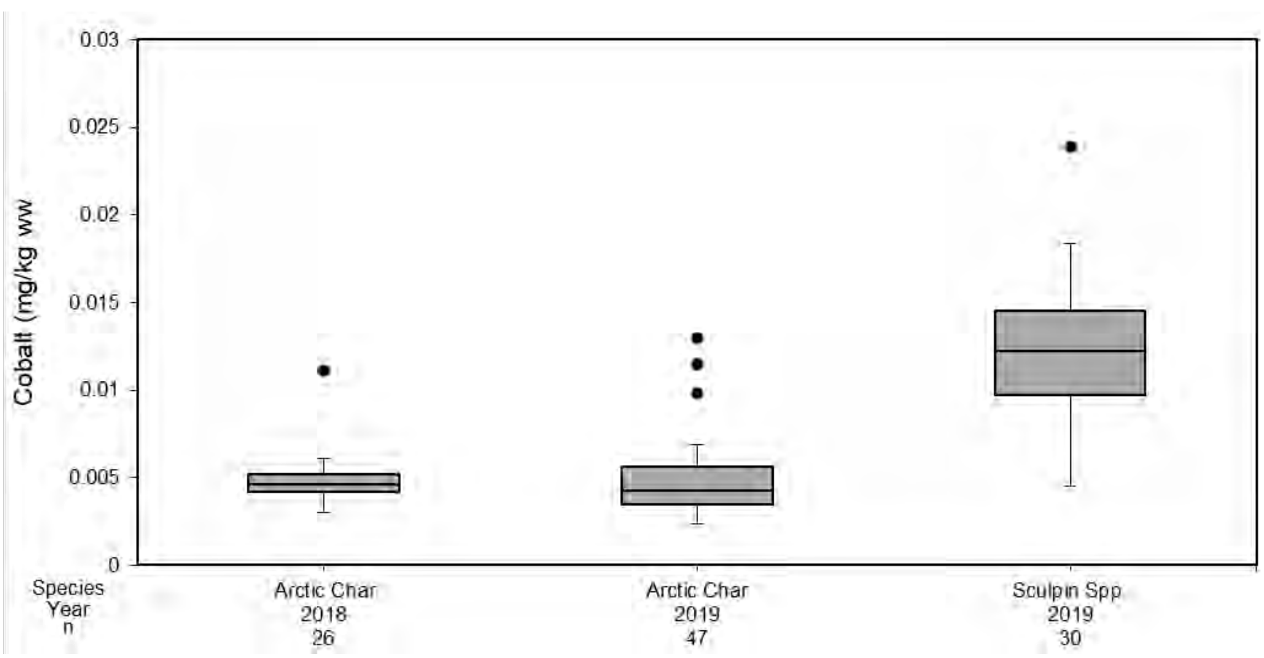
Figure G-4.10: Calcium Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



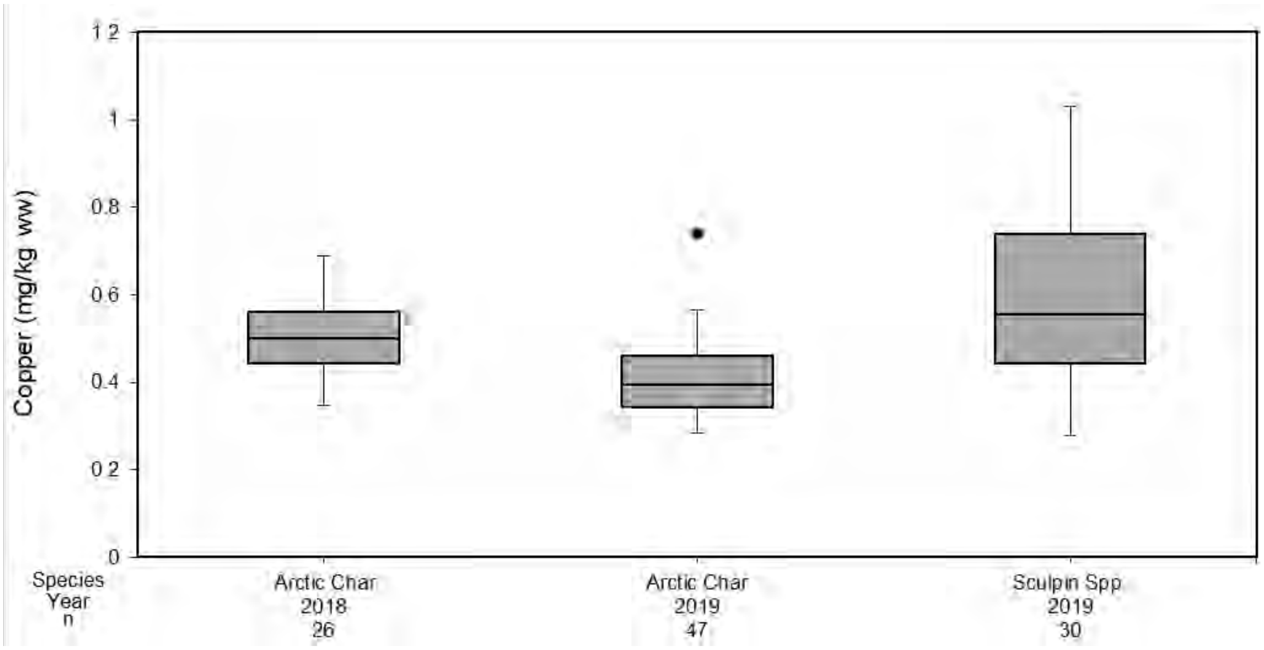
Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.11: Chromium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



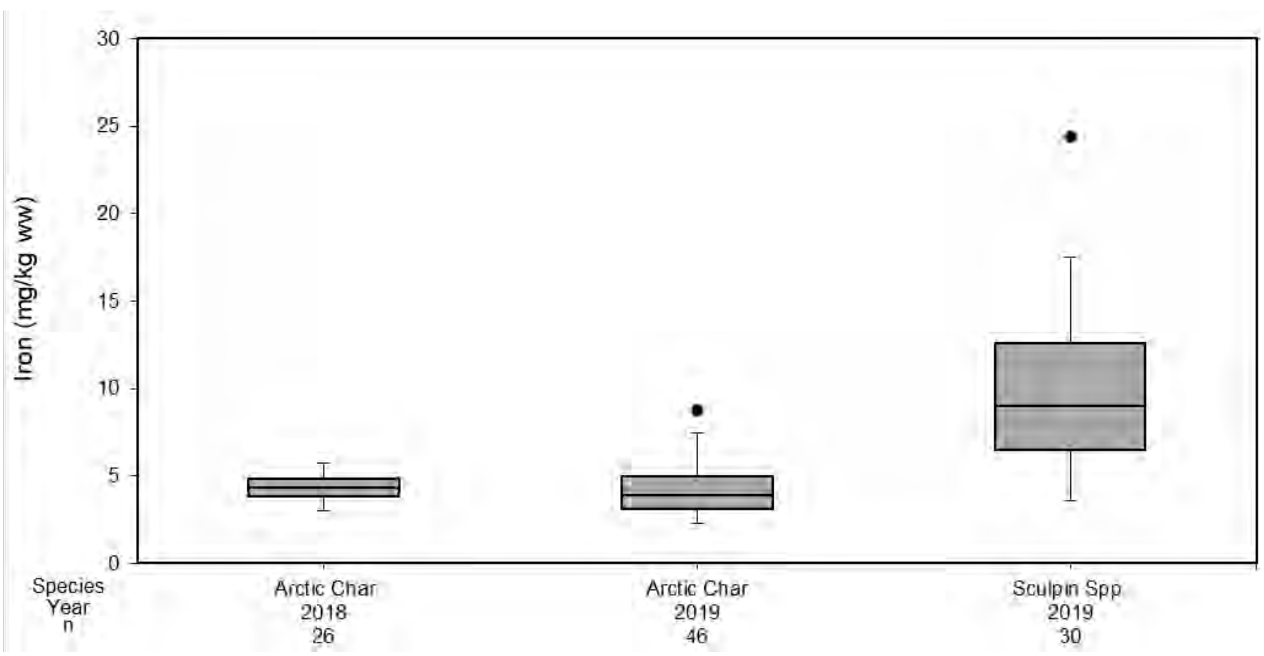
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.12: Cobalt Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



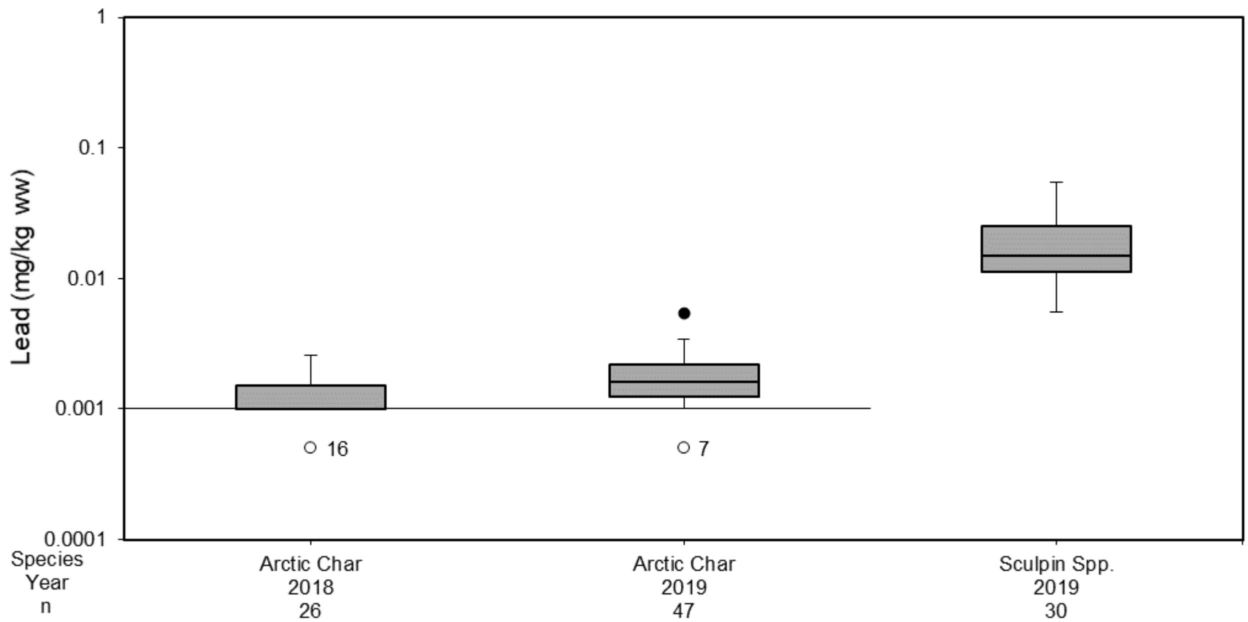
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.13: Copper Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



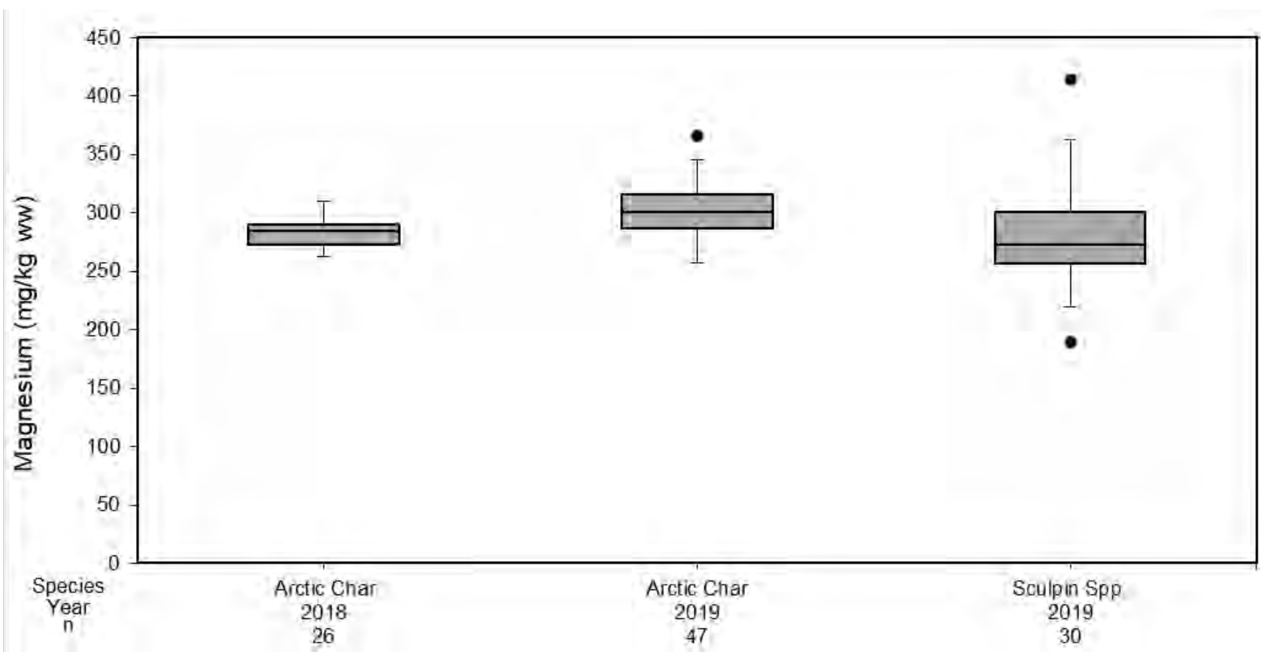
Note: One statistical outlier removed from the 2019 Arctic Char dataset to aid in data visualization (Sample 19-072-180, value 6.63); mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.14: Iron Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

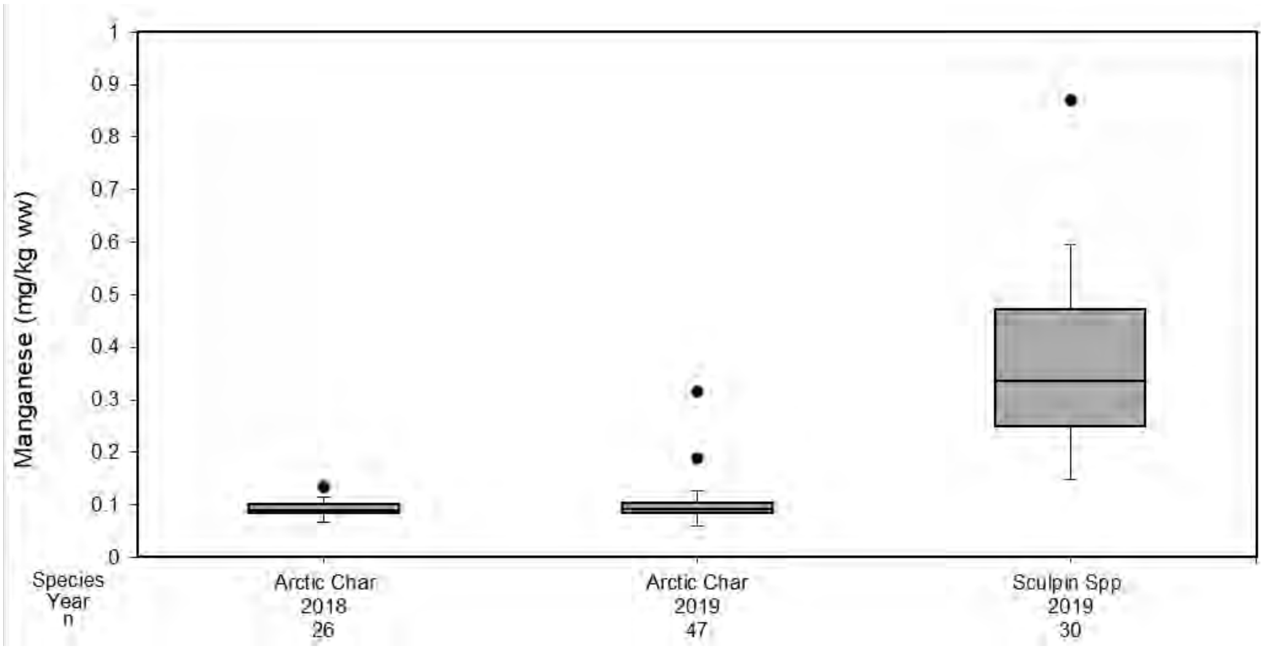
Figure G-4.15: Lead Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

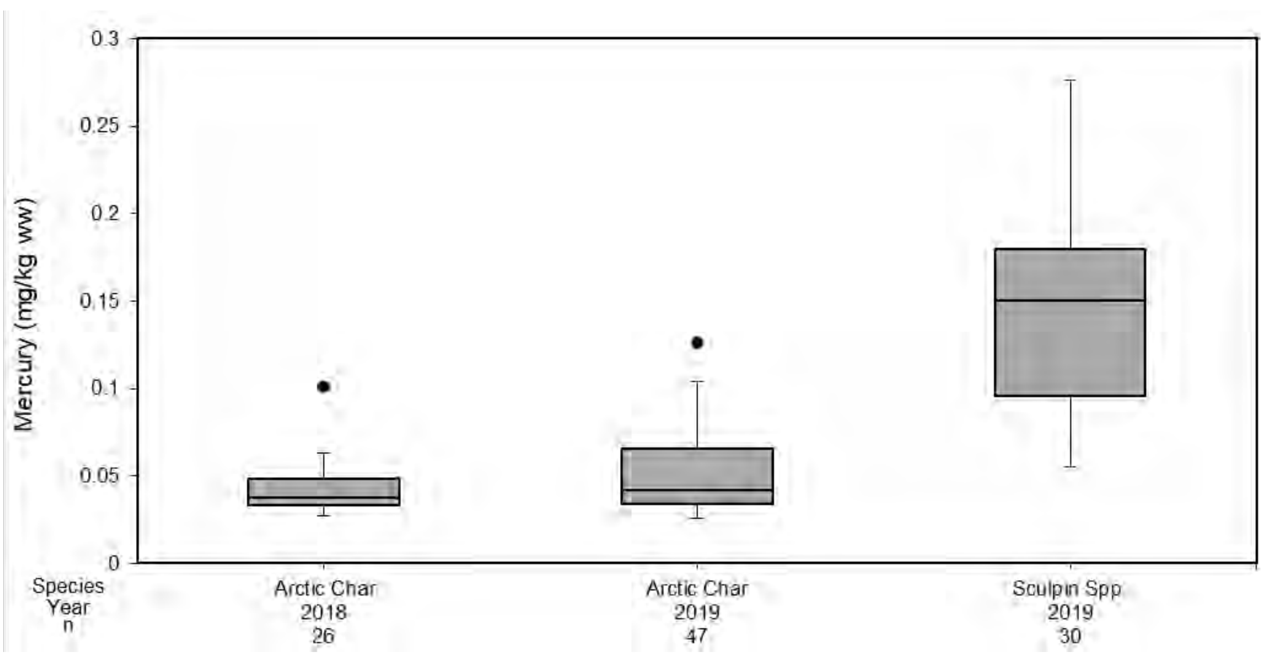
Figure G-4.16: Magnesium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



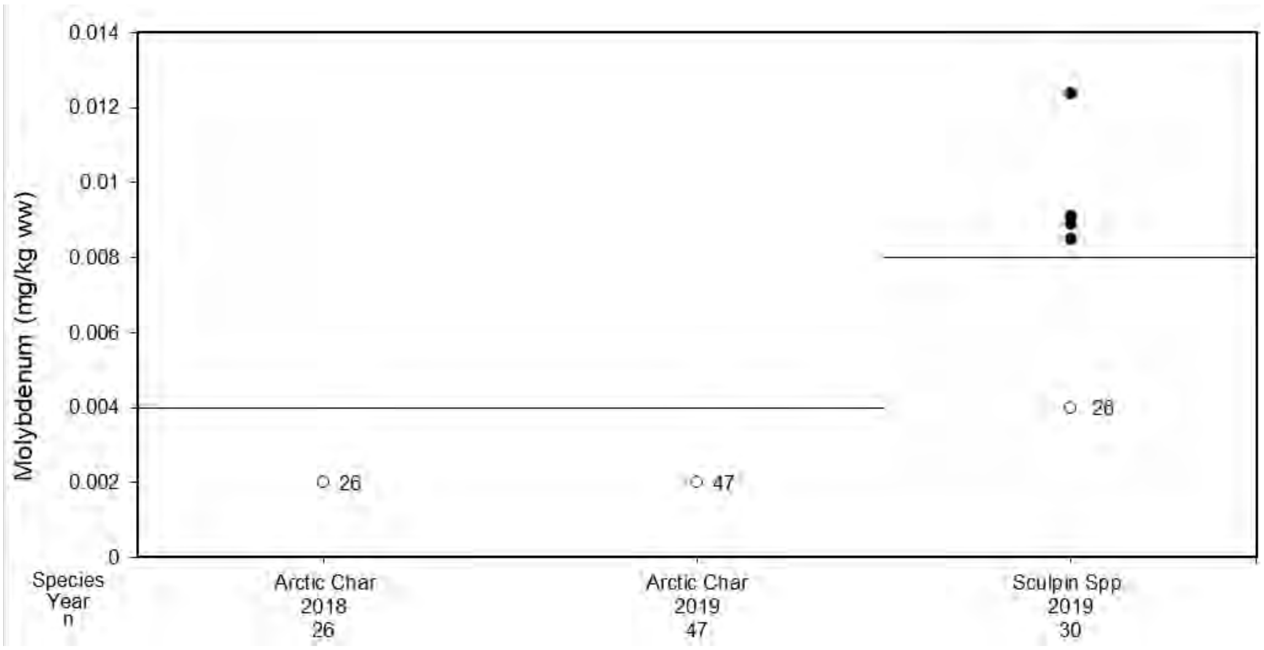
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.17: Manganese Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



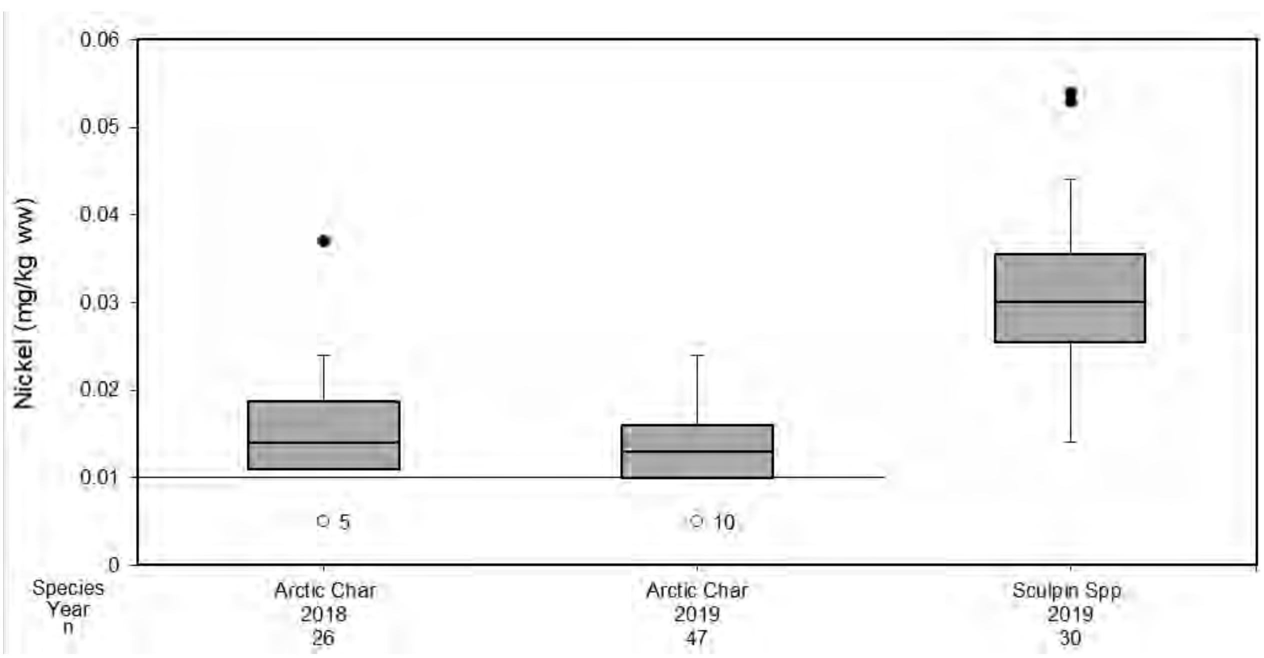
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.18: Mercury Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

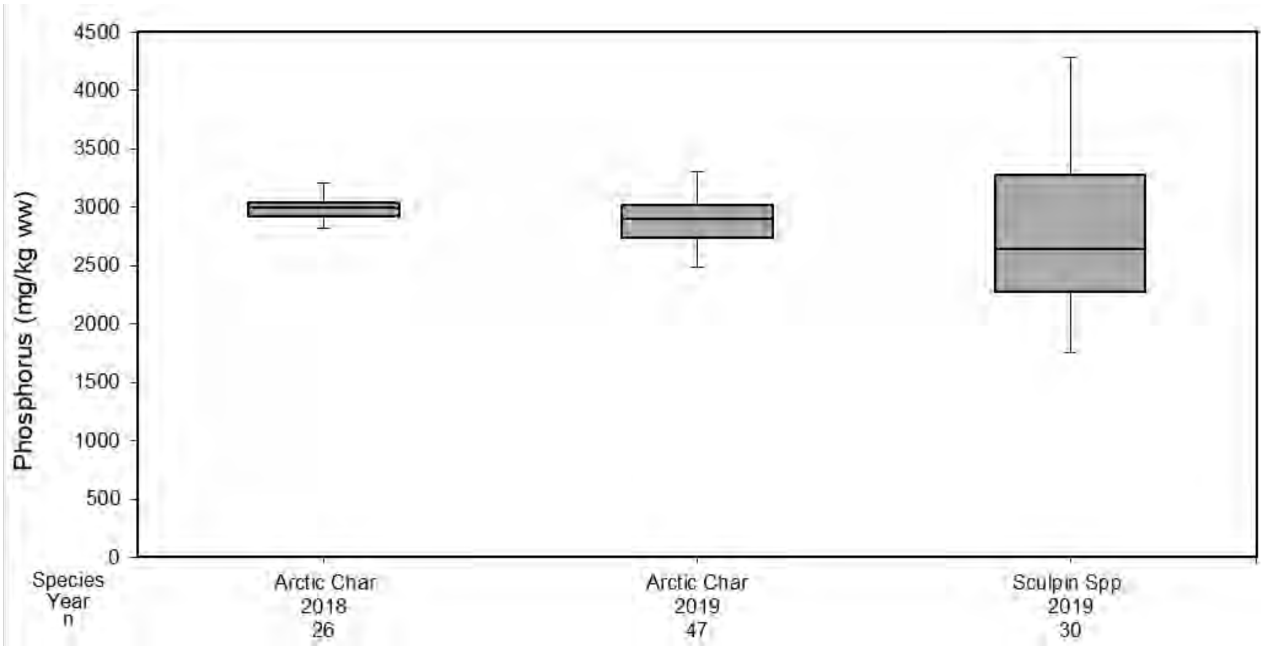
Figure G-4.19: Molybdenum Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

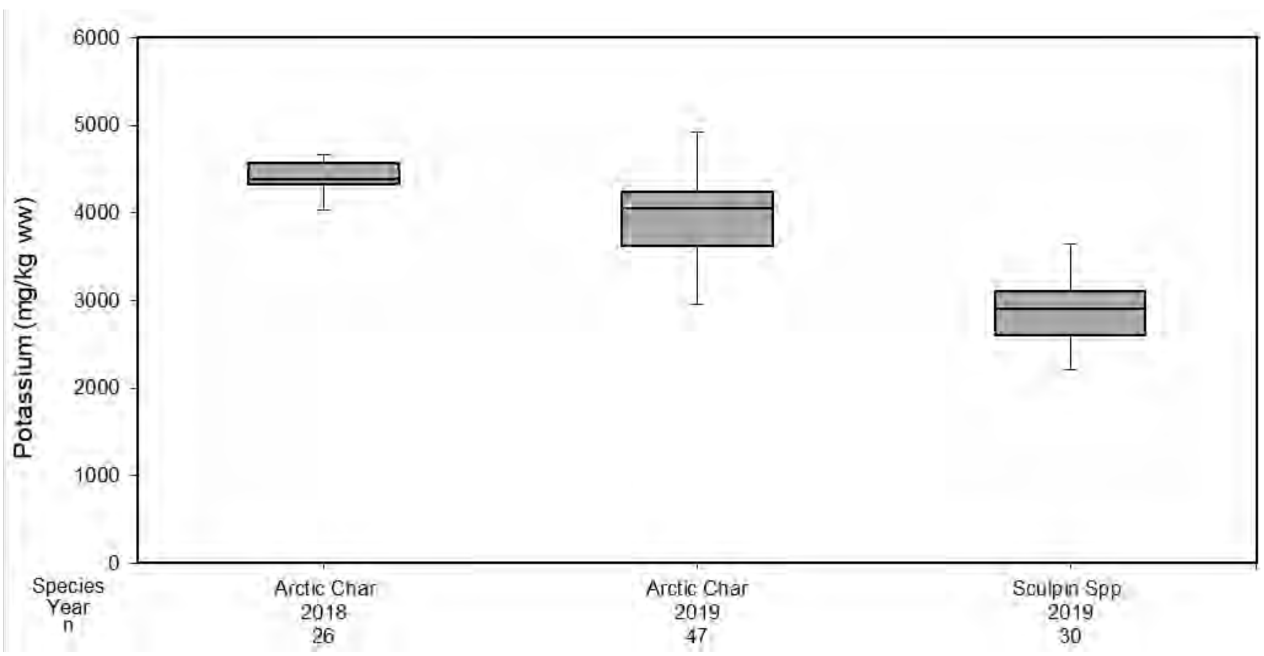
Figure G-4.20: Nickel Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

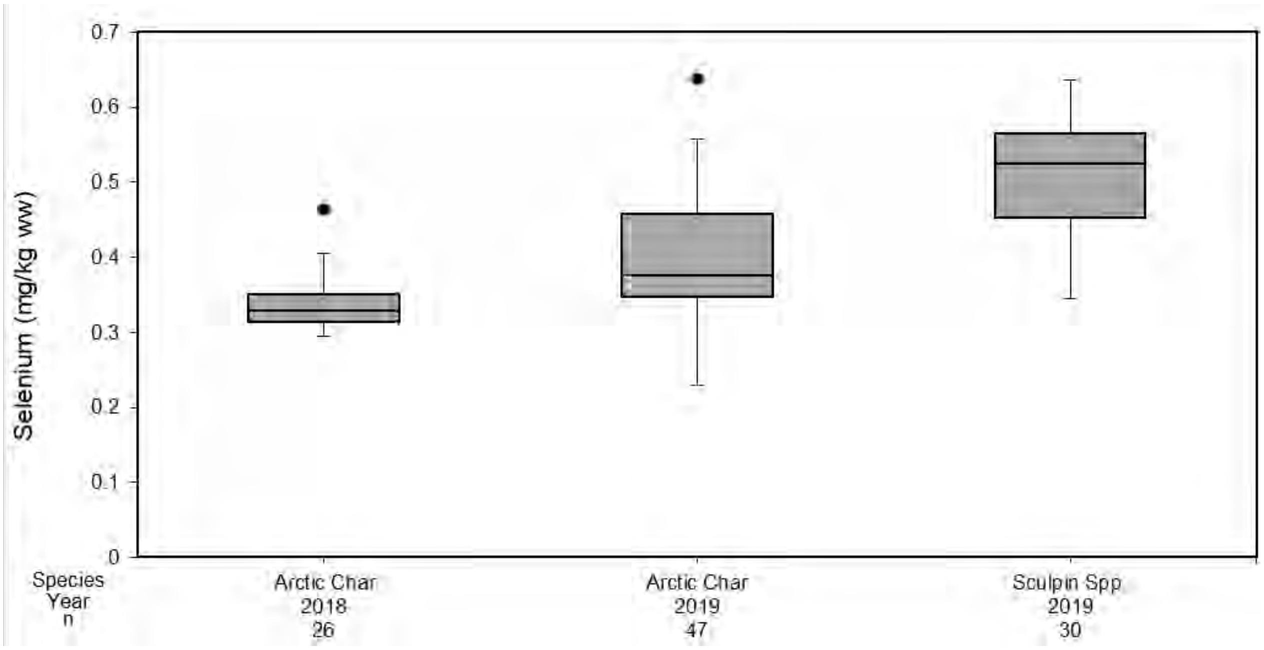
Figure G-4.21: Phosphorus Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

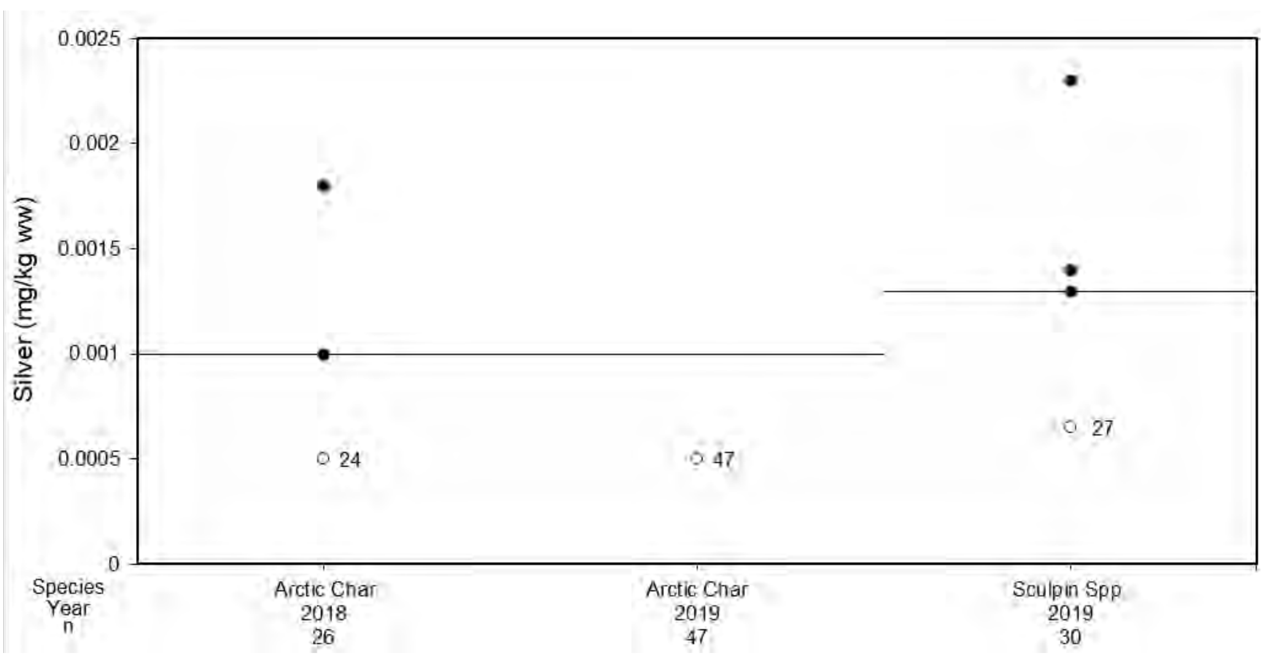
Figure G-4.22: Potassium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

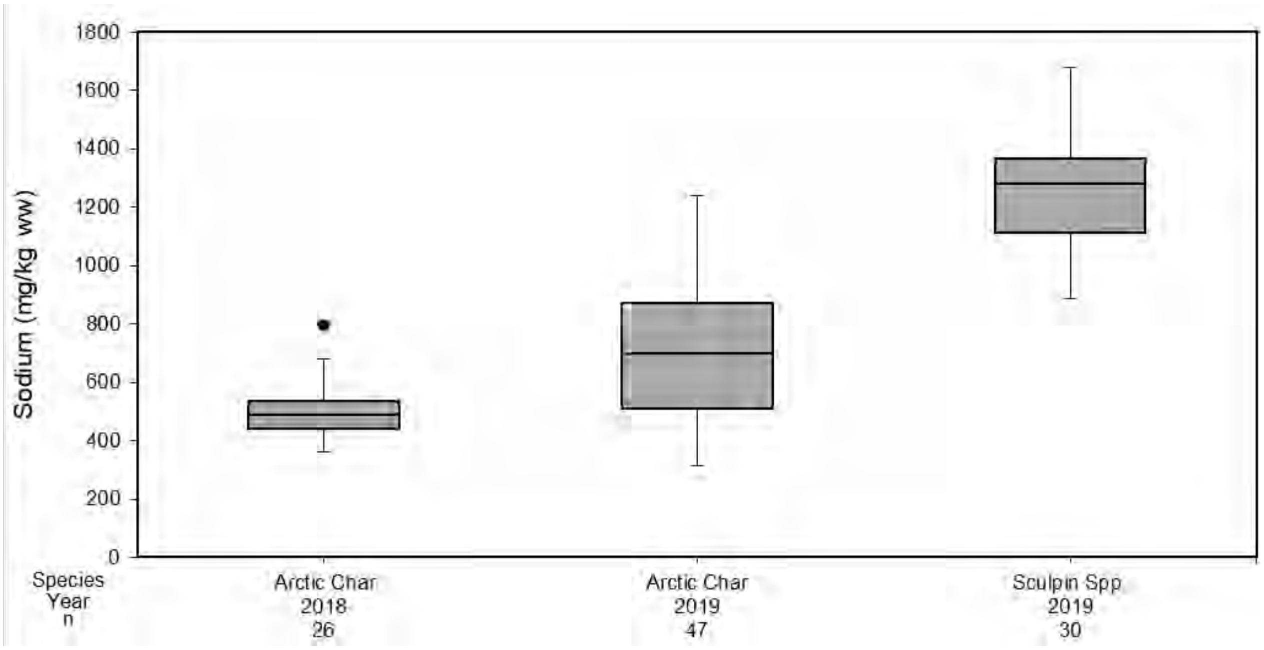
Figure G-4.23: Selenium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

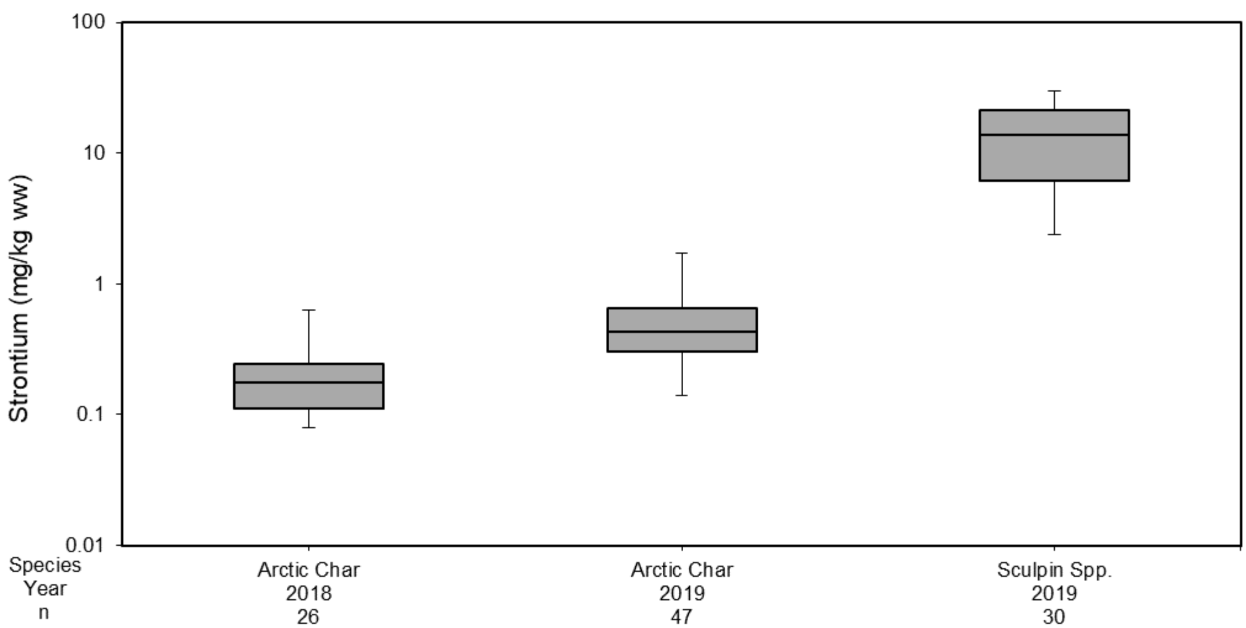
Figure G-4.24: Silver Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

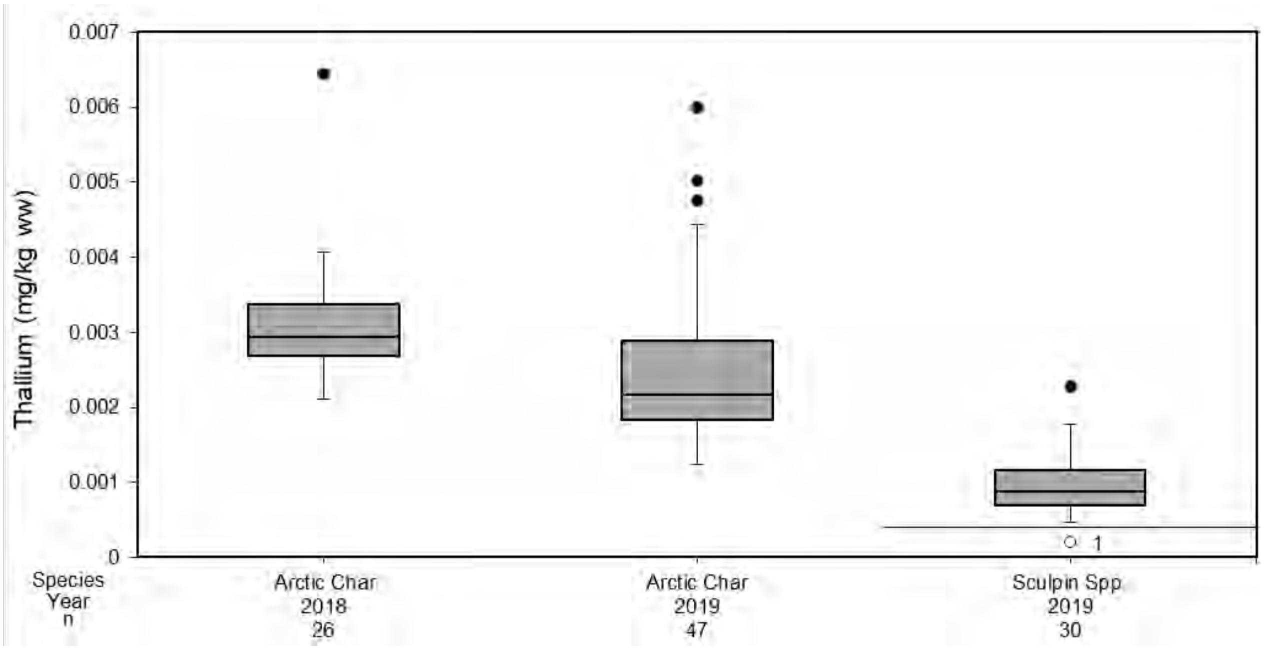
Figure G-4.25: Sodium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; mg/kg ww = milligram per kilogram wet weight; n = sample size.

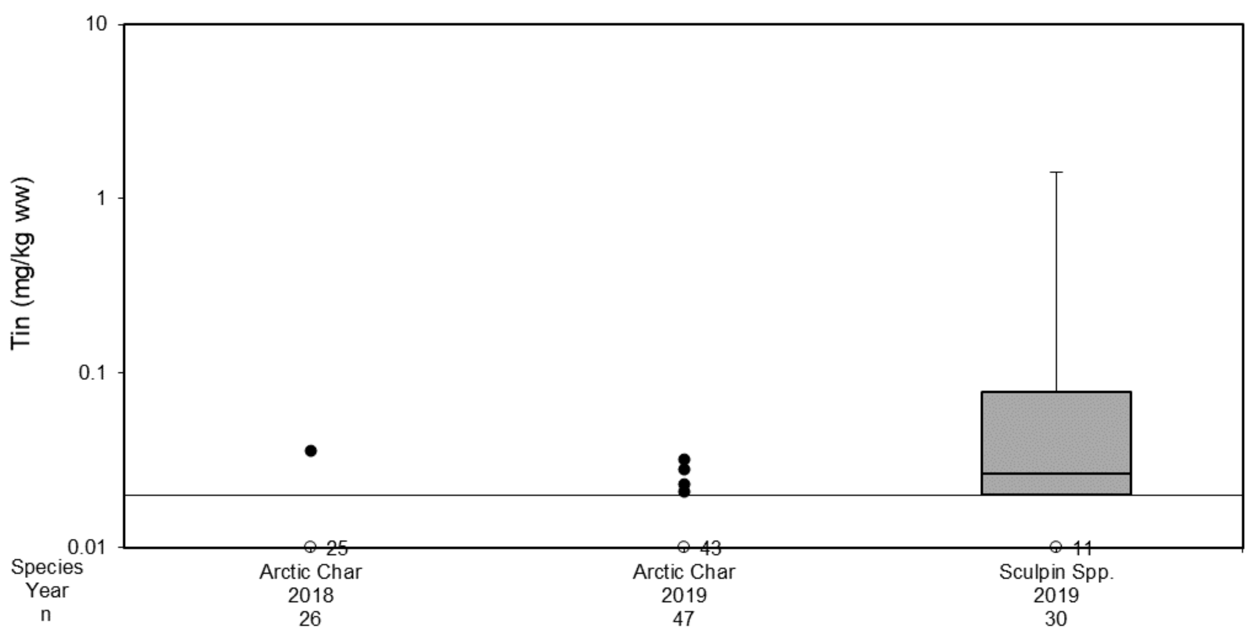
Figure G-4.26: Strontium Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

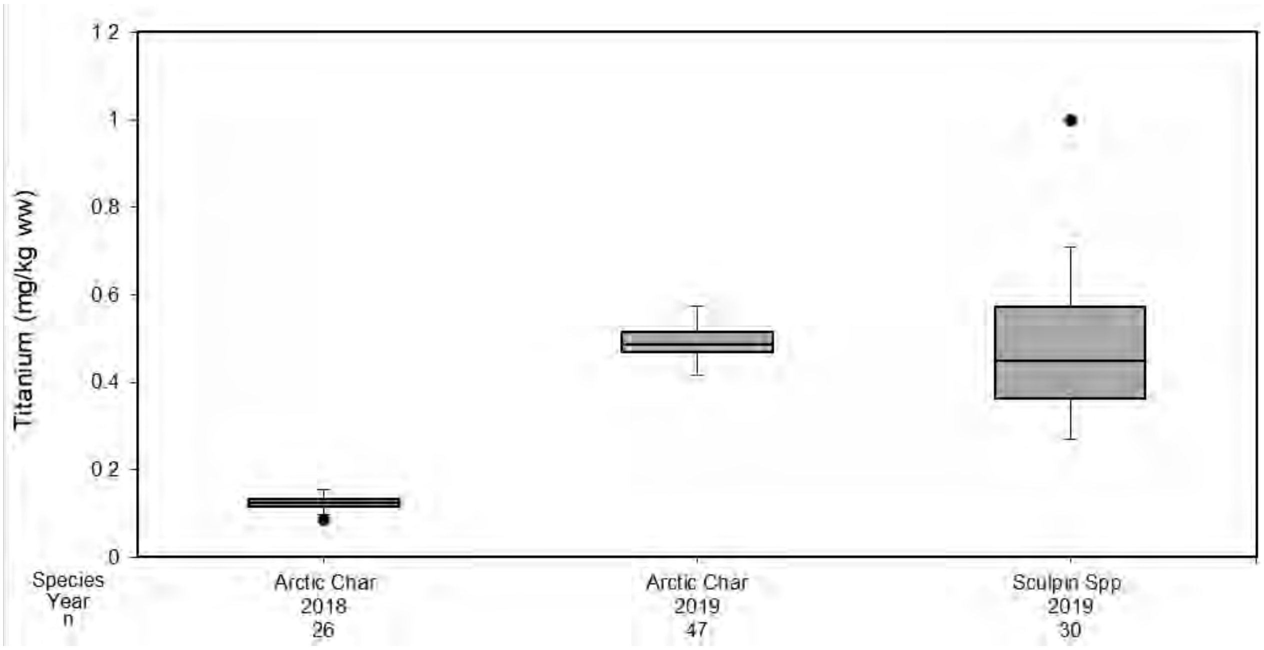
Figure G-4.27: Thallium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

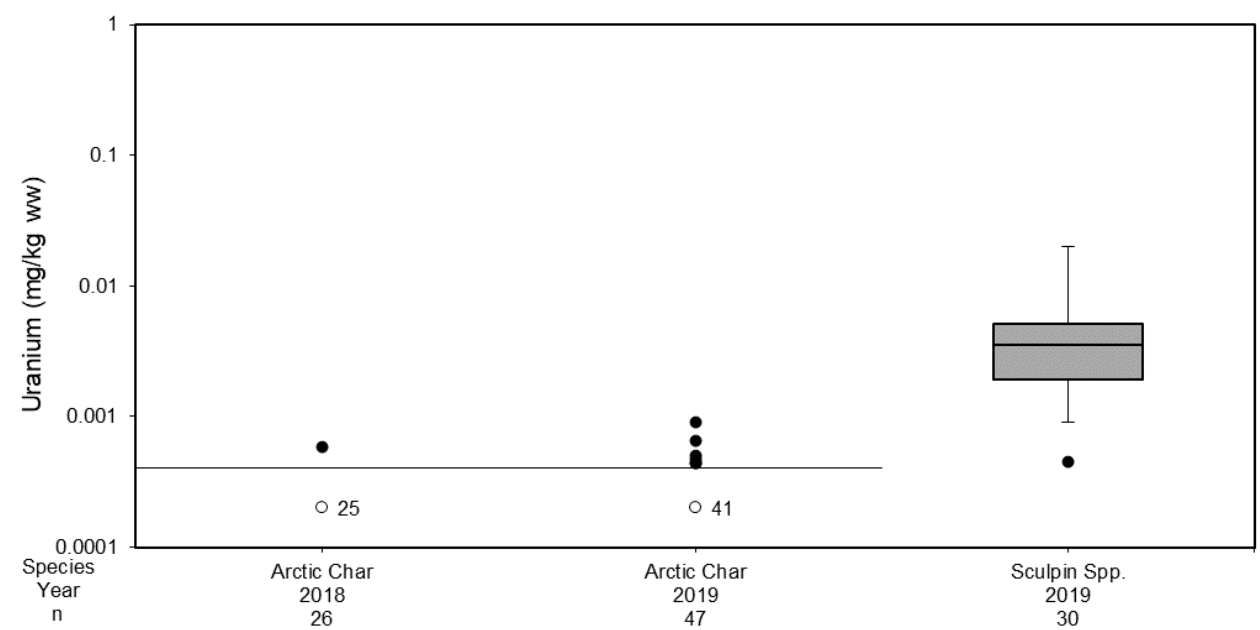
Figure G-4.28: Tin Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Fish Box Plots



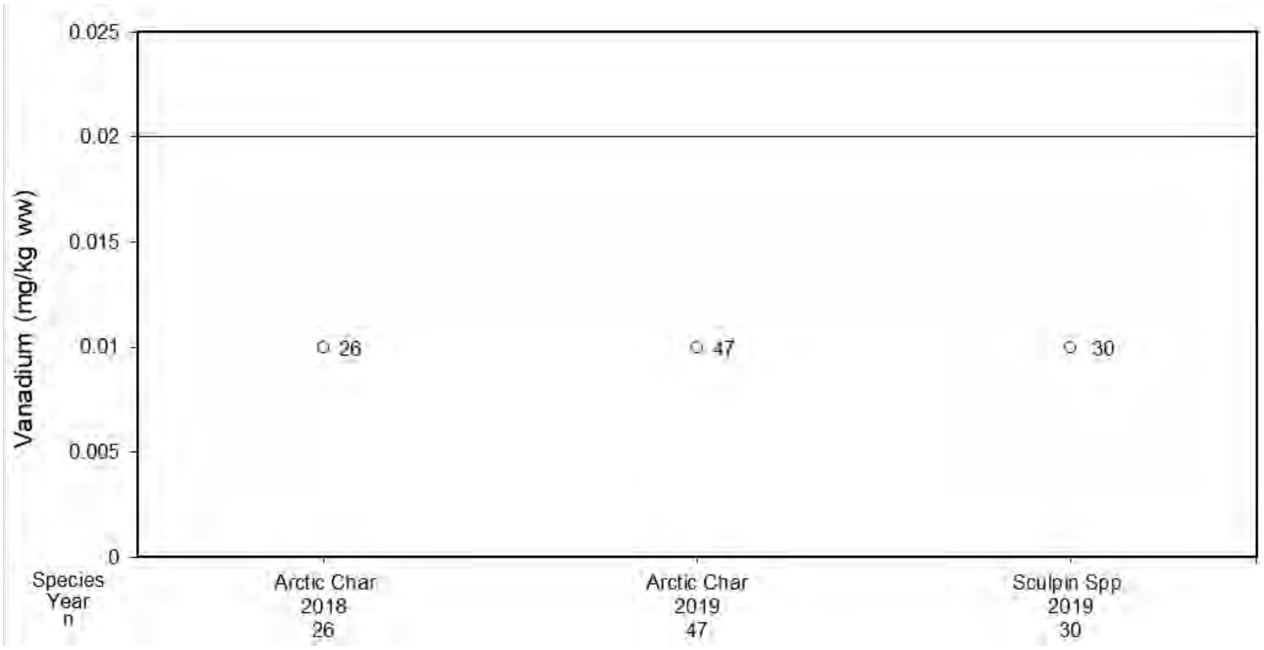
Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.29: Titanium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



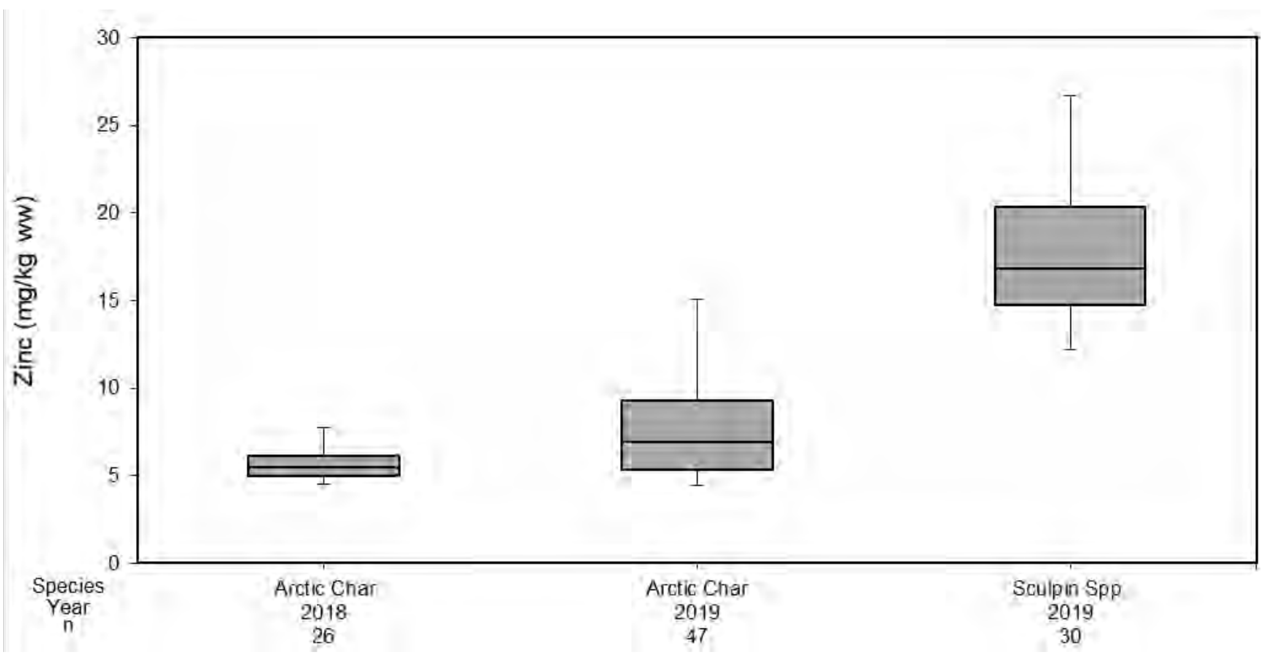
Note: Concentrations log10 transformed to aid in data visualization; Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.30: Uranium Concentration (log_{10}) of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: Horizontal line indicates detection limit; mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.31: Vanadium Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019



Note: mg/kg ww = milligram per kilogram wet weight; n = sample size.

Figure G-4.32: Zinc Concentration of Arctic Char and Sculpin Species Collected in Milne Port Area, 2018 and 2019

Historical Metals Concentrations (2010-2017)

Table 1: Descriptive Statistics for Metal Concentration in Arctic Char Muscle Tissue Samples from the Milne Port Area, 2010, 2013, 2015-2017

Parameter	2010[b] (n=11)				2013 (n=6)				2015 (n=5)				2016 (n=13)				2017 (n=2)			
	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD
Aluminum	0	2.0	<2.0	N/A	0	2.5	N/A	N/A	1	2.5	3.1	N/A	0	2.5	N/A	N/A	0	0.2	N/A	N/A
Antimony	0	0.010	<0.010	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.001	N/A	N/A
Arsenic	11	0.01	0.82	0.17	6	0.50	0.61	0.12	5	0.50	1.38	0.91	13	0.50	0.97	0.21	2	0.01	0.81	0.40
Barium	3	0.010	<0.01	N/A	0	1.5	N/A	N/A	0	1.5	N/A	N/A	0	1.5	N/A	N/A	0	0.01	N/A	N/A
Beryllium	0	0.1	<0.1	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.002	N/A	N/A
Bismuth[d]	0	0.030	<0.030	N/A	-		-	-	-	-	-	-	-	-	-	-	0	0.02	N/A	N/A
Boron[f]	-	-	-	-	0	1.5	N/A	N/A	0	1.5	N/A	N/A	0	1.5	N/A	N/A	0	0.4	N/A	N/A
Cadmium	7	0.005	0.006	0.003	0	0.05	N/A	N/A	0	0.05	N/A	N/A	0	0.05	N/A	N/A	2	0.002	0.0088	0.0005
Calcium[d]	11	2.0	122	27	-		-	-	-	-	-	-	-	-	-	-	2	2	177	64
Chromium	11	0.1	0.6	0.9	0	0.50	N/A	N/A	0	0.5	N/A	N/A	1	0.5	1	N/A	0	0.01	N/A	N/A
Cobalt	1	0.020	<0.020	N/A	0	0.2	N/A	N/A	0	0.2	N/A	N/A	0	0.2	N/A	N/A	1	0.004	0.007	N/A
Copper	11	0.01	0.85	0.27	6	0.50	1.06	0.26	4	0.50	0.62	0.14	13	0.50	1.63	1.18	2	0.01	0.56	0.12

Historical Metals Concentrations (2010-2017)

Parameter	2010[b] (n=11)				2013 (n=6)				2015 (n=5)				2016 (n=13)				2017 (n=2)			
	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD
Iron	11	0.2-2	9.9	5.0	0	15.00	N/A	N/A	0	15	N/A	N/A	1	15	19	N/A	2	1.00	6.00	0.14
Lead	0	0.02	<0.02	N/A	0	0.18	N/A	N/A	0	0.18	N/A	N/A	0	0.18	N/A	N/A	1	0.002	0.003	N/A
Lithium[e]	0	0.1	<0.1	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	-	-	-	-
Magnesium[d]	11	1.0	261	22	-		-	-	-	-	-	-	-	-	-	-	2	2	307	6
Manganese	11	0.01	0.16	0.09	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.50	N/A	N/A	2	0.02	0.09	0.02
Mercury	11	0.001	0.050	0.030	6	0.01	0.03	0.01	5	0.01	0.04	0.01	13	0.01	0.04	0.02	2	0.002	0.060	0.036
Molybdenum	9	0.01	0.02	0.02	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.01	N/A	N/A
Nickel	9	0.1	0.3	0.4	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	1	0.01	0.01	N/A
Phosphorus[d]	11	5-50	2591	177	-		-	-	-	-	-	-	-	-	-	-	2	2	2965	35
Potassium[d]	11	20-200	4030	340	-		-	-	-	-	-	-	-	-	-	-	2	2	4470	113
Selenium	11	0.2	0.5	0.1	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	2	0.01	0.447	0.004
Silver[f]	-	-	-	-	0	0.12	N/A	N/A	0	0.12	N/A	N/A	0	0.12	N/A	N/A	0	0.004	N/A	N/A
Sodium[d]	11	20-200	476	117	-		-	-	-	-	-	-	-	-	-	-	2	2	587	50

Historical Metals Concentrations (2010-2017)

Parameter	2010[b] (n=11)				2013 (n=6)				2015 (n=5)				2016 (n=13)				2017 (n=2)			
	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD	n>DL[a]	DL	Mean	SD
Strontium	11	0.01	0.32	0.12	0	1.5	N/A	N/A	0	1.5	N/A	N/A	0	1.5	N/A	N/A	1	0.01	0.49	N/A
Thallium	0	0.010	<0.010	N/A	0	0.02	N/A	N/A	0	0.02	N/A	N/A	0	0.02	N/A	N/A	2	0.0004	0.0027	0.0008
Tin	0	0.050	<0.050	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.02	N/A	N/A
Titanium[d]	0	1.0	<1.0	N/A	-		-	-	-	-	-	-	-	-	-	-	1	0.05	0.07	N/A
Uranium	0	0.0020	<0.0020	N/A	0	0.02	N/A	N/A	0	0.02	N/A	N/A	0	0.02	N/A	N/A	0	0.0004	N/A	N/A
Vanadium	0	0.10	<0.10	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.5	N/A	N/A	0	0.02	N/A	N/A
Zinc	11	0.1	6.2	0.8	6	1.5	9.2	2.0	5	1.5	6.9	1.7	13	1.5	7.2	1.3	2	0.04	5.84	0.54
Moisture (%)	11	0.1	74	1.4	5	1.0	70	4.4	-	-	-	-	-	-	-	-	-	-	-	-

(c) Includes specimens where concentrations are above detection limit.

DL = reportable detection limit; SD = standard deviation of the sample; - = not applicable; N/A = not available due to sample size; < = less than.

Table 2: Tissue Metal Outliers Removed frc

Sample Identification	Species	Year	Metal	ncentration Va	Reasoning
GN-05-P3 19-072-142	Arctic Char	2019	Aluminum	9.48	Data points have a narrow spread with the outliers 10 times the median value.
	Arctic Char	2019	Iron	20.6	Data points have a narrow spread with majority of points falling below 10 mg/kg wwt. Value removed is 2 times greater than the median value.
GN-04-1 19-072-180	Sculpin	2019	Arsenic	6.63	Outlier is over 3 times greater than the median value.

Table 3: Descriptive Statistics for Non-Detected Metal Concentration in Arctic Char Muscle Tissue Samples from the Milne Port Area, 2018-2019.

Parameter	2018 (n=26)				2019 (n=47)			
	n>DL	DL	Mean	SD	n>DL	DL	Mean	SD
Antimony	0	0.001	<0.001	N/A	0	0.001	<0.001	N/A
Beryllium	0	0.001	<0.001	N/A	0	0.001	<0.001	N/A
Bismuth	0	0.001	<0.001	N/A	0	0.001	<0.001	N/A
Molybdenum	0	0.004	<0.004	N/A	0	0.004	<0.004	N/A
Vanadium	0	0.02	<0.02	N/A	0	0.02	<0.02	N/A

Table 4: Descriptive Statistics for Non-Detected Metal Concentration in Sculpin Muscle Tissue Samples from the Milne Port Area, 2019.

Parameter	2019 (n=30)			
	n>DL	DL	Mean	SD
Beryllium	0	0.002	<0.002	N/A
Vanadium	0	0.02	<0.02	N/A

APPENDIX H

Zooplankton and Ichthyoplankton Data

biologica

Marine Zooplankton Enumeration and Identification Methods
Client: Golder
Project: Baffinlands Iron Mine

Sample Inventory

Sample arrival: 1-Oct-19
Number of samples: 19
Number of jars: 19
Screen size: 63 µm
Biologica project number: mz19-072

Upon arrival, the samples were examined and double-checked against the chain of custody to ensure (1) all samples were accounted for, (2) each sample had the appropriate number of jars as indicated on the COC. Any discrepancies were reported to the client and were resolved before further sample handling. Samples were transferred from formalin into 70% ethanol and assigned a unique identification number.

Sample Processing

Marine zooplankton samples were analyzed in fractions as follows:

(1) A “Coarse” fraction comprised of large organisms (>1.0 cm) in the sample, identified in its entirety

(2) A “2nd Coarse” fraction comprised of organisms (0.1 cm to 1.0 cm) in the sample, identified in its entirety or to a minimum 100 count, and

(2) A “Fine” fraction (<0.1 cm), in which all other organisms were identified and enumerated. Processing of the fine fraction was completed to either a 200 or 300 count as specified by the client.

The Coarse fraction was analyzed through a stereo microscope at 10–40x magnification. All organisms were identified by taxonomic experts to the lowest taxonomic level using a compound microscope (100–400x magnification), appropriate dissection tools, and standard taxonomic references. For copepods, the stage of development was also recorded (copepodite stages I–V) as is the sex for mature individuals (copepod stage VI).

Sub-sampling for all fractions was performed using a Folsom plankton splitter.

Zooplankton were identified to species wherever possible, although immature copepods lack differentiating features required for identification beyond order (e.g., Calanoida, Cyclopoida, or Harpacticoida). All identifications were performed using taxonomic references and collaborations with external experts, where necessary.

Table 1. Summary of zooplankton samples processed for Golder Baffinlands Iron Mine, 2019.

Client Sample #	Date Sampled	Biologica Sample #	Fraction	Split	Total Organism Count (raw)
ZV-01	30-Aug-19	mz19-072-034	Coarse	1/8	19
			Fine	1/32	345
ZV-02	30-Aug-19	mz19-072-035	Coarse 1	Whole	4
			Coarse 2	1/4	15
			Fine	1/32	502
ZV-03	30-Aug-19	mz19-072-036	Coarse 1	Whole	5
			Coarse 2	1/4	7
			Fine	1/32	575
ZV-04	30-Aug-19	mz19-072-037	Coarse 1	Whole	1
			Coarse 2	1/4	18
			Fine	1/64	453
ZV-05	30-Aug-19	mz19-072-038	Coarse	1/4	12
			Fine	1/64	342
ZV-06	30-Aug-19	mz19-072-039	Coarse 1	Whole	7
			Coarse 2	1/4	34
			Fine	1/64	345
ZH-01	31-Aug-19	mz19-072-040	Coarse 1	Whole	21
			Coarse 2	1/4	10
			Fine	1/64	347
ZH-02	31-Aug-19	mz19-072-041	Coarse 1	Whole	11
			Coarse 2	1/4	23
			Fine	1/64	443
ZH-03	31-Aug-19	mz19-072-042	Coarse 1	Whole	17
			Coarse 2	1/4	37
			Fine	1/32	476
ZH-04	31-Aug-19	mz19-072-043	Coarse 1	Whole	14
			Coarse 2	1/8	37
			Fine	1/128	375
ZH-05A	31-Aug-19	mz19-072-044	Coarse 1	Whole	6
			Coarse 2	1/8	37
			Coarse 3	1/64	81
			Fine	1/512	250
ZH-05B	31-Aug-19	mz19-072-045	Whole	Whole	296
ZH-06	31-Aug-19	mz19-072-046	Coarse 1	Whole	40
			Fine	1/4	282
ZH-07	1-Sep-19	mz19-072-047	Coarse 1	Whole	9
			Coarse 2	1/4	20
			Fine	1/16	341
ZH-08	1-Sep-19	mz19-072-048	Coarse 1	Whole	15
			Coarse 2	1/4	15
			Fine	1/16	417
BR1	1-Sep-19	mz19-072-049	Coarse	Whole	2
			Fine	1/8	296

Client Sample #	Date Sampled	Biologica Sample #	Fraction	Split	Total Organism Count (raw)
BR2	1-Sep-19	mz19-072-050	Coarse 1	Whole	20
			Coarse 2	1/8	14
			Fine	1/256	266
BR3	1-Sep-19	mz19-072-051	Coarse	1/2	6
			Fine	1/16	404
BR4	1-Sep-19	mz19-072-052	Coarse 1	Whole	1
			Coarse 2	1/2	22
			Fine	3/128	415

QA/QC

Ten percent (10%) of samples were reanalyzed to assess subsampling accuracy and taxonomic consistency. The sample(s) were chosen at random and processed at different times to reduce counting and identification bias. The percent agreement between QA samples is reported in Table 2.

Table 2. Summary of taxonomic QA/QC results for Golder Baffinlands Iron Mine 2019.

Biologica Sample #	Client Sample #	Original Count	QA Count	Percent Agreement
mz19-072-039-QA	ZV-06-QA	22,223	23,011	96.45%
mz19-072-049-QA	BR1-QA	2,370	2,362	99.66%
			Average:	**98.06%**

Percent Agreement:
{100 – [(difference in abundance between samples/total abundance of original sample) x 100]} %

Data

Taxonomic data were recorded in Biologica's custom database. Results were provided to the Golder project manager in Excel spreadsheets via email.

Methodological and Taxonomic References

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Abbreviations & Definitions

Worksheets:	
1. Abbreviations & Definitions	Glossary of terms and outline of report
2. Data - Matrix	Abundance data in matrix format, including total taxa (species richness) count per sample, and total abundance per sample
3. Data - Long	Abundance data in long format
4. QA/QC	Quality control report of zooplankton enumeration in QA samples
Abundance Data:	
Total Taxa	Number of taxa present, not including fish eggs or higher-order taxa of which there are identified lower-level taxa (e.g. not including Calanoida indet. if *Microcalanus* sp. present).
MEMO	Incidental organisms (not included in final count or in total taxa)
Benthic	Organisms from the benthic community (not included in final count or in total taxa)
Nauplius	Crustacean early larval stage
J	Juvenile; a non-larva without adult features
A	Adult; animal of reproductive size with adult features
L	Larvae; larval form
Size Class:	
S1	< 5.0mm
S2	< 10.0mm
S3	< 15.0mm
S4	< 20.0mm
S5	< 25.0mm
Annelids:	
Epitoke	Posterior portion of an Annelida capable of sexual reproduction
Metatrochophore	Early stage of Annelida larvae with 2-3 segments, appearing as a trochophore with segments
Nectochaete	Annelida larval stage with >3 segments, appearing ready to settle (i.e. juvenile form)
Trochophore	Annelida larval stage with a spherical body, and a band(s) of cilia
Arthropods:	
Calyptopis	Larval Euphausiacea
Cryptoniscid larvae	Larval Isopod
Cypris	Cirripede larval stage that is ready to settle
Furcilia	Larval Euphausiacea
Megalopa	Larval Decapoda
Nauplius	Crustacean early larval stage
Protozoea	Larval Decapoda
Zoea	Larval Crustacean
Bryozoans:	
Cyphonautes	Bryozoan larval stage
Copepods:	
III	Calanoid copepod stage 3; with 3 abdominal segments
IV	Calanoid copepod stage 4: with 4 abdominal segments
V	Calanoid copepod stage 5: with 5 abdominant segments
VIf	Calanoid copepod Stage 6 (reproductive, adult stage), with 6 abdominal segments. Female.
VIm	Calanoid copepod Stage 6 (reproductive, adult stage), with 6 abdominal segments. Male.
Cnidarians:	
Bract	Defensive structure
Gastrozooid	Nutritive polyp, for feeding and digestion
Gonozoid	Medusoid bud of a hydroid, sexual zooid
Medusa	Mobile form of Cnidarian
Nectophore	Medusoid locomotory structure of a siphonophore
Pneumatophore	Cnidarian gas filled bladder
Polyp	Sedentary form of Cnidarian
Ctenophore:	
Cydippid	Ctenophore larva of any stage
Echinoderms:	
Auricularia	Holothuroidea larva (sea cucumber) with a singal longitudinal ciliated band
Bipinnaria	Asteroidea larva (sea star), first stage
Brachiolaria	Asteroidea larva (sea star), second stage
Ophiopleutus	Ophiuroidea larva (brittle star)
Pentacula	Holothuroidea larva (sea cucumber)
Echinopluteus	Echinoidea larva (sea urchin)
Pluteus	Echinoderm larva
Molluscs:	
Veliger	Mollusc larval stage with shell and velar lobes
Nemerteans:	
Pilidium	Larval Nemertean
Phoronids:	
Actinotroch	Larval Phoronidae
Sipunculids:	
Pelagosphera	Larval sipunculid

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Abundance data in matrix format, including total taxa (species richness) count per sample and total abundance per sample for Golder Baffinlands Iron Mine, 2019.

Biologica Sample #				**mz19-072-034**	**mz19-072-035**	**mz19-072-036**	**mz19-072-037**	**mz19-072-038**	**mz19-072-039**	**mz19-072-040**	**mz19-072-041**	**mz19-072-042**	**mz19-072-043**	**mz19-072-044**	**mz19-072-045**	**mz19-072-046**	**mz19-072-047**	**mz19-072-048**	**mz19-072-049**	**mz19-072-050**	**mz19-072-051**	**mz19-072-052**	**mz19-072-039-QA**	**mz19-072-049-QA**
Client Sample #				**ZV-01**	**ZV-02**	**ZV-03**	**ZV-04**	**ZV-05**	**ZV-06**	**ZH-01**	**ZH-02**	**ZH-03**	**ZH-04**	**ZH-05A**	**ZH-05B**	**ZH-06**	**ZH-07**	**ZH-08**	**BR1**	**BR2**	**BR3**	**BR4**	**ZV-06-QA**	**BR1-QA**
Date Sampled		**Grand Total**		**30-Aug-19**	**30-Aug-19**	**30-Aug-19**	**30-Aug-19**	**30-Aug-19**	**30-Aug-19**	**31-Aug-19**	**31-Aug-19**	**31-Aug-19**	**31-Aug-19**	**31-Aug-19**	**31-Aug-19**	**31-Aug-19**	**1-Sep-19**	**1-Sep-19**	**1-Sep-19**	**1-Sep-19**	**1-Sep-19**	**1-Sep-19**	**30-Aug-19**	**1-Sep-19**
Groupcode	**Taxon**	**Unique Taxa**	**Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**	**Total Abundance**
CHEA	Parasagitta elegans	1	444	56	40	12	48	36	112					40		4	16			77		3	132	
CNHY	Euphysa sp.	1	1													1								
CNHY	Hybocodon prolifer	1	1			1																		
CNHY	Aeginopsis laurentii	1	2												2									
CNHY	Aglantha digitale	1	405	8							1	2		161	1	4	64	160				4		
CNHY	Obelia sp.	1	4																		4			
CNHY	Cnidaria indet.		5,578	32			64			192	4	64	160	1	5	57	1,792	1,952	16	1,024	18	197		8
CRAM	Onisimus glacialis	1	1													1								
CRAM	Hyperiidae indet.		1												1									
CRAM	Themisto libellula	1	20									1	1		14	3	1							
CRCI	Balanomorpha indet.	1	514											512								2		
CRCL	Cladocera indet. (2)	1	68							64						4								
CRCL	Cladocera indet.	1	32	32																				
CRCO	Acartia longiremis	1	502			4			4		16	4		40			144	288			2		4	
CRCO	Acartia sp.		1,239	96						24	16		8		59	188	224	624						
CRCO	Calanus finmarchicus	1	19	8					8							1		1		1				
CRCO	Calanus glacialis	1	67		2	4	1		3	1	4	7	10		5	22	2	4	1	1			3	1
CRCO	Calanus hyperboreus	1	1						1														1	
CRCO	Calanus sp.		593	80	18	8	8	12	15	17	28	28	152	48		16	80	16	16	41	4	6	19	16
CRCO	Microcalanus sp.	1	59															16				43		
CRCO	Pseudocalanus sp. complex	1	217		4		8					4	48	8	7	72	16	32	16			2		8
CRCO	Calanoida indet.		8,637	384	608	608	1,416	448	576	576	256	20	256	256	28	24	160	192	24	2,560	32	213	704	24
CRCO	Oithona similis	1	1,332	64	192	64	64		64		4	4	56	128		28	48	96	8	512				8
CRCO	Oithona sp.		120,388	7,840	9,344	11,296	15,552	12,352	12,928	512	768	276	1,920	4,416	29	104	800	880	1,152	33,536	1,776	4,907	13,760	1,216
CRCO	Cyclopoida indet.		1,029			4				832	128	64			1									
CRCO	Harpacticoida indet.	1	133								68			64	1									
CRCO	Microsetella sp.		256						64	192														
CRCO	Microstella norvegica	1	468			32					148	32	128	128										
CRCO	Oncaea sp.	1	4,642						64	128	128	36	512	192	1				24	3,072	16	469	128	8
CRCO	Copepoda indet.		240,596	1,408	3,136	3,904	7,104	5,824	4,544	14,144	22,592	11,776	36,864	93,696	84	104	704	1,136	712	19,456	4,064	9,344	4,736	760
CRIS	Isopoda indet.																						4	
CRXX	Crustacea indet.		19,413	128	224	448	1,024		640	1,600	960	704	896	11,264	4	12	64	16	80	768	112	469	384	40
CTEN	Ctenophora indet.	1	2											1		1								
ECEC	Echinoidea indet.	1	48														32	16						
MOBI	Bivalvia indet.	1	13,675		96	160	384	128	192	1,984	832	960	896	5,632	12	4	32			2,048	16	299	128	
MOGA	Clione limacina	1	126							19	70	7	3	2	1	8	4	9		3				
MOGA	Limacina helicina	1	127											1			64	60	1	1				1
MOGA	Gastropoda indet.		4,879	32	64	128	128		192	192		192	896	2,560	4		16				48	427	128	
PIXX	Gadidae indet.	1	2													1		1						
POXX	Polychaeta indet.	1	43																			43		
URAP	Fritillaria sp.	1	3,977											512	30	484	1,104	1,168	8	520	64	87		24
URAP	Oikopleura sp.	1	64															32			32			
XXXX	Unidentified		45,804	1,024	2,400	1,760	3,264	3,136	2,816	1,728	2,432	1,216	5,504	13,824	7	24	176	48	312	4,608	288	1,237	2,880	248
	Total Abundance:		**475,409**	**11,192**	**16,128**	**18,433**	**29,065**	**21,936**	**22,223**	**22,205**	**28,455**	**15,397**	**48,310**	**133,486**	**296**	**1,167**	**5,543**	**6,747**	**2,370**	**68,228**	**6,476**	**17,752**	**23,011**	**2,362**
	Total Unique Taxa (species Richness):	**30**		**7**	**6**	**8**	**6**	**4**	**10**	**9**	**9**	**10**	**10**	**15**	**13**	**16**	**12**	**13**	**7**	**9**	**9**	**12**	**9**	**7**
Benthic:																								
MEMO	Gammarus sp.		1													1								
MEMO	Harpacticoida indet.		2														2							
MEMO	Nematoda indet.		64							64														

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Abundance data in long format for Golder Baffinlands Iron Mine, 2019.

Client	Project	Year	Biologica Sample #	Client Sample #	Date Sampled	Fraction	Split	Groupcode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Stage	Raw Abundance	Split Multiplier	Total Abundance	Unique Taxa Count	Size (mm)	Larval Fish Common Name	Comments
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Coarse	1/8	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	3	8.0	24	1	5-10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Coarse	1/8	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	4	8.0	32		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Coarse	1/8	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	1	8.0	8	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	32.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCL	Arthropoda	Crustacea	Branchiopoda				Cladocera indet.	F	1	32.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	3	32.0	96	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Coarse	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus finmarchicus	V	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Coarse	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	10	8.0	80				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	12	32.0	384				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	2	32.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	205	32.0	6,560				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	40	32.0	1,280				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	44	32.0	1,408				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	4	32.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	1	32.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-034	ZV-01	30-Aug-19	Fine	1/32	XXXX	Unknown						Unidentified	Egg	32	32.0	1,024				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	7	4.0	28	1	5-10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	3	4.0	12		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1	1	4.8		
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	4	4.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	1.0	2				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	19	32.0	608				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	4	32.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	2	32.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	263	32.0	8,416				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	29	32.0	928				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	98	32.0	3,136				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	7	32.0	224				
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	3	32.0	96	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	2	32.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-035	ZV-02	30-Aug-19	Fine	1/32	XXXX	Unknown						Unidentified	Egg	75	32.0	2,400				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	3	4.0	12	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 1	Whole	CNHY	Cnidaria		Hydrozoa	Hydroidolina	Anthoathecata	Tubulariidae	Hybocodon prolifer	Medusa	1	1.0	1	1	0.64		
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	3	1.0	3				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	4.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	19	32.0	608				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	32.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	1	32.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	322	32.0	10,304				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	31	32.0	992				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida		Cyclopoida indet.	VIf	1	4.0	4		0.7		
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	V	1	32.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	122	32.0	3,904				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	14	32.0	448				
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	5	32.0	160	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	4	32.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-036	ZV-03	30-Aug-19	Fine	1/32	XXXX	Unknown						Unidentified	Egg	55	32.0	1,760				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	10	4.0	40	1	5-10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	2	4.0	8		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	4.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	2	4.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	2	4.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	22	64.0	1,408				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	238	64.0	15,232				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	5	64.0	320				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	111	64.0	7,104				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	16	64.0	1,024				
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	6	64.0	384	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-037	ZV-04	30-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	51	64.0	3,264				
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Coarse	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	8	4.0	32	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Coarse	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	1	4.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Coarse	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	3	4.0	12	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	7	64.0	448				
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	191	64.0	12,224	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	2	64.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	91	64.0	5,824				
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-038	ZV-05	30-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	49	64.0	3,136				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	5	4.0	20	1	10-15		
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	21	4.0	84		5-10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	2	4.0	8		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIm	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus finmarchicus	V	2	4.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	2	1.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus hyperboreus	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	3	4.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	3	1.0	3				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	9	64.0	576				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	185	64.0	11,840				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	17	64.0	1,088				

Appendix H-2
2019 MEEMP and AIS Zooplankton Survey Data

Client	Project	Year	Biologica Sample #	Client Sample #	Date Sampled	Fraction	Split	Groupcode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Stage	Raw Abundance	Split Multiplier	Total Abundance	Unique Taxa Count	Size (mm)	Larval Fish Common Name	Comments
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microsetella sp.	I-IV	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	VIm	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	71	64.0	4,544				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	10	64.0	640				
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	3	64.0	192	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	3	64.0	192	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039	ZV-06	30-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	44	64.0	2,816				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	7	4.0	28	1	10-15		
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	22	4.0	88		5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	4	4.0	16		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	V	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	2	1.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus hyperboreus	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	4	4.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	3	1.0	3				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	11	64.0	704				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	203	64.0	12,992	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	12	64.0	768				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	74	64.0	4,736				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Coarse 2	1/4	CRIS	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Isopoda		Isopoda indet.	Cryptoniscid	1	4.0	4	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	6	64.0	384				
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-039-QA	ZV-06-QA	30-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	45	64.0	2,880				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CNHY	Cnidaria						Cnidaria indet.	Medusa	3	64.0	192	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCL	Arthropoda	Crustacea	Branchiopoda				Cladocera indet. (2)	F	1	64.0	64	1			Sent for independent verification
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	6	4.0	24	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	4	4.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	9	64.0	576				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	5	64.0	320	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	3	64.0	192				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida		Cyclopoida indet.	I-IV	13	64.0	832				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microsetella sp.	I-IV	3	64.0	192	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	221	64.0	14,144				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	25	64.0	1,600				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	MEMO	Nematoda						Nematoda indet.	A	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	31	64.0	1,984	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	1	1.0	1	1	5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	18	1.0	18		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	3	64.0	192				
Golder	Baffinlands Iron Mine	2019	mz19-072-040	ZH-01	31-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	27	64.0	1,728				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	4.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	2	4.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIm	2	4.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	4	4.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	3	1.0	3				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	7	4.0	28				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	4	64.0	256				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	10	64.0	640				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	2	64.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida		Cyclopoida indet.	I-IV	2	64.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Harpacticoida indet.	V	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Harpacticoida indet.	I-IV	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	V	5	4.0	20	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	I-IV	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	V	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	353	64.0	22,592				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	15	64.0	960				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	13	64.0	832	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	6	1.0	6	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-041	ZH-02	31-Aug-19	Fine	1/64	XXXX	Unknown						Unidentified	Egg	38	64.0	2,432				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	2	1.0	2	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	CNHY	Cnidaria						Cnidaria indet.	Medusa	2	32.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	A	1	1.0	1	1	<15.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	I-IV	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	5	1.0	5				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	7	4.0	28				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	5	4.0	20				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	4.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	8	32.0	256				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	5	4.0	20				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida		Cyclopoida indet.	I-IV	2	32.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	I-IV	2	4.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	V	6	4.0	24				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	6	4.0	24	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 2	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	3	4.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	368	32.0	11,776				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	22	32.0	704				
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	30	32.0	960	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	7	1.0	7	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	6	32.0	192				

Client	Project	Year	Biologica Sample #	Client Sample #	Date Sampled	Fraction	Split	Groupcode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Stage	Raw Abundance	Split Multiplier	Total Abundance	Unique Taxa Count	Size (mm)	Larval Fish Common Name	Comments
Golder	Baffinlands Iron Mine	2019	mz19-072-042	ZH-03	31-Aug-19	Fine	1/32	XXXX	Unknown						Unidentified	Egg	38	32.0	1,216				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	128.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CNHY	Cnidaria						Cnidaria indet.	Medusa	4	8.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 1	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	A	1	1.0	1	1	<15.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	2	1.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	7	1.0	7				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIm	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	19	8.0	152				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	5	8.0	40	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	8.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	2	128.0	256				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	5	8.0	40	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	2	8.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	12	128.0	1,536				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	3	128.0	384				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	I-IV	1	128.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	3	128.0	384	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	1	128.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	288	128.0	36,864				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	7	128.0	896				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	7	128.0	896	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	3	1.0	3	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	7	128.0	896				
Golder	Baffinlands Iron Mine	2019	mz19-072-043	ZH-04	31-Aug-19	Fine	1/128	XXXX	Unknown						Unidentified	Egg	43	128.0	5,504				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	A	3	8.0	24	1	5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	2	8.0	16		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	20	8.0	160	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	1	1.0	1		15-20		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	1.0	1		<10.0		Damaged
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	CRCI	Arthropoda	Crustacea	Maxillopoda	Thecostraca	Sessilia		Balanomorpha indet.	Cypris	1	512.0	512	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	V	2	8.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	1	8.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIm	2	8.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	6	8.0	48	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	8.0	8	1	1.6		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	4	64.0	256				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	64.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	53	64.0	3,392				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	16	64.0	1,024				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Harpacticoida indet.	VIm	1	64.0	64	1	1		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Microstella norvegica	V	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	2	64.0	128	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 3	1/64	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	1	64.0	64				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	183	512.0	93,696				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	22	512.0	11,264				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 1	Whole	CTEN	Ctenophora						Ctenophora indet.	A	1	1.0	1	1	<10.0		Damaged
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	11	512.0	5,632	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	2	1.0	2	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	5	512.0	2,560				
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	1	512.0	512	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-044	ZH-05A	31-Aug-19	Fine	1/512	XXXX	Unknown						Unidentified	Egg	27	512.0	13,824				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CNHY	Cnidaria		Hydrozoa	Trachylinae	Narcomedusae	Solmundaeginidae	Aeginopsis laurentii	Medusa	2	1.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	1	1.0	1	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CNHY	Cnidaria						Cnidaria indet.	Medusa	5	1.0	5		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Hyperiidae indet.	J	1	1.0	1	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	A	2	1.0	2	1	15-20		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	J	8	1.0	8		5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	J	4	1.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	I-IV	5	1.0	5	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	30	1.0	30				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	VIf	12	1.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	VIm	12	1.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	3	1.0	3	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIm	2	1.0	2				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	6	1.0	6	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	28	1.0	28				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	3	1.0	3	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	13	1.0	13				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	VIf	7	1.0	7				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	VIm	6	1.0	6				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida		Cyclopoida indet.	I-IV	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Harpacticoida indet.	I-IV	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	84	1.0	84				
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	4	1.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	12	1.0	12	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	1	1.0	1	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	4	1.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	30	1.0	30	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-045	ZH-05B	31-Aug-19	Whole	Whole	XXXX	Unknown						Unidentified	Egg	7	1.0	7		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	1	4.0	4	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria		Hydrozoa	Hydroidolina	Anthoathecata	Corymorphidae	Euphysa sp.	Medusa	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	1	4.0	4	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CNHY	Cnidaria						Cnidaria indet.	Medusa	14	4.0	56		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	1.0	1		10-15		Damaged
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	J	3	1.0	3	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Emalacostraca	Amphipoda		Onisimus glacialis	A	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCL	Arthropoda	Crustacea	Branchiopoda				Cladocera indet. (2)	F	1	4.0	4	1			Sent for independent verification, Damaged
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	I-IV	6	4.0	24	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	23	4.0	92				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	VIf	11	4.0	44				

Appendix H-2
2019 MEEMP and AIS Zooplankton Survey Data

Client	Project	Year	Biologica Sample #	Client Sample #	Date Sampled	Fraction	Split	Groupcode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Stage	Raw Abundance	Split Multiplier	Total Abundance	Unique Taxa Count	Size (mm)	Larval Fish Common Name	Comments
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	VIm	7	4.0	28				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus finmarchicus	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	22	1.0	22	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	4	4.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	17	4.0	68	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	4.0	4				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	6	4.0	24				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	4	4.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	3	4.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	3	4.0	12				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	23	4.0	92				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	26	4.0	104				
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	3	4.0	12		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	CTEN	Ctenophora						Ctenophora indet.	A	1	1.0	1	1	<10.0		Damaged
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	MEMO	Arthropoda	Crustacea	Malacostraca	Emalacostraca	Amphipoda		Gammarus sp.	A	1	1.0	1		<15.0		Benthic
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	1	4.0	4	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	1	1.0	1	1	5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	1	1.0	1		20-25		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	6	1.0	6		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Coarse 1	Whole	PIXX	Chordata	Vertebrata	Actinopterygii		Gadiformes	Gadidae	Gadidae indet.	L	1	1.0	1	1		Cod	Pigment pattern is unclear but possibly Boreogadus saida (arctic cod)
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	121	4.0	484	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-046	ZH-06	31-Aug-19	Fine	1/4	XXXX	Unknown						Unidentified	Egg	6	4.0	24		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 2	1/4	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	4	4.0	16	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	4	16.0	64	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CNHY	Cnidaria						Cnidaria indet.	Medusa	112	16.0	1,792		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	CRAM	Arthropoda	Crustacea	Malacostraca	Eumalacostraca	Amphipoda	Hyperiidae	Themisto libellula	A	1	1.0	1	1	<15.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	7	16.0	112	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIm	2	16.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	I-IV	5	16.0	80				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	9	16.0	144				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	5	16.0	80				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	10	16.0	160				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	2	16.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	29	16.0	464				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	21	16.0	336				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	44	16.0	704				
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	4	16.0	64		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	ECEC	Echinodermata	Echinozoa	Echinoidea				Echinoidea indet.	Echinopluteus	2	16.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	MEMO	Arthropoda	Crustacea		Copepoda	Harpacticoida		Harpacticoida indet.	I-IV	2	1.0	2				Benthic
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	2	16.0	32	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	1	1.0	1	1	10-15		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	3	1.0	3		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Coarse 2	1/4	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	16	4.0	64	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	1	16.0	16		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	69	16.0	1,104	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-047	ZH-07	1-Sep-19	Fine	1/16	XXXX	Unknown						Unidentified	Egg	11	16.0	176		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	10	16.0	160	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CNHY	Cnidaria						Cnidaria indet.	Medusa	122	16.0	1,952		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	11	16.0	176	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIm	7	16.0	112				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	I-IV	11	16.0	176				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia sp.	V	28	16.0	448				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus finmarchicus	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	3	1.0	3	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	VIf	1	1.0	1				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	1	16.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Microcalanus sp.	VIf	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	16.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	12	16.0	192				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	4	16.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	2	16.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	33	16.0	528				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	22	16.0	352				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	71	16.0	1,136				
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	1	16.0	16		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	ECEC	Echinodermata	Echinozoa	Echinoidea				Echinoidea indet.	Echinopluteus	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	4	1.0	4	1	5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	1	1.0	1		10-15		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	4	1.0	4		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 2	1/4	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	15	4.0	60	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Coarse 1	Whole	PIXX	Chordata	Vertebrata	Actinopterygii		Gadiformes	Gadidae	Gadidae indet.	L	1	1.0	1	1		Cod	Pigment pattern is unclear but possibly Boreogadus saida (arctic cod)
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	73	16.0	1,168	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	URAP	Chordata	Tunicata	Appendicularia		Copelata	Oikopleuridae	Oikopleura sp.	A	2	16.0	32	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-048	ZH-08	1-Sep-19	Fine	1/16	XXXX	Unknown						Unidentified	Egg	3	16.0	48		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CNHY	Cnidaria						Cnidaria indet.	Medusa	2	8.0	16	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Coarse	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	I-IV	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	8.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	VIf	1	8.0	8				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	3	8.0	24				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	128	8.0	1,024				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	16	8.0	128				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	3	8.0	24	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	89	8.0	712				
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	10	8.0	80		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Coarse	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	1	8.0	8	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049	BR1	1-Sep-19	Fine	1/8	XXXX	Unknown						Unidentified	Egg	39	8.0	312		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	8.0	8	1			

Client	Project	Year	Biologica Sample #	Client Sample #	Date Sampled	Fraction	Split	Groupcode	Phylum	Subphylum	Class	Subclass	Order	Family	Taxa	Stage	Raw Abundance	Split Multiplier	Total Abundance	Unique Taxa Count	Size (mm)	Larval Fish Common Name	Comments
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Coarse	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	I-IV	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	8.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	3	8.0	24				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	138	8.0	1,104				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	14	8.0	112				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	1	8.0	8	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	95	8.0	760				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	5	8.0	40				
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Coarse	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	3	8.0	24	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-049-QA	BR1-QA	1-Sep-19	Fine	1/8	XXXX	Unknown						Unidentified	Egg	31	8.0	248				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 2	1/8	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	8	8.0	64		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	13	1.0	13	1	5-10		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CNHY	Cnidaria						Cnidaria indet.	Medusa	4	256.0	1,024				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus finmarchicus	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus glacialis	V	1	1.0	1	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 2	1/8	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	5	8.0	40		1		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	1	1.0	1		3		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	10	256.0	2,560				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIf	1	256.0	256	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona similis	VIm	1	256.0	256				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	113	256.0	28,928				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	18	256.0	4,608				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	6	256.0	1,536	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	6	256.0	1,536				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	76	256.0	19,456				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	3	256.0	768				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	8	256.0	2,048	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	A	2	1.0	2	1	10-15		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Clionidae	Clione limacina	J	1	1.0	1		<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 1	Whole	MOGA	Mollusca		Gastropoda	Heterobranchia	Pteropoda	Limacinidae	Limacina helicina	A	1	1.0	1	1	<10.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	2	256.0	512				
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Coarse 2	1/8	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	A	1	8.0	8	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-050	BR2	1-Sep-19	Fine	1/256	XXXX	Unknown						Unidentified	Egg	18	256.0	4,608				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Coarse	1/2	CNHY	Cnidaria		Hydrozoa		Leptothecata	Campanulariidae	Obelia sp.	Medusa	2	2.0	4	1	<5.0		
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	16.0	16				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Coarse	1/2	CNHY	Cnidaria						Cnidaria indet.	Medusa	1	2.0	2				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Coarse	1/2	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Acartiidae	Acartia longiremis	VIf	1	2.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Coarse	1/2	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	2	2.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	2	16.0	32				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	102	16.0	1,632	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	9	16.0	144				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	254	16.0	4,064				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	7	16.0	112				
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	1	16.0	16	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	3	16.0	48	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	4	16.0	64	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	URAP	Chordata	Tunicata	Appendicularia		Copelata	Oikopleuridae	Oikopleura sp.	J	2	16.0	32	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-051	BR3	1-Sep-19	Fine	1/16	XXXX	Unknown						Unidentified	Egg	18	16.0	288				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	1	2.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 1	Whole	CHEA	Chaetognatha		Sagittoidea	Aphragmophora		Sagittidae	Parasagitta elegans	J	1	1.0	1		4		
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CNHY	Cnidaria		Hydrozoa	Trachylinae	Trachymedusae	Rhopalonematidae	Aglantha digitale	Medusa	2	2.0	4	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CNHY	Cnidaria						Cnidaria indet.	Medusa	13	2.0	26				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CNHY	Cnidaria						Cnidaria indet.	Medusa	4	42.7	171				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CRCI	Arthropoda	Crustacea	Maxillopoda	Thecostraca	Sessilia		Balanomorpha indet.	Nauplius	1	2.0	2	1	0.8		
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Calanidae	Calanus sp.	I-IV	3	2.0	6	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Microcalanus sp.	V	1	42.7	43	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida	Clausocalanidae	Pseudocalanus sp. complex	V	1	2.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Calanoida		Calanoida indet.	I-IV	5	42.7	213				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	I-IV	106	42.7	4,523	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Cyclopoida	Oithonidae	Oithona sp.	V	9	42.7	384				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	I-IV	7	42.7	299	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda	Poecilostomatoida	Oncaeidae	Oncaea sp.	V	4	42.7	171				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRCO	Arthropoda	Crustacea		Copepoda			Copepoda indet.	Nauplius	219	42.7	9,344				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	CRXX	Arthropoda	Crustacea					Crustacea indet.	Nauplius	11	42.7	469				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	MOBI	Mollusca		Bivalvia				Bivalvia indet.	Veliger	7	42.7	299	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	MOGA	Mollusca		Gastropoda				Gastropoda indet.	Veliger	10	42.7	427	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	POXX	Annelida		Polychaeta				Polychaeta indet.	Trochophore	1	42.7	43	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Coarse 2	1/2	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	A	1	2.0	2	1			
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	URAP	Chordata	Tunicata	Appendicularia		Copelata	Fritillariidae	Fritillaria sp.	J	2	42.7	85				
Golder	Baffinlands Iron Mine	2019	mz19-072-052	BR4	1-Sep-19	Fine	3/128	XXXX	Unknown						Unidentified	Egg	29	42.7	1,237				

biologica

Zooplankton QA/QC recounts summary for Golder Baffinlands Iron Mine, 2019.

Biologica QA Sample Number	Client QA Sample Number	Abundance (Original Replicate) (A)	Abundance (QA Replicate) (B)	Percent Agreement (%)
mz19-072-039-QA	ZV-06-QA	22,223	23,011	96.45
mz19-072-049-QA	BR1-QA	2,370	2,362	99.66
			Average:	**98.06**

Percent Agreement: 100 - ([(difference in abundance between samples) / total abundance of original sample)] *100%)

Appendix H-3

Zooplankton Taxa Presence and Absence in Milne Inlet During AIS Monitoring (2014-2018)

Taxa	2014	2015	2016	2017	2018	2019
Acarti hudsonica			x			
Acartia longiremis	x	x	x	x		x
*Aeginopsis laurentii***				x	x	x
Aglantha digitale	x			x	x	x
Ammodytes sp.				x	x	
Anthomedusae indet.		x				
Pholis fasciata				x		
Balanomorpha indet.**				x		x
Beroe gracilis		x				
Beroe cucumis			x			
Bivalvia indet.	x	x	x	x	x	x
Bosmina longicornis		x	x			
Bosminidae indet.	x			x		
Bryozoa indet. **					x	
Calanoida indet.	x	x	x	x	x	x
Calanus finmarchicus	x	x	x	x	x	x
Calanus glacialis	x	x	x	x	x	x
Calanus hyperboreus	x	x	x	x	x	x
*Catablema vesicarium***				x	x	
Centropages sp.		x			x	
Chydorus sphaericus			x			
Cladocera indet.						x
Clione limacina	x			x	x	x
Clytemnestra sp.	x		x	x		
Cnidaria indet.			x	x	x	x
Corycaeus sp.		x				
Cottidae indet.				x		
Ctenocalanus vanus				x	x	
Daphnia sp.		x				
Echinoidea indet.	x	x	x	x	x	x
Erythrops sp.					x	
Eukrohnia hamata	x					
Euphysa sp.		x			x	x
Eurytemora herdmani		x				
Euterpina acutifrons		x	x	x		
Fritillaria sp.		x	x		x	x
Gadidae indet.				x	x	x
Gymnosomata	x					
Hybocodon prolifer						x
Hydracarina sp.		x				
Hyperia medusarum				x		
Hyperoche medusarum				x		

Appendix H-3

Zooplankton Taxa Presence and Absence in Milne Inlet During AIS Monitoring (2014-2018)

Taxa	2014	2015	2016	2017	2018	2019
Isopoda indet.**				x	x	x
Limacina helicina		x		x	x	x
Lucicutia sp	x		x			
Lysianassoidea indet.					x	
Metridia sp.		x		x	x	
Microcalanus sp.				x	x	x
Microsetella norvegica	x	x	x	x	x	x
Mysis litoralis				x		
Nemertea indet.				x		
Obelia sp.						x
Oikopleura sp.		x		x	x	x
Oithona atlantica	x	x	x	x	x	
Oithona similis	x	x	x	x	x	x
Oncaea minuta	x	x				
Oncaeidae indet.	x	x	x	x		
Onisimus glacialis						x
Parasagitta elegans	x			x	x	x
Polychaeta indet.	x	x	x	x	x	x
Pseudocalanus sp.	x	x	x	x	x	x
Rathkea sp.**				x		
Sabellariidae indet.				x		
*Sabinea septemcarinata***				x	x	
Sagittidae indet.	x	x	x			
Sapphirina opalina		x				
Sapphirina sp.			x	x		
Scolecithricella sp.				x	x	
Synchaeta sp.			x	x		
*Themisto abyssorum***				x		
Themisto libellula				x	x	x
Themisto sp.	x			x	x	
Triconia borealis			x	x		

Notes: Taxa identified to the lowest practical taxonomic level; presence/absence for previous years taken from SEM 2015, 2016, 2017a, Golder 2018, Golder 2019a. **=taxa not identified in 2014 through 2017 but identified during baseline studies in 2008 or 2010 (Baffinland 2012; SEM 2017a); indet.= indeterminate (taxa could not be identified beyond the taxonomic level listed); sp.=species. High taxonomic levels presented for taxa not previously identified to a lower taxonomic level (e.g. Crustacea indet. omitted due to large numbers of crustacean taxa identified to species level, Cottidae indet. presented due to lack of sculpins identified to species level).

APPENDIX I

Benthic Infauna Taxonomic List (2014-2018)

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
ANNE	Annelida	Clitellata/-	-	Oligochaeta indet.	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Clitellata/Enchytraeida	Enchytraeidae	Enchytraeidae indet.	X	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Clitellata/Rhynchobdellida	Piscicolidae	Hirudinea indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Clitellata/Rhynchobdellida	Piscicolidae	*Mysidobdella* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/-	-	Errantia indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ANNE	Annelida	Polychaeta/-	-	Polychaeta indet.	<null>	X	X	X	Y	<null>	<null>
ANNE	Annelida	Polychaeta/Archiannelida	Archiidae	Archiannelid indet.	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea (Acmira) catherinae*	<null>	X	<null>	<null>	X	<null>	X
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea (Strelzovia) antennata*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea hartmanae*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea minuta*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea nolani*	<null>	X	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Aricidea* sp.	X	X	<null>	X	Y	X	Y
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	Aricidea sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	Paraonidae indet.	<null>	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Cirratulida	Paraonidae	*Paraonis* sp.	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Echiuroidea	Echiuridae	*Parougia caeca*	<null>	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Eunicida	Dorvilleidae	*Echiurus echiurus*	<null>	X	X	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	Lumbrineridae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	*Lumbrineris* sp.	X	X	X	X	<null>	X	<null>
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	*Scoletoma fragilis*	X	<null>	X	X	X	X	X
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	*Scoletoma impatiens*	<null>	<null>	<null>	X	X	X	X
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	*Scoletoma* sp.	<null>	<null>	<null>	<null>	<null>	X	Y
ANNE	Annelida	Polychaeta/Eunicida	Lumbrineridae	*Scoletoma tenuis*	<null>	X	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Eunicida	Onuphidae	*Nothria conchylega*	X	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Capitellidae	Capitellidae indet.	<null>	<null>	<null>	X	Y	<null>	Y
ANNE	Annelida	Polychaeta/Not Assigned	Capitellidae	*Mediomastus ambiseta*	<null>	X	<null>	X	X	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Capitellidae	*Mediomastus* sp.	X	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Capitellidae	*Notomastus latericeus*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Capitellidae	*Capitella capitata* complex	X	X	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Cossuridae	*Cossura longocirrata*	<null>	X	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Not Assigned	Cossuridae	*Cossura* sp.	X	<null>	X	X	X	X	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Clymenura polaris*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Clymenura* sp.	<null>	<null>	<null>	<null>	X	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Euclymene* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Euclymeninae indet.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Heteroclymene robusta*	<null>	<null>	X	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Maldane sarsi*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Maldanidae indet.	X	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Maldanidae sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Maldanidae sp. B	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Maldanidae sp. C	<null>	<null>	<null>	X	<null>	<null>	<null>
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ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Nicomache lumbricalis*	<null>	<null>	X	X	X	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Nicomache* sp.	<null>	<null>	<null>	<null>	<null>	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	Nicomachinae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Petaloproctus* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Petaloproctus tenuis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Praxillella gracilis*	<null>	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Praxillella praetermissa*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Not Assigned	Maldanidae	*Praxillella* sp.	<null>	<null>	<null>	X	Y	<null>	<null>
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ANNE	Annelida	Polychaeta/Not Assigned	Opheliidae	*Ophelia limacina*	X	X	X	X	X	<null>	X
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ANNE	Annelida	Polychaeta/Not Assigned	Opheliidae	*Ophelina* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Not Assigned	Orbiniidae	*Leitoscoloplos acutus*	<null>	X	X	X	X	X	X
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ANNE	Annelida	Polychaeta/Not Assigned	Orbiniidae	*Scoloplos armiger*	X	<null>	<null>	<null>	X	X	X
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ANNE	Annelida	Polychaeta/Not Assigned	Protodrilidae	*Protodrilus* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Scalibregmatidae	*Polyphysia baffinensis*	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Not Assigned	Scalibregmatidae	*Polyphysia crassa*	<null>	<null>	<null>	<null>	X	X	<null>
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ANNE	Annelida	Polychaeta/Not Assigned	Scalibregmatidae	*Scalibregma inflatum*	X	X	X	X	X	X	X
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ANNE	Annelida	Polychaeta/Phyllodocida	Glyceridae	*Glycera capitata*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Glyceridae	*Glycera* sp.	<null>	<null>	<null>	<null>	Y	X	Y
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ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Aglaophamus malmgreni*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Aglaophamus* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Micronephthys cornuta*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Nephtys bucera*	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Nephtys ciliata*	X	<null>	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Nephtys paradoxa*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Nephtyidae	*Nephtys* sp.	X	X	X	X	<null>	X	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Nereididae	Nereididae indet.	X	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Nereididae	*Nereis* sp.	<null>	<null>	<null>	X	Y	<null>	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Nereididae	*Nereis zonata*	<null>	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Pholoidae	*Pholoe longa*	X	X	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Pholoidae	*Pholoe minuta*	<null>	<null>	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Pholoidae	*Pholoe* sp.	X	X	X	X	Y	X	Y

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
ANNE	Annelida	Polychaeta/Phyllodocida	Pholoidae	*Pholoe tecta*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eteone barbata*	X	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eteone flava*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eteone longa* complex*	<null>	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eteone* sp.	X	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eulalia* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Eumida* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Hypereteone sp.*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Phyllodoce groenlandica*	X	<null>	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Phyllodoce mucosa*	<null>	<null>	X	X	X	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	*Phyllodoce* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Phyllodocidae	Phyllodocidae indet.	<null>	<null>	X	X	Y	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Bylgides groenlandicus*	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Bylgides sarsi*	<null>	X	X	X	X	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Bylgides* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Bylgides* sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Gattyana cirrhosa*	X	X	X	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Harmothoe extenuata*	<null>	X	X	X	X	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Harmothoe fragilis*	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Harmothoe imbricata*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Harmothoe rarispina*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Harmothoe* sp.	X	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Hartmania moorei*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Hartmania* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Melaenis loveni*	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	*Neobylgides sp.*	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	Polynoidae indet.	X	X	X	X	Y	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Polynoidae	Polynoinae indet.	<null>	<null>	<null>	<null>	Y	<null>	Y
ANNE	Annelida	Polychaeta/Phyllodocida	Sphaerodoridae	*Sphaerodoropsis biserialis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Sphaerodoridae	*Sphaerodoropsis minutum*	X	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Eusyllis* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Exogone naidina*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Exogone* sp.	<null>	X	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Exogone verugera*	X	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Parexogone hebes*	<null>	X	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Pionosyllis compacta*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Pionosyllis* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Streptospinigera niuqtuut*	<null>	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	Syllidae indet.	X	X	X	X	Y	<null>	<null>
ANNE	Annelida	Polychaeta/Phyllodocida	Syllidae	*Syllides* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Fabriciidae	Fabriciidae indet.	<null>	<null>	<null>	<null>	X	<null>	Y
ANNE	Annelida	Polychaeta/Sabellida	Fabriciidae	*Manayunkia aesturiana***	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Fabriciidae	*Pseudofabricia* sp. nr. *aberrans*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	*Galathowenia oculata*	<null>	<null>	X	<null>	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	*Myriochele danielsseni*	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	*Myriochele heeri*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	*Myriochele* sp.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	*Owenia fusiformis*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Oweniidae	Oweniidae indet.	<null>	<null>	X	X	<null>	X	Y
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Bispira* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Branchiomma* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Chone duneri*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Chone* sp.	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Dialychone* sp.	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Dialychone* sp. 1	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Dialychone* sp. A	<null>	<null>	<null>	<null>	Y	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Dialychone* sp. B	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Euchone analis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Euchone incolor*	<null>	X	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Euchone papillosa*	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Euchone rubrocincta*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Euchone* sp.	<null>	<null>	X	X	<null>	X	Y
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Hypsicomus* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Paradialychone harrisae*	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Potamilla neglecta*	<null>	<null>	X	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	*Pseudopotamilla reniformis*	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. B	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. F	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. G	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae indet.	<null>	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. 3	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. 4	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. H	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. I	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Sabellidae	Sabellidae sp. J	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Serpulidae	*Bushiella (Jugaria) quadrangularis*	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Sabellida	Serpulidae	*Pileolaria* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Serpulidae	Serpulidae indet.	X	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Polychaeta/Sabellida	Serpulidae	Spirorbinae indet.	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Sabellida	Spirorbidae	Spirorbidae indet.	<null>	X	X	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Spionida	Apistobranchidae	*Apistobranchus* sp.	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Dipolydora caulleryi*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Dipolydora concharum*	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Dipolydora quadrilobata*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Dipolydora socialis*	<null>	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Dipolydora* sp.	<null>	<null>	<null>	<null>	Y	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Laonice cirrata*	<null>	<null>	<null>	<null>	<null>	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Marenzelleria* sp.	<null>	<null>	<null>	X	X	X	<null>

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Marenzelleria viridis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Polydora* sp. complex	X	X	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Prionospio cirrifera*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Prionospio* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Prionospio steenstrupi*	<null>	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Pygospio elegans*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Pygospio* sp.	<null>	X	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Scolelepis* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Spionida	Spionidae	*Spio filicornis*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Spionida	Spionidae	Spionidae indet.	X	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Spionida	Trochochaetidae	*Trochochaeta watsoni*	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Ampharete borealis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Ampharete oculata*	<null>	<null>	X	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Ampharete* sp.	<null>	X	<null>	X	Y	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Ampharete vega*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	Ampharetid sp. B	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	Ampharetid sp. E	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	Ampharetidae indet.	X	X	X	X	Y	<null>	Y
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Amphicteis gunneri*	<null>	X	X	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Amphicteis sundevalli*	X	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Anobothrus gracilis*	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Lysippe labiata*	<null>	<null>	X	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Melinna elisabethae*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Melinna* sp.	X	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	*Samytha* sp.	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Ampharetidae	Sosane sp. nr. wireni	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Aphelochaeta marioni*	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Aphelochaeta* sp.	<null>	<null>	<null>	<null>	X	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Chaetozone bathyala*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Chaetozone careyi*	<null>	<null>	<null>	<null>	X	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Chaetozone pigmentata*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Chaetozone setosa* complex	<null>	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Chaetozone* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	Cirratulidae indet.	X	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	Cirratulidae sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Kirkegaardia* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Cirratulidae	*Tharyx* sp.	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Flabelligeridae	*Brada villosa*	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Flabelligeridae	*Diplocirrus hirsutus*	<null>	<null>	X	X	<null>	X	X
ANNE	Annelida	Polychaeta/Terebellida	Flabelligeridae	*Flabelligera affinis*	<null>	<null>	<null>	X	<null>	<null>	X
ANNE	Annelida	Polychaeta/Terebellida	Flabelligeridae	Flabelligeridae indet.	<null>	<null>	X	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Pectinariidae	*Cistenides granulata*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Pectinariidae	*Cistenides hyperborea*	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Pectinariidae	*Pectinaria* sp.	X	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Amaeana* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Lanassa* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Lanassa venusta venusta*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Laphania boecki*	<null>	<null>	<null>	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Leaena abranchiata*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Neoamphitrite affinis*	<null>	<null>	<null>	<null>	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Nicolea venustula*	<null>	X	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Pista cristata*	<null>	<null>	<null>	X	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Pista maculata*	X	X	X	X	X	X	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Polycirrus medusa*	<null>	<null>	<null>	<null>	<null>	<null>	X
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Polycirrus* sp. complex	X	X	<null>	X	X	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Proclea graffii*	<null>	<null>	<null>	<null>	<null>	X	<null>
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	Terebellidae indet.	<null>	X	X	X	Y	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Terebellides* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ANNE	Annelida	Polychaeta/Terebellida	Terebellidae	*Terebellides stroemi*	X	X	X	X	X	<null>	X
ANNE	Annelida	Polychaeta/Terebellida	Trichobranchidae	*Terebellides reishi*	<null>	<null>	<null>	<null>	X	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Trichobranchidae	Trichobranchidae indet.	X	<null>	<null>	<null>	<null>	<null>	<null>
ANNE	Annelida	Polychaeta/Terebellida	Trichobranchidae	*Trichobranchus glacialis*	X	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Arachnida/-	-	Acari indet.	X	X	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Arachnida/Trombidiformes	Halacaridae	Halacaridae indet.	<null>	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Copepoda/Cyclopoida	-	Cyclopoida indet.	<null>	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Copepoda/Harpacticoida	-	Harpacticoida indet.	X	X	<null>	X	X	X	X
ARTH	Arthropoda	Insecta/Coleoptera	Curculionidae	Curculionidae indet.	<null>	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Insecta/Diptera	-	Diptera indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Insecta/Diptera	Chironomidae	Chironomidae indet.	X	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Insecta/Diptera	Chironomidae	Chironominae indet.	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Insecta/Diptera	Orthocladiinae	Orthocladiinae indet.	X	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	-	Amphipoda indet.	X	X	X	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Acanthonotozomatidae	*Acanthonotozoma inflatum*	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampelescidae	*Haploops* sp.	<null>	<null>	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampelescidae	*Haploops tubicola*	X	X	<null>	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampeliscidae	*Ampelisca eschrichtii*	<null>	<null>	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampeliscidae	*Ampelisca* sp.	<null>	<null>	X	X	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampeliscidae	Ampeliscidae indet.	<null>	<null>	<null>	X	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampeliscidae	*Byblis gaimardii*	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ampeliscidae	*Byblis* sp.	<null>	<null>	X	X	X	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Amphilochidae	Amphilochidae indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Amphilochidae	*Amphilochopsis hamatus*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Amphilochidae	*Amphilochus* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Atylidae	*Atylus carinatus*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Atylidae	*Nototropis* sp.	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Calliopiidae	*Apherusa jurinei*	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Calliopiidae	*Apherusa megalops*	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Calliopiidae	Calliopiidae indet.	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Corophiidae	Corophiidae indet.	<null>	<null>	<null>	X	<null>	X	Y

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
ARTH	Arthropoda	Malacostraca/Amphipoda	Corophiidae	*Corophium* sp.	X	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Corophiidae	*Crassicorophium bonellii*	<null>	X	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Corophiidae	*Monocorophium insidiosum*	<null>	X	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Corophiidae	*Monocorophium* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Dexaminidae	*Dexamine* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Dexaminidae	*Guernea nordenskioldi*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Eusiridae	*Rhachotropis helleri*	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Eusiridae	*Rhachotropis oculata*	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Eusiridae	*Rhachotropis* sp. *	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Gammaridae	*Gammarus oceanicus*	<null>	X	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Gammaridae	*Gammarus setosus*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Gammaridae	*Gammarus* sp.	<null>	X	X	X	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Hyperiidae	*Themisto* sp.	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Isaeidae	*Protomedeia fasciata*	<null>	X	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Isaeidae	*Protomedeia* sp.*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Isaeidae	*Rhachotropis aculeata*	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ischyroceridae	Ischyroceridae indet.	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ischyroceridae	*Ischyrocerus anguipes*	<null>	X	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Ischyroceridae	*Ischyrocerus* sp.	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Lysianassidae	*Gronella groenlandica*	<null>	X	<null>	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Lysianassidae	Lysianassidae indet.	X	<null>	X	<null>	Y	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Lysianassidae	Lysianassoidea indet.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Lysianassidae	*Scopelocheirus hopei*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Munnopsidae	*Eurycope* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Aceroides latipes*	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Aceroides* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Arrhis* sp.	<null>	<null>	<null>	<null>	<null>	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Bathymedon obtusifrons**	<null>	<null>	<null>	X	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Deflexilodes tesselatus*	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Monoculodes latimanus*	<null>	X	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Monoculodes* sp.	X	X	X	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Monoculopsis longicornis*	<null>	X	<null>	X	X	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Monoculopsis* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Oediceros borealis*	<null>	X	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	Oedicerotidae indet.	X	X	X	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Paroediceros lynceus*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Paroediceros* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Rostroculodes borealis*	<null>	<null>	X	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Rostroculodes kroyeri*	<null>	<null>	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Rostroculodes longirostris*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Rostroculodes* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Westwoodilla caecula*	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Oedicerotidae	*Westwoodilla* sp.	<null>	X	<null>	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Opisidae	*Opisa eschrichti*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Phoxocephalidae	*Harpinia serrata*	X	<null>	X	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Phoxocephalidae	*Harpinia* sp.	<null>	<null>	X	X	Y	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Phoxocephalidae	*Phoxocephalus holbolli*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Podoceridae	*Dyopedos* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Pontoporeiidae	*Monoporeia affinis*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Pontoporeiidae	*Pontoporeia femorata*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Pontoporeiidae	Pontoporeiidae indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Stenothoidae	*Hardametopa nasuta*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Stenothoidae	*Metopa* sp.	<null>	X	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Stenothoidae	Stenothoidae indet.	X	<null>	<null>	X	Y	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Hippomedon denticulatus*	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Hippomedon serratus*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Hippomedon* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Orchomene macroserratus*	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Orchomene* sp.	<null>	<null>	<null>	<null>	X	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Orchomenella minuta*	<null>	X	<null>	X	<null>	X	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Orchomenella pinguis*	<null>	<null>	<null>	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	*Orchomenella* sp.	<null>	X	<null>	X	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Tryphosidae	Tryphosidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx laticoxae*	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx nugax*	X	X	X	X	X	<null>	X
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx ochoticus*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx pacificus*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx sarsi*	<null>	<null>	X	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Anonyx* sp.	<null>	X	X	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Menigrates obtusifrons*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus barentsi Group*	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus brevicaudatus*	<null>	<null>	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus litoralis*	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus normani*	<null>	<null>	X	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus plautus*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	*Onisimus* sp.	X	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Amphipoda	Uristidae	Uristidae indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	-	Cumacea indet.	<null>	X	X	X	Y	X	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Bodotriidae	*Cyclaspis longicaudata*	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Brachydiastylis resima*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	Diastylidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis alaskensis*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis bradyi*	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis echinata*	<null>	<null>	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis goodsiri*	X	<null>	X	<null>	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis lucifera*	<null>	<null>	X	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis rathkei*	X	X	X	<null>	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis scorpiodes*	X	<null>	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis sculpta*	<null>	X	<null>	<null>	<null>	<null>	<null>

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis* sp.	<null>	X	<null>	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastylis spinulosa*	X	<null>	X	<null>	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Diastylidae	*Diastyloides biplicatus*	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Lampropidae	*Hemilamprops cristatus*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Lampropidae	Lampropidae indet.	<null>	<null>	X	<null>	Y	X	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Lampropidae	*Lamprops fuscatus*	X	X	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Lampropidae	*Lamprops* sp.	<null>	<null>	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Eudorella emarginata*	<null>	<null>	X	X	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Eudorella* sp.	X	<null>	X	X	Y	<null>	Y
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Eudorella truncatula*	<null>	<null>	X	X	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Eudorellopsis* sp.	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Leucon nasica*	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Leucon nasicoides*	X	X	X	X	X	<null>	X
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	*Leucon* sp.	<null>	<null>	X	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Cumacea	Leuconidae	Leuconidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Cumacea	Nannastacidae	*Campylaspis rubicunda*	<null>	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Malacostraca/Cumacea	Nannastacidae	*Campylaspis* sp.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Decapoda	Crangonidae	*Sabinea septemcarinata*	X	<null>	X	<null>	X	X	X
ARTH	Arthropoda	Malacostraca/Decapoda	Crangonidae	*Sclerocrangon boreas*	<null>	<null>	<null>	X	X	X	<null>
ARTH	Arthropoda	Malacostraca/Decapoda	Thoridae	*Lebbeus polaris*	X	<null>	<null>	<null>	<null>	X	X
ARTH	Arthropoda	Malacostraca/Decapoda	Thoridae	*Lebbeus* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ARTH	Arthropoda	Malacostraca/Isopoda	-	Asellota indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	-	Isopoda sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Desmosomatidae	*Desmosoma* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Desmosomatidae	Desmosomatidae indet.	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Desmosomatidae	*Eugerda* sp.	X	<null>	<null>	<null>	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Gnathiidae	*Gnathia maxillaris*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Gnathiidae	*Gnathia* sp.	X	X	<null>	<null>	X	<null>	Y
ARTH	Arthropoda	Malacostraca/Isopoda	Gnathiidae	Gnathiidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Isopoda	Paramunnidae	*Pleurogonium rubicundum*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Paramunnidae	*Pleurogonium* sp.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Isopoda	Paramunnidae	*Pleurogonium spinosissimum*	X	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Malacostraca/Mysida	-	Mysida indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Malacostraca/Mysida	Mysidae	*Mysis mixta*	<null>	X	<null>	X	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Mysida	Mysidae	*Mysis* sp.	<null>	X	<null>	<null>	<null>	X	<null>
ARTH	Arthropoda	Malacostraca/Tanaidacea	-	Tanaidacea indet.	X	X	X	X	Y	X	Y
ARTH	Arthropoda	Malacostraca/Tanaidacea	Akanthophoreidae	*Akanthophoreus gracilis*	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Malacostraca/Tanaidacea	Akanthophoreidae	*Akanthophoreus* sp.	<null>	<null>	<null>	<null>	Y	X	Y
ARTH	Arthropoda	Malacostraca/Tanaidacea	Pseudotanaidae	*Pseudotanais* sp.	<null>	<null>	<null>	<null>	X	X	Y
ARTH	Arthropoda	Malacostraca/Tanaidacea	Sphyrapodidae	*Pseudosphyrapus anomalus*	X	<null>	<null>	X	X	X	X
ARTH	Arthropoda	Malacostraca/Tanaidacea	Typhlotanaidae	*Typhlotanais* sp.	<null>	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Ostracoda/-	-	Myodocopa indet.	X	X	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Ostracoda/-	-	Ostracoda indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
ARTH	Arthropoda	Ostracoda/Myodocopida	Philomedidae	*Philomedes* sp.	<null>	<null>	<null>	<null>	X	X	X
ARTH	Arthropoda	Ostracoda/Podocopida	Cytheridae	Cytheridae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Ostracoda/Podocopida	Trachyleberididae	*Robertsonites tuberculatus**	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Pycnogonida/-	-	Pycnogonida indet.	X	<null>	X	<null>	X	<null>	<null>
ARTH	Arthropoda	Pycnogonida/Pantopoda	Ammotheidae	*Achelia* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
ARTH	Arthropoda	Pycnogonida/Pantopoda	Ammotheidae	*Achelia spinosa*	<null>	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Pycnogonida/Pantopoda	Numphonidae	*Nymphon* sp.	<null>	<null>	<null>	<null>	X	X	<null>
ARTH	Arthropoda	Pycnogonida/Pantopoda	Nymphonidae	*Nymphon hirtipes*	<null>	<null>	<null>	<null>	<null>	<null>	X
ARTH	Arthropoda	Thecostraca/-	-	Cirripedia indet.	<null>	<null>	X	X	<null>	<null>	<null>
ARTH	Arthropoda	Thecostraca/Balanomorpha	-	Balanomorpha indet.	<null>	<null>	<null>	<null>	X	X	Y
ARTH	Arthropoda	Thecostraca/Balanomorpha	Balanidae	*Balanus* sp.	X	<null>	<null>	X	<null>	<null>	<null>
ARTH	Arthropoda	Thecostraca/Balanomorpha	Balanidae	*Semibalanus balanoides*	X	<null>	<null>	<null>	<null>	<null>	<null>
MISC	Bryozoa	-/-	-	Bryozoa indet.	<null>	<null>	<null>	<null>	Y	X	<null>
MISC	Bryozoa	Gymnolaemata/-		Gymnolaemata indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	-	Cheilostomatida indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Calloporidae	Calloporidae indet.	<null>	<null>	<null>	<null>	<null>	X	X
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Candidae	*Scrupocellaria* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Epistomiidae	*Synnotum* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Escharellidae	*Escharella* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Hippothoidae	*Celleporella hyalina**	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Bryozoa	Gymnolaemata/Cheilostomatida	Myriaporidae	*Leieschara* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
MISC	Bryozoa	Gymnolaemata/Ctenostomatida	-	Ctenostomata indet.	<null>	<null>	<null>	<null>	X	X	<null>
MISC	Bryozoa	Gymnolaemata/Ctenostomatida	Alcyonidiidae	*Alcyonidium* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
MISC	Bryozoa	Gymnolaemata/Ctenostomatida	Triticellidae	*Triticella* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
MISC	Bryozoa	Gymnolaemata/Ctenostomatida	Vesiculariidae	*Bowerbankia* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Bryozoa	Stenolaemata/-	-	Stenolaemata indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Bryozoa	Stenolaemata/Cyclostomatida	Crisiidae	*Crisia* sp.	<null>	<null>	<null>	<null>	X	X	X
MISC	Bryozoa	Stenolaemata/Cyclostomatida	Oncousoeciidae	*Oncousoecia* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Bryozoa	Stenolaemata/Cyclostomatida	Tubuliporidae	*Tubulipora* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Bryozoa	Stenolaemata/Cyclostomatida		Cyclostomatida indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Chordata	-/-	-	Pisces indet.	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Chordata	Actinopterygii/Scorpaeniformes	Cottidae	Cottidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Chordata	Actinopyergii/Perciformes	Zoarcidae	Zoarcidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Chordata	Ascidiacea/-	-	Ascidiacea indet.	<null>	<null>	<null>	<null>	Y	<null>	Y
MISC	Chordata	Ascidiacea/-	-	Tunicate sp.	<null>	<null>	<null>	X	<null>	<null>	<null>
MISC	Chordata	Ascidiacea/Aplousobranchia	-	Aplousobranchia indet.	<null>	<null>	<null>	<null>	<null>	X	X
MISC	Chordata	Ascidiacea/Phlebobranchia	Ascidiidae	*Ascidia callosa*	<null>	X	<null>	<null>	<null>	<null>	<null>
MISC	Chordata	Ascidiacea/Phlebobranchia	Ascidiidae	*Ascidia* sp.	<null>	X	X	<null>	X	X	Y
MISC	Chordata	Ascidiacea/Stolidobranchia	Molgulidae	*Molgula* sp.	<null>	X	<null>	<null>	<null>	X	X
MISC	Chordata	Ascidiacea/Stolidobranchia	Pyuridae	*Boltenia echinata*	<null>	<null>	X	<null>	X	X	X
MISC	Chordata	Ascidiacea/Stolidobranchia	Styelidae	*Polycarpa fibrosa*	<null>	<null>	<null>	<null>	X	X	<null>
MISC	Chordata	Ascidiacea/Stolidobranchia	Styelidae	*Polycarpa* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Chordata	Ascidiacea/Stolidobranchia	Styelidae	Styelidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Cnidaria	Anthozoa/Actiniaria	Actiniidae	*Urticina* sp.*	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Cnidaria	Anthozoa/Actiniaria	Edwardsiidae	Edwardsiidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Cnidaria	Anthozoa/Actiniaria	Hormathiidae	*Hormathia digitata **	<null>	<null>	<null>	<null>	X	<null>	<null>

Appendix I
Benthic Infauna Taxa List (2014-2019)

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
MISC	Cnidaria	Anthozoa/Zoantharia	Parazoanthidae	*Parazoanthus* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
MISC	Cnidaria	Hydrozoa/-	-	Hydrozoa indet.	<null>	<null>	<null>	<null>	Y	<null>	Y
MISC	Cnidaria	Hydrozoa/Anthoathecata	-	Anthoathecata indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Cnidaria	Hydrozoa/Anthoathecata	Bougainvilliidae	Bougainvilliidae indet.	<null>	<null>	<null>	<null>	X	X	<null>
MISC	Cnidaria	Hydrozoa/Anthoathecata	Corynidae	Corynidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Cnidaria	Hydrozoa/Leptothecata	Lafoeidae	*Lafoea* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Cnidaria	Hydrozoa/Limnomedusae	Olindiidae	*Monobrachium parasitum*	<null>	<null>	<null>	<null>	X	X	X
ECHI	Echinodermata	Asteroidea/Forcipulatida	Asteriidae	Asteriidae indet.	<null>	<null>	X	<null>	<null>	<null>	<null>
ECHI	Echinodermata	Echinoidea/Camarodonta	Strongylocentrotidae	*Strongylocentrotus droebachiensis*	X	<null>	X	X	X	X	X
ECHI	Echinodermata	Echinoidea/Camarodonta	Strongylocentrotidae	*Strongylocentrotus* sp.	<null>	X	<null>	<null>	Y	X	Y
ECHI	Echinodermata	Holothuroidea/Apodida	-	Apodida indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ECHI	Echinodermata	Holothuroidea/Apodida	Myriotrochidae	*Myriotrochus rinkii*	<null>	<null>	<null>	X	<null>	<null>	X
ECHI	Echinodermata	Holothuroidea/Apodida	Psolidae	*Psolus phantapus*	<null>	<null>	<null>	<null>	X	X	<null>
ECHI	Echinodermata	Holothuroidea/Dendrochirotida	Psolidae	Holothuroidea sp. A	<null>	<null>	<null>	<null>	X	X	<null>
ECHI	Echinodermata	Holothuroidea/Dendrochirotida	Psolidae	*Psolus* sp.	<null>	<null>	<null>	<null>	<null>	<null>	Y
ECHI	Echinodermata	Holothuroidea/Molpadida	-	Molpadida indet.	<null>	<null>	<null>	<null>	X	X	<null>
ECHI	Echinodermata	Holothuroidea/Molpadida	Eupyrgidae	*Eupyrgus scaber*	<null>	<null>	<null>	<null>	<null>	<null>	X
ECHI	Echinodermata	Ophiuroidea/-	-	Ophiuroidea indet.	<null>	<null>	X	<null>	<null>	<null>	Y
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiopyrgidae	*Ophiopleura borealis*	<null>	<null>	<null>	<null>	<null>	<null>	X
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	*Ophiocten affinis*	<null>	<null>	<null>	<null>	<null>	X	X
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	*Ophiocten sericeum*	X	X	<null>	<null>	<null>	<null>	<null>
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	*Ophiura robusta*	X	<null>	X	X	X	X	X
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	*Ophiura sarsii*	X	X	X	X	X	X	X
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	*Ophiura* sp.	<null>	<null>	X	<null>	Y	<null>	Y
ECHI	Echinodermata	Ophiuroidea/Ophiurida	Ophiuridae	Ophiuridae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Aplacophora/-	-	Aplacophora indet.	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Bivalvia/-	-	Bivalvia indet.	<null>	X	X	X	Y	<null>	Y
MOLL	Mollusca	Bivalvia/-	-	Bivalvia sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Adapendonta	Hiatellidae	*Hiatella arctica*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Anomalodesmata	Cuspidariidae	*Cuspidaria arctica*	<null>	<null>	X	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Anomalodesmata	Cuspidariidae	*Cuspidaria* sp.	X	<null>	<null>	<null>	<null>	X	<null>
MOLL	Mollusca	Bivalvia/Anomalodesmata	Lyonsiidae	*Lyonsia arenosa*	<null>	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Bivalvia/Anomalodesmata	Periplomatidae	*Periploma aleuticum*	X	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Bivalvia/Anomalodesmata	Thraciidae	*Thracia myopsis*	<null>	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Anomalodesmata	Thraciidae	*Thracia* sp.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Arcida	Arcidae	*Bathyarca glacialis*	<null>	<null>	<null>	<null>	<null>	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Cardiidae	*Ciliatocardium ciliatum*	X	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Cardiidae	Clinocardiinae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Bivalvia/Cardiida	Cardiidae	*Serripes groenlandicus*	<null>	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Cardiidae	*Serripes* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Cardiida	Cardiidae	Cardiidae indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
MOLL	Mollusca	Bivalvia/Cardiida	Tellinidae	*Limecola balthica*	<null>	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Tellinidae	*Macoma calcarea*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Tellinidae	*Macoma moesta*	<null>	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Bivalvia/Cardiida	Tellinidae	*Macoma* sp.	<null>	<null>	<null>	<null>	Y	X	<null>
MOLL	Mollusca	Bivalvia/Cardiida	Tellinidae	Macominae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Bivalvia/Carditida	Astartidae	*Astarte borealis*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Carditida	Astartidae	*Astarte montagui*	X	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Carditida	Astartidae	*Astarte* sp.	X	X	X	X	Y	X	Y
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	*Axinopsida serricata*	<null>	<null>	<null>	<null>	X	<null>	X
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	*Axinopsida* sp.	<null>	<null>	<null>	<null>	<null>	X	Y
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	*Thyasira flexuosa*	<null>	X	X	X	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	*Thyasira gouldi*	X	<null>	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	*Thyasira* sp.	<null>	<null>	<null>	<null>	X	X	Y
MOLL	Mollusca	Bivalvia/Lucinida	Thyasiridae	Thyasiridae indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Myida	Myidae	*Mya arenaria*	<null>	<null>	X	X	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Myida	Myidae	*Mya* sp.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Myida	Myidae	*Mya truncata*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Crenella faba*	X	X	X	X	X	X	<null>
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Crenella* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Dacrydium vitreum*	X	<null>	<null>	<null>	<null>	X	<null>
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Musculus discors*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Musculus niger*	<null>	X	<null>	<null>	X	<null>	X
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Musculus* sp.	X	<null>	<null>	<null>	Y	<null>	Y
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	Mytilidae indet.	X	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Mytilus edulis*	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Mytilida	Mytilidae	*Mytilus* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
MOLL	Mollusca	Bivalvia/Nuculanida	-	Nuculanida indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Bivalvia/Nuculanida	Nuculanidae	*Nuculana minuta*	<null>	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Nuculanida	Nuculanidae	*Nuculana pernula*	X	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Nuculanida	Nuculanidae	*Nuculana* sp.	<null>	<null>	X	<null>	Y	X	Y

taxcode	Phylum	Class/Order	Family	TAXA	2010	2013	2015	2016	2017	2018	2019
MOLL	Mollusca	Bivalvia/Nuculanida	Nuculanoidea	Nuculanoidea indet.	<null>	<null>	<null>	<null>	Y	X	<null>
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	*Portlandia arctica*	X	X	X	X	X	<null>	X
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	*Yoldiella frigida*	<null>	<null>	<null>	<null>	<null>	X	X
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	*Yoldiella intermedia*	<null>	<null>	<null>	<null>	<null>	X	X
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	*Yoldiella lenticula*	X	<null>	<null>	<null>	<null>	X	<null>
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	*Yoldiella nana*	X	<null>	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Nuculanida	Yoldiidae	Yoldiidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Nuculida	Nuculidae	*Ennucula tenuis*	X	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Bivalvia/Nuculida	Nuculidae	*Nucula* sp.	<null>	<null>	X	<null>	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Nuculida	Nuculidae	*Pronucula tenuis*	<null>	X	X	X	<null>	<null>	<null>
MOLL	Mollusca	Bivalvia/Ostreida	Margaritidae	*Margarites groenlandicus*	<null>	X	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Ostreida	Margaritidae	*Margarites helicinus*	<null>	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Bivalvia/Ostreida	Margaritidae	*Margarites olivaceus*	X	<null>	<null>	<null>	<null>	X	<null>
MOLL	Mollusca	Bivalvia/Ostreida	Margaritidae	*Margarites* sp.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Bivalvia/Pectinida	Pectinidae	*Chlamys islandica*	<null>	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Pectinida	Pectinidae	Pectinidae indet.	<null>	<null>	<null>	<null>	Y	X	<null>
MOLL	Mollusca	Bivalvia/Pectinida	Pectinoidea	Pectinoidea indet.	<null>	<null>	<null>	<null>	Y	<null>	<null>
MOLL	Mollusca	Bivalvia/Pectinida	Propeamussiidae	*Similipecten greenlandicus*	X	<null>	X	X	X	X	X
MOLL	Mollusca	Bivalvia/Pectinida	Propeamussiidae	Propeamussiidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Caudofoveata/Chaetodermatida	Chaetodermatidae	*Chaetoderma* sp.	<null>	<null>	X	X	X	X	X
MOLL	Mollusca	Gastropoda/-	-	Gastropod sp. A	<null>	<null>	<null>	X	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/-	-	Gastropoda indet.	<null>	<null>	X	<null>	Y	X	Y
MOLL	Mollusca	Gastropoda/-	-	Patellogastropoda indet.	<null>	X	X	<null>	Y	<null>	<null>
MOLL	Mollusca	Gastropoda/Cephalaspidea	-	Cephalaspidea indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	*Acteocina canaliculata*	X	<null>	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	*Cylichna alba*	X	<null>	X	X	<null>	X	X
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	*Cylichna gouldi*	<null>	<null>	X	X	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	*Cylichna* sp.	<null>	<null>	<null>	<null>	X	X	Y
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	Cylichnidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Gastropoda/Cephalaspidea	Cylichnidae	*Cylichnoides occultus*	X	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Gastropoda/Cephalaspidea	Philinidae	Philininae indet.	<null>	<null>	<null>	<null>	<null>	<null>	X
MOLL	Mollusca	Gastropoda/Cephalaspidea	Retusidae	*Retusa obtusa*	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Cephalaspidea	Retusidae	Retusidae indet.	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Cephalaspidea	Tornatinidae	*Acteocina* sp.	<null>	<null>	<null>	<null>	X	<null>	X
MOLL	Mollusca	Gastropoda/Littorinimorpha	Capulidae	*Ariadnaria borealis*	<null>	<null>	X	X	X	X	X
MOLL	Mollusca	Gastropoda/Littorinimorpha	Naticidae	*Bulbus* sp.	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Littorinimorpha	Naticidae	*Cryptonatica affinis*	<null>	<null>	X	X	X	X	<null>
MOLL	Mollusca	Gastropoda/Littorinimorpha	Naticidae	*Euspira pallida*	X	<null>	<null>	<null>	X	X	X
MOLL	Mollusca	Gastropoda/Littorinimorpha	Naticidae	Naticidae indet.	<null>	<null>	X	<null>	<null>	<null>	Y
MOLL	Mollusca	Gastropoda/Littorinimorpha	Rissoidae	*Boreocingula castanea*	<null>	X	<null>	X	<null>	X	X
MOLL	Mollusca	Gastropoda/Littorinimorpha	Rissoidae	Rissoidae indet.	<null>	<null>	<null>	<null>	X	X	Y
MOLL	Mollusca	Gastropoda/Littorinimorpha	Skeneopsidae	*Skeneopsis planorbis*	<null>	X	<null>	<null>	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Littorinimorpha	Velutinidae	Velutinidae indet.	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Buccinidae	Buccinidae indet.	<null>	<null>	<null>	<null>	Y	X	Y
MOLL	Mollusca	Gastropoda/Neogastropoda	Buccinidae	*Buccinum ciliatum*	<null>	<null>	<null>	<null>	<null>	<null>	X
MOLL	Mollusca	Gastropoda/Neogastropoda	Buccinidae	*Buccinum hydrophanum*	<null>	<null>	<null>	<null>	<null>	X	X
MOLL	Mollusca	Gastropoda/Neogastropoda	Buccinidae	*Colus* sp.	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Buccinidae	*Volutopsius norwegicus*	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Cancellariidae	*Admete viridula*	<null>	<null>	<null>	X	<null>	X	X
MOLL	Mollusca	Gastropoda/Neogastropoda	Columbellidae	Columbellidae indet.	<null>	<null>	<null>	<null>	<null>	X	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Mangeliidae	Mangeliidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Gastropoda/Neogastropoda	Mangeliidae	*Oenopota* sp.	<null>	<null>	<null>	X	<null>	X	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Mangeliidae	*Oenopota violacea*	<null>	X	X	X	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Mangeliidae	*Propebela* sp.	<null>	<null>	<null>	<null>	X	<null>	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Mangeliidae	*Propepela nobilis*	<null>	<null>	<null>	X	<null>	<null>	<null>
MOLL	Mollusca	Gastropoda/Neogastropoda	Turridae	Turridae indet.	X	<null>	<null>	<null>	X	<null>	<null>
MOLL	Mollusca	Gastropoda/Not Assigned	Lepetidae	*Lepeta caeca*	X	X	X	X	X	X	X
MOLL	Mollusca	Gastropoda/Not Assigned	Lottiidae	Lottiidae indet.	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Gastropoda/Not Assigned	Lottiidae	*Erginus rubellus*	<null>	<null>	<null>	<null>	<null>	<null>	X
MOLL	Mollusca	Gastropoda/Not Assigned	Lottiidae	*Testudinalia testudinalis*	X	X	X	<null>	<null>	X	<null>
MOLL	Mollusca	Gastropoda/Trochida	Colloniidae	*Moelleria costulata* *	<null>	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Gastropoda/Trochida	Trochidae	Trochidae indet.	X	<null>	<null>	<null>	X	X	<null>
MOLL	Mollusca	Polyplacophora/-	-	Polyplacophora indet.*	<null>	<null>	<null>	<null>	Y	<null>	<null>
MOLL	Mollusca	Polyplacophora/Chitonida	Tonicellidae	*Tonicella marmorea*	X	<null>	X	X	X	X	x
MOLL	Mollusca	Scaphopoda/Gadilida	Gadilidae	Gadilidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MOLL	Mollusca	Scaphopoda/Gadilida	Gadilidae	*Siphonodentalium lobatum*	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Nemertea	-/-	-	Nemertea indet.	<null>	X	X	X	Y	X	Y
MISC	Nemertea	Anopla/-	-	Anopla indet.	<null>	<null>	<null>	<null>	Y	X	<null>
MISC	Nemertea	Enopla/-	-	Enopla indet.	<null>	<null>	<null>	<null>	Y	X	<null>
MISC	Nemertea	Hoplonemertea/-	-	Hoplonemertea indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Nemertea	Hoplonemertea/Monostilifera	Tetrastemmatidae	*Tetrastemma* sp.	<null>	<null>	<null>	<null>	X	<null>	X
MISC	Nemertea	Palaeonemertea/Not Assigned	Carinomidae	*Carinoma* sp.	<null>	<null>	<null>	<null>	<null>	X	<null>
MISC	Nemertea	Palaeonemertea/Not Assigned	Cephalothricidae	*Cephalothrix* sp.	<null>	<null>	<null>	<null>	X	X	X
MISC	Nemertea	Palaeonemertea/Not Assigned	Tubulanidae	*Tubulanus* sp.	<null>	<null>	<null>	<null>	<null>	X	X
MISC	Nemertea	Pilidiophora/Heternemertea	-	Heteronemertea indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Nemertea	Pilidiophora/Heternemertea	Lineidae	*Cerebratulus* sp.	<null>	X	X	<null>	X	X	X
MISC	Nemertea	Pilidiophora/Heternemertea	Lineidae	Lineidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Nemertea	Pilidiophora/Heternemertea	Lineidae	*Lineus* sp.	<null>	<null>	<null>	<null>	<null>	<null>	X
MISC	Platyhelminthes	-/-	-	Platyhelminthes indet.	<null>	<null>	<null>	<null>	X	X	<null>
MISC	Porifera	Calcarea/-	-	Calcarea indet.	<null>	<null>	<null>	<null>	X	X	X
MISC	Priapulida	-/-	-	Priapulida indet.	<null>	X	<null>	<null>	<null>	<null>	Y
MISC	Priapulida	-/Priapulomorpha	Priapulidae	*Priapulus caudatus*	X	<null>	X	X	X	X	<null>
MISC	Priapulida	-/Priapulomorpha	Priapulidae	*Priapulus* sp.	<null>	<null>	<null>	<null>	Y	X	Y
MISC	Sipuncula	-/-	-	Sipuncula indet.	<null>	<null>	X	X	<null>	<null>	<null>
MISC	Sipuncula	Sipunculidea/Golfingiida	Golfingiidae	*Golfingia* sp.	<null>	<null>	<null>	<null>	X	X	X
MISC	Sipuncula	Sipunculidea/Golfingiida	Golfingiidae	Golfingiidae indet.	<null>	<null>	<null>	<null>	<null>	<null>	Y
MISC	Sipuncula	Sipunculidea/Golfingiida	Golfingiidae	*Nephasoma* sp.	<null>	<null>	<null>	<null>	X	<null>	X
				# New Unique Taxa each year	135	84	53	50	113	47	41
				TOTAL # Taxa (COUNT)	135	147	156	188	237	320	319

APPENDIX J

Macroflora, Benthic Epifauna and Fish Taxonomic List (2014 – 2019)

Appendix J

Benthic Epifauna, Fish and Macroflora from Surveys in Milne Port (2010-2019)

Taxa	Sampling Year							
	2010	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
PELAGIC FAUNA								
Clione limnacina		x	x		x	x	x	x
Ctenophora indet.			x	x	x	x	x	x
Limacina helicina		x	x	x	x	x	x	x
BENTHIC EPIFAUNA								
Actiniaria indet.	x	x	x	x	x	x	x	x
Amphipoda indet.								x
Annelida indet.								x
Anonyx sp.						x		
Arctica islandia					x	x		x
Asteroidea indet.		x	x	x	x	x	x	x
Bivalvia indet.	x		x	x	x	x	x	x
Bourgueticrininia sp.					x		x	x
Bryozoa indet.	x							
Buccinum undatum		x	x	x	x	x	x	x
Cephalaspidea indet.								x
Cephalopod indet.								x
Cerianthidae indet.	x							
Chlamys islandica						x	x	x
Cistenides granulata								x
Cnidaria indet.		x		x	x	x	x	x
Crangonidae indet.								x
Crossaster pappuosus			x	x	x	x	x	x
Crustacea indet.								x
Ctenodiscus crispatus			x		x	x	x	
Cyrtodaria siliqua					x			
Echinocardium cordatum				x	x	x	x	
Echinoidea indet.			x	x	x	x	x	x
Ennucula tenuis		x						
Gastropoda indet.								x
Gorgonocephalus sp.			x	x			x	
Hiatella arctica		x				x	x	x
Holothuroidea indet.	x	x	x		x	x	x	x
Hydrozoan indet.								x
Macoma calcarea		x						
Musculus laevigatus		x						
Mytilidae indet.	x	x		x	x	x		
Mya truncata		x						x
Naticidae indet.								x
Nemertea indet.							x	
Nymphon sp.						x	x	x
Ophiura sarsii		x			x	x	x	x
Ophiuridea indet.	x	x	x	x	x	x	x	
Pandalus sp.		x		x	x	x	x	
Pandalus montagui		x						
Pecten albicans	x			x	x		x	x
Pectinariidae indet.							x	x
Pista maculata						x	x	x
Polycarpa pomaria								x
Polychaetea indet.		x		x	x	x	x	
Sabellidae indet.					x	x	x	x
Similipecten greenlandicus								x
Siliqua sp.					x			
Strongylocentrotus droebachiensis	x	x	x	x	x	x	x	x
Styelidae indet.						x	x	x
Weyprechtia pinguis		x	x	x				

Appendix J

Benthic Epifauna, Fish and Macroflora from Surveys in Milne Port (2010-2019)

Taxa	Sampling Year							
	2010	2013	2014	2015	2016	2017	2018	2019
FISH								
Ammodytes spp.						x	x	
Arctogadus glacialis							x	
Artediellus atlanticus			x	x				
Cottidae indet.				x			x	
Cyclopterus lumpus			x					x
Eumesogrammus praecisus			x	x	x			
Gadus ogac	x		x					
Gymnelis viridis		x		x				x
Myoxocephalus octodecemspinosus		x	x	x	x			
Myoxocephalus scorpioides			x	x		x	x	
Myoxocephalus scorpius	x	x	x	x	x	x	x	
Myoxocephalus quadricornis	x	x	x	x	x	x	x	
Myoxocephalus spp.	x	x	x	x	x	x	x	x
Salvelinus alpinus	x	x	x	x	x	x	x	
Stichaeidae indet.							x	x
Stichaeidae indet. sp. 1							x*	x
Zoarcidae indet.								x
Pisces indet.							x	x
MACROFLORA								
Agarum cibrosum			x	x	x	x	x	x
Brown algae			x	x	x	x	x	x
Chlorophyta indet.			x	x		x	x	x
Chondrus crispus			x	x	x	x	x	x
Corallinophycidae indet.							x	x
Desmarestia sp.			x	x	x	x		x
Fucus sp.			x		x	x	x	x
Laminaria sp.			x	x	x	x	x	x
Not Classified							x	x
Red algae			x	x	x	x	x	x

Notes: Taxa identified to the lowest practical taxonomic level; presence/absence for previous years taken from SEM 2015, 2016, 2017; indet.= indeterminate (taxa which could not be identified beyond the taxonomic level listed); sp.=species. *Fish within the family Stichaeidae distinct from other specimens, presumed to be in the genus *Lumpenus* .

APPENDIX K

Encrusting Epifauna

Marine Benthic Enumeration and Identification Methods
Client: Golder
Project: Baffinlands Iron Mine 2019
Protocol: EEM

Sample Inventory

Sample arrival: 3-Oct-2019
Number of samples: 1
Number of jars: 21
Screen size: 500 µm
Biologica project number: 19-072

The chain of custody documents were checked and approved with the client. The sample was transferred from formalin into 70% ethanol, and was provided a unique identification number and placed in the queue for analysis.

Table 1. Summary of settlement basket epifauna samples processed for Baffinlands Iron Mine, 2019.

Client Sample ID	Date Sampled	Biologica Sample ID	# of Jars	Split	Total Sample Volume (mL)	Organisms Counted
SBEO-1	29-Aug-19	Mb19-072-033	21	Whole	17,000	2,317

Sample Processing

Sample debris consisted of large rocks and large pieces of plastic. The large debris was rinsed into a Caton tray to capture all non-encrusting organisms. The organisms that were rinsed off the large debris were then identified. All surfaces of the large debris were then checked for any encrusting organisms by the taxonomists and identified.

Identification and Invasive species detection:

All organisms were identified using a combination of dissecting (10–40x) and compound microscopes (100–1000x) and standard taxonomic keys (see methodological and taxonomic references) to the lowest practicable level (species whenever possible). Where possible specimens were archived in air-tight glass vials with glycerin and 70% ethanol for long-term storage. Taxonomic data were recorded in Biologica's custom database.

During the identification process, taxonomists recorded if the identified taxa were beyond their recorded range and/or potentially introduced (originating from another location) or invasive (both introduced and appearing to proliferate with possible detrimental effects to the ecosystem and/or industry). Within the constraints of available literature and historical data, no taxa observed were identified as invasive taxa.

Data

All data were recorded in Biologica's custom database. Results were provided to the Golder project manager in Excel spreadsheets via email.

Selected Methodological and Taxonomic References

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Abbreviations & Definitions

Worksheets:	
1. Abbreviations & Definitions	Glossary of terms and outline of report
2. Data - Long	Abundance data in long (raw) format.
Life Stages:	
A	Adult
Int	Intermediate - has adult features but not of typical reproductive size
J	Juvenile
L	Larvae
N	Nymph
P	Pupa
Col	Colony
Deut	Deutonymph
MEMO	Incidental taxa/fragments not included in data, or whose abundance is not generally captured accurately by 1.0mm screen.
Total Number of Taxa	Number of unique taxa (=species richness), not including higher-order taxa for which there exists a lower-order identification (e.g. not including *Lumbrineris* sp. if there exists *Lumbrineris cruzensis* in the data)
Total Number of Organisms	Total Abundance, not including incidental taxa

Biologica Coding

Major Taxonomic Groups:	
Miscellaneous	
BRAC	Brachiopoda
BRYO	Bryozoa
CNAN	Cnidaria Anthozoa
CNHY	Cnidaria Hydrozoa
CNXX	Cnidaria
ENTO	Entoprocta
EURA	Echiura
HEMI	Hemichordata
KINO	Kinorhyncha
NTEA	Nemertea
PHOR	Phoronida
PIXX	Pisces
PLTY	Platyhelminthes
PORI	Porifera
PRIA	Priapulida
SIPN	Sipuncula
TARD	Tardigrada
URAS	Ascidiacea
Annelida	
ANHI	Annelida Hirudinea
ANOL	Annelida Oligochaeta
POER	Polychaeta Errantia
POSE	Polychaeta Sedentaria
POLY	Polychaeta
POXX	Polychaeta indet.
Arthropoda	
CHPY	Chelicerata Pycnogonida
CHAC	Chelicerata Arachnida
CRAM	Crustacea Amphipoda
CRCI	Crustacea Cirripedia
CRCO	Crustacea Copepoda
CRCU	Crustacea Cumacea
CRDE	Crustacea Decapoda
CRIS	Crustacea Isopoda
CRLE	Crustacea Leptostraca
CRMY	Crustacea Mysidacea
CROS	Crustacea Ostracoda
CRTA	Crustacea Tanaidacea
CRXX	Crustacea
Echinodermata	
ECAS	Echinodermata Asteroidea
ECCR	Echinodermata Crinoidea
ECEC	Echinodermata Echinoidea
ECHO	Echinodermata Holothuroidea
ECOP	Echinodermata Ophiuroidea
Mollusca	
MOAP	Mollusca Aplacophora
MOBI	Mollusca Bivalvia
MOCE	Mollusca Cephalopoda
MOGA	Mollusca Gastropoda
MOPO	Mollusca Polyplacophora
MOSC	Mollusca Scaphopoda

biologica

Abundance data in long format for Golder Baffinlands Iron Mine Settlement Basket 2019.

Client	Year	Project	Split	Biologica Sample ID	Client Sample ID	Date Sampled	taxacode	grpcode	Phylum	Class	Order	Family	Subfamily	Tribe	Taxon	A	Int	J	L	Total Abundance	Unique Taxa Count	Comments
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POER	Annelida	Polychaeta	Phyllodocida	Hesionidae	Psamathinae		Nereimyra aphroditoides	2	2			4	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POER	Annelida	Polychaeta	Phyllodocida	Pholoidae			Pholoe minuta	1	2			3	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POER	Annelida	Polychaeta	Phyllodocida	Polynoidae	Polynoinae		Harmothoe imbricata	2	1			3	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POER	Annelida	Polychaeta	Phyllodocida	Polynoidae	Polynoinae		Polynoinae indet.			2		2		
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POSE	Annelida	Polychaeta	Sabellida	Serpulidae	Spirorbinae	Circeini	Circeis armoricana	88	8	5		101	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POSE	Annelida	Polychaeta	Terebellida	Terebellidae	Terebellinae		Leaena ebranchiata	2	2			4	1	Name updated previously Leaena abranchiata
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ANNE	POSE	Annelida	Polychaeta	Terebellida	Terebellidae			Terebellidae indet.			1		1		
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ARTH	CRCO	Arthropoda	Hexanauplia	Harpacticoida				Harpacticoida indet.	3				3	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ARTH	CRCI	Arthropoda	Hexanauplia	Sessilia				Balanomorpha indet.			302		302	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	ARTH	CRAM	Arthropoda	Malacostraca	Amphipoda				Amphipoda indet.	2				2	1	Damaged
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	BRYO	Bryozoa	Gymnolaemata	Cheilostomatida				Ascophora indet.	1				1	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	BRYO	Bryozoa	Gymnolaemata	Ctenostomatida	Alcyonidiidae			Alcyonidium sp.	4				4	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	BRYO	Bryozoa	Gymnolaemata	Ctenostomatida	Vesiculariidae			Bowerbankia sp.	1				1	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	BRYO	Bryozoa	Stenolaemata	Cyclostomatida	Lichenoporidae			Patinella verrucaria	264				264	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	BRYO	Bryozoa	Stenolaemata	Cyclostomatida				Cyclostomatida indet.	1,570				1,570		
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	URAS	Chordata	Ascidiacea	Stolidobranchia				Stolidobranchia indet.			1		1	1	Features indistinct due to small size.
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	URAS	Chordata	Ascidiacea					Ascidiacea indet.			1		1	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	CNHY	Cnidaria	Hydrozoa	Anthoathecata	Tubulariidae			Tubulariidae indet.	1				1	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	CNHY	Cnidaria	Hydrozoa	Leptothecata	Campanulariidae			Gonothyraea sp.	9				9	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia	Adapedonta	Hiatellidae			Hiatella arctica			23		23	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia	Myida	Myidae			Mya truncata			2		2	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia	Mytilida	Mytilidae			Musculus sp.			2		2	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia	Mytilida	Mytilidae			Mytilidae indet.			1		1		
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia	Pectinida	Propeamussiidae			Propeamussiidae indet.			1		1	1	Immature, features indistinct
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOBI	Mollusca	Bivalvia					Bivalvia indet.			5		5		Damaged
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MOLL	MOGA	Mollusca	Gastropoda					Gastropoda indet.		1	3		4	1	Damaged/shell-less
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	MISC	NTEA	Nemertea						Nemertea indet.			1		1	1	
Golder	2019	Baffinlands Settlement Basket	Whole	mb19-072-033	SBEO-1	23-Aug-19	XXXX	XXXX							Invertebrate indet.				1	1		Immature larvae

APPENDIX L

Physical Oceanography Report

REPORT

Baffinland Iron Mines Corporation
Mary River Project

2019 Physical Oceanography Program

Submitted to:

Baffinland Iron Mines Corporation
2275 Upper Middle Road East - Suite 300
Oakville, ON L6H 0C3

Attention: Megan Lord-Hoyle and Wayne McPhee

Submitted by:

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Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada

+1 604 296 4200

1663724-091-R-Rev0-19000

22 February 2019

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FIGURES

APPENDICES

1.0 INTRODUCTION

In 2019, Baffinland Iron Mines Corporation (Baffinland) undertook physical oceanographic monitoring throughout Milne Inlet. This included continuous monitoring over a 2-month period at four sites in Milne Inlet, three at Milne Port and one at Bruce Head, and additional monitoring at select times and locations throughout Milne Inlet. The physical oceanographic monitoring program is intended to satisfy requirements of the 2019 marine-based Ecological Effects Monitoring (EEM) programs and address select Terms and Conditions of Project Certificate (PC) No. 005. This includes collection of physical oceanographic data to support the 2019 Marine Ecological Effects Monitoring Program (MEEMP), the 2019 Bruce Head Monitoring Program, the 2019 Narwhal Tagging Program, validation of the ballast water dispersion modelling at the head of Milne Inlet, and monitoring of relative sea level and storm surges at Milne Port. Additionally, results from the physical oceanographic monitoring program provide information to the Nunavut Impact Review Board (NIRB) in support of its yearly review of the Mary River Project. This report presents the results of the physical oceanographic monitoring program during the 2019 open-water season.

1.1 Objectives

The 2019 physical oceanographic monitoring program was designed to address the following objectives:

- Satisfy requirements of the 2019 marine-based EEM programs including collection of physical environmental data to support the 2019 MEEMP, the 2019 Bruce Head Monitoring Program, and the 2019 Narwhal Tagging Program.
- Improve spatial and temporal resolution of measurements of water column properties, such as salinity and temperature, in Milne Inlet near Bruce Head and Milne Port.
- Monitor relative sea level and any storm surges at Milne Port and review literature pertaining to sea-level rise land uplift and subsidence rates at the Project site and Northern Baffin Island.
- Provide additional current, temperature and salinity data to update, through further validation, the ballast water dispersion model developed for the Project in 2018 (Golder, 2018a).

The objectives of the physical oceanographic monitoring program aim to specifically address the Project-specific monitoring requirements summarized in NIRB's 2017-2018 Annual Monitoring Report:

- Condition No. 1 and 83 - "*GPS/tidal gauge monitoring of sea levels and storm surges. Install tidal gauges at Steensby and Milne Port to monitor seas levels and storm surges.*"
- Condition No. 86 - "*Prior to commercial shipping or iron ore, use more detailed bathymetry collected from Steensby and Milne Inlets to model anticipated ballast water discharges from ore carriers. This information should be used to update ballast water discharge impact predictions and sampling should be conducted to validate the model.*"
- Condition No. 89 - "*Develop and implement a ballast water management program that may include the treatment and monitoring of* ballast *water discharges in a manner consistent with or exceeds applicable regulations. The management program should reflect all inclusions outlined in the condition.*"

In addition, the Physical Oceanography Program also aims to address the relevant information gaps and recommendations identified by the applicable regulators in the Nunavut Impact Review Board's 2017-2018 Annual Monitoring Report and Board's Recommendations:

- **Ballast Water Discharge Impact Predictions (Comment from NIRB):** *Within its 2017 Annual Monitoring Report to the NIRB, Baffinland indicated that it was "partially compliant" with Term and Condition 86 of the Project Certificate which requires that the Proponent use more detailed bathymetry collected from Steensby Inlet and Milne Inlet to model the anticipated ballast water discharges from ore carriers and utilize results of the modelling to update ballast water discharge impact predictions. Baffinland further noted that ballast water dispersion modelling was undertaken in 2014 prior to the start of commercial shipping of iron ore at Milne Port and that the modelling results were used to inform the location of sampling sites between 2014 and 2017. Baffinland stated in its annual report to the NIRB that supplementary oceanographic data collected post-modelling (2014 to present) was not yet used to update or further validate the original dispersion model.*
  - ***Recommendation 9:*** *The Board requests that Baffinland utilize all the oceanographic and bathymetric data collected between 2014 and 2017 to develop an updated ballast water dispersion model for the current Project operations, independent of the assessment of the Phase 2 proposal.*
  - ***Recommendation 10:*** *The Board requests that Baffinland actively monitor ballast water discharged from Project vessels to determine the efficacy of exchange and treatment methods and use resulting data to update the invasive species risk analysis and inform adaptive management measures designed to prevent invasive species introductions.*

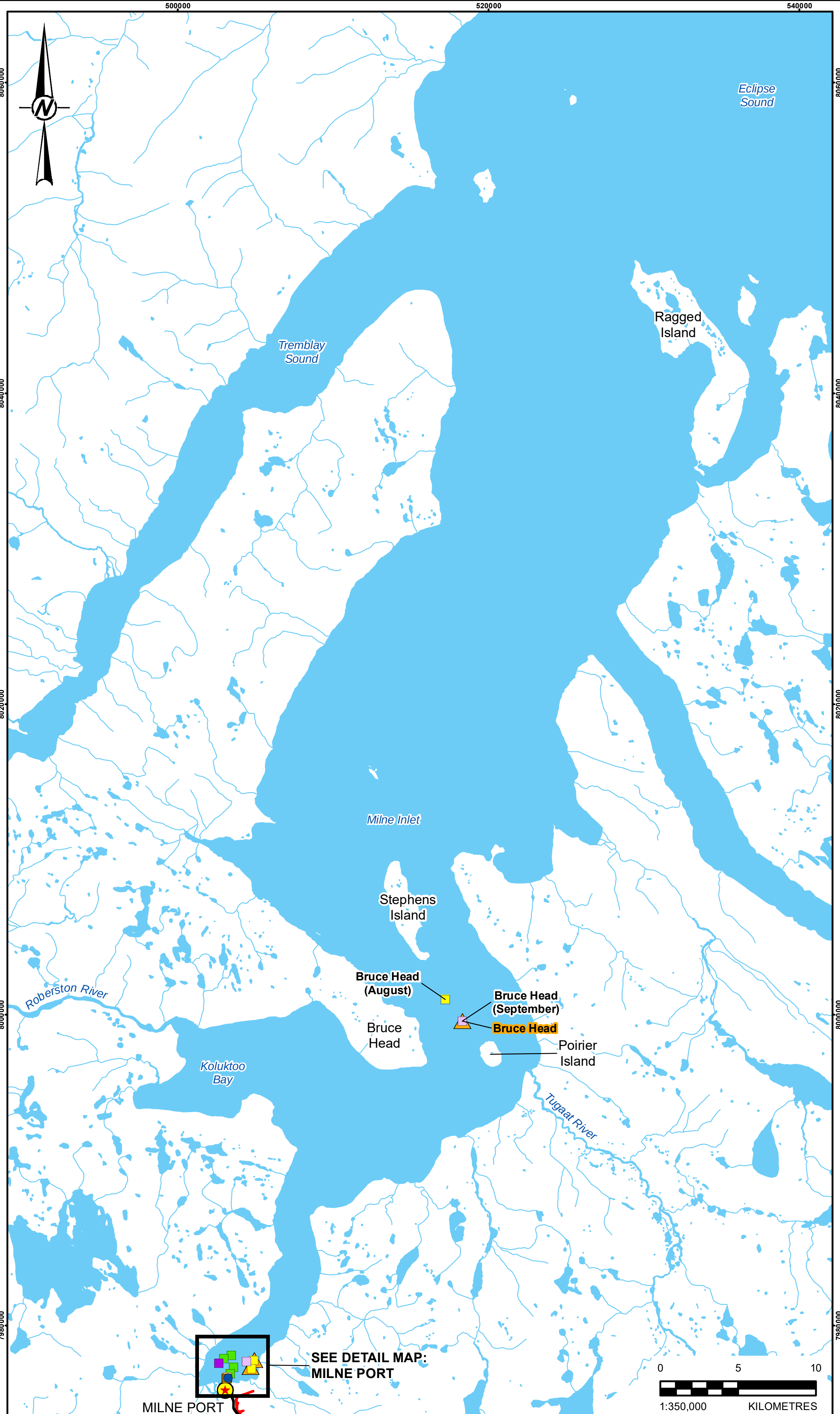
1.2 Study Area

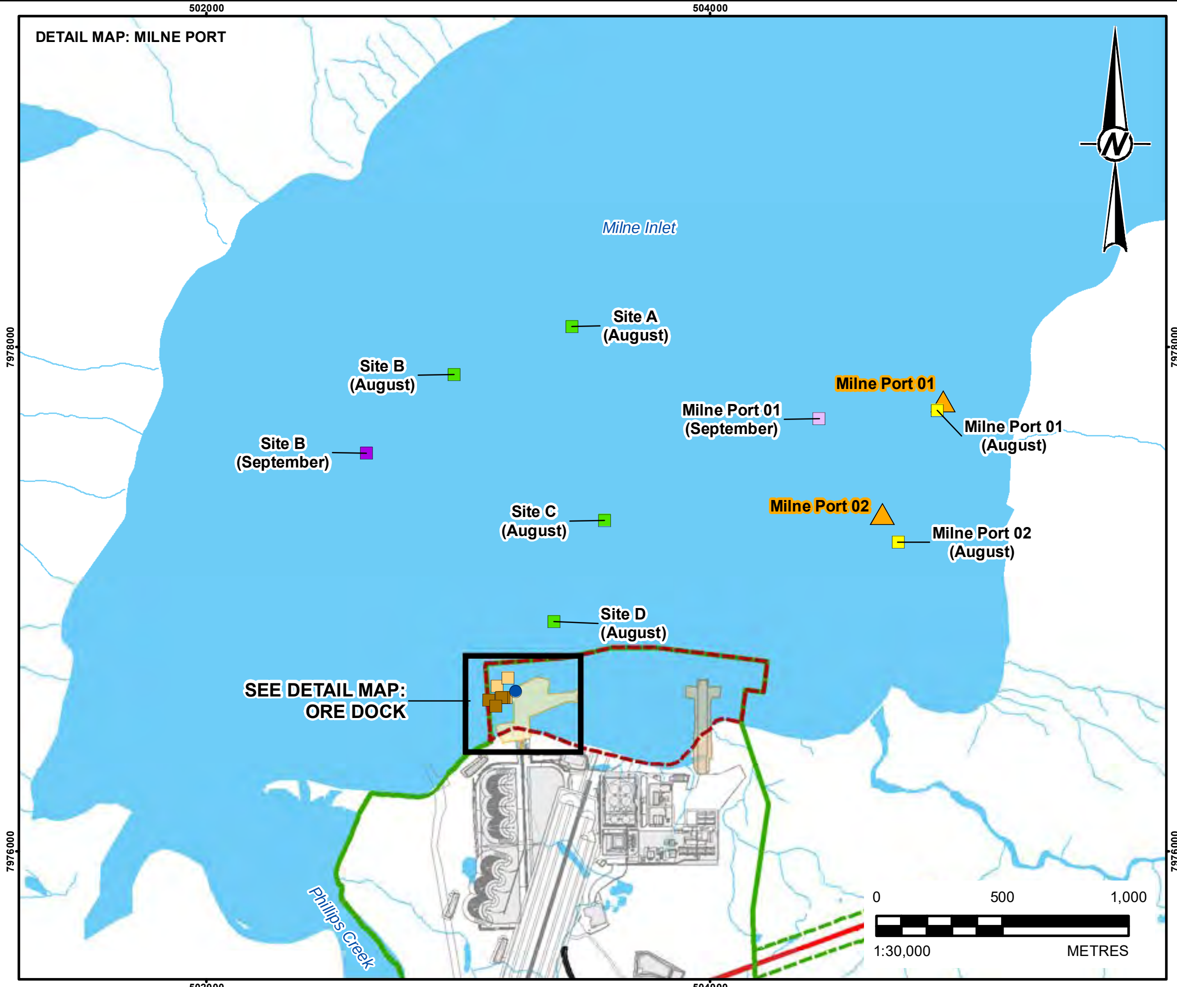
Milne Inlet is located along the Northwest coast of Baffin Island in the Qikiqtani Region of Nunavut. The inlet is connected to Baffin Bay at its northern terminus through Eclipse Sound and Navy Board Inlet which are separated by Bylot Island. The northern section of Milne Inlet, extending from Ragged Island to Bruce Head, is approximately 50 km long, up to 800 m deep, and tapers from approximately 15 km across at Ragged Island to less than 8 km across at Bruce Head. The southern section of Milne Inlet, extending from Bruce Head to the head of Milne Inlet, is approximately 25 km long, up to 400 m deep, and tapers from approximately 8 to 14 km across near Koluktoo Bay to less than 3 km across at the southern terminus.

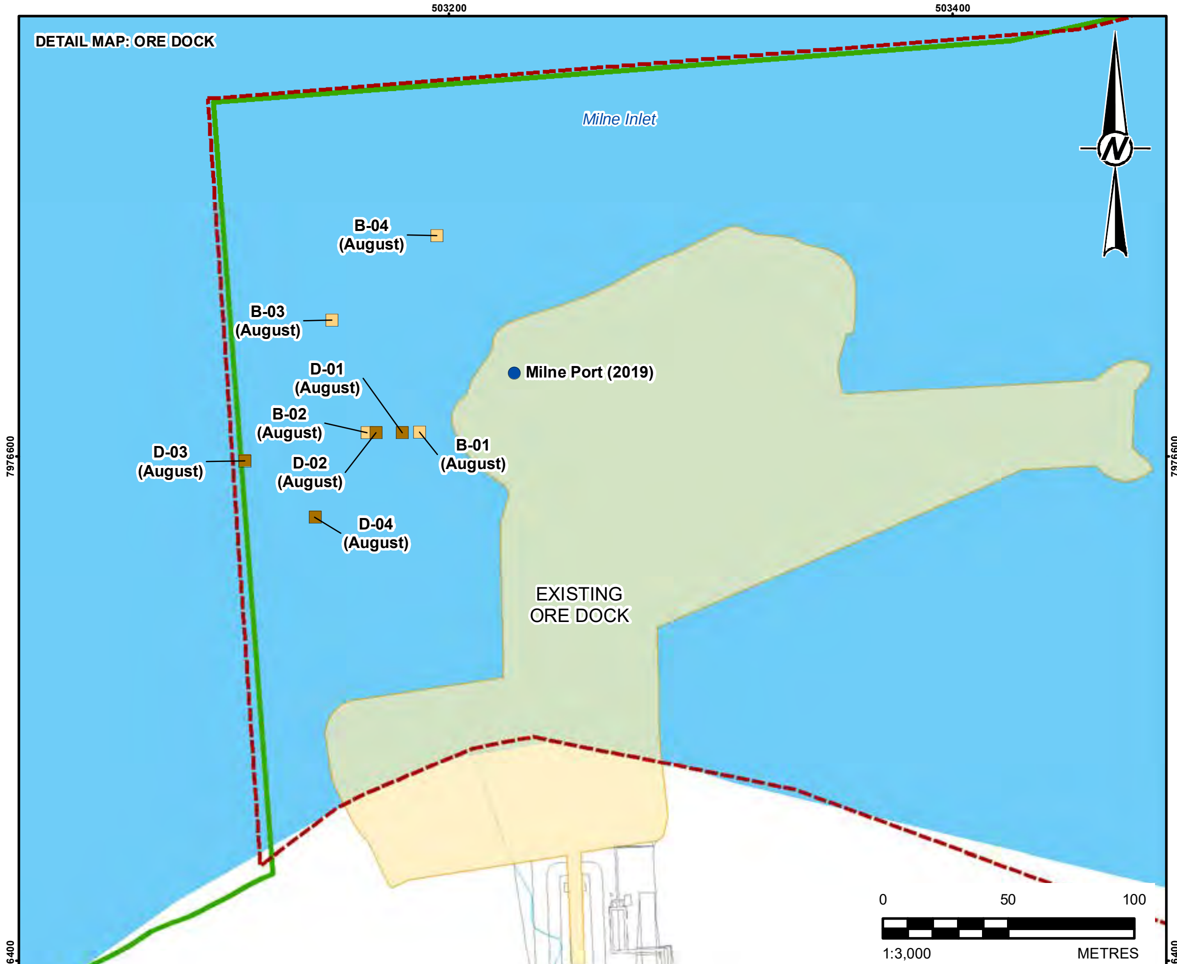
The southern and northern sections of Milne Inlet have a predominant north-south orientation, except between Bruce Head and Stephens Island where there is a northwest-southeast orientation. At Bruce Head the bathymetry is characterized by a sill (an area of decreased depth) between Bruce Head and Poirier Island. Just north of Bruce Head is Stephens Island, both Stephens Island and Poirier Island act to bifurcate the channel and subsequently create some of the narrowest sections of Milne Inlet, some sections reaching less than 3 km. Sills are also present at the north end of Stephens Island and at Ragged Island. Along all sections of the Milne Inlet the topography is characterized by mountainous terrain and steep cliffs vegetated with tundra.

At the head of Milne Inlet is Milne Port which supports Baffinland's iron ore exports via the Northern Shipping Route (from Milne Inlet to Baffin Bay) during the open-water season. The bathymetry of Milne Port is between 10 m and 100 m and characterized by a steep nearshore shelf that drops off into a gradual sloping bed extending northward away from the port. Near Milne Port, there are two sources of freshwater discharge, Phillips Creek to the west and Robertson River to the east of the port.

In 2019, the physical oceanography monitoring program focused on data collection overtop of the sill at Bruce Head and at the head of Milne Inlet near Milne Port. These locations were selected primarily to increase the quantity and quality of current measurements in the southern section of the inlet in the region of port development and ballast water discharge to improve understanding of circulation in this area and to further validate the oceanographic numerical model in this key region of Project activity. The physical oceanography monitoring locations in 2019 are shown in Figure 1 and







LEGEND

- 2019 TIDE GAUGE LOCATION
- MOORING LOCATION

2019 CONDUCTIVITY TEMPERATURE DEPTH (CTD) VERTICAL PROFILES

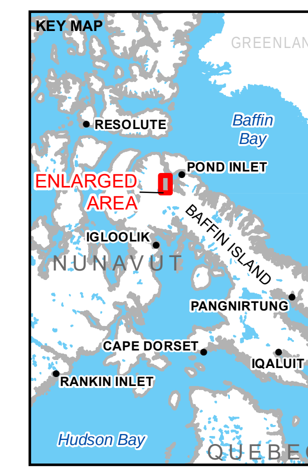
DEPLOYMENT TRIP (AUGUST)

- ADJACENT TO MOORING
- BEFORE BALLAST DISCHARGE
- DURING BALLAST DISCHARGE
- NEAR PORT

RECOVERY TRIP (SEPTEMBER)

- ADJACENT TO MOORING
- NEAR PORT

- COMMUNITY
- MILNE PORT
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- INAC FORESHORE LEASE
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- WATERBODY



DRAFT

REFERENCE(S)

FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT - 2019 MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

TITLE
SUMMARY OF PROJECT AND DATA COLLECTION LOCATIONS BETWEEN MILNE PORT AND BRUCE HEAD

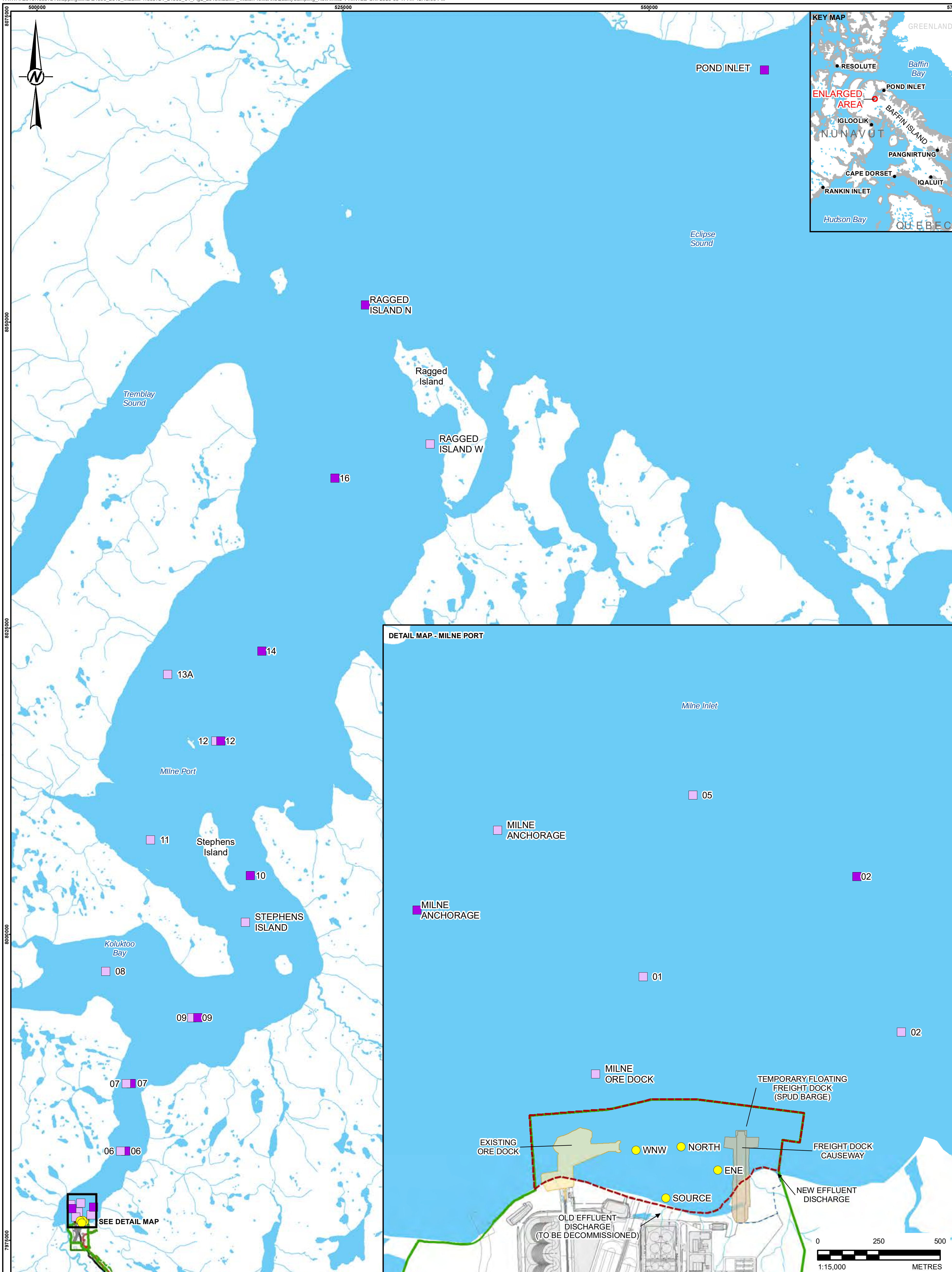
CONSULTANT

YYYY-MM-DD	2020-03-17
DESIGNED	EE
PREPARED	AA
REVIEWED	DH
APPROVED	

GOLDER

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000-04	A	1

PATH: I:\2016\1663724\Mapping\MXD\24000_2019_MEEMP\1663724_24000_04_Fig2_2019MEEMP_WaterProfileAndQualitySampling_RevA.mxd PRINTED ON: 2020-03-17 AT: 12:12:06 PM



LEGEND

- AUGUST BIOLOGICAL CONDUCTIVITY TEMPERATURE DEPTH (CTD) VERTICAL PROFILE
- SEPTEMBER BIOLOGICAL CONDUCTIVITY TEMPERATURE DEPTH (CTD) VERTICAL PROFILE
- DISCRETE WATER QUALITY SAMPLE
- MILNE INLET TOTE ROAD
- NEW EFFLUENT PIPELINE
- PROPOSED NORTH RAILWAY
- WATERCOURSE
- EXISTING INFRASTRUCTURE
- EXISTING ORE DOCK
- PROPOSED FREIGHT DOCK AND CAUSEWAY
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- INAC FORESHORE LEASE
- WATERBODY

DRAFT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)

FREIGHT DOCK DATA PROVIDED BY HATCH, MARCH 4, 2020. ADDITIONAL MILNE PORT INFRASTRUCTURE DATA OBTAINED FROM CLIENT, MAY 28, 2018, AND BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – 2019 MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

TITLE
SUMMARY OF PROJECT AND DATA COLLECTION LOCATIONS BETWEEN MILNE PORT AND ECLIPSE SOUND

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-17
DESIGNED	EE
PREPARED	AA
REVIEWED	DH
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	24000-04	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

2.0 METHODS

The physical oceanographic monitoring program consists of three subsurface tautline moorings deployed in Milne Inlet, one at Bruce Head and two near Milne Port, through water column conductivity, temperature and depth (CTD) profiles, and a tide gauge deployed at Milne Port. All measurements are taken during the open-water season. The moorings are designed to provide a time series of instrument depth, current speed and direction through the water column, and conductivity, salinity and temperature at select depths. Continuous in-situ measurements from the moorings are supplemented by CTD profiles taken adjacent to the moorings at select times during the deployment. The Milne Port tide gauge is designed to provide a time series of water surface elevations and conductivity, salinity and temperature near surface. Additionally, CTD profiles were taken along a transect from Milne Port to Ragged Island and around ore carrier vessels while berthed at Milne Port Ore Dock to better characterize the vertical structure of the water column.

This section presents the design, any applicable calibration and maintenance, the deployment and recovery, and data processing of the oceanographic moorings, CTD profiles, and the Milne Port tide gauge.

2.1 Unit Conventions

All dates and times are reported in Coordinated Universal Time (UTC), four hours ahead of the local time zone, Eastern Daylight Time (EDT). All horizontal positions are reported in Universal Transverse Mercator (UTM) coordinates referenced to the North American Datum of 1983 (NAD83) and/or in decimal degrees. Instrument elevations on moorings are reported as meters Mean Sea Level (MSL), where MSL is a relative measure of the average water surface elevation during the entire deployment. Elevations of the Milne Port tide gauge are referenced to the Canadian Geodetic Vertical Datum (CGVD). Wind directions are reported in the meteorological convention as direction the wind is blowing from and current directions are reported in the oceanographic convention as direction the current is flowing towards.

2.2 Oceanographic Moorings

2.2.1 Design

The moorings deployed at Bruce Head and southern Milne Inlet are a subsurface tautline design with in-line buoyancy and steel anchor weights. Steps in mooring design included selection of instruments and mooring hardware including shackles, and line, and calculation of buoyancy and anchor requirements based on immersed weight of mooring components. Additional considerations included the gross and net vertical forces induced by buoyancy and anchors during deployment as well as horizontal forces induced by expected near bed and through water column currents (assumed maximum 50 cm/s). All moorings were designed with a tandem acoustic release system connected to the steel anchors with 1m of galvanized chain and the top of each mooring was equipped with an Iridium GPS transceiver to aid in mooring recovery.

At Bruce Head the mooring design included 8 Viny floats on a pentagonal steel frame with an upward-looking 500 kHz Acoustic Doppler Current Profiler (ADCP), downward-looking 300 kHz ADCP, and temperature and salinity sensor. The mooring was approximately 115 m in length. At Milne Port 01 mooring the design included 4 Viny floats on a rectangular steel frame with an upward-looking 600 kHz ADCP, downward-looking 600 kHz ADCP, and temperature and salinity sensor. The mooring was approximately 38 m in length. At Milne Port mooring 02 the design included one ellipsoid mooring float with one temperature and salinity sensor and one temperature, salinity and depth sensor attached approximately 5 m and 20 m below the float, respectively. The mooring was approximately 45 m in length.

The mooring layout and specifications as designed are shown in Figure 3 through

Figure 5. The instrumentation on the three moorings and sampling specifications are summarized in Table 1 through Table 3.

Table 1: Bruce Head Mooring Instrumentation and Sampling Strategy

Instrumentation	Sampling Strategy	Instrument Uncertainty
Sensor: Nortek 500 kHz Signature Series ADCP, measuring water column currents (u, v, w) and relative water surface elevations **Sensor direction:** Upward-looking **Target depth:** -35 m Mean Sea Level (MSL)	**Ensemble interval:** 600 s **Averaging interval**: 120 s **Number of pings:** 258 **Bin size:** 2 m **Blanking distance:** 0.5 m **Bandwidth:** Narrow **Max Range:** 40.0 m	**Horizontal standard deviation:** 0.49 cm/s **Vertical standard deviation:** 0.16 cm/s **Compass direction accuracy:** ±2˚ **Tilt sensor accuracy:** ±0.2˚
Sensor: TRDI 300 kHz WorkHorse Sentinel ADCP, measuring water column currents (u, v, w) and relative water surface elevations **Sensor direction:** Downward-looking **Target depth:** -36 m MSL	**Ensemble interval:** 600 s **Pings per ensemble**: 60 pings **Bin size:** 4 m **Blanking Distance:** 1.76 m **Bandwidth:** Narrow **Max Range:** 130.1 m	**Horizontal standard deviation:** 0.96 cm/s **Compass direction accuracy:** ±2˚ **Tilt sensor accuracy:** ±2˚
Sensor: RBR-XR420 salinity and temperature (CT) data logger **Target depth:** -35.5 m MSL	**Measurement Interval:** 30 s **Sampling Rate:** 1 Hz **Sampling Regime:** Continuous	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.003 mS/cm

Table 2: Milne Port 01 Mooring Instrumentation and Sampling Strategy

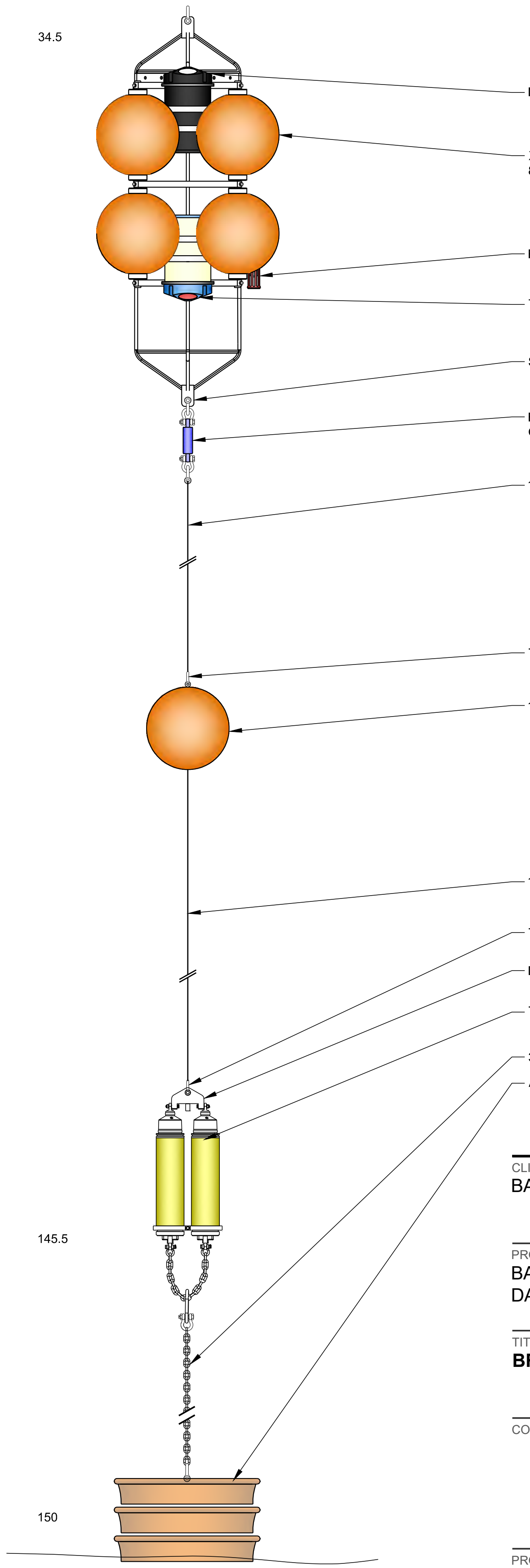
Instrumentation	Sampling Strategy	Instrument Uncertainty
Sensor: TRDI 600 kHz WorkHorse Sentinel ADCP, measuring water column currents (u, v, w) and relative water surface elevations **Sensor direction:** Upward-looking **Target depth:** -37 m Mean Sea Level (MSL)	**Ensemble interval:** 600 s **Pings per ensemble**: 125 pings **Bin size:** 1 m **Blanking Distance:** 0.88 m **Bandwidth:** Wide **Max Range:** 46.1 m	**Horizontal standard deviation:** 0.63 cm/s **Compass direction accuracy:** ±2˚ **Tilt sensor accuracy:** ±2˚
Sensor: TRDI 600 kHz WorkHorse Sentinel ADCP, measuring water column currents (u, v, w) and relative water surface elevations **Sensor direction:** Downward-looking	**Ensemble interval:** 600 s **Pings per ensemble**: 125 pings **Bin size:** 1 m **Blanking Distance:** 0.88 m **Bandwidth:** Wide **Max Range:** 46.1 m	**Horizontal standard deviation:** 0.63 cm/s **Compass direction accuracy:** ±2˚ **Tilt sensor accuracy:** ±2˚

Target depth: -38 m Mean Sea Level (MSL)		
Sensor: Sea-Bird Electronics (SBE) 37-SM MicroCAT salinity and temperature (CT) data logger **Target depth:** -37.5 m MSL	**Measurement Interval:** 60 s **Sampling Rate:** 1 Hz	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.003 mS/cm

Table 3: Milne Port 02 Mooring Instrumentation and Sampling Strategy

Instrumentation	Sampling Strategy	Instrument Uncertainty
Sensor: Sea-Bird Electronics (SBE) 37-SM MicroCAT salinity and temperature (CT) data logger **Target depth:** -5 m MSL	**Measurement Interval:** 60 s **Sampling Rate:** 1 Hz	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.003 mS/cm
Sensor: Sea-Bird Electronics (SBE) 37-SM MicroCAT salinity, temperature, and depth (CTD) data logger **Target depth:** -20 m MSL	**Measurement Interval:** 60 s **Sampling Rate:** 1 Hz	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.003 mS/cm **Pressure accuracy:** ±0.1% of full-scale range

TARGET DEPTH (m) | COMPONENT



NOT TO SCALE

CLIENT
BAFFINLAND IRON MINES

PROJECT
BAFFINLAND IRON MINES 2019 PHYSICAL OCEANOGRAPHY DATA COLLECTION

TITLE
BRUCE HEAD MOORING

CONSULTANT

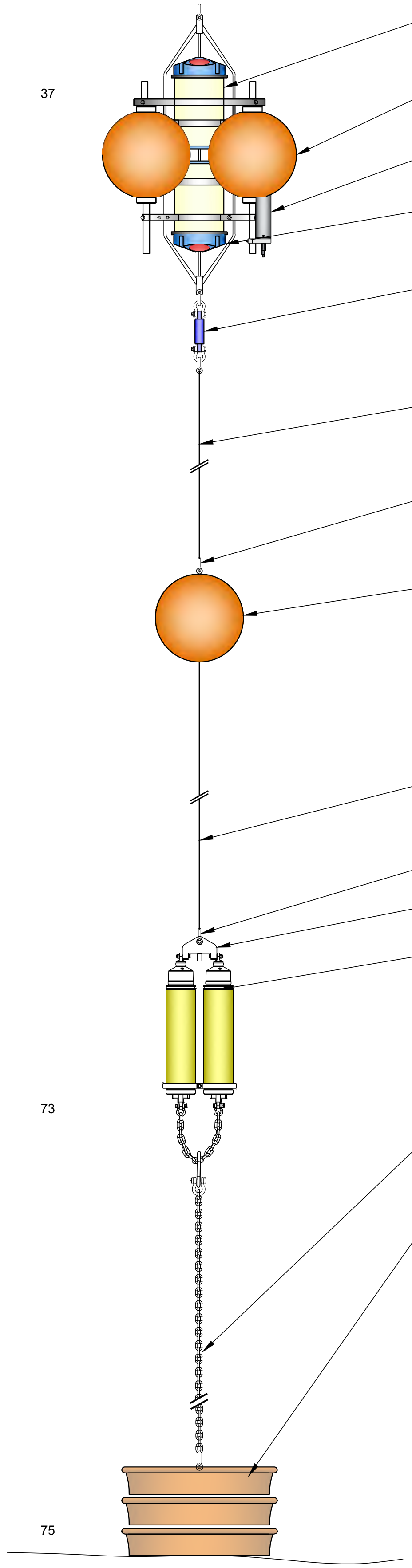
GOLDER

YYYY-MM-DD	2019-12-10
PREPARED	REDMOND
DESIGN	DH
REVIEW	EE
APPROVED	PO

PROJECT No.	PHASE	Rev.	FIGURE
1663724	24000	A	3

TARGET DEPTH (m)

COMPONENT



- TRDI WORKHORSE SENTINEL 600 kHz ADCP, UP-LOOKING
- STAINLESS STEEL FRAME
  4 VINYL 12B3 FLOATS
  XEOS KILO IRIDIUM BEACON
- SBE-37 MICROCAT CT
- TRDI WORKHORSE SENTINEL 600 kHz ADCP, DOWN-LOOKING
- BLUELINE SWIVEL
  GALVANIZED SHACKLES (3- 7/16"; 1- 1/2")
- 1/4" AMSTEEL II MOORING LINE; 32m
- 7 /16" GALVANIZED SHACKLE
- 1 VINYL 12B3 FLOATS
- 1/4" AMSTEEL II MOORING LINE; 3m
- 7 /16" GALVANIZED SHACKLE
- DUAL PORT LF RELEASES
- TANDEM ASSEMBLY, DROP LINK, 5/16" CHAIN (2 ft), AND 2 - 5/16" GALVANIZED SHACKLES
- 1 m 3/8" CHAIN TO DROP LINK WITH 2 -3/4" GALVANIZED SHACKLES
- ANCHOR WITH 1/2" OR 5/8" GALVANIZED SHACKLES; 268 lb DRY WEIGHT

NOT TO SCALE

CLIENT
BAFFINLAND IRON MINES

PROJECT
BAFFINLAND IRON MINES 2019 PHYSICAL OCEANOGRAPHY DATA COLLECTION

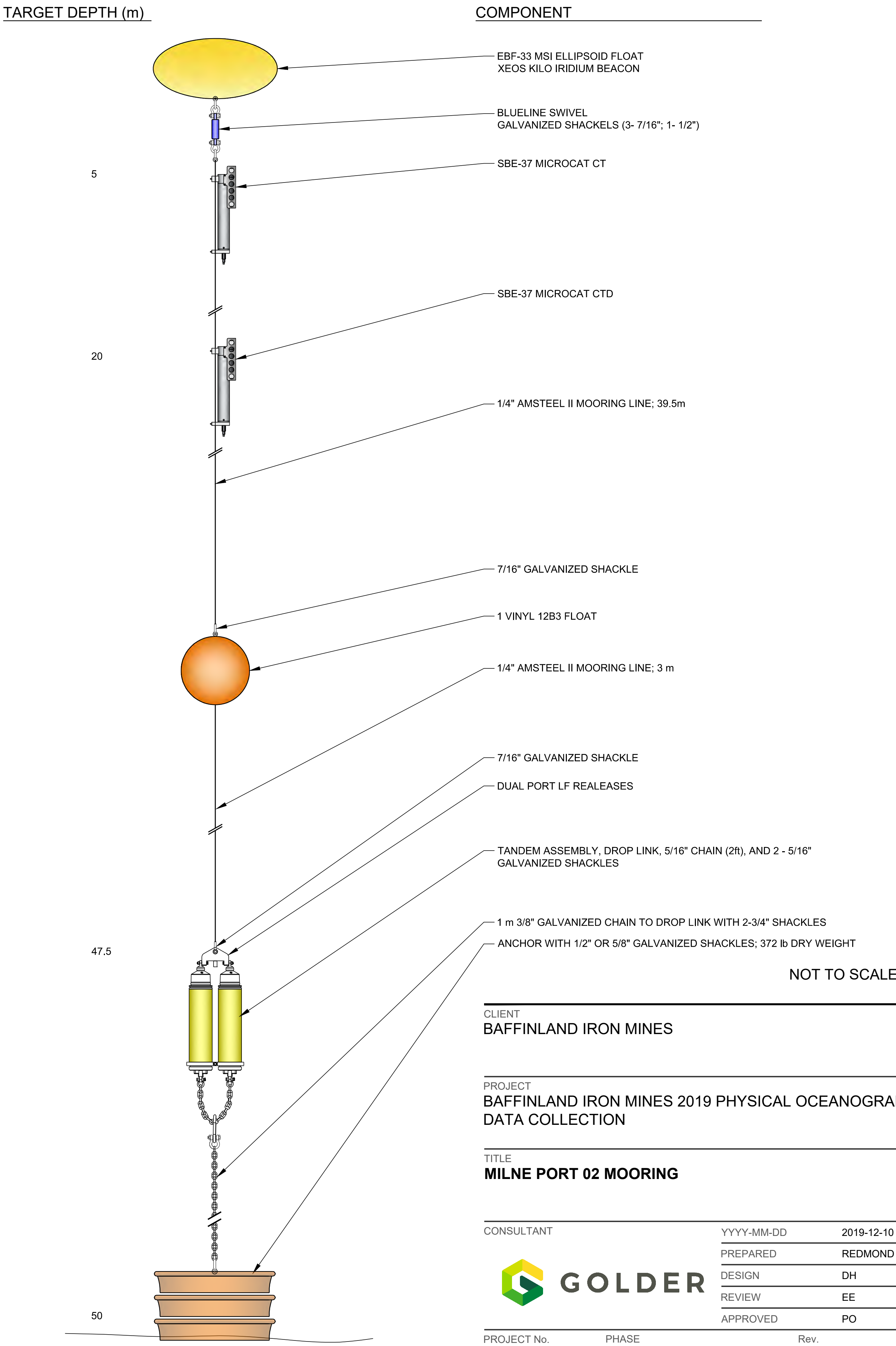
TITLE
MILNE PORT 01 MOORING

CONSULTANT

GOLDER

YYYY-MM-DD	2019-12-10
PREPARED	REDMOND
DESIGN	DH
REVIEW	EE
APPROVED	PO

PROJECT No.	PHASE	Rev.	FIGURE
1663724	24000	A	4



NOT TO SCALE

CLIENT
BAFFINLAND IRON MINES

PROJECT
BAFFINLAND IRON MINES 2019 PHYSICAL OCEANOGRAPHY DATA COLLECTION

TITLE
MILNE PORT 02 MOORING

CONSULTANT

GOLDER

YYYY-MM-DD	2019-12-10
PREPARED	REDMOND
DESIGN	DH
REVIEW	EE
APPROVED	PO

PROJECT No.	PHASE	Rev.	FIGURE
1663724	24000	A	5

2.2.2 Instrument Calibration

The conductivity, temperature and depth (where applicable) sensors were calibrated for the RBR-XR420 and SBE 37-SM MicroCAT instruments at the factory prior to deployment. The calibration certificates for these instruments are included in APPENDIX A.

Calibration and verification of the ADCP compasses near the approximate latitude where they will be deployed is advisable prior to deployment to account for the hard and soft iron effects. However, care must be taken to eliminate sources of ferrous material from the mooring cages and in the immediate vicinity of the calibration activities, as well as any other sources of magnetic interference not stemming from the earths magnetic field. During the 2018 physical oceanographic monitoring program (Golder, 2018b), the combination of reduced horizontal component in earths magnetic field coupled with the presence of iron ore at Milne Port introduced significant errors to the calibration parameters computed for the ADCP compass in the Milne Port area. As a result, several corrective measures were taken in attempt to better resolve current direction n 2019:

- In conjunction with manufacturer recommendations, it was determined that the factory compass calibration settings, computed at a more southern latitude, would be used in place of locally determined calibration parameters.
- All frames on the subsurface moorings were equipped with a Plexiglas fin and a swivel so that the frame could freely rotate and align with current direction, even during weak current speeds (Figure 6). Additionally, all ADCPs were positioned such that the northward beam was inline with the fin.
- A up-looking Nortek Signature 500 kHz ADCP was installed on the Bruce Head mooring. The Nortek Signature series has a much greater tilt sensor accuracy than other ADCPs which leads to greater overall heading accuracy. Additionally, the Nortek Signature series are built, and factory calibrated in Oslo Norway (60 degrees North).

The present techniques used to measure currents in Milne Inlet follow industry standards for measuring currents at high Northern latitudes. Additionally, Golder has followed the same approach to successfully measure currents in the Beaufort Sea (69-74 degrees North). In future deployments, ADCP instruments will undergo a post-calibration spin using a compass calibration table and satellite GPS at a location off-site. The location will be chosen to best reduce the interference of local magnetic effects (i.e. ore). Additionally, Nortek Signature series instruments will be added to the Milne Port moorings. It should be noted that while these practices will help reduce compass errors, they will not eliminate them. As discussed, the far northern latitude combined with a fluctuating geomagnetic field around Baffin Island and scarcity of overhead satellites makes the use of magnetic and satellite compasses challenging.

Figure 6: Bruce Head subsurface tautline mooring prior depicting the up-looking Nortek Signature 500 kHz ADCP, down-looking TRDI 300 kHz ADCP, RBR CT, satellite beacon, and Plexiglas fin

2.2.3 Deployment and Recovery

Table 4 summarizes the post-deployment triangulated mooring positions, the mooring deployment and recovery times, and the deployed water depth for the steel plate anchors as measured by the vessel-based depth sounder. The triangulated mooring position was 350 m, 1,473 m, and 267 m (horizontally) off the targeted mooring position for the Bruce Head mooring, Milne Port 01 mooring, and Milne Port 02 mooring, respectively. Once on-station the target position of each mooring was adjusted in order to more closely achieve the target depth (e.g. the target position for Bruce Head mooring was 40 m to deep). Additionally, near Milne Port there was in-water project works (i.e. dredging, anchorage lines, mooring lines) and increased vessel activity during mooring deployment. As a result, the position of the Milne Port 01 and Milne Port 02 moorings was moved from the target position along a similar depth contour. This led to differences in the triangulated and targeted mooring position at all mooring locations.

Table 4: Deployment and Recovery Details for Deployed Moorings

Mooring	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Date/Time Recovered (UTC)	Measured Water Depth (m, MSL)
Bruce Head	72.095˚	-80.466˚	518332	7999598	17X	August 05, 2019 12:40:00	September 28, 2019 15:24:00	-156
Milne Port 01[1]	71.900˚	-80.858˚	504913	7977756	17W	August 06, 2019 15:01:00	September 30, 2019 18:30:00	-78
Milne Port 02[1,2]	71.896˚	-80.865˚	504693	7977280	17W	August 07, 2019 13:45:00	September 30, 2019 19:17:00	-66

Notes:
[1]Deployment of Milne Port 01 and Milne Port 02 was delayed on August 06, 2019 by one day due to bad weather; [2]Milne Port 02 was deemed to have been deployed to shallow and to near the navigation channel on August 06, 2019 and was redeployed on August 07, 2019.

Deployment

Mooring deployment was conducted onboard the Ocean Tundra tug based out of Quebec City, QC, operated by Ocean Group. The moorings were loaded onto the Ocean Tundra on August 05, 2019 via a crane from the Milne Port Ore Dock (Figure 7).

On August 05, 2019, the weather conditions in Milne Inlet were -1 to 0 ˚C with periods of rain and overcast skies and southeasterly winds at 35-55 km/h. The sea state consisted of moderate waves approximately 0.5 to 1 m in height. The Bruce Head mooring was deployed at 12:40 UTC. The decision was made not to deploy the Milne Port 01 or 02 moorings that day because of the worsening sea state.

On August 06, 2019, the weather conditions in Milne Inlet were 5 to 7 ˚C and sunny with southerly winds at 10-20 km/h turning southwesterly in the afternoon. The sea state was calm. The Milne Port 01 mooring was deployed at 15:01 UTC. The Milne Port 02 mooring was deployed shortly after, but a decision was made to retrieve the mooring at a loss of the anchor after observing that the mooring float was too shallow and located too near the navigation channel. A new anchor for the Milne Port 02 mooring was fabricated from scrap mooring chain available on-site. A new location was selected for re-deployment of the Milne Port 02 mooring that was in deeper water and further from the navigation channel.

On August 07, 2019, the weather conditions in Milne Inlet were 3 to 5 ˚C and sunny with northwesterly winds at 5-15 km/h. The sea state was calm. The Milne Port 02 mooring was deployed successfully at 13:45 UTC (Figure 7).

All moorings were deployed off the starboard side of the tugboat. The vessel crane was used to lift and lower the mooring floats onto the water. At Bruce Head the mooring floats and line were kept close to the tugboat while at Milne Port 01 and Milne Port 02 a tender vessel was used to pull the mooring floats and line away from the tug so that the line was taut. A length of rope (i.e., pass-through line) was then passed through the anchor shackle and tied off to a vessel cleat. The anchor was lifted and lowered into the water until the acoustic releases and inline floats were submerged and the pass-through line was taut. The anchor and mooring floats were first disconnected from the vessel crane using a SeaCatch Quick Release. The anchor was then released from the vessel by releasing the pass-through line once the vessel was over the target deployment position which pulled the mooring down into position on the seabed.

Figure 7: Equipment being lifted from the Milne Port Ore Dock to the Ocean Tundra (left) and the staging area on the back of the Ocean Tundra during deployment of Milne Port 01 mooring (right)

Recovery

Mooring recovery was conducted onboard the MPSV Botnica ("Botnica") based out of Tallinn, Estonia, operated by TS Shipping. Personnel loaded onto the Botnica via the Ocean Tundra on September 27, 2019.

On September 28, 2019, the weather conditions in Milne Inlet were -7 ˚C and overcast with light winds and calm seas. The Bruce Head mooring was released to the surface at 15:24 UTC. The mooring was observed to be in generally good condition. However, the battery canister for the up-looking Nortek Signature500 ADCP was found to have flooded causing a loss of power to the instrument. As a result, the Nortek Signature 500 ADCP failed to record any data.

On September 30, 2019, the weather conditions in Milne Inlet were -8 ˚C and overcast. Wind and wave conditions were calm. Milne Port 01 mooring was released at 18:30 UTC and Milne Port 02 mooring was released at 19:17 UTC. The moorings were observed to be in good condition.

The moorings were recovered by sending the acoustic release code from a Fast Rescue Craft (FRC) launched from the Botnica. Release codes were triggered when the FRC was positioned approximately 150-200 m horizontally away from the mooring positions for the Bruce Head and Milne Port 01 moorings. The Milne Port 02 mooring was estimated to be located about 50 m to the stern of an anchored carrier vessel; once its location had been confirmed by triangulation the release codes were triggered when the FRC was positioned approximately 50 m horizontally away in order to ensure a safe and efficient recovery. After the floats had surfaced the FRC approached the moorings and towed them back to the Botnica. The moorings were then connected to the Botnica's crane and lifted onto the port side of the vessel (Figure 8).

Figure 8: Milne Port 01 mooring being loaded onto tender vessel following recovery (left) and the Botnica port-side crane used for lifting moorings onto deck (right)

2.2.4 Data Processing

A preliminary check of the data recorded by instruments on the moorings was performed following the recovery. Quality checks included the following:

- Reviewing time series measured by the instruments, including various diagnostic parameters;
- Checking the instrument clock for drift during the deployment;
- Checking internal recorder and file status; and
- Plotting and viewing the time series data.

Checking the instruments for clock drift involved comparing the clock time upon recovery to a Global Positioning System (GPS) receiver clock to determine any drift ahead (fast) or behind (slow) GPS time. Due to the relatively small overall deviations the data were not corrected for clock drift for the purposes of this report. The data record start and end times and clock drift for the instruments on the moorings are provided in Table 5. Quality Controlled (QC) data are provided in APPENDIX B.

Table 5: Summary of Recorded Data Start and End Times for Instruments on the Moorings

Instrument	Mooring	Start of Data Logging (UTC)	End of Data Logging (UTC)	Clock Drift (hh:mm:ss)
Nortek Signature 500 kHz ADCP (up-looking)	Bruce Head	August 02, 2019 00:00:00	August 05, 2019 20:10:59	N/A
TRDI 300 kHz WorkHorse Sentinel ADCP (down-looking)	Bruce Head	August 02, 2019 00:00:00	September 28, 2019 21:00:00	00:00:37 slow

Instrument	Mooring	Start of Data Logging (UTC)	End of Data Logging (UTC)	Clock Drift (hh:mm:ss)
RBR-XR420 CT	Bruce Head	August 05, 2019 12:00:00	September 28, 2019 17:52:30	00:00:17 fast
TRDI 600 kHz WorkHorse Sentinel ADCP (up-looking)	Milne Port 01	August 02, 2019 00:00:00	October 01, 2019 12:50:00	00:00:10 slow
TRDI 600 kHz WorkHorse Sentinel ADCP (down-looking)	Milne Port 01	August 02, 2019 00:00:00	October 01, 2019 12:40:00	00:00:27 slow
SBE 37-SM MicroCAT CT	Milne Port 01	August 02, 2019 00:00:00	October 01, 2019 13:28:01	00:00:06 slow
SBE 37-SM MicroCAT CT	Milne Port 02	August 02, 2019 00:00:00	October 01, 2019 19:13:00	00:00:04 slow
SBE 37-SM MicroCAT CTD	Milne Port 02	August 02, 2019 00:00:00	October 01, 2019 13:28:01	00:00:02 slow

2.2.4.1 ADCP

The data from each ADCP were exported from raw binary format to ASCII format using the TRDI software WinSC®. Measured water depths and water temperature were output directly from the ADCP through WinSC®. Plots of current speed and direction and ancillary parameters, along with tabulated bulk statistics (minimum, median, mean, maximum, and standard deviation) for select bin depths of each instrument were generated.

Post-processing and quality-checking was completed using the MATLAB® (Mathworks, 2019) scientific computing software and included the following:

- Plotting and inspection of heading, tilt (vector sum of pitch and roll angles), battery voltage, and instrument depth and water temperature (Figure 9 through Figure 10). Tilt was inspected to identify periods of increased mooring layover that could affect the integrity of current measurements. Data associated with tilts greater than 10˚ was replaced with a -999 value.
- Horizontal components (east and north) of velocities were corrected from magnetic north to true north direction using the magnetic declination for the location at the time of deployment. A magnetic declination of 32.93˚ W was applied to the moorings and based on the Natural Resources Canada numerical model for the International Geomagnetic Reference Field (Natural Resources Canada, 2019).
- Signal amplitude was plotted to check the quality of the instrument signal return and filtered for amplitudes below the noise floor of the respective instrument (TRDI, 2014). Filtered data were replaced with a -999 value.

- Data were filtered for sidelobe interference using a beam slant angle of 20˚ (TRDI, 2014). Filtered data were replaced with a -999 value. The filtered range corresponds to the top 10% of the measured water column, surface or bottom depending on whether the instrument was up-looking or down-looking.
- Measurements made by the instrument while it was out of water, as determined from the pressure gauge, were replaced with a -999 value.
- Data were filtered for vertical velocities greater than 0.3 m/s and error velocities, computed onboard the ADCP, greater than 0.15 m/s.
- Flagged and missing data values, identified onboard the ADCP, were replaced with a -999 value. Additional manual editing to remove, or flag, spurious data was performed as necessary.
- Data from the up-looking 600 kHz and down-looking 600 kHz ADCP on the Milne Port 01 mooring were combined to a single timeseries.
- The percentage of good data for each ADCP instrument was calculated and presented in Table 6.

In general, ADCPs had few flagged and missing data except for the Nortek 500 kHz at Bruce Head which failed to collect any data due to an instrument failure. The Milne Port 01 up-looking ADCP had 5.32% of data flagged internally by the ADCP during deployment. This was due to poor internally calculated beam correlation near the surface, likely due to surface interference. Tilts on all ADCPs were minimal and much less than the maximum allowable tilt and water levels between ADCPs show good agreement. The ADCPs on the Milne Port 01 mooring were mounted to the same frame and oriented in the same direction, therefore it's expected that the heading data agree between the two instruments. However, the heading data from the down-looking Milne Port 01 ADCP appears restricted to a 90-degree sector for the first month of deployment and shows poor agreement with the up-looking Milne Port 01 ADCP. The instrument is being evaluated by Golder and the manufacturer to further assess the cause of this heading discrepancy.

Table 6: Recorded Data Statistics for ADCP's on the Moorings. Total and expected samples are for all depths.

Mooring/Instrument	Total Samples Recorded (#)	Total Samples Expected (#)	Flagged and Missing Data (#)	Percent Valid Data (%)
Bruce Head – Nortek 500 kHz ADCP	N/A	N/A	N/A	0.00[1]
Bruce Head – TRDI 300 kHz ADCP	179216	179216	0	100.0%
Milne Port 01 – TRDI 600 kHz ADCP (up-looking)	285710	301758	16048	94.68%
Milne Port 01 – TRDI 600 kHz ADCP (down-looking)	206466	206466	0	100.0%

Note: [1]Battery canister flooded and experienced a sensor failure

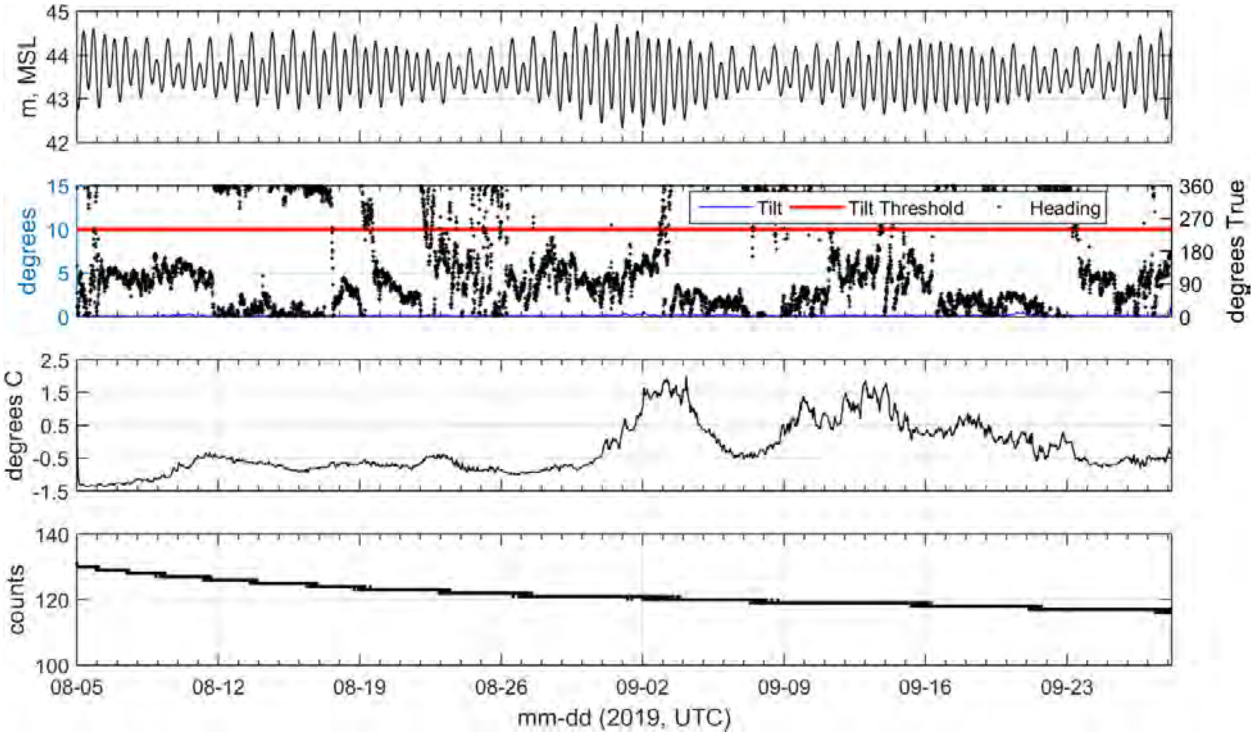


Figure 9: Time series of quality control parameters measured at Bruce Head mooring by the 300 kHz down-looking ADCP including instrument depth (top), instrument tilt and heading, water temperature, and battery voltage (bottom) for August 05 to September 28, 2019 in UTC.

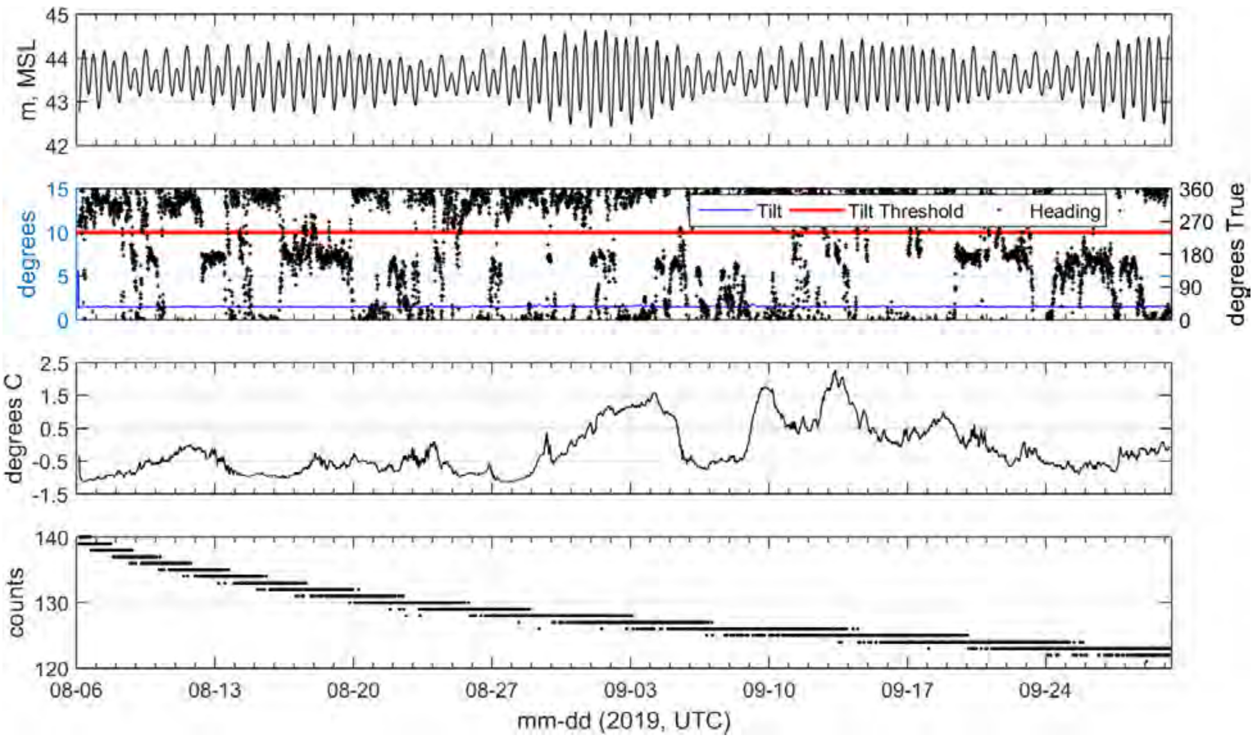


Figure 10: Time series of quality control parameters measured at Milne Port 01 mooring by the 600 kHz up-looking ADCP including instrument depth (top), instrument tilt and heading, water temperature, and battery voltage (bottom) for August 06 to September 30, 2019 in UTC.

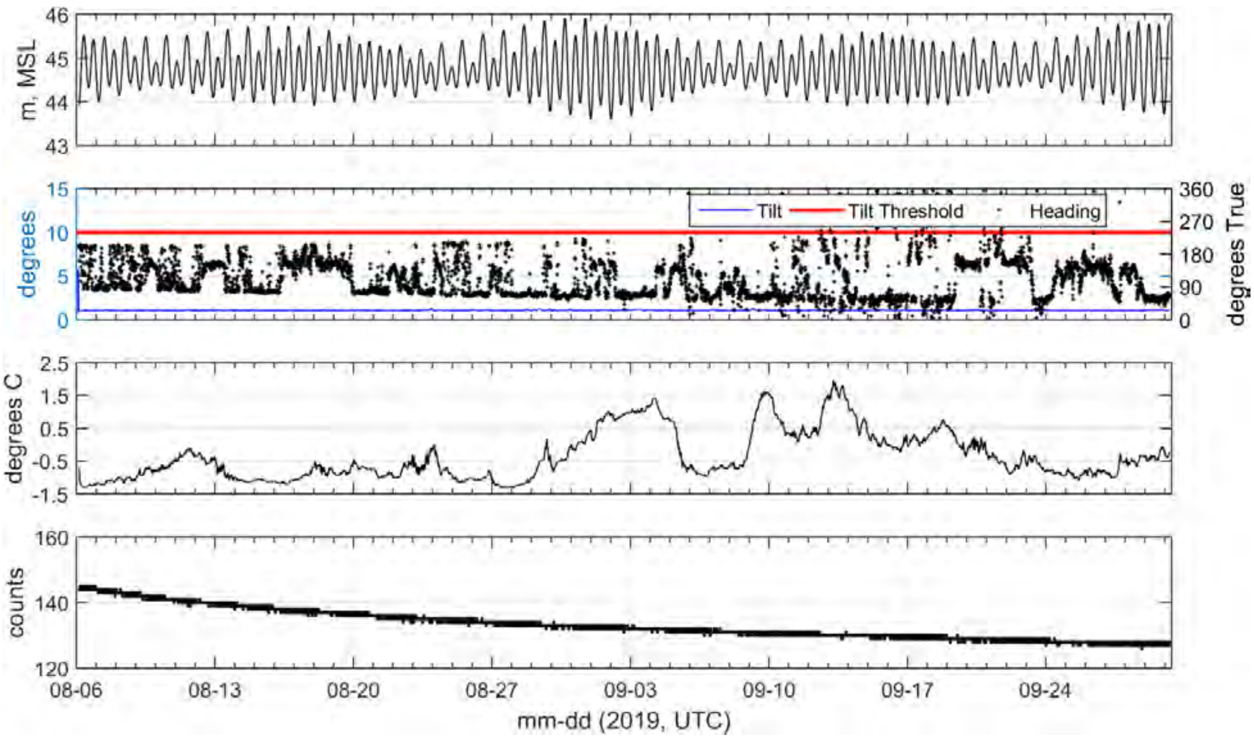


Figure 11: Time series of quality control parameters measured at Milne Port 01 mooring by the 600 kHz down-looking ADCP including instrument depth (top), instrument tilt and heading, water temperature, and battery voltage (bottom) for August 06 to September 30, 2019 in UTC.

2.2.4.2 CT/CTD

The data from the RBR-XR420 CT and SBE 37-SM MicroCAT CT/CTD sensors were exported from raw instrument format to ASCII format using Ruskin® and SBE Data Processing® softwares, respectively. Plots of measured water quality parameters were generated. Post-processing and quality-checking was completed using the MATLAB® (Mathworks 2019) scientific computing software and included the following:

- Measurements made by the instrument while it was out of water, as determined from either the pressure or salinity gauge, were replaced with a -999 value.
- Data were filtered for values above a maximum and below a minimum water temperature and salinity. The maximum and minimum water temperature was defined as 10 ˚C and -2.5 ˚C and the maximum and minimum salinity was 20 PSU and 36 PSU. Filtered values were replaced with a -999 value. Additional manual editing to remove or flag spurious data was performed as necessary.
- Where applicable, data were filtered for periods when the change in pressure between consecutive samples exceeded 0.5 dbar (approximately 0.5 m of water). Filtered values were replaced with a -999 value.
- Flagged and missing data values, identified onboard the instrument, were replaced with a -999 value. Additional manual editing to remove or flag spurious data was performed as necessary.
- The percentage of good data for each CT/CTD instrument was calculated and presented in Table 7.

The CT and CTD instruments on all moorings had few to no flagged and missing data. The RBR CT mounted on the Bruce Head mooring was missing 20 samples or less than 0.01% of data. These were attributed to spurious spikes in salinity throughout the deployment.

Table 7: Recorded Data Statistics for CT/CTD's on the Moorings

Mooring/Instrument	Total Records Recorded (#)	Total Records Expected (#)	Flagged and Missing Data (#)	Percent Valid Data (%)
Bruce Head – RBR-XR420 CT	156206	156206	20	99.99%
Milne Port 01 – SBE 37-SM MicroCAT CT	87209	87209	0	100
Milne Port 02 – SBE 37-SM MicroCAT CT	78056	78056	0	100
Milne Port 02 – SBE 37-SM MicroCAT CTD	78058	78058	0	100

2.3 CTD Profiles

2.3.1 Design

An SBE 19plus V2 SeaCAT Profiler (herein "SBE 19plus") was used to measure CTD profiles between Milne Port and Bruce Head. The SBE 19plus is designed to measure conductivity (salinity), temperature, and pressure and includes auxiliary instrument to measure turbidity, dissolved oxygen, and fluorescence (Chlorophyll *a*). It uses an internally mounted strain-gauge pressure sensor and pumped CT duct, which ensures the temperature and conductivity measurements are made on the same parcel of water. Auxiliary sensors are attached to the outside of the SBE 19plus near the pumped CT duct intake. The SBE 19plus and auxiliary sensors were mounted to a rectangular steel frame affixed with a stainless-steel shackle. The SBE 19plus and all auxiliary sensors were calibrated at the factory prior to deployment. The calibration certificates are included in APPENDIX A. The instrumentation on the SBE 19plus and the sampling specifications are summarized in Table 8.

Table 8: CTD Profile Instrumentation and Sampling Strategy

Instrumentation	Sampling Strategy	Instrument Accuracy
Sensor: SBE 19plus V2 SeaCAT Profiler, measuring through water column CTD profiles	**Profiling:** 4 Hz **Depth Rating:** 600 m	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.005 mS/cm **Pressure accuracy:** ±0.1% of full-scale range
Sensor: SBE 43 Dissolved Oxygen	**Profiling:** 4 Hz **Depth Rating:** 600 m	**Oxygen accuracy:** ±2% saturation
Sensor: ECO-FL Chlorophyll *a* Fluorometer	**Profiling:** 4 Hz **Depth Rating:** 600 m	**Chlorophyll *a* accuracy:** ±0.02 µg/L

Instrumentation	Sampling Strategy	Instrument Accuracy
Sensor: WET Labs Optical Turbidity	**Profiling:** 4 Hz **Depth Rating:** 6000 m	**Turbidity accuracy:** 0.01 NTU

2.3.2 CTD Deployment and Recovery

CTD profiles were taken adjacent to oceanographic moorings and in select locations near Milne Port following mooring deployment and recovery. Additionally, CTD profiles were taken along a transect between Milne Port and Eclipse Sound and near Milne Port Ore Dock prior to and during a ballast water discharge event. Prior to deployment all instruments were checked, programmed, and synchronized to UTC time. The steel frame, containing the SBE, was then attached to the wire cable of the vessel's davit. During deployment the instrument package was lowered into the water until fully submerged and profiles were taken by lowering the instrument package through the water column at a rate of 0.5 m/s on the downcast. Additionally, the time, position, and water depth were noted.

During deployment of oceanographic moorings CTD profiles were taken adjacent to the Milne Port 01 and Milne Port 02 moorings. The worsening sea state made it ill-advised to do a CTD profile adjacent to the Bruce Head mooring during its deployment; however, a profile conducted near Stephens Island the day before was considered representative. Additionally, profiles were taken at 4 other locations near Milne Port.

During recovery of oceanographic moorings CTD profiles were taken adjacent to Bruce Head and Milne Port 01 moorings and in one additional location near Milne Port. Due to vessel constraints during the recovery period, CTD profiles near Milne Port 02 mooring and in locations near Milne Port sampled during deployment were not taken. CTD profiles were taken from the Botnica along a transect between Milne Port and Eclipse Sound during the mooring recovery programme.

2.3.2.1 CTD Profiles – Milne Port to Eclipse Sound

CTD profiles were taken at 18 locations in Milne Inlet between Milne Port and Eclipse Sound during two separate sampling events in August and September 2019. The coordinates of each profile, the deployment time, and measured water depth are summarized in Table 10 and Table 11. The locations of these profiles are presented in Figure 2.

Table 9: CTD Profiles – Transect between Milne Port and Eclipse Sound

Profile ID	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
01	503579	17977307	17W	August 07, 2019 13:02:37	71 m
02	504634	17977080	17W	August 07, 2019 13:13:50	56 m
05	503782	17978049	17W	August 07, 2019 13:29:24	93 m
06	507041	17982285	17W	August 05, 2019 17:08:30	164 m

Profile ID	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
07	507505	17987797	17W	August 05, 2019 16:17:38	155.5 m
08	505830	17996960	17X	August 05, 2019 03:57:59	284.5 m
09	512859	17993188	17X	August 05, 2019 02:40:17	140.5 m
11	509488	18007715	17X	August 04, 2019 23:36:47	272 m
12	514799	18015789	17X	August 04, 2019 22:17:00	236 m
13A	510884	18021217	17X	August 04, 2019 20:58:59	271.5 m
Milne Anchorage	502985	17977905	17W	Aug-07-2019 13:42:39	79.5 m
Milne Ore Dock	503385	17976909	17 W	Aug-07-2019 13:53:21	46.5 m
Ragged Island W	532298	18040043	17 X	August 04, 2019 18:28:37	58.5 m
Stephens Island	517231	18000984	17X	August 05, 2019 01:02:15	154.5 m
02	504431	17977716	17W	September 30, 2019 19:50:31	86 m
06	507040	17982288	17W	September 30, 2019 17:37:01	162.5 m
07	507505	17987796	17W	September 30, 2019 16:38:57	156.5 m
09	512922	17993183	17X	September 30, 2019 15:16:51	284.5 m
10	517229	18004792	17X	September 30, 2019 13:45:56	229 m
12	514799	18015792	17X	September 30, 2019 12:23:01	225 m
14	518155	18023128	17X	September 29, 2019 22:18:01	341.5 m
16	524138	18037255	17X	September 29, 2019 19:38:44	341 m
Milne Anchorage	502635	17977579	17W	September 30, 2019 20:27:59	70 m
Pond Inlet	559197	18070582	17X	September 29, 2019 15:16:14	302.5 m
Ragged Island N	526622	18051404	17X	September 29, 2019 00:04:39	110.5 m

2.3.2.2 CTD Profiles – Milne Port and Bruce Head

Adjacent to Moorings

CTD profiles were taken adjacent to oceanographic moorings during mooring deployment and recovery for the Bruce Head and Milne Port 01 moorings: and during deployment for Milne Port 02. A CTD profile for Milne Port 02 was not possible on recovery due to its proximity to the stern of an anchored carrier vessel, but a profile near Milne Anchorage was deemed an adequate substitute. The coordinates of each profile, the deployment time, and measured water depth are summarized in Table 10 and Table 11. The locations of these profiles are presented in Figure 1.

Table 10: CTD Profiles – Adjacent to Moorings: Locations and Times during Mooring Deployment

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
Bruce Head	72.1074˚	-80.4975˚	517231	8000982	17 X	August 05, 2019, 12:53	-154
Milne Port 01	71.8997°	-80.8587˚	504900	7977754	17 W	August 07, 2019, 12:45	-81
Milne Port 02	71.8950°	-80.8632°	504745	7977223	17 W	August 07, 2019, 14:11	-56

Table 11: CTD Profiles – Adjacent to Moorings: Locations and Times during Mooring Recovery

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
Bruce Head	72.0949°	-80.4658°	518331	7999599	17 X	September 28, 2019, 17:10	-174
Milne Port 01	71.8994°	-80.8722°	504431	7977714	17 W	September 30, 2019, 19:48	-86

Near Milne Port

CTD profiles were taken at four select locations near Milne Port during the mooring deployment trip and at one of these locations during the mooring recovery trip. The coordinates of each profile, its deployment time, and measured water depth are summarized in Table 12 and Table 13. The locations of these profiles are presented in Figure 1.

Table 12: CTD Profiles – Near Milne Port: Locations and Times during Mooring Deployment

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
Site A	71.9027°	-80.9005°	503451	7978080	17 W	August 06, 2019, 19:08	-23
Site B	71.9010°	-80.9140°	502982	7977892	17 W	August 07, 2019, 13:39	-79
Site C	71.8958°	-80.8968°	503579	7977309	17 W	August 07, 2019, 12:59	-70
Site D	71.8922°	-80.9026°	503378	7976911	17 W	August 07, 2019, 13:51	-46

Table 13: CTD Profiles – Near Milne Port: Locations and Times during Mooring Recovery

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)
Site B	71.8982°	-80.9240°	502634	7977583	17 W	September 30, 2019, 20:26	-70

2.3.2.3 CTD Profiles – Milne Port Ore Dock

CTD profiles were taken adjacent to an ore carrier vessel berthed at the Milne Port Ore Dock on August 07, 2019 before and during a ballast water discharge event. A total of 8 profiles were conducted before and during ballast water discharge. Profiles were taken as close to the same location and in time as was possible under navigation constraints, weather, and proximity to vessel traffic.

Table 14: CTD Profiles – Ore Carrier Vessel Berthed at Milne Port Ore Dock: Locations and Times for Before and During a Ballast Water Discharge Event

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)	Discharge Status	Salinity of Discharged Ballast Water
B-01	71.8895°	-80.9081°	503188	7976614	17 W	August 07, 2019, 12:19	-19	Before	32
B-02	71.8895°	-80.9087°	503169	7976614	17 W	August 07, 2019, 12:22	-20	Before	32

Profile ID	Latitude (WGS 84)	Longitude (WGS 84)	Easting (m)	Northing (m)	UTM Zone	Date/Time Deployed (UTC)	Measured Water Depth (m, MSL)	Discharge Status	Salinity of Discharged Ballast Water
B-03	71.8899°	-80.9091°	503153	7976655	17 W	August 07, 2019, 12:31	-23	Before	32
B-04	71.8902°	-80.9079°	503197	7976684	17 W	August 07, 2019, 12:35	-24	Before	32
D-01	71.8895°	-80.9083°	503182	7976610	17 W	August 07, 2019, 14:30	-18	During	32
D-02	71.8895°	-80.9086°	503169	7976610	17 W	August 07, 2019, 14:36	-20	During	32
D-03	71.8894°	-80.9101°	503120	7976596	17 W	August 07, 2019, 14:44	-22	During	32
D-04	71.8892°	-80.9093°	503145	7976571	17 W	August 07, 2019, 14:42	-13	During	32

2.3.3 Data Processing

The data from the SBE 19plus was extracted from raw instrument format to ASCII using the SBE Data Processing® software. Post-processing modules recommended by Sea-Bird were then applied in SeaBird SBE Data Processing® software. Plots of measured water quality parameters were generated using the Sea Plot module of the SBE Data Processing® software.

During mooring deployment, the upcast data of the CTD profiles was used for analysis as the pump failed to measure for the first 30 seconds of the downcast. During mooring recovery, the downcast data of the CTD profiles was used for analysis. Spurious data was flagged and removed as necessary.

2.4 Milne Port Tide Gauge

2.4.1 Design

The approach to the tide gauge design for 2019 was identical to that of 2018 (Golder, 2018c). This was necessary to keep a repeatable installation location and elevation from season to season, which is critical to support an inter-annual comparison of water level data.

An RBRconcerto CTD sensor (herein “RBR”) was used to measure conductivity, temperature and water levels at the Milne Port Ore Dock. The RBR is designed to be a simple and self-contained CTD sensor capable of working in cold (rated to -5 ˚C) and corrosive (i.e. salty) environments. The RBR was mounted in an aluminum housing which was secured to the Milne Port ore dock ladder through two welded L-brackets. The ladder was installed at the end of June, near the start of open-water season (typically mid-July), and removed before ice-on (typically October). The Ore Dock ladder was chosen as it provides a stable mounting point that can be reinstalled each year at the same location as part of standard port operations. The instrumentation on the RBRconcerto and the sampling specifications are summarized in Table 15. Additional details on the tide gauge design, installation and recovery, and mounting hardware are provided in the Milne Port Tide Gauge Installation and Recovery Instructions (APPENDIX C).

Table 15: Tide Gauge Instrumentation and Sampling Strategy

Instrumentation	Sampling Strategy	Instrument Accuracy
Sensor: RBRconcerto CTD	**Measurement Interval:** 300 s **Sampling Rate:** 1 Hz **Averaging Duration:** 60 s	**Temperature accuracy:** ±0.002˚C **Conductivity accuracy:** ±0.005 mS/cm **Pressure accuracy:** ±0.05% of full-scale range

2.4.2 Deployment and Recovery

Prior to deployment the RBR sensor was calibrated at the factory. The calibration certificates are included in APPENDIX A. Additionally, the RBR sensor was given a visual inspection, programmed, and synchronized to UTC time. The deployment and recovery of the RBR sensor, attached to the Milne Port Ore Dock ladder, was conducted by Baffinland personnel with coordination from Golder personnel on June 23, 2019 and October 30, 2019, respectively. Prior to shipment of the RBR to Milne Port, the sensor was programed to start recording on June 15, 2019. Post-deployment, a GPS RTK (real-time kinematic) survey was conducted to determine the elevation and position of the ladder top plate (Table 16). This involved surveying five points in close proximity on the ladder top plate and calculating an average elevation. Following recovery of the RBR sensor the data was downloaded by Baffinland personnel and shipped to Golder for sensor inspection and demobilization. Upon downloading the data, it was observed that the RBR stopped recording data on September 19, 2019 at 14:11:48 due to an internal logger error. Golder is working with the manufacturer to determine the cause of this error.

Table 16: Deployment and Recovery Details for the RBR Tide Gauge

Survey Point	Easting (m)	Northing (m)	UTM Zone	Elevation (m, CGVD)	Tide Gauge Elevation (m, CGVD)[1]
Point 01	503226.872	7976632.321	17W	3.566	-3.924
Point 02	503227.446	7976633.151	17W	3.558	-3.932
Point 03	503226.660	7976633.727	17W	3.541	-3.949
Point 04	503226.179	7976632.900	17W	3.538	-3.952
Point 05	503226.910	7976632.990	17W	3.638	-3.852
Average Elevation				3.568	-3.921

Notes:

CGVD=Canadian Geodetic Vertical Datum; [1]Distance from the tide gauge pressure sensor to the surveyed steel ladder top plate is 7.49 m based on a personal communication with Baffinland personnel on June 26, 2019 (Ritgen D., pers. comms.)

2.4.3 Data Processing

A preliminary review of the data recorded by the RBR was performed following the recovery. Quality checks included the following:

- Reviewing time series measured by the instruments, including various diagnostic parameters;
- Checking internal recorder and file status; and
- Plotting and viewing the time series data.

The data from the RBR sensor was extracted from Raw instrument format to ASCII using the instrument specific software Ruskin®. Plots of measured water quality parameters were generated, and post-processing and quality-checking of data was completed using the MATLAB® (Mathworks 2019) scientific computing software and included:

- Measurements made by the instrument while it was out of water, as determined from either the pressure or salinity gauge, were replaced with a -999 value.
- Data were filtered for values above a maximum water temperature and salinity. The maximum water temperature was defined as 15 ˚C and salinity as 36 PSU. Filtered values were replaced with a -999 value.
- Where applicable, data were filtered for periods when the change in pressure between consecutive samples exceeded 0.5 dbar (approximately 0.5 m of water). Filtered values were replaced with a -999 value.
- Flagged and missing data values, identified onboard the instrument, were replaced with a -999 value. Additional manual editing to remove, or flag spurious data was performed as necessary.
- The instrument deployment and recovery dates and percentage of good data during the deployment period is provided in Table 17. Quality Controlled (QC) data are provided in APPENDIX B.

Table 17: Recorded Data Statistics for the RBR Sensor

Instrument	Date/Time Deployed (UTC)	Date/Time Recovered (UTC)	Total Records Recorded (#)	Total Records Expected (#)	Flagged and Missing Data (#)	Percent Valid Data (%)
RBRconcerto CTD	June 23, 2019, 23:50:00	October 30, 2019, 14:48:00	23730	37044	13314	64.10

3.0 DATA SUMMARY

3.1 Environmental Conditions

Weather and water level conditions for the period June 20 through October 03, 2019 are summarized in Figure 12. Meteorological data were obtained from the Milne Port meteorological station and water level data from Milne Port Tide Gauge. During the period August 18 through October 03, 2019 the anemometer on the meteorological station experienced a sensor failure and no data was recorded. From September 14, 2019 onwards the tide gauge experienced a sensor failure and stopped recording. At the beginning of the record the air temperature was between 0 and -10 ˚C and decreased rapidly in early September reaching less than -10 ˚C by the end of September. The wind direction during the record was predominantly out of the northeast and southeast with the occasional winds from the north and west. Wind speed averaged 5 m/s with occasional storms peaking above 10 m/s and a maximum recorded wind of 26.4 m/s on August 23, 2019. Wind directions in Milne Inlet are strongly influenced by local topography (i.e. mountains and cliffs), with typical summer winds out of the southeast and winter winds out of the northeast and north. Observed water levels at Milne Port Tide Gauge ranged from approximately -4.25 m to -2.0 m referenced to Canadian Geodetic Vertical Datum. The mooring deployment spanned approximately three spring tide (largest water level fluctuations) and two neap tide cycles (smallest water level fluctuations).

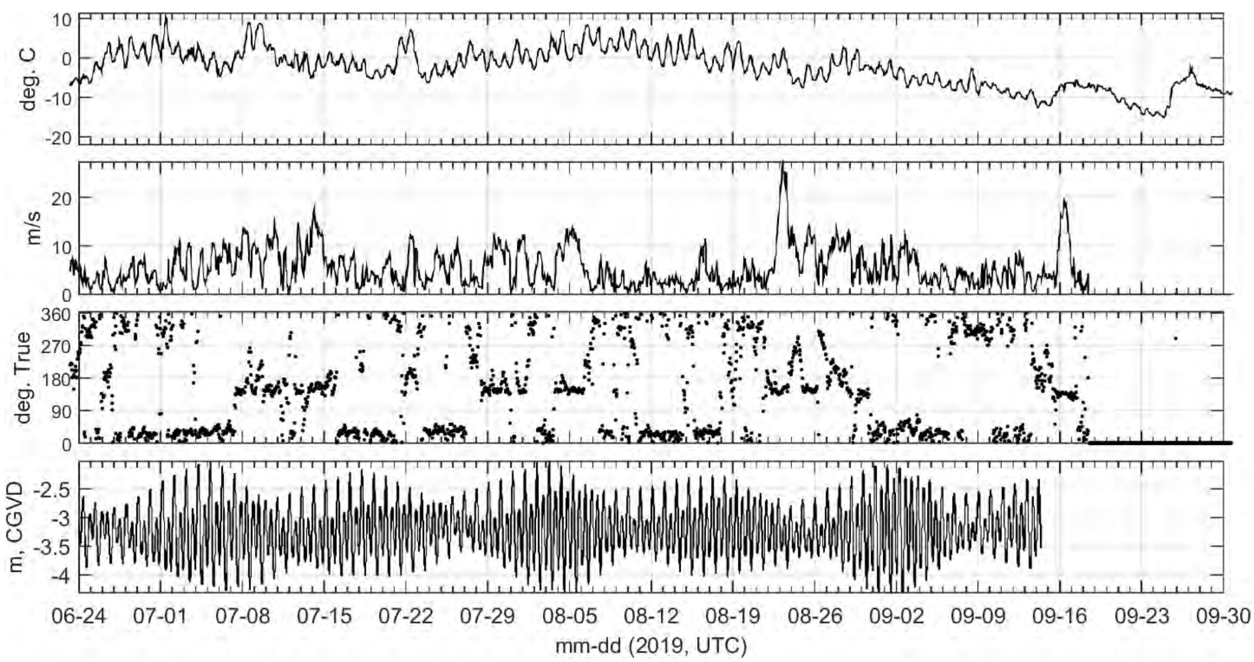


Figure 12: Time series of observed temperature (top), wind speed, wind direction, and water level (bottom) at the Milne Port Tide Gauge and Milne Port meteorological station from June 20 to October 03, 2019 in UTC.

3.2 Oceanographic Moorings

3.2.1 Currents

Figure 13 through Figure 18 illustrate the temporal and vertical variations in current speed and direction as measured by the ADCP's at the location of the Bruce Head and Milne Port 01 moorings.

Contour plots of current speed, direction, and acoustic backscatter amplitude (echo intensity) at Bruce Head and Milne Port 01, as measured by the ADCPs, are shown in Figure 13 and Figure 14, respectively. At both sites, the maximum current speeds are approximately 25 cm/s. At the Bruce Head mooring, the Nortek 500 kHz ADCP experienced an instrument failure so the measured data only covers the range from -150 m to approximately -50 m MSL. At Milne Port 01, the maximum current speeds generally occur in the upper 50 m of the water column, suggesting that wind is the primary driver of currents. An example of this can be seen on August 23, 2019 when the maximum observed wind speed coincided with the maximum observed near-surface current at Milne Port 01. During sustained wind events, such as the period August 27 to September 04, increased current speeds are observed deeper in the water column at Milne Port 01. Wind episodes of this magnitude can break down salinity and temperature stratification, which generally limits the depth of wind mixing, and generate currents across the full water column. At Bruce Head, variations in measured current speed and direction are likely driven primarily by mixed semidiurnal tides as the depth of the ADCP places it below the expected depth of wind mixing, except during strong wind events. This is seen as an approximate twice daily oscillation in current direction (i.e., along channel) and speed. However, the current direction at Bruce Head is not uniform throughout the water column for a given point in time suggesting stratified flows exist. Additionally, strong currents exist near-bed suggesting estuarine circulation (i.e. separate outflow and inflow of water). At Milne Port 01 the currents don't show as clear a tidal oscillation as Bruce Head and instead seem to be forced from the surface to bed by wind mixing. This is likely because of the moorings position at the head of the inlet where depths are shallower, tidal forcing is weaker, and complex circulation patterns, such as upwelling/downwelling and eddies, are present.

Rose plots of current speed and direction for selected depths and time series of depth averaged current speed and direction at Bruce Head and Milne Port 01 are shown in Figure 15 through Figure 18. At Bruce Head the mid-water column flows are dominantly from southerly directions and take on a bimodal direction near the seabed, coming from the northeast and southwest near the bed. The bimodal direction could be attributed to several things such as the interaction of stratified flows with complex bathymetric features in the area (i.e. sill, underwater canyons, etc.) and estuarine circulation to balance salinity gradients (i.e. balance freshwater inputs). Overall, the currents at Bruce Head are oriented along channel. In general, the depth average currents at Bruce Head are between 5-10 cm/s but peak as high as 15 cm/s. At Milne Port 01, the surface currents show a dominant north-south direction (i.e. tidal ebb/flood). At depth the Milne Port 01 currents become unimodal and are dominantly towards the north with a slight turning to the northwest near bed. In general, the depth average currents at Milne port 01 are between 5-10 cm/s but peak as high as 15 cm/s during wind events. At both moorings, the largest depth average currents speeds are to the north at Bruce Head and northeast at Milne Port 01 and occur during sustained northerly winds in late August and early September. The magnitude of the currents at both moorings is weak and nearing the uncertainty of the ADCPs.

Summary statistics for current speeds and directions at select depths at Bruce Head and Milne Port 01 mooring are presented in Table 18 and Table 19.

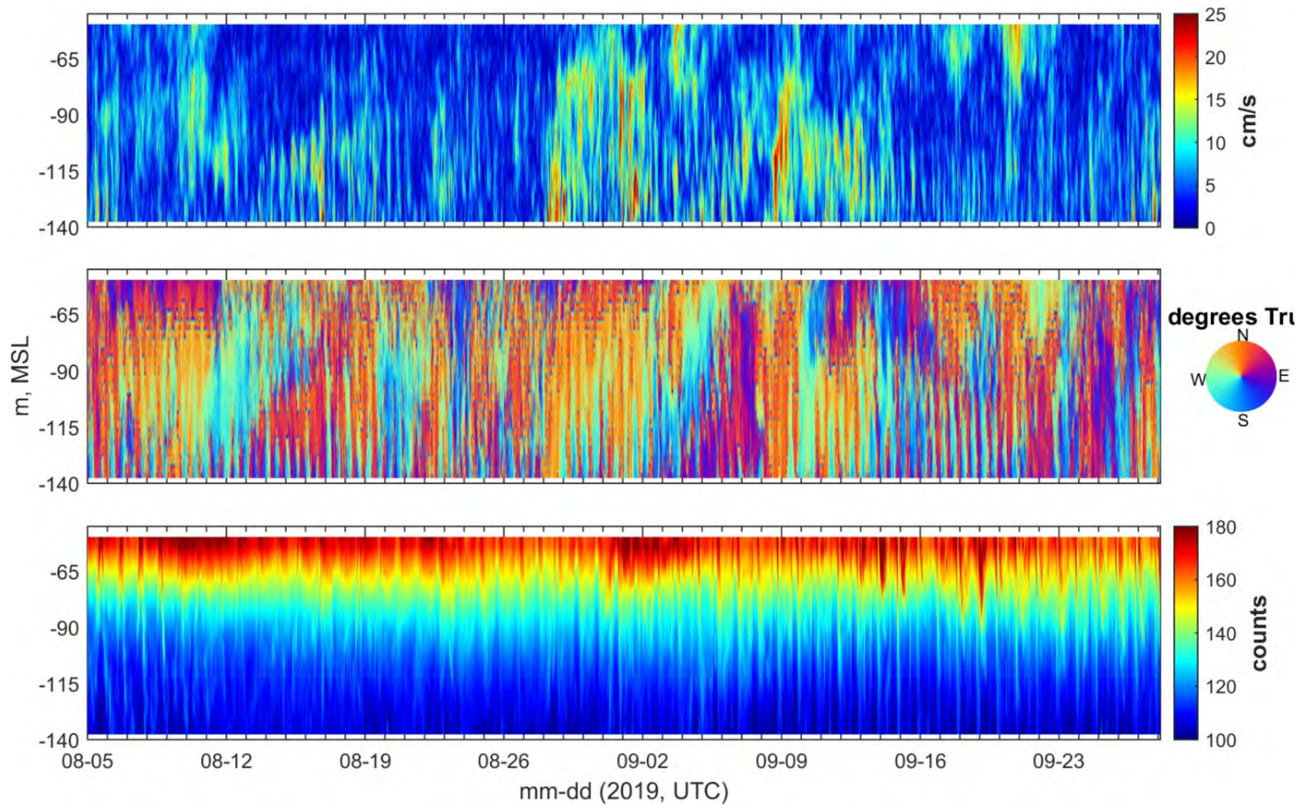


Figure 13: Contour plot of current speed (top), direction, and echo intensity profiles (bottom) measured at Bruce Head mooring by the 300 kHz down-looking ADCP from August 05 to September 28, 2019 in UTC.

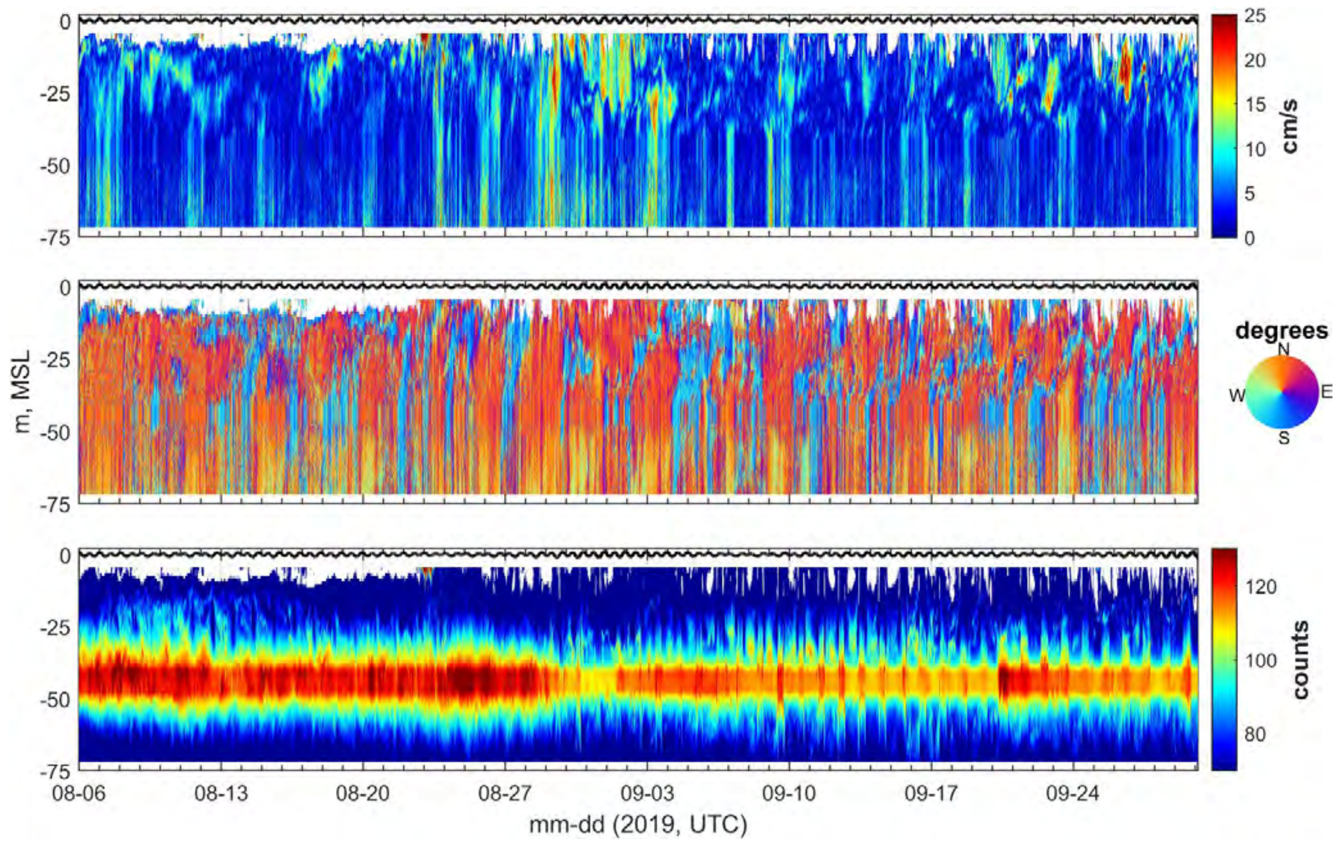


Figure 14: Contour plot of current speed (top), direction, and echo intensity profiles (bottom) measured at Milne Port 01 mooring by the 600 kHz up-looking and 600-kHz down-looking ADCP from August 06 to September 30, 2019 in UTC. The black line indicates the water level during deployment.

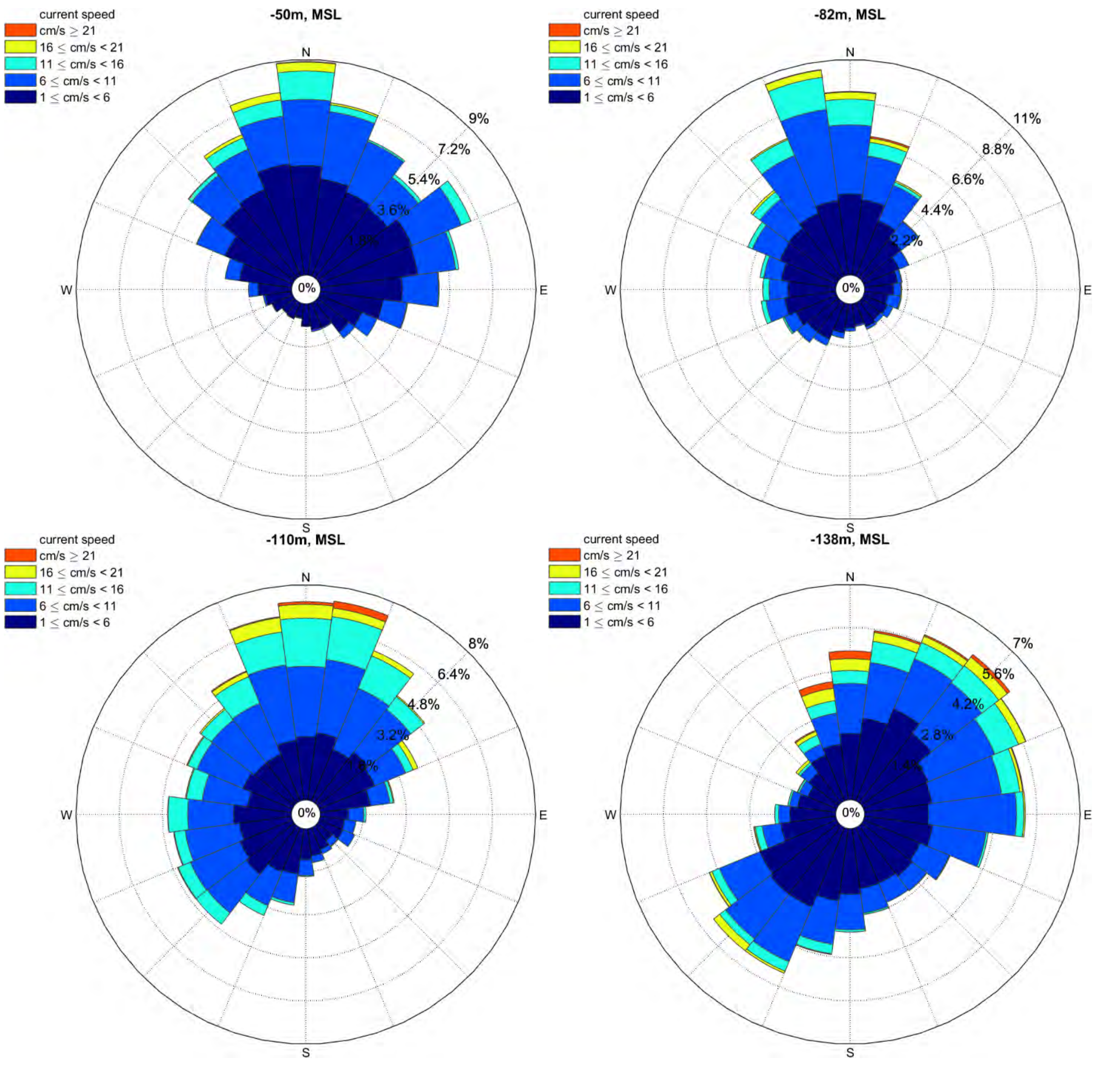


Figure 15: Current roses for select bin depths measured at 50, 82, 110, and 138 m below MSL at Bruce Head mooring by the 300 kHz down-looking ADCP from August 05 to September 28, 2019 in UTC.

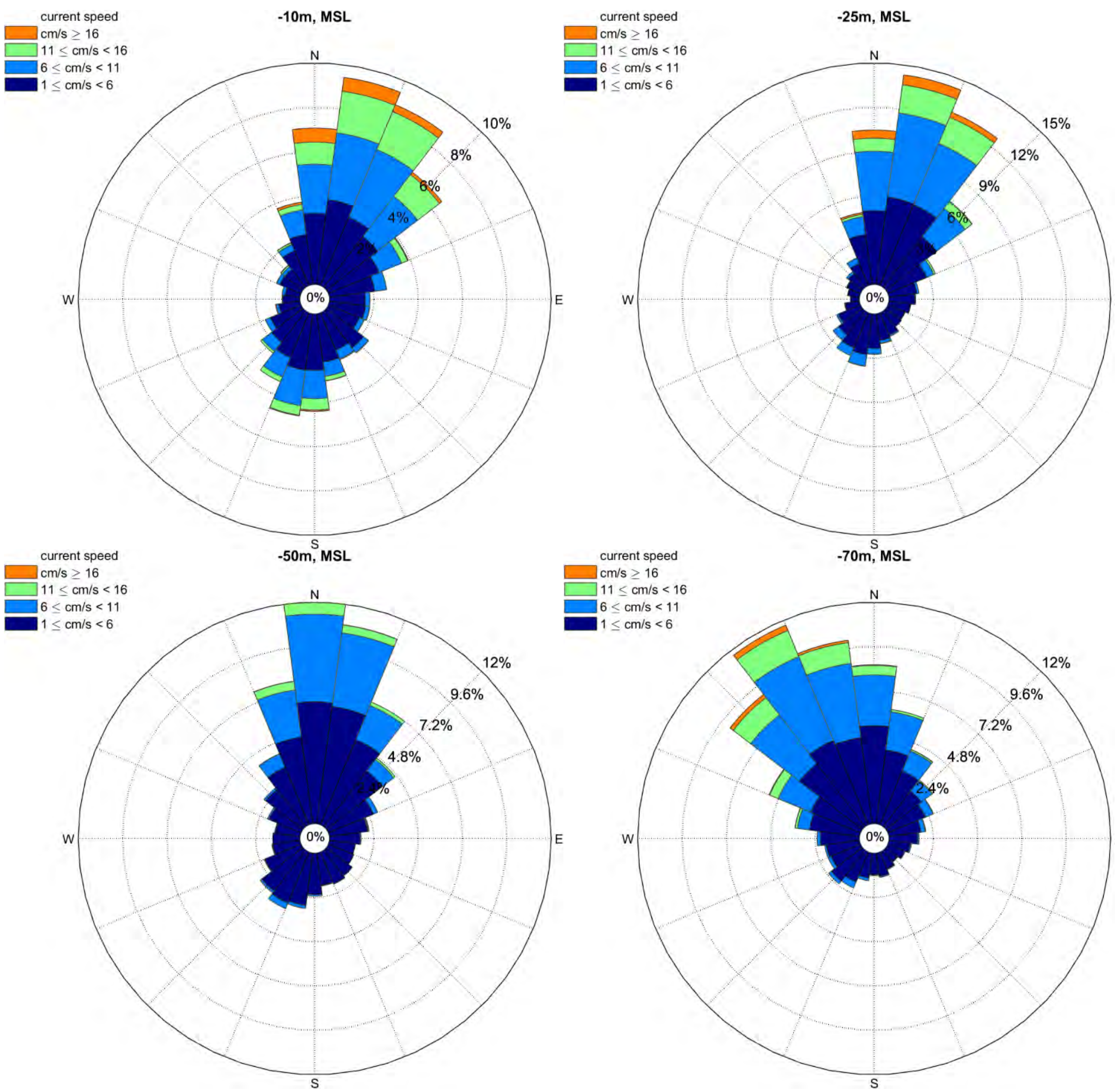


Figure 16: Current roses for select bin depths measured at 10, 25, 50, and 70 m below MSL at Milne Port 01 mooring by the 600 kHz up-looking and600 kHz down-looking ADCPs from August 06 to September 30, 2019 in UTC.

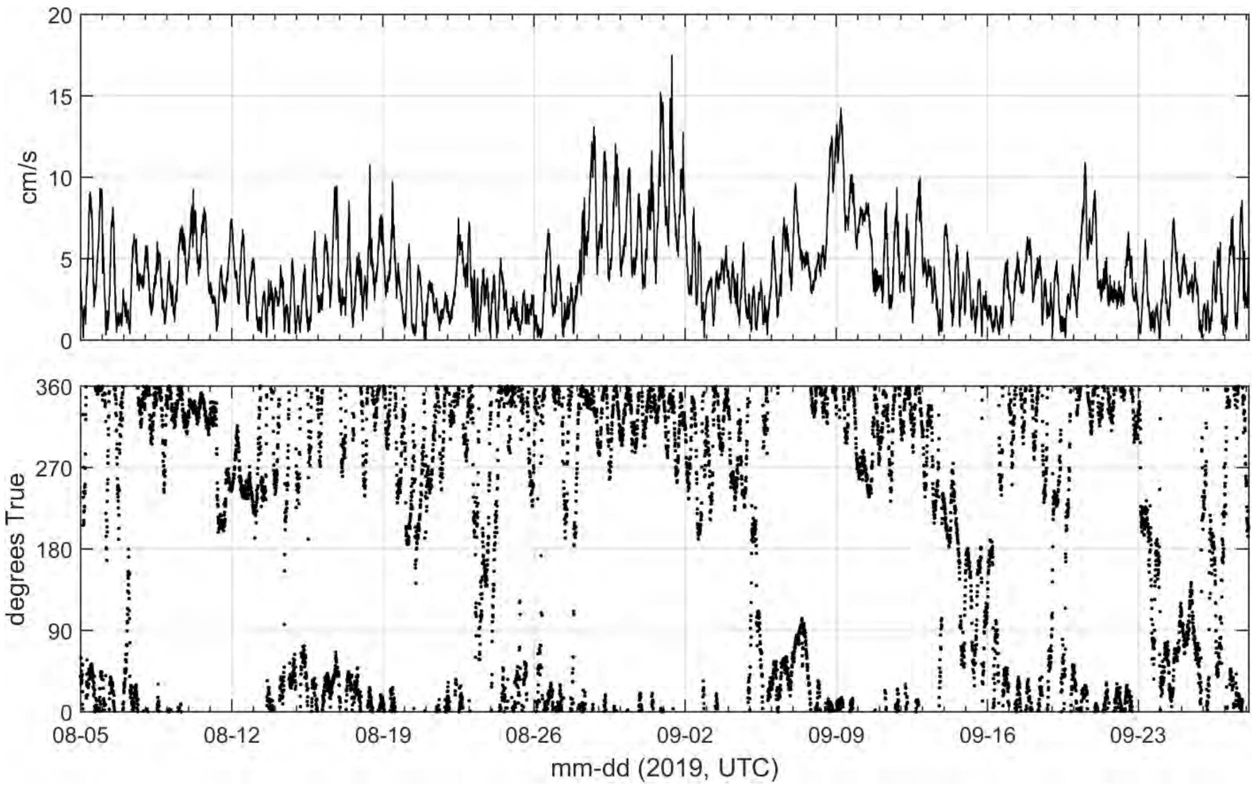


Figure 17: Full water column depth average current speed (top) and direction (bottom) measured at Bruce Head mooring by the 300 kHz down-looking from August 05 to September 28, 2019 in UTC.

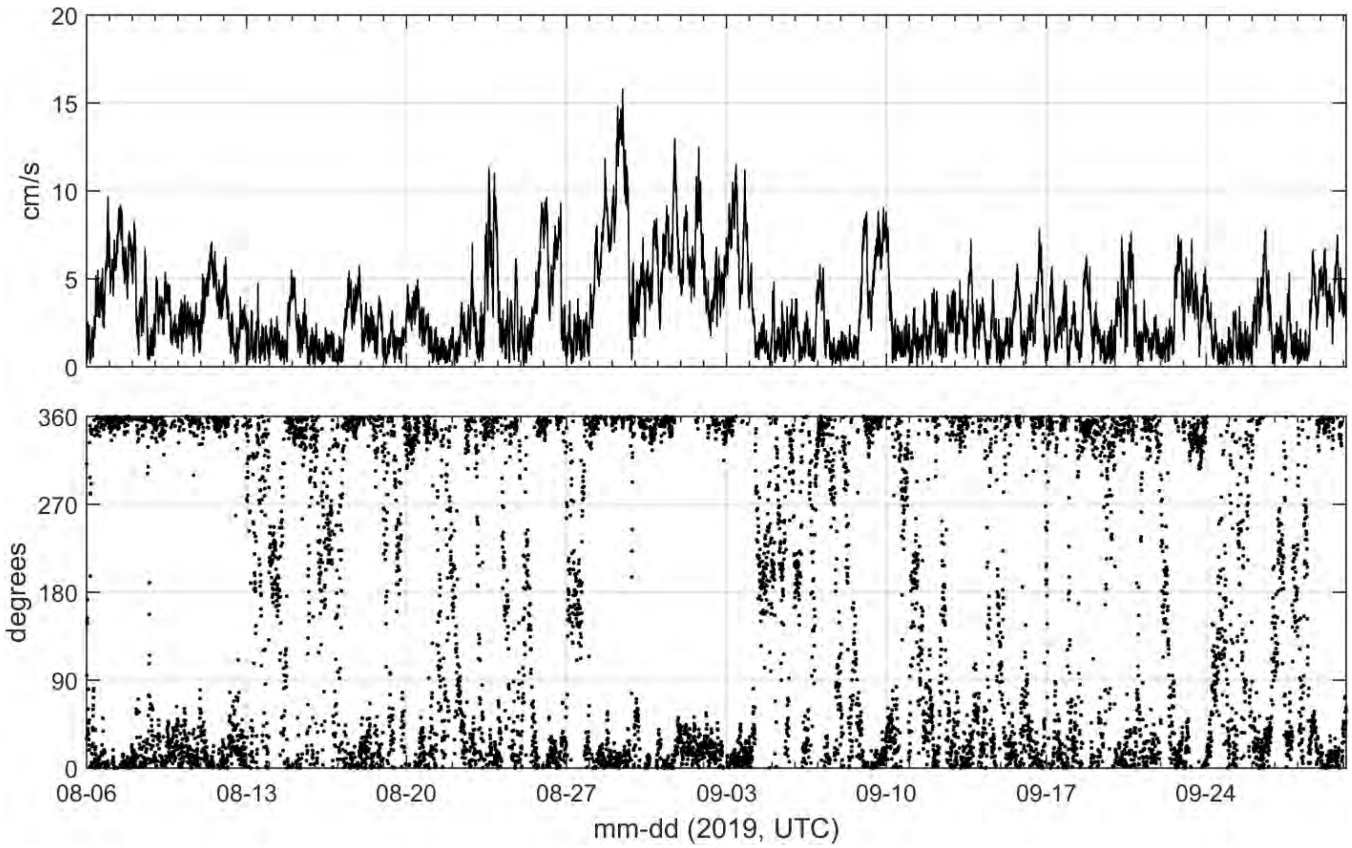


Figure 18: Full water column depth average current speed (top) and direction (bottom) measured at Milne Port 01 mooring by the 600 kHz up-looking and 600 kHz down-looking ADCPs from August 06 to September 30, 2019 in UTC.

Table 18: Statistics of current speed and direction for selected depths as measured at Bruce Head mooring by the down-looking 600 kHz ADCP from August 05 to September 28, 2019 in UTC.

Depth (m, MSL)	Bin No.	Min Speed (cm/s)	Median Speed (cm/s)	Mean Speed (cm/s)	Max Speed (cm/s)	Std Speed (cm/s)	Mean Direction (degrees)	Percent Valid Data (%)
-50	1	0.00	4.40	5.06	21.6	3.21	16	100
-82	9	0.00	6.00	6.72	25.6	4.03	351	100
-110	16	0.00	4.50	5.26	18.2	3.29	340	100
-138	23	0.00	5.70	6.61	44.4	4.41	58	100

Table 19: Statistics of current speed and direction for selected depths as measured at Milne Port 01 mooring by the 600 kHz up-looking and 600 kHz down-looking ADCPs from August 06 to September 30, 2019 in UTC.

Depth (m, MSL)	Bin No.	Min Speed (cm/s)	Median Speed (cm/s)	Mean Speed (cm/s)	Max Speed (cm/s)	Std Speed (cm/s)	Mean Direction (degrees)	Percent Valid Data (%)
-10	14	0.00	2.20	2.60	13.3	1.78	17	90.7
-25	29	0.00	2.10	2.39	12.00	1.50	2	100
-50	49	0.00	2.80	3.10	11.9	1.74	5	100
-70	69	0.00	2.40	2.63	10.0	1.50	37	100

3.2.2 Temperature and Salinity

Figure 19 through Figure 22 illustrate the time varying water temperature, conductivity, salinity and depth as measured by the CT and CTD instruments on the Bruce Head, Milne Port 01, and Milne Port 02 moorings. During the deployment period the depth of the pycnocline (i.e. layer of water in which density changes rapidly with depth) was approximately surface to -20m in early August and -15m to -40m in late September as indicated by CTD profiles (see Section 3.3.2).

At Bruce Head the CT sensor was at a depth of approximately -44 m MSL. The temperature and salinity were relatively constant during the first 3 weeks of the deployment, between -1.3 and -0.5 ˚C and 31 and 32 PSU. This is due to the instrument depth below the pycnocline depth which shelters the instrument from wind driven salinity and temperature fluctuations. From the end of August onwards the temperature and salinity show fluctuations between 0 and 2 ˚C and 30 and 32 PSU, this is due to a deepening of the pycnocline to the instrument deployment depth. The deepening of the pycnocline corresponds to a drop in air temperature and overall switch in wind conditions to stronger and more sustained winds from the north. This change in atmospheric conditions increases the movement of water at the pycnocline depth and would explain the daily spikes in temperature and salinity.

At Milne Port 01 the CT sensor was at a depth of approximately -45 m MSL. The temperature and salinity, much like Bruce Head, is relatively constant during the first 3 weeks of the deployment, but shows oscillations from the end of August onwards due to a deepening of the pycnocline. At Milne Port 02 the CTD sensor was at a depth of approximately -33 m MSL and the CT sensor at a depth of -18 m MSL. Both sensors showed large fluctuations in temperature and to a lesser extent salinity from the end of August onwards, like the observations from the Bruce Head and Milne Port 01 moorings. The CT sensor at -18m is within the pycnocline in early August and above the pycnocline in late September. During late September, spikes in temperature and salinity observed at the -18m sensor are driven by intense wind mixing above the pycnocline.

The increased fluctuations in all sensors from the end of August onwards corresponds to strengthening northerly winds and dropping air temperatures. During September in Milne Inlet, the upper water column began to de-stratify (i.e. increased mixing) as deeper waters became mixed with the surface, decreasing the strength of stratification, which allowed wind forcing to reach deeper depths and caused increased oscillations of the mid-water column characteristics (i.e. temperature and salinity variations).

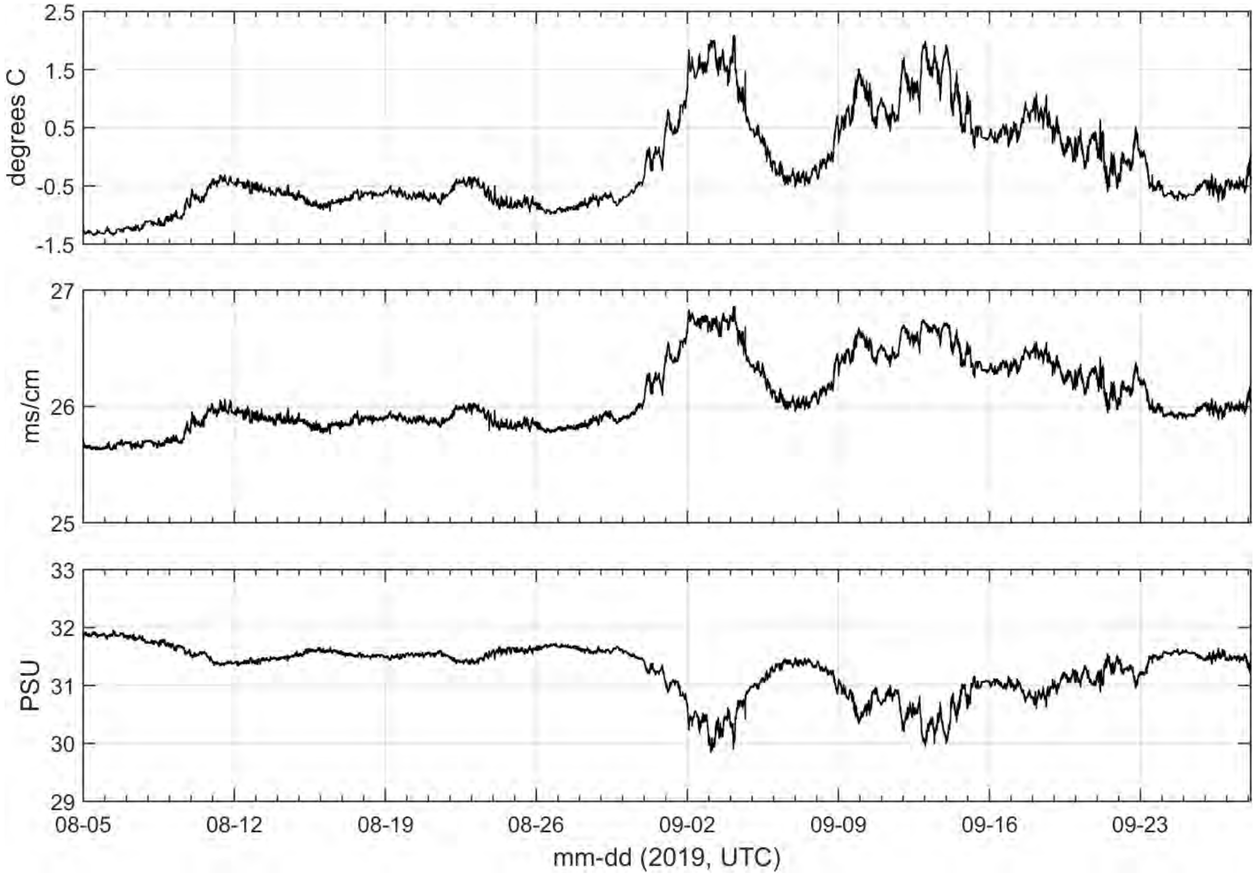


Figure 19: Time series of temperature (top), conductivity, and salinity (bottom) measured at Bruce Head mooring by the RBR-XR420 CT from August 05 to September 28, 2019 in UTC.

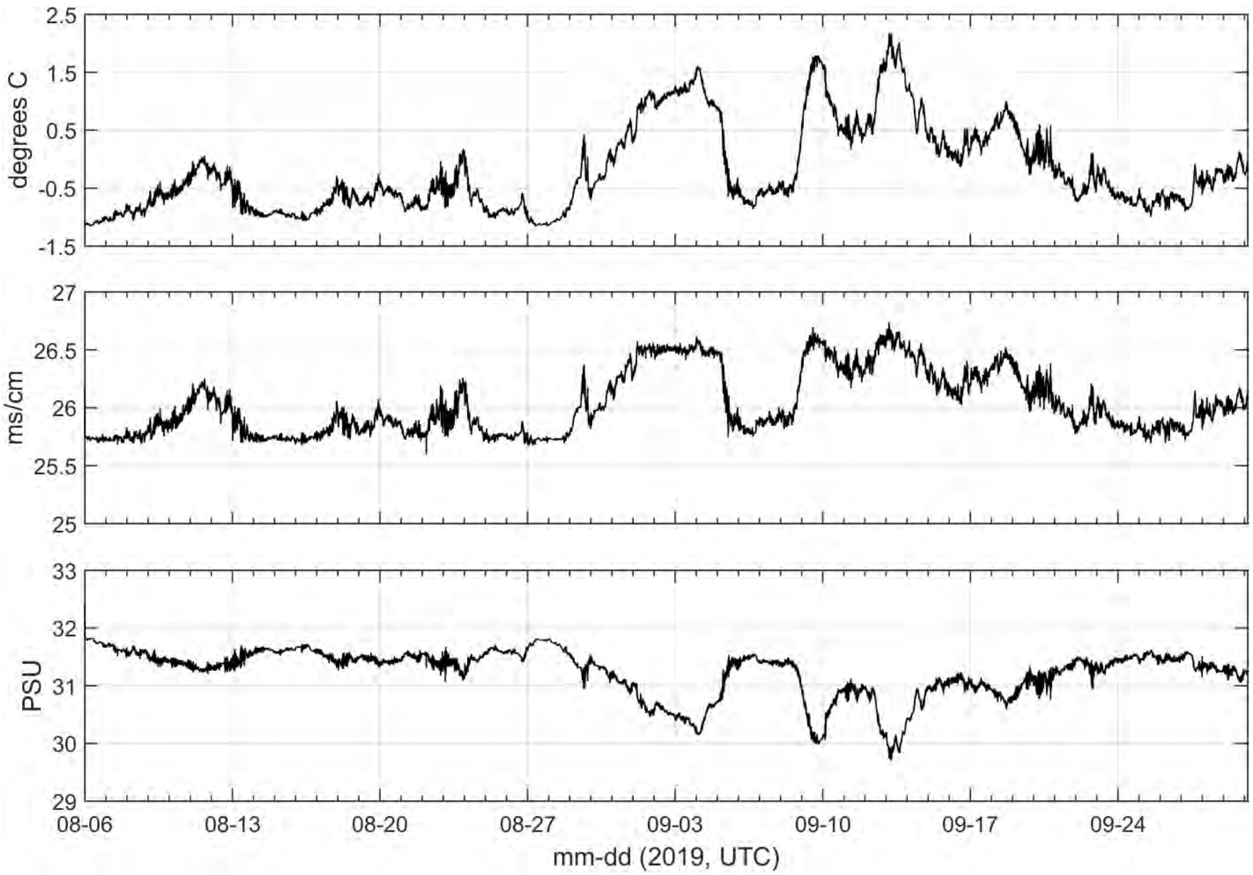


Figure 20: Time series of temperature (top), conductivity, and salinity (bottom) measured at Milne Port 01 mooring by the SBE 37-SM MicroCAT CT from August 06 to September 30, 2019 in UTC.

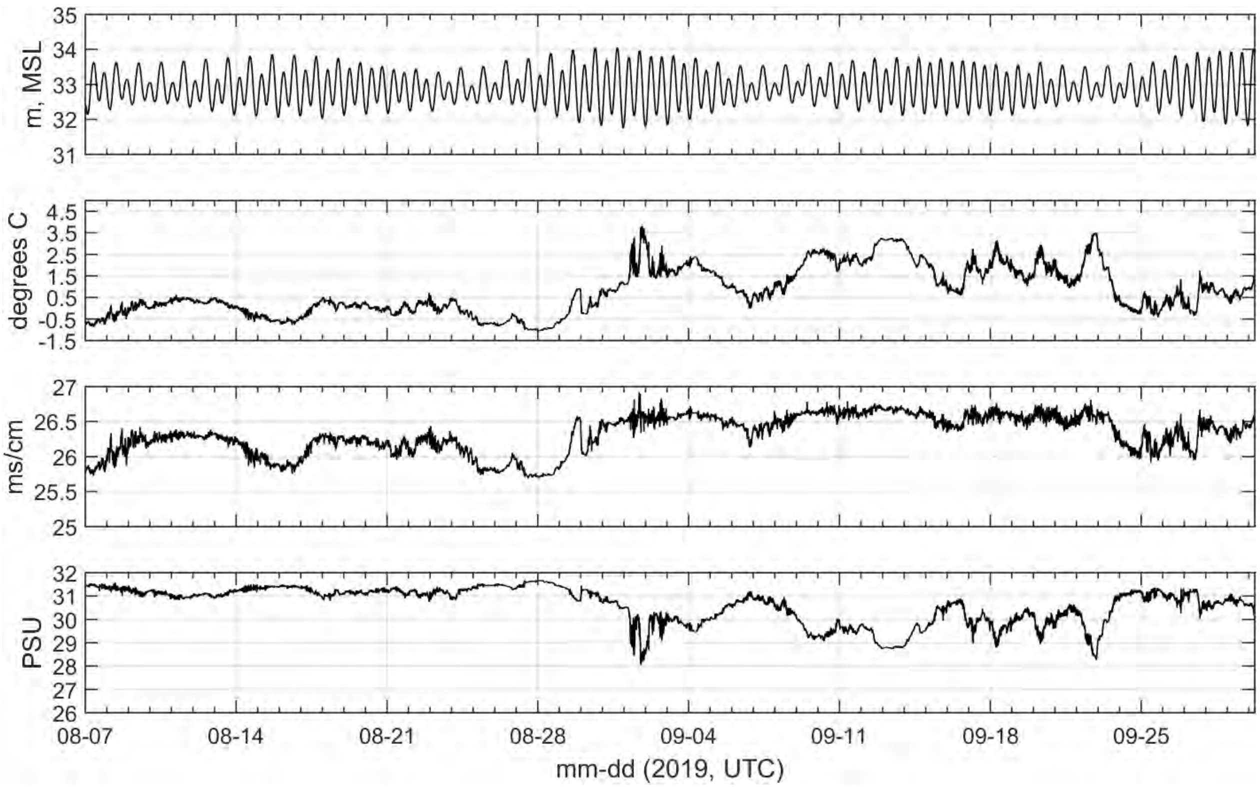


Figure 21: Time series of depth (top), temperature, conductivity, and salinity (bottom) measured at Milne Port 02 mooring by the SBE 37-SM MicroCAT CTD from August 07 to September 28, 2019 in UTC

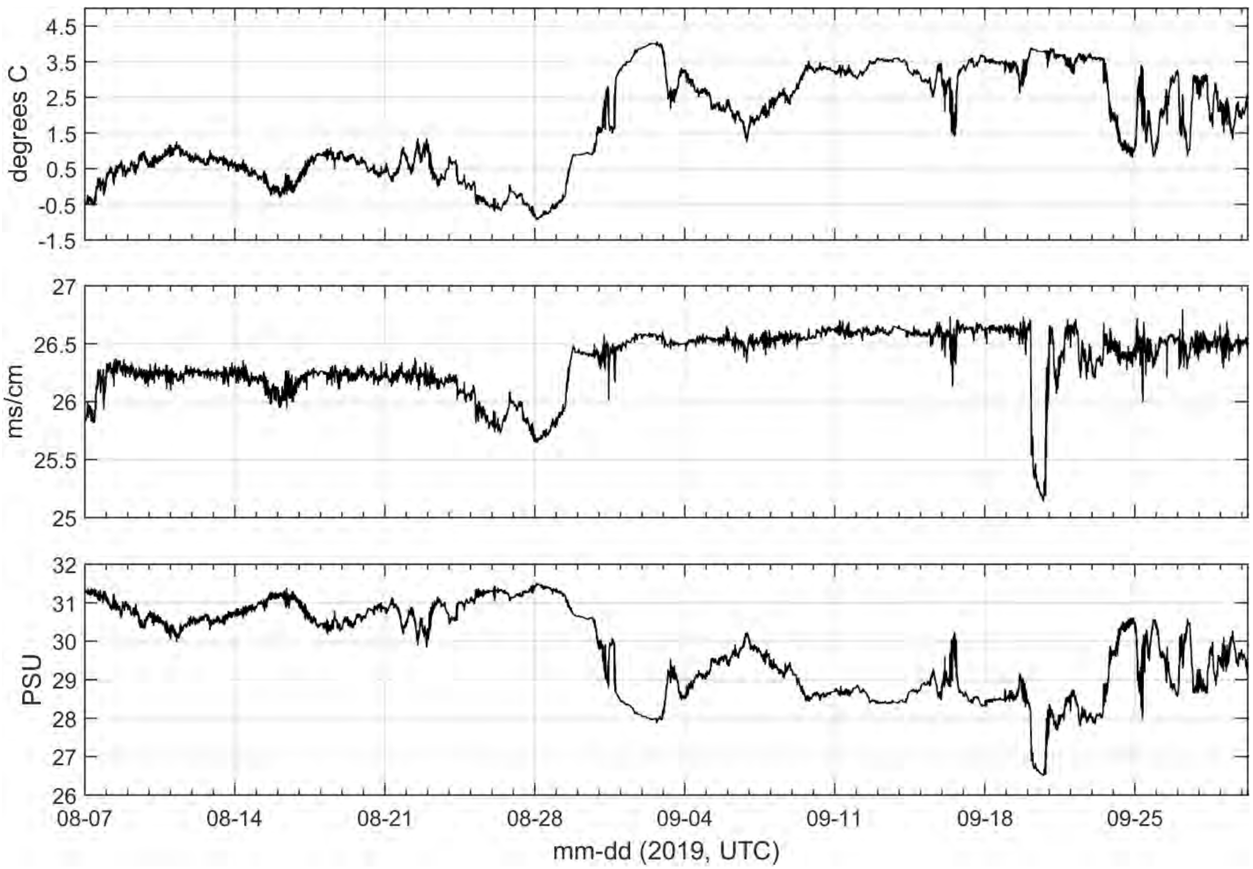


Figure 22: Time series of temperature (top), conductivity, and salinity (bottom) measured at Milne Port 02 mooring by the SBE 37-SM MicroCAT CT from August 07 to September 28, 2019 in UTC. The approximate depth of this sensor was -18 m MSL.

3.3 CTD Profiles

3.3.1 Milne Port to Eclipse Sound

Figure 23 through Figure 30 show CTD profile data collected throughout Milne Inlet, from Milne Port to Eclipse Sound, in early August and late September. Profile data included measurements of salinity, temperature, chlorophyll *a*, turbidity, and dissolved oxygen. Dissolved oxygen results in August were flagged as erroneous and are not shown. This may have been a result of the pump delay which required the up-cast values to be used in August. Locations of the CTD profiles are shown in Figure 2.

3.3.1.1 August

Figure 23 and Figure 24 show a cross-section salinity, temperature, density, chlorophyll *a*, turbidity, and dissolved oxygen, interpolated horizontally for visualization, measured between Milne Port Ore Dock and Ragged Island. Figure 25 and Figure 26 show CTD profiles of measured parameters at select locations along the cross section. Throughout Milne Inlet, there is a thin layer of fresher water from the surface to -20m MSL (i.e. the location of the pycnocline), as indicated by a decrease in density. Below a depth of -20m MSL the water column temperature and salinity become nearly constant, as indicated by near constant density. Near Milne Port, the surface water is fresher than surface waters further along Milne Inlet. This is shown in Figure 25 as a lower density at station 5 and

9. In general, the density variation with depth suggests the pycnocline is strongly stratified in the upper 20m and likely prevents wind mixing below this depth. Chlorophyll *a* increased from the surface and peaked at and below the depth of the pycnocline, approximately -17 and -40m MSL depending on the station. Concentrations decreased to near zero below -60m MSL (i.e. below the photic zone) for all stations. Turbidity in Milne Inlet was highest near the surface (i.e. between 0 and -10m MSL) and increase near the bottom in select locations. The increase turbidity near the surface is likely a result of wind mixing while at depth the increase could be due to estuarine circulation and near bottom currents suspending sediments.

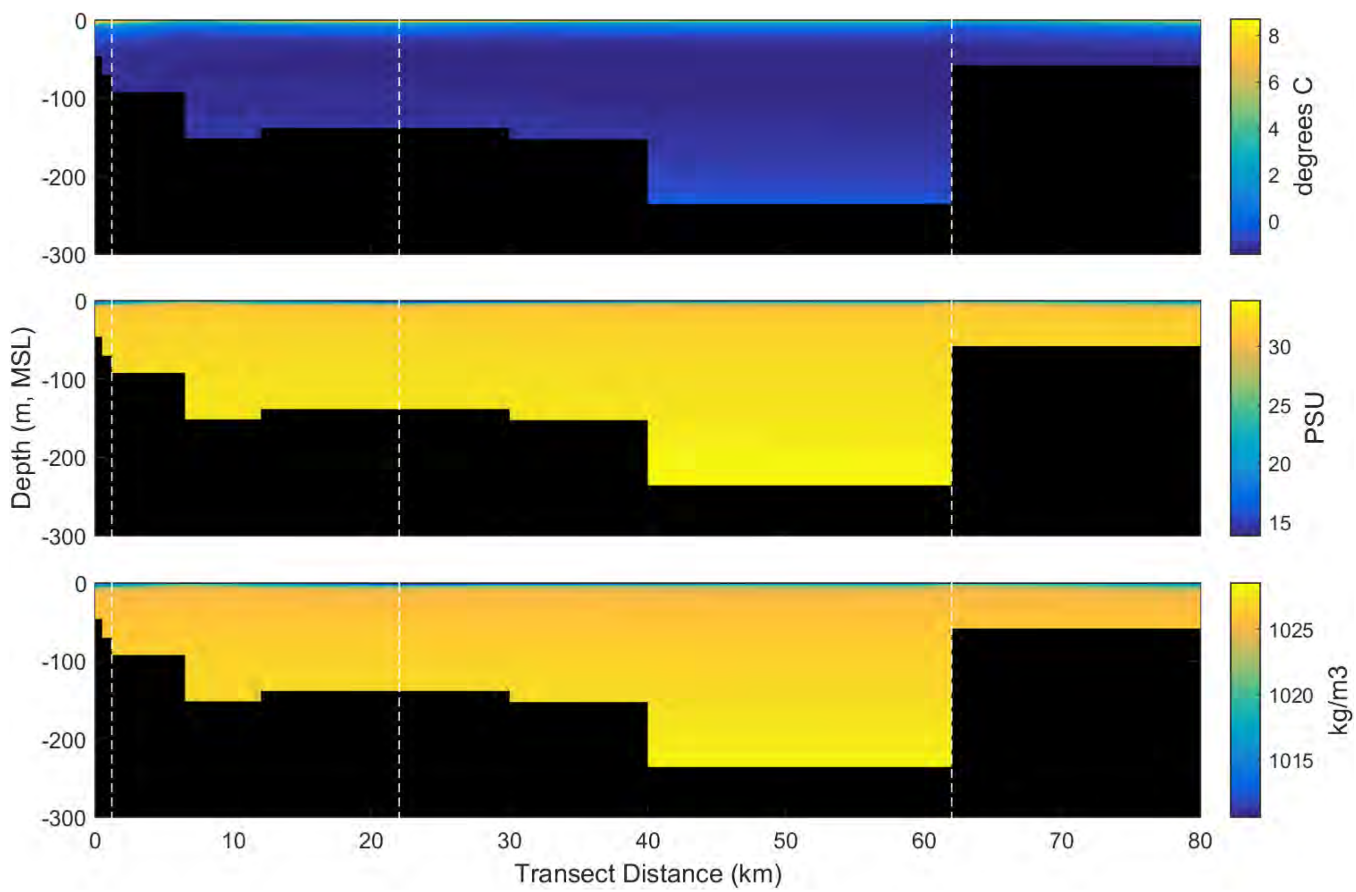


Figure 23: Cross-section of temperature (top), salinity (middle), and density (bottom) between Milne Port Ore Dock (0km) and Ragged Island (80km) as interpolated from CTD profiles taken in early August 2019 (Figure 2). Location of CTD profiles 05, 09, and 12 are shown as dashed white line left to right. Bottom depth is the maximum profiled depth.

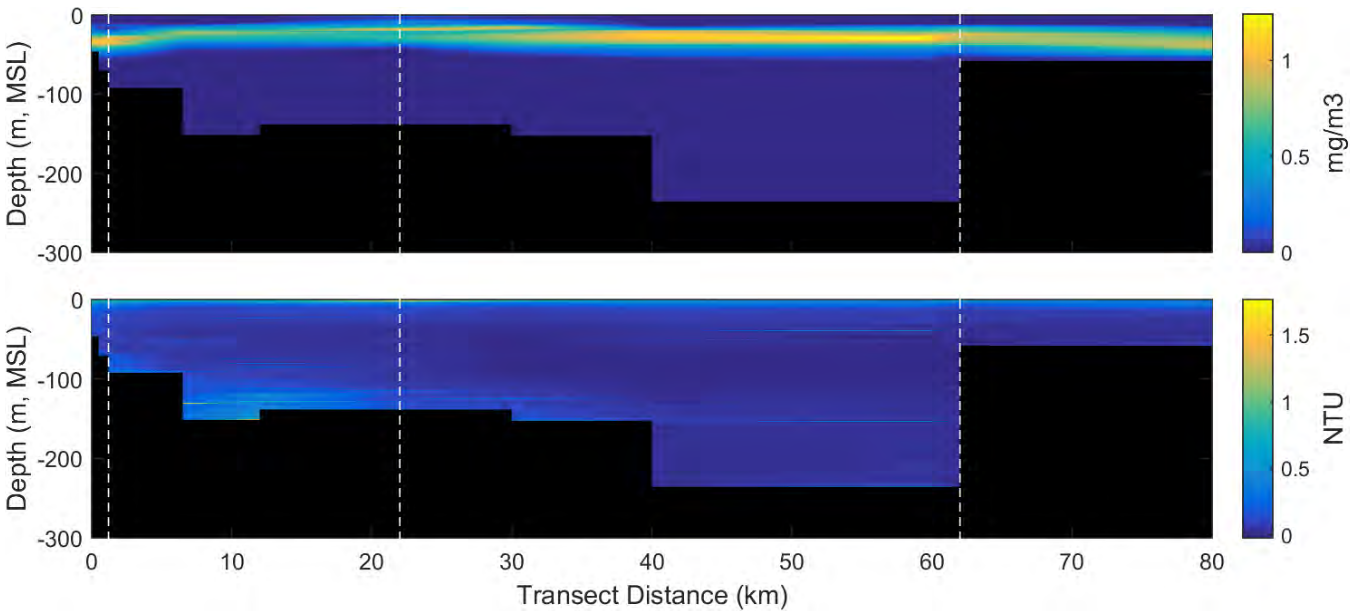


Figure 24: Cross-section of chlorophyll *a* (top) and turbidity (bottom) between Milne Port Ore Dock (0km) and Ragged Island (80km) as interpolated from CTD profiles taken in early August 2019 (Figure 2). Location of CTD profiles 05, 09, and 12 are shown as dashed white line left to right. Bottom depth is the maximum profiled depth.

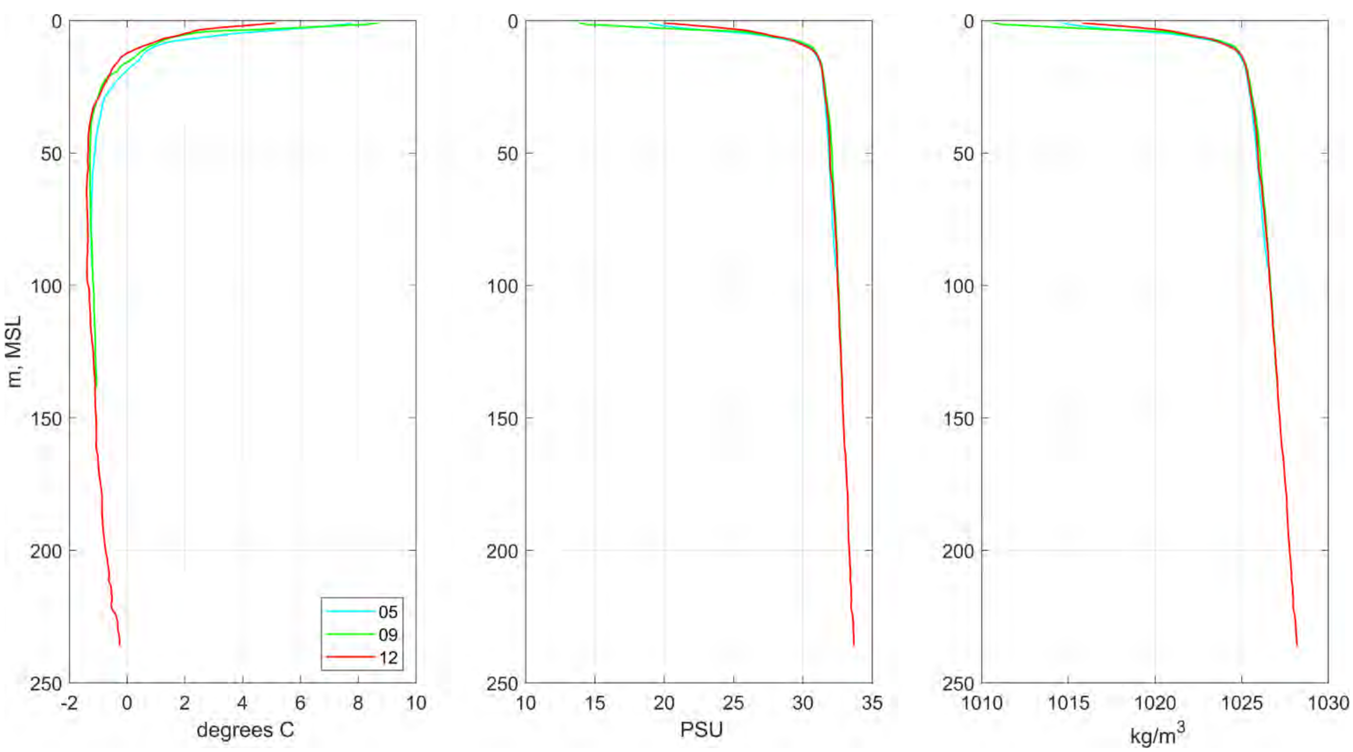


Figure 25: CTD profiles of temperature (left), salinity (middle), and density (right) at location 05, 09, and 12 as shown in Figure 23 and Figure 2

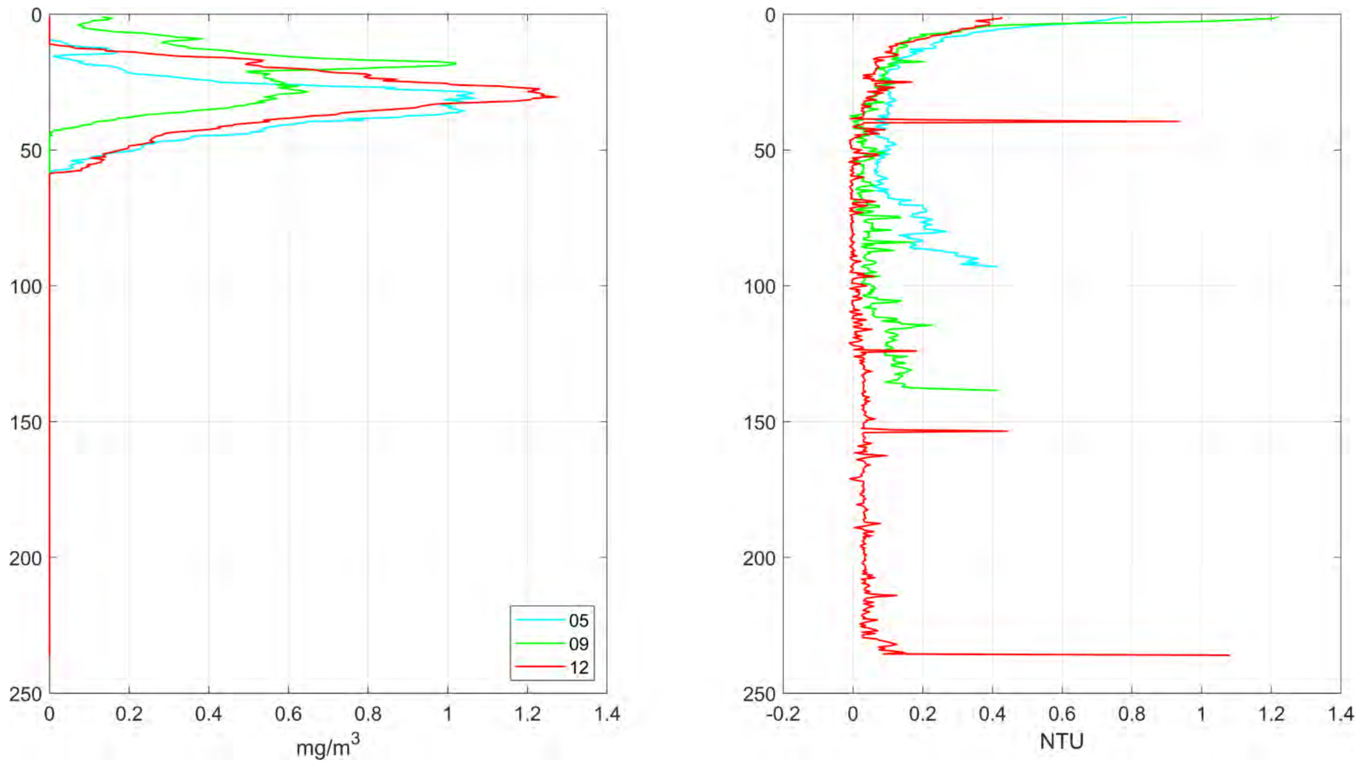


Figure 26: CTD profiles of chlorophyll *a* and turbidity at location 05, 09, and 12 as show in Figure 24 and Figure 2

3.3.1.2 September

Figure 27 and Figure 28 show cross-sections of salinity, temperature, density, chlorophyll *a*, turbidity, and dissolved oxygen, interpolated horizontally for visualization, measured between Milne Port Ore Dock and Ragged Island. Figure 29 and Figure 30 show CTD profiles of measured parameters at select locations along the cross section. Throughout Milne Inlet, the upper 15 to 20m of the water column is well mixed (i.e. constant density). Between approximately -15m and -40m MSL temperature and salinity and density changes with depth (i.e. depth of the pycnocline) and below approximately -50m MSL temperature and salinity and density become more constant with depth. Within Milne Inlet, there is a noticeable tongue of warmer fresher water in the upper 20m of the water column. This layer is particularly noticeable from Milne Port to approximately Bruce Head. The well mixed layer near the surface can be attributed to the breakdown of stratification as atmospheric conditions change and the pycnocline deepens.

Chlorophyll *a* increased from the surface and peaked above and at the depth of the pycnocline, approximately -30m MSL depending on the station. Concentrations decreased to near zero below -45m MSL for all stations. Turbidity in Milne Inlet was highest near the surface (i.e. between 0 and -10m MSL) and increased near the bottom in select locations. The increase turbidity near the surface is likely a result of wind mixing while at depth the increase could be due to estuarine circulation and near bottom currents suspending sediments. Dissolved oxygen was highest at depths between -10m and -30m MSL and decreased with depth to near zero. The highest values of dissolved oxygen were measured near Milne Port near the depth of the pycnocline.

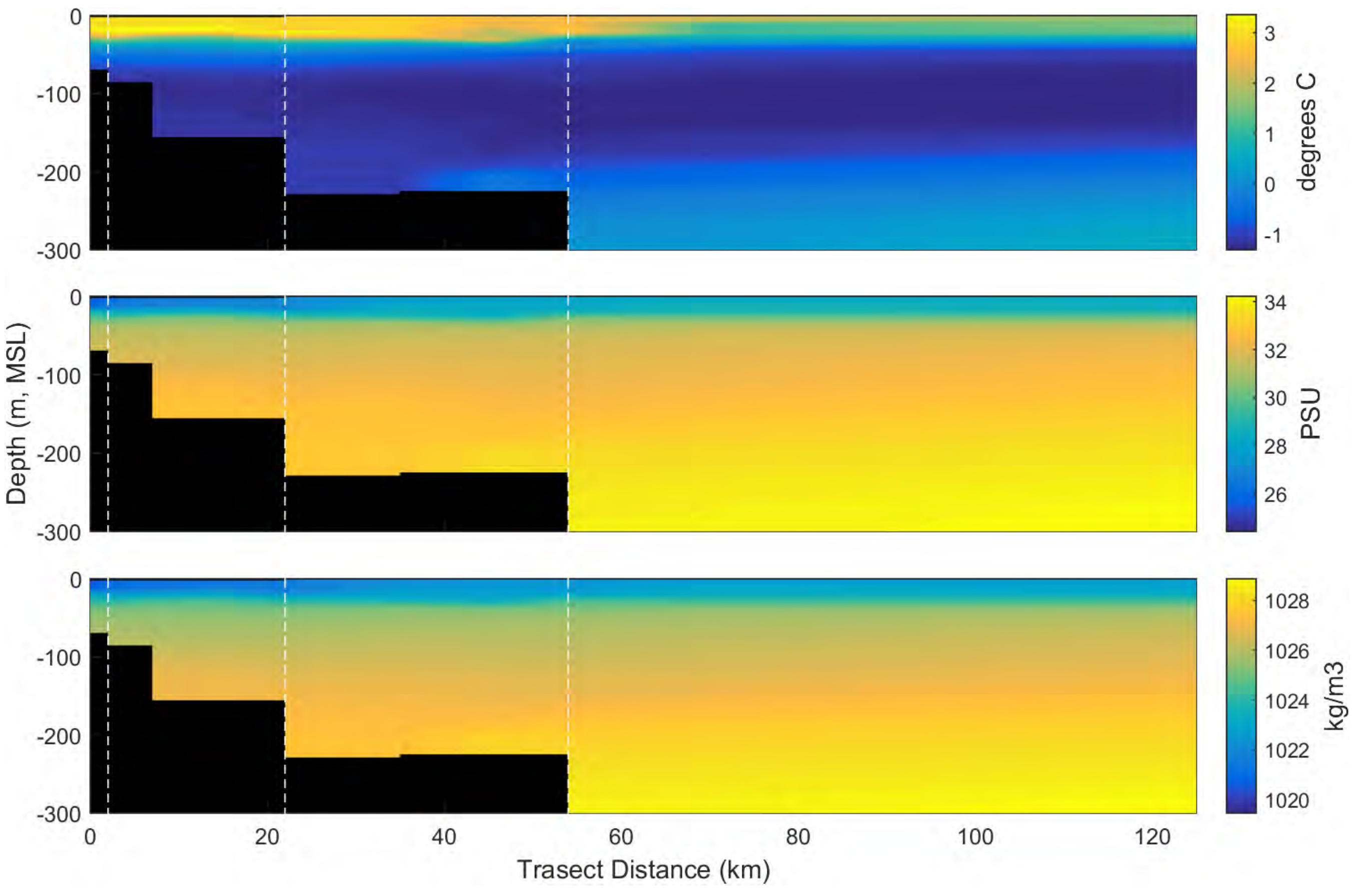


Figure 27: Cross-section of temperature (top), salinity (middle), and density (bottom) between Milne Anchorage #01 (0km) and Pond Inlet (125km) as interpolated from CTD profiles taken in late September 2019 (Figure 2). Location of CTD profiles 02, 09, and 14 are shown as dashed white line left to right. Bottom depth is the maximum profiled depth.

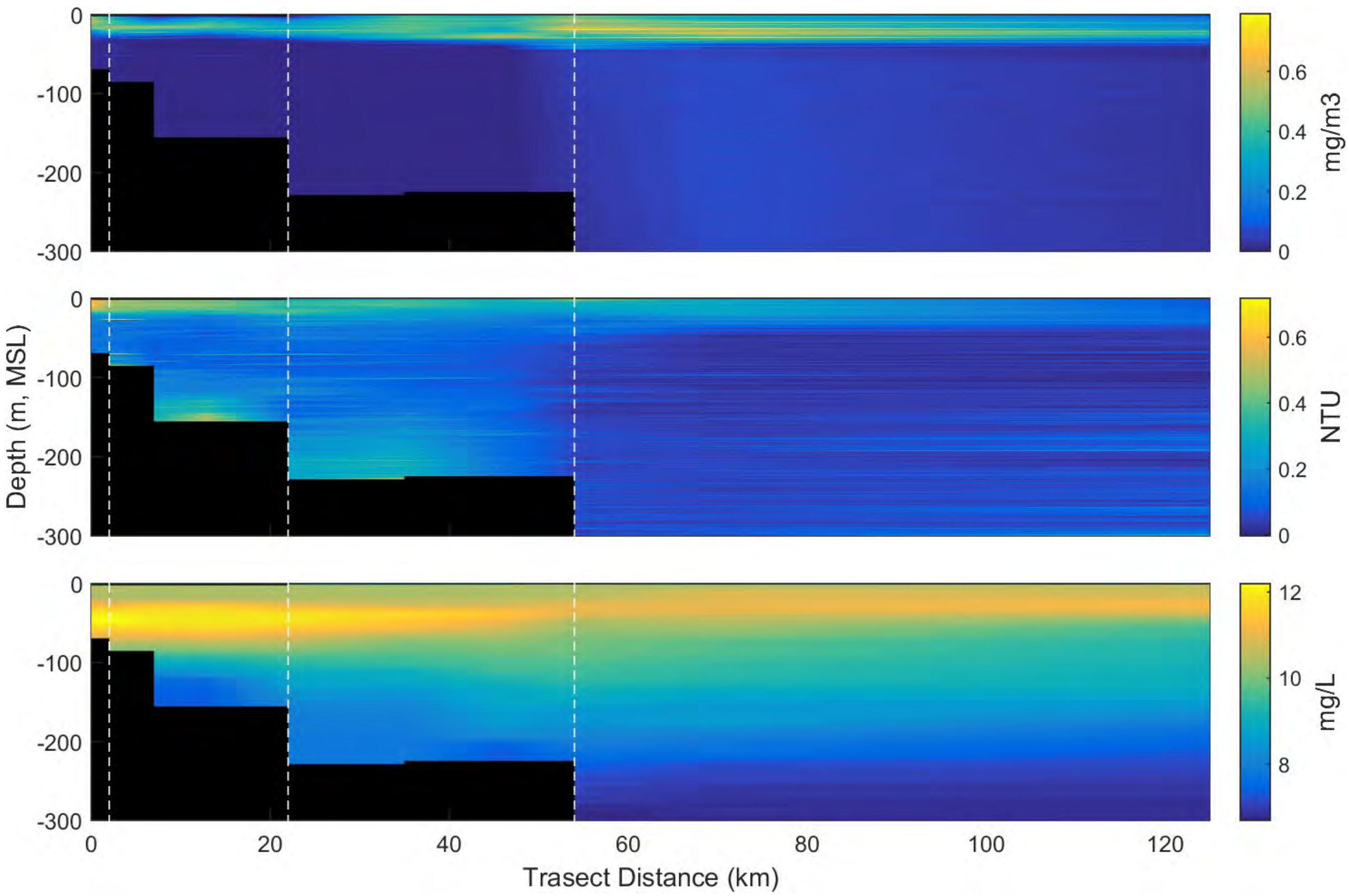


Figure 28: Cross-section of chlorophyll *a* (top), turbidity, and dissolved oxygen (bottom) between Milne Anchorage #01 (0km) and Pond Inlet (125km) as interpolated from CTD profiles taken in late September 2019 (Figure 2). Location of CTD profiles 02, 09, and 14 are shown as dashed white line left to right. Bottom depth is the maximum profiled depth.

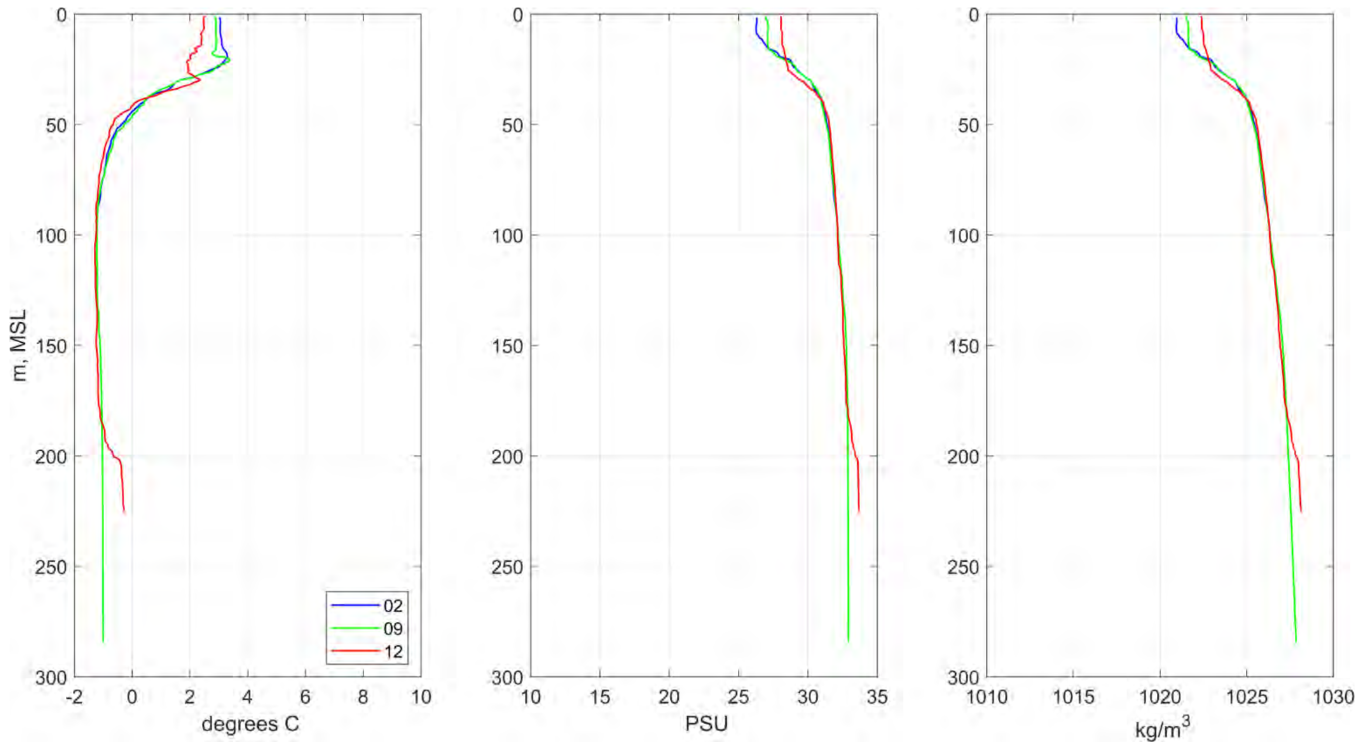


Figure 29: CTD profiles of temperature (left), salinity, and density (right) at location 02, 09, and 12 as shown in Figure 27 and Figure 2

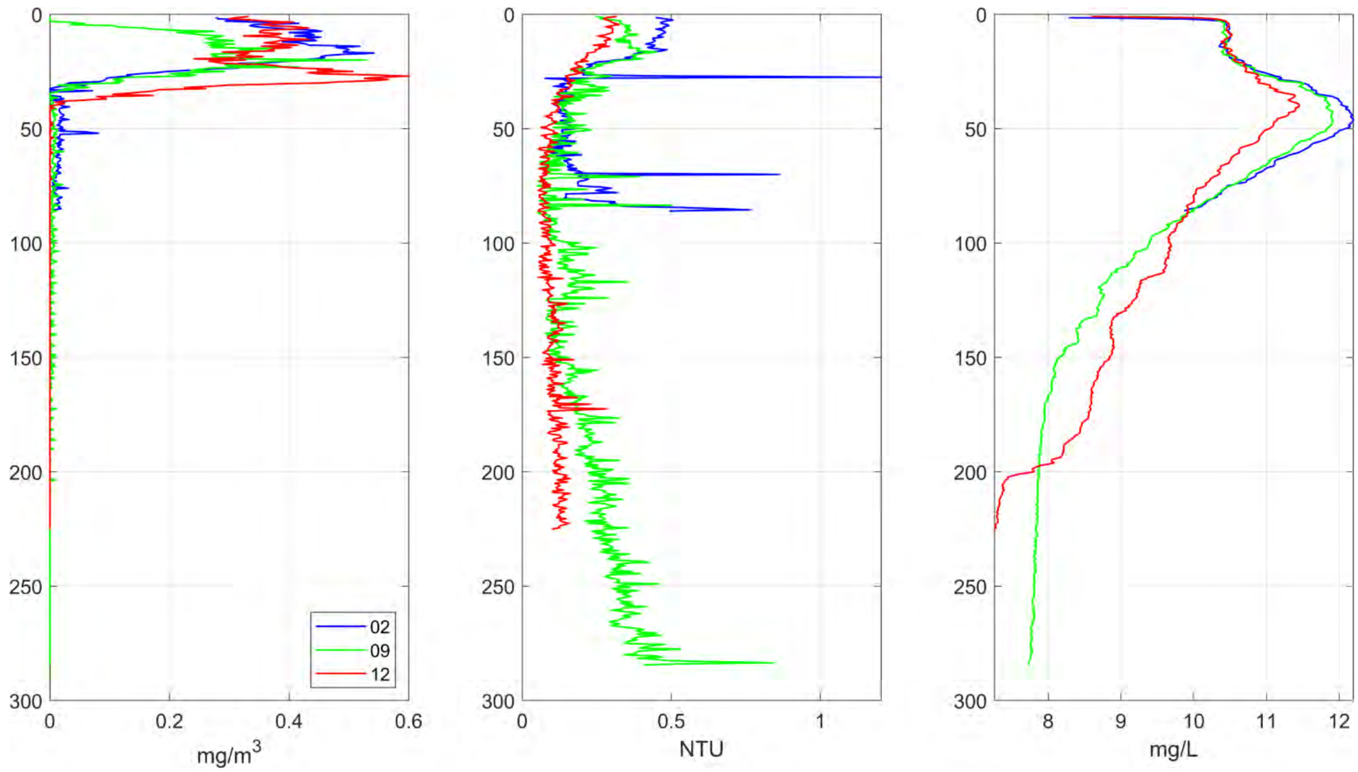


Figure 30: CTD profiles of chlorophyll *a* (left), turbidity, and dissolved oxygen (right) at location 02, 09, and 12 as show in Figure 28 and Figure 2

3.3.2 Milne Port and Bruce Head

Adjacent to Moorings

The CTD profiles conducted adjacent to oceanographic moorings for both mooring deployment and recovery are presented in Figure 31, Figure 32, and Figure 33. The locations of these profiles are presented in Figure 1.

According to the CTD profiles conducted during the mooring deployments in early August:

- The water at the surface appears to be influenced by fresh water, with a temperature of approximately 8 ˚C and a salinity of approximately 15-18 PSU.
- The temperature decreases and the salinity increases rapidly with depth from the surface to a depth of approximately -10 m MSL at all locations. This layer represents the pycnocline in early August.

According to the CTD profiles conducted during the mooring recoveries in late September:

- The temperature is relatively uniform at approximately 2-3 ˚C and the salinity is relatively uniform at approximately 26-28 PSU from the surface to a depth of approximately -15 m MSL for both Milne Port 01 and Bruce Head. This lack of stratification in temperature and salinity indicates a well-mixed surface layer.

- The temperature decreases and the salinity increases rapidly for both Milne Port 01 and Bruce Head from depths of approximately -15 m MSL to -40 m MSL. This layer represents the pycnocline in late September and is deeper than in early August.

At all locations, for both early August and late September, the temperature and salinity vary little with depth below the pycnocline and represent a well-mixed bottom layer of the water column as the pycnocline acts as a barrier to wind-generated circulation and mixing. The strongest currents are therefore expected above or at the pycnocline. The near-surface water is fresh and is likely from runoff, rain events, sea ice melt, snowmelt, and iceberg melt.

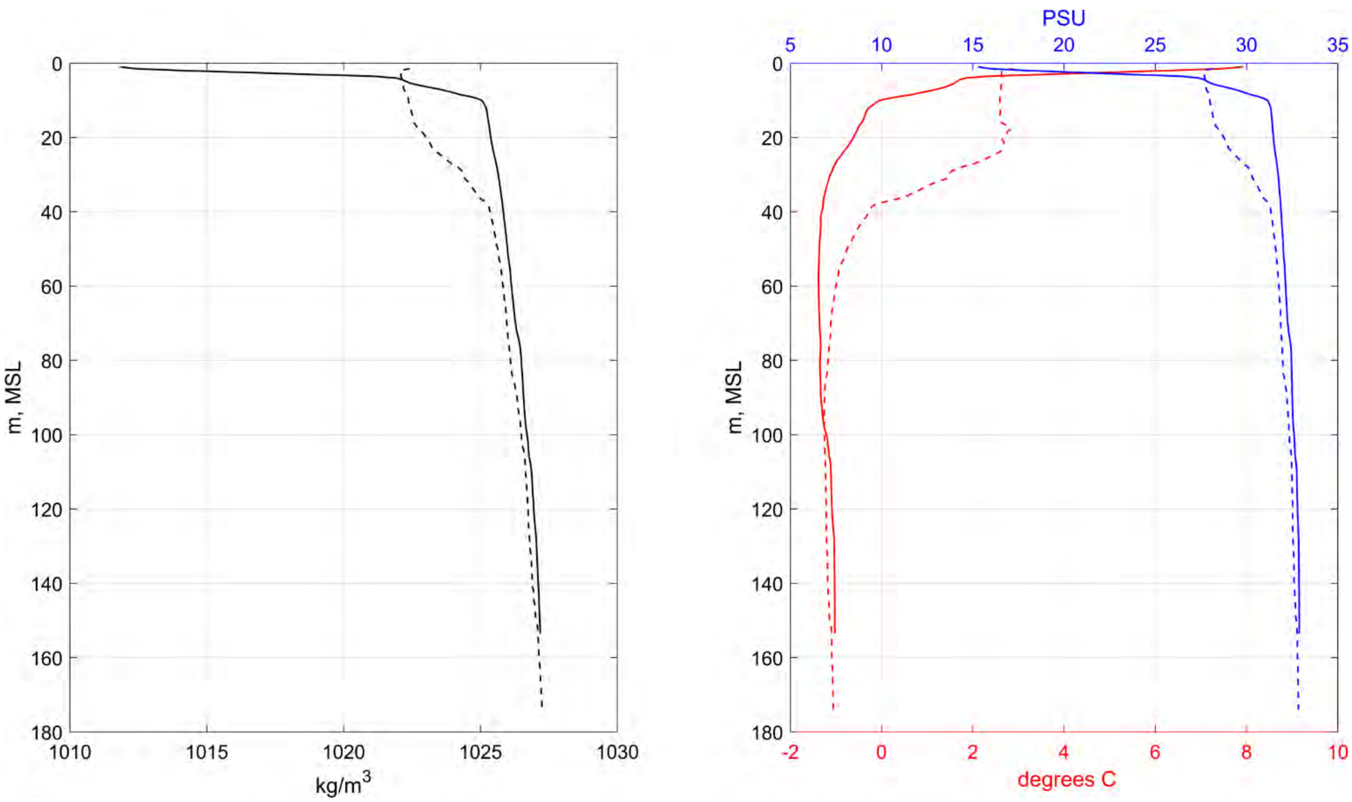


Figure 31: CTD profiles measured at the Bruce Head Mooring on August 05, 2019 (solid line) and September 28, 2019 (dashed line) in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

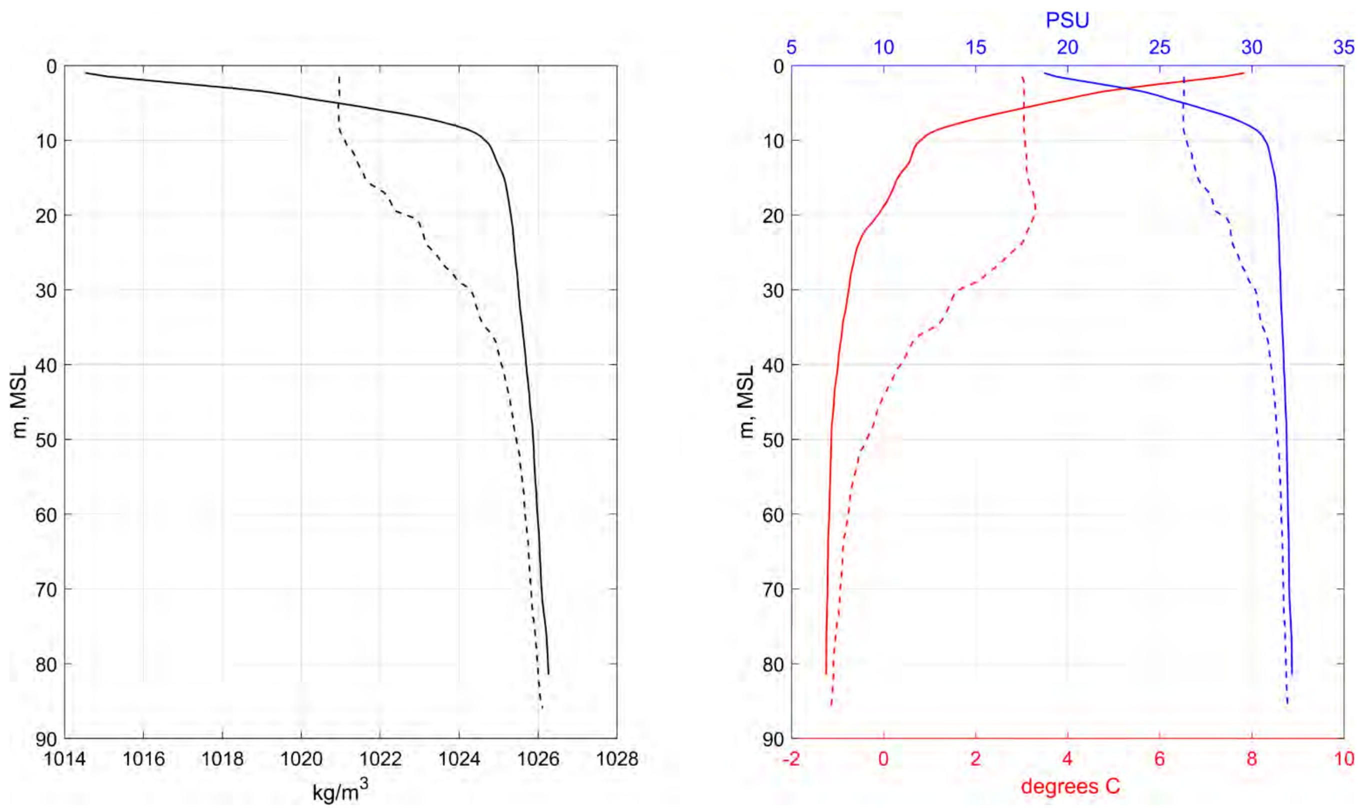


Figure 32: CTD profiles measured at the Milne Port 01 Mooring on August 07, 2019 (solid line) and September 30, 2019 (dashed line) in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

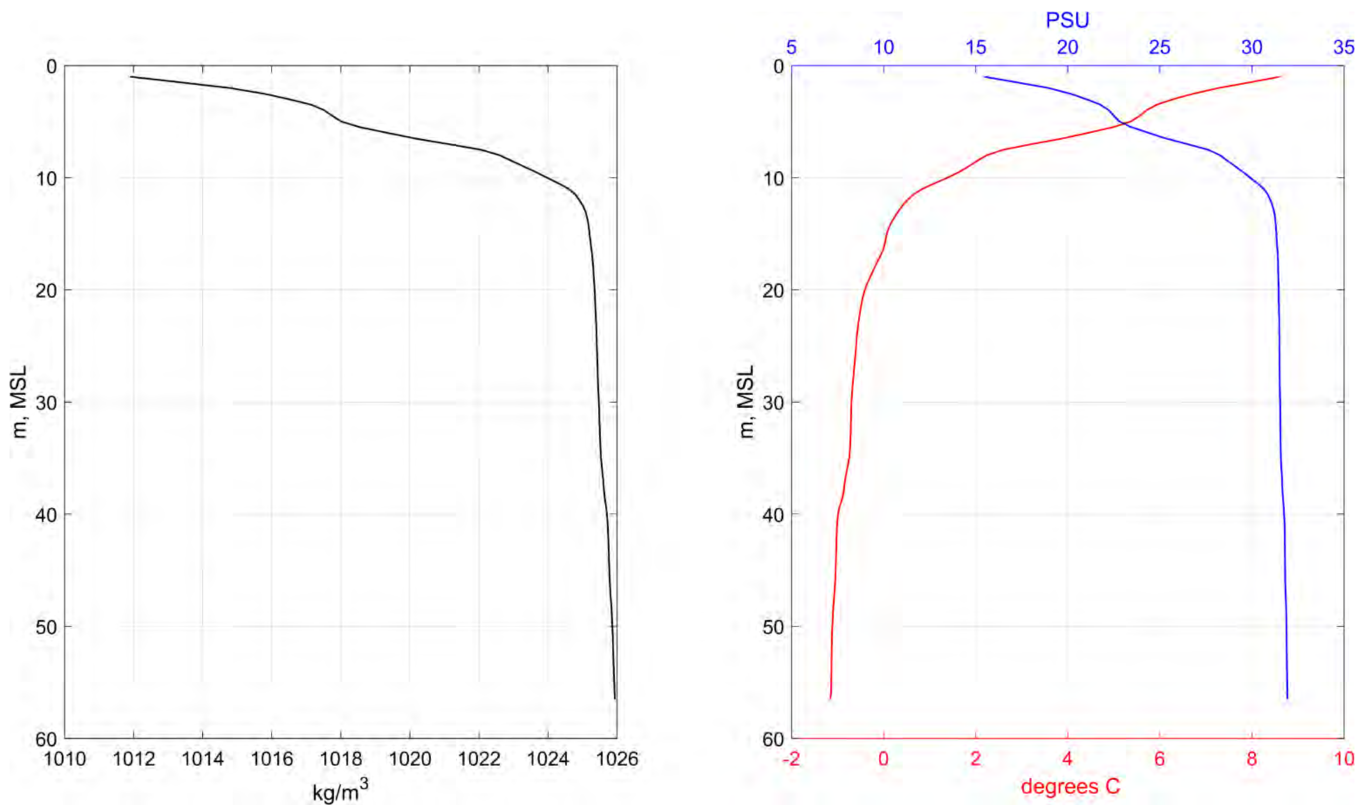


Figure 33: CTD profile measured at the Milne Port 02 Mooring on August 07, 2019 in UTC. Density is shown on the left plot x-axis while salinity and temperature are shown on the right plot x-axis. Depth is on the y-axis.

Near Milne Port

The CTD profiles conducted at select locations near Milne Port are presented in Figure 34, Figure 35, Figure 36, and Figure 37. The locations of these profiles are presented in Figure 1.

According to the CTD profiles conducted during the mooring deployments in early August:

- The water at the surfaces appears to be influenced by fresh water, with a temperature of approximately 8-9 ˚C and a salinity of approximately 17 PSU.
- The temperature decreases and the salinity increases rapidly with depth from the surface to a depth of approximately -10 m MSL. This layer represents the pycnocline in early August.

According to the CTD profile conducted during the mooring recoveries in late September:

- The temperature is relatively uniform at approximately 3 ˚C and the salinity is relatively uniform at approximately 25-26 PSU from the surface to a depth of approximately -15 m MSL. This lack of stratification in temperature and salinity indicates a well-mixed surface layer.
- The temperature decreases and the salinity increases rapidly from depths of approximately -15 m MSL to -40 m MSL. This layer represents the pycnocline in late September and is deeper than in early August.

At all locations, for both early August and late September, the temperature and salinity vary little with depth below the pycnocline and represent a well-mixed bottom layer of the water column as the pycnocline acts as a barrier to wind-generated circulation and mixing. The strongest currents are therefore expected above or at the pycnocline. The near-surface water is fresh and is likely from runoff, rain events, sea ice melt, snowmelt, and iceberg melt.

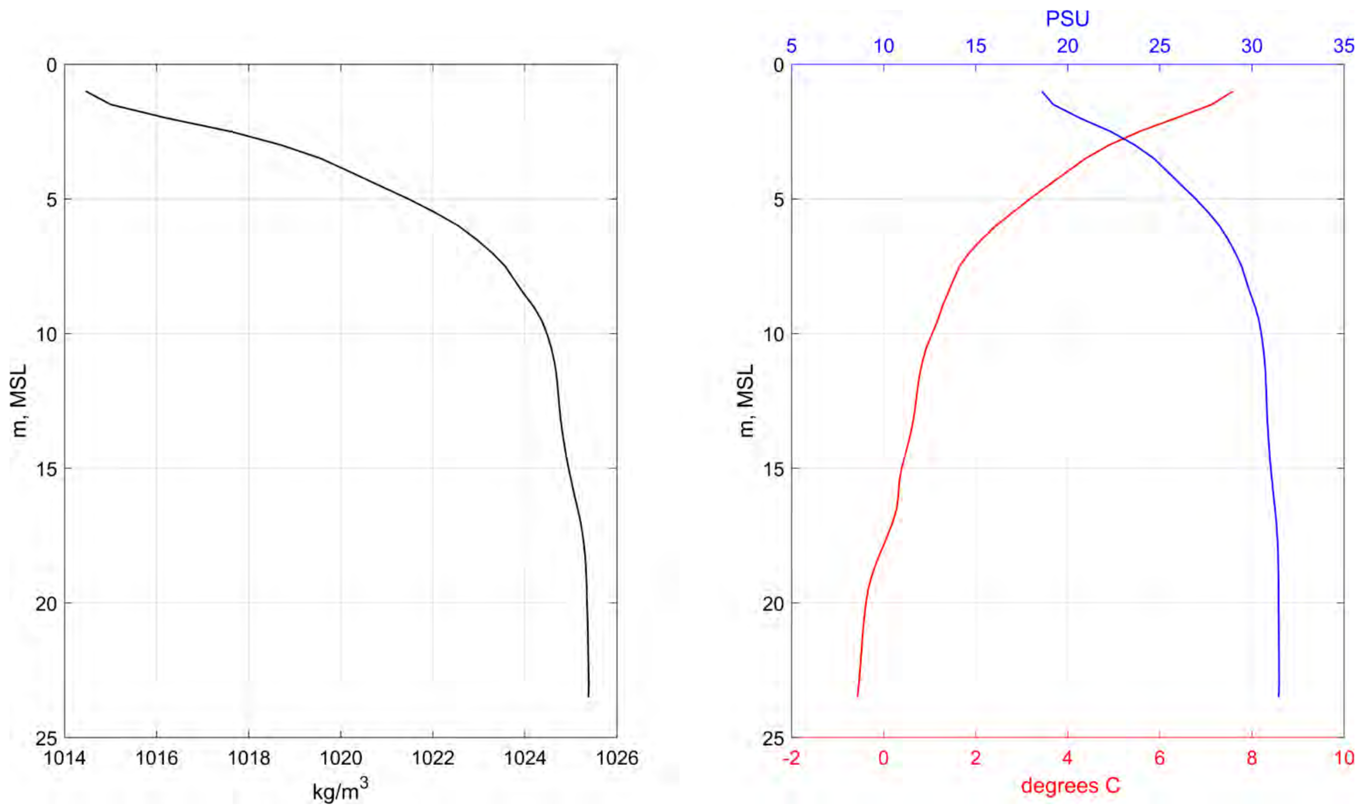


Figure 34: CTD profile measured at Site A on August 06, 2019 in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

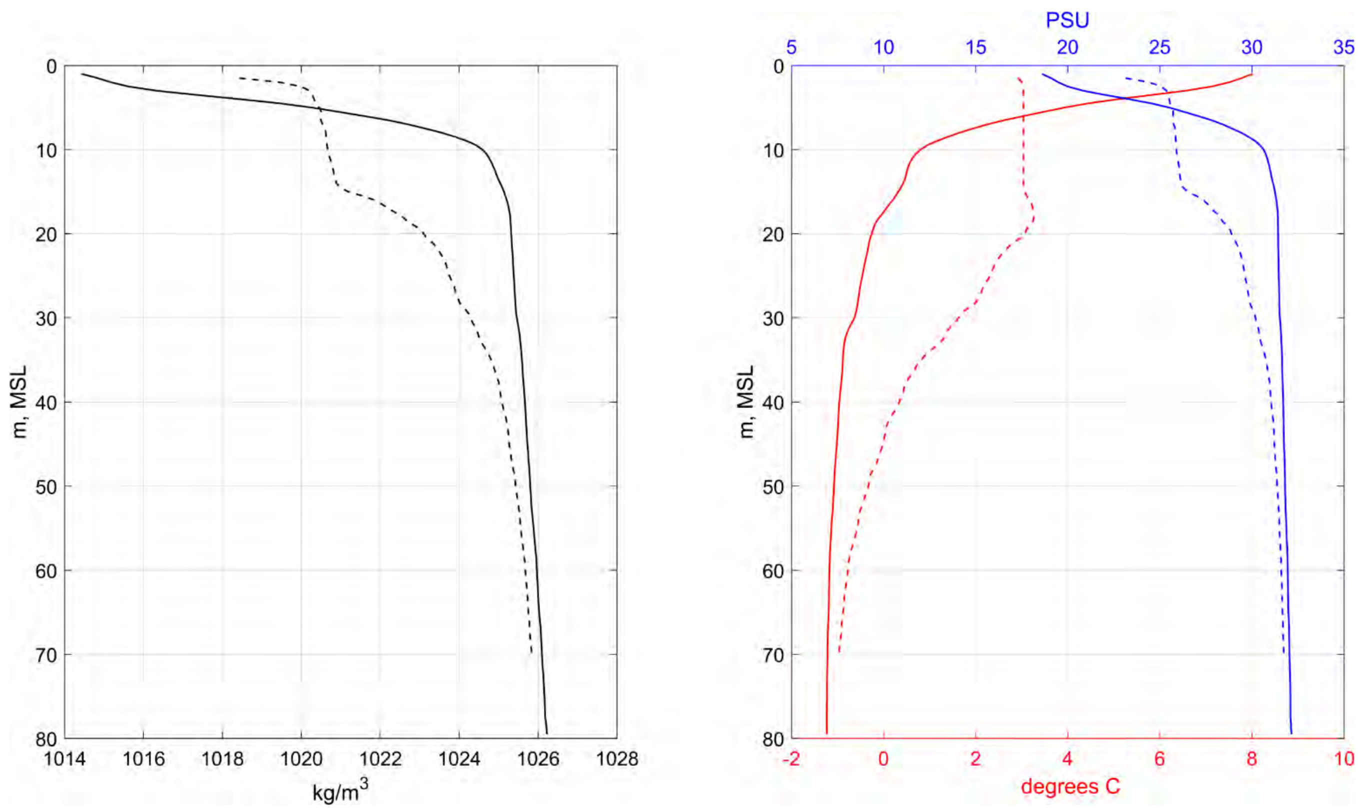


Figure 35: CTD profiles measured at the Site B on August 07, 2019 (solid line) and September 30, 2019 (dashed line) in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

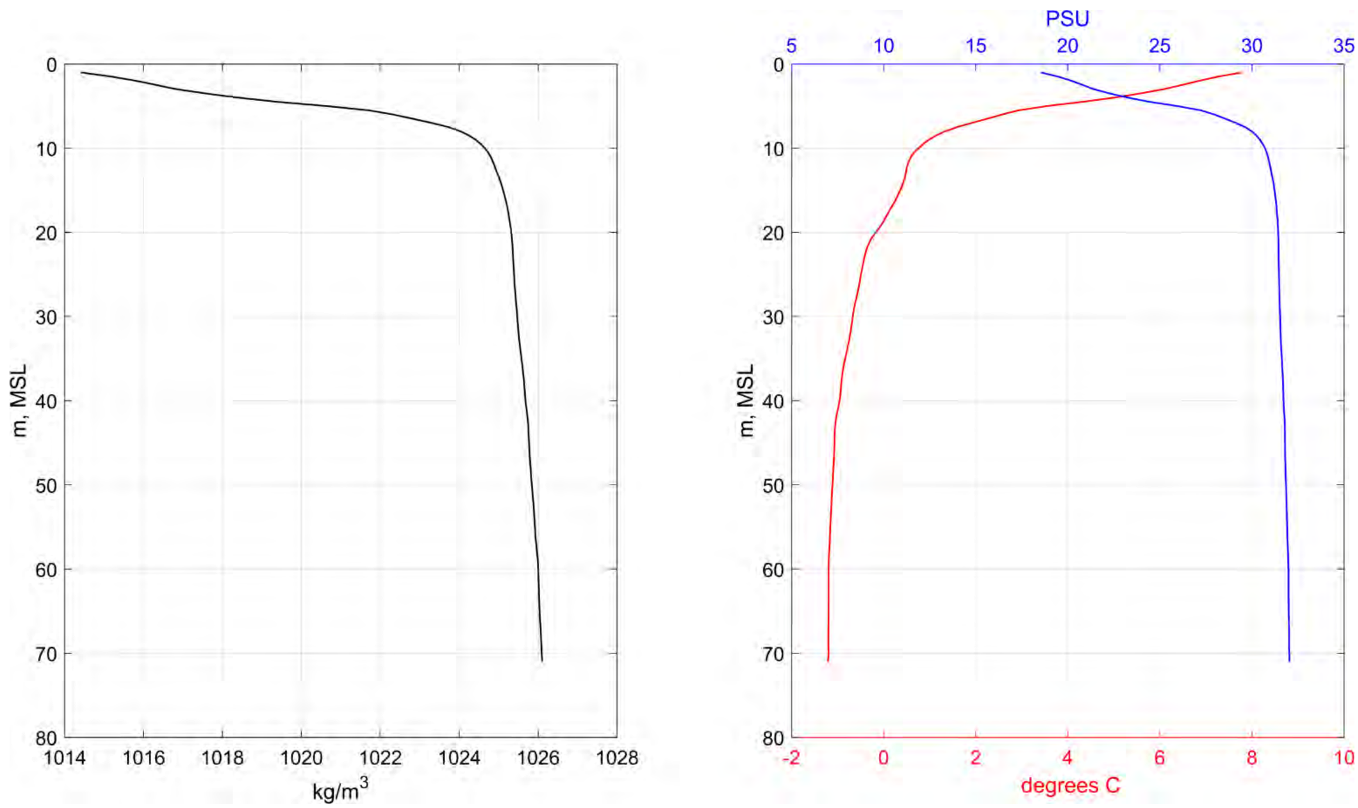


Figure 36: CTD profile measured at Site C on August 07, 2019 in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

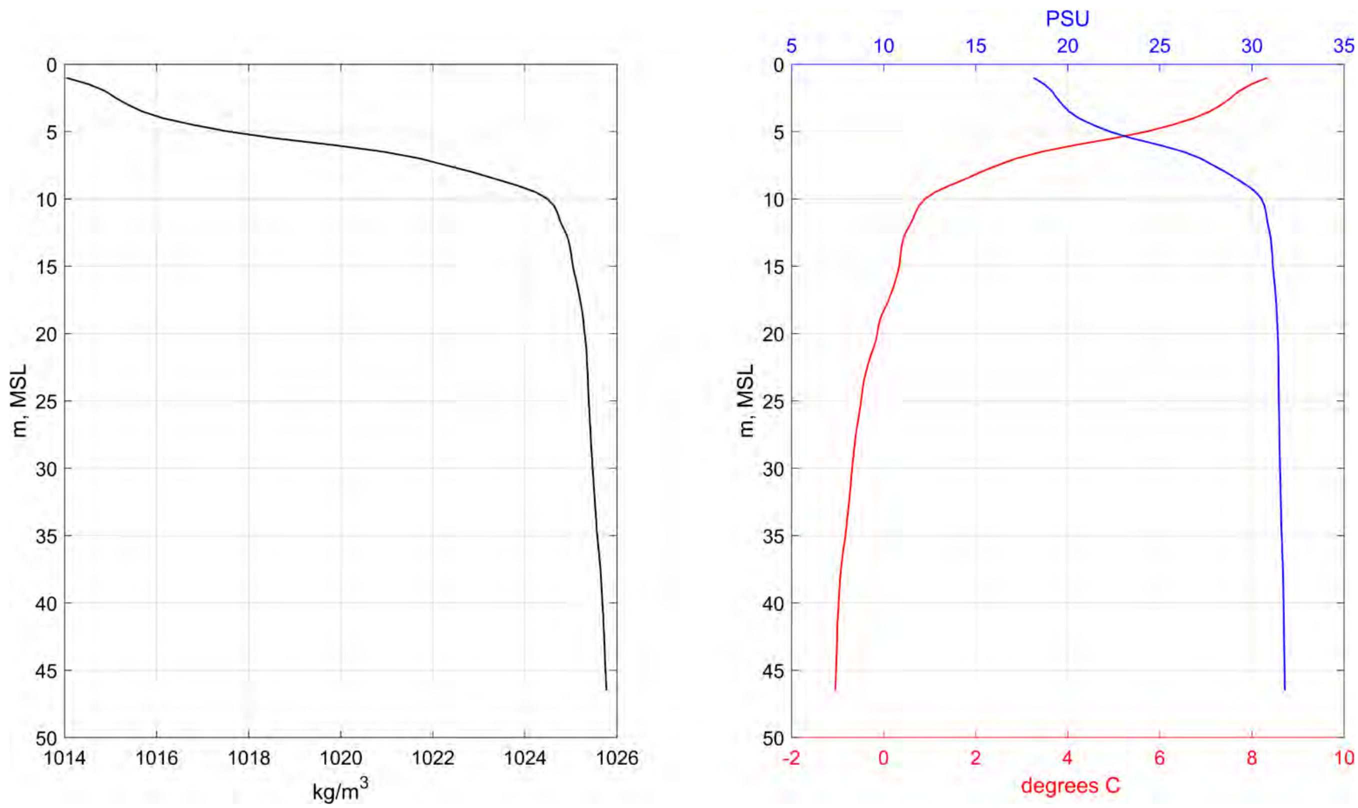


Figure 37: CTD profile measured at Site D on August 07, 2019 in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

3.3.3 Milne Port Ore Dock

The CTD profiles conducted adjacent to an ore carrier vessel berthed at the Milne Port Ore Dock before and during a ballast water discharge event on August 07, 2019 are presented in Figure 38 and Figure 39. The locations of these profiles are presented in Figure 1.

The CTD profiles conducted before and during the discharge both show that the water at the surfaces appears to be influenced by fresh water, with a temperature of approximately 8 ˚C and a salinity of approximately 18 PSU. The temperature decreases and the salinity increases rapidly with depth from the surface down to a depth of approximately -10 m MSL, representing the pycnocline. Below -10 m MSL (i.e. the pycnocline) the temperature and salinity vary little with depth and represent a well-mixed bottom layer of the water column. This is a result pycnocline acting as a barrier to wind-generated circulation and mixing. The near-surface water is fresh and is likely from runoff, rain events, sea ice melt, snowmelt, and iceberg melt.

Water column differences were observed between the before and during CTD profiles, this is shown as a slight freshening of the upper water column (i.e. warmer temperatures and lower salinities. Ballast water discharged during this event had a salinity of 32 PSU, which is higher than the ambient salinity in the water column. Therefore, ballast water discharge was unlikely to have driven the decrease in salinity. It is noted that CTD profiles taken during the discharge event were conducted approximately two hours after the CTD profiles taken before the discharge event. Therefore, the differences in the top 5m of the temperature and salinity profiles were likely due to changing physical processes such as increased runoff and melt in mid-day and wind and tidally-influenced surface mixing as the tidal stage changed from slack to flooding (see Figure 40).

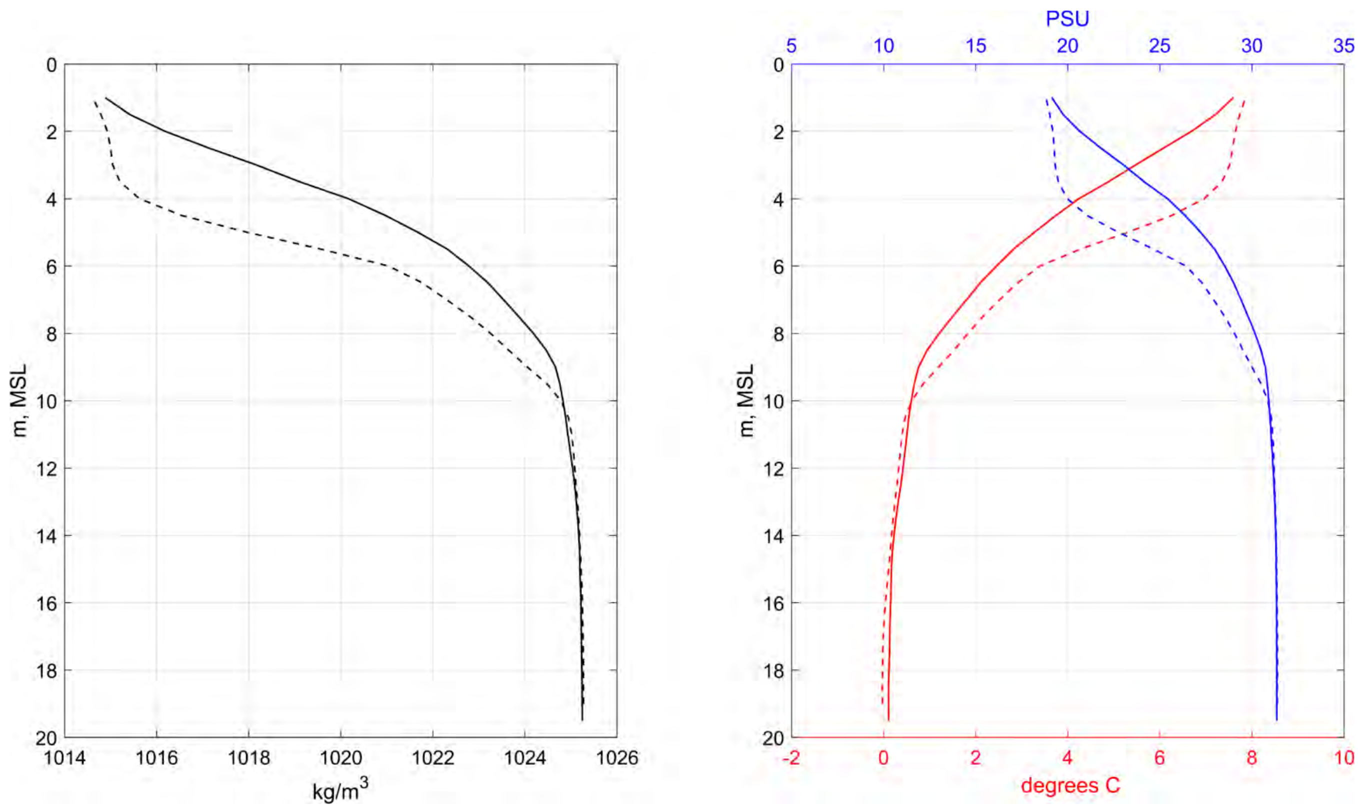


Figure 38: CTD profiles measured Before Discharge (B-01, solid line) and During Discharge (D-01, dashed line) on August 07, 2019 in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

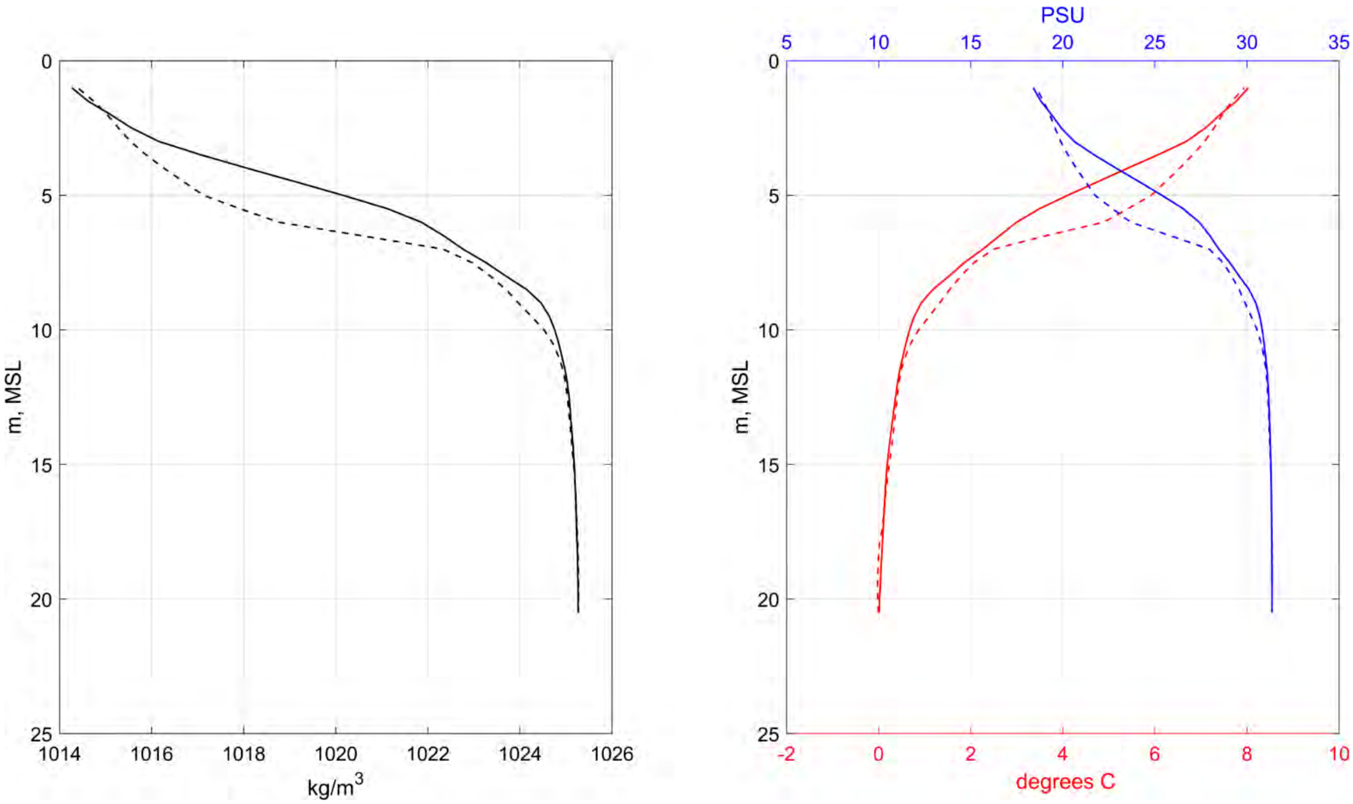


Figure 39: CTD profiles measured Before Discharge (B-02, solid line) and During Discharge (D-02, dashed line) on August 07, 2019 in UTC. Density is shown on the x-axis in the left plot while salinity and temperature are shown on the x-axes in the right plot. Depth is shown on the y-axis for both plots.

3.4 Tide Gauge

3.4.1 Data Collection

Time series of temperature, conductivity, salinity and water level referenced to CGVD as measured by the RBR at the Milne Port Ore Dock over the length of the deployment are shown in Figure 40. The red and blue dashed lines indicate the insets shown in Figure 41 and Figure 42. In the first month of the deployment the RBR measured large fluctuations in temperature and salinity: the temperature oscillated between 0 and 10 ˚C and the salinity between 1 and 30 PSU. This range is primarily the result of freshwater runoff accompanying the spring freshet combined with the melting of sea ice in Milne Inlet near Milne Port. After the spring freshet, the temperature and salinity timeseries stabilize and exhibits a smaller diurnal fluctuation. It is likely that these smaller diurnal fluctuations are wind and tidally driven surface mixing at the ore dock. In the fall, temperatures in Milne Port begin to cool while wind speed typically increases, such that the surface layer becomes well mixed with layers below, resulting in generally colder and more saline surface waters. This is clearly observable in the temperature and salinity measurements from September 01 to the end of the deployment (Figure 40). During the deployment the RBR measured seven spring tide and eight neap tide events. The proximity of the ballast water discharge to the RBR location is shown in Figure 43.

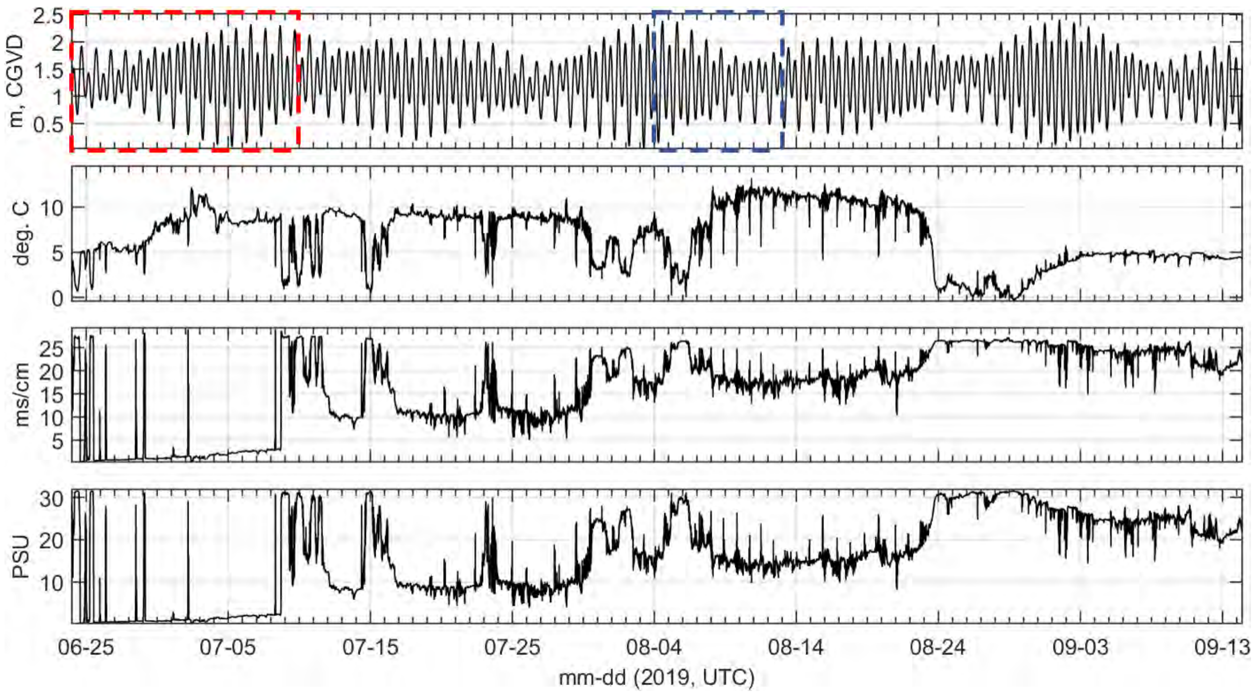


Figure 40: Time series of water level, temperature, conductivity, and salinity measured at Milne Port Tide Gauge by the RBRconcerto CTD from June 23 to September 14, 2019 in UTC. The red and blue dashed lines indicate the insets for Figure 41 and Figure 42.

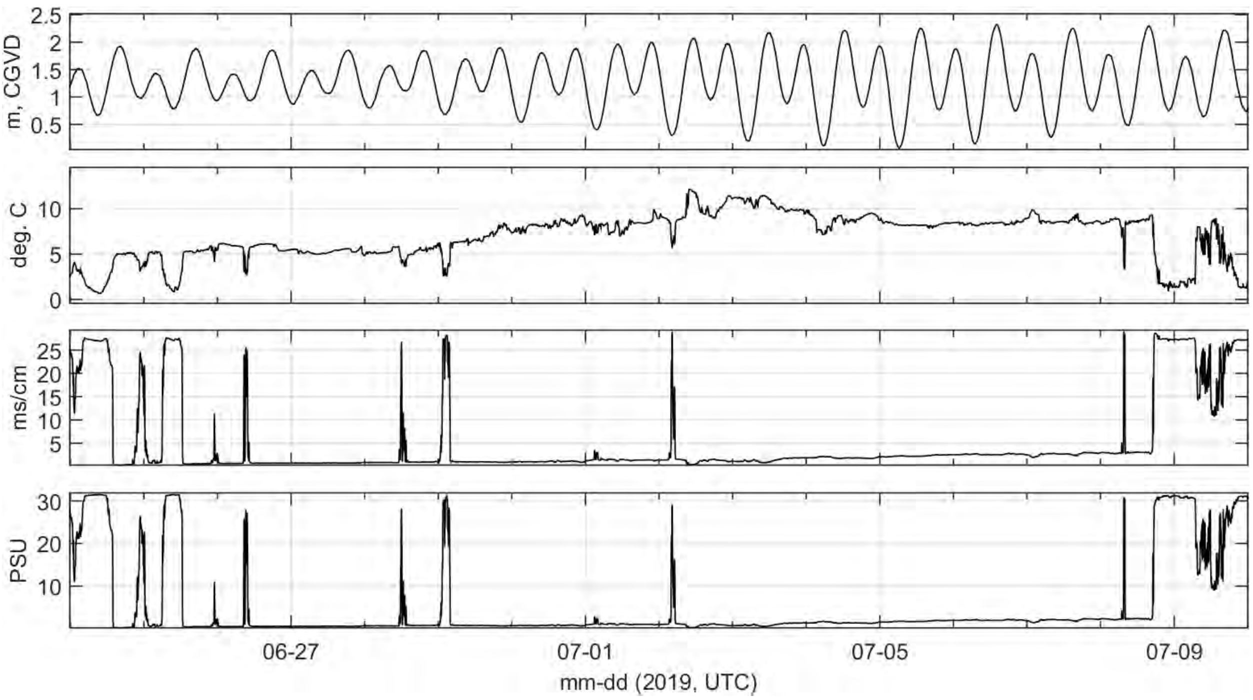


Figure 41: Time series of water level, temperature, conductivity, and salinity measured at Milne Port Tide Gauge by the RBRconcerto CTD from June 23 to July 10, 2019 in UTC.

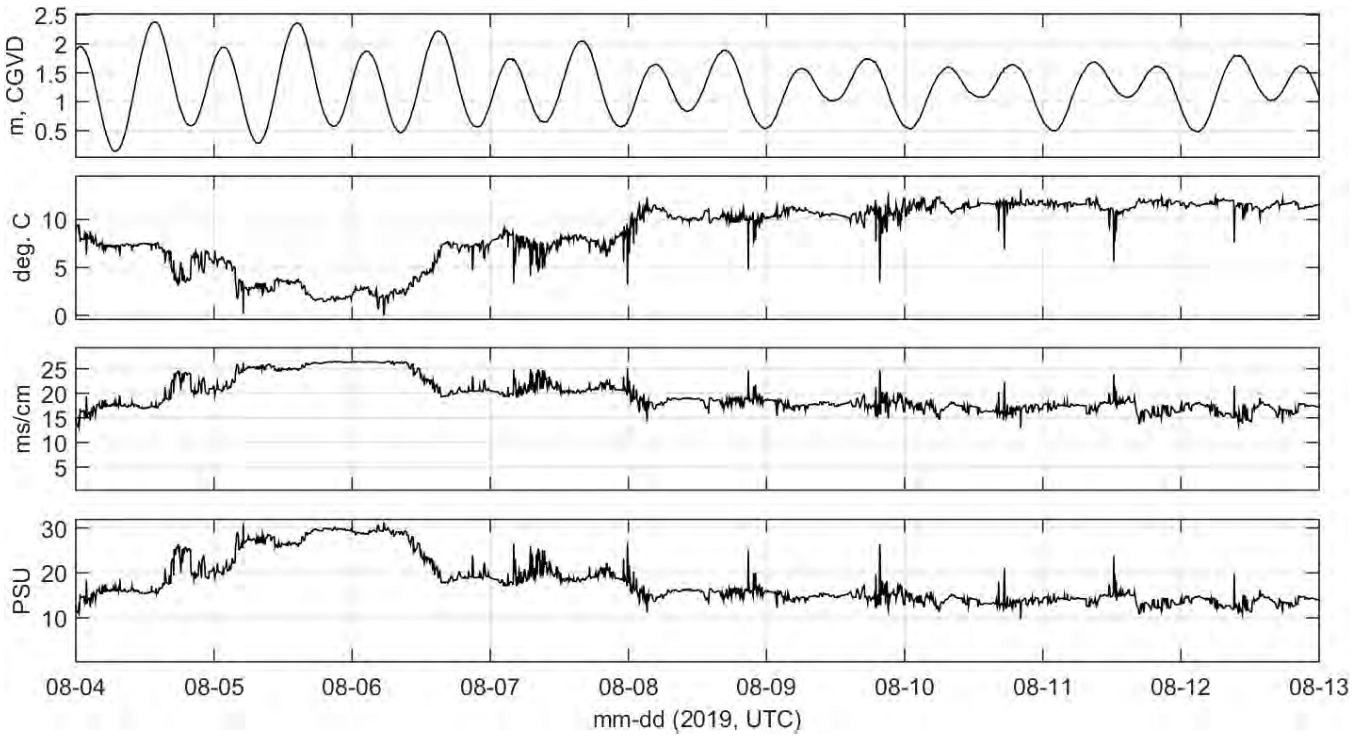


Figure 42: Time series of water level, temperature, conductivity, and salinity measured at Milne Port Tide Gauge by the RBRconcerto CTD from August 04 to August 13, 2019 in UTC. The red lines indicate periods when ore vessels were berthed adjacent to the tide gauge.

Figure 43: Ballast water release adjacent to the ore dock on August 07, 2019 at 14:30 UTC.

3.4.2 Tidal and Hydrological Data Review

A tidal water level monitoring program for Milne Inlet (hereafter the Inlet) was carried out in 2018 to extend the tidal water level dataset over two years (2017 and 2018) and to provide insight into relative sea level and storm surges at the Project Site. The extension of the program to two years provides annual time series of water levels through two open water periods. Golder has previously carried out a desktop review of sea-level rise (SLR) and relative land uplift/subsidence rates for the region to provide background information and context for tidal water level monitoring (Golder 2018).

3.4.2.1 Existing tidal water level monitoring data

The existing tidal water level monitoring station at the Site is located at Milne Port. Data is available for the open water seasons of 2017 and 2018 (Golder 2017, 2018). A summary of the monitoring periods is presented in Table 1.

Table 20: Tide Gauge Summary

Monitoring Season	Start Date	End Date	Tide Gauge Installed Elevation (m, CGVD)
Season 2017	20-Jul-2017	17-Oct-2017	6.31
Season 2018	30-Jun-2018	19-Oct-2018	6.42

The tidal water level gauge installed at the Site also measures temperature, conductivity, salinity in addition to water level. The recorded water quality data suggests that temperature and salinity typically fluctuate diurnally early in the open water season. This is likely a result of combined daily inputs of freshwater sourced from melting sea ice in the Inlet and spring freshet flows on streams feeding the Inlet, such as Phillips Creek (Golder 2018). Temperature and salinity are more stable after the spring freshet, but diurnal fluctuations are still apparent and are likely caused by upwelling and downwelling at the Site during conditions with high windspeeds and/or tidal forcing. At the end of autumn, temperature and salinity are relatively stable, indicating well-mixed water conditions in the Inlet and lower inputs of freshwater from Phillips Creek (Golder, 2018).

3.4.2.2 SLR Projections at Milne Inlet using Sea Level Projections

SLR projections for the region around Milne Inlet are available from the Geological Survey of Canada (GSC). The GSC used global positioning system (GPS) measurements of vertical land motion combined with projections of future climate conditions to produce sea-level projections for 59 locations in Canada through the 21st century, relative to 1986-2005 (James et al. 2014). The climate projections developed by the GSC are based on the Representative Concentration Pathway (RCP) scenarios of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). They include contributions from thermal expansion of the ocean, land ice melting and discharge, and anthropogenic influences. The regional SLR projections developed by the GSC that are relevant to Milne Inlet are summarized in Table 21.

Table 21: SLR Stations and the median SLR for RCP2.6 and RCP8.5

Location	GPS ID	Lat	Long	SLR RCP2.6 (cm)	SLR RCP8.5 (cm)
Eureka, NU	EUR2	79.9933	-85.8498	-47.3	-45.5
Igloolik, NU	IGLO	69.3738	-81.8021	-84.4	-72.9
Qikiqtarjuaq, NU	QIKI	67.5526	-64.0175	-17.3	-12.4
Resolute, NU	RESO	74.7156	-94.9616	-35.9	-26
Iqaluit, NU	IQAL	63.7573	-68.6140	-15.7	-1
Baker Lake, NU	BAKE	64.3109	-96.0330	-76.8	-56.9

Golder reviewed the regional projections for SLR developed by the GSC and completed an analysis to estimate 21st century SLR projections at the Site. The analysis considered the six stations from the GSC report nearest to the Inlet (Table 21). Output from the RCP2.6 scenario (low RCP) and RCP8.5 scenario (high RCP) were used to provide a range of potential SLR (Table 22). SLR at the Inlet was estimated by interpolating SLR values at the six stations using two methods: Inverse Distance Weighted and Triangulation. The outcomes of the interpolation of SLR are presented in Table 22.

Table 22: SLR Projection Estimations at site (cm) (for 2081-2100 relative to 1986-2005)

Location	Latitude (decimal degrees)	Longitude (decimal degrees)	SLR RCP2.6 (IDW / TIN)	SLR RCP8.5 (IDW / TIN)
Milne Inlet	71.886	-80.908	-77.2 / -71.0	-66.3 / -62.2
Mean SLR Projection			-74.1	-64.3

The results of the analysis suggest that sea level can be expected to drop by the year 2081-2100 between approximately 74.1 cm and 64.3 cm relative to sea levels observed in 1986-2005 (Table 3). This is equivalent to an annual rate of sea level change of approximately -7.4 mm/yr for the RCP2.6 scenario, and approximately -6.4 mm/yr for the RCP8.5 scenario.

3.4.2.3 Geodetic Surveys at Milne Port

The survey of geodetic control benchmarks at Milne Port was ongoing at the time this report was written; therefore, no data were available for review and the surveys were not included in the analysis.

3.5 Analysis of Storm Events

Data collected during a strong southerly wind event and a sustained northerly wind event was analyzed to assess the response of physical oceanographic parameters in Milne Inlet, near Milne Port and Bruce Head. At both locations, the response of current speed and direction to wind forcing is clear.

3.5.1 August 23, 2019

Figure 44 shows the wind speed and direction and current speed at Milne Port 01 and Bruce Head mooring during a strong southerly wind event that occurred between August 22 and August 24, 2019. During the event, the maximum wind speed peaked at approximately 26 m/s and the wind direction was from the south-southeast. Figure 45 shows the current speed and direction at select bin depths on the Milne Port 01 mooring during the wind event. It’s clear that the surface flows are wind driven (i.e. unimodal and flowing to the north) and the deeper flows are more isolated from wind forcing (i.e. bimodal and flowing north-south). It is likely that the pycnocline helps isolate the deeper water from wind mixing, though no CTD profiles exist for this exact period to confirm the depth of the pycnocline. Looking at the depth-average flows in Figure 44 the maximum current speed is flowing to the north and correlates well with the maximum observed wind speed. During weak southerly winds (i.e. first day of the wind event) there is no dominant current direction, but during strong southerly winds (i.e. second day of the wind event) there is a dominant northerly current direction. This suggests that during weak wind events, even events with a dominant wind direction, the current speed and direction is due to a combination of tidal and wind forcing. However, during strong wind events, the current speed and direction in the upper water column is primarily wind driven.

To further illustrate the wind mixing in Milne Inlet, temperature and salinity measured on the Bruce Head, Milne Port 01 and Milne Port 02 moorings and the tide gauge during the wind event are shown in Figure 46. The near surface temperature and salinity oscillate more than the temperature and salinity at depth, and measurements taken below approximately -35m MSL appear to show little variation. Starting on August 23 the upper water column begins to mix, as seen by the tightening of temperature and salinity values between various depths, and large oscillations in temperature and salinity over minutes and hours suggest fluctuations of the pycnocline (i.e. internal waves).

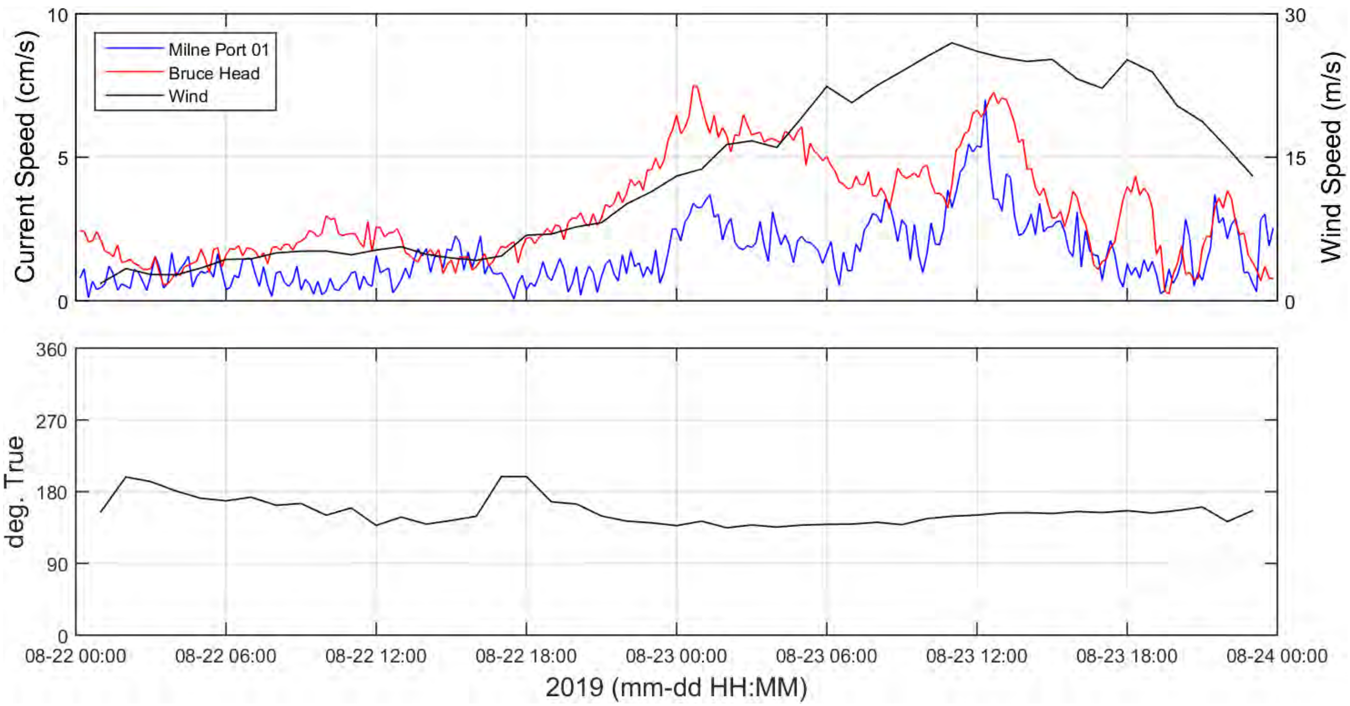


Figure 44: Full water column depth average current speed measured at Milne Port 01 mooring, partial water column depth average at Bruce Head mooring and wind speed (top) and wind direction (bottom) measured at Milne Port meteorological station from August 22 to August 24, 2019 in UTC

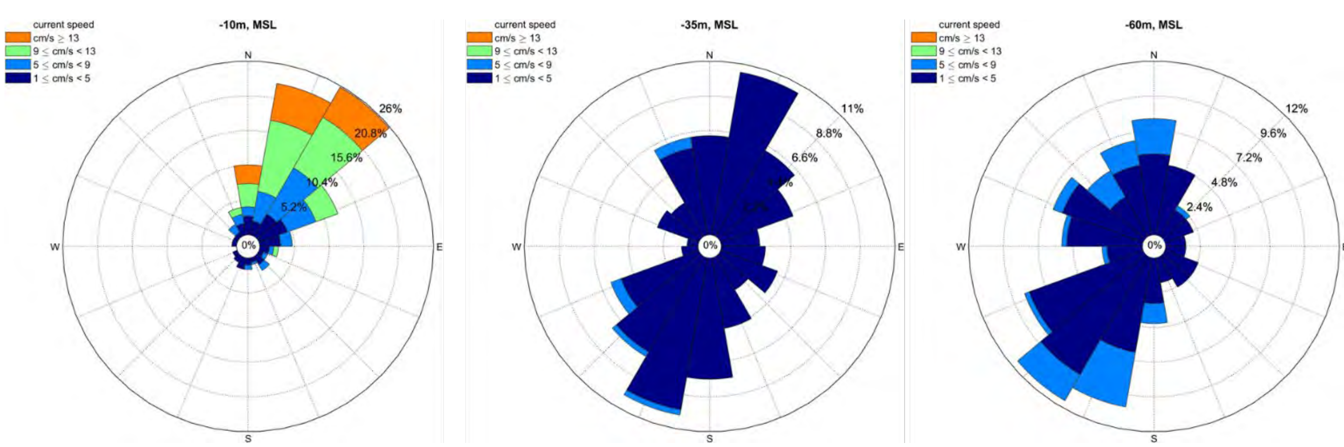


Figure 45: Current roses for select bin depths measured at 10, 35, and 60 m below MSL the Milne Port 01 mooring by the 600 kHz up-looking and 600 kHz down-looking ADCPs from August 22 to August 24, 2019 in UTC

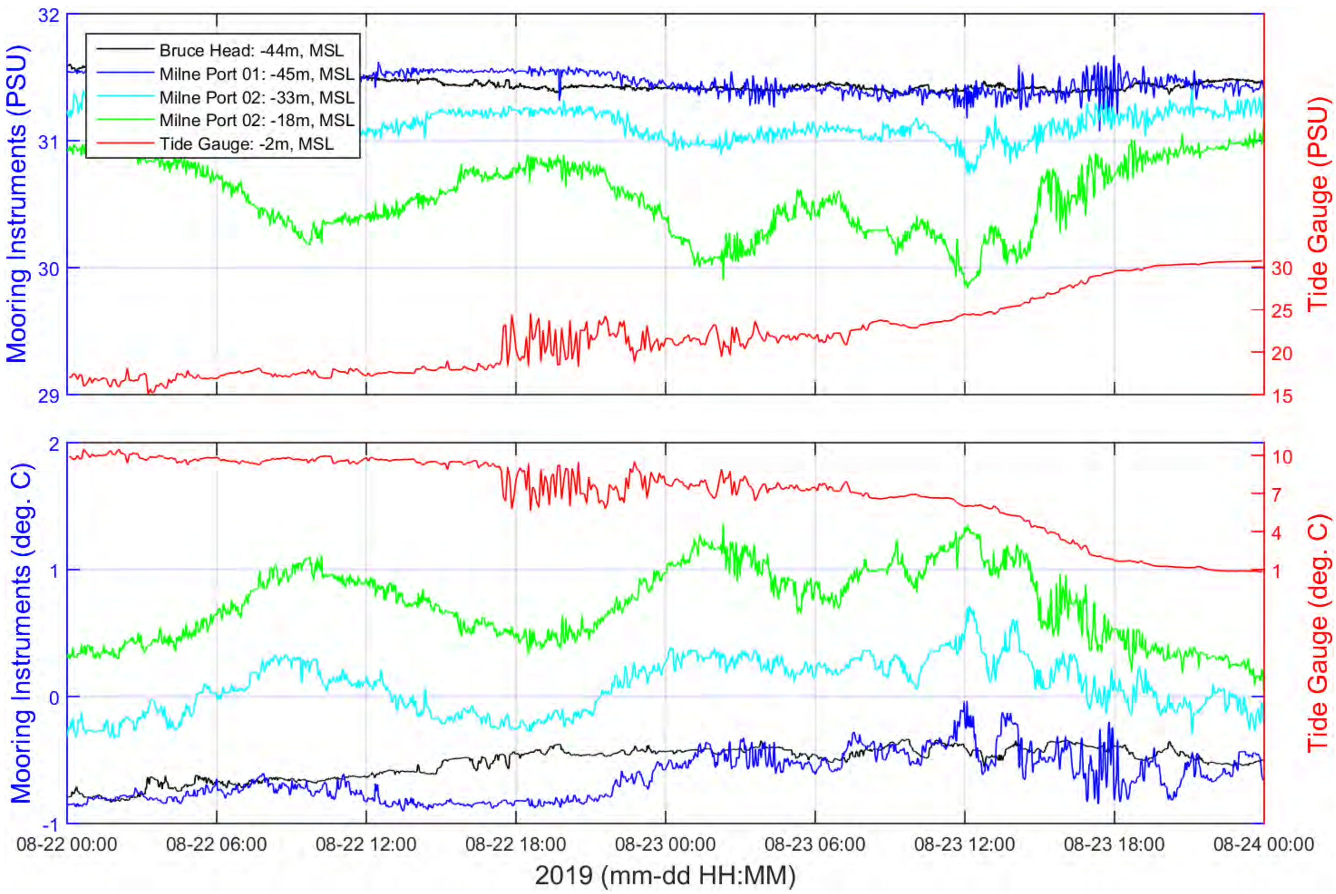


Figure 46: Time series of temperature (top) and salinity (bottom) measured by instruments on the subsurface moorings and the tide gauge from August 22 to August 24, 2019 in UTC

3.5.2 September 02, 2019

Figure 47 shows the wind speed and direction and current speed measured at Milne Port 01 and Bruce Head moorings during a northerly wind event that occurred between September 05 and September 07, 2019. During the event, wind speeds were not particularly strong, maximum of 6m/s, and the wind direction was sustained from the north-northeast. Figure 48 shows the current speed and direction at select bin depths on the Milne Port 01 mooring during the wind event. It's clear that the surface and mid-water column flows are wind driven (i.e. unimodal and flowing to the south) and the near-bed flows are more isolated from wind forcing (i.e. bimodal and flowing north-south). In September, following a cooling of the air temperature, the depth of the pycnocline has likely increased compared to August, though no CTD profiles exist for this exact period to confirm the depth of the pycnocline. This means mid-water column flows are no longer isolated from wind mixing, as seen by the apparent wind driven flow at -35m MSL in September compared to a bimodal flow at the same depth in August. Looking at the depth-average flows in Figure 47 the current directions are generally to the south, inline with the wind direction. Additionally, only small increases in wind speed are needed to generate peaks in current speed throughout the water column as compared to August, again an artifact of the upper water column becoming well mixed.

To further illustrate the wind mixing in Milne Inlet, temperature and salinity measured onboard the Bruce Head, Milne Port 01 and Milne Port 02 moorings and the tide gauge during the wind event are shown in Figure 49. During this period there is a general increase in salinity and decrease in temperature at all depths, except at the tide gauge where large minute and hourly scale fluctuations dominate. It's likely that the upper water column in this period is well mixed, this can be interpreted by smaller fluctuations in temperature and salinity as compared to the same depths in August.

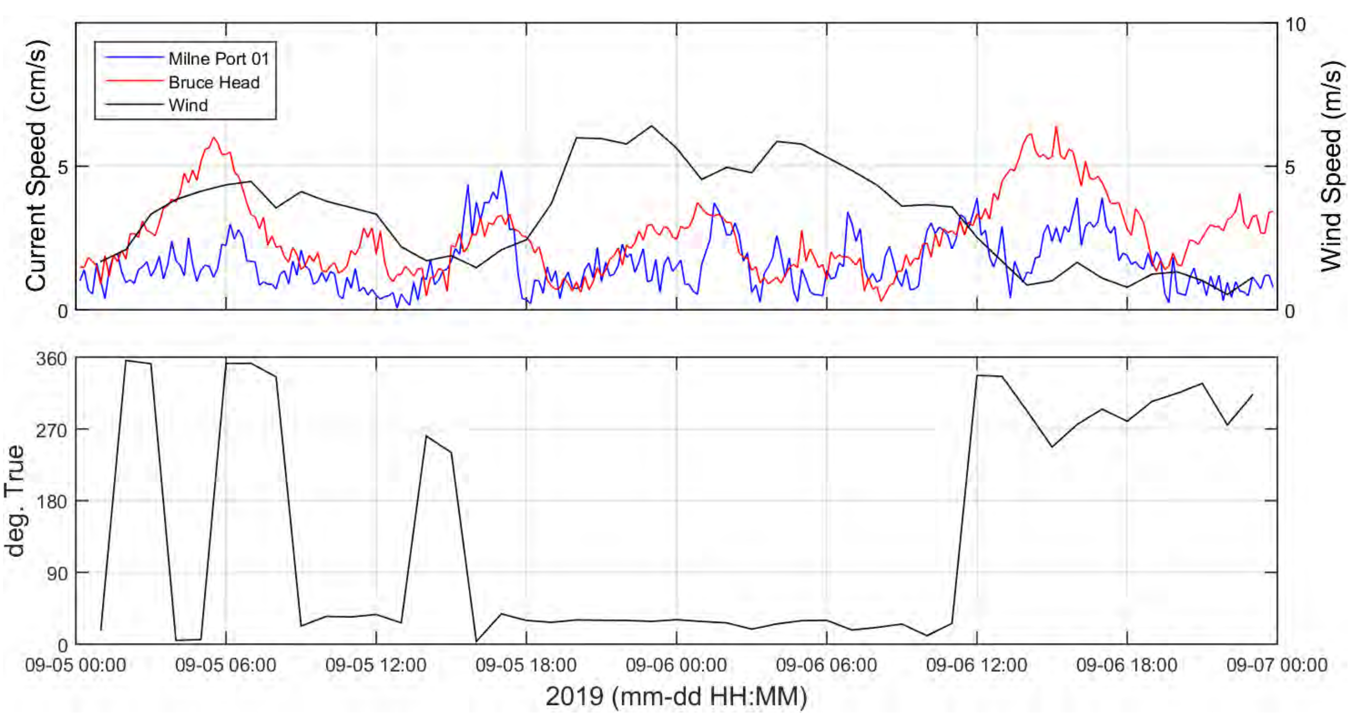


Figure 47: Full water column depth average current speed measured at Milne Port 01 and Bruce Head moorings and wind speed (top) and wind direction (bottom) measured at Milne Port meteorological station from September 05 to September 07 2019 in UTC

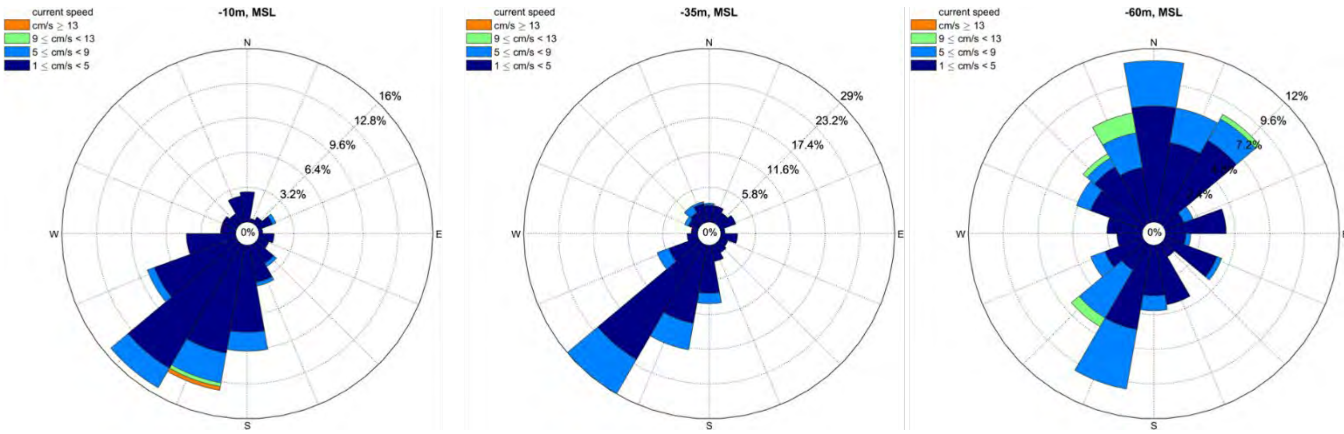


Figure 48: Current roses for select bin depths measured at 10, 35, and 60 m below MSL the Milne Port 01 mooring by the 600 kHz up-looking and 600 kHz down-looking ADCPs from September 05 to September 07, 2019 in UTC

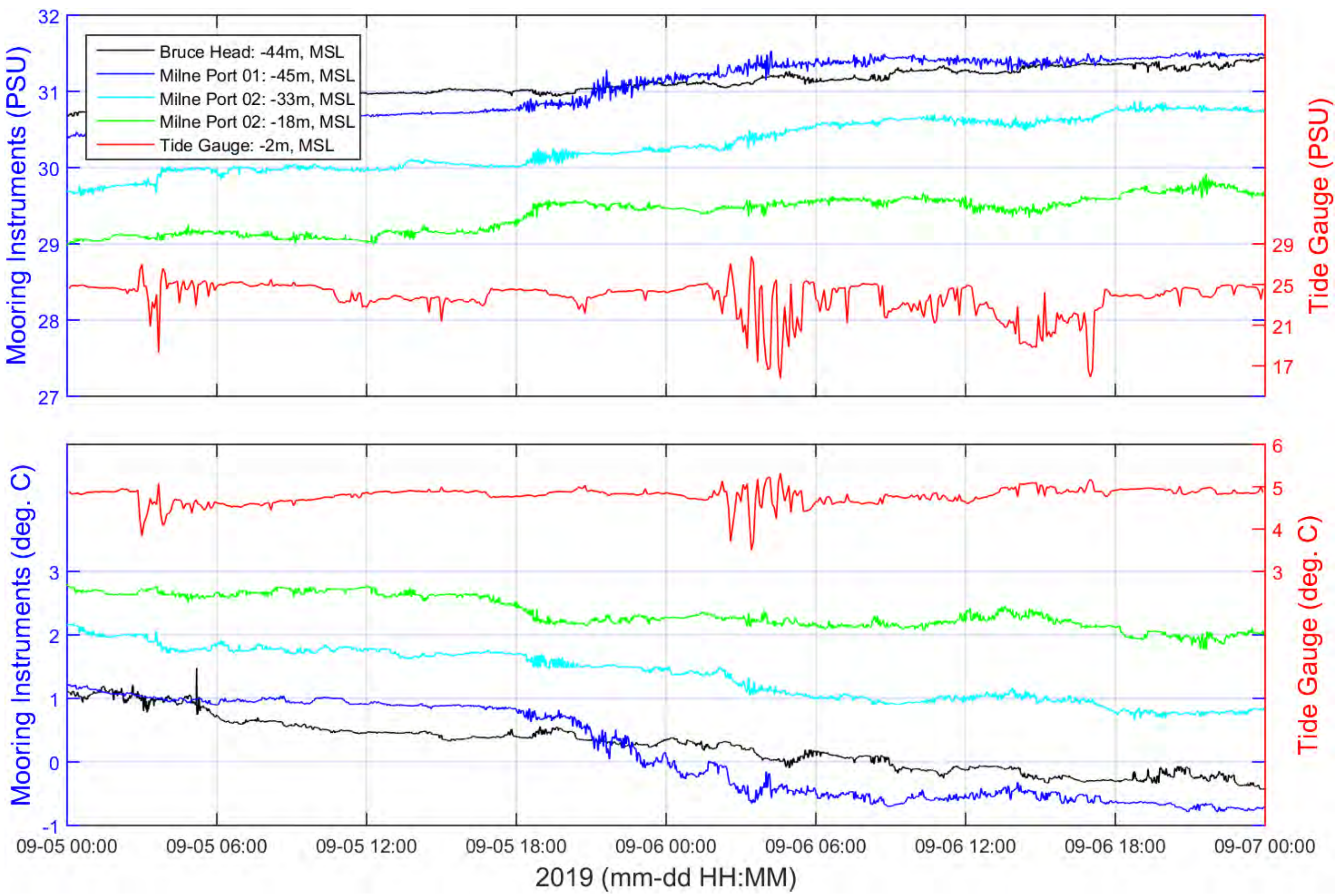


Figure 49: Time series of temperature (top) and salinity (bottom) measured by instruments on the subsurface moorings and the tide gauge from September 05 to September 07, 2019 in UTC

4.0 CONCLUSIONS AND RECOMMENDATIONS

The measurements collected during the 2019 Physical Oceanographic monitoring program support the following conclusions and recommendations:

- In general, Milne Inlet has weak current speeds (i.e. less than 15 cm/s). Since the ADCPs have uncertainty on the order of a few cm/s there is some uncertainty in measuring such weak currents. Steps have been taken to confirm the quality of the measurements and to improve future measurements.
- Wind is the primary driver of flows in Milne Inlet and to a lesser extent tide. This is illustrated by current speed and direction responding to both northerly and southerly wind events.
- Measurements of current speed and direction agree well with conceptual understanding during storm events, giving confidence to measurement techniques.
- In early August, Milne Inlet is strongly stratified from the surface to a depth of approximately -20m MSL. Below this depth, the water column is nearly constant in temperature and salinity and other physiochemical properties.
- In late September, Milne Inlet is well mixed from the surface to approximately -15m MSL and stratified from approximately -15m MSL to -40m MSL. Changing atmospheric conditions in September (i.e. colder temperature and more intense northerly winds) lead to a break down of near surface stratification.
- In later June and early July, near the peak of the Phillips Creek freshet, the surface water at the head of Milne Inlet has a freshwater lens, as indicated by very fresh water measured at Milne Port ore dock. The depth of this freshwater lens decreases as freshet slows and eventually is fully mixed with the waters of Milne Inlet (i.e. well mixed layer in September).
- Analysis of available data on land uplift/subsidence rates in Nunavut suggest that the land is glacially rebounding and therefore sea level rise is unlikely at Milne Port. However, further analysis of storm surge at Milne Port should be completed now that a mult-year time series of water level elevations exists.

5.0 DATA DELIVERABLE

In addition to this report, Golder is issuing the oceanographic data that was processed and quality checked following the methods described in Section 2.0. The data are provided as text files. All dates and times are reported in UTC time. The data include the following files:

Bruce Head Mooring

- ‘BH_012948_RBR_Calculated Parameters.txt’
- ‘BH_300_20766_Ancillary Parameters.txt’
- ‘BH_300_20766_BinDepth.txt’
- ‘BH_300_20766_CurrentDirection.txt’

- ‘BH_300_20766_CurrentSpeed.txt’
- ‘BH_300_20766_EAA.txt’
- ‘BH_300_20766_VelocityEast.txt’
- ‘BH_300_20766_VelocityNorth.txt’

Milne Port 01 Mooring

- ‘MI_600_21100_Ancillary Parameters.txt’
- ‘MI_600_21100_BinDepth.txt’
- ‘MI_600_21100_CurrentDirection.txt’
- ‘MI_600_21100_CurrentSpeed.txt’
- ‘MI_600_21100_EAA.txt’
- ‘MI_600_21100_VelocityEast.txt’
- ‘MI_600_21100_VelocityNorth.txt’
- ‘MI_600_21674_Ancillary Parameters.txt’
- ‘MI_600_21674_BinDepth.txt’
- ‘MI_600_21674_CurrentDirection.txt’
- ‘MI_600_21674_CurrentSpeed.txt’
- ‘MI_600_21674_EAA.txt’
- ‘MI_600_21674_VelocityEast.txt’
- ‘MI_600_21674_VelocityNorth.txt’
- ‘MI_12345_SBE_Calculated Parameters.txt’

Milne Port 02 Mooring

- ‘MI_11252_SBE_Calculated Parameters.txt’
- ‘MI_12344_SBE_Calculated Parameters.txt’

August CTD Profiles

- ‘1_CTD_cast.txt’
- ‘2_CTD_cast.txt’

- ‘5_CTD_cast.txt’
- ‘6_CTD_cast.txt’
- ‘7_CTD_cast.txt’
- ‘8_CTD_cast.txt’
- ‘9_CTD_cast.txt’
- ‘11_CTD_cast.txt’
- ‘12_CTD_cast.txt’
- ‘13A_CTD_cast.txt’
- ‘B-01_CTD_cast.txt’
- ‘B-02_CTD_cast.txt’
- ‘B-03_CTD_cast.txt’
- ‘B-04_CTD_cast.txt’
- ‘Bruce-Head_Aug_CTD_cast.txt’
- ‘D-01_CTD_cast.txt’
- ‘D-02_CTD_cast.txt’
- ‘D-03_CTD_cast.txt’
- ‘D-04_CTD_cast.txt’
- ‘Milne-Port-01_Aug_CTD_cast.txt’
- ‘Milne-Port-02_Aug_CTD_cast.txt’
- ‘Milne Anchorage_CTD_cast.txt’
- ‘Milne Ore Dock_CTD_cast.txt’
- ‘Ragged Island W_CTD_cast.txt’
- ‘Stephens Island_CTD_cast.txt’
- ‘Site-A_CTD_cast.txt’
- ‘Site-B_Aug_CTD_cast.txt’
- ‘Site-C_CTD_cast.txt’
- ‘Site-D_CTD_cast.txt’

September CTD Profiles

- '2_CTD_cast.txt'
- '6_CTD_cast.txt'
- '7_CTD_cast.txt'
- '9_CTD_cast.txt'
- '10_CTD_cast.txt'
- '12_CTD_cast.txt'
- '14_CTD_cast.txt'
- '16_CTD_cast.txt'
- 'Milne-Port-01_Sep_CTD_cast.txt'
- 'Site-B_Sep_CTD_cast.txt'
- 'Milne Anchorage_CTD_cast.txt'
- 'Pond Inlet_CTD_cast.txt'
- 'Ragged Island N_CTD_cast.txt'

Milne Port Tide Gauge

- 'MP_CTD_60550_RBRconcerto_2019_Calculated Parameters.txt'

6.0 CLOSURE

This report presents the results of the 2019 Physical Oceanographic Monitoring Program for Milne Inlet. We trust the information contained in this report is sufficient for your present needs. Should you have any additional questions regarding the project, please do not hesitate to contact the undersigned.

Golder Associates Ltd.

David Hurley, MASc
Coastal Designer and Modeller

Phil Osborne, PhD, PGeo
Principal, Senior Coastal Geomorphologist

DH/PO/lih

7.0 REFERENCES

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APPENDIX A

Calibration Documents

RBR

rbr-global.com

RBR Limited, 95 Hines Road, Unit 5, Kanata, Ontario, K2K 2M5, Canada
Tel: +1 613 599 8900 Fax: +1 599 8929 info@rbr-global.com

XR-420 CT № 12948

Conductivity Calibration Certificate

Test Resistance	Cond. mS/cm	Voltage Ratio	Residuals mS/cm
open	0.0000	-0.000677	-0.0013
331.923	10.1536	0.087109	-0.0009
150.010	22.4666	0.193575	0.0009
100.014	33.6974	0.290674	0.0013
75.014	44.9278	0.387766	0.0015
55.510	60.7136	0.524228	0.0000
47.015	71.6837	0.619064	-0.0007
39.098	86.1991	0.744552	-0.0009

Logger Setup

Calibration Coefficients:

C0=	0.076978308
C1=	115.6684183
C2=	0
C3=	0

Correction Coefficients:

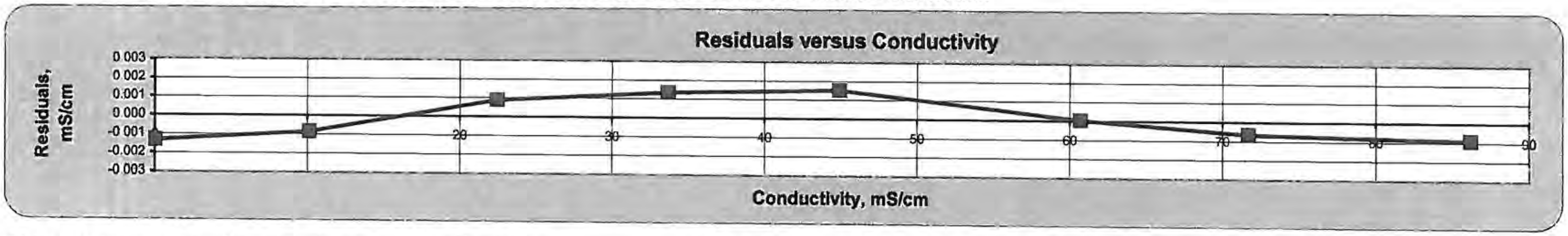
a=	0.000121
b=	0.00010
Tc=	15.0

Logger Conductivity =C0+C1*Vc+C2*Vc^2+C3*Vc^3

Residuals=Logger conductivity-Resistance loop conductivity

Corrected conductivity=[Logger conductivity-b*(T-Tc)]/[1+a*(T-Tc)+c*P]

Conductivity correction coefficients work with Ruskin and RBRWS v.6.13 software



Measurements in Baths:	T15S35	T25S35
Voltage Ratio =	0.370575	0.4730089
Bath Temperature,ITS-90=	15.01106	26.5551
Bath Salinity, PSS-78=	35.0113	35.0073
Bath Conductivity, mS/cm=	42.9408	54.7119

Zero Conductivity to Temperature Test:

Voltage Ratio=	-0.0006674	-0.000647
Temperature,°C=	0.5	23.5

Cell Constant @T15S35= 3370.211

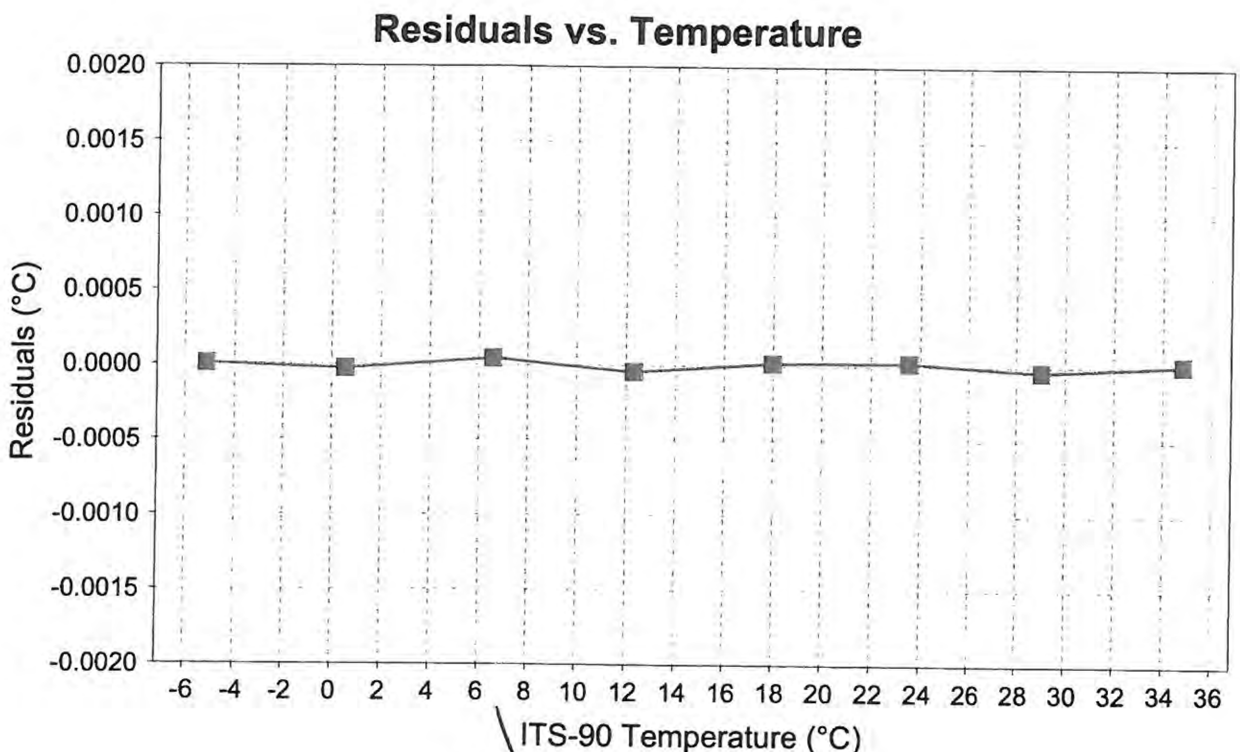
Calibration Date: 23-Sep-15

Operator: [signature]

RBR Temperature Calibration Certificate

Logger ID: XR-420 Serial No: 012948 Channel No: 2

ITS-90 Temp	Voltage Ratio	Residuals	Coefficients
-5.14873	0.726138	0.00001	0.003480582362126
0.54515	0.662701	-0.00003	-0.000254566418590
6.57552	0.591275	0.00004	0.000002574878350
12.29877	0.522232	-0.00004	-0.000000068496136
17.97536	0.455222	0.00002	
23.54442	0.393069	0.00002	
29.04747	0.336660	-0.00003	
34.82294	0.283762	0.00001	



Operator Signature: ____________________

Operator Name: mluong

Calibration Date: 21/Sep/2015
Print Date:
Calibration ID: 10492

RBR Calibration Shipping Certificate

Calibration values for all channels when shipped.

Logger ID: XR-420   Serial No: 12948

2015/Sep/23 14:56:46
1: 0.076978308000000 115.668418300000000 0.000000000000000 0.000000000000000
2: 0.003480582362126 -0.000254566418590 0.000002574878350 -0.000000068496136

Operator: ____________________

25/Sep/2015

Richard Brancker Research Ltd.   27 Monk St., Ottawa, Canada K1S 3Y7 (613) 233-1621

RBR Pressure Calibration Certificate

RBRconcerto C.T.D|fast6 s/n: 60550
Sensor rating: 50 dbar s/n: H130848
Nominal accuracy: 0.05%FS (0.025 dbar)
Reference instrument: Mensor CPC6000 s/n: 612676

Applied pressure, P_{app} (dbar)	Voltage ratio, V	Measured pressure, P_{meas} (dbar)	Calibration error (dbar)
10.0256	0.056476	10.0263	0.0007
15.0000	0.076760	14.9989	-0.0011
20.0001	0.097159	19.9999	-0.0002
25.0001	0.117555	25.0003	0.0002
30.0000	0.137949	30.0004	0.0004
35.0001	0.158342	35.0006	0.0005
40.0002	0.178733	40.0002	0.0000
45.0001	0.199124	44.9997	-0.0004
50.0001	0.219517	49.9999	-0.0002
55.0001	0.239909	54.9998	-0.0003
60.0001	0.260305	60.0004	0.0003

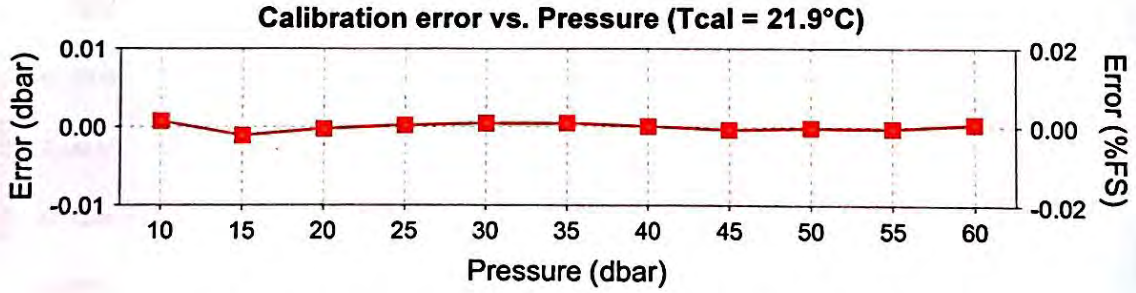
Coefficients

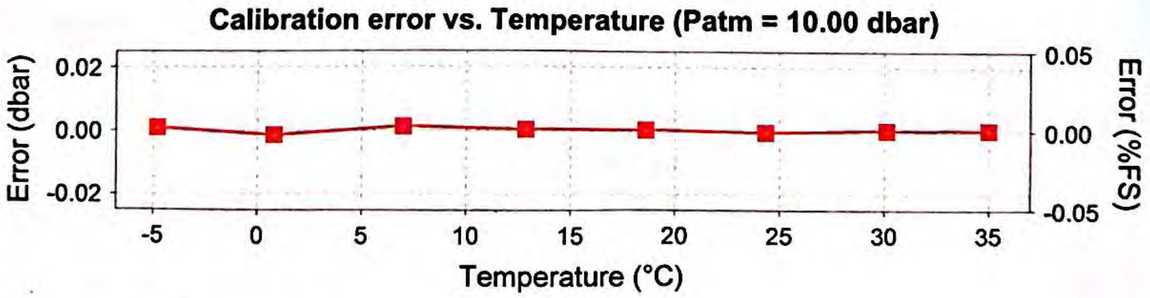
C0:	-3.27340891
C1:	245.08061456
C2:	0.57934029
C3:	-1.01804256
X0 (Patm):	10.026
X1:	0.01923982
X2:	0.00007668
X3:	0.00000038
X4:	0.00019823
X5 (Tcal):	21.9

$$P_{meas} = C_0 + C_1 \cdot V + C_2 \cdot V^2 + C_3 \cdot V^3$$

$$P_{tcor} = X_0 + \frac{P_{meas} - X_0 - X_1(T - X_5) - X_2(T - X_5)^2 - X_3(T - X_5)^3}{1 + X_4(T - X_5)}$$

Head (mm) = 543





Calibration Date: 19/May/2019
Issue Date: 21/May/2019
File Name: 060550_20190521_0855P.rsk

Operator: takuetteh

Approver: kmalorny

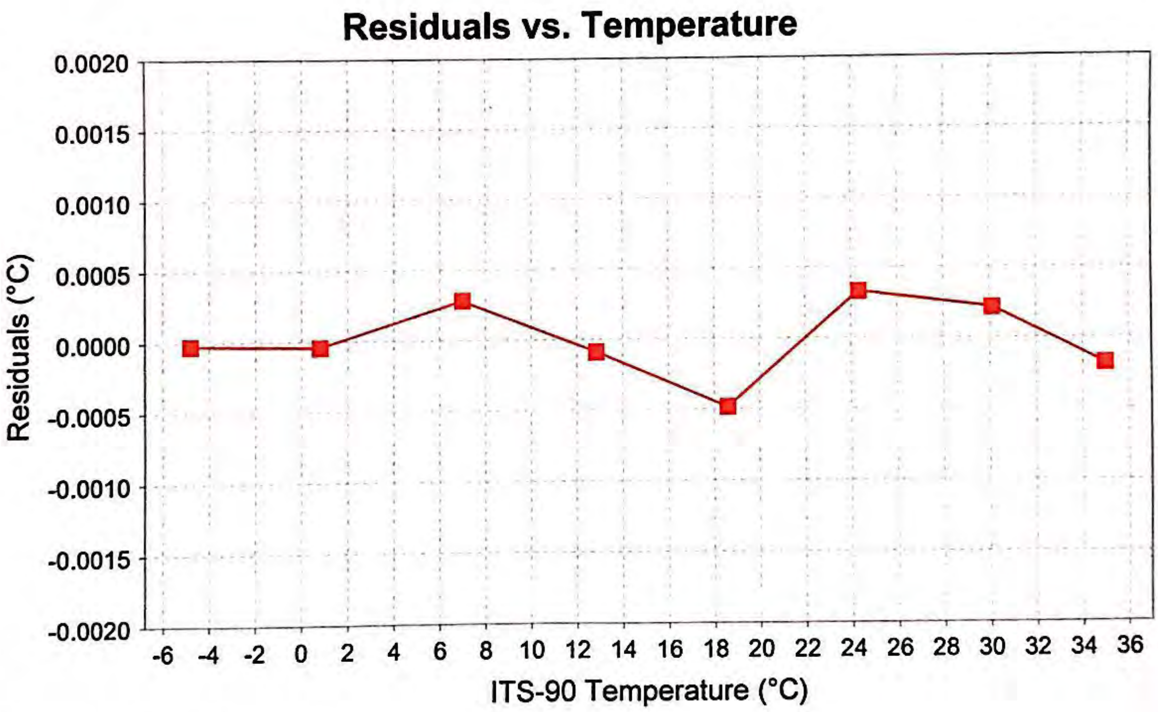
RBR Temperature Calibration Certificate

Logger ID: RBRconcerto **Serial No: 60550** **Channel No: 2**

Reference Temperature, ITS-90	Voltage ratio, V	Measured Temperature, ITS-90	Calibration error
-4.79489	0.816198	-4.79491	-0.00003
0.80077	0.768283	0.80073	-0.00004
6.98589	0.708342	6.98617	0.00028
12.86262	0.646199	12.86253	-0.00009
18.60769	0.582594	18.60721	-0.00049
24.33365	0.518584	24.33398	0.00033
30.11523	0.455509	30.11544	0.00021
34.99124	0.404894	34.99106	-0.00018

Coefficients

C0:	0.003342642746260
C1:	-0.000253731722338
C2:	0.000002327467753
C3:	-0.000000099148160



Calibration Date: 17/May/2019
Issue Date: 19/May/2019
Calibration ID: 32961

Operator: cmazerolle

Approver: kmalorny

RBR Conductivity Calibration Certificate

RBRconcerto C.T.D|fast6 s/n: 60550

References: Autosal8400B#66289, MS-315#15506, SSW P160, RC#002

Reference Resistance (ohm)	Reference Conductivity (mS/cm)	Voltage Ratio, V	Measured Conductivity (mS/cm)	Calibration Error (mS/cm)
open	0.0000	-0.000166	0.0014	0.0014
694.027	6.2296	0.039076	6.2298	0.0002
331.920	13.0258	0.081891	13.0253	-0.0005
150.012	28.8211	0.181411	28.8209	-0.0003
100.011	43.2304	0.272193	43.2296	-0.0008
75.013	57.6369	0.362956	57.6351	-0.0018
55.511	77.8858	0.490549	77.8863	0.0005
47.018	91.9543	0.579192	91.9555	0.0012

Coefficients

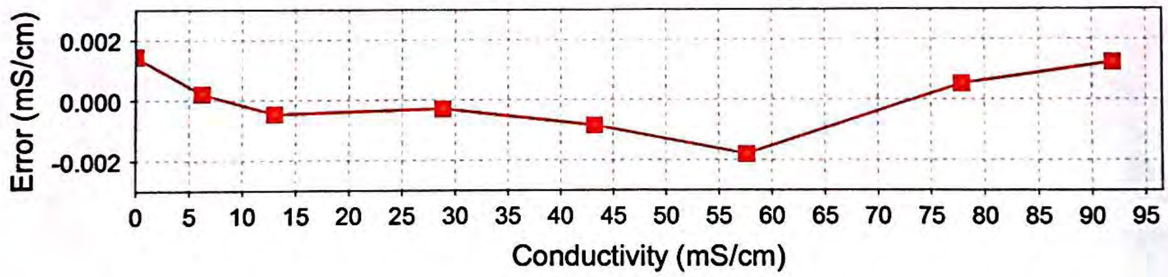
C0:	27.85028E-3
C1:	158.71706
X0:	331.30337E-6
X1:	-19.580142E-6
X2:	600E-9
X3:	14.96221
X4:	10

Bath	Voltage Ratio	Temperature (ITS-90)	Salinity (PSS-78)	Conductivity (mS/cm)
T15S35	0.2700085	14.96221	35.0022	42.8828
T25S35	0.3399555	25.89200	34.9910	53.9925

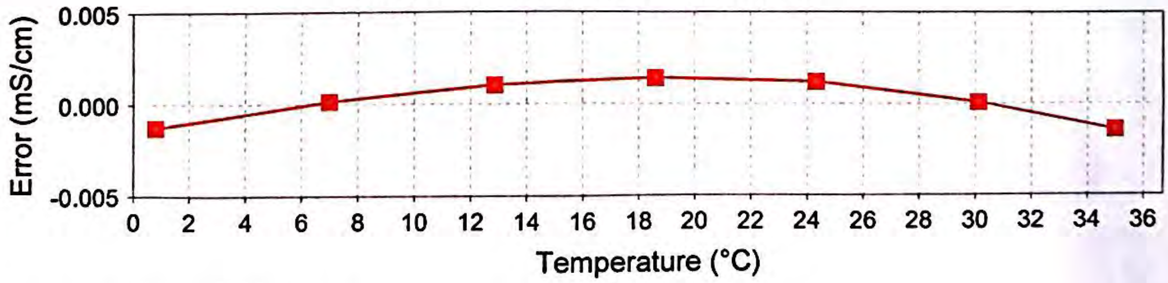
Cell Constant @T15S35 = 4.32352 1/cm

$$C_{cor} = \frac{C_0 + C_1 * V - X_0 * (T - X_3)}{1 + X_1 * (T - X_3) + X_2 * (P - X_4))}$$

Calibration error vs. Conductivity



Calibration error vs. Temperature



Calibration Date: 21/May/2019
Issue Date: 21/May/2019
File Name: 060550_20190521_1457C.rsk

Operator: ishkvorets

Approver: kmalorny

Sea-Bird Scientific
13431 NE 20th Street
Bellevue, WA 98005
USA

+1 425-643-9866
seabird@seabird.com
www.seabird.com

SENSOR SERIAL NUMBER: 7329
CALIBRATION DATE: 14-Mar-19

SBE 19plus V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:
g = -9.896489e-001
h = 1.309622e-001
i = -3.240002e-004
j = 3.968700e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006

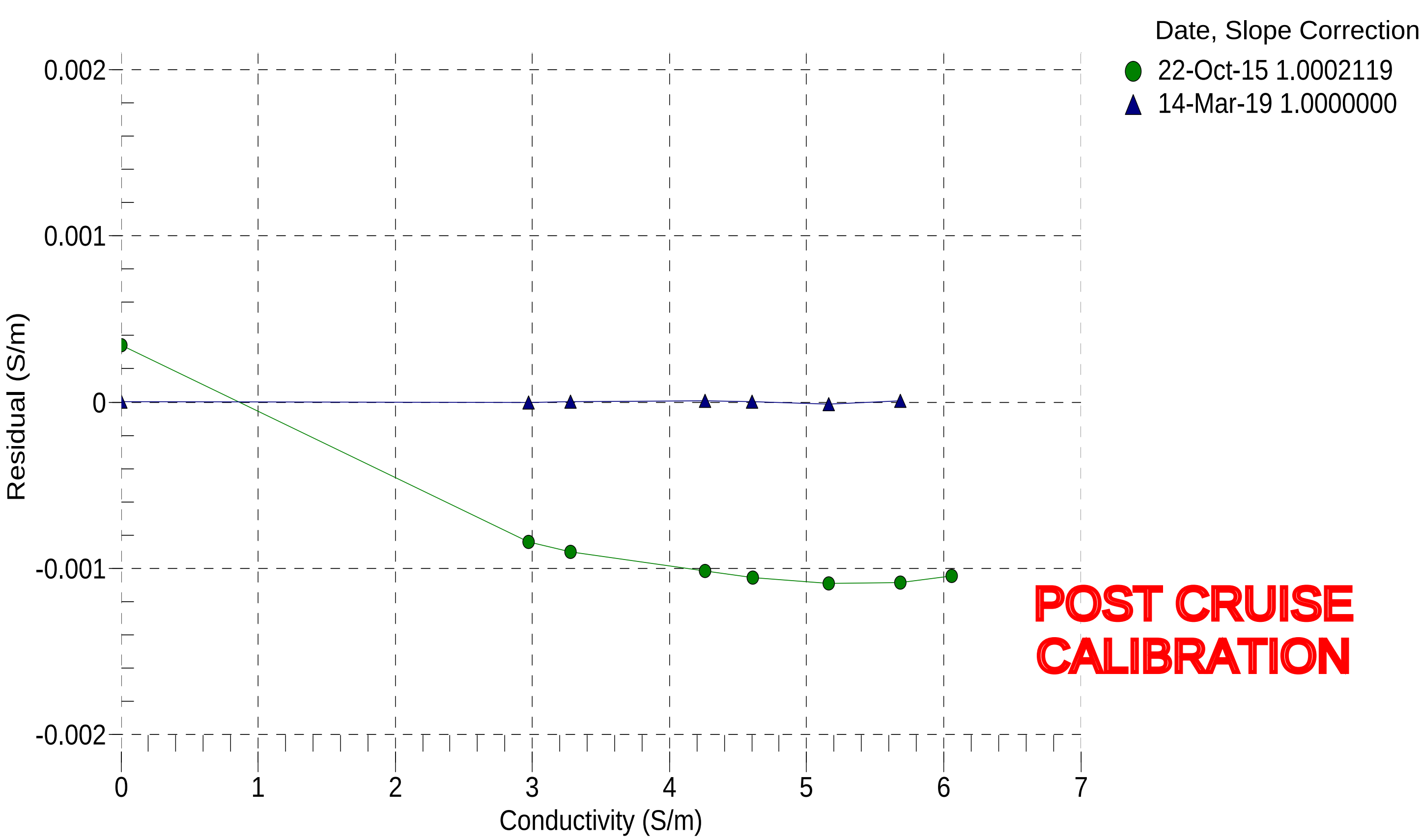
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2755.18	0.0000	0.00000
0.9999	34.7754	2.97279	5512.81	2.9728	-0.00000
4.5000	34.7554	3.27954	5721.68	3.2795	0.00000
15.0000	34.7128	4.26026	6342.69	4.2603	0.00001
18.5000	34.7033	4.60499	6546.69	4.6050	0.00000
24.0000	34.6927	5.16227	6863.32	5.1623	-0.00001
28.9999	34.6849	5.68320	7146.27	5.6832	0.00001
32.5000	34.6770	6.05444	7341.06	6.0545	0.00007

f = Instrument Output (Hz) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



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SENSOR SERIAL NUMBER: 7329
CALIBRATION DATE: 28-Jan-19

SBE 19plus V2 PRESSURE CALIBRATION DATA
508 psia S/N 3840098

COEFFICIENTS:

PA0 = 7.793521e-002
PA1 = 1.546613e-003
PA2 = 8.140641e-012
PTEMPA0 = -6.199354e+001
PTEMPA1 = 5.355963e+001
PTEMPA2 = -2.967411e-001

PTCA0 = 5.250496e+005
PTCA1 = 4.715455e+000
PTCA2 = -1.193423e-001
PTCB0 = 2.505213e+001
PTCB1 = -9.750000e-004
PTCB2 = 0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE (PSIA)	INSTRUMENT OUTPUT (counts)	THERMISTOR OUTPUT (volts)	COMPUTED PRESSURE (PSIA)	RESIDUAL (%FSR)
14.75	534576.0	1.6	14.75	-0.00
105.00	592842.0	1.6	104.98	-0.00
205.01	657375.0	1.6	204.98	-0.01
305.01	721873.0	1.6	304.99	-0.01
405.01	786323.0	1.6	404.99	-0.00
505.01	850742.0	1.6	505.01	-0.00
405.01	786356.0	1.6	405.04	0.01
305.01	721909.0	1.6	305.04	0.01
205.01	657416.0	1.6	205.04	0.01
105.01	592878.0	1.6	105.04	0.01
14.75	534575.0	1.6	14.75	0.00

THERMAL CORRECTION

TEMP (°C)	THERMISTOR OUTPUT (volts)	INSTRUMENT OUTPUT (counts)
32.50	1.78	534769.46
29.00	1.72	534779.58
24.00	1.62	534787.11
18.50	1.52	534790.83
15.00	1.45	534785.12
4.50	1.25	534760.94
1.00	1.18	534748.00

TEMPERATURE (°C)	SPAN
-5.00	25.06
35.00	25.02

y = thermistor output (volts)

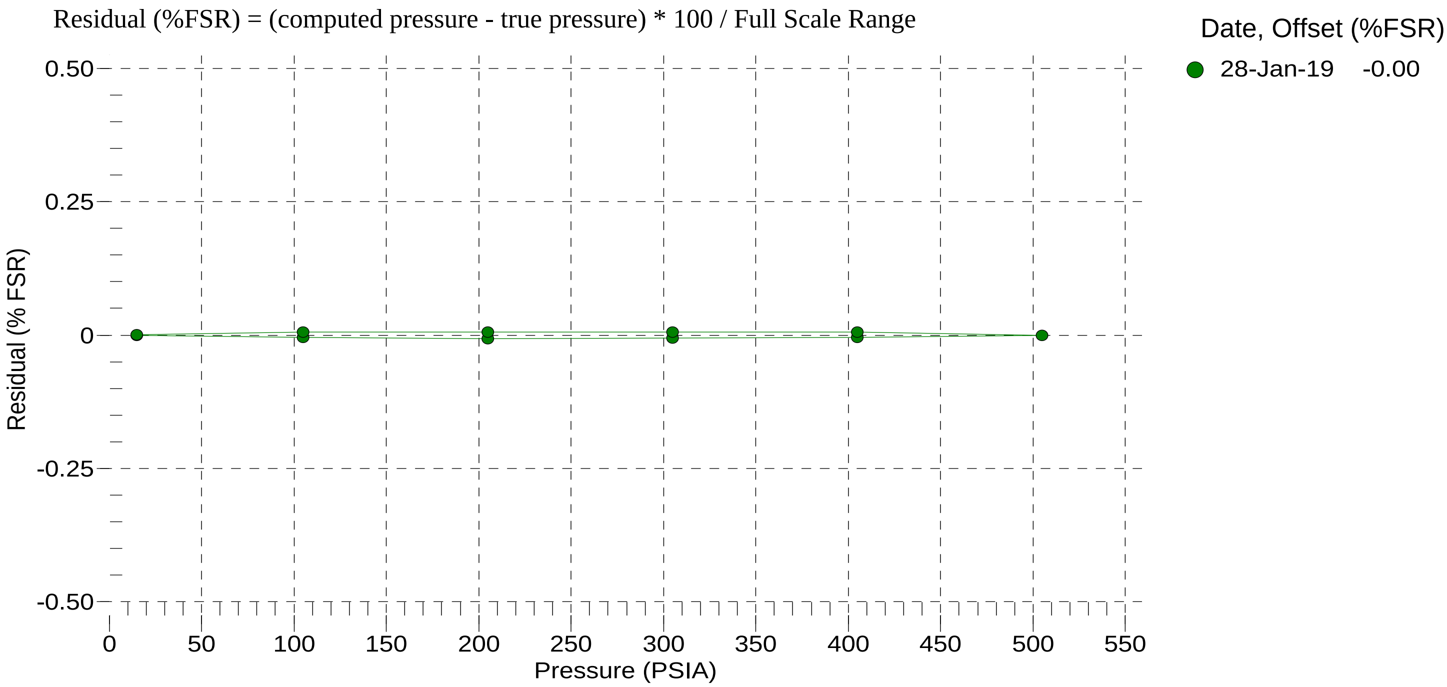
$t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

$x = \text{instrument output} - PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

$\text{pressure (PSIA)} = PA0 + PA1 * n + PA2 * n^2$

Residual (%FSR) = (computed pressure - true pressure) * 100 / Full Scale Range



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seabird@seabird.com
www.seabird.com

SENSOR SERIAL NUMBER: 7329
CALIBRATION DATE: 14-Mar-19

SBE 19plus V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

COEFFICIENTS:
a0 = 1.274596e-003
a1 = 2.669846e-004
a2 = -3.099807e-007
a3 = 1.503621e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
0.9999	566101.661	1.0000	0.0001
4.5000	499923.644	4.4999	-0.0001
15.0000	338055.881	15.0001	0.0001
18.5000	295181.475	18.5000	0.0000
24.0000	237379.339	23.9998	-0.0002
28.9999	193692.627	29.0000	0.0001
32.5000	167441.169	32.5000	-0.0000

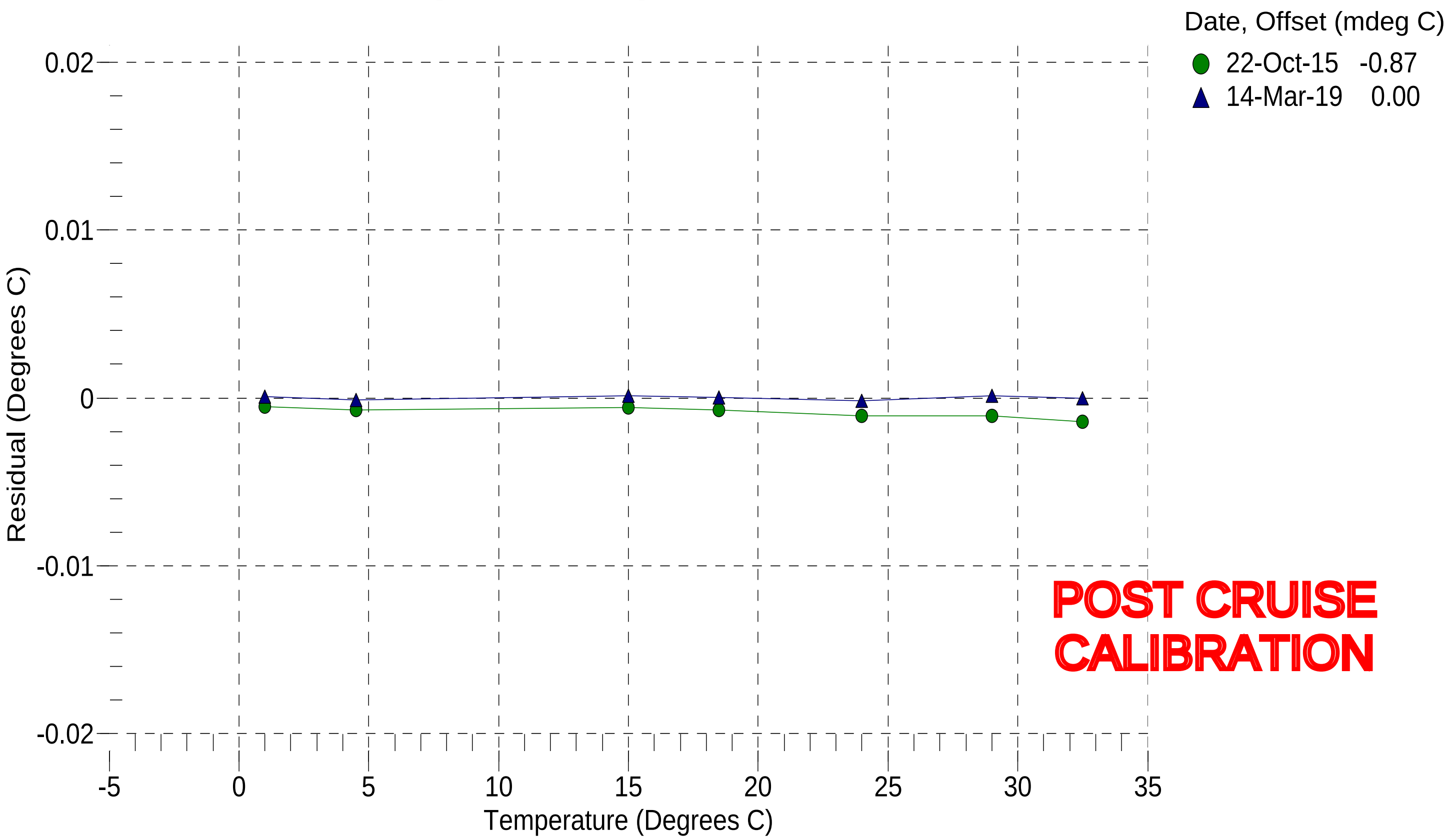
n = Instrument Output (counts)

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 (°C) = $1/\{a0 + a1[\ln(R)] + a2[\ln^2(R)] + a3[\ln^3(R)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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13431 NE 20th Street
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www.seabird.com

SENSOR SERIAL NUMBER: 2868
CALIBRATION DATE: 05-Mar-19

SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS:		NOMINAL DYNAMIC COEFFICIENTS	
Soc = 0.4026	A = -3.6424e-003	D1 = 1.92634e-4	H1 = -3.300000e-2
Voffset = -0.5286	B = 1.4083e-004	D2 = -4.64803e-2	H2 = 5.00000e+3
Tau20 = 1.17	C = -1.8135e-006		H3 = 1.45000e+3
	E nominal = 0.036		

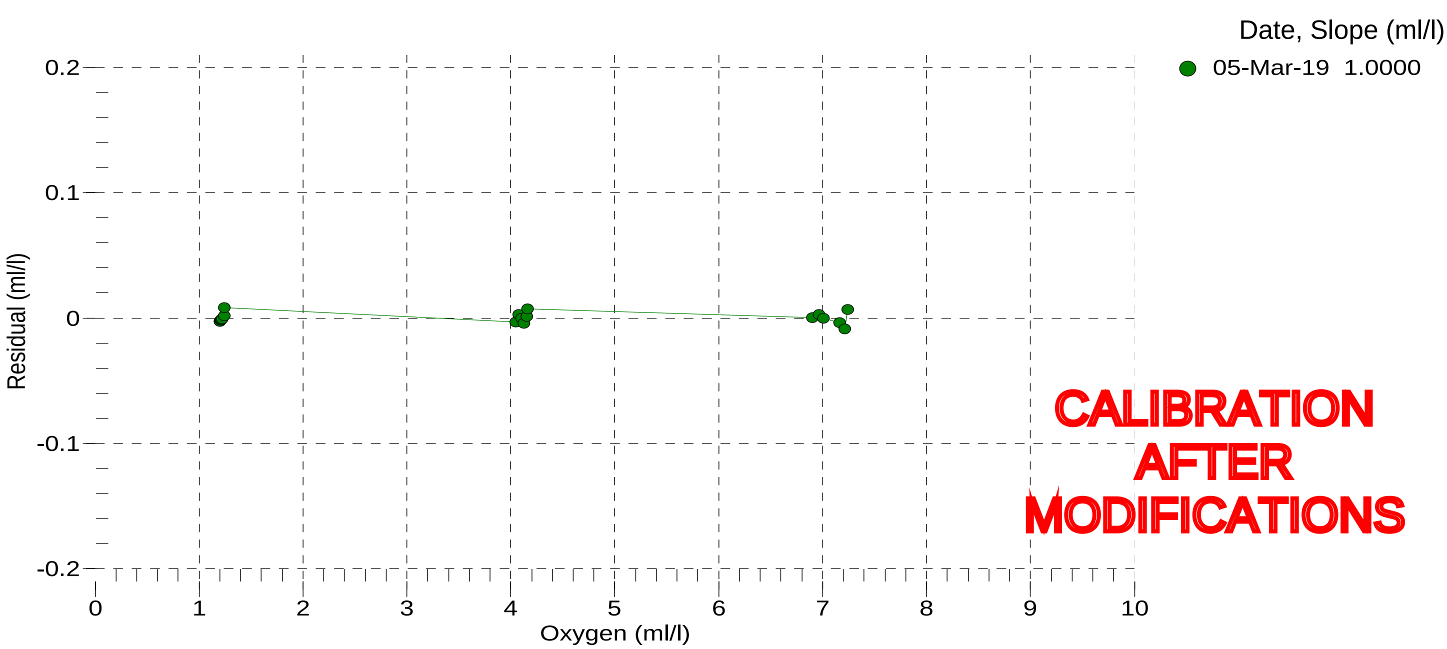
BATH OXYGEN (ml/l)	BATH TEMPERATURE (° C)	BATH SALINITY (PSU)	INSTRUMENT OUTPUT (volts)	INSTRUMENT OXYGEN (ml/l)	RESIDUAL (ml/l)
1.20	2.00	0.00	0.838	1.20	-0.00
1.21	6.00	0.00	0.879	1.21	-0.00
1.22	12.00	0.00	0.939	1.21	-0.00
1.22	20.00	0.00	1.020	1.22	-0.00
1.24	26.00	0.00	1.089	1.24	0.00
1.25	30.00	0.00	1.136	1.25	0.01
4.04	2.00	0.00	1.573	4.04	-0.00
4.07	6.00	0.00	1.711	4.08	0.00
4.10	12.00	0.00	1.917	4.10	-0.00
4.13	20.00	0.00	2.190	4.12	-0.00
4.15	26.00	0.00	2.405	4.15	0.00
4.16	30.00	0.00	2.550	4.17	0.01
6.90	2.00	0.00	2.311	6.90	0.00
6.96	6.00	0.00	2.550	6.96	0.00
7.00	12.00	0.00	2.899	7.00	-0.00
7.17	20.00	0.00	3.414	7.16	-0.00
7.22	30.00	0.00	4.024	7.21	-0.01
7.24	26.00	0.00	3.803	7.25	0.01

V = instrument output (volts); T = temperature (°C); S = salinity (PSU); K = temperature (°K)

Oxsol(T,S) = oxygen saturation (ml/l); P = pressure (dbar)

$$\text{Oxygen (ml/l)} = Soc * (V + Voffset) * (1.0 + A * T + B * T^2 + C * T^3) * Oxsol(T,S) * \exp(E * P / K)$$

Residual (ml/l) = instrument oxygen - bath oxygen



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www.seabird.com

SENSOR SERIAL NUMBER: 11252
CALIBRATION DATE: 31-May-18

SBE 37 V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

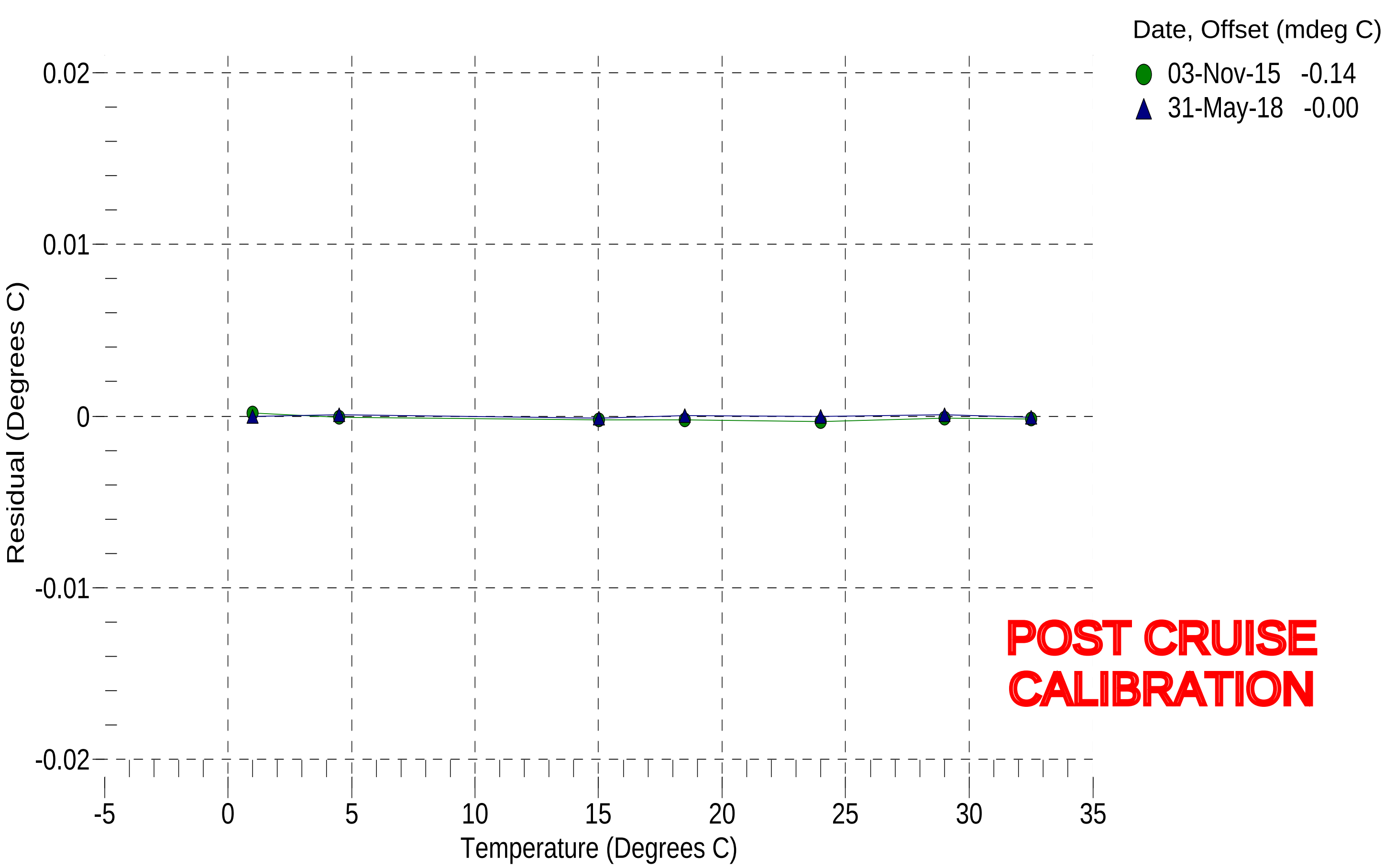
COEFFICIENTS:
a0 = -9.248418e-005
a1 = 3.070650e-004
a2 = -4.636060e-006
a3 = 2.047676e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	586039.9	1.0000	-0.0000
4.5000	500578.1	4.5001	0.0001
15.0000	318206.3	14.9999	-0.0001
18.5000	275327.3	18.5000	0.0000
24.0000	220645.1	24.0000	-0.0000
29.0000	181533.1	29.0001	0.0001
32.5000	158892.7	32.4999	-0.0001

n = Instrument Output (counts)

Temperature ITS-90 (°C) = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 11252
CALIBRATION DATE: 08-Jun-18

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g =  -9.761750e-001
h =   1.388766e-001
i =  -1.732387e-004
j =   3.225712e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC = -6.2809e-008
```

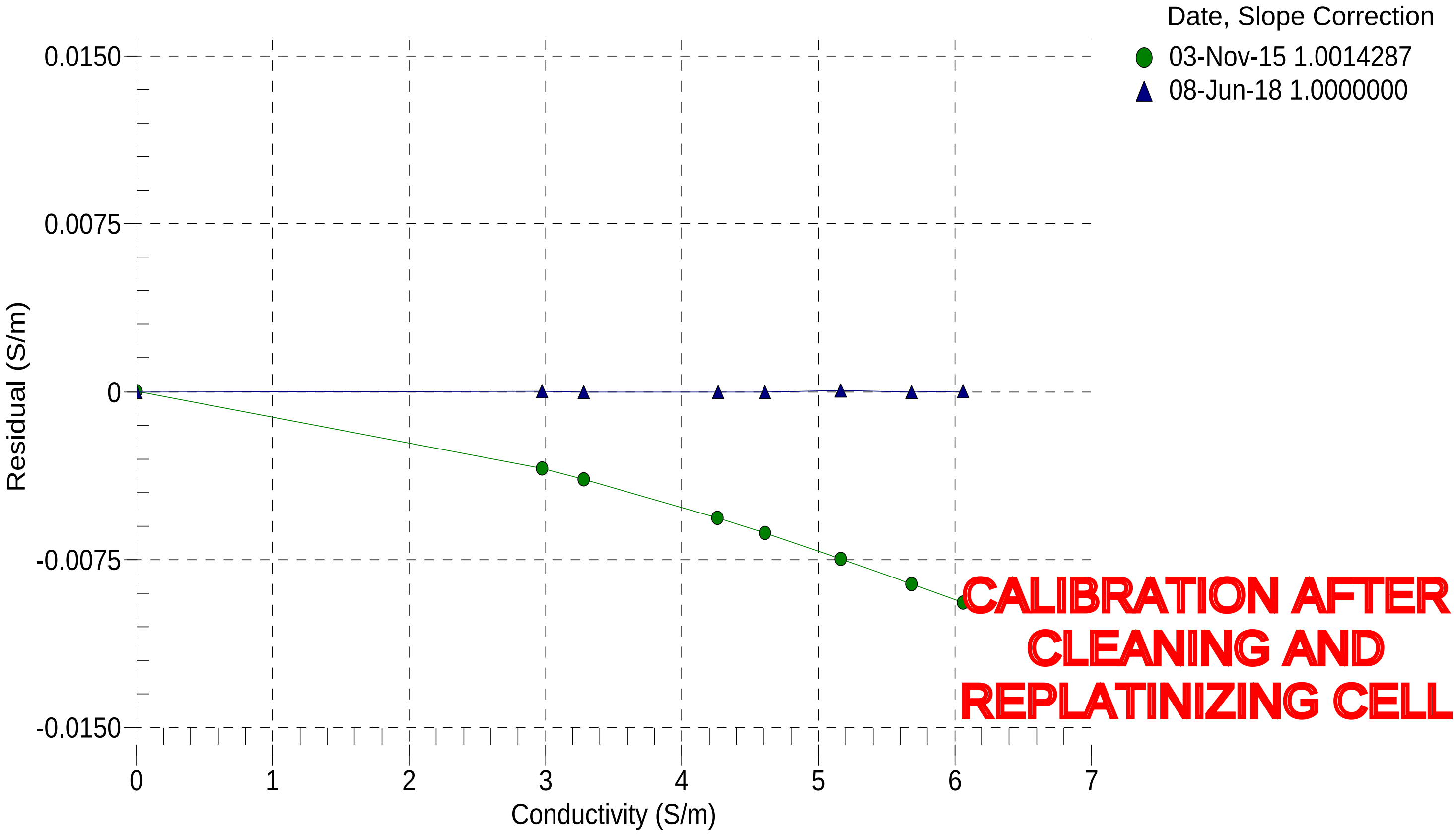
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2653.47	0.00000	0.00000
1.0000	34.8031	2.97494	5334.05	2.97496	0.00002
4.5000	34.7834	3.28193	5536.67	3.28191	-0.00002
15.0000	34.7409	4.26334	6139.06	4.26333	-0.00001
18.4999	34.7316	4.60833	6336.95	4.60832	-0.00001
24.0000	34.7212	5.16604	6644.13	5.16609	0.00004
29.0000	34.7159	5.68772	6918.74	5.68770	-0.00002
32.5000	34.7118	6.05983	7107.99	6.05983	0.00000

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



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SENSOR SERIAL NUMBER: 11252
CALIBRATION DATE: 31-May-18

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -9.792290e-001
h =  1.393377e-001
i = -1.902171e-004
j =  3.469723e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC = -6.2809e-008
```

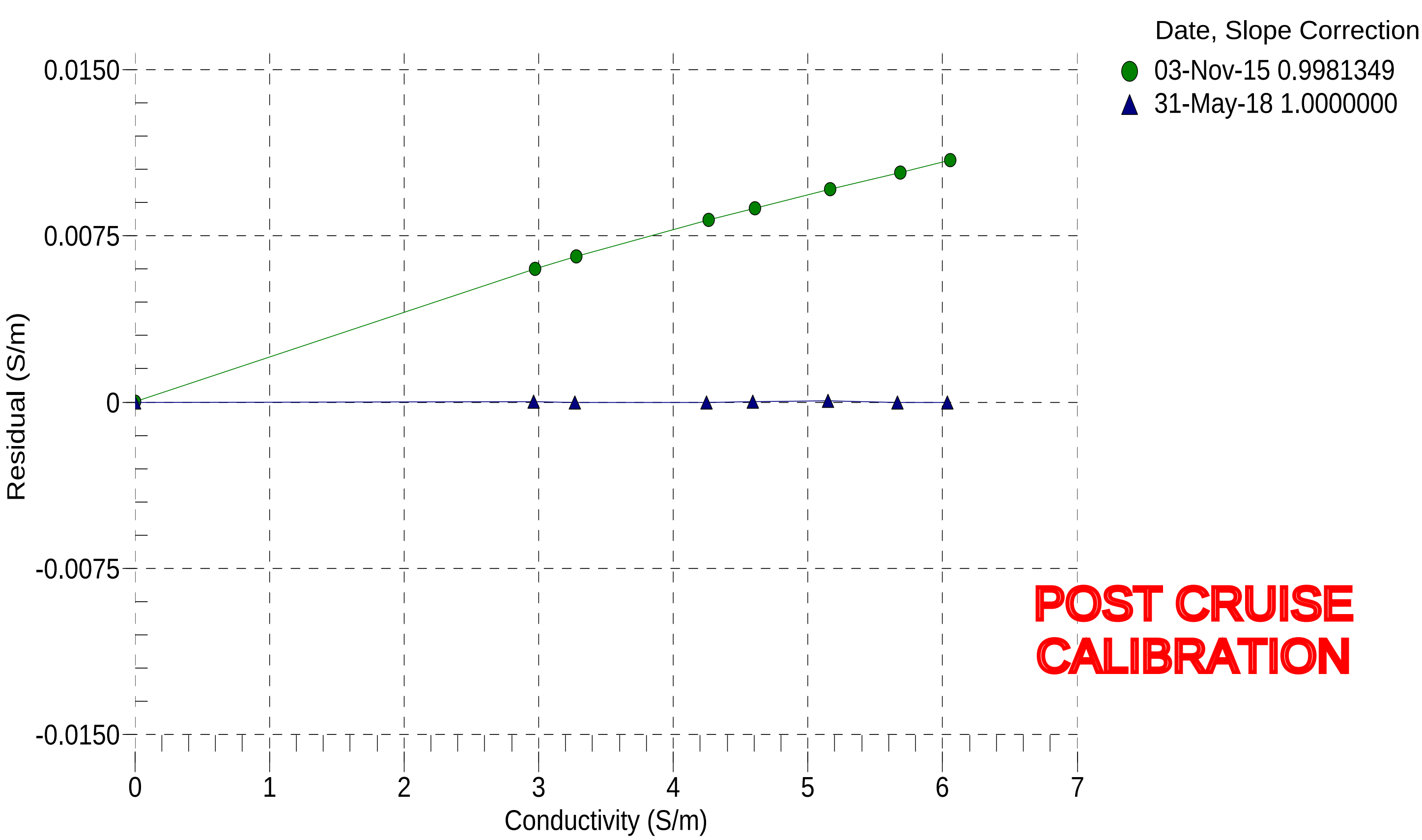
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2653.47	0.00000	0.00000
1.0000	34.6557	2.96354	5320.03	2.96356	0.00002
4.5000	34.6361	3.26939	5521.79	3.26939	-0.00001
15.0000	34.5937	4.24719	6121.58	4.24715	-0.00003
18.5000	34.5845	4.59092	6318.65	4.59093	0.00000
24.0000	34.5744	5.14660	6624.54	5.14665	0.00005
29.0000	34.5690	5.66635	6897.98	5.66634	-0.00002
32.5000	34.5646	6.03704	7086.39	6.03704	-0.00000

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



POST CRUISE CALIBRATION

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SENSOR SERIAL NUMBER: 11252
CALIBRATION DATE: 25-May-18

SBE 37 V2 PRESSURE CALIBRATION DATA
160 psia S/N 3906061

COEFFICIENTS:

PA0 =	2.690688e-002	PTCA0 =	5.259889e+005
PA1 =	5.071149e-004	PTCA1 =	2.022164e+000
PA2 =	-3.287246e-012	PTCA2 =	1.385508e-002
PTEMPA0 =	-6.712914e+001	PTCB0 =	2.512175e+001
PTEMPA1 =	5.239464e-002	PTCB1 =	-5.000000e-005
PTEMPA2 =	-6.444972e-007	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE (PSIA)	INSTRUMENT OUTPUT (counts)	THERMISTOR OUTPUT (counts)	COMPUTED PRESSURE (PSIA)	RESIDUAL (%FSR)
14.62	554752.0	1750.0	14.58	-0.02
29.80	584808.0	1756.0	29.82	0.01
59.74	643996.0	1756.0	59.80	0.04
94.84	713170.0	1756.0	94.81	-0.02
124.84	772514.0	1755.0	124.82	-0.01
159.84	841854.0	1755.0	159.86	0.02
124.84	772534.0	1756.0	124.83	-0.00
94.85	713195.0	1756.0	94.82	-0.01
59.85	644069.0	1759.0	59.84	-0.01
29.80	584853.0	1759.0	29.84	0.03
14.62	554756.0	1761.0	14.59	-0.02

THERMAL CORRECTION

TEMP (°C)	THERMISTOR OUTPUT (counts)	INSTRUMENT OUTPUT (counts)
32.50	1948	556312.70
29.00	1878	556288.21
24.00	1778	556271.45
18.50	1669	556266.01
15.00	1599	556265.65
4.50	1391	556238.49
1.00	1322	556220.52

TEMPERATURE (°C)	SPAN
-5.00	25.12
35.00	25.12

y = thermistor output (counts)

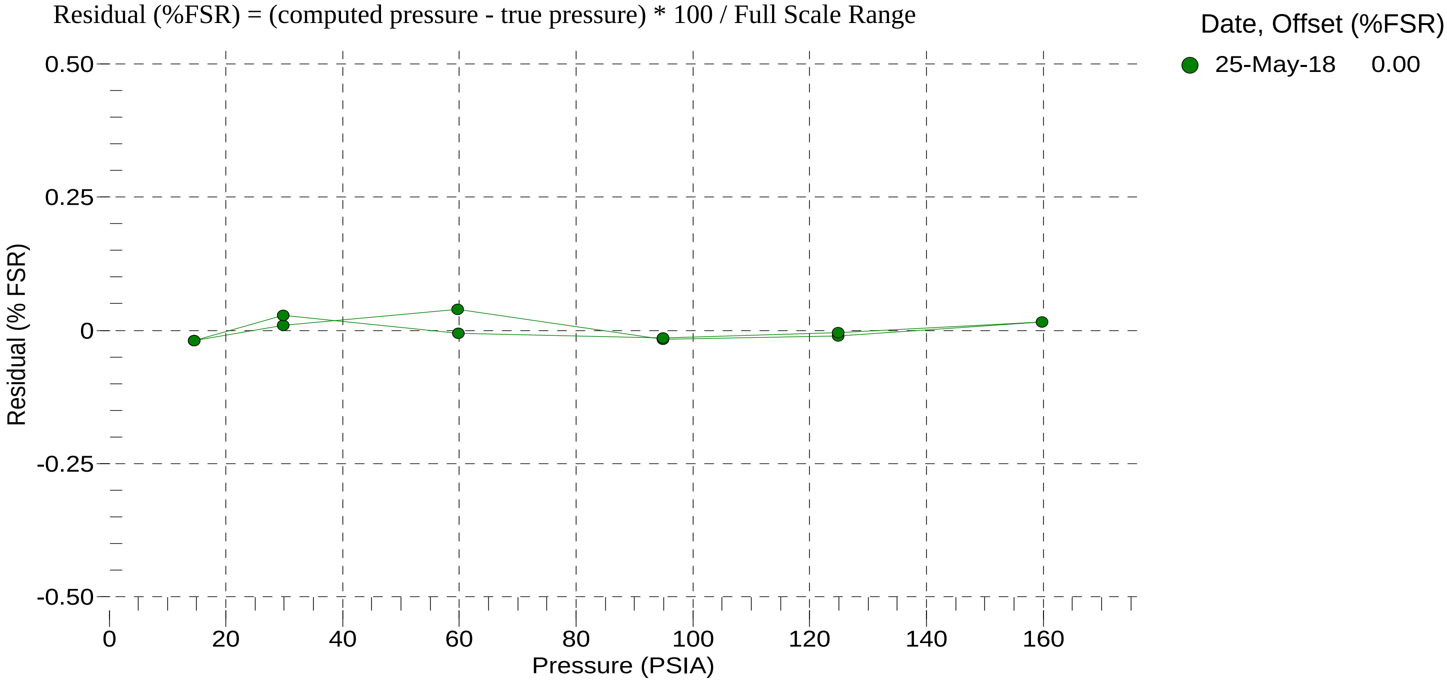
$t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

$x = \text{instrument output} - PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

$\text{pressure (PSIA)} = PA0 + PA1 * n + PA2 * n^2$

Residual (%FSR) = (computed pressure - true pressure) * 100 / Full Scale Range



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SENSOR SERIAL NUMBER: 11252
CALIBRATION DATE: 08-Jun-18

SBE 37 V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

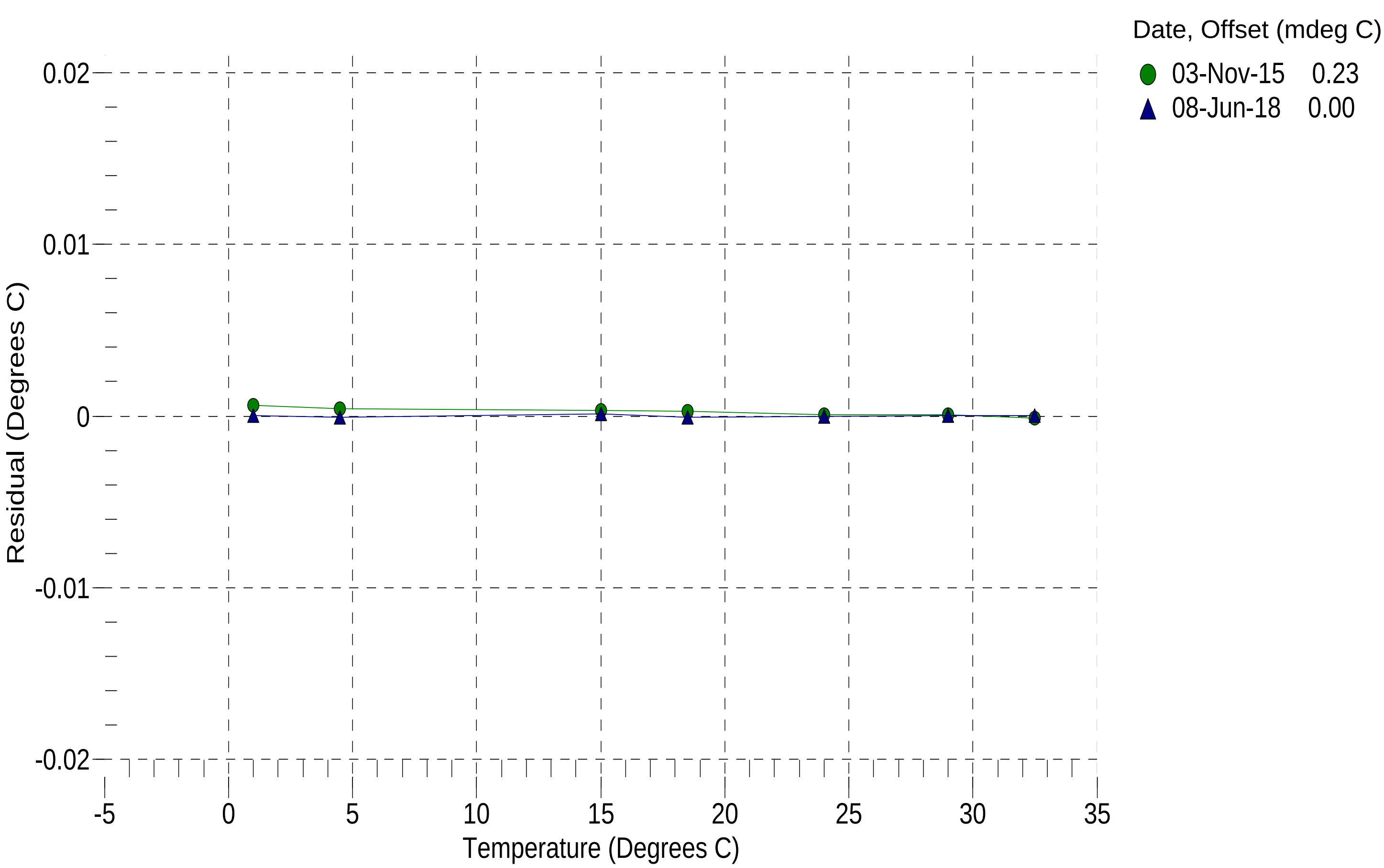
COEFFICIENTS:
a0 = -8.791366e-005
a1 = 3.060765e-004
a2 = -4.565337e-006
a3 = 2.030932e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	586049.2	1.0000	0.0000
4.5000	500593.0	4.4999	-0.0001
15.0000	318210.3	15.0001	0.0001
18.4999	275335.2	18.4998	-0.0001
24.0000	220648.9	24.0000	-0.0000
29.0000	181535.0	29.0000	0.0000
32.5000	158892.7	32.5000	0.0000

n = Instrument Output (counts)

Temperature ITS-90 (°C) = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 12344
CALIBRATION DATE: 01-Jun-18

SBE 37 V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

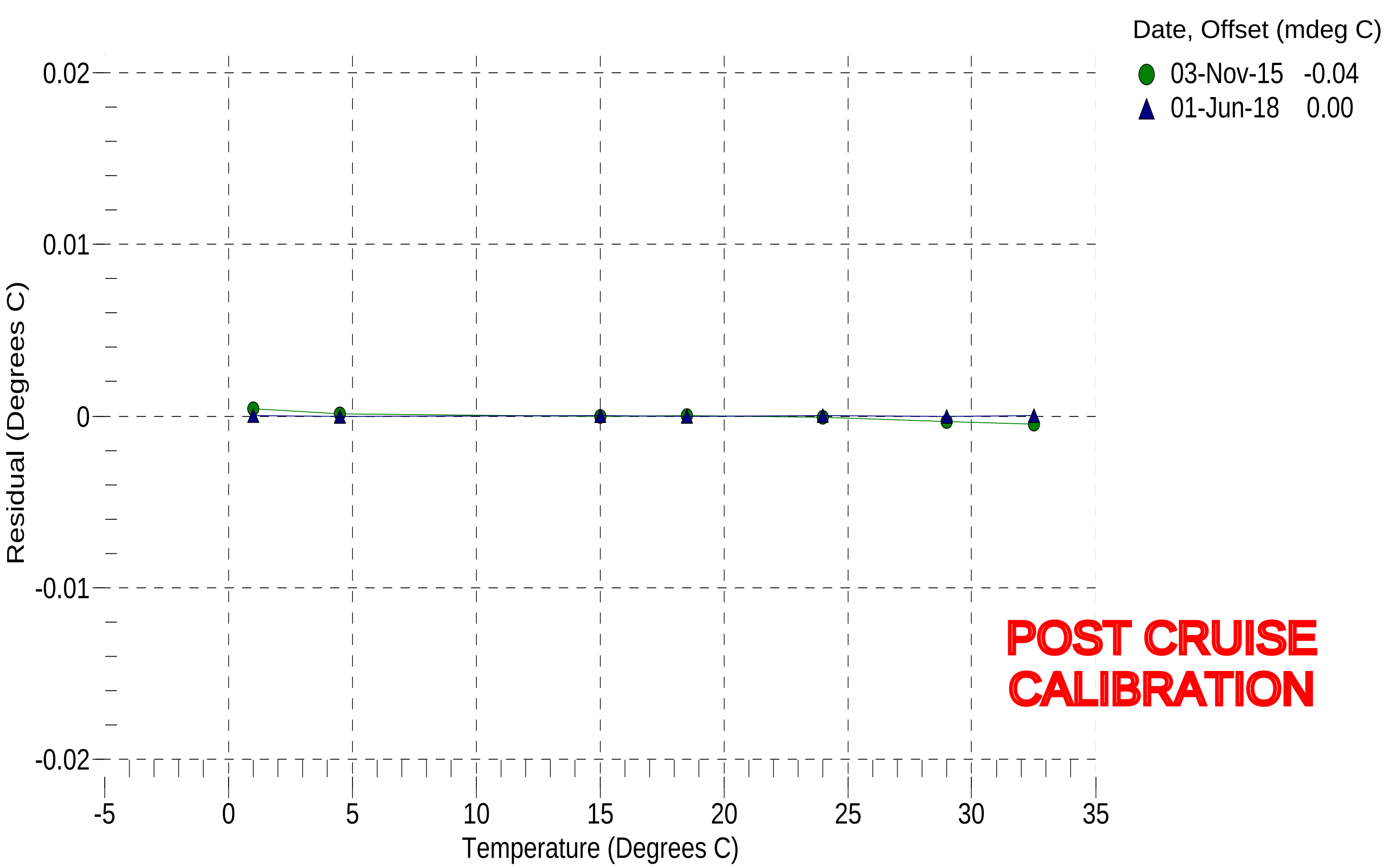
COEFFICIENTS:
a0 = -8.215480e-005
a1 = 3.029415e-004
a2 = -4.212222e-006
a3 = 1.935234e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	578134.3	1.0000	0.0000
4.5000	494120.6	4.5000	-0.0000
15.0000	314645.9	15.0000	0.0000
18.4999	272404.8	18.4999	-0.0000
24.0000	218492.8	24.0000	0.0000
29.0000	179903.2	29.0000	-0.0000
32.5000	157549.1	32.5000	0.0000

n = Instrument Output (counts)

Temperature ITS-90 (°C) = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 12344
CALIBRATION DATE: 01-Jun-18

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.784640e-001
h = 1.711911e-001
i = -2.684323e-004
j = 5.277146e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 3.4820e-008

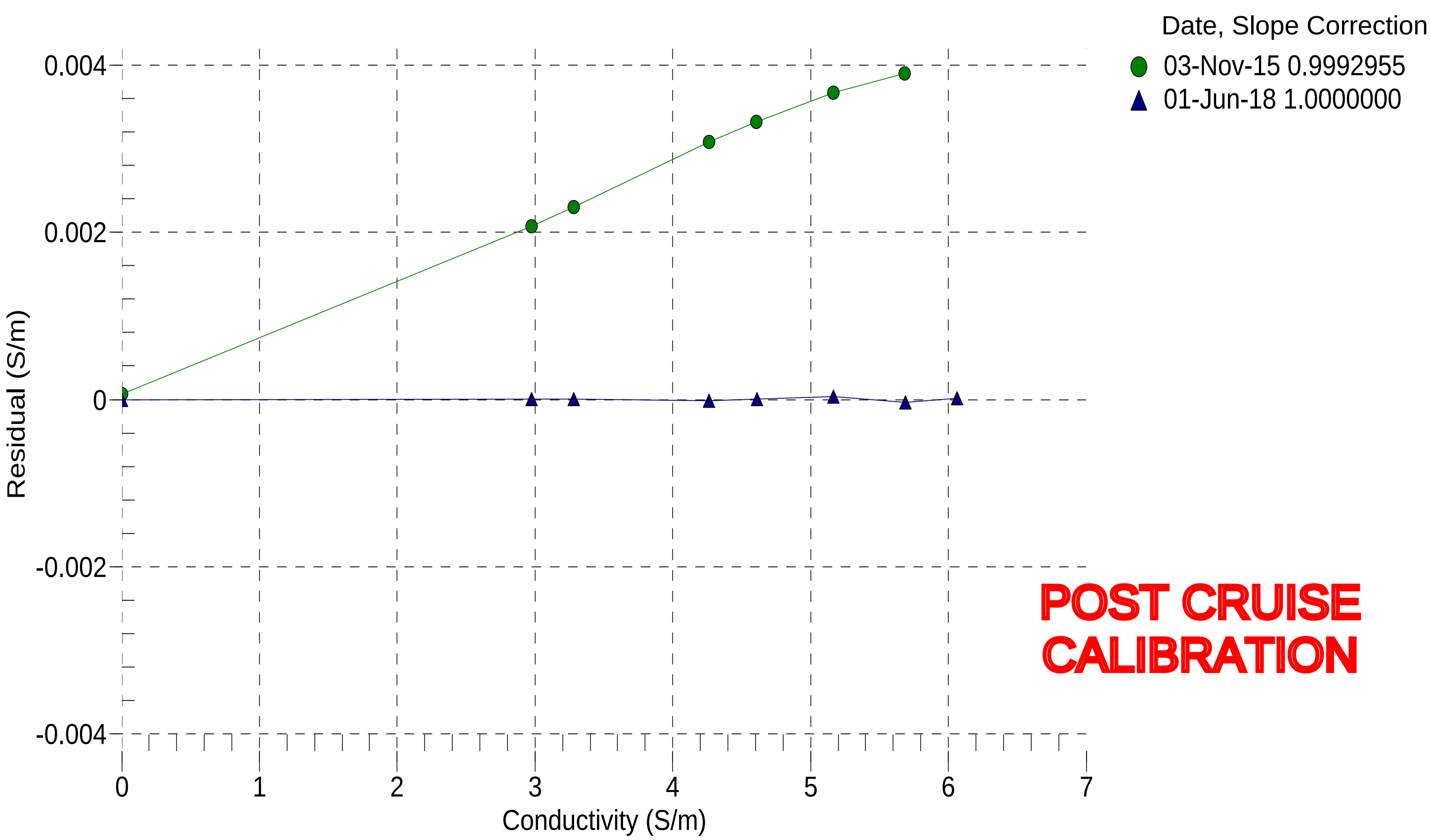
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2393.11	0.00000	0.00000
1.0000	34.8098	2.97546	4806.89	2.97546	0.00000
4.5000	34.7899	3.28248	4989.39	3.28248	0.00000
15.0000	34.7472	4.26403	5531.86	4.26401	-0.00002
18.4999	34.7378	4.60907	5710.08	4.60907	0.00001
24.0000	34.7273	5.16685	5986.68	5.16688	0.00003
29.0000	34.7217	5.68857	6233.95	5.68853	-0.00003
32.5000	34.7178	6.06075	6404.38	6.06076	0.00001

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



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SENSOR SERIAL NUMBER: 12345
CALIBRATION DATE: 01-Jun-18

SBE 37 V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

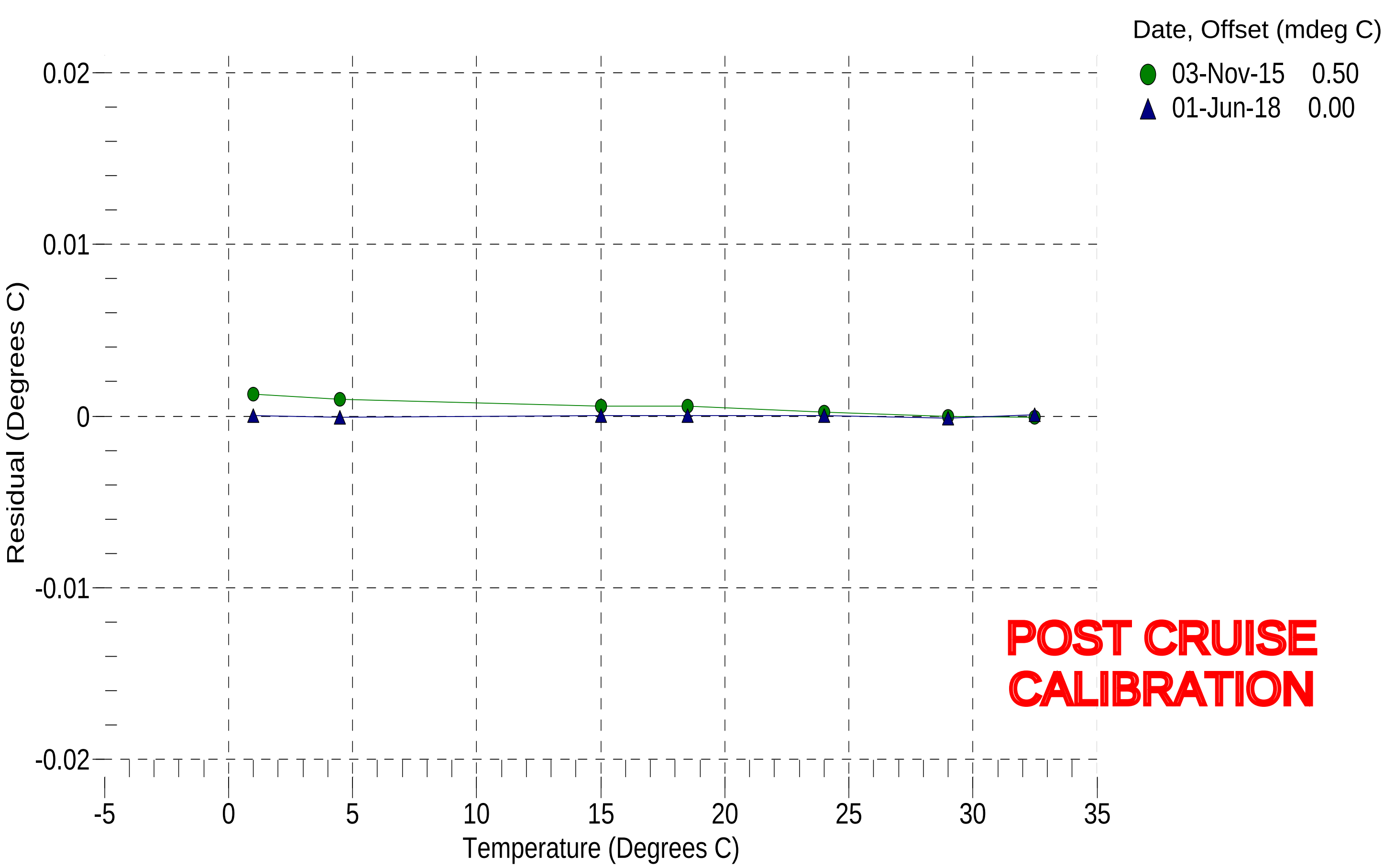
COEFFICIENTS:
a0 = -8.529164e-005
a1 = 3.004206e-004
a2 = -3.961759e-006
a3 = 1.900550e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	579299.3	1.0000	0.0000
4.5000	495722.5	4.4999	-0.0001
15.0000	316756.2	15.0000	0.0000
18.4999	274527.3	18.4999	0.0000
24.0000	220555.4	24.0000	0.0000
29.0000	181859.4	28.9999	-0.0001
32.5000	159413.1	32.5001	0.0001

n = Instrument Output (counts)

Temperature ITS-90 (°C) = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 12345
CALIBRATION DATE: 08-Jun-18

SBE 37 V2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

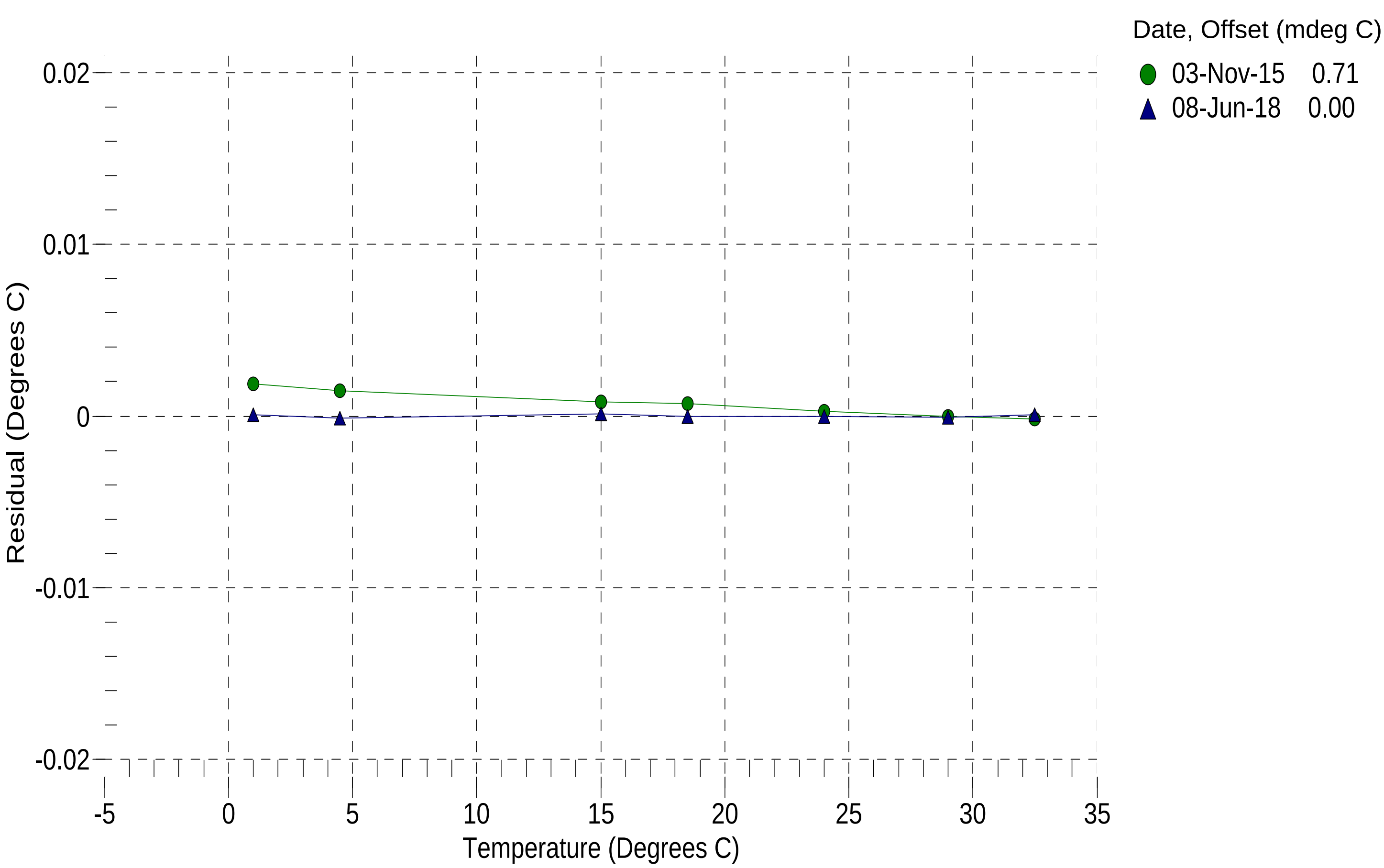
COEFFICIENTS:
a0 = -8.984541e-005
a1 = 3.014890e-004
a2 = -4.044746e-006
a3 = 1.921871e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	579313.6	1.0001	0.0001
4.5000	495735.1	4.4999	-0.0001
15.0000	316757.9	15.0001	0.0001
18.4999	274529.7	18.4999	-0.0000
24.0000	220556.2	24.0000	-0.0000
29.0000	181858.9	28.9999	-0.0001
32.5000	159412.7	32.5001	0.0001

n = Instrument Output (counts)

Temperature ITS-90 (°C) = $1/\{a0 + a1[\ln(n)] + a2[\ln^2(n)] + a3[\ln^3(n)]\} - 273.15$

Residual (°C) = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 12345
CALIBRATION DATE: 01-Jun-18

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.804405e-001
h = 1.716467e-001
i = -2.098498e-004
j = 4.630533e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 0.0000e+000

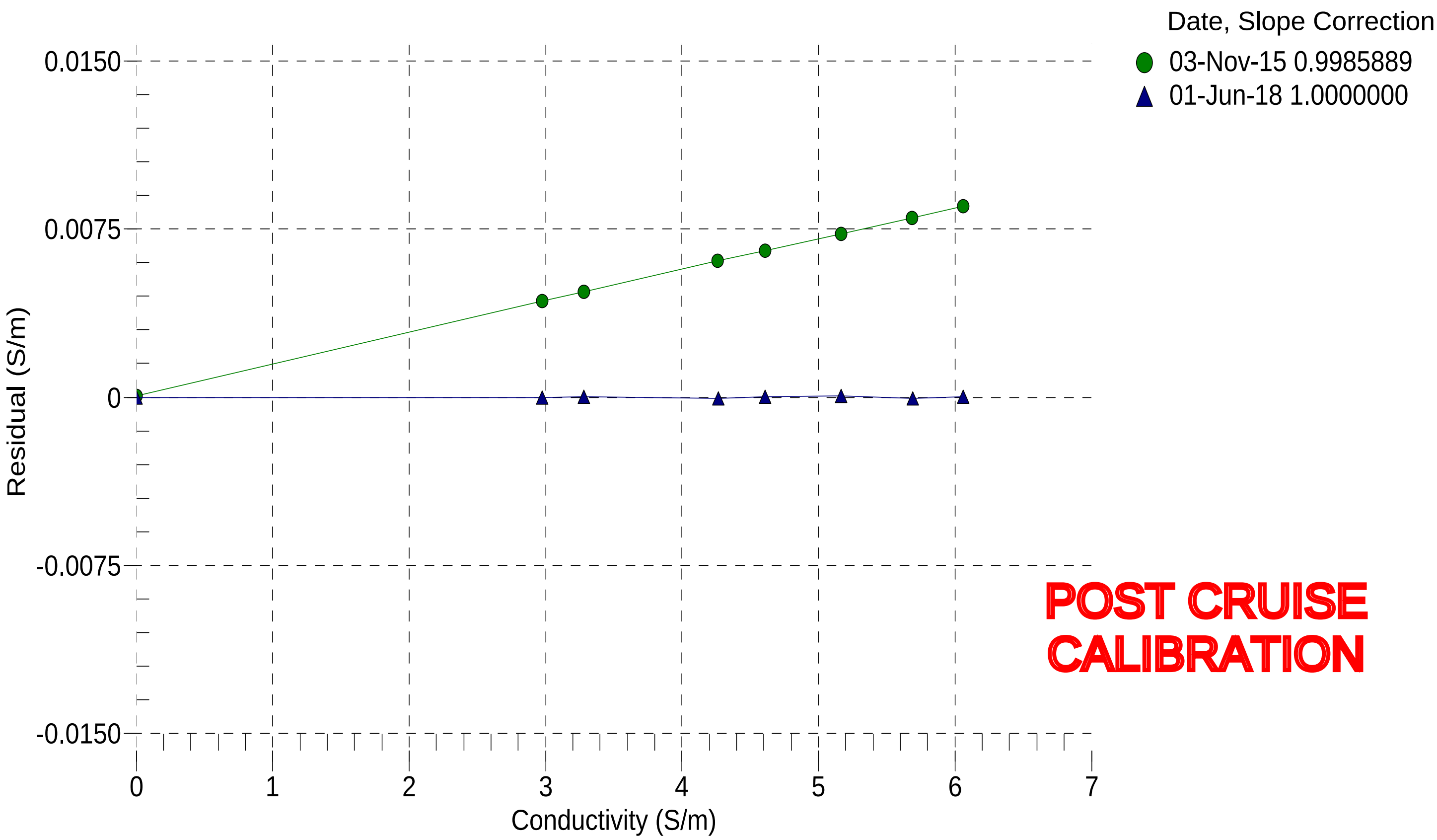
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2391.62	0.00000	0.00000
1.0000	34.8098	2.97546	4799.88	2.97546	-0.00000
4.5000	34.7899	3.28248	4982.05	3.28249	0.00002
15.0000	34.7472	4.26403	5523.56	4.26399	-0.00004
18.4999	34.7378	4.60907	5701.51	4.60907	0.00001
24.0000	34.7273	5.16685	5977.70	5.16690	0.00005
29.0000	34.7217	5.68857	6224.62	5.68853	-0.00004
32.5000	34.7178	6.06075	6394.82	6.06076	0.00001

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



POST CRUISE CALIBRATION

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SENSOR SERIAL NUMBER: 12345
CALIBRATION DATE: 08-Jun-18

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -9.790813e-001
h =  1.715394e-001
i = -2.720936e-004
j =  4.919215e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC =  0.0000e+000
```

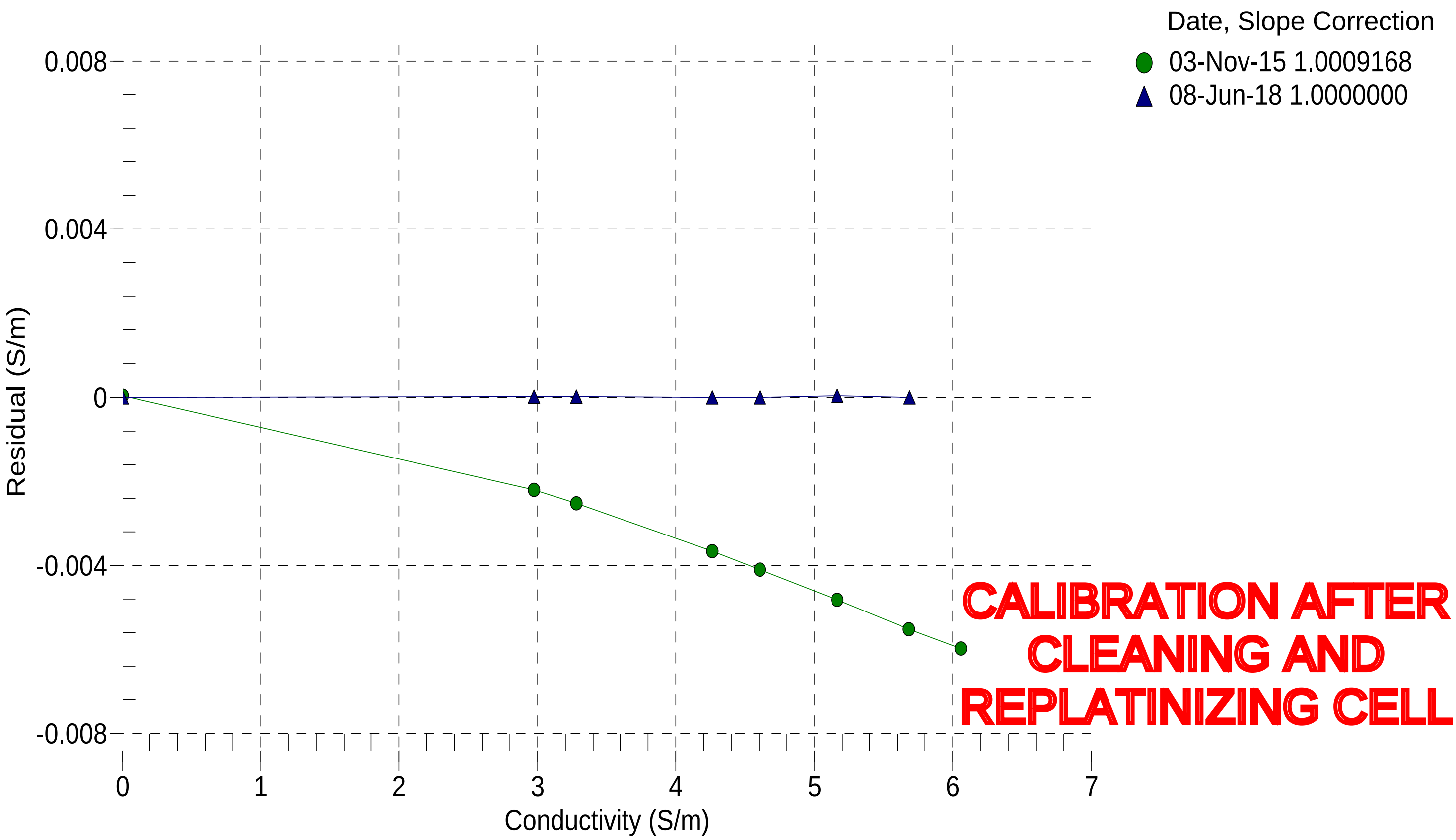
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2391.64	0.00000	0.00000
1.0000	34.8031	2.97494	4803.48	2.97494	0.00000
4.5000	34.7834	3.28193	4985.93	3.28193	0.00001
15.0000	34.7409	4.26334	5528.32	4.26332	-0.00002
18.4999	34.7316	4.60833	5706.53	4.60833	-0.00000
24.0000	34.7212	5.16604	5983.15	5.16606	0.00002
29.0000	34.7159	5.68772	6230.50	5.68771	-0.00001
32.5000	34.7118	6.05983	6400.98	6.05992	0.00009

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity



APPENDIX B

Data Deliverable (delivered electronically)

APPENDIX C

Tide Gauge Installation Instructions

TECHNICAL MEMORANDUM

DATE May 13, 2019 **Project No.** 1663724

TO Dominic Ritgen
Baffinland

CC

FROM David Hurley **EMAIL david_hurley@golder.com**

MILNE PORT TIDE GAUGE INSTALLATION AND RECOVERY INSTRUCTIONS

Golder Associates Ltd. (Golder) was retained by Baffinland in 2019 to re-install the tide gauge, an RBR concerto CTD, first deployed in 2017 at Milne Port to provide water level monitoring on-site during the open-water season (typically July to October) of 2019. The objective of this technical memorandum is to provide installation instructions for the tide gauge at Milne Port and itemize the necessary consumables for installation.

1.0 ALUMINUM MOUNTING SYSTEM OVERVIEW

The tide gauge is housed inside a 26-inch long aluminum square tube (4-inch diameter) to provide protection from vessels and reduce wind and wave effects. The aluminum square tube is mounted to the ladder with two steel L brackets that will be welded to the side of the bottom of the steel ladder located on the ore dock (Figure 1).

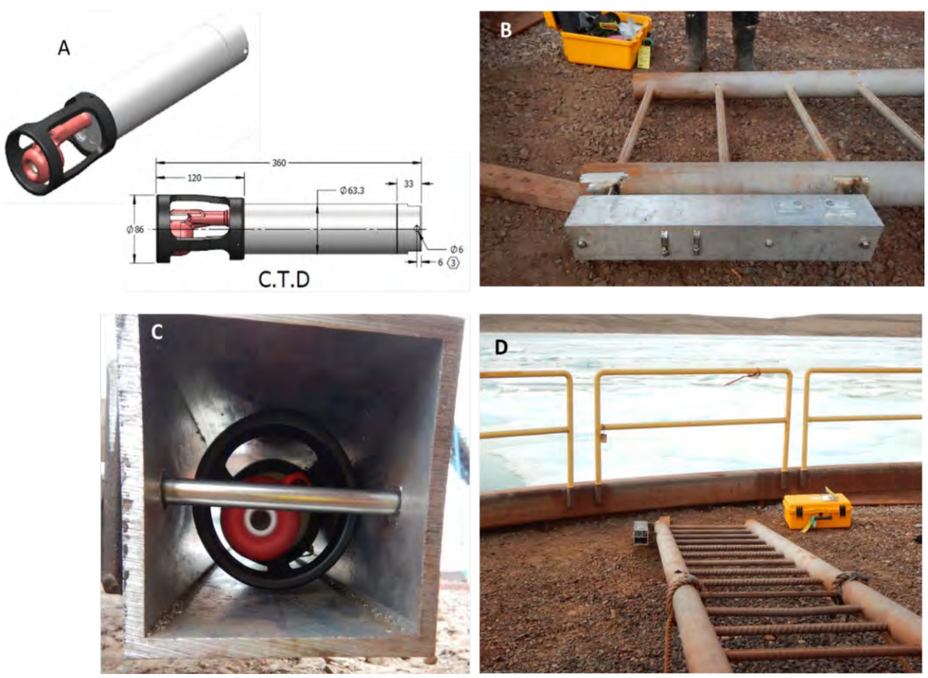


Figure 1: Overview of tide gauge installation

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2.0 TIDE GAUGE INSTALLATION

Step 1) Two 1/4" diameter holes need to be drilled in the aluminum tube. These holes will be used to add a length of 3mm 316 stainless steel wire rope as redundant security against a hardware failure (Figure 2). On the outside of the aluminum tube two zinc anodes should be replaced with new anodes and secured with one stainless steel bolt (316 stainless 1/2" x 1”) per anode (Figure 4).

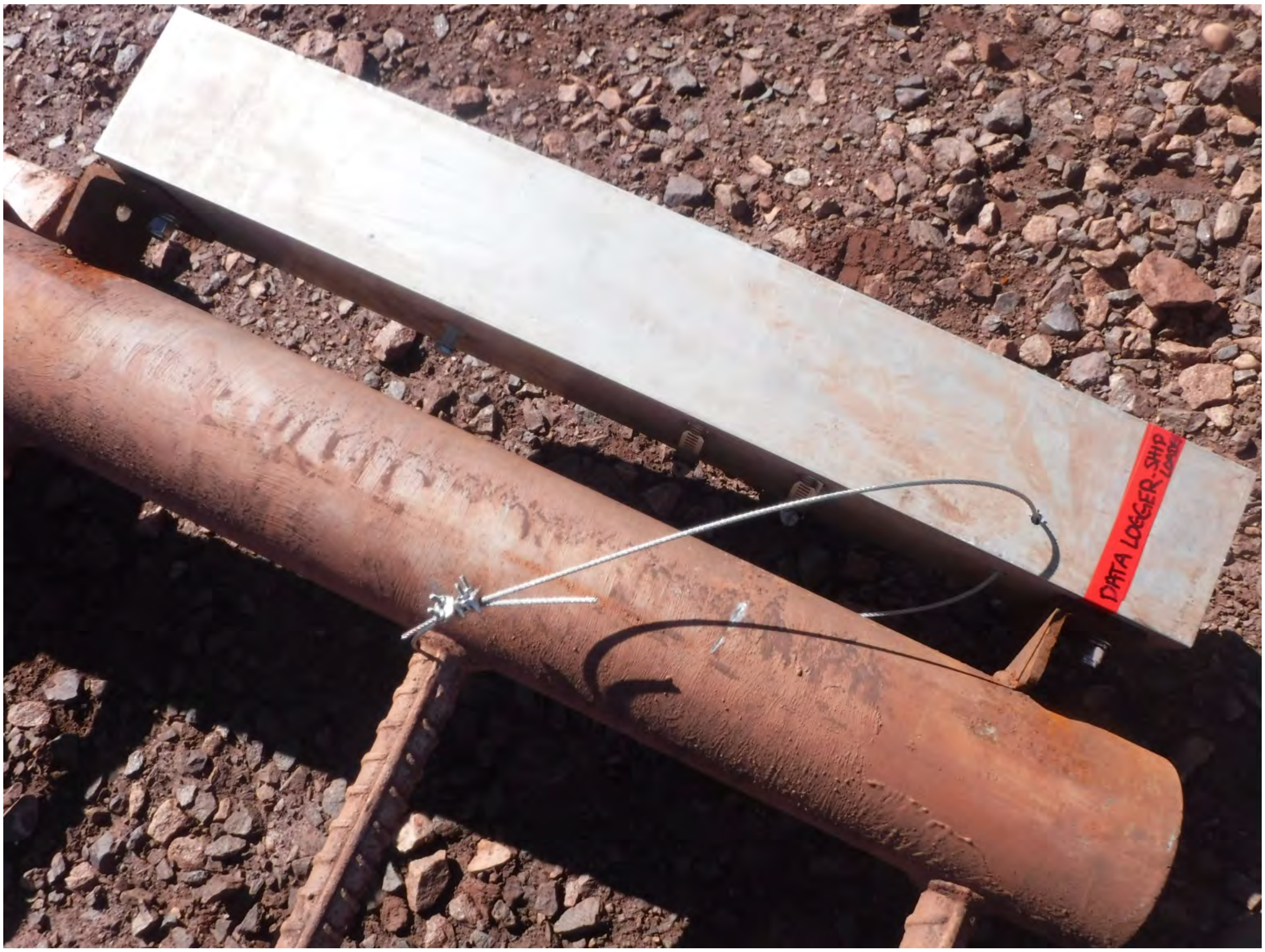

Figure 2: Hardware attaching aluminum tube to steel L brackets and wire rope for redundancy of the L bracket attachments.

Step 2) The tide gauge (RBR concerto – white Delrin cylinder) should be mounted inside the aluminum square tube with one stainless steel bolt (316 stainless 1/4" x 4 1/2"), washer, nylon shoulder washer, lock nut (Figure 3) and two stainless steel hose clamps wrapping around the tide gauge body, using caution to not overtighten against the plastic housing. The bolt should be passed through the hole on the end cap of the tide gauge, making sure not to twist the end cap in the process, and secured to the square tube with nylon shoulder washers inserted in the drilled holes on the aluminium square tube (Figure 4).

Figure 3: Hardware attaching aluminum tube to L brackets and view of the tide gauge mounted in the tube. Arrow shows location of the ¼" bolt that should pass through the end cap of the tide gauge.

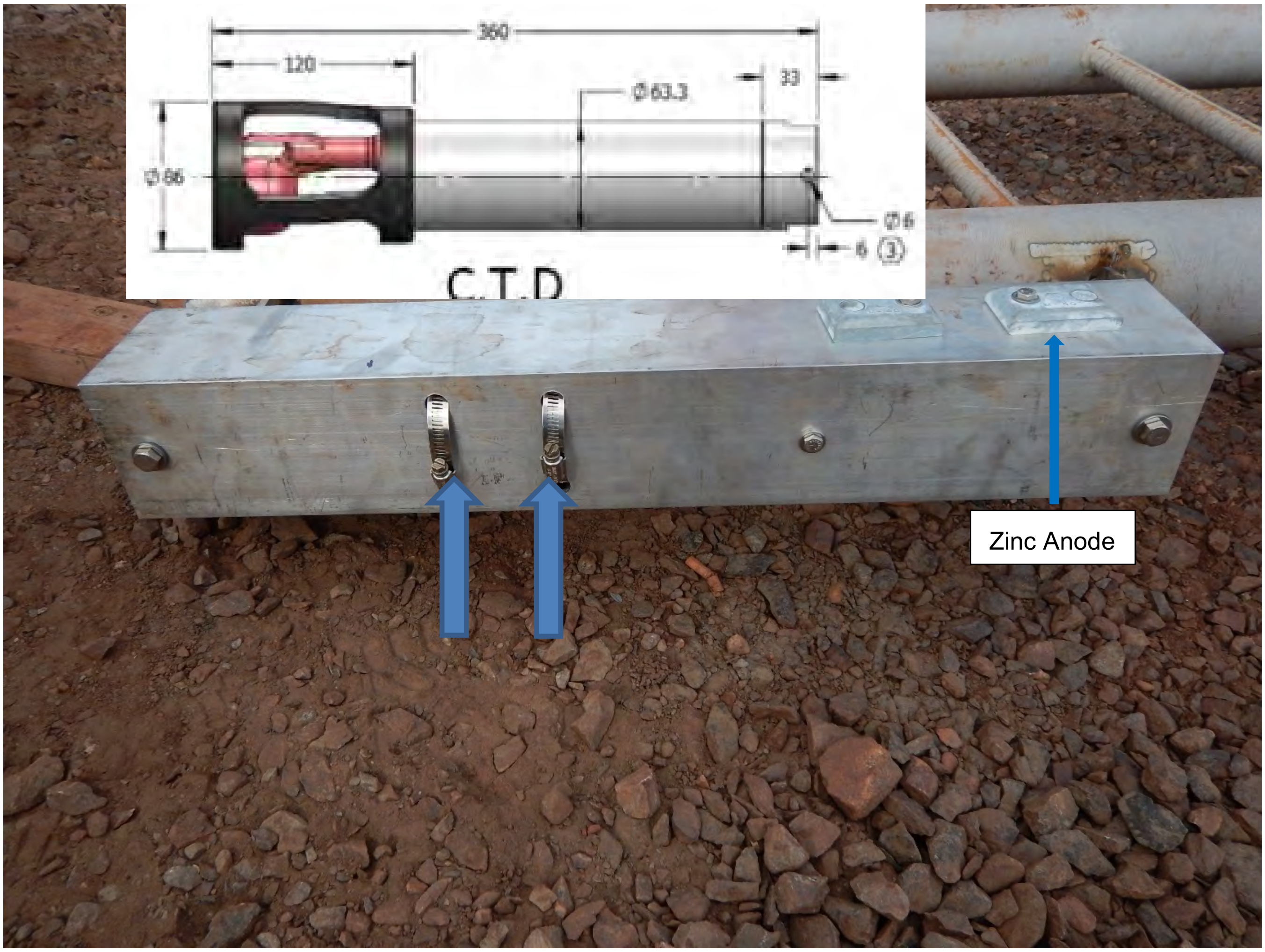

Figure 4: Hardware attaching tide gauge to tube. Arrows show the location of the hose clamps which mount the tide gauge to the square tube and the zinc anodes.

Step 3)

The aluminum square tube is mounted to the ladder at two steel L brackets that are welded to the side of the bottom of the steel ladder located on the ore dock. The tide gauge should be mounted such that the red and black end cap is pointing downwards towards the sea bed. The integrity of the welds on the ladder should be inspected before mounting the square tube. Mount the aluminum tube to the L brackets with stainless steel bolts (316 stainless 3/8” x 5”), washers, nylon shoulder washers, lock washers and lock nuts (Figure 5).

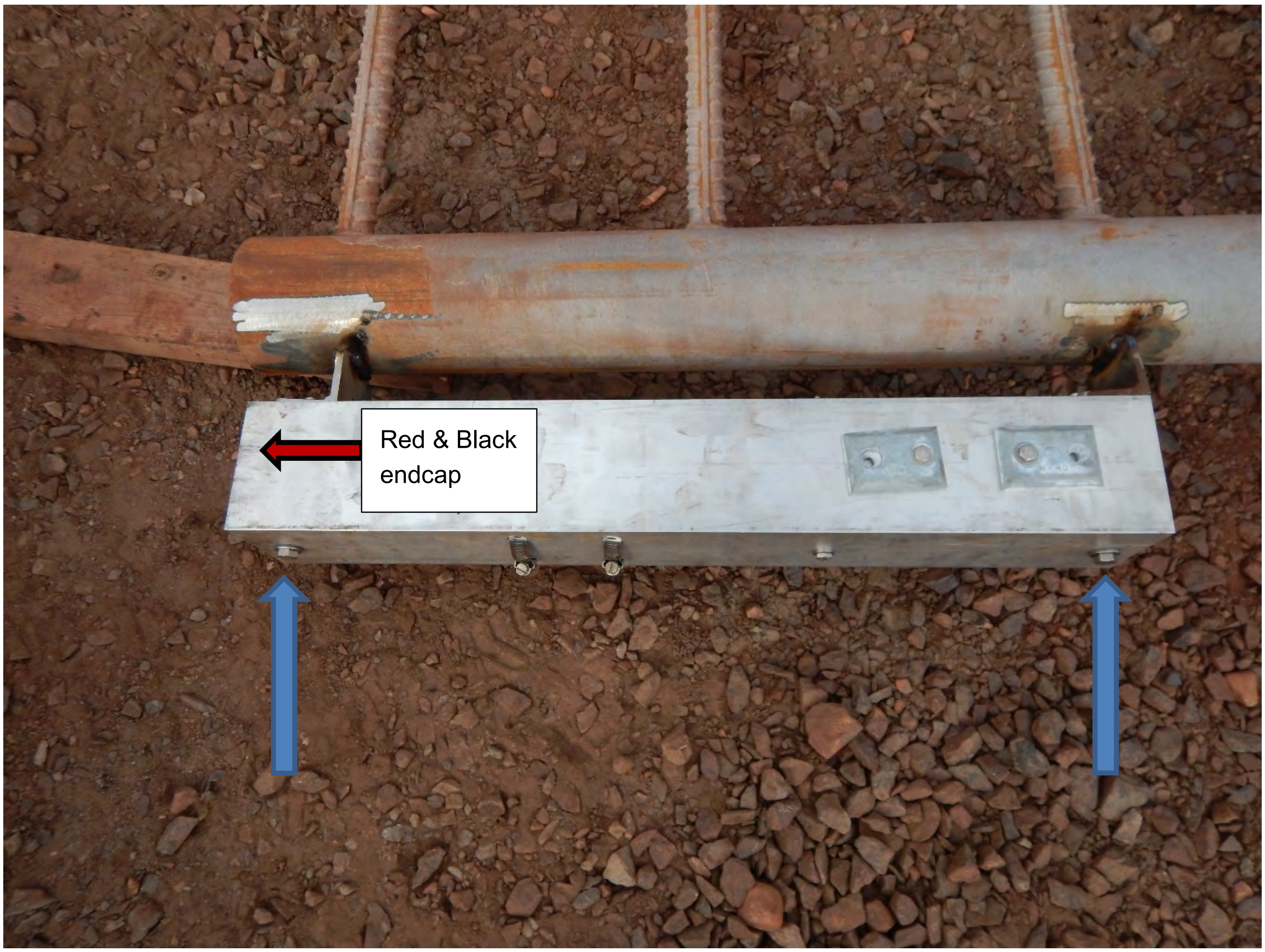

Figure 5: Aluminum square tube mounted to the bottom of the steel ladder located at the ore dock. Arrows show location of mounting bolts which attach the square tube to the welding tabs on the steel ladder.

Step 4)

Add a length of 3mm 316 stainless steel wire rope passed through the two holes on the square tube, and around the bottom ladder rung, and join wire rope together with 2 wire rope clips (1/8” stainless steel). This is to provide a redundant mounting system (Figure 2).

Step 5)

Take photos during each step of the installation process for documentation purposes and provide a record of hardware used and any changes to the above steps.

Step 6)

In 2018 the elevation and position of the ladder was surveyed using five survey points measured from an RTK GPS system. The following table provides the survey position and elevation of the pressure sensor in 2018. The pressure sensor is located behind the plastic sensor cover on the downward facing end of the instrument (Figure 6). The distance from the bottom of the aluminum tube to a point at the top plate of the ladder and from the pressure sensor to a point at the top plate of the ladder was measured as 6.57 m and 6.42 m in 2018, respectively.

An RTK GPS survey will need to be conducted in 2019 to reference the steel ladder top plate and provide a reference for instrument to chart datum. Additionally, the distance from the pressure sensor to the ladder top plate and from the bottom of the aluminum tube to the ladder top plate should be measured.

Table 1: RTK GPS survey 2018

Survey Point	Easting (m)	Northing (m)	UTM Zone	Elevation (m, CGVD)	Tide Gauge Elevation (m, CGVD)[1]
Point 01	503227.211	7976633.252	17W	3.505	-2.915
Point 02	503227.205	7976633.246	17W	3.516	-2.904
Point 03	503227.205	7976633.242	17W	3.491	-2.93
Point 04	503227.197	7976633.241	17W	3.495	-2.925
Point 05	503227.215	7976633.268	17W	3.496	-2.924
Average Elevation				3.501	-2.920

Notes: CGVD=Canadian Geodetic Vertical Datum; [1]Distance from the tide gauge pressure sensor to the surveyed steel ladder top plate is 6.42 m

Figure 6: Pressure sensor location, shown by the arrow, on the downward facing end of the tide gauge

Figure 7: RTK GPS survey conducted in 2018

3.0 HARDWARE LIST

The following is a list of necessary hardware to complete the tide gauge installation:

Item Description	Quantity
26" aluminum square tube	1
Stainless steel L-brackets	2
316 stainless steel hex bolt 5"- 3/8"	2
316 stainless steel lock nut 3/8"	2
316 stainless steel lock washer 3/8"	2
316 stainless steel washer 3/8"	4
Nylon shoulder washer 3/8"	4
316 stainless steel hex bolt 4 1/2"- 1/4"	2
316 stainless steel lock nut 1/4"	2
316 stainless steel washer 1/4"	4

Item Description	Quantity
Nylon shoulder washer 1/4"	2
Zinc anode	2
316 stainless steel hex bolt 1" – 1/2"	2
316 stainless steel washer 1/2"	2
316 stainless steel lock nut 1/2"	2
316 stainless steel ½" band width hose clamps 2 9/16"-3 1/2" diameter	2
3mm 316 stainless steel wire rope	1 roll
1/8" stainless steel wire rope clip	2

4.0 TIDE GAUGE RECOVERY

Upon recovery of the tide gauge from the ore dock ladder the following steps should be done.

Step 1)

The distance from the tide gauge pressure sensor (Figure 6) and the bottom of the aluminum tube to the steel ladder top plate (Figure 7) should be recorded and accompanied by a photo of the measurements (i.e. a photo of the tape measure).

Step 2)

If determined applicable, data from the tide gauge should be downloaded using the computer software program Ruskin before shipping. The software program Ruskin can be obtained from https://rbr-global.com/products/software. The following steps should be followed when using Ruskin:

- Unscrew the tide gauge end cap to expose the USB port and battery compartment.
- Plug one end of the Apple 30 pin cable, found in the tide gauge box, into the tide gauge and the remaining end into the computer (Figure 8)
- Open the software program Ruskin. The instrument should appear in the Navigator tab under the subheading Instruments.
- Click on the Download tab and select "download". Save the .RSK file to a location on the local machine.
- Disconnect the USB cable from the logger and computer.
- Screw the tide gauge end cap back on.
- DO NOT select stop logging or enable logging.

- DO NOT remove the batteries from the instrument.

Figure 8: Apple 30 pin cable for tide gauge data download

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APPENDIX M

Background Review of Hydrology and Geomorphology in Phillips Creek Estuary

TECHNICAL MEMORANDUM

DATE 13 March 2020 **Reference No.** 1663724-182-TM-Rev0

TO Lou Kamermans, Corporate Director of Sustainability
Baffinland Iron Mines Corporation

FROM Phil Rouget **EMAIL** Philippe_Rouget@golder.com

BACKGROUND REVIEW OF HYDROLOGY AND GEOMORPHOLOGY IN PHILLIPS CREEK ESTUARY

1.0 INTRODUCTION

In 2019, Baffinland Iron Mines Corporation (Baffinland) retained Golder Associates Ltd. (Golder) to conduct a background review of arctic hydrology and geomorphology in Phillips Creek estuary. The review is intended to satisfy select requirements of Project Certificate (PC) No. 005 issued by the Nunavut Impact Review Board and to provide information to the NIRB in support of its yearly review of the Mary River Project. This memorandum presents the information collected as part of the background review conducted in 2019.

2.0 BACKGROUND

In the FEIS (Baffinland, 2012) and the FEIS Addendum for the ERP (Baffinland, 2013), it was predicted that installation of the ore dock will have minimal effect on local sediment transport and that Project operations were not likely to result in significant adverse effects on water or sediment quality. These impact predictions were used to inform the Marine Ecological Effects Monitoring Program (MEEMP) sampling design (2014 through to 2019) including the selection of sample locations and analytical parameters.

In accordance with Project Certificate Condition No. 76 and 83a, Golder on behalf of Baffinland undertook a sediment quality sampling program as part of the MEEMP (Golder, 2017). The purpose of the program was to monitor for any project-induced change to the sediment environment. Samples were collected from four transects (East Transect, West Transect, Coastal Transect, and North Transect), which were oriented in a radial pattern originating at the Milne ore dock (see Figure 2 in Golder, 2018a, provided in Attachment 1). The dock represents the potential point source of contaminants (e.g., ore dust, hydrocarbon deposition) and physical perturbations (sediment re-suspension and transportation). The radial pattern is designed to detect potential Project-related effects based on a gradient of key components with numerical indicators (e.g., percent fines and metal concentrations in sediment) with increasing distance from the point source (ore dock and effluent discharge). The statistical design is based on repeated measures (RM) distance regression analyses with each station re-sampled annually. From the point source, stations are established along the distance gradient which allows for physical, chemical and biological changes to be assessed spatially.

Sediment samples were analyzed for particle size composition, organic content, and concentrations of metals and hydrocarbons. These concentrations were compared to Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Level (PEL) guidelines for sediment. Analysis of covariance (ANCOVA) was applied to baseline and monitoring data to determine if monitoring results are significantly different than baseline conditions.

The ANCOVA results presented in Golder (2018a) reported notable changes in sediment conditions (per cent fines, iron concentration) between years, particularly on the West and East transects. However, it is unclear as to whether these changes are indicative of Project-related effects. For example, on the West Transect, no inter-annual differences were observed in percent fines or iron concentrations at sampling stations located near the dock. However, percent fines were shown to increase significantly at the far-field sampling stations from 2014 to 2017 (although measurements in 2015 and 2016 were not significantly different from either 2014 or 2017). Iron concentrations at the far-field sampling stations on the West Transect were also shown to increase significantly from 2015 to 2017 (although measurements in 2017 were not significantly different than 2014 and 2016). It was suggested that sediment conditions observed on the West Transect could be associated with alluvial deposits from Philips Creek. Golder subsequently recommended sediment sampling continue in 2018 to evaluate if temporal trends identified in the 2014-2017 sediment data continue in the same direction and to assess whether identified changes are a result of the Project or are a result of natural variation in sediment loading from Phillips Creek. Additionally, in its 2017-2018 Annual Monitoring Report, NIRB required Baffinland to further investigate how alluvial transport may be affecting sediment deposition and composition near the head of Milne Inlet.

3.0 OBJECTIVES

The objectives of the background review of arctic hydrology and geomorphology in Phillips Creek Estuary aim to specifically address Project-specific requirements outlined in the Terms and Conditions of PC No. 005 and Recommendation No. 11 from the NIRB 2017-2018 Annual Monitoring Report and Board's Recommendations.

- **Shoreline Effects Sediment Redistribution (Comment from NIRB):** *Terms and Condition 83(a) of the Project Certificate require that the Proponent identify potential for, and conduct monitoring to, identify effects of sediment redistribution associated with construction and operation of the Milne Port. Within the 2017 Annual Monitoring Report to the NIRB, Baffinland indicated that the sampling in 2018 suggested there was a significant increase in the percentage of fine sediment at far-field sampling stations (500 metre (m), 1000 m, and 1,500 m) along the West Transect from 2014 to 2017 and further noted that this change was associated with alluvial depositions from Phillips Creek.*
  - **Recommendation 11:** *The Board requires that Baffinland conduct sediment sampling in 2018 and subsequent years to further evaluate temporal trends and monitor annual sediment transport via Phillips Creek into Milne Inlet, as well as to learn how alluvial transport may be affecting sediment deposition and composition near the head of Milne Inlet.*
- **Condition No 83(a):** *To identify potential for and conduct monitoring to identify effects of sediment redistribution associated with construction and operation of the Milne Port.*

4.0 HYDROLOGICAL AND GEOMORPHOLOGICAL LITERATURE REVIEW

A literature review was carried out to synthesize background data and interpretations of arctic hydrology and geomorphology that could be used to describe the typical hydrologic regimes of arctic watersheds similar to those near the Site, particularly Phillips Creek, the primary stream draining into Milne Inlet. Aspects of arctic hydrology, including snowfall, rainfall, and permafrost have been summarized, followed by a review of their influence on local stream sediment regimes.

4.1 Arctic Hydrology and Geomorphology Regime Review

4.1.1 Stream Hydrology Regime

Milne Inlet is located on Northern Baffin Island. The region is situated within the transition zone between the High Arctic and the Middle Arctic (Prowse, 1987). The climate is characterized by long cold winters interrupted by short cool summers. Precipitation is relatively low and is concentrated in the warmer months, from June to September.

Arctic watersheds similar to Phillips Creek typically have nival hydrologic regimes dominated by snow and permafrost. The discharge hydrograph is characterized by a distinct peak flow in the spring that is produced by snowmelt followed by a rapid decline in flow volume to a low discharge period which is interrupted by short peaks in discharge generated by rainfall events. During the melt season, which occurs from late spring to early summer, stream discharge hydrographs typically exhibit a diurnal cycle resulting from the daily fluctuations in solar radiation and melt rate where the peak melt and runoff occurs in the early to mid-afternoon (e.g. Woo, 2000). A lag is typically observed for the diurnal cycle between the beginning of the snowmelt and the streamflow response, and between daily maximum melt time and the daily peak flow time. The impacts of snowfall, rainfall, and permafrost on the hydrologic regime are described in more detail in the following sections.

4.1.2 Snowpack and Snowmelt Regime

In the Arctic, the spring snowmelt is typically the dominant hydrological event of the year and is responsible for up to approximately 90% of the annual discharge (Forbes and Lamoureux, 2005; Marsh et al., 1995). Runoff during the snowmelt season typically lasts from late May until late June. The magnitude and duration of runoff during this period is related to snow accumulation and distribution, as well as the timing of snowmelt and influencing hydrometeorological factors, such as incoming solar radiation, air temperature, and precipitation during the summer melt season.

Snowfall across the Arctic is variable with some regions receiving more snow than others (Frugal and Prowse, 2008). The mean annual snowfall at the Environment Canada climate station nearest to the Site, Pond Inlet, Climate ID 2403201, is approximately 131 cm (EC Climate Normals 1981 to 2010)[1]. Based on observations in other arctic watersheds, (McNamara et al., 1998) snowfall is expected to be higher in catchment headwater areas and lower at lower elevations). Due to open terrain, limited shelter, and characteristically high winds across the region, the snow cover over a typical watershed is usually redistributed. Topographic depressions and valleys within the watershed tend to accumulate more snow at the expense of exposed terrain (Woo, 1983). The distribution of snowpack and snow water equivalent can vary significantly from year-to-year due to annual variability in both snowfall and wind conditions. These processes, compounded by topographic effects on solar radiation exposure, result in runoff regimes that are highly variable both between watersheds and over time.

[1] Station Pond Inlet A (Station ID 2403201); elevation is approximately 60 m

Phillips Creek watershed, located approximately 150 km southwest from the Pond Inlet climate station, is expected to have similar annual snowfall values, and a similar snowfall distribution pattern within the watershed to the catchments studied by McNamara et al. (1998)– higher values over the headwater catchments and lower values over the downstream catchments (located at lower elevations). In addition, watershed topography (depression, valleys) will have a similar influence over snow distribution within Phillips Creek Watershed as the catchments described by Woo (1983).

4.1.3 Permafrost

Permafrost (frozen ground) is a common feature in arctic environments. It acts as an impermeable layer, limiting the infiltration of water into the ground below the active layer. This means most hydrological processes are typically restricted to the surface and the shallow active layer above it; therefore, most snowmelt and rainfall is converted into runoff (Forbes and Lamoureux, 2005). Extreme seasonal changes in surface energy impact the magnitude of soil freezing and thawing and therefore the depth of the active layer (Kane et al., 2000; Woo, 2000).

The permafrost layer within Phillips Creek watershed likely has similar effects on the hydrological processes of the watershed as those described above. A shallow active layer at the surface contains most hydrological processes, and the watershed runoff and ground infiltration from Phillips Creek watershed will typically be limited to the active surface layer.

4.1.4 Rainfall

Rainfall in arctic watersheds is typically limited to the period from June through August. The rainfall events are typically of low intensity (EC Climate Normals 1981-2010, Pond Inlet A Climate Station), although storm events with shorter durations and higher intensities often occur. High-intensity rainfall events usually cover smaller areas and therefore will tend to generate a rapid response in small headwater watersheds.

While the majority of annual runoff is generated by snowmelt in arctic regions, instantaneous peak flow rates are sometimes higher following summer rainstorms than following snowmelt, especially for small headwater watersheds (McNamara et al., 1998).

Rainfall over Phillips Creek watershed will have similar patterns that are typical to published data on rainfall over arctic watersheds. Most of the rainfall will occur between June and August and will have typically low intensities. Some storm events with higher intensities and short duration are expected, but they will likely be limited to smaller sub-basins and have a smaller effect on Phillips Creek discharge.

4.1.5 Arctic Sediment Regime

Sediment yield in rivers is a function of both water discharge and sediment supply. The hydrological response of an arctic watershed directly influences fluvial erosion and sediment transfer, and even with a relative short streamflow season, streams in arctic environments are capable of considerable sediment transport due to high sediment supply from sparsely vegetated surfaces.

Streams typically transport a mixture of inorganic material (mineral or soil-based sediment – e.g., silt, sand, gravel, etc.) and organic material (detritus of biological origin, including plant matter). The sediment load can be separated into three components: the suspended load (finer materials suspended in the water column), the bed load (coarser materials on the streambed frequently transported by saltation or rolling), and the dissolved load (sediment typically derived from chemical weathering that is carried by the flow in solution). For the purpose of this review only the suspended and bed load sediments are discussed.

The sediment transport load in a stream varies between the open water season and the frozen water season due to differences in flow regime and sediment availability. Typical sediment transport characteristics for each season are described below.

The sediment regime of Phillips Creek is expected to be similar to a typical arctic watershed, as described above. Sediment transport in Phillips Creek will have different characteristics for each season, as different hydrological process will dominate each season. The following sections describe the main seasons and the hydrological processes and the associated sediment transport characteristics for each of them.

Freshet and spring snow melting

Arctic streams typically have high sediment concentrations during the spring melting period. Even though the snowmelt period usually only lasts a few weeks, typically over 80% of the annual sediment yield is transported during that time (Lewkowicz and Wolfe, 1994). The sediment load varies from year-to-year and depends on the magnitude and duration of high flow events, which are functions of the hydrometric factors described above (available snowpack from the winter snow accumulation, temperature, and the intensity and duration of the melt. In addition, other local watershed-specific conditions (e.g. snow dams, wind activity, and mass movements) can affect the availability of water available for streamflow generation (e.g. Woo and Young, 1981).

Sediment supply to the channel during the snowmelt period is typically derived from erosion of the riverbanks, re-entrainment of sediments contained within the active channels after the ice melt is complete, and the inclusion of additional loose eolian materials that melt out of the terrestrial snowpack and are carried by runoff or by winds into nearby streams. As the snow-cover is depleted and exposed soils undergo thaw, substantial typically unvegetated and unconsolidated material is available for transport. In addition, ice-rich materials are subject to loss of volume during melt, causing considerable subsidence and slumping, especially for steep terrain closer to the stream channel (Woo and McCann, 1994). As an arctic stream, sediment transport in Phillips Creek during the freshet will present similar patterns as the surrounding area. The largest discharges typically occur during this period (KP, 2018; EAG, 2019; SE, 2018) and they are expected to carry the largest volume of sediments. As described above, most of these sediments are sourced from locations adjacent to the stream, where melting is occurring. As the melting season progresses and more parts of the watershed melt, the sediment sources will extend further away from the main channel of Phillips Creek, into its tributaries.

Summer Rainfall Events

Sediment transport for the arctic streams in the summer typically occurs after rainfall events. High-intensity storms can potentially generate similar or even higher sediment concentrations compared to typical summer values, over short periods (typically a few hours). However, averaged over the season, the total volume of sediments transported during storms is typically lower than the spring melting period. High intensity summer rainfall events tend to occur over a reduced area, and therefore high sediment loads are typically limited to smaller tributaries and tend to be more diluted further downstream with the increase in catchment area and stream discharge.

In the summer, sediment sources are typically derived from snow free zones adjacent to the stream channel, such as floodplains, terraces, and nearby hillslopes (Woo and McCann, 1994). The processes that deliver sediment to the river include bank and bed scour, slopewash, mass wasting (either a rapid or a slow-moving soil mass), gullying, and eolian transport. There is less snow cover in the summer, meaning that sediment is typically sourced from a higher proportion of the watershed, including locations farther away from the streams.

Sediment delivery in the summer season is typically characterized by a pulse-like behaviour, with each pulse being associated with a rainfall event. Sediment yield does not, however, always scale with water discharge because of hysteresis, a phenomenon caused by time-dependent availability of sediment. Some streams may exhibit clockwise hysteresis, whereby the sediment load for a given discharge is greater for a given flow during the rising limb of the event hydrograph than on the falling limb. This could occur if the majority of the available sediment supply is transported at the beginning of the flow event or season, meaning that less sediment is available during later flows (e.g. Coch et al., 2018; Tananaev, 2015). In contrast, if bank erosion, connectivity to fresh sources of sediment throughout the season, or a mass failure releases a fresh supply of sediment to the channel during a flow event, the stream may experience counter-clockwise hysteresis, where sediment loads during the falling limb of the event hydrograph exceed those of the rising limb (e.g. Tananaev, 2015). Hysteresis may occur over an individual flow event or over the course of a season, and the stream may experience different types of hysteresis from year to year and between different rainfall events.

Rainfall events over Phillips Creek watershed will present similar patterns to an arctic watershed and therefore will generate similar sediment transport patterns. The sediment sources are typically found in areas with exposed (no snow or vegetation) materials near the stream channel, and further away the stream later in the season. The sediment delivery will occur through similar processes: bank and bed scour, slopewash, mass wasting (either a rapid or a slow-moving soil mass), gullying, and eolian transport.

Winter Flows

During the winter, discharge is much lower than the summer flows, and only the larger streams support flows. During this period, little sediment transport typically occurs. The surrounding terrain and the stream banks are frozen and covered with snow; therefore, the main sources of sediment are not available. Because of the low flows and the low stream energy available for sediment transport, only fine sediments (sand or smaller) are transported by the river.

Winter flows in Phillips Creek are expected to be similar to the surrounding Arctic watersheds. The low flows recorded at the end of the open water season (KP, 2018; EAG, 2019; SE, 2018) within Phillips Creek watershed show a reduced discharge compared to the summer flows, and with the entire watershed covered by snow, the sediment transport is expected to be low and only present along the mainstem.

4.2 Summary

The snowpack, atmospheric energy input during the melt season, and sediment availability are the main contributing factors to the annual transfer of water and sediment from typical nival arctic watersheds. The watersheds draining into Milne Inlet are characterized by this general hydrologic and sediment transport regime. Peak discharges tend to occur over the spring melt period and are typically a driving factor for sediment transfer. The majority of the annual sediment load (around 80%, Lewkowicz and Wolfe, 1994) typically occurs over the spring melting period, and this is likely to be the case for Phillips Creek and other streams draining into Milne Inlet.

Summer rainfall can also generate large peak flows; however, runoff is rarely higher than the spring runoff, especially on larger streams, because large rainfall events are relatively rare in arctic environments and tends to be limited to sudden downpours confined to only small areas such that the effect within an overall watershed is limited. This is likely to be the case for Phillips Creek as is supported by available hydrometric data (presented below).

A large degree of spatial and temporal variability for sediment transport has been observed on arctic watersheds (Cogley and McCann, 1976, Church, 1988, Woo and Young, 1997). The variation is caused by annual variability in the flow regime as well as variability in sediment supply (either sediment source limitation or depletion in or near the river channel and floodplain, or within the entire watershed), vegetation cover, topography and geology, localized mass wasting, watershed size (smaller watersheds tend to have high-rates of rain-induced sediments).

Because of all the factors that can influence the sediment and runoff production of an arctic watershed, its annual sediment yield is highly variable (temporal – year to year, during a single open water season, and spatially). Available data from Phillips Creek, including air photographs and stream discharge measurements, indicates that the stream is typical of Arctic streams and experiences similar variability in runoff and sediment load. These data will be discussed below.

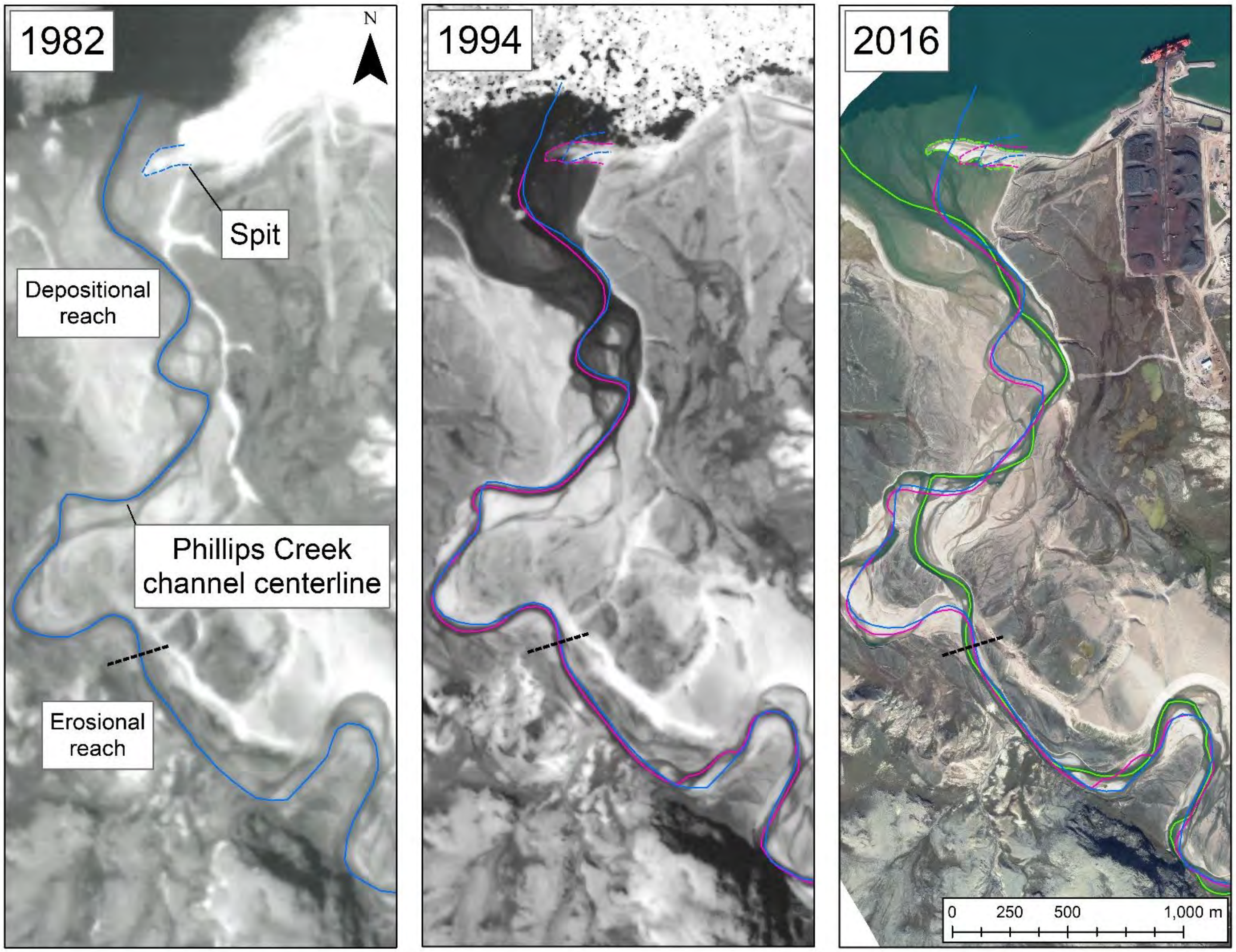

Figure 1: Geomorphic change in the vicinity of the Phillips Creek delta

5.0 SEDIMENT TRANSPORT REGIME OF PHILLIPS CREEK AT MILNE INLET

A review of the hydrological and geomorphic data was carried out for the project. The data are reported in the following sections.

5.1 Historical Air Photos Review

Two sets of historical air photos from the National Air Photos Library were reviewed to assess spatial and temporal characteristics of the Phillips Creek sediment regime and depositional environment. The photos cover two different epochs: the year of 1994 and year of 1982 (Table 1). In addition, August 2016 satellite imagery provided by Baffinland was included as a more recent reference.

Table 1: Historical Air Photos Summary

Date	Air Photo ID	Scale	Spectral Range	Notes
30 June 1982	A26037 – 206, 207	90,000	Black & White	Low Tide for Milne Inlet, with open waters at the mouth and ice cover further from the mouth. Phillips Creek flows appear below bankfull elevations (islands are exposed). The main channel at the mouth appears to be covered by fine sediments (gravel and finer).
11 August 1994	A28108 – 81, 82, 83, 98, 99, 100, 101	60,000	Black & White	High tide for Milne Inlet, with blocks of ice. Phillips Creek flows appear below bankfull elevations (islands are exposed). The main channel at the mouth appears to be covered by fine sediments (gravel and finer).
August 2016	N/A (satellite image)	N/A	Colour	High tide for Milne Inlet, with open water conditions. Phillips Creek flows appear below bankfull elevations (islands are exposed). The main channel at the mouth appears to be covered by fine sediments (gravel and finer). Longshore drift was noticed on the right bank of Phillips Creek that diverted the main channel to the west.

The review of the historical air photos for Phillips Creek mouth into Milne Inlet is summarized below:

- Phillips Creek channel planform at the mouth shows an irregular meandering form, with a relatively high sinuosity. Meander length in this section of the stream was estimated between 500 and 900 m.
- The channel morphology as observed from the historical air photos appears to be a riffle-pool.
- The imagery suggest that the streambed materials are composed primarily of gravel and finer sediment.
- The 1982 air photos, taken in late June, show Phillips Creek entering Milne Inlet. The streamflow is interpreted to be warmer than the ocean and with river water levels above average given the freshet period. The freshwater discharge appears to be behaving like a density plume and flowing out over top of the salt water, flowing into an open water area of the ocean for at least 2.5 km. It is inferred and likely that the contribution of freshwater is a factor in this ice-free area. This distance was interpreted to represent the area where the Phillips Creek sediments could be deposited during the given photo year, although the length of the plume can be expected to be highly variable from year to year depending on peak discharge and water temperature in the stream and inlet.

- Sediment deposition at the mouth of Phillips Creek is interpreted to have resulted in delta formation. A delta is a depositional feature that typically occurs at the mouth of a river entering standing water. When Phillips Creek enters Milne Inlet, its velocity is greatly reduced, resulting in sediment deposition. Deltas typically contain numerous small sub-dominant channels in addition to the main channel that are active and often migrate. This results in a complex and highly variable stream channel distribution and sediment deposition regime.
- A spit (an elongated deposit of beach material projecting into the inlet) is present along the eastern portion of the delta in all three sets of imagery (Figure 1). Its formation is attributed to longshore drift (sediment movement along a shoreline due to prevailing winds causing waves to hit the shore obliquely).
- The spit expanded westward between 1994 and 2006, increasing in length from approximately 200 to 425 m (an annual spit migration rate of approximately 10 m/year). Most of the spit development is interpreted to be due to the primary channel of Phillips Creek moving from the eastern margin to the western margin of the delta between 1994 and 2016, allowing westwards deposition of sediment due to longshore drift to establish in the area. The flow velocity of freshwater discharge from the river would have interrupted the wave-driven current velocity of longshore transport in the area of the modern (post 1994) spit while Phillips Creek discharged on the eastern side of the delta. With the change in location of the point of discharge, longshore transport re-established and the spit was built
- The reach stretching from Phillips Creek mouth upstream approximately 2.5 km appears to have a low gradient and a braided wandering morphology characterized by a dominant channel and numerous sub-dominant channels, mid-channel and side bars, and meanders (active or cut-offs, Figure 1). This area is interpreted from the air photos to be primarily depositional.
- The reach stretching from approximately 2.5 km upstream from the mouth to approximately 17.5 km upstream of the mouth appears to be typically erosional; the main channel appears to be incising into its own historical glaciofluvial sediments (mostly gravel, sand, and finer). These sediments may constitute a significant portion of the sediment supply to the Phillips Creek delta.
- Lateral channel migration occurred on Phillips Creek approximately 1.5 km upstream of its mouth between 1982 and 2016 (Figure 1). The channel moved towards the right bank (eastward) by approximately 330 m. It is possible that this channel movement took place over a short period of time (river avulsion during an open water season), possibly a result of a freshet event. At the same location, local bank erosion occurred on the outside bend of a meander along the right bank, with erosion of up to 50 m in some locations (an average migration rate of approximately 0.7 m/year). These erosional events will have released sediment to Phillips Creek and were likely associated with an increase in sediment load to Milne Inlet.
- A meander cut-off was observed approximately 2.5 km upstream of the stream mouth, where the main channel migrated toward the right bank (eastward) by approximately 400 m, between 1982 and 2016 (Figure 1). Local bank erosion was also observed at this location; the annual migration rate is similar to the rate downstream. The meander cut-off would have locally increased stream gradient through the cut-off leading to increased sediment load to the mouth of Phillips Creek and Milne Inlet.
- Both stream banks in the downstream-most 2.5 km of Phillips Creek were interpreted to be composed of fine sediments (gravel and finer sizes) that have a low erosional resistance. These banks provide readily erodible sources of sediment to Phillips Creek, the Phillips Creek delta and to Milne Inlet.

The river morphology and the river processes interpreted from the aerial imagery indicate an active stream characterized by bank erosion, channel migration, and meander development and cut-offs that form significant sources of sediment to the Phillips Creek delta and Milne Inlet. This stream reach is characterized by an ongoing imbalance between sediment erosion (greater) and sediment storage (lesser) based on observed evidence for channel incision into older river valley sediments, with material released downstream to the Phillips Creek delta and Milne Inlet as the stream reworks its deposits. Most morphologic change likely occurs during the freshet periods, when flow is elevated for a relatively long period of time and when the high-water levels are recorded).

5.2 Hydrology Regime of Phillips Creek Watershed

Hydrometric monitoring data within the Phillips Creek watershed is only available for a tributary located approximately 50 km upstream of the Phillips Creek mouth (Site H1, KPL, 2012). The measured flow data and site observations indicate that streamflow within the upper watershed typically begins in early June and ends in late September. The annual hydrographs are dominated by a nival (snowmelt) peak flow that occurs between late June and mid July, followed by a flow recession into the fall season. The recession is punctuated by short and intense runoff events generated by summer rainfall storms (the rainfall signal is likely dampened with distance downstream). In addition, the flow diagrams also present significant diurnal variability, mostly during the freshet period and before the freeze up, caused by temperature driven processes – snowmelt in the spring and soil freeze in the fall.

A typical seasonal flow hydrograph for Phillips Creek is presented in Figure 2. The freshet period is highlighted and shows the largest flows of the year, and the typical diurnal variations in flow, likely driven by snowmelt processes.

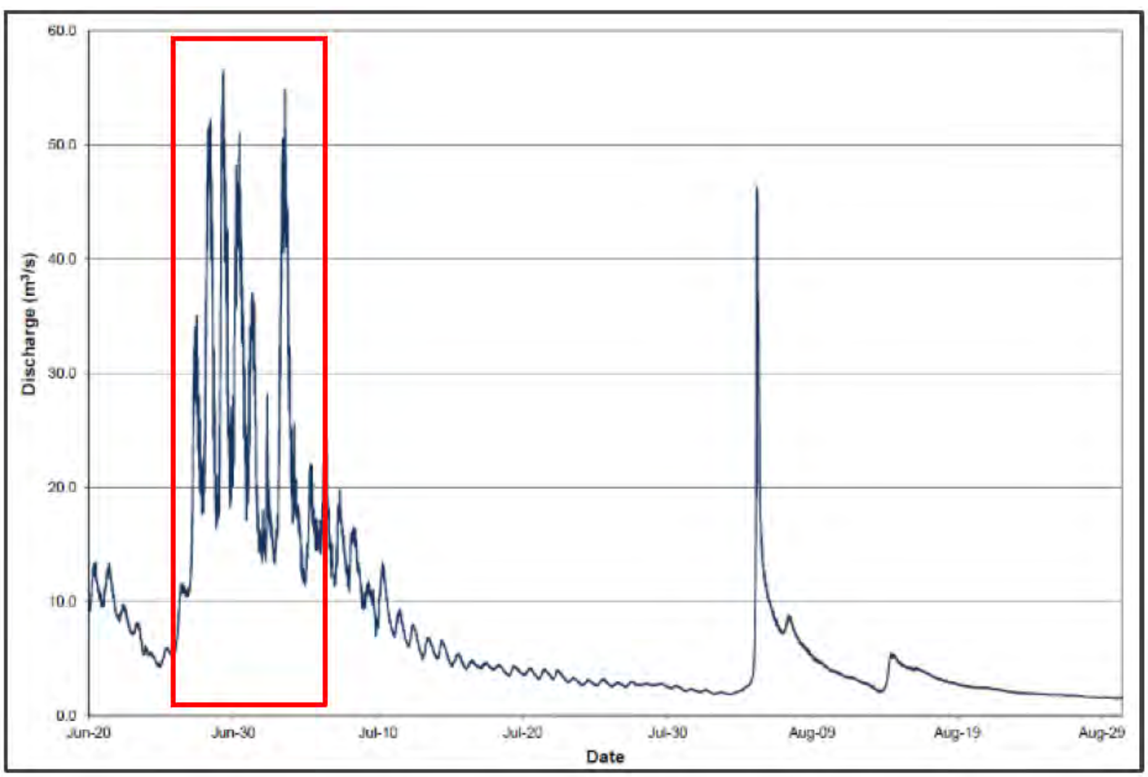

Figure 2: 2016 hydrograph for Site H1, a tributary of Phillips Creek. The freshet period is highlighted. Adapted from Story Environmental (2017).

5.3 Milne Inlet Sediment Data Review

This section presents a summary of the sediment data collected at Milne Inlet. Sediment sampling was completed during the open water season (typically in August) in 2014, 2015, 2016, and 2017 using a sediment sampler with a sampling area of approximately 225 cm^2.

The West Transect, which extends closest to the Phillips Creek mouth, was selected for this review. The transect starts on the east side of Milne Port infrastructure (i.e. ore dock and ship loader) and extends westward approximately 500 m, from the mouth of Phillips Creek into the inlet. The measured sediment size data are summarized in Table 2.

It was reported in the Golder (2018a) analysis that the measured sediment distribution may have changed along this transect over the review period (2014 to 2017). Golder had performed an ANCOVA statistical analysis on the 2014-2017 sediment size data and found that there were statistically significant differences in the relationship between sediment size and distance from the port between sampling years and transects. The statistical analysis references only the sediment size and the distance from the transect origin and does not consider the potential effects of stream-related inputs to local conditions that the transect crosses. For the West Transect, the length of the transect includes the area of influence of Phillips Creek. As will be discussed in Section 6.0, the size and composition of sediments in the vicinity of the Phillips Creek delta are strongly influenced both by coastal processes and by geomorphological processes occurring within the Phillips Creek watershed.

Table 2: Summary Sediment Data SW Transect

Station, UTM E UTM N	Date	% Gravel (>2mm)	% Sand (2.0mm - 0.063mm)	% Silt (0.063mm - 4um)	% Clay (<4um)
SW-1 E 503419 N 7976660	2014	--	--	18.2	7.0
	2015	--	--	22.3	6.1
	08-Aug-16	8.7	57.0	24.3	9.8
	13-Aug-17	41.7	56.8	1.1	1.0
SW-2 E 503147 N 7976572	2014	--	--	26.3	8.4
	2015	--	--	41.3	5.4
	08-Aug-16	6.7	58.0	26.3	9.2
	14-Aug-17	5.0	74.2	17.2	3.8
SW-3 E 502961 N 7976467	2014	--	--	31.4	4.4
	2015	--	--	35.5	3.2
	08-Aug-16	12.7	51.3	31.7	4.2
	13-Aug-17	10.9	51.5	30.7	6.9
SW-4 E 502721 N 7976424	2014	--	--	40.0	2.9
	2015	--	--	24.0	3.7
	08-Aug-16	8.2	70.7	18.3	3.2
	13-Aug-17	5.6	55.0	32.5	6.9
SW-5 E 502264 N 7976526	2014	--	--	6.6	3.1
	2015	--	--	17.0	5.1
	08-Aug-16	5.7	59.3	29.0	5.7
	13-Aug-17	1.0	61.2	32.9	4.9

Note: -- = data not available for the coarser portion of the sample.

6.0 DISCUSSION – SEDIMENT TRANSPORT REGIME OF PHILLIPS CREEK

The following presents a summary description following Golder's review of the sediment transport regime of Phillips Creek and its effects on Milne Inlet:

1) Arctic hydrology and stream morphology:

The hydrology of arctic streams is dominated by the spring snowmelt: the total amount of snow accumulation on the ground and the timing of the snowmelt in the spring are the main drivers that determine the magnitude and duration of the main hydrological event of the year (open water season) for Phillips Creek. The annual hydrograph is characterized by a distinct snowmelt-driven peak flow in the spring, which generates the largest discharge volume. The peak is followed by a recession to low flows interspersed by short peaks generated by summer rainfall events. Flow is minimal in the fall and winter. Given the large catchment area of Phillips Creek and the typically localized extent of rainfall in the arctic, the summer short flow peaks are likely to be higher in amplitude in the headwater areas (with smaller catchment areas), compared to the downstream areas at the river mouth.

Flow is typically highly variable in arctic streams from year to year because of annual differences in the amount of snowfall, snow redistribution, solar radiation during the melt season, and the nature of summer rainfall.

2) Arctic sediment transport regime and fluvial morphology:

The historical air photo review indicates that the downstream-most 15 km of Phillips Creek is an active stream that appears to be eroding and incising into its own glaciofluvial deposits (likely sand and gravels) deposited during the last glaciation. Its meanders are actively eroding on the outside bends and delivering sediments to the channel resulting in a braided wandering channel planform typical of rivers with a surplus of sediment supply relative to the ability of the channel to move that sediment. These sediments provide a natural supply of sediment that is transported to the Phillips Creek mouth and delta.

There is ample evidence of sediment erosion and transport within the Phillips Creek watershed and deposition of this sediment on the Phillips Creek delta and out into Milne Inlet. Sediment transport, erosion, and deposition are correlated with the hydrological response of the watershed. As such, the majority of the annual sediment load near the mouth of Phillips Creek (typically greater than 80%) is likely transferred during the spring-melt generated peak flows. The sediment load depends on the snowpack, the intensity and duration of snowmelt, and the amount of sediment available for transport. Sediment supply typically varies from year to year and can be sourced from bank erosion, mass movements, snow dams, and aeolian transport. The natural variability of all these factors means that the sediment load is typically variable from year to year:

- Years with a high-water yield will typically transport a larger sediment volume, provided that adequate supply is available.
- Years with high peak flows are able to transport sediment with a coarser grain size (large gravels and sand)
- Years with reduced flows will typically transport a smaller sediment volume with a finer grain size distribution (primarily sand and silt).

3) Coastal factors and morphodynamics:

Air photo and field observations of Phillips Creek and Milne Inlet suggest that multiple processes are responsible for sediment transport to, and deposition within the delta, as well as out into Milne Inlet near the mouth of Phillips Creek. Data from 2017 collected along the south shore of Milne Inlet (Golder, 2018a) to characterize the inter-tidal morphology and sediments along the shoreline indicates that the beach is formed of massive deposits of sand, gravel, and cobble, likely of glacial or glacio-fluvial origin. Local relict drainage channels that cut through the shoreline berm show inter-bedded layers of sand, silt and gravel features from larger scale fluvial or glacio-fluvial deposition. The observed sediment layers appear to have the coarse fraction (mostly gravels) represented as a discontinuous layers that pinch out between other layers and have a lens-like (lentiform) shape. These lenses of coarse materials and the pinching out of these discontinuous layers are indicative of former depositional events (pulses of fluvial sediment delivery) associated with previous (historical) large flood events. The relative proximity to active or historically abandoned channels of any sediment sampling conducted will strongly influence the grain size distribution of materials found at the seabed.

Review of site imagery (historical air photos and recent satellite imagery) shows that longshore drift occurs in Milne Inlet. Sediment is transported from east to west along the south shoreline of the inlet. The mouth of Phillips Creek is located in the southwest corner of Milne Inlet and therefore receives sediment transported along the Inlet shoreline in addition to sediment from the creek. This was interpreted from the spit formation that developed at the mouth of the creek, observed between 1982 and 2006. Over the last 35 years, the mouth of Phillips Creek has moved westward as the sand spit advanced across the delta. This advancement of longshore sediment implies that sediment sampling around the delta will incorporate both recent and historical fluvially deposited sediments as well as coastally derived sediments and the sediments sampled from the seabed may be expected naturally to vary significantly over short distances and through time.

The sediment transport regime at the mouth of Phillips Creek will also be affected by other coastal factors, including wave transport and ocean ice drift. In the shallower areas of the delta, ice drift can mix and redistribute sediment, especially during the winter and spring.

Weather parameters such as wind and temperature can contribute to a further intensification of the coastal factors listed above:

- Wind speed and direction can affect local shoreline currents or wave generation. Wave reworking of sediments along the shore can further contribute to sediment mixing and redistribution. Wave reworking at depth in near-offshore locations of the delta will depend on the severity of wave events during the open water season.
- Air temperature can affect the rate of ice melting at the Phillips Creek mouth. It also impacts the temperature (and therefore density) of fresh water coming from Phillips Creek during the melting period, which partially determines how far water (and entrained sediment) are carried in a sediment plume into the inlet.

4) Measured sediment size data:

The 2019 review of the sediment data collected along the transect that crosses the Phillips Creek mouth indicates that there is natural variability in the grain size distribution over time (2016, 2017 and 2018). These variations in grain size are interpreted to be due to the natural variability in sediment erosion and deposition typical of fluvial, deltaic, and coastal environments.

7.0 CONCLUSIONS

Following the above considerations as lines of evidence for the sediment transport regime of Phillips Creek and Milne Inlet, the following can be concluded:

- The deltaic environment and landforms near the Phillips Creek mouth into Milne Inlet are highly variable with complex depositional patterns that are further reworked by coastal processes. Within the period of available air photo records (1982-2016), the delta was reworked by natural geomorphic processes including sediment deposition, migration, and avulsion of Phillips Creek and the westward extension of a coastal spit on its eastern side. Sediment composition at any given location is expected to change due to this reworking.
- The amount and size of sediment that is deposited by Phillips Creek on the delta in Milne Inlet is expected to change from year to year due to annual variability in the sediment load (caused by the flow rate, sediment supply, proximity to the active mouth of Phillips Creek, and proximity to the extent of the river sediment plume in any given year), coastal factors at the Phillips Creek delta, the rate of melt and therefore presence of material dropped from floating ice, and the depth of wave-related stirring of seabed sediments during the open water period.
- The SW transect that crosses into the Phillips Creek mouth measures sediments in a highly variable deltaic environment with coastal and fluvial processes affecting the sedimentation. These processes create spatial and temporal variabilities that are larger than the size/area of the sampler (approximately 225 cm^2). Therefore, the measured sediment size percentages for the 2014 to 2017 samples are reasonable and within the expected range of natural variability. This implies that the conclusions from Golder (2018a), specifically that there had been a significant increase in the percentage of fines as a result of the Project, is no longer valid and that the observed changes are within natural norms.

The sediment transport and deposition of Phillips Creek plays an important role in the geomorphology and the sediment transport regime at the head of Milne Inlet, in addition to prevailing coastal processes. The sediment transport and deposition within Phillips Creek delta at Milne Inlet has a high natural variability and is controlled/influenced by coastal and river factors at the same time. These factors are more variable and have a much larger influence on the deposition patterns compared to local activities at the port in the inlet. Changes to sediment size observed between 2014 and 2017 (Golder, 2018a) cannot be attributed to the Project.

The sediment quality sampling program as part of the MEEMP and procedure for detection of impact is based on the premise that sedimentological impacts of the Project on the Inlet (e.g. sediment fining and iron concentration increases due to iron ore deposition) would be most severe in the vicinity of the port, with declining impact with distance away from Project infrastructure. These patterns are expected to be typically detectible along portions of the sampling transect outside of the influence of the delta, where there is less spatial and temporal variability in sediment deposition. In addition, while any possible Project impacts cannot be resolved at the delta over the short term (up to several years), long term trends such as an increase of fines observable over decades may be an indicator of iron ore dust or fines deposition.

In light of these conclusions, Golder recommends that the sediment sampling program, conducted annually since 2014 in accordance with Project Certificate Condition No. 76 and to address the requirements of 83a, continue annually as planned to further evaluate changes in sediment chemistry and composition, and to confirm results of hydrodynamic and sediment transport modelling conducted for Baffinland's Phase 2 proposal (Golder, 2018b). It is recognized that a limitation of the current sampling program is that short-term sedimentological impacts to the Phillips Creek delta and spit area (the outer portion of West Transect) caused by the Project cannot be detected given the naturally high spatial and temporal variability of sediment deposition there. However, resolving impacts of the Project along the delta and spit would require a comprehensive research program of the Phillips Creek and Milne Inlet sediment regimes, which is out of the scope of the Project. The current sampling program is running at its practical capacity given the short duration of ice-free conditions in the Inlet. Golder recommends that sampling focus on assessing potential Project-related sedimentological changes to the Coastal, North, and East Transects and on identifying any long-term trends that may emerge on the West Transect after many more years of sample collection.

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Attachments: Map Showing MEEMP Sampling Transects

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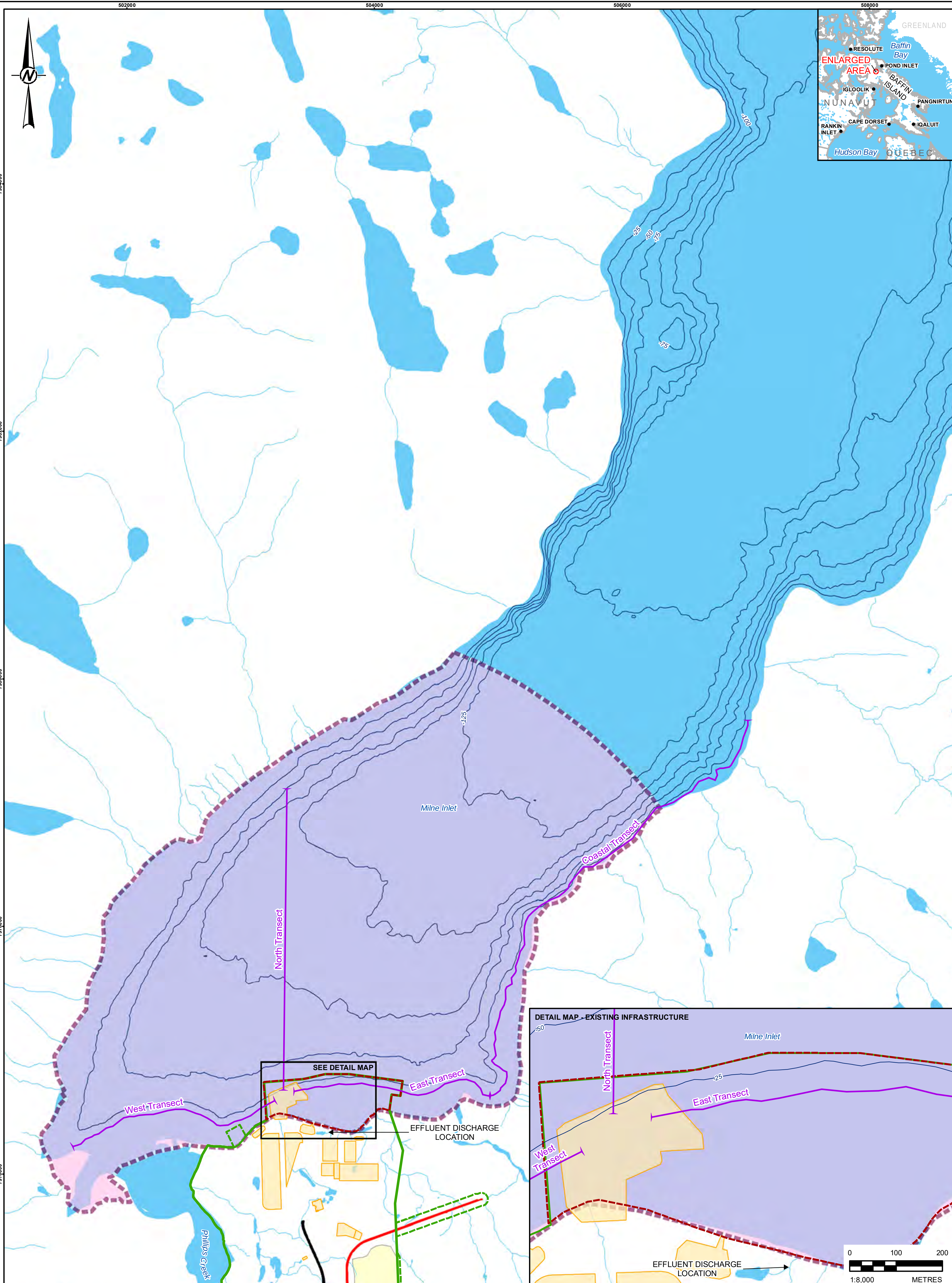
ATTACHMENT 1

Map Showing MEEMP Sampling Transects

PATH: I:\2016\1663724\Mapping\MXD\Fish\10000_MEEMP\1663724_10000_Fig2_RadialGradientStudyDesign_Rev0.mxd PRINTED ON: 2018-02-19 AT: 11:17:30 AM



LEGEND

- POPULATED PLACE
- BATHYMETRIC CONTOUR (25 m INTERVAL)
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- PDA / QIA COMMERCIAL LEASE
- REVISED PDA FOR PHASE 2 PROPOSAL
- TRANSECT
- WATERCOURSE
- AGGREGATE SOURCE (BORROW PIT OR QUARRY)
- EXISTING INFRASTRUCTURE
- INAC FORESHORE LEASE
- LOCAL STUDY AREA
- WATERBODY

0 500 1,000

1:30,000 METRES

REFERENCE(S)

BATHYMETRY CREATED BY GOLDER FROM MULTIPLE DATA SOURCES.
HYDROGRAPHY AND TOPOGRAPHY DATA BY EAGLE MAPPING (2005), RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE, MAY 2017.
MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017.
HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT
BAFFINLAND IRON MINES CORPORATION

PROJECT
MARY RIVER PROJECT – MARINE ENVIRONMENTAL EFFECTS MONITORING PROGRAM

TITLE
RADIAL GRADIENT STUDY DESIGN

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-02-19
DESIGNED	EG
PREPARED	AA
REVIEWED	JS
APPROVED	PR

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	10000	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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APPENDIX N

2019 MEEMP Program Participant Survey

2019 MEEMP Program Participant Survey

Program Design

1. How was your experience with the MEEMP Program?
   - Very interesting, enjoyed seeing the variety of organisms
   - Bring extra equipment that is being deployed into the water (i.e., grab).

2. What changes would you suggest to the program for the future?
   - Safety reasons with starting the zodiac, it would be beneficial to install a floating freight dock. In case of a Code 1, it would be a good idea to have a rescue kit, Hunters needed a rescue and it took a long time to get everything together (boat drifting off of Bruce Head)
   - Handling of the fish removes the slime causing them to be susceptible to getting sick. Bring them back as they will die anyway

3. What do you think the MEEMP program accomplishes in its study?
   - Confirming the contamination in the area, getting info on what the seals are eating.
   - Would like to know how the contaminants are affecting the seals? (i.e., tumors observed)

4. Do you think that water quality and sediment quality are accurately captured?
   - Yes, the contaminants are settling out of water column onto seafloor.
   - Fukui traps are being set too close to shore, need to account for the tides. Set them in deeper waters (80-90 m), SEM was collecting a lot of organisms in their Fukui traps. Not accurately placed.

5. Do you like the sampling equipment and procedures currently used in the program?
   - Yes, grab seems efficient.
   - The winch/davit system is a lot better than hand deploying the grab by hand
   - Would like the crew to get training/certificates to operate the ROV. If SCUBA is required, he would like that training to be offered to the team
   - SCUBA diving is also beneficial for emergency response

6. Do you think the program should expand to include a larger study area outside of Milne Inlet?
   - A lot of drifting by the ore carriers when waiting to be called into Port. Concerned about release of ballast water.
   - A good idea to see if any organisms or contamination is being carried by the currents from Ragged Island towards Pond Inlet. Additional sample locations to confirm

7. Do you think more samples should be taken?
   - Potentially collecting more samples outside of Ragged Island

8. What did you learn from the Golder scientists on the boat?
   - Learned a lot, the operation of the equipment, organisms
   - Good to have people with field experience, not someone direct out of university (attitude they know everything), this type of attitude can cause friction on the boat

9. What do you think you taught scientists working on the boat?
   - The fabrication of the 3-pronged grappling hook to retrieve the grab
   - Knowledge of retrieval
   - Good knowledge of working on water and boat operations

10. What areas within Milne Inlet and/or along the shipping route do you think are most important for the MEEMP program to study?
   - Some coverage in the middle of the shipping route (between Milne Inlet and Ragged Island).
   - Determine how far the contamination is travelling
   - Collection of samples around the island left of Bruce Head (Stephen's Island)

Data Analysis

1. What are your biggest concerns about how shipping activities and operation of Milne port could affect fish and water in Milne Inlet?
   - Movement of animals away from their traditional route. He does not see a solution to this though.

2. Have you ever noticed changes to the water near Pond Inlet or Milne Inlet? If yes, were these before the start of the Project or after? What about the way the water looked or smelt made you think something was different?
   - Observed a small cod fish dead on the shore at Milne Inlet at the start of the season. Would be good to collect the fish for sampling to see why they died

3. How do you estimate fish populations in Milne Inlet?
   - A healthy stock of fish populations, based on 30 years of experience. Catch 36 lb Arctic char, larger than documented world record of 32 lb.

4. What do you look for on fish before consumption? Tumors, Lesions, parasites? Have you noted any change in the frequency of these symptoms?
   - Look for tumors, open scars, any abnormalities
   - Worms inside fish stomachs, son-in-law caught a seal that also had worms in the stomach and heart
   - No noted frequency in these abnormalities

5. Which species of fish do you commonly catch in the area? Any changes in abundances?
    - Greenland Cod and Arctic fish and sculpins
    - Hasn't had enough time to comment on changes in abundances

6. Have you noticed any unusual or new fish species in the area? Any changes in abundances?
    - Caught a blue fish six years ago
    - No nemo fish found here

7. What concerns do you have regarding dust settlement on snow and do you think this will affect water quality in the area?
    - Dust causes the snow to melt faster
    - Drinking water near Mary River when they are hunting, were informed not to drink the water anymore. Go to camp to get water
    - Filtering the water/treatment to reuse it

Reporting

1. What do you think is the best way to describe the studies that were undertaken for the MEEMP program this year?
    - Marine survey
    - Hard question to answer

2. What is the best way to communicate results?
    - Communicate through HTO bulletin board, public places
    - Announce on the radio where everyone can find the information

3. What do you think people are most interested in hearing about?
    - See the results of what is happening to the animals, narwhals, seals and fish.
    - Concerned about the presence of contaminants in the food they eat

GOLDER

Adaptive Management

1. What changes to Port operations or shipping activities concern you the most? How come?
   - The railroad because it will block access to a traditional caribou hunting grounds.
   - Bridge to crossover railway. Large barrier to community, "like the Berlin Wall".

2. Are your concerns about Port operations or shipping activities the same as they were before you participated in the program or have, they changed?
   - Same views but they are moving forward
   - QIA is keeping the money and it should be distributed to the community (i.e. dividends)

3. What activities related to shipping do you expect to see changes in, for example:
   - Water Quality
   - Invasive species
   - Fish Population

   Explain why?
   - WQ – concerned with ballast water, what is being brought into their waters.
   - Invasive species – cold arctic waters will zap them, can't survive.
   - Fish Populations – don't see a concern now, but may be impacted when shipping activities increase. Will have to see in a few years

4. Do you have any suggestions on how to improve the quality of the program?
   - Floating dock and more training for ROV
   - Have experience with all of the program's equipment
   - SCUBA diving training
   - Settlement baskets at Ragged Island could not be retrieved for the last two years as buoy has deflated. Deploy new basket with a hard plastic buoy so it will not deflate
   - Dissect the otoliths and stomach content so the rest of the fish can be used instead of thrown away. Have experience with these studies

APPENDIX O

Power Analysis

POWER ANALYSIS - METHODS

A Type I error is concluding there is a significant effect when none exists (i.e., a false positive). Alpha (α) is the probability of committing a Type I error. A Type II error is the probability of concluding there is no significant effect when there is a real effect of some specified magnitude (i.e., a false negative). Beta (β) is the probability of committing a Type II error. The power of a statistical test (1 - β) is the probability of detecting a real effect. In this analysis, the Type I error-rate (α), also referred to as the significance level, was set to 0.05. The desired minimum statistical power was 80%, which corresponds to a type II error-rate of 0.2. Power analyses were conducted to assess the power of statistical tests under multiple effect sizes. For each model, a set of effect sizes was created, based on preliminary power analyses, so that power >80% was achieved at the largest absolute values of effect sizes, but also so that power is assessed at a range of effect sizes. Both negative and positive effect sizes were used, to assess the power of detecting either a reduction or an increase in values of the response variables. Since the analysis focused on assessment of changes to statistical power at different effect sizes, the power analysis used the observed samples sizes from the collected data.

Data Simulation following Effect Size Application

The power to detect statistically significant effects was estimated using residual bootstrapping in R v. 3.6.1 (R 2019), following the approach of Fox and Weisberg (2018). The general approach was to simulate data based on the model selected for interpretation, the observed sample size, and the residuals, and re-run the models that were used for the original analysis using the simulated data. The data simulation and analysis were repeated 1,000 times, and the proportion of repetitions where the *P*-values of interest were significant ($P<0.05$) was interpreted as the statistical power of the test.

To produce simulated data, the original model was used to predict values of the response variable, and the raw residuals (i.e. the difference between the predicted and observed value for each observation) from the original model were calculated and retained. The predicted values were then adjusted according to the effect size, depending on analysis (see below for details). For each iteration of the simulation, the residuals from the original analysis were sampled with replacement, and then summed with effect size-adjusted model predictions, to produce a set of simulated data. Adding the residuals to the effect size-adjusted predictions was done to create a level of variability in the simulated data that was similar to the observed data. The simulated data were then analyzed using the same model structure as the original analysis.

Effect sizes and statistical tests were applied differently to different models and datasets, as detailed below.

Effect Sizes in Analysis of 2019 Data – Parabolic Relationship with Distance

In the analysis of 2019 data, where the question of interest was the detection of change in response variables with distance within each transect, and where the relationship between distance and the response variable was parabolic (e.g., percent fines in sediment), the effect was applied as percentage relative to the curvature of the fitted parabola. That is, an increasing effect size resulted in a steeper parabola, whereas a decreasing effect size resulted in a flatter parabola, and an effect size of zero resulted in the observed relationship (Figure 1). The simulated data were analyzed using the same model as the original analysis described in the main report, and the *P*-values for the effects of distance on the response variable were retained, which included both the main effect of distance and any interactions with distance. If any of these *P*-values were less than 0.05, it was considered a significant overall effect of distance. The proportion of repetitions with *P*-values less than 0.05 was interpreted as the statistical power of the overall regression for that effect size. Following tests of the overall effect of distance, multiple comparisons of the predicted values of the response variable between adjacent distances (at 100 m increments) were performed, with the Dunn–Šidák adjustment for multiple comparisons using the package emmeans (Lenth 2019). The *P*-values of each comparison were retained, and the magnitude of difference between the least squares means (i.e., model predictions) at each comparison was calculated as a simple difference between the predicted value at the farther distance and the predicted value at the nearer distance (e.g., estimate at 100 m minus estimate at 0 m). For analyses where the response variable was transformed to meet model assumptions, the values were back-transformed to the original units prior to calculation of the magnitude. For each effect size, the median value of magnitude of difference was retained, and the proportion of repetitions with *P*-values below 0.05 at each transect and distance was interpreted as the statistical power of the multiple comparisons.

Effect Sizes in Analysis of 2019 Data – Linear Relationship with Distance

In the analysis of 2019 data, where the question of interest was the detection of change in response variables with distance within each transect, and where the relationship between distance and the response variable was linear (e.g., benthos density), the effect size was applied as percentage to the slope of the effect of distance on the response variable. That is, an increasing effect size resulted in a steeper trend, whereas a decreasing effect size resulted in a flatter trend, and an effect size of zero resulted in the observed relationship (Figure 2). The simulated data were analyzed using the same model as the original analysis described in the main report, and the *P*-values for the effects of distance on the response variable were retained, which included both the main effect of distance and any interactions with distance. If any of these *P*-values were less than 0.05, it was considered a significant overall effect of distance. The proportion of repetitions with *P*-values less than 0.05 was interpreted as the statistical power of the overall regression for that effect size. Following tests of the overall effect of distance, the statistical significance of each transect's effect of distance (i.e., slope) was estimated using the package emmeans (Lenth 2019). The *P*-values of each transect's slope were retained, and the value of the slope was retained as the magnitude for that effect size. For each effect size, the median value of magnitude (i.e., slope of distance effect) was calculated, and the proportion of repetitions with *P*-values less than 0.05 at each transect was interpreted as the statistical power to detect the statistical significance of that transect's trend with distance.

Effect Sizes in Analysis of Data Collected from All Years

In the analysis of 2014-2019 data, where the question of interest was the analysis' power to detect between-year differences at various distances within transect, the effect size was applied to the effect of year. Specifically, the effect size was applied as a percentage difference relative to the observed values in 2019. Where the response variable was transformed prior to analysis, the effect sizes were applied to back-transformed values on the original scale of the response variable. An example of the effect size application to a dataset with a parabolic relationship between the response variable and year is provided in Figure 3. For datasets with a linear relationship with distance, the application of the year-based effect size would be similar, but result in parallel lines.

The simulated data based on effect sizes applied to values of the response variable from 2019 were combined with simulated data from 2014 to 2018 (with an effect size of zero). This combined dataset was analyzed using the model from the original analysis in the main report and the *P*-values for the effects of year on the response variable were retained, which included both the main effect of year and any interactions with year. If any of these *P*-values were less than 0.05, it was considered a significant overall effect of year. The proportion of repetitions with *P*-values less than 0.05 was interpreted as the statistical power.

Following the test of the overall year effect, multiple comparisons between years at several distances along each transect were performed with the Dunn–Šidák adjustment for multiple comparisons using the package emmeans (Lenth 2019). The *P*-values of each comparison were retained, and the magnitude of difference between the least squares means (i.e., model predictions) at each comparison was calculated as a simple difference between the predicted value of a previous year and the predicted value of the next year (e.g., estimate in 2014 minus estimate in 2019). The values were back-transformed prior to magnitude calculation, if applicable. Only comparisons with 2019 were shown in the results, since the effect size was applied to the 2019 data. For each effect size, the median value of magnitude of difference was retained, and the proportion of repetitions with *P*-values less than 0.05 at each transect and distance was interpreted as the statistical power of the multiple comparisons to detect a year effect. Comparing values from 2014-2018 to simulated data from 2019 was done to assess how much higher or lower the 2019 values would have to be to detect a significant difference relative to previous years.

Power Analysis – Reporting of Results

Power curves were produced, showing statistical power as a function of effect size in percentages (for overall effects) or the median magnitude of difference between the two values compared in multiple comparisons. Reporting the effect size as a magnitude of difference in the original units of the response variable, rather than as a percent difference from 2019 values, was done to make the results easier to interpret, as the ecological importance of the difference may be easier to judge on the original scale of the variable. Horizontal lines were added to visualize statistical power values of 0.8 (hereafter sufficient power) and 0.9 (hereafter high power), and a vertical line was added to visualize the magnitude of difference (or the slope value, for linear relationships) that was observed in the original data.

In the multiple comparisons of year effects, an effect size equal to twice the standard deviation (SD) of the residuals for each transect in 2019 was calculated as a simple difference between predicted and observed values. This was displayed on the plots in addition to the observed between-year effect sizes, to visualize the magnitude difference required to have sufficient power to detect between-year effects in relation to the observed variability in 2019.

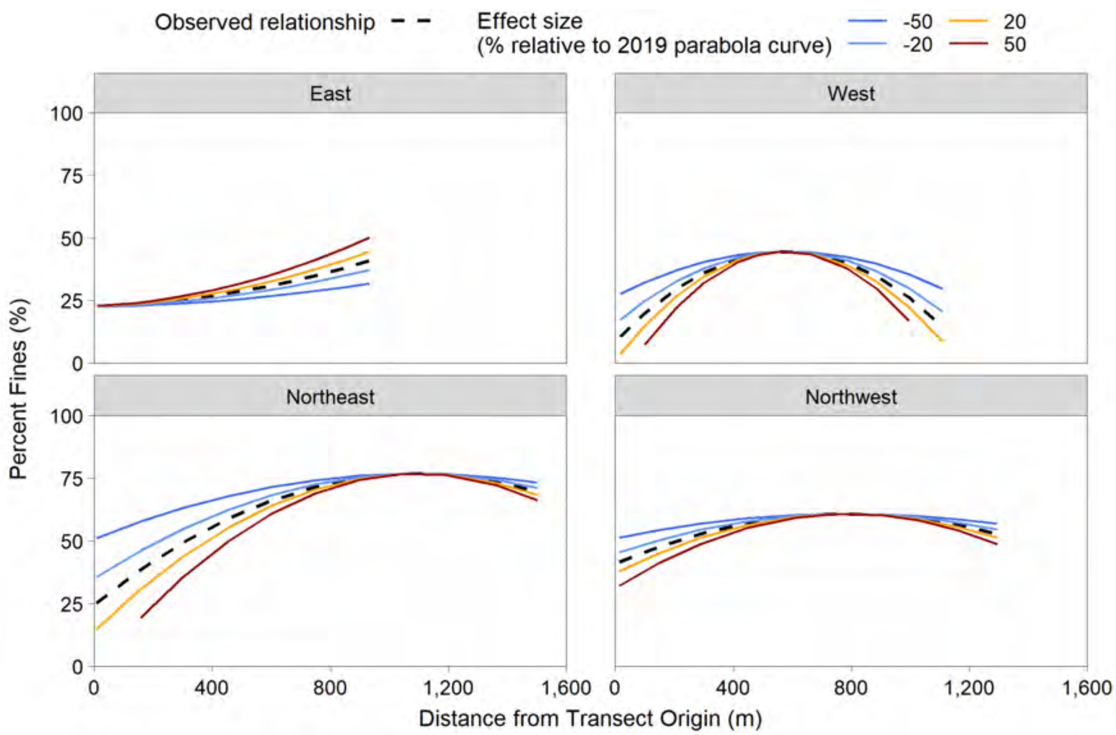

Figure 1 Application of effect sizes to examine effect of distance from ore dock in a parabolic relationship (2019 percent fines model).

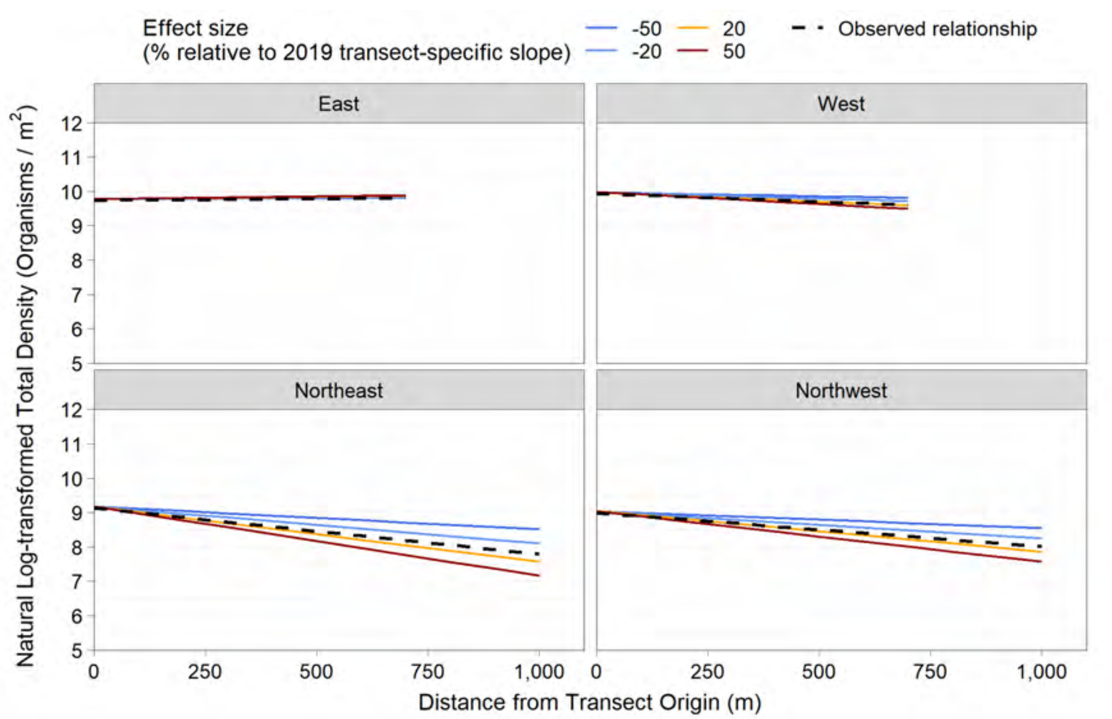

Figure 2 Application of effect sizes to examine effect of distance from ore dock in a linear relationship (2019 benthos infauna density model).

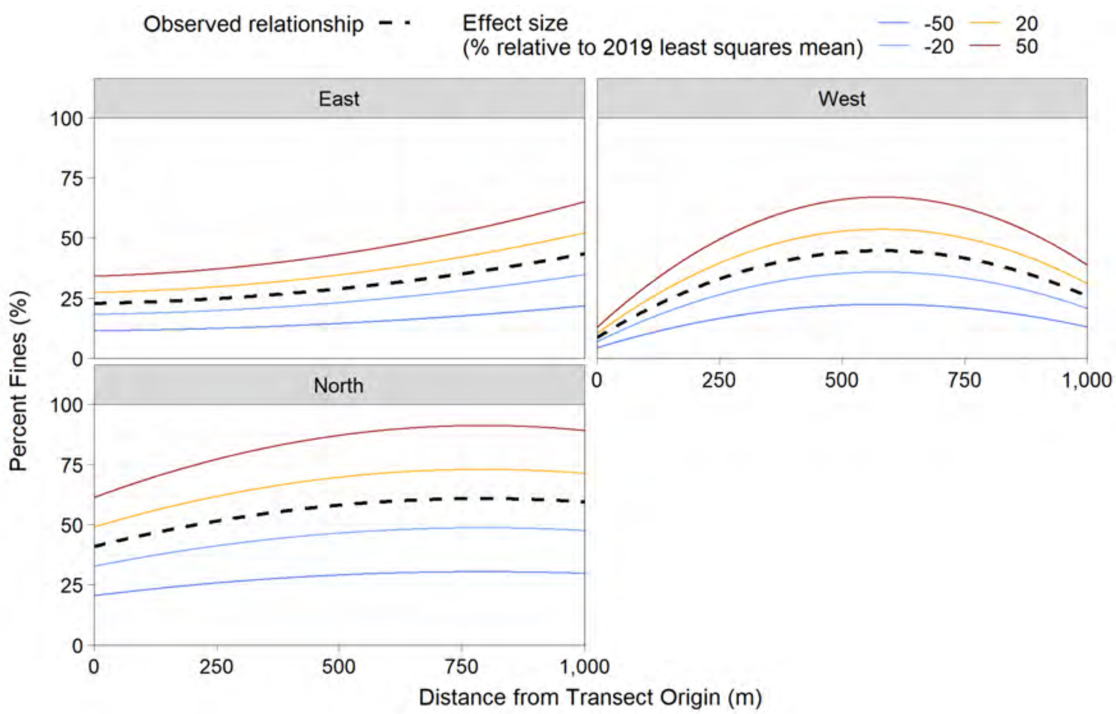

Figure 3 Application of effect sizes to examine effect of sampling year in a parabolic relationship (2014-2019 percent fines model).

POWER ANALYSIS – RESULTS

Sediment Quality – Percent Fines in 2019

The power analysis indicated that the analysis of percent fines data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed effect size (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between distance and transect in the original analysis of percent fines in 2019 (Section 4.1.4.1 in the main report).

In multiple comparisons between consecutive 100 m increments along each transect, the power analysis indicated that along the East Transect, there was low power to detect significant differences at the observed magnitudes of difference in percent fines (Figure). Specifically, since distances of 0 m, 100 m, 200 m, and 300 m from the transect origin had very similar values of percent fines (i.e., magnitudes of difference close to zero), power to detect differences between these distances was very low. Power to detect statistically significant differences was higher at distances ranging from 400 m to 700 m. However, the analysis estimated that a difference of 4% in percent fines (magnitude of difference; not percentage difference) was needed to detect a significant difference between 500 m and 400 m and between 600 m and 500 m. Similarly, a difference of 6% in percent fines (magnitude of difference; not percentage difference) was needed for sufficient power to detect a significant difference between 700 m and 600 m. Overall, 2019 data collected along the East Transect had sufficient power to detect differences of 4-6%

fines mid-transect. Since observed differences were much lower, the multiple comparisons along the East Transect did not find significant differences in the original analysis (Section 4.1.4.1 in the main report).

Along the Northeast Transect, statistical power to detect significant differences under the observed magnitudes of difference in percent fines was high (power >0.9) at all distances up to 900 m from transect origin (Figure). These are the distances at which the original analysis has found significant differences in multiple comparisons (Section 4.1.4.1 in the main report). At these distances, the observed magnitudes of differences in percent fines ranged between ~3% (800 m – 700 m comparisons) and ~9% (100 m to 0 m comparisons). Starting at 900 m, statistical power decreased with distance from origin. Overall, 2019 data collected along the Northeast Transect had sufficient power to detect differences of 3-9% fines between consecutive 100 m increments up to 800 m from transect origin.

Along the Northwest Transect, statistical power to detect significant differences under the observed magnitudes of difference in percent fines was low at all distances along the transect (Figure); this is reflected by the original analysis, which did not find any statistically significant differences in the multiple comparisons (Section 4.1.4.1 in the main report). Near transect origin, percent fines had to be greater by a magnitude of at least ~7-8% for sufficient power to detect a significant difference between 100 m and 0 m and between 200 m and 100 m, and by a magnitude of at least 3-6% for sufficient power to detect a significant difference between consecutive 100 m increments between 300 m and 600 m. Overall, 2019 data collected along the Northwest Transect had sufficient power to detect differences of ~8% fines content between consecutive 100 m increments up to 600 m from transect origin.

Along the West Transect, statistical power to detect significant differences under the observed magnitudes of difference in percent fines was high (>0.9) up to 400 m from transect origin and from 800 m to 1,100 m (Figure). These are the distances at which the original analysis found significant differences in multiple comparisons (Section 4.1.4.1 in the main report). Mid-transect, percent fines had to be greater by magnitude of at least ~3-4% for sufficient power to detect a significant difference between 500 m and 400 m and between 600 m and 700 m. Overall, 2019 data collected along the West Transect had sufficient power to detect differences >4% fines content between consecutive 100 m increments up to 500 m from transect origin and from 700 m to transect end.

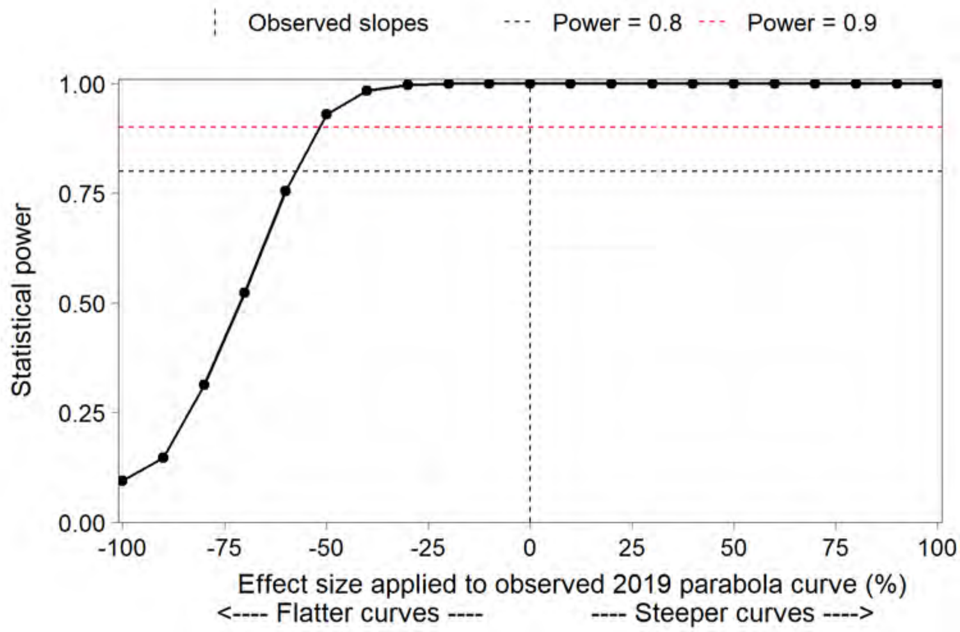

Figure 4 Statistical power of the overall model of 2019 percent fines to detect a significant distance effect or a significant difference in distance effects between transects.

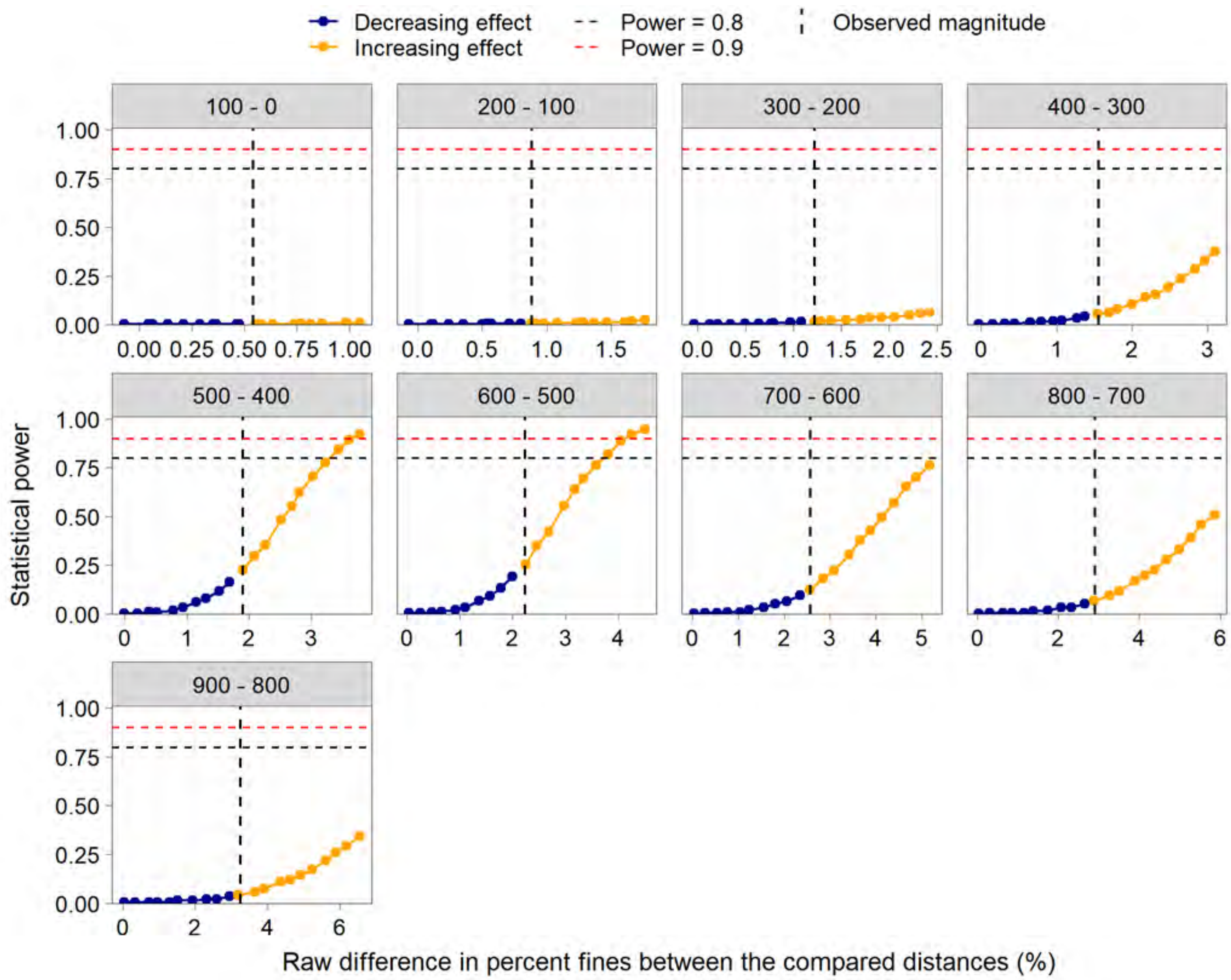

Figure 5 Statistical power of multiple comparisons between distances along the East Transect relative to the difference in percent fines between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

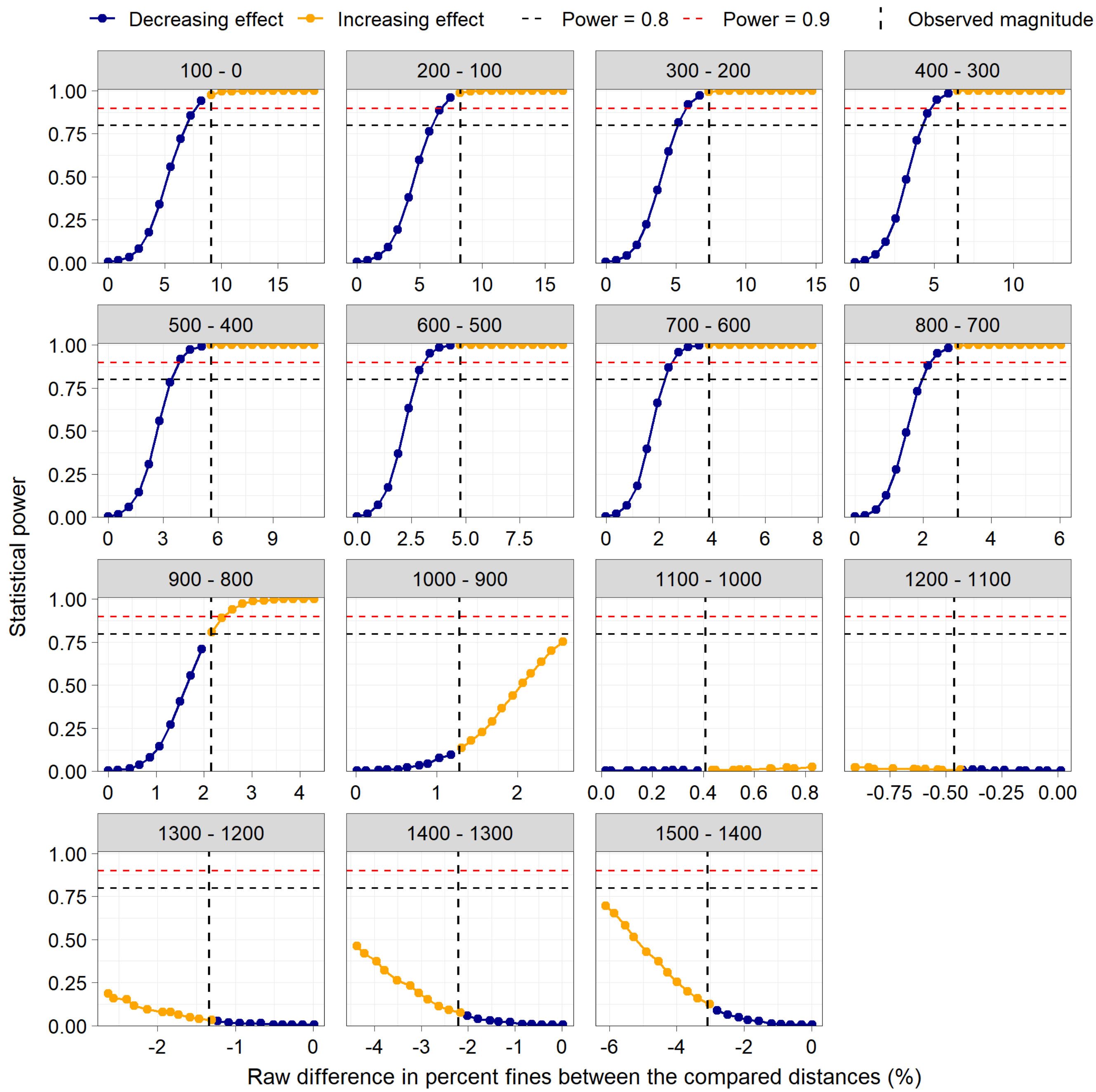

Figure 6 Statistical power of multiple comparisons between distances along the Northeast Transect relative to the difference in percent fines between the compared distances. Each panel shows a separate multiple comparison, with the distances compared displayed at the top of the panel.

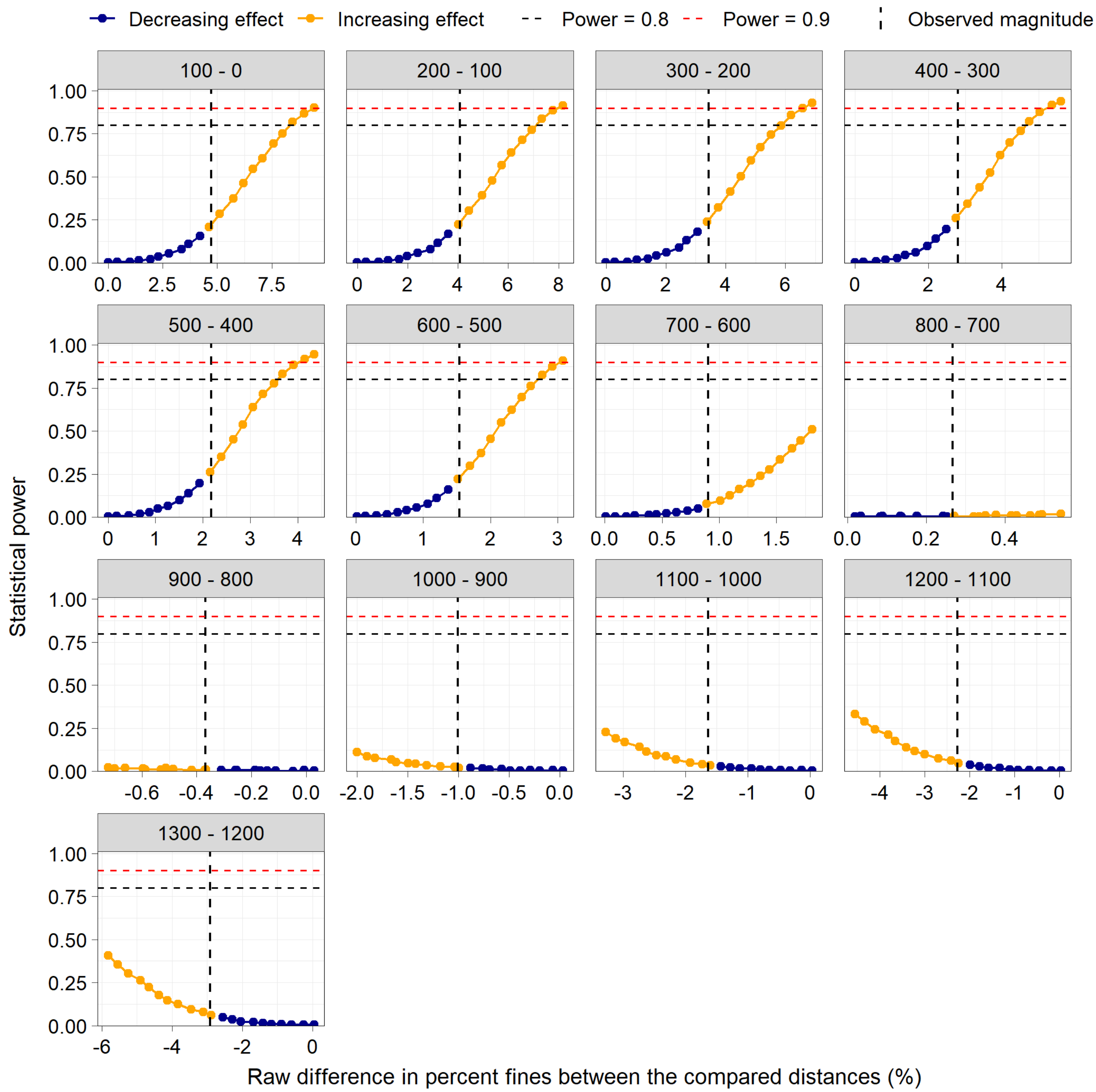

Figure 7 Statistical power of multiple comparisons between distances along the Northwest Transect relative to the difference in percent fines between the compared distances. Each panel shows a separate multiple comparison, with the distances compared displayed at the top of the panel.

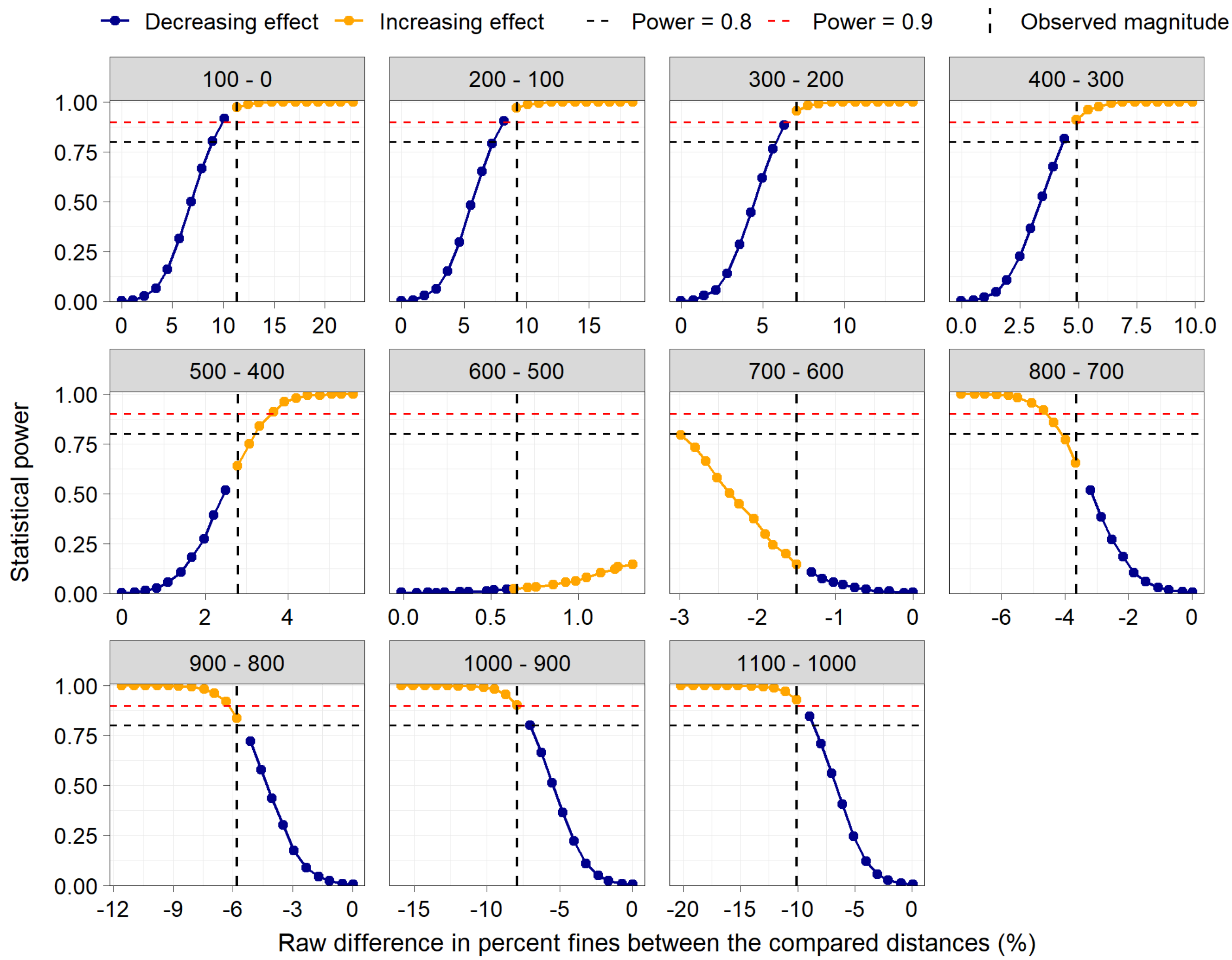

Figure 8 Statistical power of multiple comparisons between distances along the West Transect relative to the difference in percent fines between the compared distances. Each panel shows a separate multiple comparison, with the distances compared displayed at the top of the panel.

Sediment Quality – Percent Fines in 2014-2019

The power analysis indicated that the analysis of 2014-2019 percent fines data had high power (>0.9) to detect an overall effect of year or an overall significant difference between years between distances and sampled transects at any of the assessed effect sizes, including the observed effect size (indicated by the vertical line in Figure). Although the power analysis suggested high power at the observed effect size, in the original analysis, the minimum P-value associated with a year effect was only marginally significant (*P*=0.089; Section 4.1.4.1 in the main report).

In multiple comparisons between all years, the power analysis indicated that along the East Transect, there was low power to detect significant differences at the observed magnitudes of difference in percent fines (Figure). However, at 500 m, power to detect a 2 SD effect size was high (where SD is the standard deviation of the East Transect residuals in 2019), with statistical power >0.9 for comparisons of all years to 2019. At both 0 m and 100 m, the power to detect a 2 SD effect size was not sufficient (<0.8). At 0 m, the absolute difference in percent fines between 2019 and a previous sampling year had to be at least 31-34% to achieve statistical power of 0.8 (in 2014-2019, 2016-2016, and 2018-2019 comparison). At 1000 m, the magnitude of difference in percent fines between 2019 and a previous sampling year had to be at least 26% (in 2018-2019 comparison). In comparison, the 2 SD effect size was only equivalent to ~23% fines, and the test therefore had insufficient power to detect a difference of 2 SD.

Along the North Transect, there was low power to detect differences at the observed magnitudes and at the ±2 SD effect size at all distances (Figure). Along the North Transect, the magnitude of difference in percent fines between 2019 and a previous sampling year had to be at least 29-34% for a statistical power value of 0.8 at a distance of 0 m, at least 18% at a distance of 500 m, and at least 20% at a distance of 1000 m. In comparison, the 2 SD effect size was only equivalent to ~10% fines, and the test therefore had insufficient power to detect a difference of SD at all distances from 0 to 1000 m.

Along the West Transect, there was low power to detect significant differences under the observed magnitudes and under the ±2 SD effect size relative to 2019 transect-specific regression residuals at all distances (Figure). Along the West Transect, the magnitude of difference in percent fines between 2019 and a previous sampling year had to be at least 40% to achieve statistical power of 0.8 at a distance of 0 m, at least 17% at a distance of 500 m, and at least 20% at a distance of 1000 m. In comparison, the 2 SD effect size was only equivalent to ~9% fines, and the test therefore had insufficient power to detect a 2 SD difference.

Overall, power to detect effects between years was highest mid-transect (e.g., 500 m) along all three examined transects, and not sufficient to detect observed effect sizes. This is consistent with not finding significant differences between years at any of the examined transects and distances in the original analysis (Section 4.1.4.1 in the main report). Power to detect 2 SD effect sizes was only sufficient (>0.8) at 500 m along the East Transect, and not at any of the other examined distances or transects. For sufficient power at the remaining two transects, the magnitude of difference in percent fines between 2019 and a previous sampling year had to be at least ~17% (West Transect, 500 m) and 18% (North Transect, 500 m).

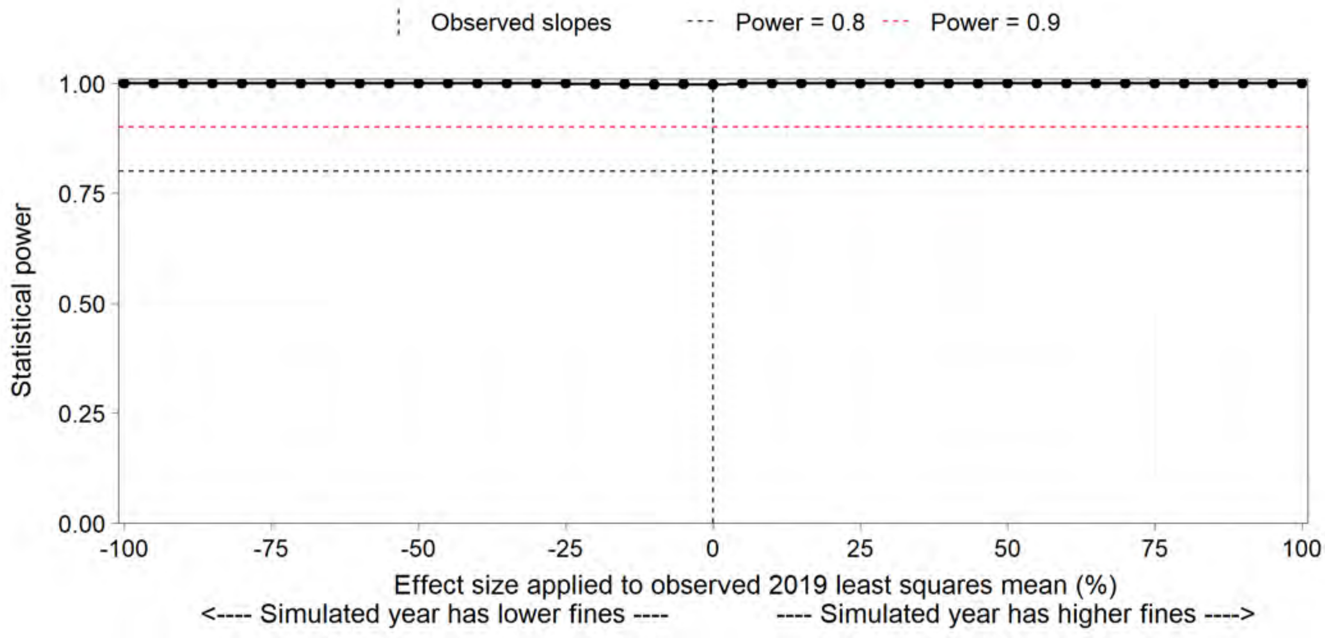

Figure 9 Statistical power of the overall model of 2014-2019 percent fines to detect a significant year effect or a significant difference in year effects between transects and distances.

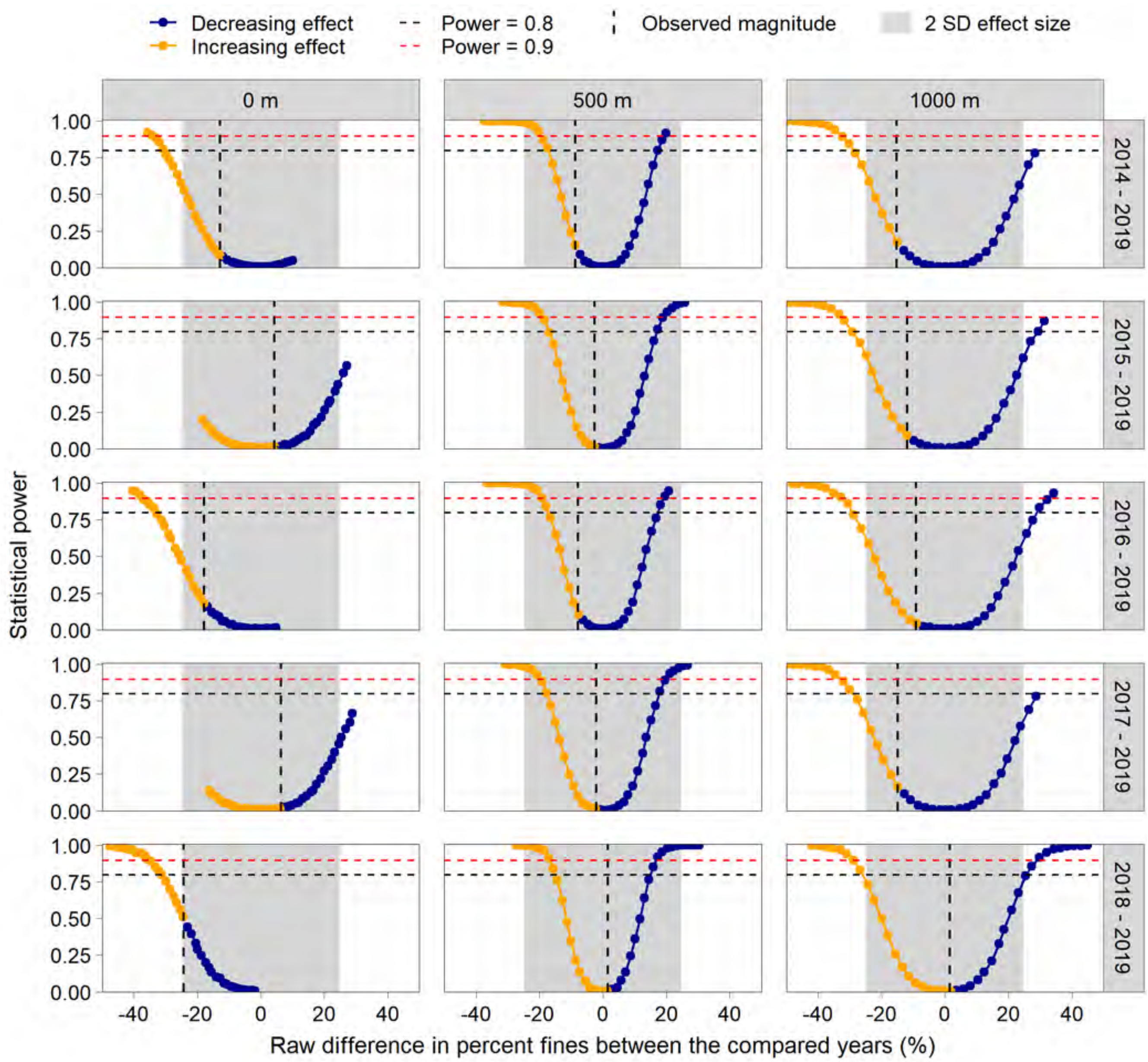

Figure 10 Statistical power of multiple comparisons between years at three distances along the East Transect relative to the difference in percent fines between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

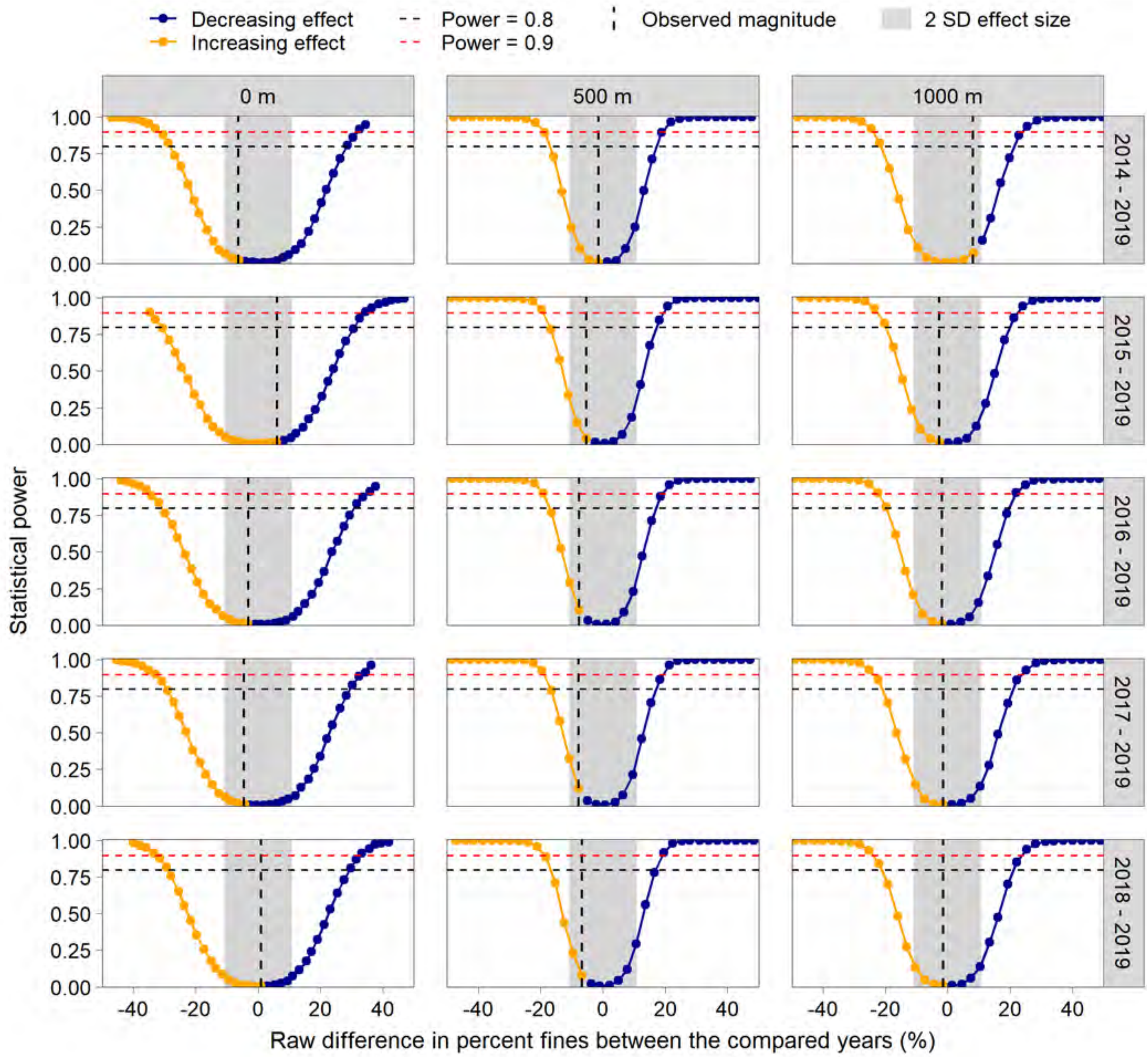

Figure 11 Statistical power of multiple comparisons between years at three distances along the North Transect relative to the difference in percent fines between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

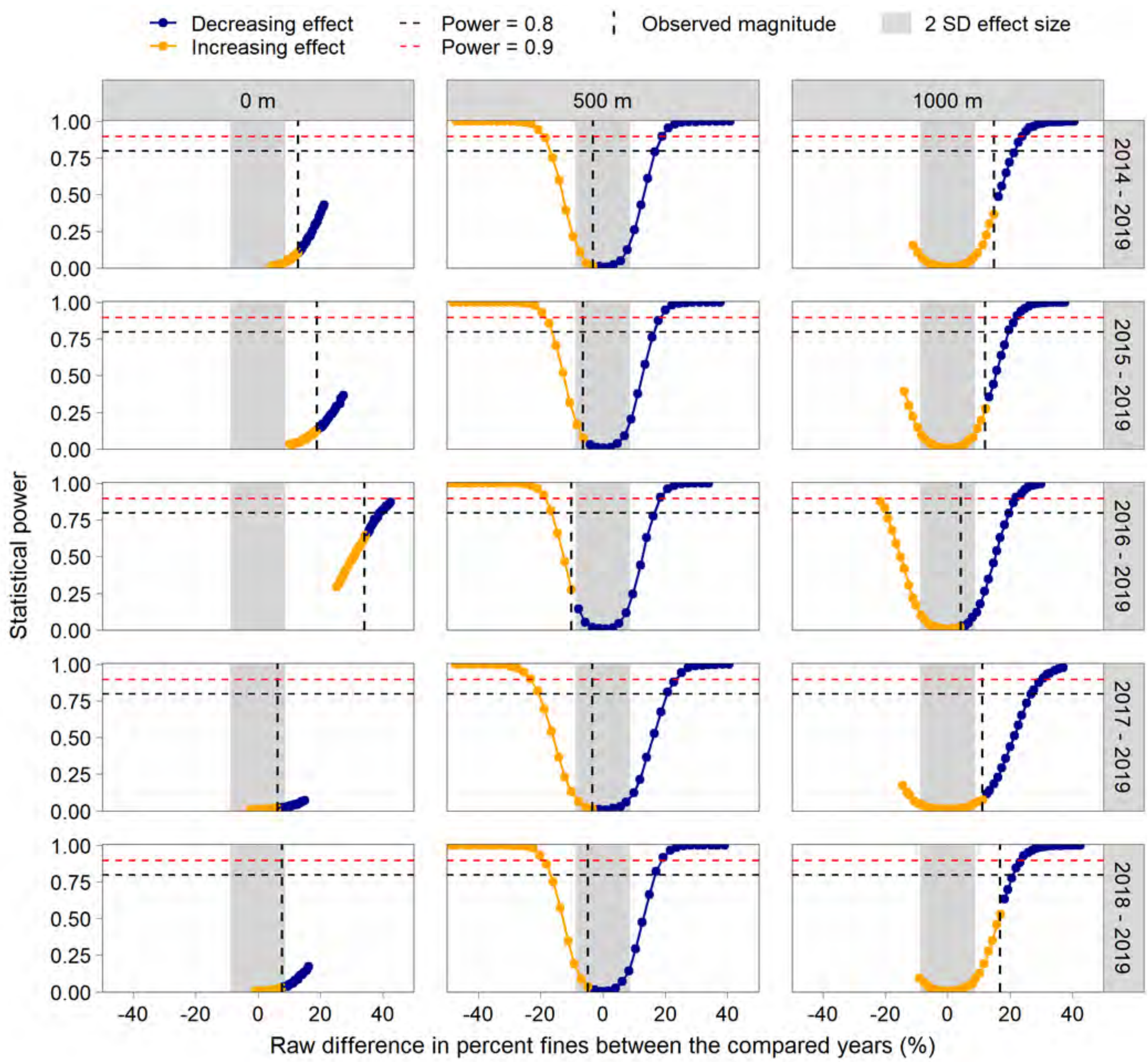

Figure 12 Statistical power of multiple comparisons between years at three distances along the West Transect relative to the difference in percent fines between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

Sediment Quality – Iron Content in 2019

The power analysis indicated that the analysis of iron content data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed effect size (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between distance and transect in the original analysis of iron content in 2019 (Section 4.1.4.2 in the main report).

In multiple comparisons between consecutive 100 m increments along each transect, the power analysis indicated that along the East Transect, power was low to detect significant differences under the observed magnitudes of difference in iron content (Figure 2). The analysis estimated that the magnitude difference in iron content (adjusted to mean of natural log-transformed percent fines) had to be at least ~1,500 mg/kg for sufficient power to detect a significant difference between 100 m and 0 m, at least 1,000 mg/kg for sufficient power to detect a difference between 200 m and 100 m, and at least ~800 mg/kg for sufficient power to detect a difference between 300 m and 200 m. At the end of the transect, magnitude difference in iron content (adjusted to mean of natural log-transformed percent fines) had to be at least ~800 mg/kg for sufficient power to detect a significant difference between 800 m and 700 m, and at least ~1,100 mg/kg for sufficient power to detect a difference between 900 m and 800 m. Since observed differences were much lower, the multiple comparisons along the East Transect did not find significant differences in the original analysis (Section 4.1.4.2 in the main report).

Along the Northeast Transect, statistical power to detect significant differences under the observed magnitudes of difference in iron content (adjusted to mean natural log-transformed fines) was high up to 900 m from transect origin (Figure 3). At these distances, the observed magnitudes of differences in fines-adjusted iron content ranged between ~320 mg/kg (900 m – 800 m comparisons) and ~820 mg/kg (100 m to 0 m comparisons). Starting at 900 m, statistical power decreased with distance from origin. Overall, 2019 data collected along the Northeast Transect had sufficient power to detect statistically significant differences as low as ~320 mg/kg iron content fines content, depending on distance from transect origin. This finding is consistent with the significance of multiple comparisons performed in the original analysis (Section 4.1.4.2 in the main report).

Along the Northwest Transect, statistical power to detect significant differences under the observed magnitudes of difference in iron content (adjusted to mean natural log-transformed fines) was low throughout the transect (Figure 4). At mid-transect, the difference in iron content (adjusted to mean of natural log-transformed percent fines) had to be at least ~250-300 mg/kg for sufficient power to detect a significant difference between 700 m and 600 m and between 800 m and 700 m. At the end of the transect, the difference in iron content (adjusted to mean of natural log-transformed percent fines) had to be at least ~2,000 mg/kg for sufficient power to detect a significant difference between 1,500 m and 1,400 m. Since observed differences were much lower, the multiple comparisons along the East Transect did not find significant differences in the original analysis (Section 4.1.4.2 in the main report).

Along the West Transect, statistical power to detect significant differences under the observed magnitudes of difference in percent fines was low throughout the transect (Figure 5). Overall, the curve of iron content as function of distance from transect in the original model was not very steep (Figure 4-11 in main report), resulting in a low ability to detect differences between consecutive 100 m increments along the transect.

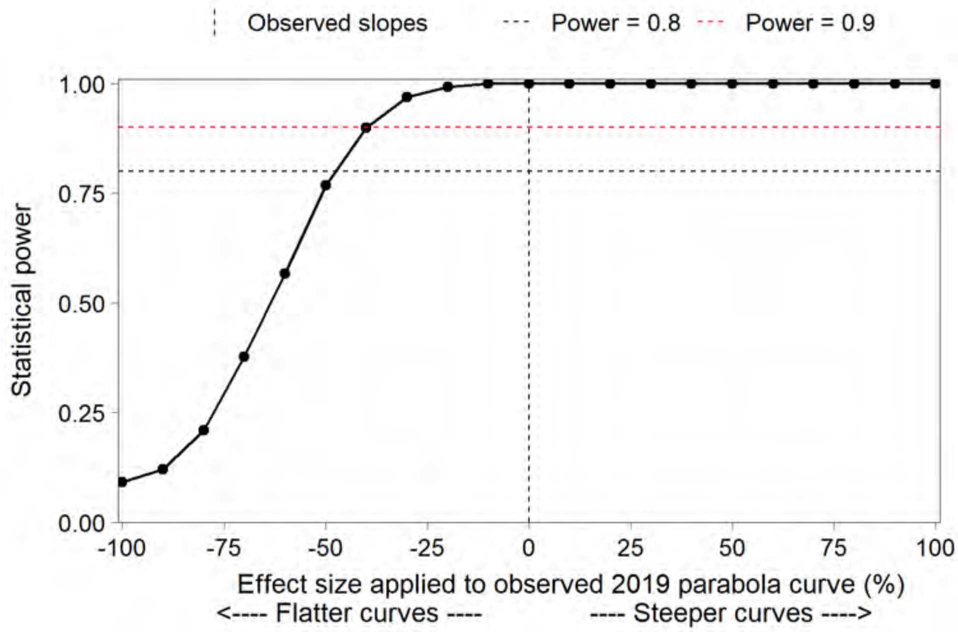

Figure 13 Statistical power of the overall model of 2019 iron content to detect a significant distance effect or a significant difference in distance effects between transects.

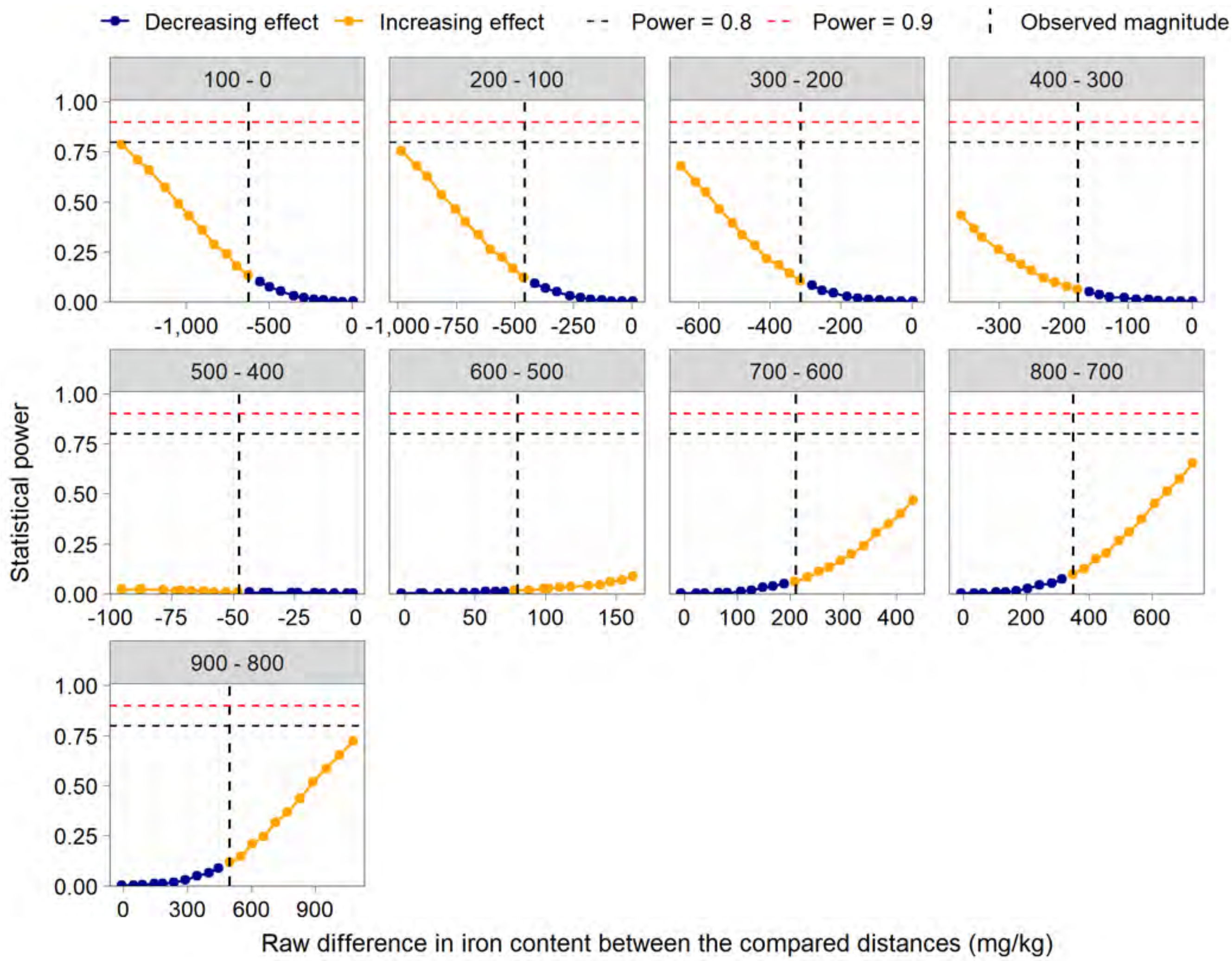

Figure 24 Statistical power of multiple comparisons between distances along the East Transect relative to the difference in iron content between the compared distances (iron content adjusted to mean percent fines). Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

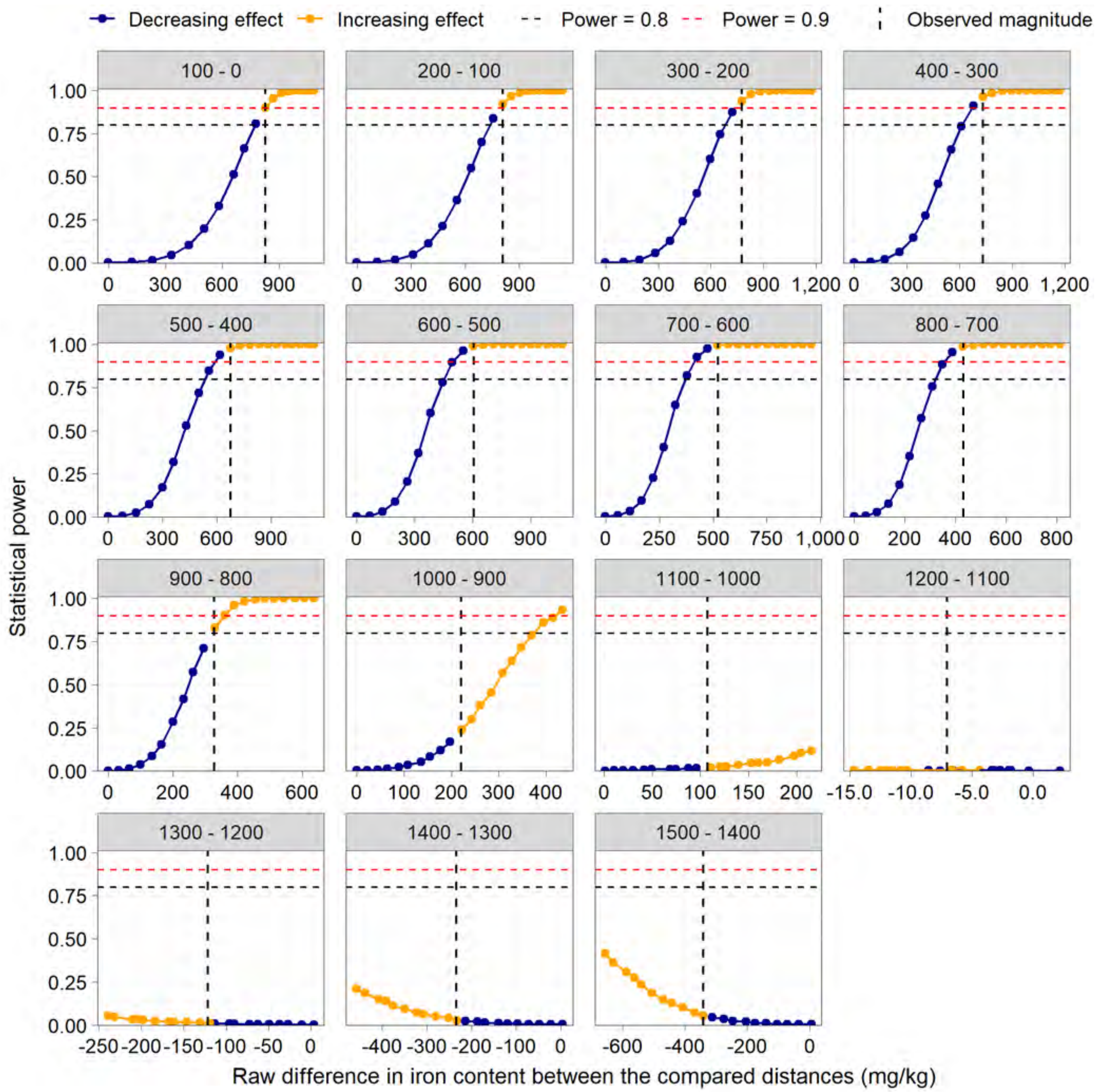

Figure 3 Statistical power of multiple comparisons between distances along the Northeast Transect relative to the difference in iron content between the compared distances (iron content adjusted to mean percent fines). Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

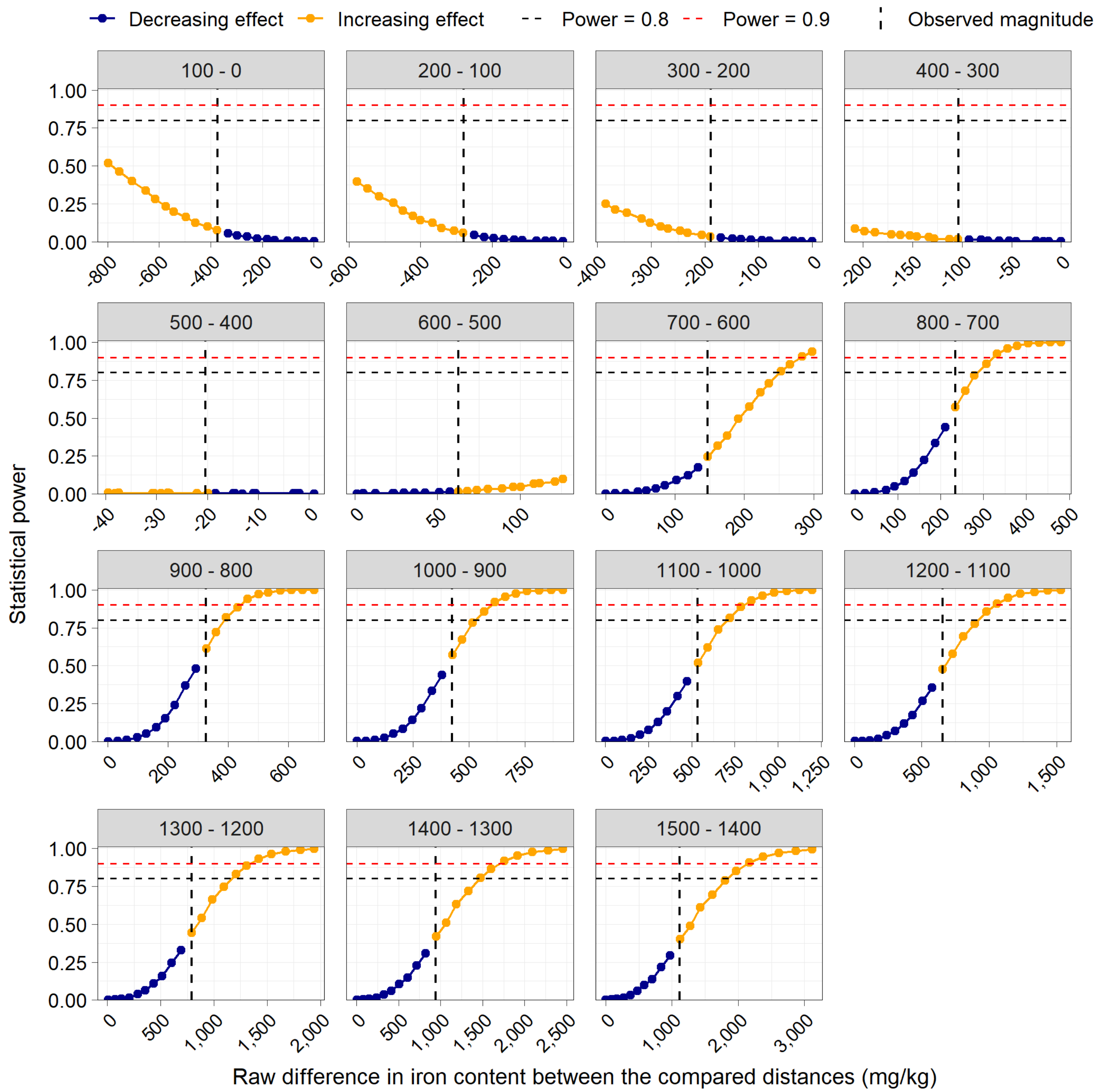

Figure 4 Statistical power of multiple comparisons between distances along the Northwest Transect relative to the difference in iron content between the compared distances (iron content adjusted to mean percent fines). Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

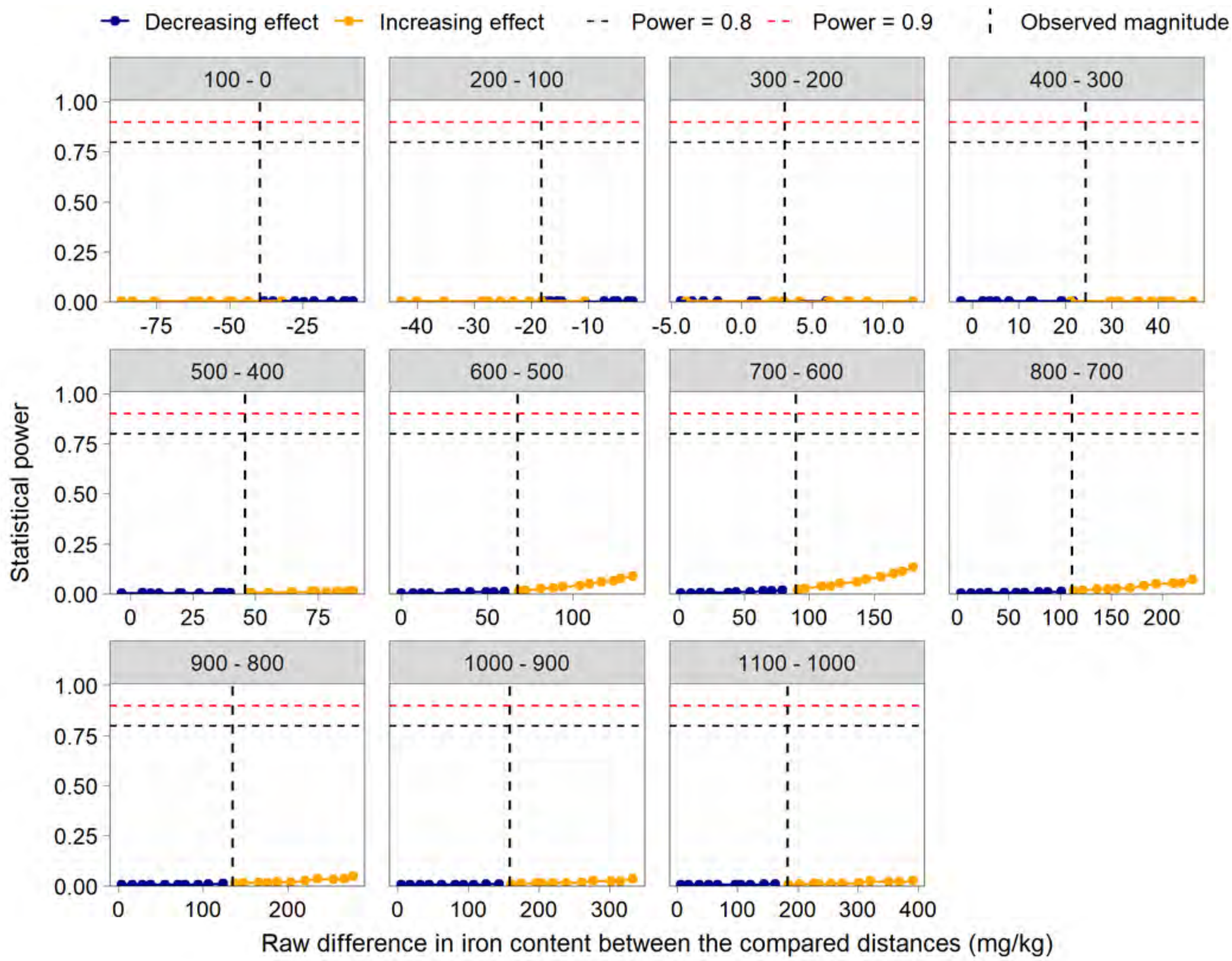

Figure 5 Statistical power of multiple comparisons between distances along the West Transect relative to the difference in iron content between the compared distances (iron content adjusted to mean percent fines). Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

Sediment Quality – Iron Content in 2014-2019

The power analysis indicated that the analysis of 2014-2019 iron content data had high power (>0.9) to detect an overall effect of year or an overall significant difference between years between distances and sampled transects at any of the assessed effect sizes, including the observed effect size (indicated by the vertical line in Figure). This is consistent with the finding of a significant interactions between year and distance and year and transect in the original analysis of iron content in 2014-2019 (Section 4.1.4.2 in the main report).

In multiple comparisons between all years, the power analysis indicated that along the East Transect, power was sufficient to detect significant differences under the observed magnitudes of difference in iron content at several comparisons and at all three distances (Figure). However, power was low to detect a ±2 SD effect size. For sufficient power to detect an effect, the magnitude difference in iron content between 2019 and a previous sampling year had to be at least 2,300 mg/kg at 0 m (2014-2019 and 2015-

2019 comparisons), at least 1,000 mg/kg at 500 m (in 2016-2019 comparisons), and at least 1,500 mg/kg at 1,000 m (2015-2019 comparisons). In comparison, the 2 SD effect size only extended to ~800 mg/kg iron content, and therefore had insufficient power.

Along the North Transect, power was sufficient to detect observed effect sizes at 0 m (for 2015-2019 and 2016-2019 comparisons) and to detect a ±2 SD effect size at 500 m and 1000 m, as well as +2 SD effect sizes (all comparisons; Figure). For sufficient power to detect an effect, the magnitude difference in iron content between 2019 and a previous sampling year had to be at least 2,000 mg/kg at 0 m (2016-2019 comparisons), at least 1,300 mg/kg at 500 m (in 2016-2019 comparisons), and at least 1,700 mg/kg at 1,000 m (2016-2019 comparisons). Since the 2 SD effect size extended to ~2,300 mg/kg iron content, there was sufficient power to detect this effect size for most comparisons (except for decreasing effects at 0 m).

Along the West Transect, power was sufficient to detect observed effect sizes at 500 m (for 2015-2019 and 2016-2019 comparisons) and at 1000 m (for 2015-2019 comparisons). At the three distances, power was not sufficient to detect a ±2 SD effect size (all comparisons; Figure). For sufficient power, the magnitude difference in iron content between 2019 and a previous sampling year had to be at least 2,100 mg/kg 0 m (for 2018-2019 comparisons), at least 1,400 mg/kg at 500 m (2015-2019 comparisons) and at least 1,600 mg/kg at 1,000 m (2016-2019 comparisons). In comparison, the 2 SD effect size only extended to 1,350 mg/kg iron content, and therefore have insufficient power.

Overall, power to detect observed effect sizes between years was sufficient in 12 comparisons at 0 m, 500 m, and 1,000 m, depending on transect. This is consistent with finding significant differences between years at several distances along the East and West transects in the original analysis (Section 4.1.4.2 in the main report). For power of at least 0.8, the absolute difference in iron content (adjusted to mean natural log-transformed fines) between 2019 and a previous sampling year had to be at least 1,500 mg/kg at the East Transect, at least 1,300 at the North Transect.

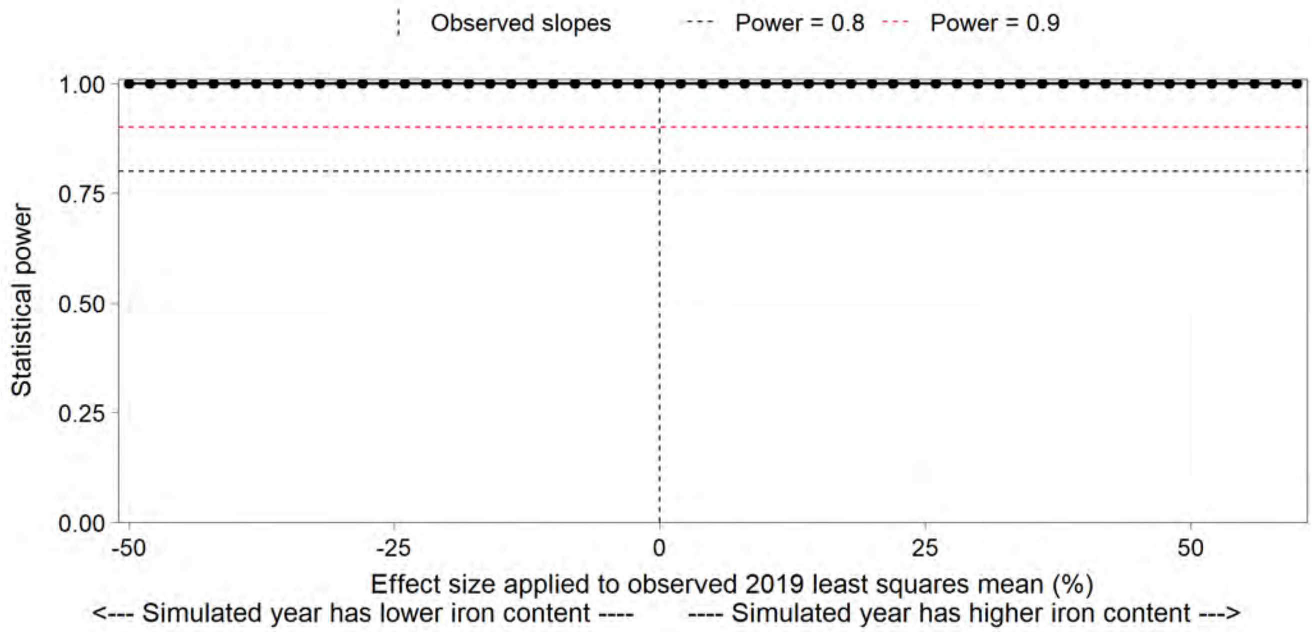

Figure 18 Statistical power of the overall model of 2014-2019 iron content to detect a significant year effect or a significant difference in year effects between transects and distances.

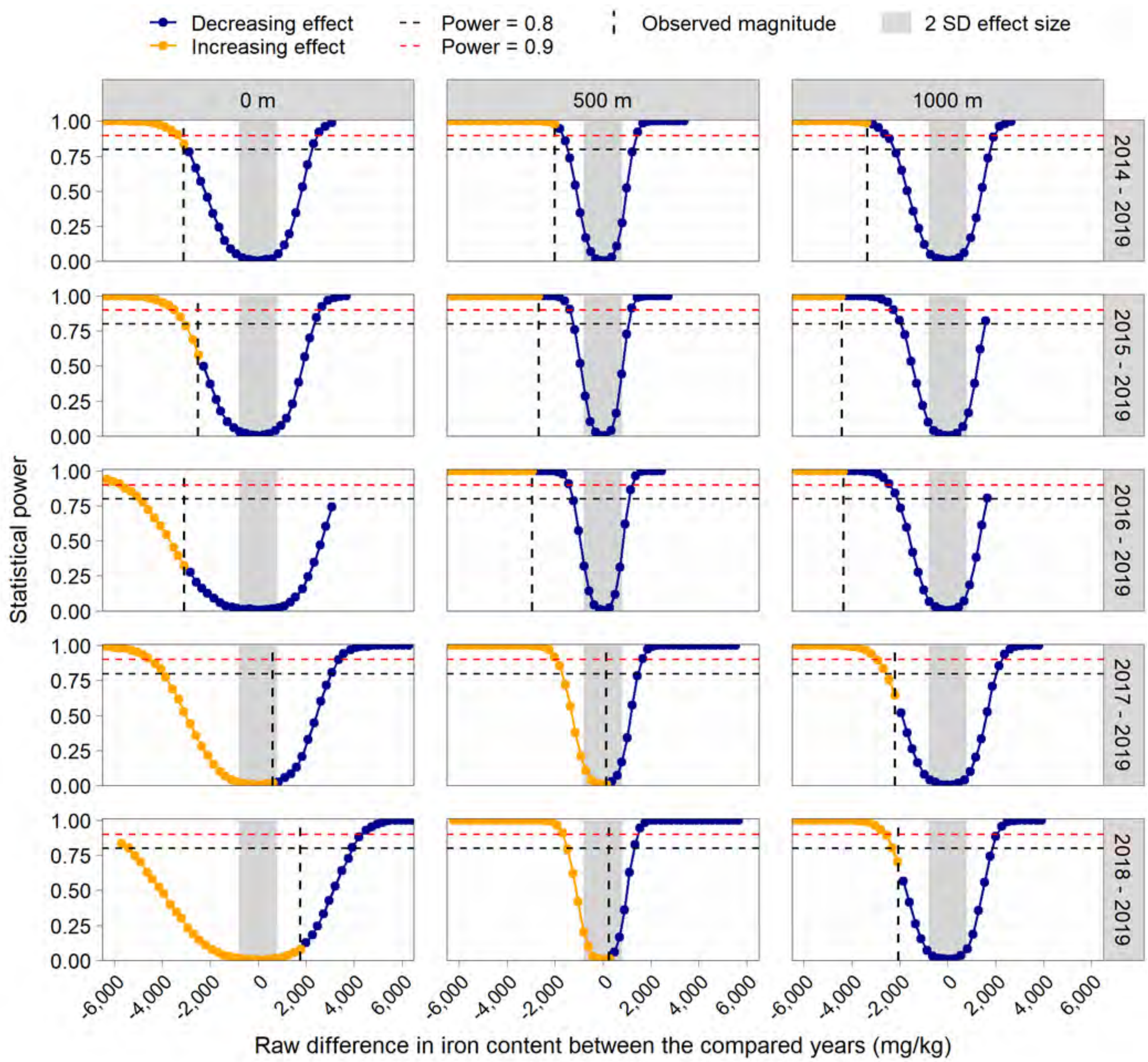

Figure 19 Statistical power of multiple comparisons between years at three distances along the East Transect relative to the difference in iron content between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

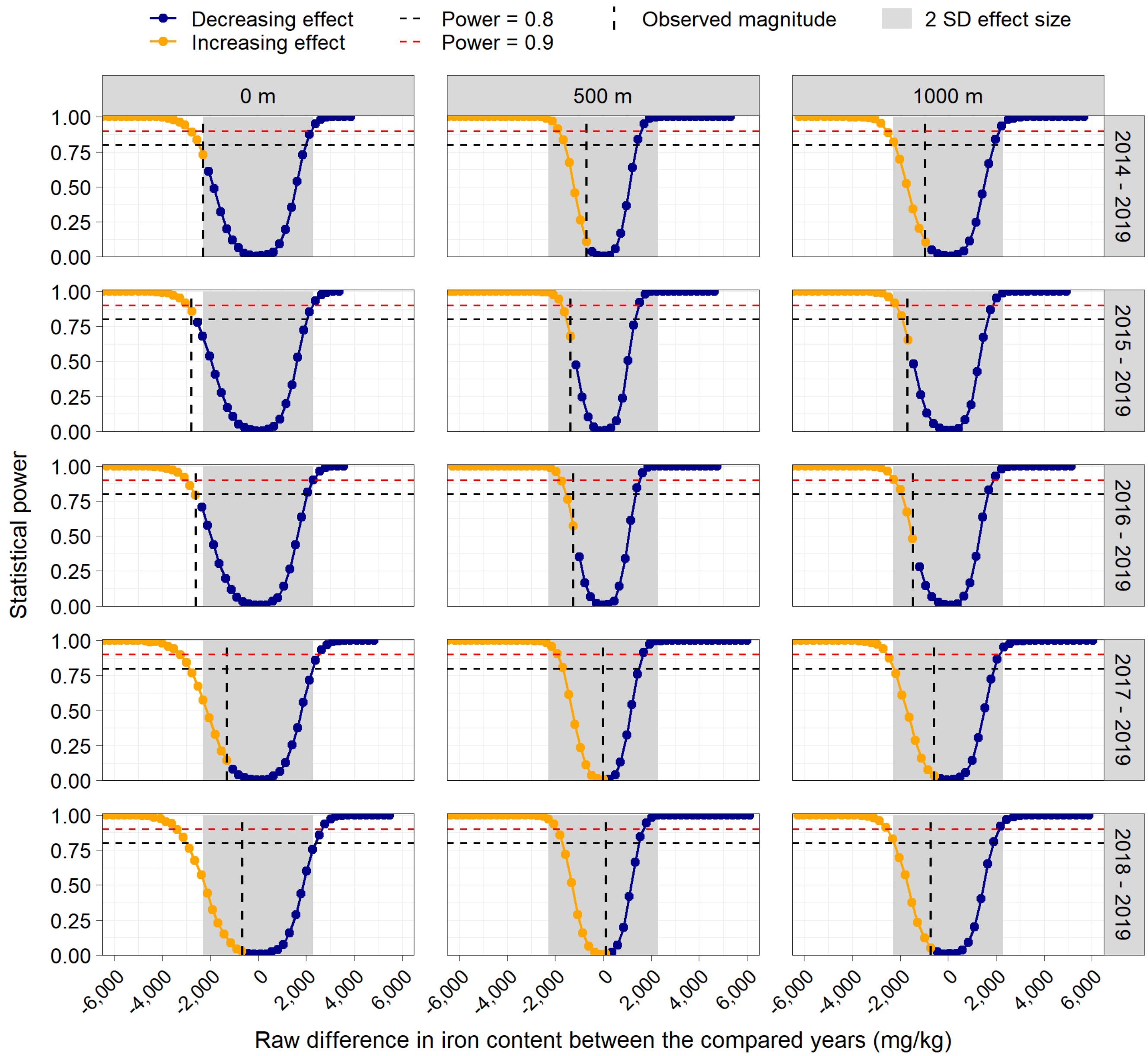

Figure 20 Statistical power of multiple comparisons between years at three distances along the North Transect relative to the difference in iron content between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

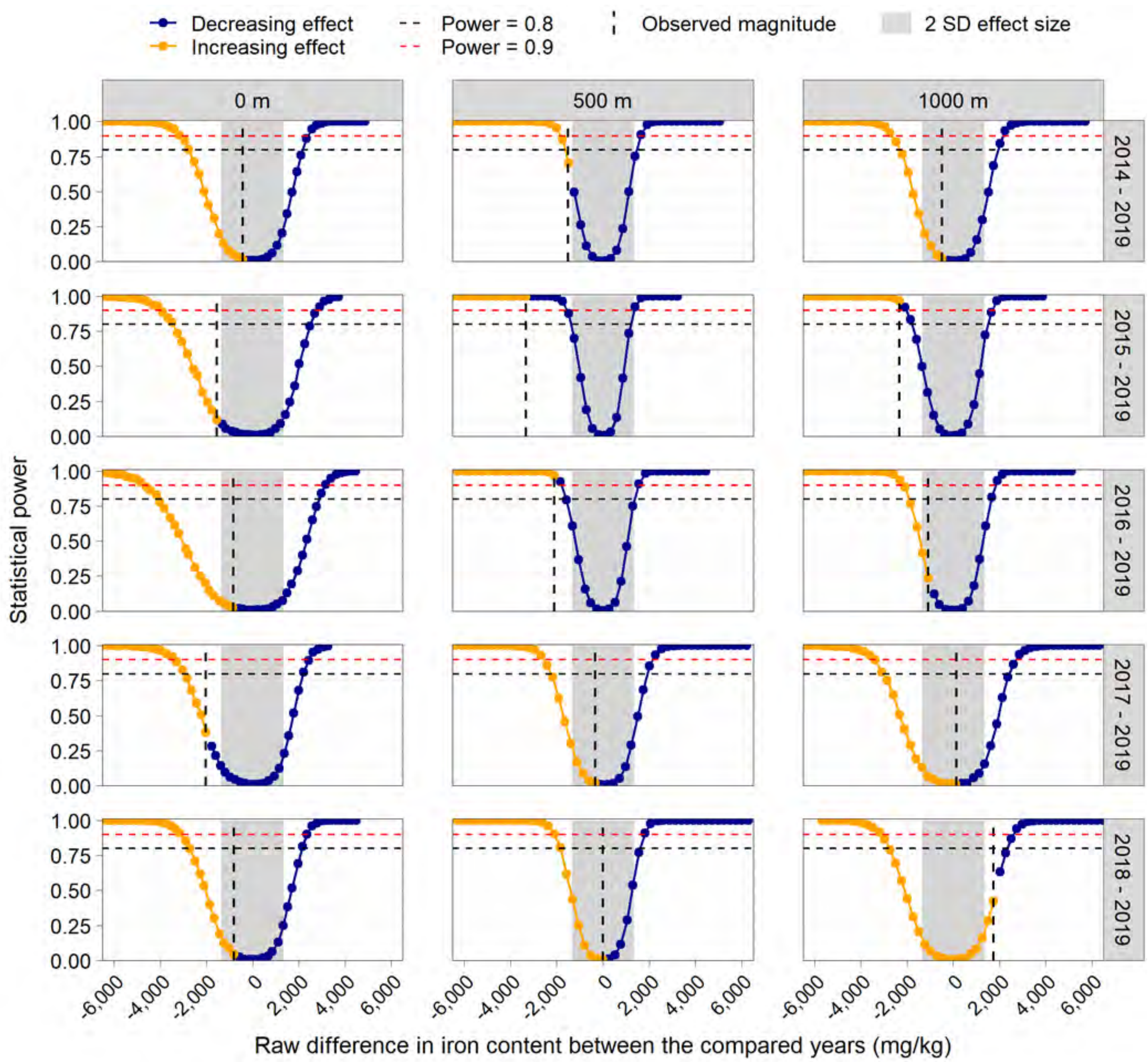

Figure 21 Statistical power of multiple comparisons between years at three distances along the West Transect relative to the difference in iron content between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

Benthos – Total Density in 2019

The power analysis indicated that the analysis of total benthos density data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed linear slope values (indicated by the vertical line in Figure

). This is consistent with the finding of a significant effect of distance in the original analysis of benthos density in 2019 (Section 4.1.5.1.1 in the main report).

In assessment of significance of individual slopes, power was sufficient to identify the significance of the observed slope values at the Northwest Transect, but not the other three transects (Figure 23). At the Northeast Transect, the slope had to be slightly steeper (a decrease of at least 0.13 organisms/m² per 100 m transect increment) to have power of 0.8. At the West Transect, the slope had to be considerably steeper (a decrease of at least 0.16 organisms/m² per 100 m transect increment) to be identified as a significant effect, which was a 250% increase in steepness relative to the observed trend. At the East Transect, due to the lack of trend in the observed data, an increase of even 400% in slope steepness still had very low power. These findings are consistent with the results of a significant slope for Northwest and Northeast transects, but not West and East transects in the original analysis of benthos density in 2019 (Section 4.1.5.1.1 in the main report). Overall, the model had sufficient power to detect changes of approximately 0.13-0.16 organisms / m² per 100 m increments of transects.

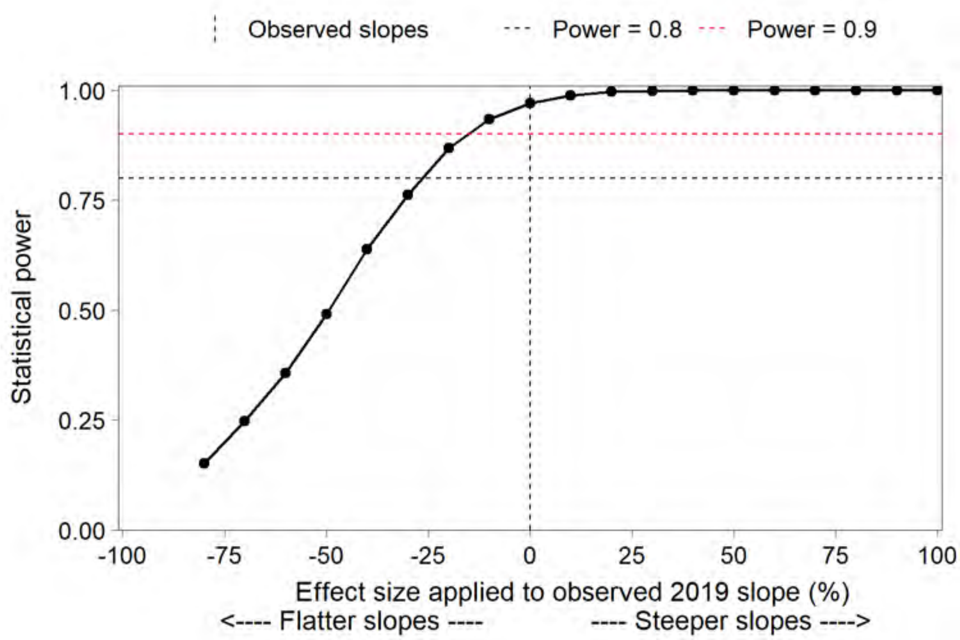

Figure 22 Statistical power of the overall model of 2019 benthos infauna total density (organisms/m²) to detect an effect of distance or a significant difference in distance effects between transects.

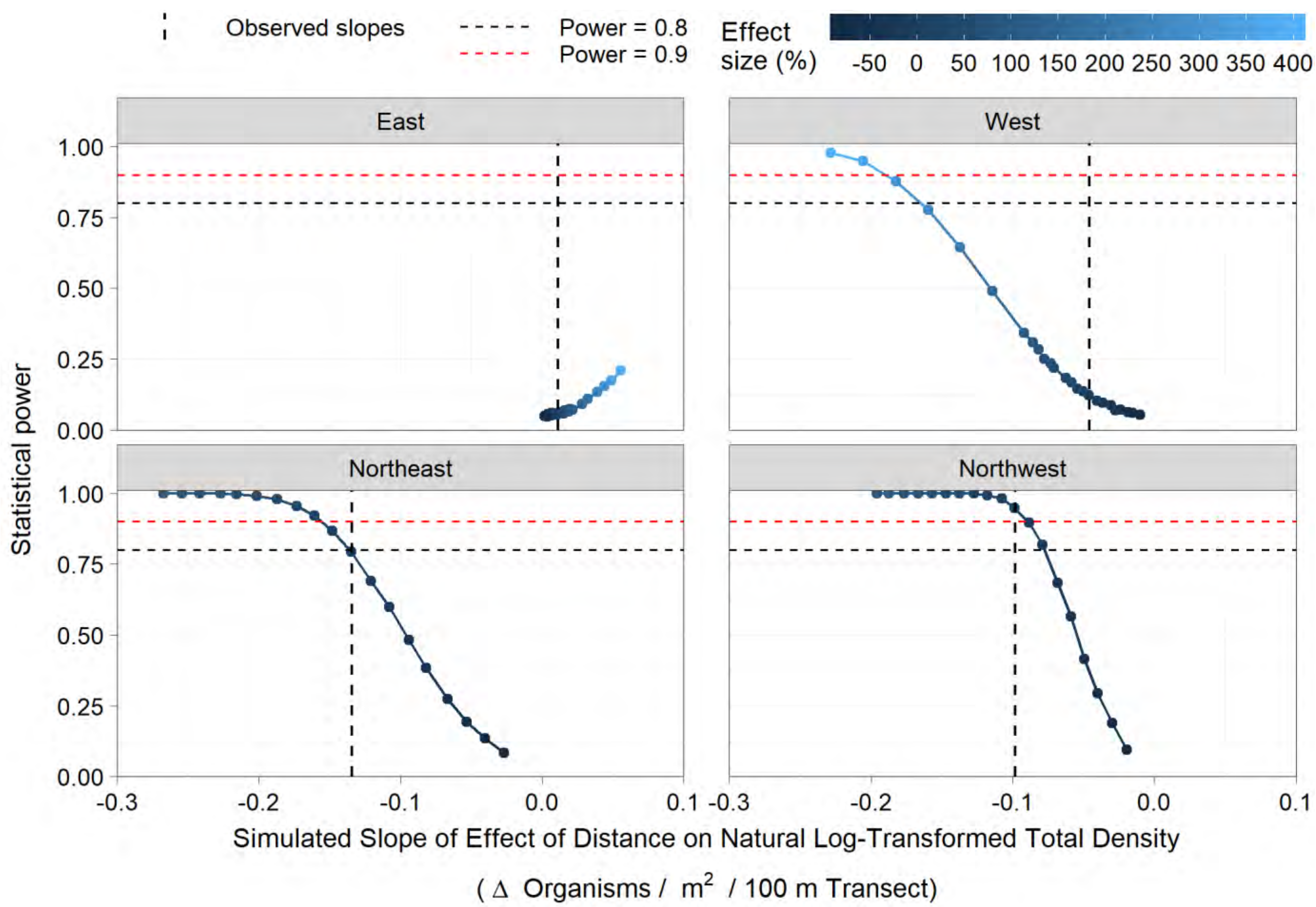

Figure 23 Statistical power of benthos density-distance slope significance by transect relative to the simulated slope values by transect and effect size (effect size is relative to the original transect-specific slope).

Benthos – Total Density in 2018-2019

The power analysis indicated that the analysis of 2018-2019 benthos total density data had sufficient power (>0.8) to detect an overall effect of year or a significant interaction between year and distance and/or transect at most of the assessed effect sizes, including the observed effect size (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between year, distance, and transect in the original analysis of benthos density in 2018-2019 (Section 4.1.5.1.1 in the main report).

In multiple comparisons between 2018 and 2019, the power analysis indicated that along the East Transect, power was not sufficient to detect significant differences under the observed magnitudes of difference or the ±2 SD effect size at all three distances (Figure). At 0 m, 500 m, and 1,000 m, the absolute difference in total density between 2018 and 2019 had to be least ~10,000 organisms/m² for a statistical power value of 0.8 (decreasing effect). And increasing effect generally required a larger difference still. In comparison, the 2 SD effect size only extended to ~5,900 organisms/m², and therefore had insufficient power.

Along the North Transect, power was not sufficient to detect observed effect sizes at either of the three distances, but was sufficient (>0.8) to detect a 2 SD decrease at 500 m and 1,000 m from the transect origin, and only slightly underpowered at 0 m (Figure 26). At 500 m, the statistical power was sufficient to also detect a 2 SD increase in total density; at 500 m, the statistical power for this effect size was slightly below 0.8. At 0 m, statistical power for this effect size was low.

Along the West Transect, power was not sufficient to detect observed effect sizes at either distance, but was sufficient (>0.8) or high (>0.9) to detect a 2 SD decrease in density at all three distances, and sufficient to detect a 2 SD increase in density at 500 m (Figure).

Overall, power to detect observed effect sizes between years was not sufficient for any of the comparisons, which is consistent with the results of the original analysis of benthos density in 2018-2019 (Section 4.1.5.1.1 in the main report). However, power was sufficient or high to detect a 2 SD reduction in density at four of the nine comparisons. For power of at least 0.8, the absolute difference in benthos density between 2019 and a previous sampling year had to be at least ~10,000 organisms/m² at the East Transect, at least ~2,000 organisms/m² at the North Transect, and at least ~5,000 organisms/m² at the West Transect.

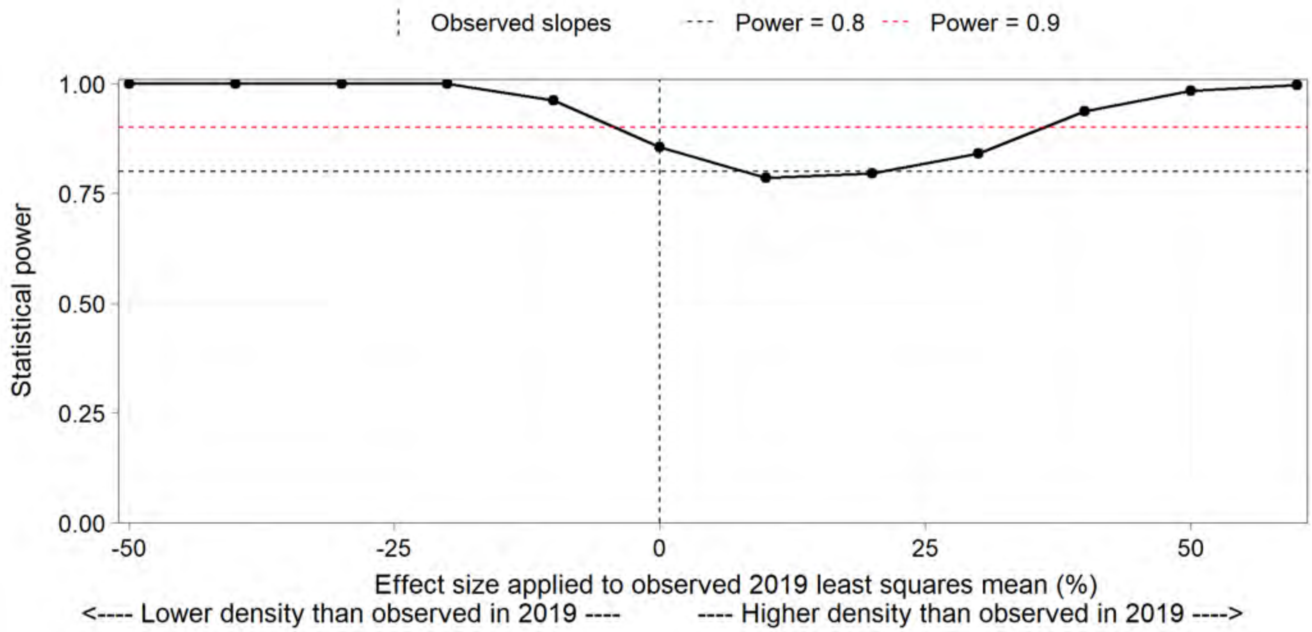

Figure 24 Statistical power of the overall model of 2018-2019 benthos density to detect a significant year effect or a significant difference in year effects between transects and distances.

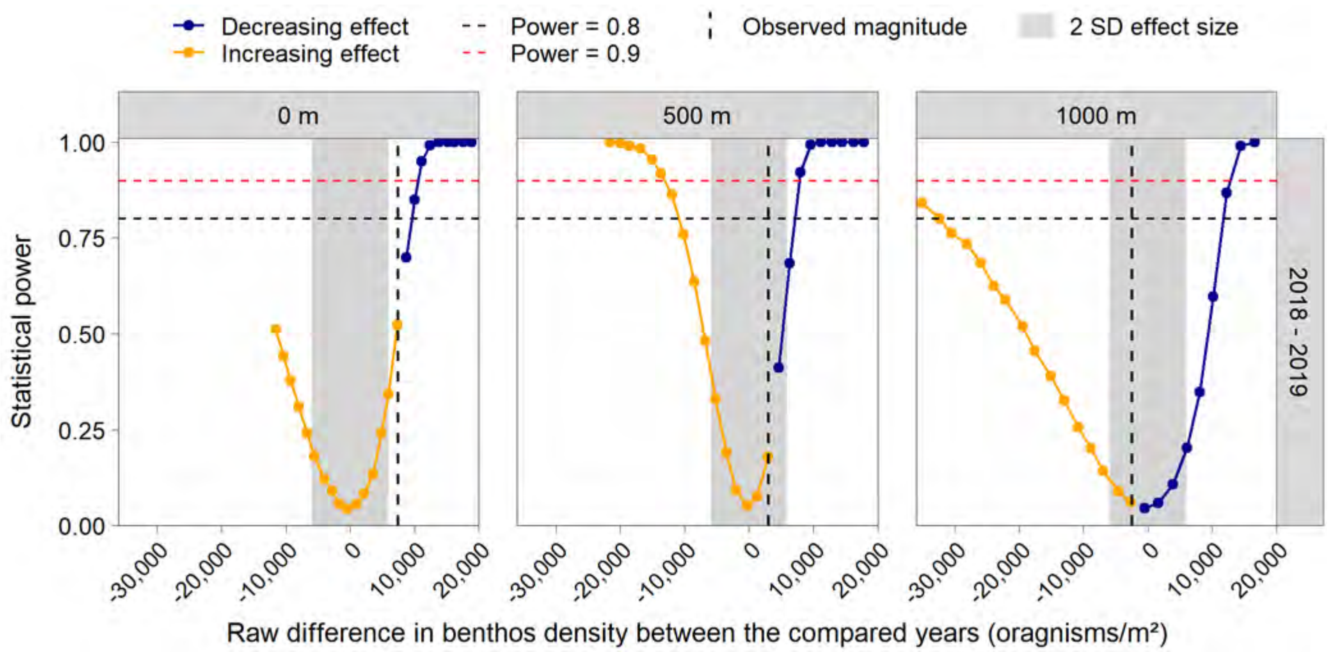

Figure 25 Statistical power of multiple comparisons between years at three distances along the East Transect relative to the difference in benthos total density between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

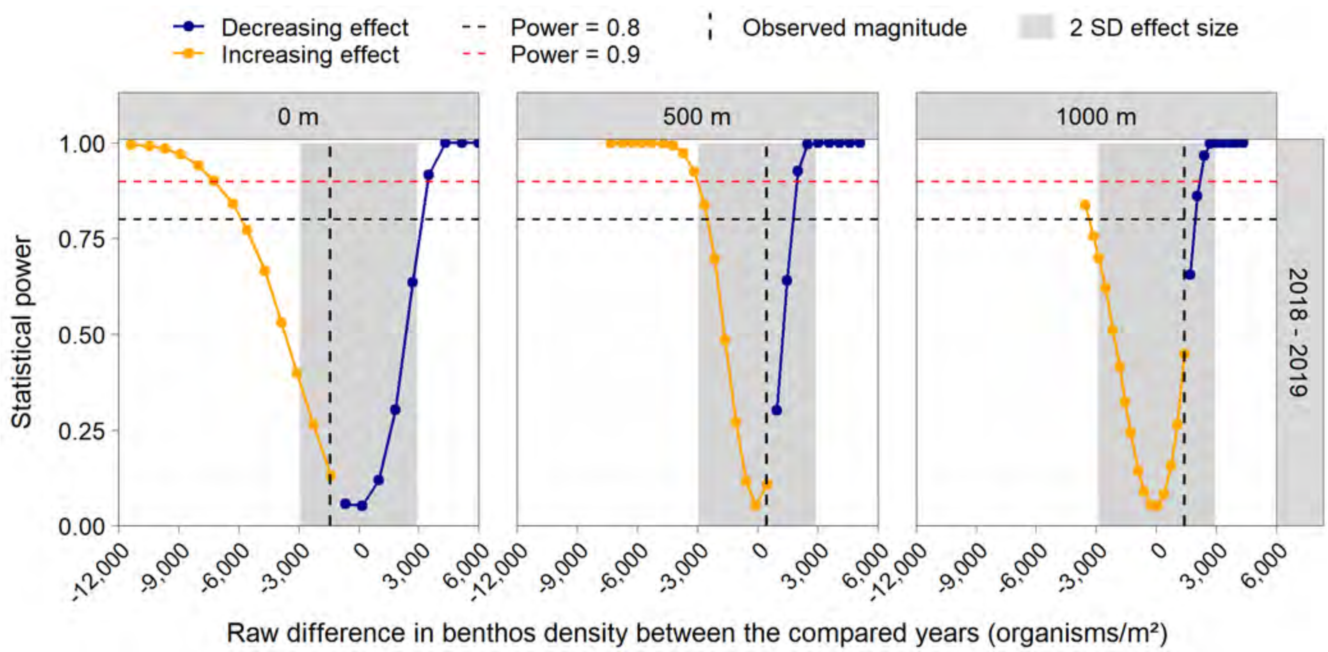

Figure 26 Statistical power of multiple comparisons between years at three distances along the North Transect relative to the difference in total benthos density between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

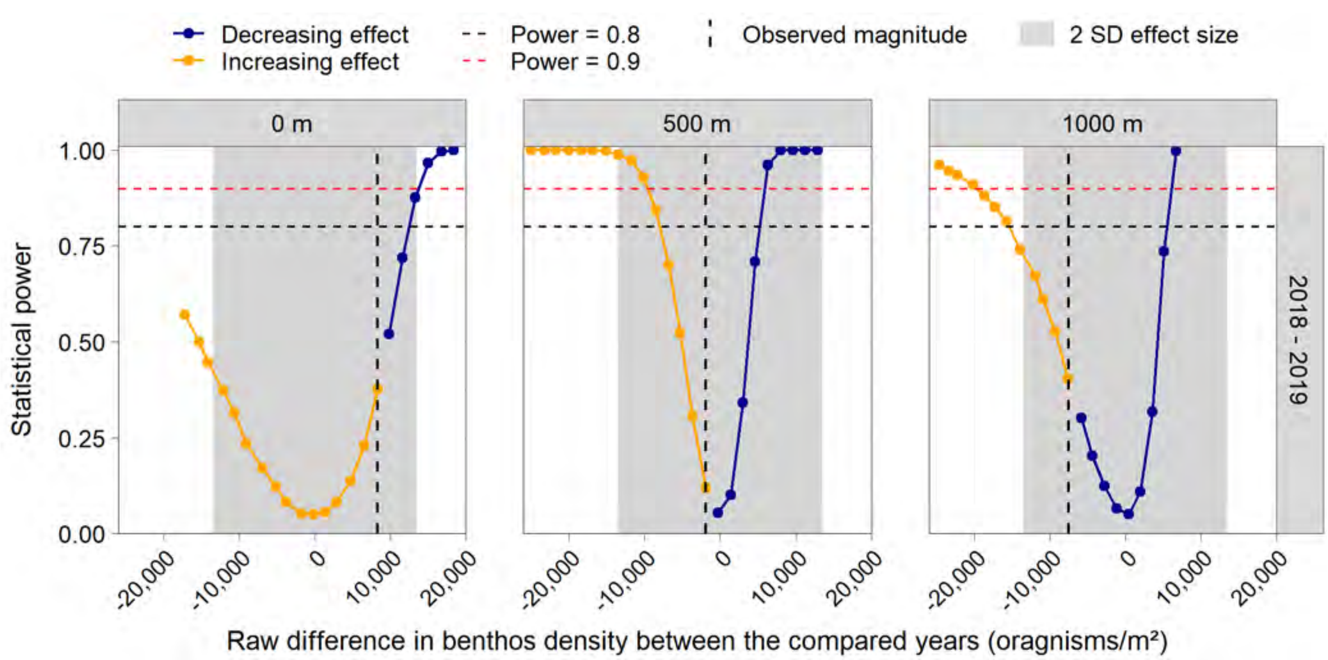

Figure 27 Statistical power of multiple comparisons between years at three distances along the West Transect relative to the difference in benthos density between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

Benthos – Total Richness in 2019

The power analysis indicated that the analysis of benthos richness data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed trends (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between distance and transect in the original analysis of benthos richness in 2019 (Section 4.1.5.1.2 in the main report).

In multiple comparisons between consecutive 100 m increments along each transect, the power analysis indicated that along the East Transect, power was low to detect significant differences under the observed magnitudes of difference in benthos richness (Figure 2). That said, the original analysis detected a significant difference between 300 m and 200 m along this transect, despite the test being slightly underpowered. The analysis estimated that for sufficient statistical power, the magnitude difference in richness had to be at least ~10 unique species/sample between 100 m and 0 m, at least ~7.5 species/ between 200 m and 100 m, and at least 4.5 species/sample between 300 m and 200 m. At the end of the transect, power was low for all assessed effect sizes.

Along the Northeast Transect, statistical power to detect significant differences under the observed magnitudes of difference in richness was low under all assessed effect sizes, due to the flat trend between richness and distance at this transect in the original analysis (Figure 4-21 in the main report).

Along the Northwest Transect, statistical power to detect significant differences under the observed magnitudes of difference in richness was insufficient throughout the transect (Figure 4). At mid-transect, the difference richness had to be at least ~2.0-2.5 species/sample for sufficient power to detect a significant difference between 500 m and 400 m, 600 m and 500 m, and 700 m and 600 m. That said, the original analysis detected a significant difference between 600 m and 500 m along this transect, despite the test being slightly underpowered.

Along the West Transect, statistical power to detect significant differences under the observed magnitudes of difference in richness was low along the transect up to 400 m, however power was sufficient to detect observed differences at comparisons between 500 m and 400 m and 600 m and 500 m (Figure 5).

Overall, power to detect observed effect sizes along transects was sufficient only along the West Transect, whereas the East, Northeast, and Northwest transects did not have sufficient power. That said, multiple comparisons from the original analysis found significant differences along both East and Northwest transects, despite the tests being slightly underpowered. For power of at least 0.8, the magnitude difference in benthos richness between consecutive 100 m increments had to be at least 4.5 taxa/sample at the East Transect, and at least 2 taxa/sample at the Northwest Transect.

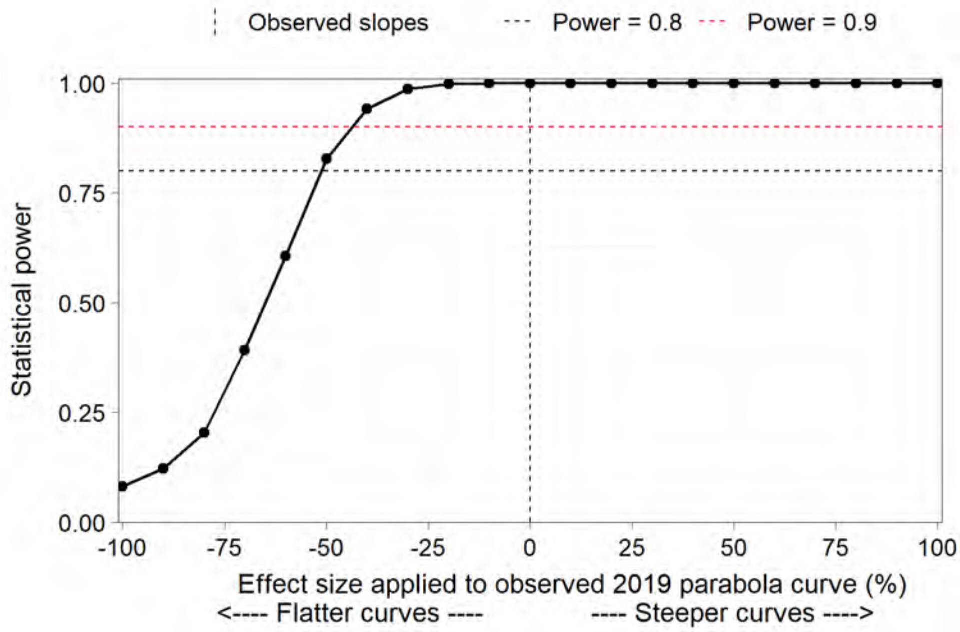

Figure 24 Statistical power of the overall model of 2019 benthos infauna richness (number of unique taxa per sample) to detect a significant year effect or a significant difference in year effects between transects and distances.

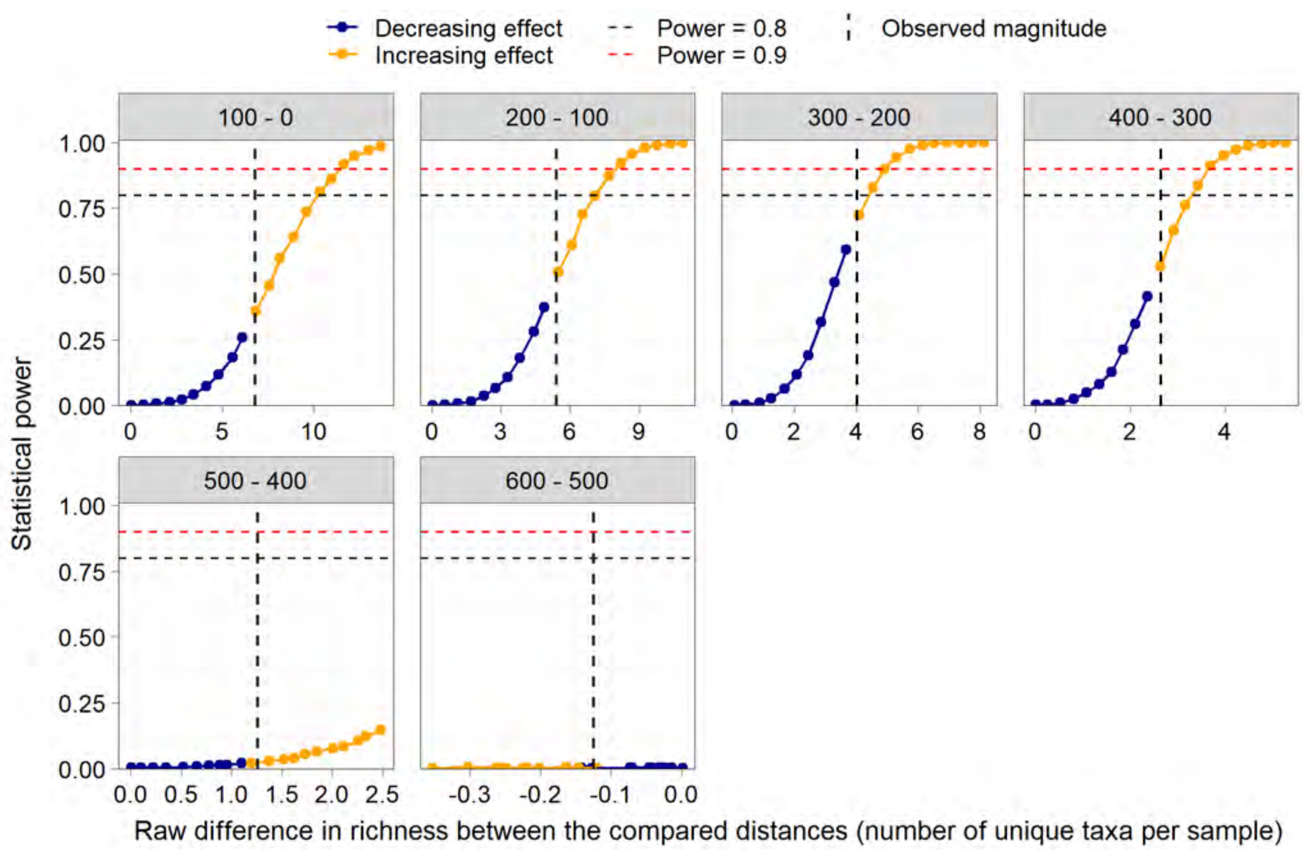

Figure 25 Statistical power of multiple comparisons between distances along the East Transect relative to the difference in benthos richness between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

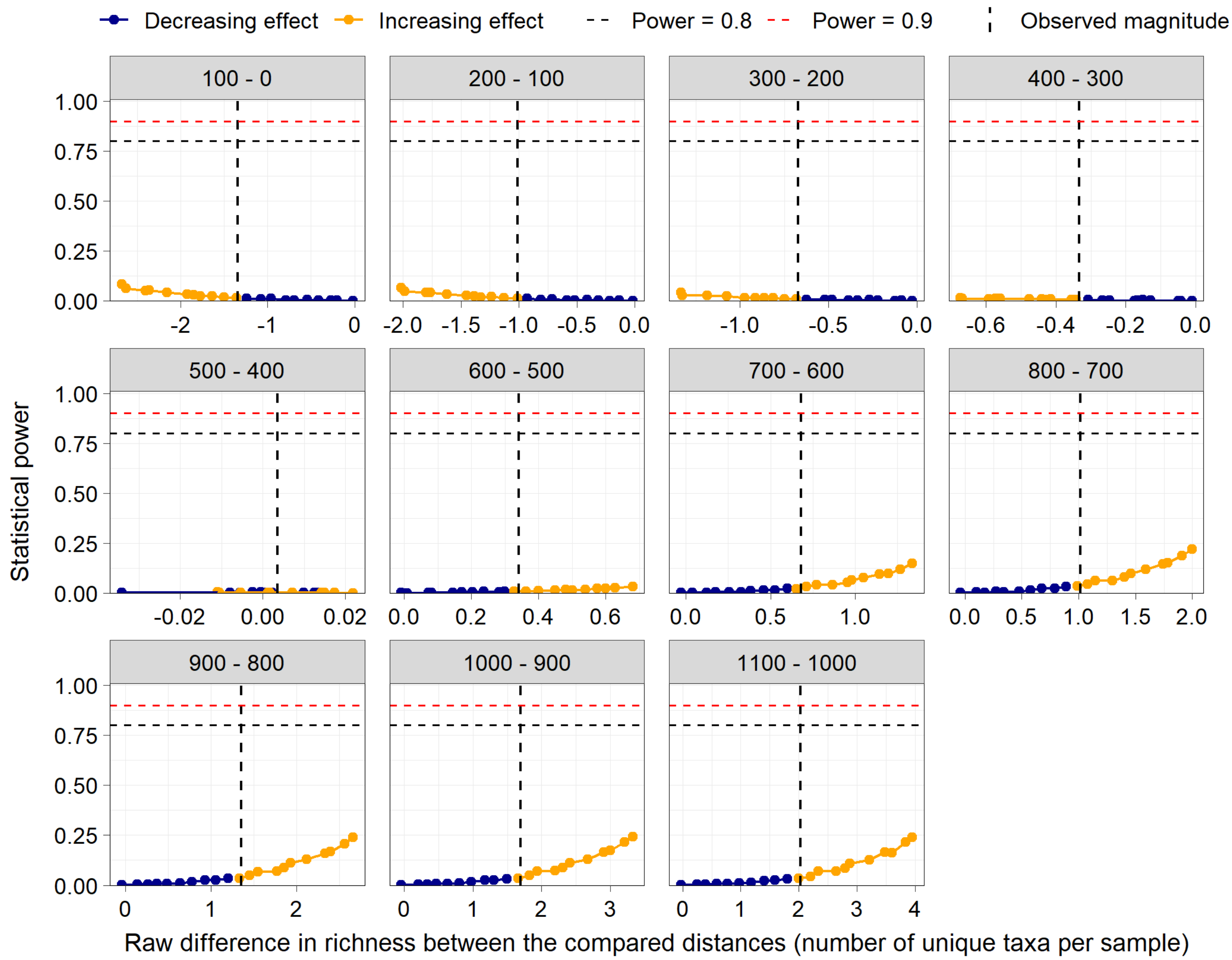

Figure 26 Statistical power of multiple comparisons between distances along the Northeast Transect relative to the difference in benthos richness between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

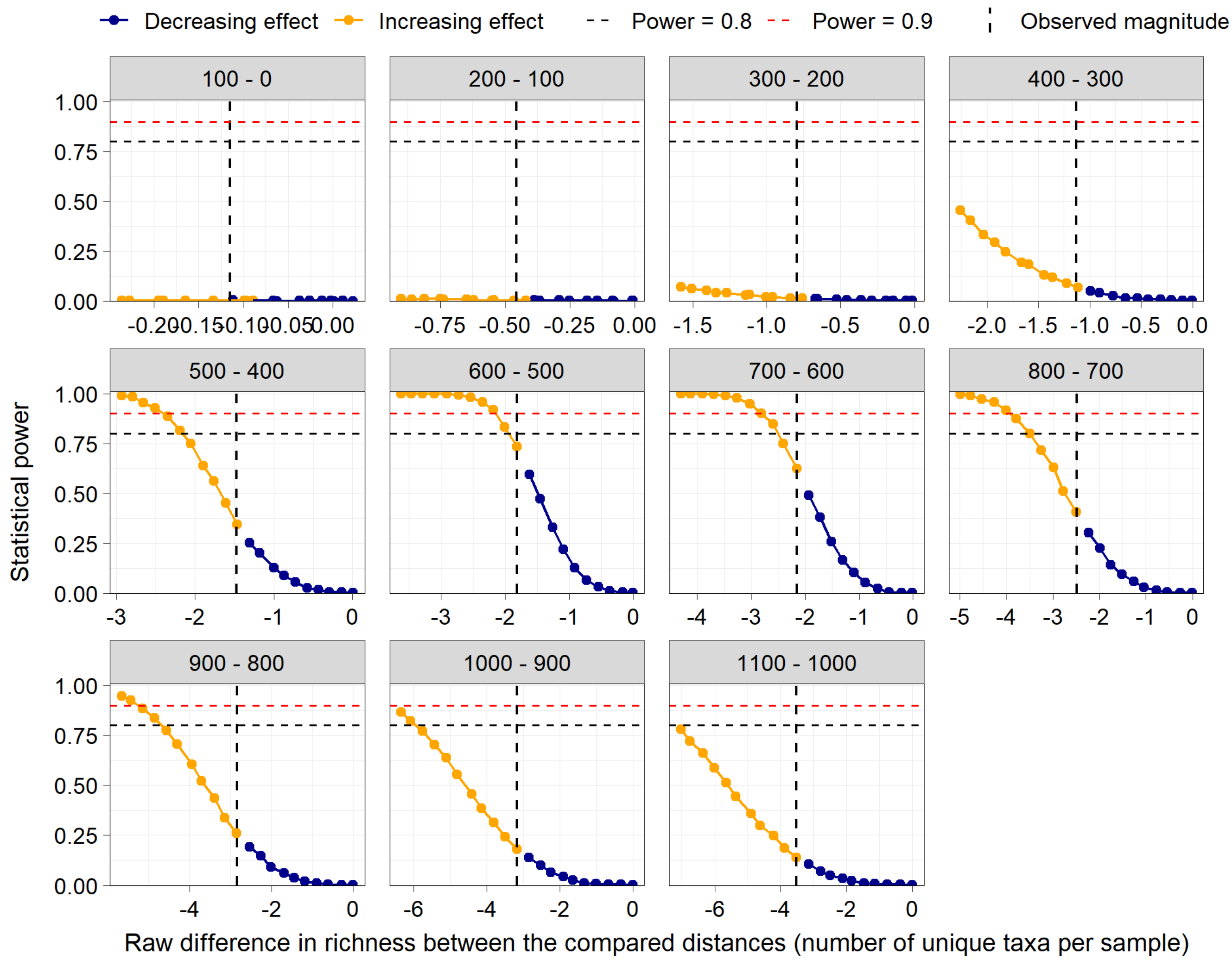

Figure 27 Statistical power of multiple comparisons between distances along the Northwest Transect relative to the difference in benthos richness between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

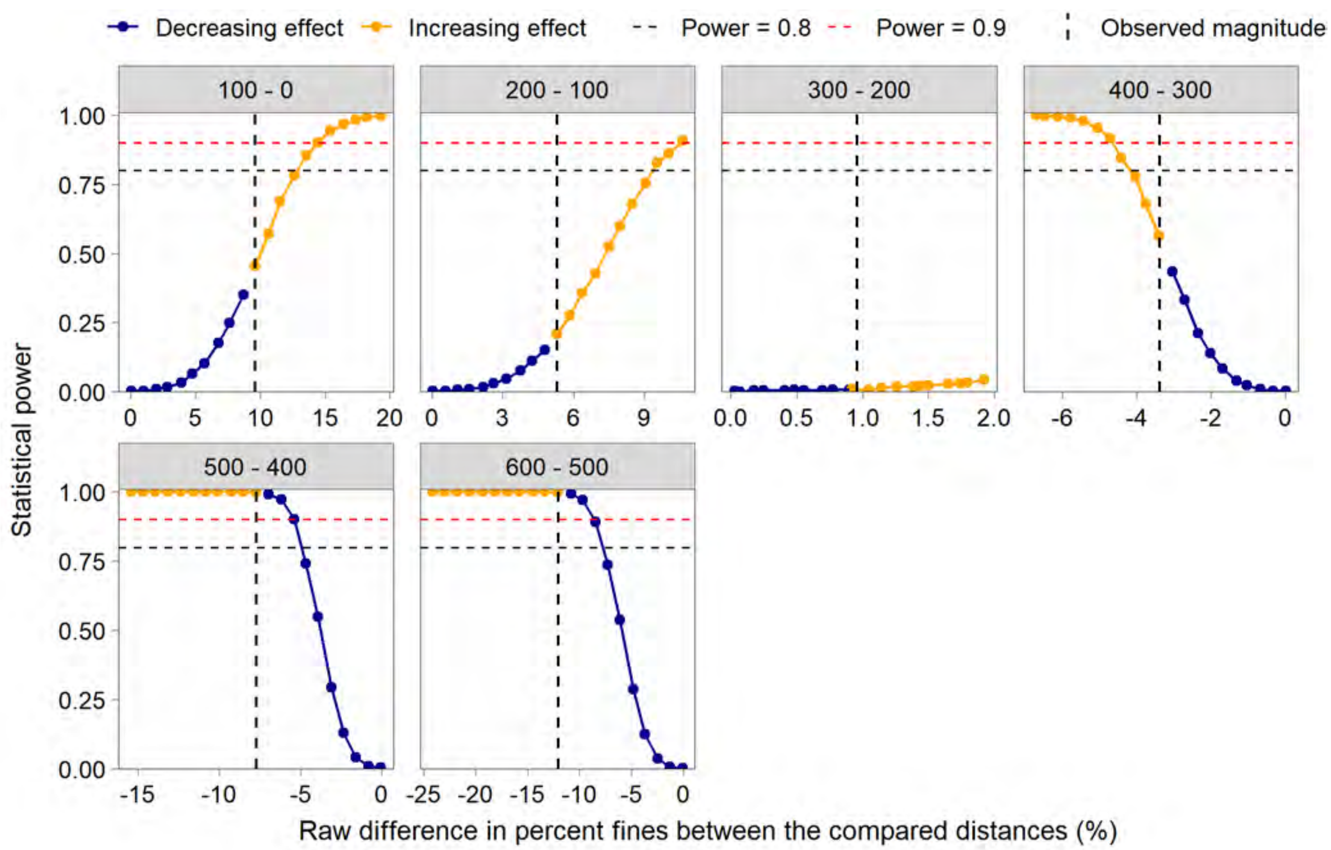

Figure 28 Statistical power of multiple comparisons between distances along the West Transect relative to the difference in benthos richness between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

Benthos – Total Richness in 2018-2019

The power analysis indicated that the analysis of 2018-2019 benthos richness data had sufficient power (>0.8) to detect an overall effect of year or an overall significant difference between years between distances and sampled transects at all of the assessed effect sizes, including the observed effect size (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between year, distance, and transect in the original analysis of benthos richness in 2018-2019 (Section 4.1.5.1.2 in the main report).

In multiple comparisons between 2018 and 2019, the power analysis indicated that along the East Transect, power was sufficient to detect significant differences under the observed magnitudes of difference at 500 m and 1,000 m, but not at 0 m from the dock (Figure). At 0 m, the absolute difference in richness between 2018 and 2019 had to be least 19 taxa/sample for a statistical power value of 0.8 (either increasing or decreasing effect). This is consistent with the findings in the original analysis (Section 4.1.5.1.2 in the main report).

Along the North Transect, power was not sufficient to detect observed effect sizes at either of the three distances, but was sufficient (>0.8) to detect a 2 SD decrease at 500 m from the transect origin, and only slightly underpowered at 1,000 m (Figure 31). At 0 m, the absolute difference in richness between 2018 and 2019 had to be least 17 taxa/sample for a statistical power value of 0.8 (either increasing or decreasing effect).

Along the West Transect, power was sufficient to detect the observed effect size at 0 m, and to detect a 2 SD effect size at 500 m, but not to detect either at 1,000 m (Figure). At 1000 m, the absolute difference in richness between 2018 and 2019 had to be least 28 taxa/sample for a statistical power value of 0.8 (either increasing or decreasing effect). This is consistent with the findings in the original analysis (Section 4.1.5.1.2 in the main report).

Overall, for power of at least 0.8 to detect a significant difference at least at one of the distances examined, the absolute difference in richness between 2019 and a previous sampling year had to be at least 12 taxa/sample at all three transects.

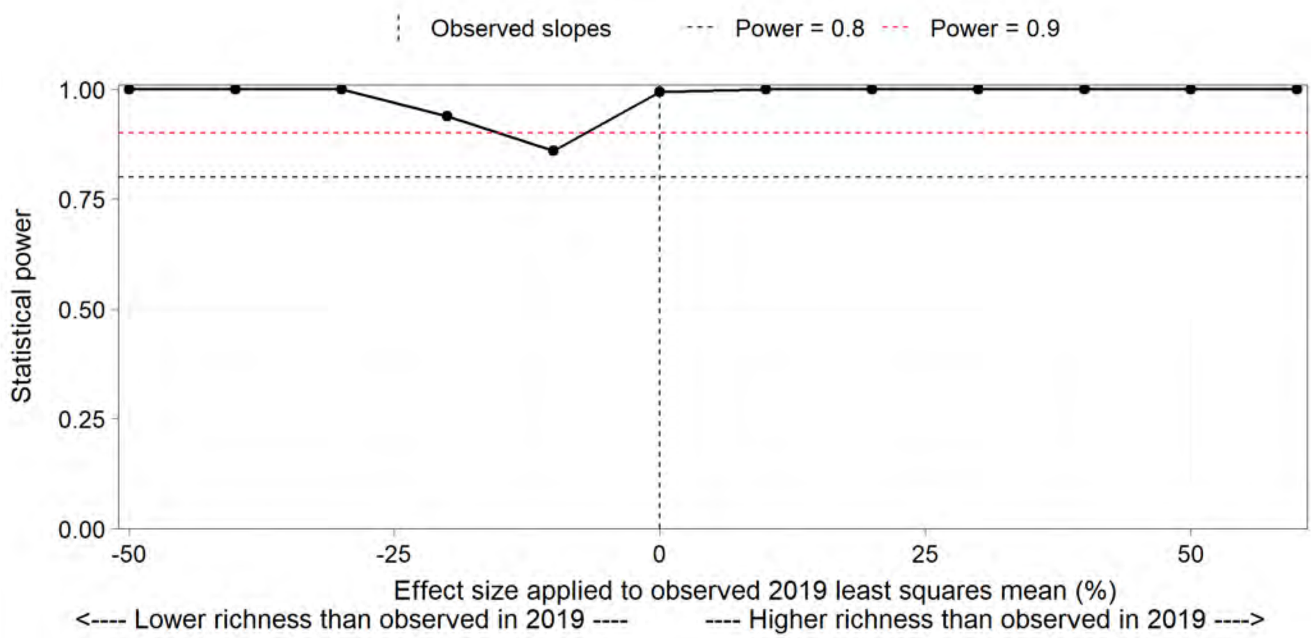

Figure 29 Statistical power of the overall model of 2018-2019 benthos richness to detect a significant year effect or a significant difference in year effects between transects and distances.

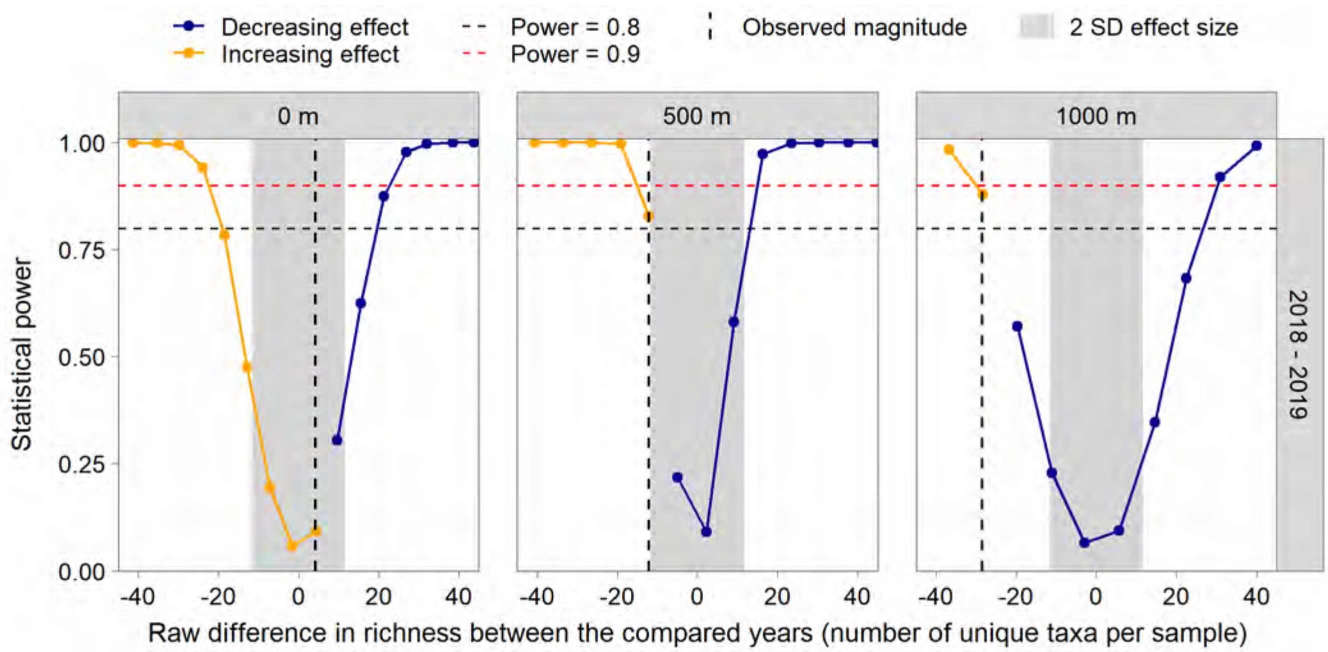

Figure 30 Statistical power of multiple comparisons between years at three distances along the East Transect relative to the difference in benthos richness between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

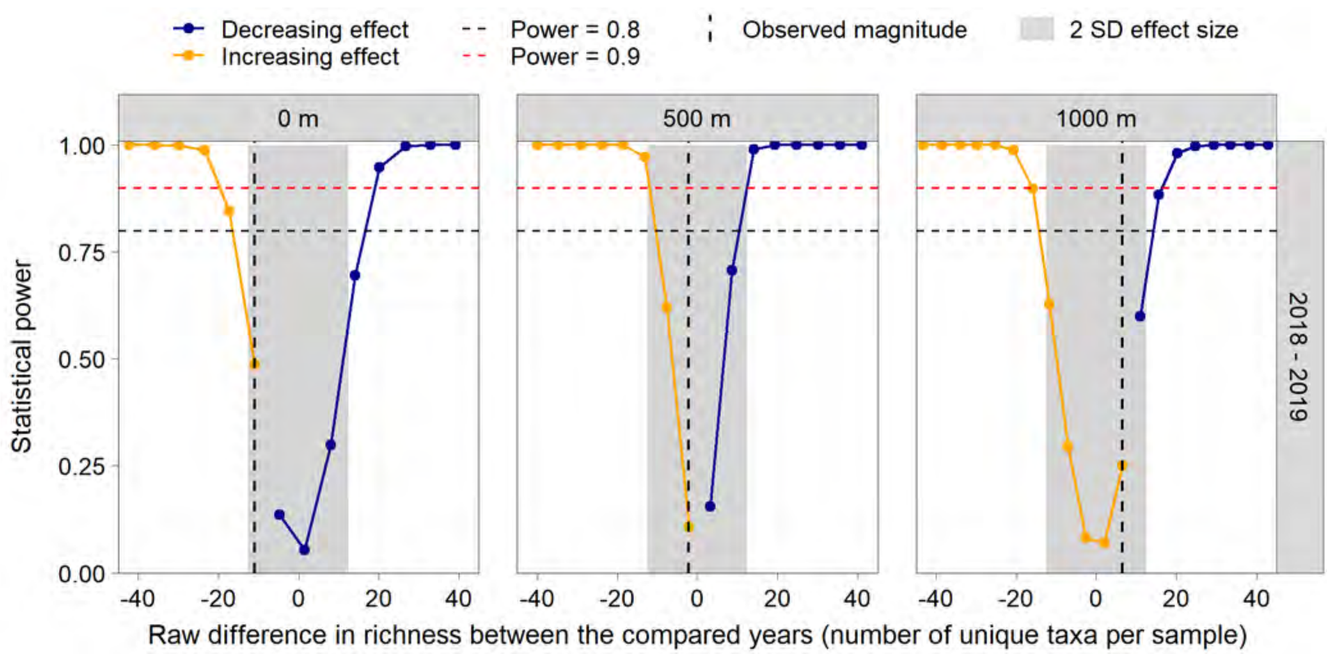

Figure 31 Statistical power of multiple comparisons between years at three distances along the North Transect relative to the difference in benthos richness between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

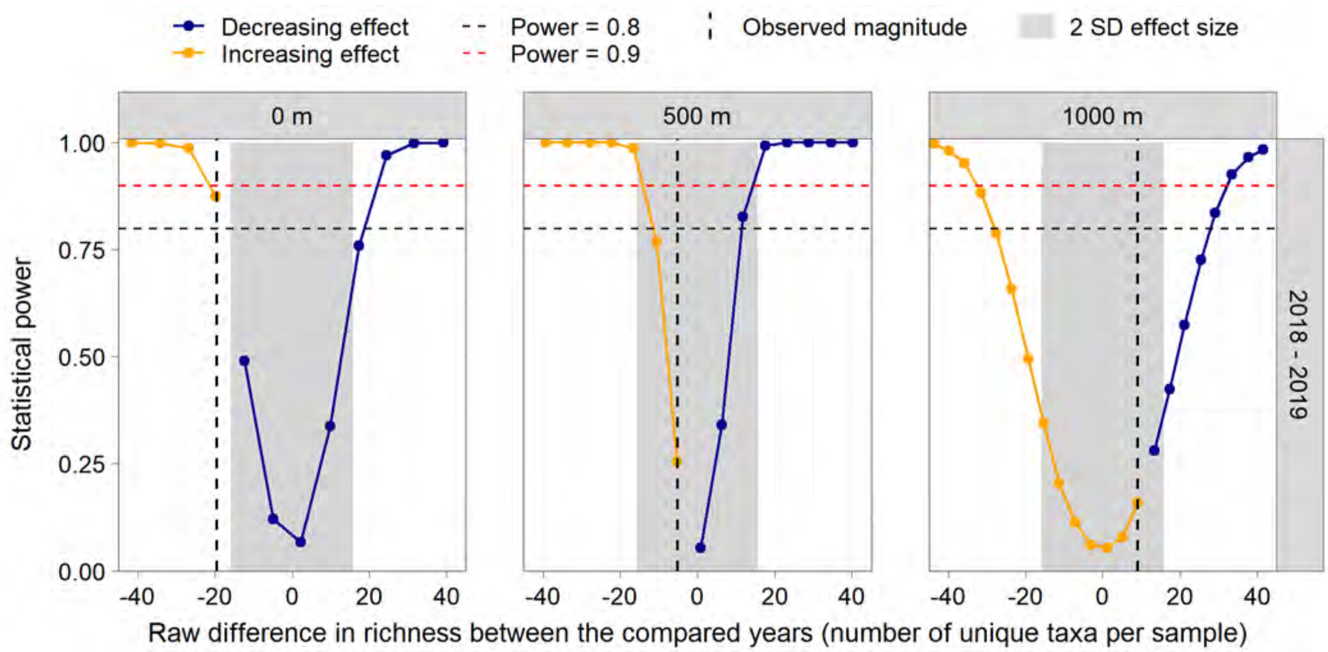

Figure 32 Statistical power of multiple comparisons between years at three distances along the West Transect relative to the difference in benthos richness between the compared years. Each panel shows a separate comparison, with the years compared displayed on the right and the distance at which the comparison is performed displayed at the top.

Benthos – SDI in 2019

The power analysis indicated that the analysis of benthos SDI data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed linear slope values (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between distance and transect in the original analysis of benthos SDI in 2019 (Section 4.1.5.1.3 in the main report).

In assessment of significance of individual slopes, power was sufficient to identify the significance of the observed slope values at the East and West transects (consistent with the findings in the original analysis), but not the Northeast and Northwest transects (Figure 34). At the Northeast Transect, the slope had to be slightly steeper (a change in SDI of at least 0.009 per 100 m transect increment) to be identified as a significant effect. At the Northeast Transect, due to the lack of trend in the observed data (Figure 4-23 in the main report), an increase of even 300% in slope steepness still had very low power. Overall, the model had sufficient power to detect changes of in SDI approximately 0.01 and larger per 100 m increment of transect.

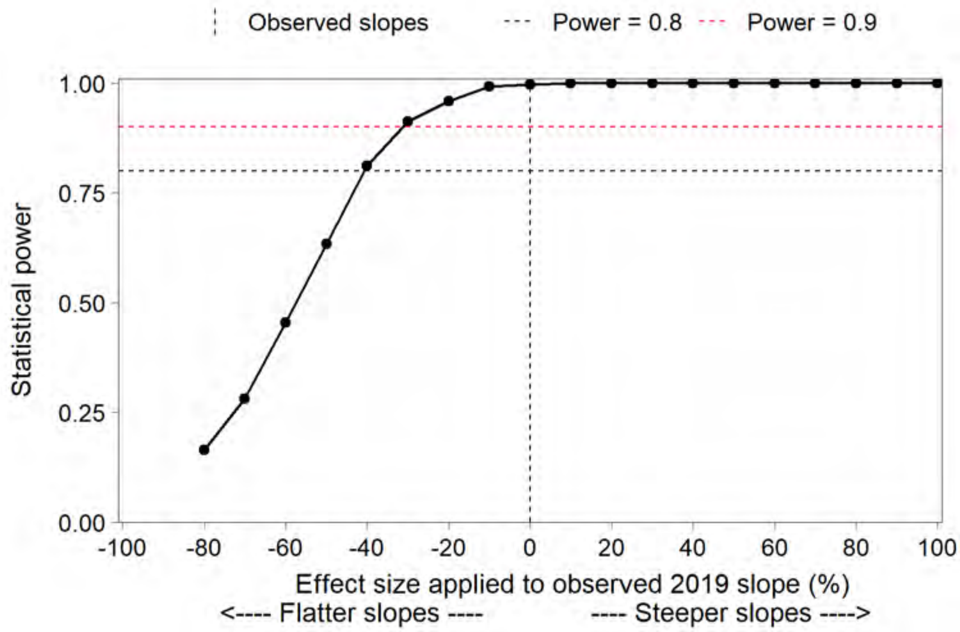

Figure 33 Statistical power of the overall model of 2019 benthos infauna total density (organisms/m²) to detect an effect of distance or a significant difference in distance effects between transects.

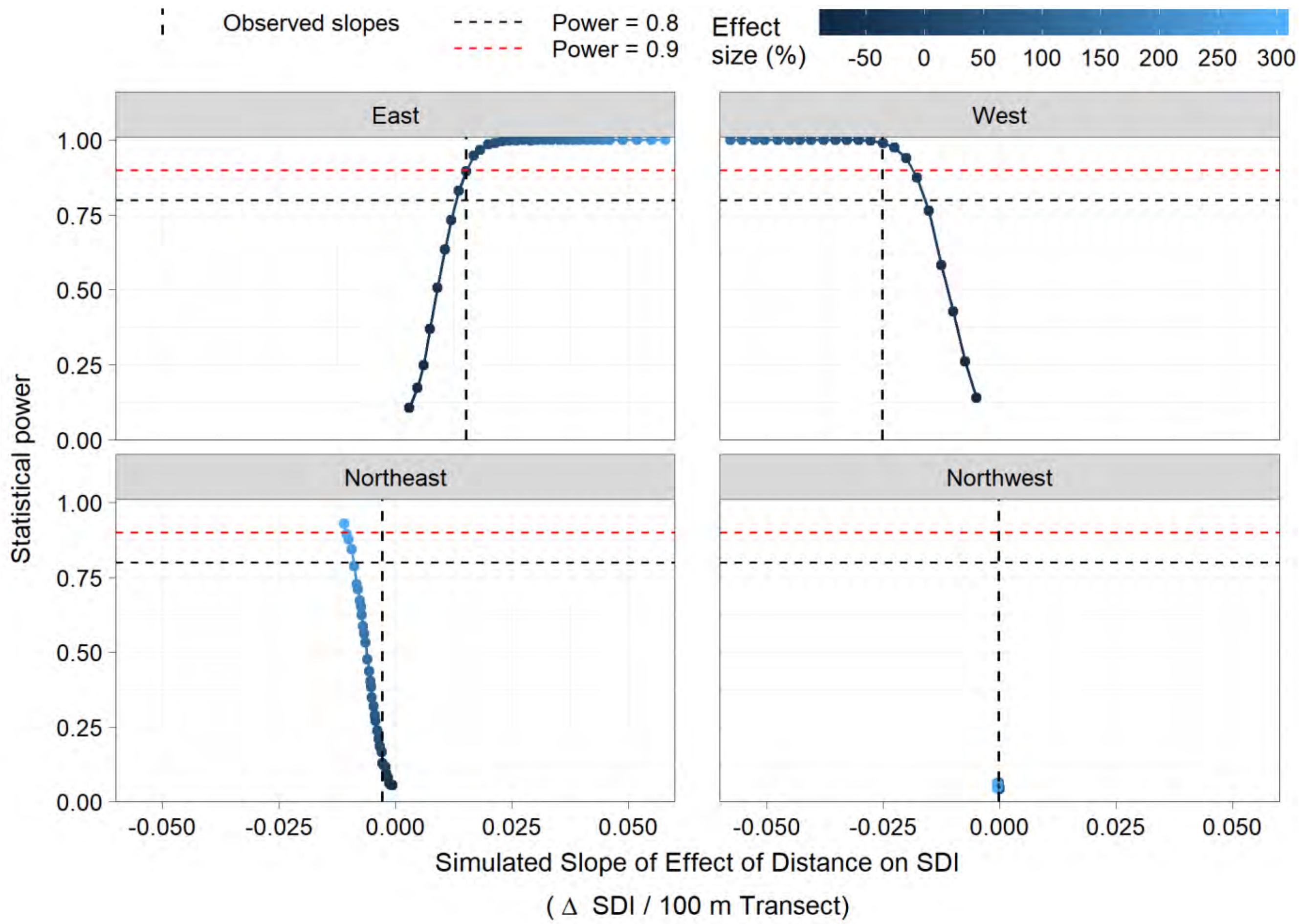

Figure 6 Statistical power of SDI-distance slope significance by transect relative to the simulated slope values by transect and effect size (effect size is relative to the original transect-specific slope).

Benthos – SEI in 2019

The power analysis indicated that the analysis of benthos SEI data collected in 2019 had high power (>0.9) to detect an overall effect of distance or an overall significant difference in distance effects between the sampled transects at the observed trends (indicated by the vertical line in Figure). This is consistent with the finding of a significant interaction between distance and transect in the original analysis of benthos richness in 2019 (Section 4.1.5.1.3 in the main report).

In multiple comparisons between consecutive 100 m increments along each transect, the power analysis indicated that along the East Transect, power was low to detect significant differences under the observed magnitudes of difference in benthos SEI (Figure 2). The analysis estimated that the raw difference in SEI had to be at least ~0.05 for sufficient power to detect a significant difference between 200 m and 100 m, and at least 0.02-0.03 for sufficient power to detect a difference between 300 m and 200 m and between 400 m and 300 m. At the end of the transect, power was low for all assessed effect sizes.

Along the Northeast Transect, statistical power to detect significant differences under the observed magnitudes of difference in richness was low under all assessed effect sizes, albeit by a narrow margin at the end of the transect (Figure 37). The analysis estimated that the raw difference in SEI had to be at least ~0.05 for sufficient power to detect a significant difference between 100 m and 0 m, and at least 0.03-0.04 for sufficient power to detect a difference between 200 m and 100 m and between 300 m and 200 m. Mid-transect, only an absolute difference of 0.02 was required to have sufficient power to detect an effect. At the end of the transect, power was low for all assessed effect sizes.

Along the Northwest Transect, statistical power to detect significant differences under the observed magnitudes of difference in SEI was sufficient at distances of 700-1000 m, but low at closer proximity to the dock (Figure 4). This is consistent with the multiple comparison results in the original analysis of benthos SDI in 2019 (Section 4.1.5.1.3 in the main report). At dock origin, the difference in SEI had to be at least ~0.05 to have sufficient power for the multiple comparison.

Along the West Transect, statistical power to detect significant differences under the observed magnitudes of difference in SEI was low throughout the transect (Figure 5). The difference in SEI had to be at least ~0.03-0.04 to have sufficient power for the multiple comparisons at 200-400 m.

Overall, the SEI power analysis confirmed that observed relationships between SEI and distance from the ore dock were generally too flat to detect significant differences between 100 m increments along the transects, with the exception of the Northwest Transect, where significant differences were detected under observed magnitudes. The analysis would have sufficient power to detect differences in SEI of at least 0.02-0.05 along the four Transects, depending on distance from the dock.

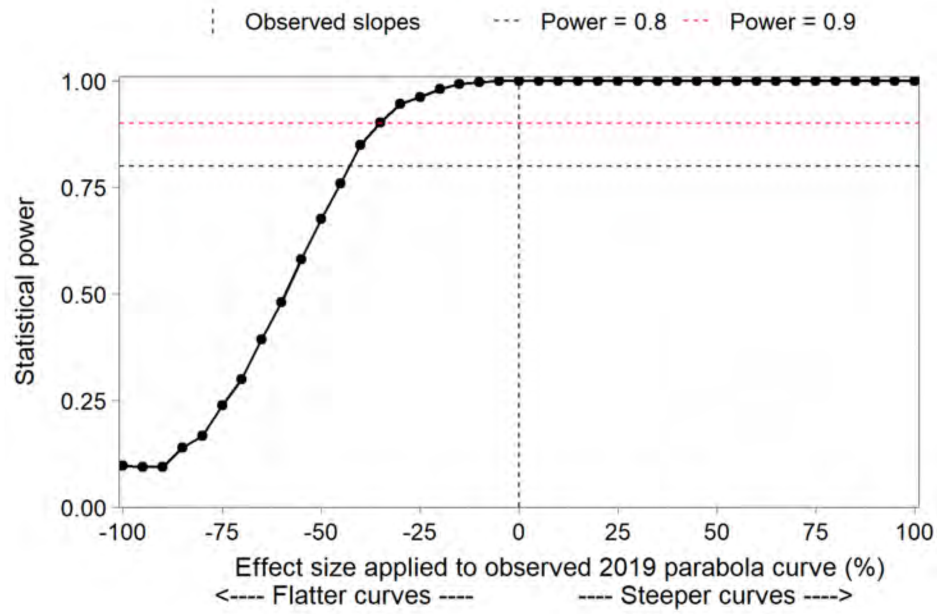

Figure 35 Statistical power of the overall model of 2019 benthos SEI to detect a significant year effect or a significant difference in year effects between transects and distances.

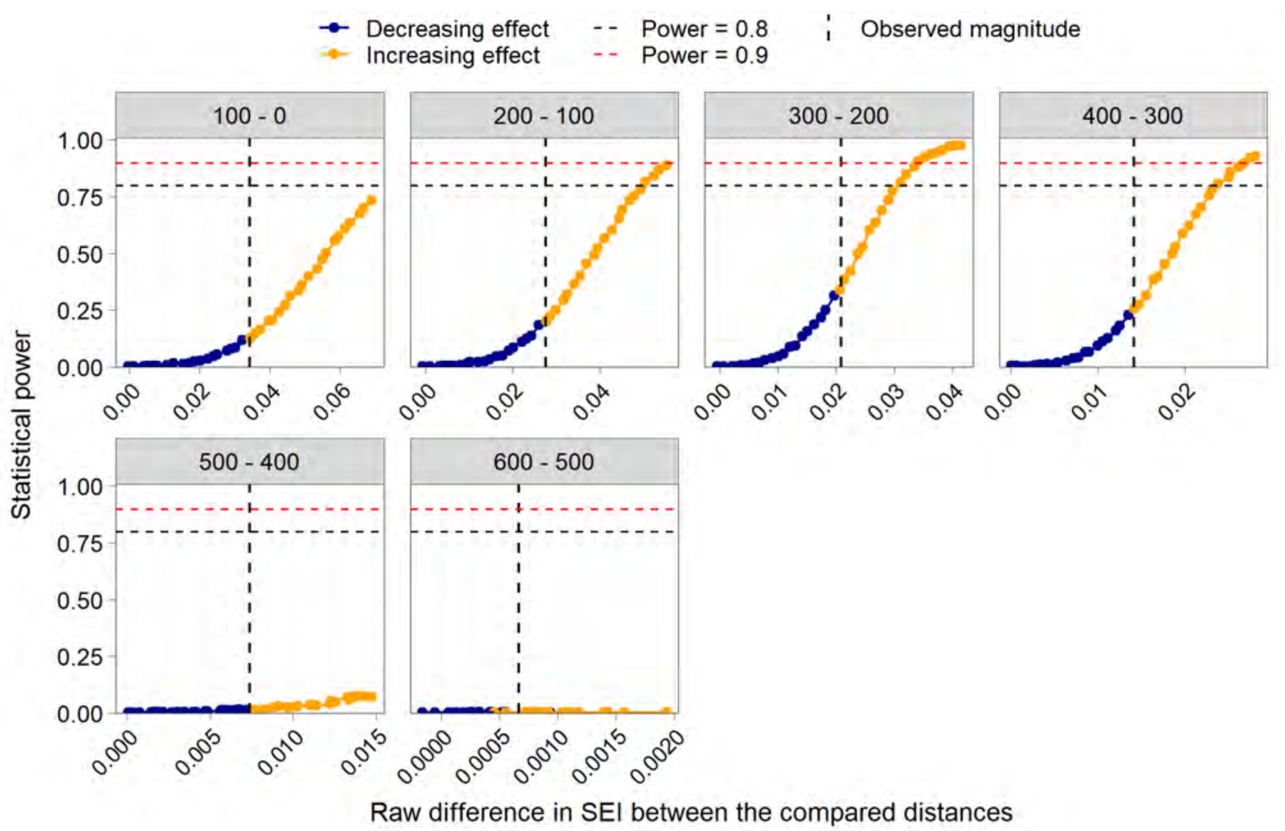

Figure 36 Statistical power of multiple comparisons between distances along the East Transect relative to the difference in benthos SEI between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

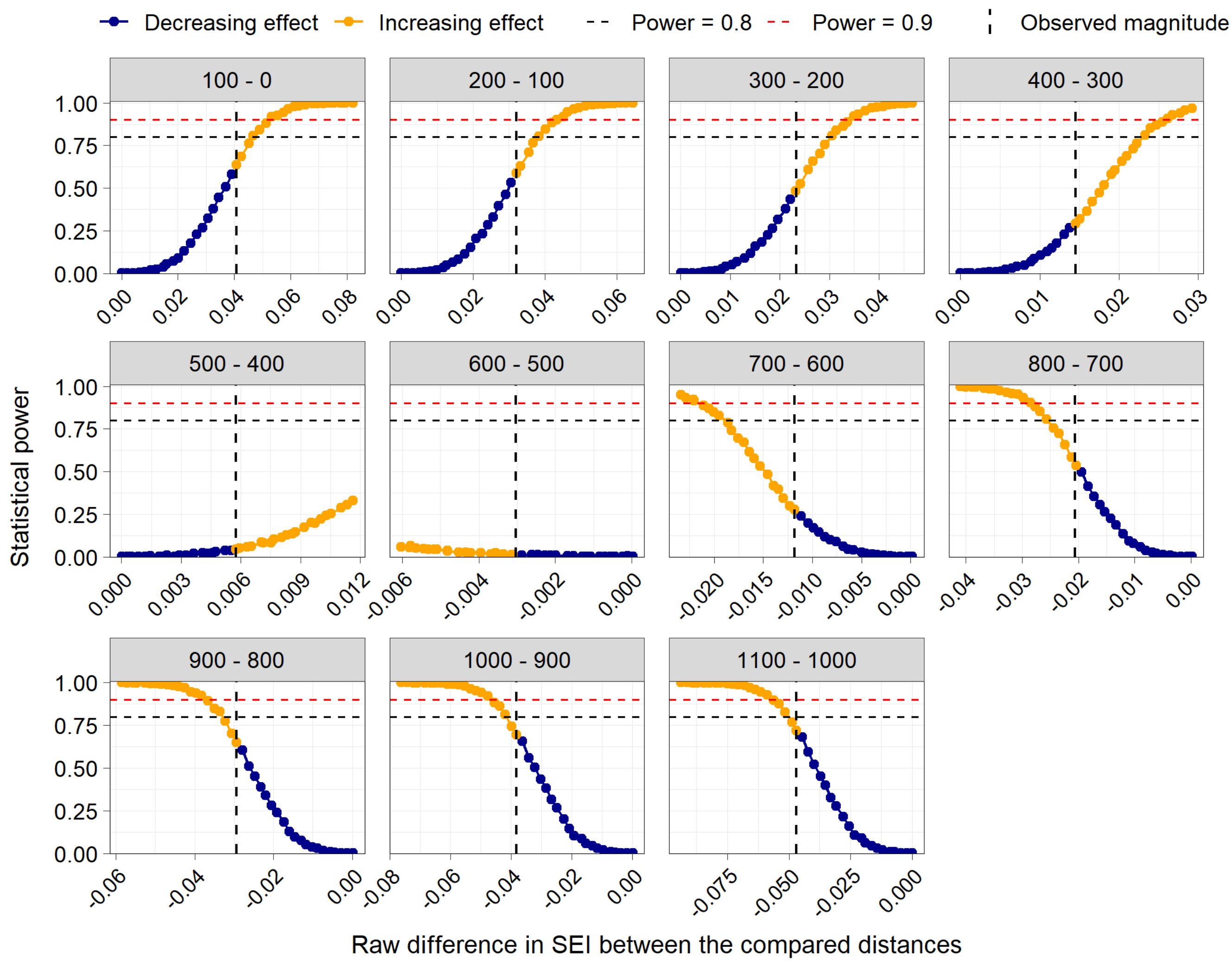

Figure 37 Statistical power of multiple comparisons between distances along the Northeast Transect relative to the difference in benthos SEI between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

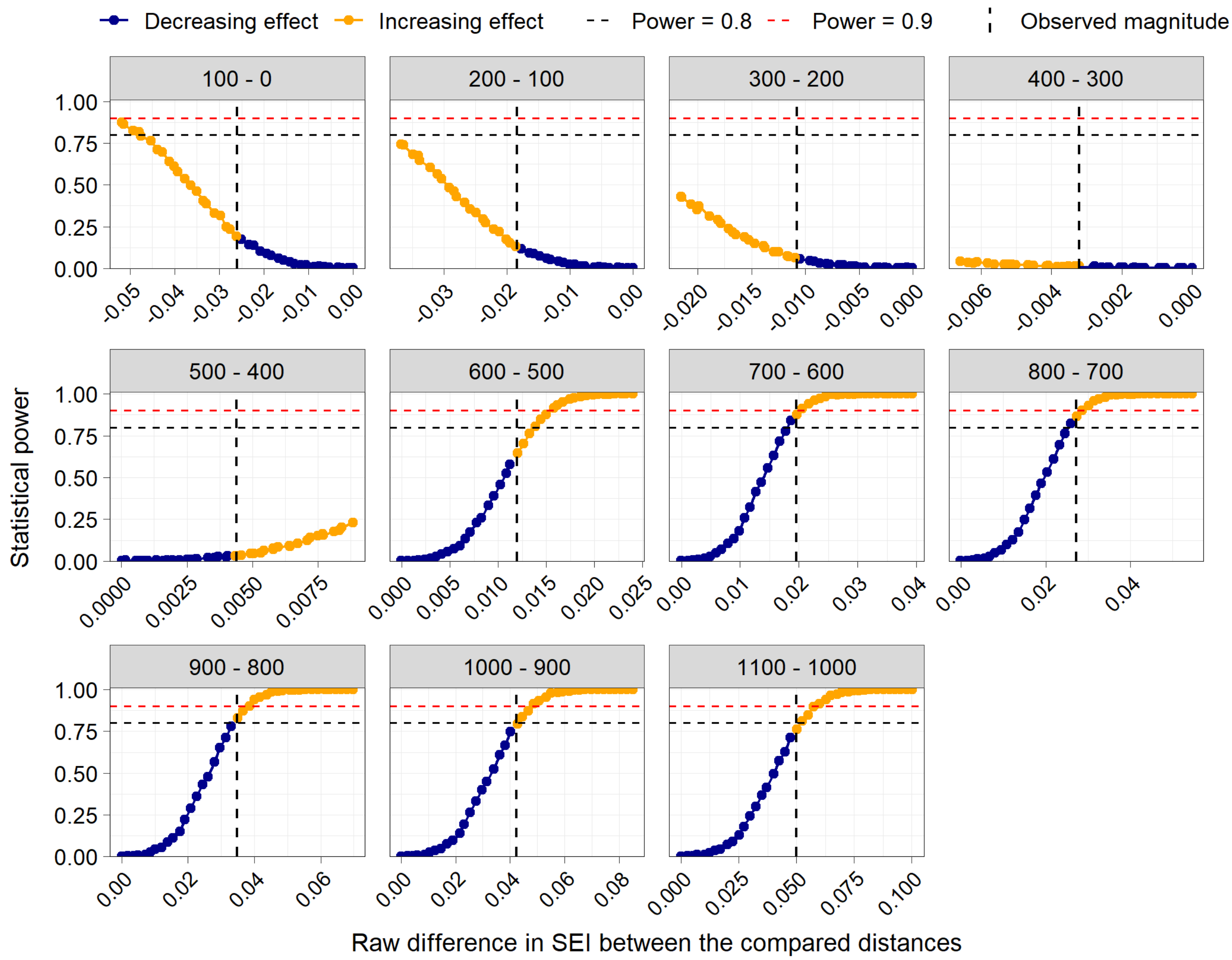

Figure 38 Statistical power of multiple comparisons between distances along the Northwest Transect relative to the difference in benthos richness between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

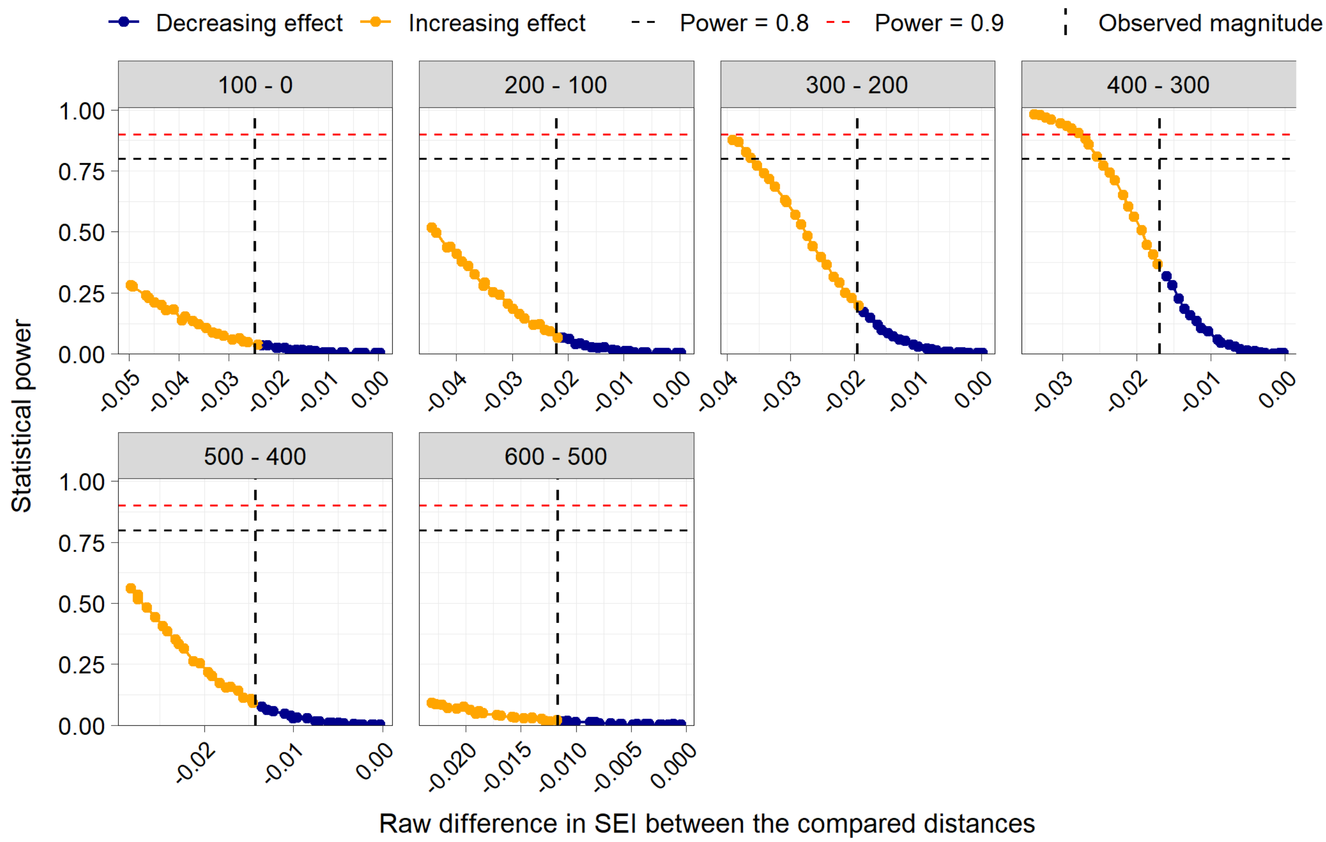

Figure 39 Statistical power of multiple comparisons between distances along the West Transect relative to the difference in benthos SEI between the compared distances. Each panel shows a separate comparison, with the distances compared displayed at the top of the panel.

POWER ANALYSIS – SUMMARY

Summary of Findings

- Percent fines, distance effects – statistical power was sufficient to detect magnitude differences of ~2-4% fines between consecutive 100 m increments at all four transects.
- Percent fines, year effects - statistical power was sufficient to detect minimum magnitude differences of 16-18% fines between 2019 and a previous sampling year, depending on the transect and the distance along the transect.
- Iron content, distance effects - statistical power was sufficient to detect minimum magnitude differences of ~250-800 mg/kg iron (adjusted to mean natural log-transformed fines) between consecutive 100 m increments, depending on the transect and the distance along the transect.
- Iron content, year effects - statistical power was sufficient to detect minimum magnitude differences of 1,000-1,400 mg/kg iron (adjusted to mean natural log-transformed fines) between 2019 and a previous sampling year, depending on the transect and the distance along the transect

- Benthos total density, distance effects - statistical power was sufficient to detect trends of 0.08-0.18 Δ density / 100 m transect, depending on transect.
- Benthos total density, year effects - statistical power was sufficient to detect minimum magnitude differences of 2,000-8,000 organisms/m² between 2019 and a previous sampling year, depending on the transect and the distance along the transect.
- Benthos richness, distance effects - statistical power was sufficient to detect minimum magnitude differences of ~2-4 taxa/sample between consecutive 100 m increments, depending on the transect and the distance along the transect.
- Benthos richness, year effects - statistical power was sufficient to detect minimum magnitude differences of 12-13 taxa/sample between 2019 and a previous sampling year, depending on the transect and the distance along the transect.
- Benthos SDI, distance effects - statistical power was sufficient to detect trends of 0.009-0.018 Δ SDI / 100 m transect, depending on transect.
- Benthos SEI, distance effects - statistical power was sufficient to detect minimum magnitude differences of ~0.01-0.02 between consecutive 100 m increments, depending on the transect and the distance along the transect

Implications of Power Analysis Results

- The results suggested sufficient power to detect distance effects (within 2019 data) for all variables, under reasonable magnitudes of effect. That is, data collected in 2019 are deemed sufficient to identify ecologically relevant changes in the variables of interest along the sampled transects.
- The results suggested that to detect a year effect, magnitude differences had to be considerably higher than the magnitude differences required to detect a distance effect within 2019 data (e.g., 16-18% fines to detect a year effect, versus 2-4% fines to detect a distance effect). In the case of sediment quality, these magnitude differences were deemed ecologically reasonable given their observed values (e.g., 16-18% fines, 1,000-1,400 mg/kg iron content). In the case of benthos, the detection of year effects required a high magnitude of difference (e.g., 2,000-8,000 organisms/m² change in density and 12-13 taxa/sample). Therefore, for benthos analyses, it is possible that the current sample size may not be sufficient to detect a year effect under an ecologically significant effect size.
- In 2019, the number of benthos samples collected was lower than planned, due to technical difficulties. It is expected that the number of samples going forward will match the full sampling design, thereby increasing sample size and improving power. Since current sample size is sufficient to detect distance effects within the sampling year, and since sample size in the future is expected to increase relative to 2019, the statistical power of the analyses will be assessed in 2020, and the sampling design will be re-evaluated if deemed necessary.

APPENDIX P

Responses to MEWG Comments

Baffinland

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Agency / Organization: DFO/PCA

Date of Comment Submission: June 21, 2020

#	Document Name	Section Reference	Comment	Baffinland Response
1	2019 MEEMP and AIS Monitoring Program	3.1.7.2 Fish Surveys 4.1.7.1 Catch Data	Sampling in 2019 was largely completed at the end of July and the end of August, with limited sampling occurring between these events (pgs 28-32). DFO notes that in the 2018 MEEMP Report, sampling occurred more frequently between the end of July and the end of August (2018 MEEMP AIS Report, Section 3.1.5.2, pgs 23-25). As demonstrated in Table 4-23 of the 2019 MEEMP, the total number of fish caught and the total number of fish species caught was lower in 2019 than in 2018. What factors influenced the frequency and timing of fish sampling in 2019? Consistency in sampling methodology and frequency each year will better allow for any potential effects to fish community structure from the construction and operation of Milne Port to be detected, and will allow for better comparison of data.	It is, and has been, our intention to maintain consistency in sampling methodology, timing, and frequency among years for the MEEMP components to the extent possible. An unexpected health and safety incident disrupted the 2019 sampling schedule, such that on-water sampling was not possible for approximately a week during the program. The 2019 MEEMP report has been updated to provide this explanation. And, moving forward, when factors beyond the field crews' reasonable control affect the field schedule or the ability to complete all scheduled tasks within the planned timeframe, these deviations will be clearly reported in the MEEMP annual report.
2	2019 MEEMP and AIS Monitoring Program	General Comments	Baseline is not well established (they often compare to data when the project had already started or only one year of baseline data), and to use CCME guidelines (where available) as baseline or level to stay below and conclude no significant effects is something that should be discussed; these guidelines are set for southern areas, already influenced by many decades of industrialization/pollution, not for pristine Arctic environments.	If there are other regulatory guidelines more appropriate for the north established by DFO or other crown agencies (i.e. ECCC), we would be happy to use these. In the meantime, we will continue to use the CCME guidelines as these represent the only widely accepted option available (i.e., most environmental assessments in Canada employ CCME guidelines). CCME guidelines are effects-based and derived to be inherently conservative using laboratory-based toxicity test data that includes some species present in northern environments or species that are representative of northern taxa. For major elements of the MEEMP, the baseline is well established; for example, sediment, water quality, and benthics data were first collected in 2014 (prior to project operations) and have been collected annually since.
3	2019 MEEMP and AIS Monitoring Program	Pdf p 5/1149 and pdf pp 117-118/1149 (Marine Water Quality section)	For marine water quality, the conclusion that there has been no increase in iron is based on the result that iron concentrations in 2019 were no different from those in 2015-2018 (years in which the mine was already operational). As the mine was operational during those years, this cannot serve as a baseline. The comparison might be made with other areas for which water quality data is available.	The water quality (WQ) monitoring component of the MEEMP is designed to act as a surveillance study to monitor WQ in the receiving environment for compliance at select stations downgradient of the effluent through comparisons to CCME guidelines; it is not designed to characterize, or be representative of, WQ conditions in Milne Inlet as a whole. Further, because baseline water investigations were predominantly conducted offshore, it was not considered appropriate to make direct comparisons with nearshore sampling stations collected as part of the MEEMP, where turbidity levels are likely to be greater; this is consistent with the approach used in previous years.

#	Document Name	Section Reference	Comment	Baffinland Response
				Because iron ore particulates potentially blowing off the stockpiles and into the marine environment are in a mineral form, they would be expected to predominantly settle and accumulate in marine sediments; thus, as outlined in the Baffinland (2016) Marine Environment Effects Monitoring Plan, the marine sediment program was considered to represent a more appropriate medium than surface water to monitor for temporal changes in iron concentrations within the marine environment. Measured sediment iron concentrations collected in 2019 were not determined to be statistically different than those measured in 2014 (pre-operations), with the exception of two stations toward the distal end of the East Transect. It is acknowledged that a statement indicating that levels of iron in water samples collected in 2019 are within the range of concentrations observed between 2015 and 2018 was included in the 2019 MEEMP report; however, to clarify, this relates to effluent monitoring only. For effluent to be discharged, the mine must be operational, hence 2015 is considered an appropriate baseline to meet sampling objectives. It must be reiterated that marine water quality results reported in the MEEMP are linked to effluent discharge and are not an indication of overall water quality at Milne Port or in Milne Inlet. Baffinland Iron Mines Corporation (Baffinland). 2016. Marine Environmental Effects Monitoring Plan. Prepared by Sikumiut Environmental Management Limited (SEM) and LGL Limited for Baffinland Iron Mines Corporation, Oakville, ON. 81 pp.
4	2019 MEEMP and AIS Monitoring Program	General Comments	Results - Are there any visuals (graphs or charts) that illustrate trend over time of the various parameters for the MEEMP? While there is lots of textual description and comparison to CCME guidelines, it may be beneficial to also see the actual trends so it is clear what is decreasing/increasing/staying the same compared to the actual baseline conditions. This could then be followed by all the textual discussion and comparison of actuals to guidelines etc.	For water quality, the maximum, minimum, and mean concentrations for key parameters assessed between 2015 and 2019 are summarized in Table 4-2. Additional figures were not considered warranted due to the low concentrations measured relative to available water quality guidelines that are conservatively derived. For sediment concentrations, temporal trends are depicted in Figures 4-9 and 4-13 for percent fines and iron concentration, respectively. Figure 4-9 shows that fines have not changed significantly changed over time while, similarly, Figure 4-13 verifies that the primary contaminant of concern, iron, has not measurably increased along the north, west or east transect over the six years that the MEEMP has been implemented.
5	2019 MEEMP and AIS Monitoring Program	Pdf p 198 /1149 (first bullet, water quality)	It is indicated that measured concentrations were “generally consistent” with previous years and CCME guidelines. However, this is not the same as “entirely consistent”. Were there significant differences? If so, in what and to what degree and why?	Results for conventional water quality parameters, major ions, nutrients, metals, hydrocarbons, and PAHs showed no exceedances of CCME water quality guidelines. As would be expected, there is some variability in measured concentrations for some parameters (as summarized in

#	Document Name	Section Reference	Comment	Baffinland Response
				Appendix B3) – hence the use of the phrase "generally consistent"; however, the data did not indicate an increasing trend that would suggest the potential for adverse biological effects. The only exception to this trend of consistent water quality was copper, as discussed in detail in Section 5.1.1 of the MEEMP report. While individual exceedances were reported, the mean total copper concentration for the 2019 open water season was still below the long-term guideline.
6	2019 MEEMP and AIS Monitoring Program	Pdf p 188/1149 (section 5.2.6)	It is stated that diving on a ship's hull to conduct specimen collection can be severely hazardous in an active port. Diving may be done elsewhere in Canadian ports. Can those safety protocols be adopted?	There are different protocols for diving in a port versus diving on a vessel. Both Golder and Baffinland health and safety protocols regarding diving prohibits diving in and around vessels, due to requirements for locking out the vessel, and other additional risks.
7	2019 MEEMP and AIS Monitoring Program	Pdf p 185/1149 (section 5.2.2)	This section identifies 5 examples of potentially A/NIS and flags them for further review. Do we have a sense of how rapidly this review will occur as, if there is delay in this, there may be a danger of the species becoming established if indeed it is invasive. Is this where there should be a better link to a rapid response program?	The delay is due to lab closures under COVID-19 restrictions therefore it is uncertain how long it will take for the review of the specimens. In the interim, if DFO has any guidance for RRP with respect to the sample sent for further investigation, we would be happy to review this.
8	2019 MEEMP and AIS Monitoring Program	AIS Monitoring Program 3.2	Multiple references that Casas-Monroy et al. (2014) was used as a definitive list of invasive species in Canada (e.g. Executive Summary, AIS Zooplankton section). Please note that the Casas-Monroy list is a subset of Molnar et al. 2008 data, limited to those species listed by Molnar from ecoregions connected to Canada by ship traffic during the period of study, with some species removed when recognized as being native to Canada. This reference is not an exhaustive list of existing or potential species considered invasive to Canada. As the reference is a subset of Molnar et al, it may be best to retain only the references to the Molnar study and remove the citations to Casas-Monroy completely to avoid misunderstanding. While using global AIS lists such as Molnar can be informative, they are not exhaustive, and quickly become outdated. Criteria used to determine status of a species as nonindigenous and/or invasive should follow that of Goldsmit et al 2014 and Dispas 2019 who used a process of cross referencing with comprehensive historical native species occurrence data to identify species that are new to a given ecoregion or to the Canadian Arctic more generally. All NIS should be treated as having potential to become invasive given the uncertainty as to how they may spread once introduced to a new region.	The references in the Executive Summary were intended to be examples, and not exhaustive, to demonstrate that due diligence was being performed in terms of comparing to both global and domestic databases. Collected specimens not listed on Baffinland's existing inventory are evaluated against multiple sources, which are detailed in Section 3.2. Casas-Monroy and Molnar were both used as starting points, but not as a definitive list of invasive species in Canada. The literature review that was performed for each flagged species involved cross-referencing with collection records and regional specimen lists as well as broader taxonomic records, as recommended by DFO.
9	2019 MEEMP and AIS Monitoring Program	3.2.6 Ship Hull Monitoring Methods	It is not clear how the ships were selected for hull monitoring. Recommend that ships are selected based on age of anti-fouling paint/time since last dry-dock aiming to survey ships that have not recently been painted or cleaned. Together with the above factors, greater time spent in previous ports of call, and greater number of regions visited since last cleaning have also been shown to be associated with increased extent of fouling and could be used to select vessels for monitoring (e.g. see Sylvester eta l. 2011). DFO recommends identification of factors influencing biofouling risk of vessels calling on Milne Port through a validated risk assessment, however this would require initial sampling from a subset of vessels to assess of percent cover and physical collection of organisms in a representative, standardized and comprehensive manner (including both hull and niche areas) that will allow for identification of non-native species that may be transported through project shipping (DFO 2020).	Due to the limited time the ROV is available for AIS surveys, selecting ships based on risk factors such as anti-fouling paint is not practicable. Efforts are made to survey as many of the ships as possible while the equipment and operator are on site. It is also noted that the paper referenced by DFO in Comment No. 10 (Sylvester & MacIsaac (2010) Diversity & Distributions 16(1)) describes the use of an opportunistic sampling method, making efforts where feasible to sample a range of vessels. This method is consistent with the current approach undertaken by Golder.
10	2019 MEEMP and AIS Monitoring Program	3.2.6 Ship Hull Monitoring Methods	The methods for the surveys are insufficient to understand what was surveyed on each ship. A standardized, stratified survey design should be implemented for consistency, such as used by Sylvester & MacIsaac (2010) Diversity & Distributions 16(1).	Surveys were systematic and conducted along the hulls of the ore carriers covering a representative range of depths of the submerged hulls. Much of the effort was focused on areas of the hull where biofouling was most likely to occur (e.g., chain lockers, bulbous bow and stem, sea-

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				chest grating, stern tube, rope guard, propeller nose cone and blades, rudder side, bottom, leading and trailing edges), consistent with Sylvester and MacIsaac (2010).
11	2019 MEEMP and AIS Monitoring Program	4.2 accumulation curves 3.2.1	The use of accumulation curves is good, but given that the curves are based on samples collected over 3 days, they may underestimate seasonal diversity. Caution should be used in the interpretation of the asymptote for curves based on a 'single' point in time. i.e. sampling may have been sufficient for that point in time, but underestimate of annual diversity over multiple seasons of the year. Plankton are well known to exhibit high seasonal variability in both abundance and species richness (e.g., McKinstry and Campbell 2018 and references therein). This has been well demonstrated in surveys of other Canadian Arctic ports where variability in density and species richness across months was found to greatly exceed variability among sites at a given port (Dispas 2019). Sampling at regular intervals over a 3-month period versus overs a two week window resulted in a 40% increase in species richness (Dispas 2019). Collection of more frequent plankton samples (at least once/month during open water season when plankton are blooming) is recommended to improve baseline coverage of species that may be present. We note that some of the oblique tows are being done with a 64um net and have concerns that there may be a bow wave created with such a small mesh size which could bias results. This method is best suited to larger mesh nets for capturing larger faster swimming zooplankton and ichthyoplankton. Overall densities of plankton in the oblique hauls are unusually low (suggesting there may be a problem in the way the net is being towed an or bow wave effects.	The point around accumulation curves and seasonal diversity is acknowledged; however, sampling is limited to the open water season in Milne Inlet. Additionally, there is recent evidence to suggest seasonal invariability in benthic community functioning, despite high seasonal variability of environmental conditions in Arctic systems (e.g., Mazurkiewicz et al. 2019), suggesting a summer "snapshot" may be fairly representative of multiple seasons. The recommendation to sample at regular intervals over a 3-month period consistent with Dispas 2019 is not feasible, given the length of the open water season at Milne Port. We agree that plankton exhibit high variability, due to many factors, and are therefore not considered a reliable indicator with which to evaluate potential Project effects. Accordingly, zooplankton abundance is not discussed within the MEEMP Report; however, species diversity is presented as part of the AIS/NIS component only. Species richness and abundances are simply presented as supplemental information which helps place the information in the context of previous sample years. With respect to the comment around oblique tows, we acknowledge an incorrect net was accidentally used for some of the oblique tows during field sampling in 2019. This led to the loss of the 64 um net during sampling and the 250 um net (normally used for oblique tows in this program) was used for the rest of the program. Larger mesh size were used for oblique tows in 2020. The "unusually low" densities referred to in the comment were due to tows with the 250 um net. Abundances within four survey efforts, including both oblique tows at Ragged Island, were very low compared to the tows that used the 64 um net (with comparable species richness between all tows). However, these low abundances are similar to values observed in all previous MEEMP oblique tows since 2014 (range of 54-351 org/m3). Note there was mistake in the data entry and the abundances in Milne Port (which primarily used the 64 um net) were much higher than all previous MEEMP surveys, with 769 org/m3.
12	2019 MEEMP and AIS Monitoring Program	4.2.6	113 minutes of video footage across five ships is very small and may be inadequate to assess fouling coverage adequately, noting that previous studies have taken between 1-3 h per ship (e.g. Sylvester & MacIsaac (2010)).	Acknowledged. However, the ~23 minutes of footage per ship is considered sufficient to assess fouling coverage, particularly considering the ROV is collecting video for post-processing and can be slowed down when reviewed.

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#	Document Name	Section Reference	Comment	Baffinland Response
13	2019 MEEMP and AIS Monitoring Program	4.2.6 Table 4-46	While the methods section 3.2.6 indicated that much effort was focused on niche areas where biofouling was most likely to occur, this table shows only stern sections and one bow section were surveyed. Combined with the minutes of video footage, it appears the ROV surveys were insufficient to determine biofouling extent on any vessel.	Table 4-46 was not as specific as it could be with regard to location of survey in that it simply lists "bow section" or "stern section". However, the niche areas described in Section 3.2.6 are nested under the heading of either bow or stern; for example, "stern" refers to the propeller nose and blades, any crevices, intake ports etc.
14	2019 MEEMP and AIS Monitoring Program	5.2.6	Identifications were insufficient due to use of video footage only. Addition of a biologist at the time the ROV is being operated is unlikely to improve the ability to acquire species-level identifications as normally a specimen would be required. ROV technology is currently suitable only for assessing % coverage. Divers in the water are needed to obtain specimens for species level identifications. A combination approach could be used in the future to acquire specimens while minimizing diver time in the water.	Due to safety concerns around diving on a vessel undergoing active loading, combined with the difficult access to areas where biofouling has been observed, collection of samples for identification by divers from ship hulls is not feasible. Both Golder and Baffinland's Health and Safety regulations surrounding diving prohibit divers from surveying ore carriers. That said, divers will be part of the 2020 program for monitoring offset habitat along the freight dock, checking and redeploying AIS belt transects, and will be used opportunistically along AIS transects as time allows. During these surveys, specimen collections will be made opportunistically to aid in identification of species.
15	2019 MEEMP and AIS Monitoring Program	Executive Summary, Ship Hull Monitoring	The statement that *No NIS or AIS taxa were identified among biofouling species observed in ship hull surveys* is inappropriate for the executive summary considering the limited survey effort (minute of video footage) and the lack of specimen collection and species-level identifications. Similarly, the statement that most of ships' surfaces were found free of biofouling may be an overreach, depending on the extent of hull surface actually surveyed.	Acknowledged. Sentence has been edited to "No NIS or AIS taxa were flagged among the biofouling species observed on the ship hulls during surveys". Further, "Where observations were made" was added to the free of biofouling statement
16	2019 MEEMP and AIS Monitoring Program	Executive summary MEEMP 2.2.1	DFO supports the 2019 modifications of extra sampling intensity for benthos and including sculpin in fish tissue sampling, however we would like to know rationale for why the 3 subsamples at each station were combined for a composite sample. It is unclear if this was only done for the Van Veen or the Ponar Grabs as well and unclear why 2 different grab methods were used. If subsampling is used there must be care that the sample is being split evenly from top to bottom so as to not bias results since the distribution of biota from the source to deeper sediments will vary.	Using a composite of three grabs comes from the Metal Mining Diamonds Environmental Regulations, specifically the Metal Mining Technical Guidance for EEM, to help ensure replication is achieved. To clarify, the methodology has always been to collect a composite of three subsamples; the only difference in 2019 being the switch to the Van Veen grab from the Ponar. The experimental design originally called for the Ponar to be used for all stations; however, during sampling, the Ponar was unable to make grabs past certain depths, prompting the switch to the Van Veen grab. The Van Veen was used for all benthic and sediment collection in 2020. The design of the splitter allows for an even split from top to bottom to address any potential issues associated with introducing a bias to the results.
17	2019 MEEMP and AIS Monitoring Program	3.5.1	"Species from several major taxa groups were excluded from the dataset before data analysis because these are meiofauna and not reliably retained on 500 um mesh, or not strictly invertebrates". Although removing these for the MEEP analyses seems reasonable, these species should be retained for the AIS program. Could BIM provide confirmation if this was done.	All species collected were retained for the AIS analysis, even when excluded from other analyses.

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18	2019 MEEMP and AIS Monitoring Program	Executive summary AIS Zooplankton 4.2.1	It is reassuring to see that BIMs annual monitoring is able to pick up new species, demonstrating the benefits of regular monitoring, something which is not feasible in most areas of the Arctic. The specimen of Obelia from the zooplankton samples is of particular interst. This genus is rare in the Canadian Arctic, however, *Obelia longissima* is relatively common in the Eurasian Arctic and north Sea (Europe) – for example, of 1400 records in the GBIF biodiversity database, there are only 2 historical reports of specimens from the Canadian Arctic, one of which is at Canadian Museum of Nature; DFO has requested confirmation of the identity of this specimen. Based on NEMESIS database (http://invasions.si.edu/nemesis/jtmd/SpeciesSummary.jsp?taxon=Obelia%20longissima), the species is thought to be spread via biofouling and considered exotic/cryptogenic in north pacific to Alaska and also listed as non-native to temperate northern Atlantic, however, references in NEMESIS should be checked carefully to confirm this. Type locality for species in Black Sea and Ireland suggesting possible origin in this region. Given the limited reports in Canadian Arctic and possibilities of introductions of this species from other northern locations, the specimen (s) found by BIM should be examined to see if the species can be confirmed and background on the species should be examined more carefully to evaluate if this species would be considered an NIS to the region. We note that recent specimens of *Obelia* spp. were also detected in port of Churchill (Dispas 2019) and Deception Bay (Goldsmit 2016). At least one of these collections has been preserved in ethanol which may allow for further examination of genetic affinities with populations elsewhere. Likewise records of *Hybocodon prolifer* in the Canadian Arctic are limited to a handful of specimens previously found in the port of Iqaluit, but there more frequent detections in northern Europe and the Bering Sea (GBIF, OBIS), suggesting this species should be examined more carefully and museum specimens from the Canadian Arctic verified to confirm previous identifications – there do not, however, appear to reports of the species being invasive or introduced elsewhere. In contrast to these two species, *Onisimus glacialis*, although not common, has been historically reported in a number of areas across the Canadian Arctic through multiple studies, providing better confidence that it is native to the region. Given the above comments, it may be misleading or premature to state that "**No NIS taxa were identified in zooplankton samples**…". A statement that "**Further review of natural ranges and vectors of introduction are re required to confirm NIS status**" similar to the statement regarding benthic infauna would be more appropriate.	Acknowledged. The statement has been edited as suggested in section 4.2.1 and Section 5.2.1
19	2019 MEEMP and AIS Monitoring Program	Executive summary AIS Benthic Infauna 3.2.2	There is mention that benthic specimens identified as potentially non-indigenous were sent to Philippe Archambault's lab for identification. Could Baffinland please provide a list of which species?	Baffinland commits to providing a list of specimens sent for independent verification.
20	2019 MEEMP and AIS Monitoring Program	Executive summary AIS Benthic Infauna 4.2.2 4.2.2.1.1 4.2.2.1.2	The identification of *Marenzellaria viridis* is interesting as this was a species identified as having potential risk for invasion to the Arctic and has been assessed and ranked in two a recent screening level risk assessments (Vizilli et al. submitted; Goldsmit et al. in prep). Although the Bim report suggests multiple specimens have been collected in the &0's and 80's, we found this species has had limited historical reports from the Canadian Arctic: one from an Imperial Oil consultant report (the same record noted in this MEEMP AIS report originally from Conover and Stewart 1978) near Baffin Island and 5 specimens (under the orginal synonym of *Scolecolepides viridis*) from the Beaufort Sea area in 1980's by Hopcroft (2016). The species was also reported in a recent survey at the community of Gjoa Haven (Brown et al. 2011). However, it should be noted that the genus Marenzelleria consists of five species, which are very difficult to discriminate by morphological characters alone (Blank et al 2008). This species (particularly older records) could be confused for *Marenzellaria arctica* which has recently been found in other locations in the Arctic so it is possible these isolated reports represent misidentifications of this closely related species (C. Conlon, Canadian Museum of Nature, pers. comm). We would suggest reexamination of specimens by a Polychaeta expert to verify if specimens found at Milne Inlet are indeed *M. viridis,* a species which has successfully invaded California, Scotland, the North Sea, and the Baltic Sea where it has reached high densities in its, and replaced native infauna/ altered sediment characteristics in some locations (NEMESIS; https://invasions.si.edu/nemesis/browseDB/SpeciesSummary.jsp?TSN=-47). While formalin allows for better preservation of specimens, situations such as this point to the benefits of good preservation in ethanol which would allow for genetic barcoding as a potential option for verifying identity of morphologically challenging species such as this. While it is helpful to see descriptions of distributions for new species, Table 4-41 would be much more informative if the specific references associated with previously known distributions of <u>each</u> new species were given as another column. This would allow the reader to check references associated with individual species to better assess the quality of baseline data upon which a species designation is based. We request that the table be updated with this information in a similar fashion to how it is presented in supplementary tables of Goldsmit et al. (2014). Once this is done, we would like the opportunity to review each species in light of information contained in supporting refernces and any additional information that may be relevant. Likewise species found in previous years at the port and not included in 4-41 should also have clearly linked references to support their designations as native, invasive or cytogenic, so as to have a cumulative list covering the life of the monitoring program.	The specimens identified as *M. viridis* were sent for independent verification to the Archambault lab at Laval University, which confirmed the identification. Plans were discussed to subsequently send the specimen for additional verification by a polychaete specialist; however, this was hampered by COVID-19 related lab closures resulting in an inability to have the sample forwarded. During the 2020 program, the locations where *M. viridis* were collected in 2019 will be sampled again with the specific intent of preservation of the samples in ethanol. Any taxa of interest (including *M. viridis*, Monocorophium and other potential NIS) in the ethanol preserved samples will be sent for genetic barcoding. Table 4-41 will be adjusted for the 2020 report to include specific references requested. Further, the updated list of taxa sent for verification will be included in the 2020 report. This will include details on the lab where the taxa are verified, the specific identifications made by each lab, and comments detailing the reasons for verification Coe 1944 describes four species of the genus Lineus (koalensis, maris-albi, ruber and saint-hilairi) with known Arctic distributions, of these L. marisalbi, ruber and sainthilairi all have

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			We would also like to know which of the species in 4-41 were validate in Philippe Archambault's lab – we suggest this be included in the table or tracked somewhere in the document and associated database. Will specimens that could not be identified to species also be sent to experts either from the Archambault lab or to another lab with expertise in the respective taxonomic groups? We recommend this be done as specimens in 2018 that were not identified to species by Biologica, were in some cases be identified by another lab (Archambault's lab). We checked distributions for *Lineas* and could not find evidence of the genus occurring anywhere in the Arctic aside from one record in Alaska. The genus appears widespread elsewhere, particularly in northern Europe, suggesting it could be a potential NIS. We suggest having this specimen verified, examining potential vectors and checking its known distribution carefully to evaluate status. We are pleased to see there will be further work to validate specimens of Moocrophium by a third lab given uncertainties and the potential for this species to be non-indigenous. We would be interested to know which sites this species was found at in 2019 and whether it appears to have spread from the original site near the ore dock. Are there any plans for response to manage/contain this species?	documented distributions in the Arctic Ocean according to WoRMS. See Coe 1944 Nemerteans from the Northwest Coast of Greenland and Other Arctic seas. Journal of the Washington Academy of Sciences 34(2):59-61. GBIF also indicates a specimen of Lineus ruber in the Arctic Ocean on the Northern Alaskan Coast. We are unable to determine if Monocorophium has spread from the original site near the ore dock. The sites where this species was identified in 2019 were not sampled in previous years, but they occur in the general ore dock area where it was observed previously. In 2020, effort will be made to sample in those areas where this species has been identified, and at representative step out locations. Samples will be preserved in ethanol for genetic barcoding to help resolve the identification. This is part of the early plans to confirm the identification and monitor potential spread in order to inform possible steps for management or containment
21	2019 MEEMP and AIS Monitoring Program	Executive summary AIS macroflora and benthic epifauna 4.2.3	Given the difficulty in identifying taxa to species level with video surveys the that "**No NIS or AIS tax were identified…**" is misleading. Rather there should be acknowledgement that these methods are not suitable for identifying most taxa at the level needed for proper assessment of their status as native or introduced and that improvements are needed. We recognize that BIM is working toward improving methods for sampling of epifauna to include more specimen-based collection and encourage them to continue these efforts. Further we note that of the following taxa identified to species may be NIS based on known distributions: *Pecten albicans* was not mentioned, but a search of global data bases (ARMS, GBIF, OBIS) shows that this species only occurs in Japan. There should be verification of footage to determine if this species identification is correct as it would be considered an NIS with potential to compete with other scallop species in the area. *Polycarpa pomeria* is a species with a strictly European distribution and other species of *Pomaria*, while more widely distributed have not been documented anywhere in the Arctic with the exception of northern Europe suggesting this species may be an established NIS given that it was previously observed in benthic infauna samples (2018). Video footage as well as specimens should be verified by a tunicate expert to validate if these identifications are correct.	Acknowledged, the statement in the Executive summary has been edited. *Pecten albicans* was erroneously entered in the table, the scallop seen was not identifiable to species, the report has been corrected. The identification of *Polycarpa pomeria* in 2018 was updated to *Polycarpa fibrosa* following independent verification. Arctic specimens have been collected (including in the Greenland Sea). The identification in the 2019 report should have been *Polycarpa sp*. and has been corrected
22	2019 MEEMP and AIS Monitoring Program	Executive summary AIS encrusting epifauna 4.2.4	*Circeis amoricana* is not listed in either of the sources mentioned to have been used as references supporting a known Arctic distribution for this species. A quick search in global databases (OBIS, GBIF) shows it has only been reported on one occasion recently (2008) in Churchill, the area of highest shipping in the Canadian Arctic at that time. It is interesting to see it reported in Milne inlet for the first time and should be investigated more carefully to better understand it distribution and to confirm identity of specimens found on settlement baskets. *Patinella verrucaria* was only found in the ARMS database reference that is cited in the report (Sirenko etal. 2020), but distribution is shown to be on the Atlantic coasts of north America and Europe, not the Canadian Arctic or elsewhere in the Arctic. A search of global databases (GBIF, OBIS) show this (and the synonym *Lichenopora verrucaria*) to have been found elsewhere in the Canadian Arctic in a range of locations, though the species does not appear to be commonly reported. *Gonothyraea* was not found in any of the cited references, however a search of OBIS and GBIF showed it to be found in a few locations within the Arctic with generally limited distribution information globally. We suggest updating the references to only include those that support statements in the text. We would like to confirm if unidentified species (those only identified to genus) will be given to other experts to try and identify these to the species level. Further, given the above notes, it may be misleading or premature to state that "**No NIS taxa were identified in encrusting epifauna samples**…" in the executive summary until	The reference to the Churchill specimen was one of the points of verification as an Arctic species in this report, there was also a record in the Arctic in Scandinavia as seen in GBIF. We note that the method of presenting the most commonly used references in the text and generally listing the others has led to difficulties in following the path of verification. The 2020 report will be edited to include a reference column in the species list table as suggested in Comment #20 which should be able to address this issue. Unidentified species will only be sent to specialists when there is concern that it may be NIS or AIS (based on the literature review, e.g. where a genus contains a flagged species of concern for the Canadian Arctic). Due to the large number of unidentified taxa and the reasons for the lack of identification typically being due to specimen condition, it is not practical to send all for verification.

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			Circeis amoricana is investigated further. A statement that "**Further review of natural ranges and vectors of introduction are are required to confirm NIS status**" similar to the statement regarding benthic infauna would be more appropriate.	The statement in the executive summary has been amended as suggested.

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Baffinland

Name: Meagan Tobin / Anne Wilson

Agency / Organization: ECCC

Date of Comment Submission: June 15, 2020

#	Document Name	Section Reference	Comment	Baffinland Response
1	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft	Section 3.1.1.1 – Data Analysis	The report states that for water quality parameters without guidelines that concentrations were compared to the concentration ranges from data collected from 2015 – 2018. There is no mention made about whether comparisons are also made to baseline conditions. ECCC recommends that concentrations are also compared to baseline conditions as well as analyzed for trends during operational years.	It must be noted that marine water quality results reported in the MEEMP are linked to effluent discharge and are not an indication of overall water quality at Milne Port or in Milne Inlet. The water quality (WQ) monitoring component of the MEEMP is designed to act as a surveillance study to monitor WQ in the receiving environment for compliance at select stations downgradient of the effluent through comparisons to CCME guidelines; it is not designed to characterize, or be representative of, WQ conditions in Milne Inlet as a whole. For effluent to be discharged, the mine must be operational, hence 2015 is considered an appropriate baseline to meet the objectives of the MEEMP. Further, because historical baseline (i.e., pre-2015) water investigations were predominantly conducted offshore, it was not considered appropriate to make direct comparisons with nearshore sampling stations collected as part of the MEEMP, where turbidity levels are likely to be greater; this is consistent with the approach used in previous years.

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2	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft	Section 3.1.4 – Sediment Quality	The report states that due to logistical complications only a subset of the sediment transects were sampled and no sediment samples were collected from the coastal transect. No further discussion is provided on the logistical complications or how they may be prevented in future monitoring years. ECCC recommends the Proponent provide additional discussion on the logistical complications that prevented sediment sampling, including a discussion of how such complications may be prevented in the future.	A health and safety incident on site led to a loss of over a week of sampling time. Biologists returned to site in September/October to complete as much as possible of the sediment and benthic program. Due to the large number of sites, and other complications including poor weather and damage to sampling equipment, not all sites were visited. Weather complications will always be anticipated, but due to the large scale of the program, there will always be a risk that some sites are not able to be visited, particularly as the program continues to grow in scope. Extra equipment is being sourced for the 2020 program to guard against complications related to faulty equipment or other similar issues
3	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft	Section 4.1.1 – Water Quality Results	The report indicates that several samples had copper concentrations that exceeded the BC marine copper guideline of 2 ug/L, but that overall the mean concentration of copper in samples was below guidelines. However, based on Table 4-1, it appears that the higher concentrations of copper were associated with the source sample, with the mean of the source samples exceeding the guideline and a maximum concentration of 11 ug/L. In addition, as per Table 4-2, copper concentrations appear to be higher than all other previous sampling years. The report acknowledges the elevated concentrations however no discussion or investigation is proposed, only stating that monitoring will continue in 2020. Given that the elevated concentrations of copper are associated with the source samples (closest to point of discharge), additional discussion on the	As indicated, copper was measured at concentrations above the BC marine guideline during the surface water monitoring program; however, the exceedances of the chronic guideline of 2 µg/L were only noted during two of the six sampling events (i.e., 3 of 4 samples collected on 23 September; 1 of 4 samples collected on 1 October). The specific cause of these guideline exceedances was not identified. The mine's discharge monitoring data was reviewed over the sampling period and copper was within discharge limits of 3 µg/L during each of the discharge sampling events. In 2019, these discharge sampling events did not temporarily align with the MEEMP sampling events that identified copper concentrations above guidelines in the receiving environment. For the 2020 study plan, concurrent sampling of the effluent and receiving environment is being undertaken to facilitate evaluation of receiving environment water quality.

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			potential causes of the copper exceedances and how this may related to effluent discharge into the receiving environment. ECCC recommends the Proponent provide additional discussion on the potential causes of copper exceedances in the source samples.	
4	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft	Appendix M – Background Review of Hydrology and Geomorphology in Phillips Creek Estuary Section 7.0 Conclusions	The review of conditions and sediment behaviour concludes that there is high natural variability in sediment transport and deposition in and from Phillips Creek, and that this has a much larger influence on deposition patterns at the inlet than mine-related activities would. The report recommends that sediment monitoring continue on an annual basis, with the perspective that long term trends (decades) be monitored. ECCC acknowledges the interannual variation in sediment transport in Phillips Creek, which can be increased by ice damming events, but questions whether upstream mine-related contributions can be assessed. Is it possible for Baffinland to quantify the contributions from dust associated with the tote road and adjacent ore-handling operations to the sediment transport in Phillips Creek and additional loads to the inlet?	Knight Piesold considered the impact of dust to Phillips Creek in their (2018) Freshwater Assessment. Inputs of dust to the stream are expected to occur during high flow conditions and are estimated to contribute approximately 1-9 mg/L of suspended sediment to the creek, which is below CCME guidelines. In addition, Golder determined in the 2018 Marine Environmental Effects Assessment that in the most conservative scenario, dust transport into Phillips Creek will only result in 0.23 mm of deposition in the Inlet, and this is not expected to result in detectable changes in metal concentrations. Therefore, Project effects are likely to be insignificant compared to natural levels of deposition and the range of natural variability in TSS which is expected to be high seasonally, from year to year and spatially.

Baffinland

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Agency / Organization: Qikiqtani Inuit Association

Date of Comment Submission: 13 June 2019

#	Document Name	Section Reference	Comment	Baffinland Response
1	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	MEEMP Executive Summary, p. iii	Recent studies suggest inputs of biologically available iron can facilitate phytoplankton productivity and thereby alter light penetration and carbon availability. What fraction of Project-generated iron deposition that enters the marine environment is biologically available? Are these iron inputs affecting phytoplankton composition and production, and the availability of carbon to other marine biota? See: Conway, T.M., Hamilton, D.S., Shelley, R.U., Aguilar-Islas, A.M., Landing, W.M., Mahowald, N.M., and John, S.G. 2019. Tracing and constraining anthropogenic aerosol iron fluxes to the North Atlantic Ocean using iron isotopes. Nat. Commun. 10, 2628 (2019). https://doi.org/10.1038/s41467-019-10457-w Cwiertny, D.M., Young, M.A., and Grassian, V.H. 2008. Chemistry and photochemistry of mineral dust aerosol. Annu. Rev. Phys. Chem. 2008. 59:27–51,	For iron to be biologically-available to phytoplankton and other marine biota, it generally needs to be in a dissolved form so that it can effectively cross biological membranes. Because iron ore particulates stored at the Site are in mineral form, they would be expected to predominantly settle in marine sediments and is expected to be fairly inert biologically. This is why, as outlined in Baffinland's (2016) Marine Environment Effects Monitoring Plan, the marine sediment program was considered to represent a more appropriate medium than surface water to monitor for temporal changes in

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			https://www.annualreviews.org/doi/full/10.1146/annurev.physchem.59.032607.093630 Khatiwala, S., Schmittner, A., Muglia, J. 2019. Air-sea disequilibrium enhances ocean carbon storage during glacial periods. Sci. Adv. 5, eaaw4981 (2019). https://advances.sciencemag.org/content/5/6/eaaw4981/tab-pdf Lambert, F., Tagliabue, A., Shaffer, G., Lamy, F., Winckler, G., Farias, L. Gallardo, L., and De Pol-Holz, R. 2015. Dust fluxes and iron fertilization in Holocene and Last Glacial Maximum climates, Geophys. Res.Lett., 42: 6014–6023, doi:10.1002/2015GL064250. Shoenfelt, E.M., Winckler, J.S.G., Kaplan, M.R., Borunda, A.L., Farrell, K.R., Moreno, P.I., D.M., Recasens, C., Sambrotto, R.N., Bostick, B.C. 2017. High particulate iron(II) content in glacially sourced dusts enhances productivity of a model diatom. Sci. Adv. 3, e1700314 Shoenfelt, E.M., Winckler, G., Lamy, F., Anderson, R.F., and Bostick, B.C. 2018. Highly bioavailable dust-borne iron delivered to the Southern Ocean during glacial periods. PNAS 115(44): 11180-11185. www.pnas.org/cgi/doi/10.1073/pnas.1809755115 Underwood, E. 2020. The Complicated role of iron in Ocean health and climate change. Knowable Magazine. https://www.smithsonianmag.com/science-	iron concentrations within the marine environment. Measured sediment iron concentrations collected in 2019 were not determined to be statistically different than those measured in 2014 (pre-operations), with the exception of two stations toward the distal end of the East Transect. Environmental conditions in the receiving environment, such as pH, dissolved oxygen concentrations and redox potential, can influence the proportion of biologically available iron that can be released from particulates into surrounding waters. According to Millero (1998) and Lis et al. (2015), in circumneutral pH and well oxygenated environments, similar to those observed in Milne Inlet, iron tends to be poorly soluble. As a result, many open ocean waters and some freshwater systems are characterized by low dissolved iron concentrations (Johnson et al., 1997; McKay et al., 2004). The WQ element of the MEEMP measures and reports on iron

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			nature/complicated-role-iron-ocean-health-and-climate-change-180973893/	concentrations in terms of total and dissolved fractions; however, this element specifically relates to monitoring compliance in the receiving environment from effluent and site run-off and is therefore not representative of Milne Inlet overall. The analysis of surface water samples collected close to the Port is consistent with what is indicated in the literature, where <10 µg/L of iron was present in dissolved forms in each of the samples (see Appendix B1 for analytical results). In 2019, Baffinland deployed CTD remote profiling equipment in the offshore environment in Milne Inlet which measured in-situ water quality parameters, including turbidity, and also chlorophyll a as proxies of phytoplankton abundance. The results obtained indicate that the construction and operation of Milne Port did not appear to have resulted in an increase in chlorophyll a concentrations or turbidity in Milne Inlet offshore from the port. Thus, mine operations at the port did not result in altered light penetration

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				(turbidity) or an increase in phytoplankton productivity (chlorophyll a). These findings were consistent with those observed in previous monitoring years for the MEEMP. -Johnson KS, Gordon RM, Coale KH. (1997). What controls dissolved iron concentrations in the world ocean? Mar Chem 57: 137–161. -Lis H, Saked Y, Kranzler C, Keren N, Morel FMM. (2015). Iron bioavailability to phytoplankton: an empirical approach. ISME J. 9(4): 1003-1013. -McKay RML, Bullerjahn GS, Porta D, Brown ET, Sherrell RM, Smutka TM et al. (2004). Consideration of the bioavailability of iron in the North American Great Lakes: development of novel approaches toward understanding iron biogeochemistry. Aquat Ecosyst Health 7: 475–490. -Millero FJ. (1998). Solubility of Fe (III) in seawater. Earth Planet Sci Lett 154: 323–329.

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2	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. iv	The hydrology and geomorphology of Phillips Creek are described as "within the range of natural variability." Project effects will be in addition to natural variability. How great is this addition, which will consist largely of fine-grained sediment?	Knight Piesold considered the impact of dust to Phillips Creek in their (2018) Freshwater Assessment. Inputs of dust to the creek are expected to occur during high flow conditions and are estimated to contribute approximately 1-9 mg/L of suspended sediment to the creek, which is below CCME guidelines. In addition, Golder determined in the Marine Environment Effects Assessment (TSD #17; Golder 2018) for the Phase 2 Proposal that in the most conservative scenario, dust transport into Phillips Creek will only result in 0.23 mm of deposition in the Inlet, and this is not expected to result in detectable changes in metal concentrations. Therefore, Project effects are likely to be insignificant compared to natural levels of deposition and the range of natural variability in TSS which is expected to be high seasonally, from year to year and spatially.

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3	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. v 4.1.4.4 Comparison of Sediment Quality Guidelines, p. 70 5.1.4 Sediment Quality, p. 155	Exceedances of organic contaminants were not concentrated around the Ore Dock. Were these exceedances related to Project activities conducted away from the ore dock (e.g., at moorings)?	While it is possible that the few CCME ISQG exceedances identified could be related to Port activities, it is unlikely because (i) exceedances are low level (<PEL in each station investigated) and (ii) organic constituents were not distributed in a way that would indicate a point source (i.e., concentrations were not clustered around a specific source location such as the ore dock.
4	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. vi	No changes in fish condition were detected. What is the power of the analyses to detect change in condition, given the variety of sampling methods, sample sizes, etc.?	The term 'condition' in the 2019 MEEMP report is used in reference to the overall appearance and state of health in which fish were observed (i.e.," what is the condition of the fish"). The term is not used in specific reference to the fish health index known as Fulton's Condition Factor (K), which considers fish weight relative to length based on a defined equation, as considered under the Federal Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (EEM) program. Formal analyses of K have been proposed in the 2020 MEEMP program consistent with EEM guidance, and as such, statistical power of these analyses

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				(i.e., power to detect change in condition, K) will be considered as part of the 2020 MEEMP report.
5	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. vii	…"dedicated fish survey methods are not fully characterizing the fish populations…" (p. vii). Increased trolling effort and replacement of the Fukui nets with fyke nets have been recommended for 2020 to address information gap. QIA supports these recommendations but further recommends an additional transition year of Fukui trap use for future comparison. Consideration should also be given to use of bottom set survey type gillnets to capture other species, and revisiting sculpin mark-recapture to provide an index of abundance.	Fukui traps will continue to be used while alternative methods are being considered and until a suitable replacement method has been decided. Transitional years of sampling will be used during any changes in fishing methodologies to ensure continuity. Bottom set gill nets will be added for the program in 2020 in addition to surface sets. A mark-recapture study will be considered for future survey years.
6	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. ix-xi	The AIS section emphasizes that no species have been confirmed as invasive. What percentage of species in each category (e.g. Macroflora and Benthic Epifauna) remain unidentified, and how many are currently being examined by external experts to determine their identity and status?	As unidentified taxa are unable to be defined to the species level, it is impossible to determine the percentage of species in each category that are unidentified. For example, in the settlement basket samples, 302 individual specimens were only able to be identified as Balanomorpha indet. These individuals could be from any number of species within the suborder. In 2019, 9 taxa were sent for verification. Of these taxa, one independent identification agreed with the first lab's assessment, and

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				two were not able to be resolved further. The remaining specimens are awaiting verification, which has been delayed due to COVID-19 related lab closures. Note that taxa sent for verification were not necessarily an indeterminate species. Taxa verification was also performed for taxa that had undergone redescription to confirm the species matched the updated definition, or to verify an identification when a species described range did not include Arctic waters.
7	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. x See also: 3.2.4 Encrusting Epifauna, p. 42 4.2.4 Encrusting Epifauna, p. 145 6.0 Conclusion and Recommendations, p. 167.	Settlement basket and plates on the west side of the Ore Dock were lost due to severing of the rope attachment by ice-breakup. How will this problem be prevented in future? QIA supports the recommendation to replace the lost deployment and deploy additional baskets and plates in other locations; and recommends installing additional baskets and plates at each location to provide backup in case of loss and enable longer installation to facilitate species identification.	It is difficult to control against the impacts of ice movements without increasing the risk of being unable to retrieve the baskets due to shortened lines or other implemented controls. For 2020, lost settlement baskets will be replaced and additional baskets will be deployed along the Freight Dock and at other locations in port. The deployments will include extra baskets that will be left for periods of time ranging from 1 to 10 years as part of offset monitoring and for 1-3 years for AIS monitoring. These longer deployments are anticipated to help resolve identification of

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				species that were previously only observed in juvenile stages
8	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Executive Summary, p. xi	"The taxonomic resolution of biofouling organisms did not improve in the second year of monitoring, despite inclusion of a high-resolution camera." This is an important gap in the invasive species monitoring. What measures are planned to enable species identification in 2020?	This is not considered a gap because the AIS monitoring in the receiving environment (via zooplankton tows, benthic grabs, fishing efforts etc.) adequately addresses monitoring for AIS/NIS that may have potentially been introduced via hull fouling. Unlike ROV footage, these monitoring efforts focus on collection of specimens that can be sent to a lab for identification.
9	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	2.1.1 Modifications to the MEEMP (2019), p. 11	Modifications to the Fukui traps should be mentioned here.	Fukui traps were slightly modified in 2019 using the 'string modification' method described in Bergshoeff et al. 2019). There were no modifications to the Fukui traps in 2019. Previously suggested modifications were designed for improving the capture rates of green crab, based on observed behaviours. These modifications increase the risk of fish escaping from the traps and therefore did not make sense in the context of this program

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10	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	2.1.1 Modifications to the MEEMP (2019), p. 12	Figure 2-2 provides a clear, informative illustration of how the MEEMP sediment and benthic monitoring sites have changed over time--nicely done!	Acknowledged.
11	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	2.2 AIS Monitoring (2014-2018), p. 13	Need to clarify that the releases of ballast water into Milne Port occur at the Milne anchorages and the ore dock.	Wording has been adjusted to clarify.
12	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.1.1 Water Quality, p. 16	"Samples were preserved in the field according to laboratory instructions..." This does not provide enough information to repeat the sampling for comparison. What were the instructions or where can they be found?	The laboratory instructions represent requirements specified in the analytical methods performed (e.g., acidification of metals samples with nitric acid). It might make sense to change this to "samples were preserved according to requirements outlined in the respective laboratory methods for the constituents evaluated" to clarify. It is not typical practice to

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				describe in detail each of the preservation methods used, as preservation methods represent standard practices and are also requirements for the analytical tests performed. The analytical methods used during the program are referenced in the respective laboratory reports appended to the MEEMP reports, which would provide detailed instructions on requirements for field preservation.
13	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.1.4 Sediment Quality, p. 17	QIA recommends that SE18-1 and SE18-2 be sampled in 2020 to provide results that allow direct comparison with those from 2018 and 2019.	Agreed. SE18-1 and SE18-2 will be sampled again in 2020, as suggested.

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14	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	3.1.5 Benthic Infauna, p. 22 and 5.2.2 Benthic Infauna, p. 160.	The Van Veen samples were cut in half to standardize the area of the samples, but this larger grab sampler can penetrate deeper into the bottom sediment than the Ponar and Petite Ponar samplers. Were differences in the depth penetration of these samplers considered in the standardization?	For benthic invertebrate surveys, the depth of penetration is less important than the surface area sampled. This is because benthic invertebrates tend to occupy only the upper few centimeters of the sediment surface (generally the top 5 cm). Both grab samplers sample this biologically active layer and any added penetration depth of the Van Veen compared to the Ponar would not be expected to affect interpretation of the data between years. The surface area that the Van Veen covers (0.1 m2) is larger than the Ponar (0.05 m2), which is why the Van Veen samples were split in half using a splitter. The Van Veen sampler (with splitter) will be used exclusively during future monitoring programs, as the Ponar was determined to be ineffective at collecting sediment samples at the deeper sampling stations. The design of the splitter allows for an even split from top to bottom to address any potential issues associated with introducing a bias to the results.

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15	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.1.7.2.2 Gill netting, p. 29	Bottom set multi mesh survey gillnets might be useful for capturing benthic fish species that are not vulnerable to the current fishing gear.	Bottom set gillnets were added to fishing methodology for the 2020 MEEMP program.
16	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.1.7.2.4 Fukui traps, p. 30	How were the Fukui traps modified for the 2019 field season?	Fukui traps were not modified in 2019. Suggestions from the MEWG on the 2018 MEEMP report were considered, however, upon review of the provided literature (i.e., Bergshoeff et al. 2019) it was apparent that the modifications were not suitable for the purpose of the field program (i.e., catching fish), because they were designed to improve capture of invasive green crab. In fact, the literature indicated the modifications would potentially increase the risk of fish escape from traps, which is incongruent with sampling objectives. Bergshoeff, J., McKenzie, C.H. and B. Favaro. 2019. Improving the Efficiency of the Fukui Trap as a

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				Capture Tool for the Invasive European Green Crab (Carcinus maenas) in Newfoundland, Canada. PeerJ. 2019;7:e6308. Published 2019 Jan 29. doi:10.7717/peerj.6308
17	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.1.8.1 Fish, p. 35 See also: 3.3.2.6 Fish, p. 49.	Sculpins were only identified to Genus "due to fish condition upon arrival at the lab...". Were the fish not identified to species prior to processing for shipment to the lab? What led to their deterioration? How will these problems be avoided in future?	The issue regarding fish condition was directly related to a H&S incident on site that necessitated the rapid processing of the samples from two nets that had extended deployments. Under the time constraints during clearing the nets, field personnel were required to place all samples in plastic bags on hand, which were then frozen together. Fish species were identified as they were being processed and the species counts are included in the catch record, but due to the condition following thawing, it was no longer possible to speciate the fish during tissue sampling. It was this suboptimal sample preservation method that led to all

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				cases of fish in poor condition. As this was the result of an unprecedented incident, it is not anticipated that a similar issue will occur in sample preservation in 2020.
18	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	3.1.8.2 Shellfish, p. 35	"A tissue punch was used to collect tissue plugs from each specimen." Metal accumulation can vary with tissue type. What tissue was collected and analyzed?	This statement in Section 3.1.8.2 was written in error. Whole body samples for *Hiatella arctica* were analyzed, not tissue plugs. This error arose as a result of the analytical report from BV labs indicating the method as "Elements by ICPMS - Tissue Plug Wet Wt". The method name in this instance is related to the small volume sample, not the fact that tissue plugs were analyzed. The text has been edited to correct the error.
19	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	3.1.8.2 Shellfish, p. 36	Why are the detection limits for some metals different between the char and shellfish?	Detection limits were consistent between analytical methods; *Hiatella arctica* and sculpin tissues were both analyzed by inductively coupled plasma mass spectrometry, or ICPMS (Laboratory method BBY WI-00033), while Arctic Char tissues were analyzed by collision reactor cell (CRC) ICPMS (Laboratory method BBY7SOP-00021/BBY7SOP-00002). The difference in analytical methods was related to sample

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				volumes (i.e., small volume samples had higher detection limits, while the larger sample volume methodology used with char tissues achieved better/lower detection limits). In some instances, individual sample detection limits are adjusted based on non-homogenous samples that result in matrix interference (i.e., small fragments of interfering materials such as bone exist in an otherwise homogenous sample and interfere with the spectrometer). These types of detection limit adjustments are unavoidable, and usually made on a per-sample basis (and are indicated in laboratory reports, as presented in Appendix G).
20	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	3.2.1 Zooplankton, p. 39	64 and 250 micron mesh nets were used to collect zooplankton samples. It is not clear where or when the different mesh sized nets were used. Were both used at each station or on each haul to facilitate direct comparisons?	In previous years, all vertical hauls were performed using the 64 um mesh net and all oblique tows with the 250 um mesh net according to the original sample design. In 2019, the 64 um net was lost during sampling and the remaining samples stations had to be sampled using the 250 um net (for both vertical and horizontal tows). A replacement 64 um net and back up

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				nets were ordered for the 2020 program.
21	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	3.3.2.7 Tissue Chemistry, p. 49	Treatment of the outliers is not clear. Were the scatter plots used to identify data entry errors, which were then corrected if possible? How were other outliers treated?	As described in Section 3.3.2.7, outliers were identified using scatterplots, and if identified as transcription errors that could be corrected, the datum was corrected and retained in the dataset for subsequent analyses. If an outlier was not able to be resolved, i.e., no reason for the extreme value was identified, the datum was noted in the outlier summary tables and removed from subsequent analysis and interpretation. Tissue metal outliers are identified, including rationale for their removal, in Table 1 of Appendix F for *Hiatella*, and in Table 2 of Appendix G-4 for Arctic Char and Sculpin.
22	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	3.3.3.1 Zooplankton, p. 49	"nets were rinsed using the same rinsing techniques". What were these "same rinsing techniques"?	Nets and bottles were flushed with sea water on the outside of the net to rinse the entire sample down into the dolphin bottle, or by using a spray bottle. The spray bottle was filled with sea water through the net mesh to exclude organisms from the spray bottle. Once the sample was transferred to the sample bottle, water was splashed or sprayed on the outside of the net

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				to rinse any remaining sample out the bottom. A description of the rinsing technique was added to Section 3.2.1 - Zooplankton.
23	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.1.1 QA/QC Results, p. 51	"The data should still be comparable to previous yearly measurements as similar issues with hold time exceedances have been encountered." So, the results should have been comparable because of their similar sources of error. How do these sources of error affect accuracy of the long-term results?	These sources of error are not expected to significantly impact the interpretation of the long-term monitoring because measured concentrations of parameters collected outside hold times (pH, fecal coliforms, nitrite, nitrate, turbidity, and TSS) have not approached levels that would be a concern in the receiving environment. As described in the response to Comment 1 issued by ECCC, the objective of the water quality monitoring is not to characterize conditions over time; rather, to monitor water quality in receiving environments for compliance at select stations downgradient of the effluent, through comparisons to CCME guidelines.

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24	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.1.4 Metals, p. 54	A substantial portion of the total iron concentration was described as "present in particulate form, and likely less bioavailable for uptake by aquatic biota." This statement requires support, particularly in terms of the bioavailability of iron to the phytoplankton.	As discussed by Lis et.al (2015), the solubility of iron is low in circumneutral and oxygenated marine waters – such as those that characterize Milne Inlet; rather, iron tends to precipitate out of solution, resulting in substantially higher total iron concentrations compared to dissolved iron concentrations in water samples. Iron in the dissolved dissociated form is the most bioavailable form for uptake by marine organisms, including phytoplankton. In contrast, particulate and colloidal iron fractions – such as those associated with the Project – are not as available for uptake and so have lower bioavailability. Mineralized iron is not typically bioavailable unless conditions in the receiving environment were to cause release of the free ionic iron from iron-containing particulates. Lis H, Shaked Y, Kranzler C, Keren N, Morel FMM. 2015. Iron bioavailability to phytoplankton: an empirical approach. ISM Journal 9, 1003-1013.

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25	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.3 Background Hydrology and Geomorphology, p. 59 5.1.3 Background Hydrology and Geomorphology, p. 153.	The text in these sections identified a number of natural sources of sediment. Project-related sources of sediment also warrant mention (e.g., fugitive dust from the tote road, ore dust, erosion at crossings).	Project-related sources of sediment are already mentioned in Section 4.1.3. Midway through the first paragraph it is stated that "Sediment derived from Project-related sources, such as fugitive dust from the tote road, ore dust, and erosion at road crossings may also contribute to the supply to Phillips Creek, although Knight Piesold (2018) concluded that inputs of dust resulting from the project are expected to be under levels outlined in the Canadian Council of Ministers of the Environment (CCME) water quality guidelines." Section 5.1.3 discusses results of the review, which are that any Project-related sources of sediment would not be detectable against natural inputs.

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26	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.4.2 Correlation Analyses, p. 61 Principal Component Analysis, p. 64 4.1.4.4 Comparison of Sediment Quality Guidelines, p. 65 .1.4.5 EEM - Content of Fines 2019: spatial comparison, p. 71	The Spearman Rank Correlation analysis and Principal Component Analysis "did not suggest that sediment metal concentrations were accumulating at elevated levels close to the Ore Dock relative to other locations sampled within Milne Port." Figure 4-1 shows a general increase in fine sediment moving away from the port along the West, Northwest and Northeast transects, and variability in fine sediment % at the 4 sites closest to the Port along the east transect (which has higher gravel content). Given that metals are associated with fine sediments and prop wash is more likely to redistribute fine sediments, is the apparent lack of metal accumulation in port area sediments perhaps due to redistribution of fine sediment away from the loading area by vessel prop wash?	This does not appear to be the case based on the available data, as sediment fines were not determined to have significantly changed over time (since 2014). If the Port was contributing significant amounts of fine-grained iron ore particulates to the system that were being distributed away from the Port via prop wash, we would expect to see a temporal change in both iron concentrations and sediment fines at certain offshore stations situated along the transects over time, which has not been apparent during the MEEMP.
27	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.4.5 EEM - Content of Fines 2014-2019: temporal comparison, p. 73	Figure 4-9: Differences in the transect length among years make direct comparisons of these curves difficult. Upper right panel label should be "Northwest".	Acknowledged. 2019 was the first year of implementation of the updated, spatially expanded sediment and benthic sampling program (15 stations instead of 5 stations along each transect). In this first year of implementation, logistical and time constraints affected the number of samples able to be collected along each transect. Based on lessons learned in 2019, we expect to be able to sample all targeted stations along the multiple transects in 2020, which should facilitate

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				interpretation of the sediment and benthic results. Acknowledged. It is noted that the transects are north, northeast, east and west. We will update accordingly in the 2020 report.
28	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.4.6 EEM - Iron Concentrations (Temporal Comparison and Coastal Transects), p. 77 and 78	QIA supports further monitoring along the east transect to determine whether observed differences in iron concentrations at 500 m and 1,000 m from the Ore Dock reflect an upward trend related to Port operations.	Acknowledged. This will continue in 2020.
29	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.5.2 Community Studies, p. 90	"samples were not collected beyond 800 m along the East or West Transect or beyond 1,000 m along the North Transect in 2019..." This was presumably "due to logistical complications during the field program" that also led to the coastal transect not being sampled for benthic infauna (3.1.5, pg. 22). Will these sites be sampled in 2020?	That is correct. Yes, we plan on sampling these stations in 2020. Please see the response to QIA Comment # 27.

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30	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.5.2 Community Studies, p. 92 to 98,	Was depth considered as a variable in comparisons of species richness (spatial, temporal), diversity, and evenness (spatial)? If not, it might be worth considering.	In 2019, depth was indirectly assessed as distance along the north and northeast transects because depth increased with distance offshore. Depth would be less applicable along the east and west transects, as these transects are situated along the 15 m depth contour to control for potential depth related effects. A more direct assessment of relationships with depth will be considered for the 2020 report where applicable.
31	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.5.2 Community Studies, Species Richness 2018-2019: Spatial Comparison, p. 94.	Log transformed percent fines was not a statistically significant explanatory variable of benthic richness over space but it was over time. Is the latter perhaps an artefact of increasing the sampling effort in 2019? If so, how will this be dealt with going forward?	As is typical with benthic invertebrate data, richness tended to be quite variable during both the 2018 and 2019 programs. The insignificant determination with fines using only the 2019 data may be a result of the lower number of data points available when compared to the pooled data from 2018 and 2019. The higher number of data points achieved using the pooled 2018 and 2019 data would be expected to increase the power of the statistical assessment and, thus, increase the confidence level. The result of this determination is that the power to detect an effect is expected to increase with a greater number of MEEMP

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				sampling programs, which is to be expected with a larger data set. Therefore, we recommend continuing to monitor these parameters as part of the MEEMP to increase our power to detect changes in richness over time.
32	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Pg. 97, S. 4.1.5.2 Community Studies, p. 97	The Simpson's Diversity Index spatial comparison data nearest the ore dock on the east and west transects are quite different, and the trends with distance from the ore dock are opposite (Figures 4-23 and 4-24). This suggests that activities at the dock, such as vessels arriving and departing, may be affecting these benthic communities differently. Are there other obvious factors that would explain these differences?	Our analysis of the sediment and benthic data collected in 2019 did not suggest that activities at the dock could be the cause of the contrasting trends observed along the east and west transects. This conclusion is based on the following rationale: - The sediment analysis did not determine that parameters of interest were concentrating around the dock, nor were they present at levels that would be expected to adversely affect benthic invertebrate communities. - The available sediment data did not suggest obvious factors that would explain the slight differences in Simpson's Diversity Index scores observed along the east and west transects.

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				- Though it is acknowledged that the trends along the east and west transect were statistically significant and appeared to be in opposite directions, it should also be acknowledged that most stations had a Simpson's Diversity Index that ranged between 0.8 and 1.0. Furthermore, as depicted in Figure 4-22, species richness was determined to be greater (although not significantly greater) at stations located closer to the dock during the 2019 program relative to 2018. As depicted in Figure 4-18, community composition of major taxa was quite similar at the majority of stations along the East and West Transects. Significant differences among the four community metrics assessed were also rarely observed. - Review of the various lines of evidence suggested that despite high variability in benthic endpoints, the available data do not suggest benthic communities close to the Port have been impacted by Port-related activities.

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				Further monitoring of benthic conditions along the east and west transect should provide better clarity on factors that have influenced the observed trends.
33	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.5.2 Community Studies	The section title is "Simpson's Evenness Index" but the tables are titled "Shannon Evenness index". Are these correct?	This is a typo. It should be Simpson's Evenness Index throughout. This will be corrected in the 2020 report.
34	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.6 Substrate, Macroflora, and Benthic Fauna, p. 99 6.0 Conclusions and Recommendations, General, p. 166	Taxonomic resolution that is limited to Phylum, or identifies all algae at a station as "unidentifiable algae" (e.g., Figures 4-25 and 4-26), limit the value of these studies for monitoring change. Alternatives for species identification should be considered, such as real-time taxonomic assessment of the videos by Arctic marine taxonomists who can direct the camera operator to key features or periodic diver surveys.	Marine biologists skilled in species identification are actively running the program and perform the video review. However, having a biologist review the footage will do little to improve taxonomic resolution between closely related taxa. Many of these species are identified definitively using characteristics that may require lethal sampling (such as counting fin rays or gill structures in fish) or examining the specimen in a laboratory setting with access to a taxonomic database. In 2020, survey plans

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				include a dedicated marine scientist to direct the ROV operator to potentially allow for better camera angles to aid in resolving some identifications. However, without collection of specimens, many taxa will not be resolved to the species level.
35	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.1 Catch Data, p. 103	Capture of a ninespine stickleback in brackish water at the north end of Baffin Island is of scientific interest as a range extension for the species. Specimens are worth preserving and forwarding to the Canadian Museum of Nature for archiving and future study.	Currently, permitting for the program does not allow for the lethal sampling of fish specimens and all incidental mortalities should be sent for tissue analysis. In 2020, the program will expand to include provisions for the lethal sampling of targeted species for fish health sampling only. Any other incidental mortalities will be sent for analysis or disposed of on-site according to the Animal Use Permit.
36	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.1.1 Angling, p. 103 See also Executive Summary, p. vii	The declining catch-per-unit of sampling effort (CPUE) suggests there may be Project effects but the angling (trolling, jigging) effort is very low. If angling is to be used as a long-term tool for monitoring benthic and demersal fishes it must be approached with rigor. Otherwise, bottom set gillnets or other methods should be considered as an alternative.	Time constraints in 2019 led to limited time available to conduct angling. 2019 represents only the third year of angling efforts and it is difficult to determine the source of the lower CPUE for angling with this limited time series. Angling will continue to be part of the program due to the ability for this method to be used opportunistically during other sampling efforts, such as

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				during gill net sets. Bottom set gill nets are included in the 2020 program.
37	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.1.1 Angling, p. 104 and 4.1.7.1.2 Gill Netting, p. 105	Figures 4-28 and 4-29 would be easier to interpret if the keys were ordered in the same sequence as in the bar graph.	This is an ongoing formatting issue occurring when the file is converted to PDF, will try to fix in the updated version.
38	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.2 Fish Length and Weight, p. 108	RE: "…from 56 mm to 832 mm…" should read "…from 56 mm to 405 mm…". It is still a whopper!	Value has been corrected in text.

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39	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.2 Fish Length and Weight, p. 110	This is a fairly broad scatter of length at age for char, and no fish was older than age 19 y. This could be natural, an artefact of age determination, or a mixed-stock fishery. Has Inuit knowledge of local stock structure and movements been sought out to inform sampling design? It is also worth asking DFO to check a subset of ages for verification and to analyze genetic samples to check for a mixed stock fishery.	The lack of a notable relationship between Arctic char length and age was also noted in 2018. It is uncertain where this variation arises but could be due to a variety of factors including genetics, environment and/or fish stock. Fishing efforts in the field were informed by research on fish behaviour as well as on the experience, advice and knowledge of Inuit members of the field crew during sampling efforts. Identifying the source stock of the captured fish is not within the scope of the MEEMP.
40	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.7.3.1 Arctic Char, p. 111	"Due to degradation and damage to some fish during transportation sex was not determinable for all fish..." How will this degradation and loss of data be avoided in future?	The issue regarding fish condition was directly related to an incident on site (vessel capsize event) that necessitated the rapid processing of the samples from two nets that had extended deployments. Under the time constraints during clearing the nets, field personnel were required to place all samples in plastic bags on hand, which were then frozen together. It was this suboptimal sample preservation method that led to all cases of fish in poor condition. As this was the result of an unprecedented incident, it is not

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				anticipated that a similar issue will occur in sample preservation in 2020
41	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.1.8 Tissue Chemistry, Table 4-32 (p. 120) and Table 4-36 (p. 126). See also Executive Summary, Tissue chemistry, p. vii 6.0 Conclusions and Recommendations, p. 166	In 2018 the mean concentration of 6 metals sampled in Arctic char were higher than in 2019, while in 2019 the mean concentration of 13 metals was higher than in 2018 (Table 4-32). This pattern is much stronger in *Hiatella arctica* (Table 4-36), where only 3 of the mean metal concentrations were higher in 2018, cf. 26 in 2019. These differences, while often not statistically significant, suggest that the sampled populations are not directly comparable (possibly due to differences in mean age, sample sizes, locations, timing, etc.), that changes have occurred in the sampling and analysis, or that metal exposure is increasing. These questions must be addressed to ensure that the sampled populations and methodologies are directly comparable going forward so the root causes of any further increases can be correctly attributed.	As acknowledged in Comment #41, the differences observed in tissue metal concentrations in 2019 were often not statistically significant. Large variability in chemistry results is typical and to be expected. For example, a difference of less than a factor of two for water chemistry results is considered normal per the Metal Mining Technical Guidance for Environmental Effects Monitoring (Environment Canada 2012); this two-fold change is recommended to "ensure that differences between exposed and reference area concentrations are real differences, and not just differences that may be attributed to such factors as low concentrations of target contaminants, analytical variability, small minimal sample size, and seasonable variability" (see Section 5.7.5 of Environment Canada 2012). Natural variability will exist among samples, which in the case of fish tissue means between individuals of the same species sampled in any

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				given year, as well as across years. This natural variability is unavoidable and is a result of inconsistencies in climate and weather conditions among years, as well as innate fish behaviours, habitat and food choices or age/size differences in the sampled population within and among years that influence their exposure to, and uptake of, metals present in the environment. Where relevant (e.g., for substances that biomagnify, such as mercury and selenium), differences in metal concentrations relative to fish age/size are considered in statistical testing by including size as a covariate (i.e., in analysis of covariance, ANCOVA). In general, fish tissue data and the mean value(s) associated with those data should only be interpreted with consideration of the results of the associated statistical tests. If statistical tests are not available, then at a minimum the appropriate metric of variability (i.e., standard deviation, and standard error of the mean, respectively) should be considered to interpret the mean values relative to the variability in

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				the dataset. Future MEEMP field programs, associated analyses and reports will continue to consider appropriate sampling methods and protocols to establish valid data acquisition and laboratory methods, and appropriate statistical analyses to determine if metal concentrations in fish and shellfish are changing over time, or in the future when reference areas are established, among study areas. Reference: Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. Environment Canada, Ottawa, Ontario.
42	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.2.3 Macroflora and Benthic Epifauna, p. 141	Of the 52 taxa collected or observed by the AIS/NIS surveys of macroflora and benthic epifauna in 2019 (Table 4-43), 21 were identified to species, 2 to genus, and 29 were not identified to genus or species. Not knowing the species identity of over half of the taxa weakens this monitoring program and future comparisons. What measures will be taken in 2020 to improve the proportion of taxa identified to species?	Features that may distinguish between two similar taxa are often small and require a specimen in hand in order to make a positive ID to the species level and may require close observation under a microscope. ROV footage is limited in its ability to focus on the defining areas. It is important to note that a high percentage of identification is achieved in the benthic infauna samples, where the highest number of taxa are observed. While ROV monitoring may not be able to provide definitive species

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				identifications in many cases, it is a valuable tool for analyzing for potential community changes, which may indicate potential AIS which can be targeted for future sampling. Note that this low rate of identification was in the ROV transects. Benthic infauna samples have a much higher rate of identification as well as more taxa observations. Definitively identifying species is not possible in many cases without a specimen to observe. With an ROV, species identifications are often made using assumptions based on taxa likely to be present in an area, using local taxonomic guides and local knowledge. As this is a monitoring program for non-indigenous species, these assumptions cannot be applied as it risks overlooking NIS where there are local species that match a similar description.

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43	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	4.2.4 Encrusting Epifauna, Table 4.4.4, p. 146.	Table 4.4.4. requires editing to clarify that it is the higher taxonomic groups (e.g., genus, family, etc.) to which the 20 unidentified species (i.e., indet. or sp.) belong that may have a broad distribution (e.g., "globally distributed") but that the distribution of the species captured is unknown. Otherwise it gives the impression that the organism is indigenous, when it may not be. Also, only 8 of 28 taxa were identified to species. What measures will be taken in 2020 to improve the proportion of taxa identified to species?	The table will be edited to clarify that it is the broader taxonomic group that has global distribution to avoid indicating the unknown taxa is indigenous. Identification of encrusting epifauna is dependent on a number of factors which includes the age, life stage and condition of the organism. Encrusting organisms may be damaged during removal from the substrate for identification purposes. While all reasonable efforts are made to keep the specimen intact, it is not possible to avoid damage in all cases due to the delicate nature of the animal, or the presence of calcareous structures (where removal damages tissues). It should be noted, controls against damage to specimens include sending the settlement substrates directly to the lab with minimal handling, where the professional taxonomists prepare the specimens for identification. Additionally, features that allow for positive species identification often are not developed until adult life stages. A large proportion of the

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				unidentified taxa were juveniles, which likely lacked the features necessary to make a definitive identification. Due to the nature of the settlement substrates, high numbers of juveniles are expected and changes to improve the rates of confident species identification are not feasible. Future monitoring of offset habitat will include the deployment of substrates that will be left in the water for multiple years, there is potential that these longer deployments may result in the establishment of more adult stages, which could improve identification rates, however, high numbers of juveniles will still be expected.
44	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	4.2.6 Ship Hull Monitoring, p. 149.	Barnacles were observed fouling the hulls of 4 of the 5 vessels examined. There are numerous invasive barnacle species (e.g. *Amphibalanus amphitrite, A. eburneus, A. improvisus*; Fofonoff et al. 2018). Those on incoming vessels should be identified to species. Fofonoff PW, Ruiz GM, Steves B, Simkanin C, & Carlton JT (2018) National Exotic Marine and Estuarine Species Information System. http://invasions.si.edu/nemesis/. Access Date: 7-Jun -2020	As observed in the settlement substrates, species identification of barnacles is difficult even with collected specimens sent to a taxonomic laboratory. The identifying features required to make a positive identification to even the genus level generally requires an intact adult specimen observed by a taxonomic lab. Under current safety limitations, collection of specimens for identification and

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				clarification of the species identification are not possible.
45	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	5.1.2 Physical Oceanography, p. 153 6.0 Conclusions and Recommendations, p. 163	p. 153 (1st line) and p. 163 (4th line from bottom), both read "...land subsidence (Glacial rebound)...". They should be edited to read "...land uplift (post-glacial rebound)..." as in the Executive Summary, p. iii.	Acknowledged
46	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	5.1.6 Substrate, Macroflora and Benthic Epifauna, p. 156	QIA supports consideration of alternative methods for setting the belt transects and completing the benthic surveys that would ensure all belt transects are usable, and improve taxonomic identifications.	Acknowledged, Golder is exploring a new form of quadrat that potentially is more robust to be deployed in 2020

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47	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	5.2.3 Macroflora and Benthic Epifauna, p. 161.	The new Cephalopod has not been identified to species so it should not be identified as locally distributed.	A qualifier was added to indicate that it was likely locally distributed.
48	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	5.2.6 Ship Hull Monitoring, p. 162	Were the barnacles of "an" undetermined species or more than one species? How was this confirmed when the barnacles were not identified to genus or species?	It is unknown whether the barnacles represent one or multiple species. Updated wording in report to "barnacles of indeterminate species" to address this confusion.
49	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	6.0 Conclusions and Recommendations, p. 165.	QIA supports the recommendation that substrate, macroflora, and epibenthic surveys continue to monitor for changes in benthic communities but with modifications to improve species identification rates.	Acknowledged.

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50	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	6.0 Conclusions and Recommendations, p. 166 See also Executive Summary, Tissue chemistry, p. vii 4.1.7.4 Shellfish Aging, p. 119 4.1.8 Tissue Chemistry, Table 4-32 (p. 120) and Table 4-36 (p. 126) 5.1.8 Tissue Chemistry change since 2018, p. 157	Changes in tissue metals in Arctic char and *Hiatella arctica* between 2018 and 2019 were not considered Project-related as "the metals that were elevated are not materially associated with iron ore" and "more likely reflect natural geologic sources or atmospheric deposition from further afield". If that is the case, what changes have occurred in the monitoring program (locations, timing, catch composition, analytical methodology, etc.) that would explain the sampled population’s change in exposure to different geological or atmospheric contaminants between years? This is very important to sort out to ensure that the long-term monitoring is directly comparable from year to year. QIA supports the recommendation to "adjust sampling to target minimum sample sizes of sentinel species", and recommends that measures be taken to control for differences in age/size and sampling location, perhaps by sampling more individuals within selected size ranges at key nearfield locations.	The statement relating to "natural geologic sources or atmospheric deposition from further afield" relates only to suggesting possible alternate sources of the metals to the study area as a whole, since they do not appear to be attributed to the Project. This statement was not intended to imply changes in fish capture locations may be unduly influenced by either of these atmospheric or geological processes, both of which occur on a scale that does not align with the small changes in fish capture locations between years. As discussed further in response to Comment #41 and presented in Tables 4-33 and 4-37 in the 2019 MEEMP report, the magnitude of differences in metals concentrations reported among years (i.e. between 2018 and 2019) are largely less than 100%, with only three exceptions (strontium and titanium in Arctic Char, and antimony in *Hiatella arctica*). These magnitudes of differences observed in fish tissue chemistry in 2019 suggest analytical precision and/or natural variability are the likely cause for the reported differences

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				in metals concentrations in fish and shellfish tissue in 2019, rather than a Project-related effect. The 2020 MEEMP program will target minimum sample sizes of sentinel species (i.e., sculpin and *Hiatella arctica*), however, the study is also designed to support subsequent statistical analyses which are dependent on a randomized (to the extent possible with natural biological data) study design. Therefore, targeting fish of a specific age or size would violate the assumption of the samples being selected randomly from a (presumably) normally distributed population. The 2020 MEEMP field program will collect fish and shellfish by methods consistent with previous years from locations that are also consistent with previous years, and will target a range of ages/sizes as available in the sampled population (i.e., without bias towards larger or smaller individuals). This study design supports the subsequent statistical analyses to determine if differences in fish health and tissue chemistry endpoints exist between years.

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51	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	6.0 Conclusions and Recommendations, General, p. 166.	QIA supports the General Recommendations but remains concerned by the number of new taxa, and taxa in video recordings of benthic transects and hull fouling, that have not been identified to genus or species. QIA recognizes the cooperative efforts made to identify aquatic invasive species (AIS) and nonindigenous species (NIS) using external expertise, and recommends further consideration of how best to improve the identification rates of species, particularly on settlement plates and ship hulls, and in videos and belt transect plots.	Acknowledged.
52	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Appendix K. Encrusting Epifauna, p. 2 (96 of 1149)	The "Selected methodological and Taxonomic References" does not mention taxonomic keys from the Canadian Eastern Arctic. Are they being used?	The selected methodological and taxonomic references is just the general list of resources used by the lab. These resources are not tailored to specific projects and as such is weighted to resources for the Pacific due to the lab's location. The Lab only uses taxonomic keys that have described taxa from the region of sample collection and will provide a specific reference list for the 2020 identifications.

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53	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Appendix M, 5.1 Historical Air Photos Review, p. 10 (1084 of 1149) See also: 6.0 Discussion, p. 14 (1088 of 1149)	p. 10, 3rd bullet, first line and p. 14, 2nd pgph: Should 2006 be 2016? If not, where are the 2006 data?	It should be 2016. The Report has been updated.
54	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Appendix M. 5.5 Milne Inlet sediment data review, Table 2, pg. 12 (1086 of 1149) See also Attachment 1, Figure 2, pg. 20 (1094 of 1149)	Interannual variability has been too high and sampling effort too low to properly assess changes in sediment distribution--hence the DFO power analysis requirement and expansion of the sampling program in 2019. Figure 2 should be swapped out for a Figure that provides an accurate depiction of where the sampling sites were located and how many there were prior to 2019 when sampling efforts were increased to improve the program's power to detect change	The sampling intensity and spatial coverage are more than adequate to meet program objectives. There are more than 60 sites with replicates. The 2020 report will include a figure(s) depicting where the sampling sites were location and how many there were prior to 2019.

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55	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Appendix M, 6.0 Discussion, 2) Arctic sediment transport regime and fluvial morphology, p. 13 (1086 of 1150) See also, 7.0 Conclusions, p. 15 (1089 of 1149).	This discussion has not addressed the questions of how much sediment is being added to Phillips Creek annually by Project activities, where it ends up, and what its effects are on the environment. Project-related dustfall and erosion contribute sediment to the creek transport. This material is in addition to the natural transport; it may increase the overall transport and affect the range of variability.	The amount of dust falling on land and eventually making it to Phillips Creek has been addressed in the 2018 Marine Environmental Effects Assessment (Phase 2 Proposal, FEIS Addendum). The majority of fine sediment will be flushed straight through the river system without depositing or contributing to geomorphic response and will dilute and disperse broadly into Milne Inlet. Overall deposition rates (~0.23 mm) will be very low, as discussed in the Effects Assessment.
56	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	7.0 Conclusions, p. 15 (1089 of 1149).	The Conclusion suggests Golder (2018a) was wrong to conclude there had been a significant increase in the percentage of fines as a result of the Project. QIA recommends that this conclusion be retested once there are several years of sediment data from the expanded sampling program (i.e., 2020 and beyond).	The Golder 2018a report did not attribute the increase in fines observed between 2014-17 to the Project. Rather, the Golder 2019 report demonstrates that there is no basis to connect or attribute the observed changes in sediment size to the Project.

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57	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	7.0 Conclusions, p. 15 (1089 of 1149).	"Changes in sediment size observed between 2014 and 2017 (Golder, 2018a) cannot be attributed to the Project." To what extent is this lack of attribution an artefact of low sampling effort in the past and lack of data on sediment inputs from Phillips Creek?	Sampling intensity and spatial coverage are sufficient to meet program objectives. Also, there is no basis to connect or attribute the changes in sediment size that were observed between 2014 and 2017 to the Project. Project effects would be expected to appear at stations nearest the source and spread over time. Whereas, the short term increases in fines observed in the distal portions of sampling transects can be attributed to natural variability over the Phillips Creek delta and spit complex.
58	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name "2019 MEEMP AIS DRAFT FOR MEWG.pdf")	Appendix O. Power Analysis, Implications of Power Analysis Results, p. 1148 of 1149.	The additional sediment and benthic sampling in 2019 improved the power to detect change, but may not be sufficient to detect a year effect in the benthos under an ecologically significant effect size. QIA recommends that the statistical power of the analyses be reassessed following the 2020 field season.	BIM plans to re-perform the power analysis, as part of the annual analysis and reporting for 2020. This is fully aligned with QIA's recommendation.

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59	2019 Marine Environmental Effects Monitoring Program (MEEMP) and Aquatic Invasive Species (AIS) Monitoring Program Report draft (file name “2019 MEEMP AIS DRAFT FOR MEWG.pdf”)	Typos worth correcting	Pg. 51 : "...pH in during..." Missing descriptor? Pg. 122: change “asses” to “assess” Pg. 133, 4th row from the bottom: plural of “Genus” is “Genera”. Appendix A. Photo Log, p. 23 (224 of 1149). Oval missed resting cod?	"in" removed corrected Corrected to genera Figure corrected

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