Marine Environmental Analyses
The Whale Sanctuary Project Site
Port Hilford Bay, Nova Scotia

This report presents the culmination of several years of environmental data collection and analyses collected at the Whale Sanctuary Project Site in Port Hilford Bay, Nova Scotia. This document includes the following sections:

I. Summary of Marine Environmental Analyses by The Whale Sanctuary Project
II. Marine Ecological Risk Assessment by Dillon Consulting Limited
III. Assessment of Potential Arsenic Impacts by Dr. K.J. Reimer, PhD

The Whale Sanctuary Project

I. Summary of Marine Environmental Analyses

by The Whale Sanctuary Project

Summary of Whale Sanctuary Site Marine Environmental Analyses

As part of both the permitting process and due diligence of creating a healthy and sustainable seaside sanctuary for cetaceans, the Whale Sanctuary Project (WSP) conducted in-depth environmental analyses of the proposed site location in Nova Scotia. These environmental analyses have been undertaken to gain a comprehensive understanding of the ecology and physical properties of the sanctuary site, as well as to assess any potential risks to the sanctuary's resident cetaceans or marine organisms native to the site.

Based on these analyses we conclude that the chosen site **poses negligible risks to future whale residents** and to the native marine environment. Below we discuss our findings, and the sources of information used to arrive at this conclusion. These include:

(A) Environmental Site Assessments (ESA I, II, and III)

(B) a formal Marine Ecological Risk Assessment (MERA) of the sanctuary waters;

(C) an exhaustive review of the relevant peer-reviewed scientific literature;

(D) consultation with appropriate marine experts;

(E) in-depth consultation and analyses with Dr. Ken Reimer, expert on the effects of arsenic on living organisms.

This report focuses specifically on the research and analyses to determine potential risks posed to the sanctuary's residents and the native marine ecosystem. This work represents just one aspect of a much larger and comprehensive array of studies undertaken over the past several years. These have included:

- acoustic studies of the marine environment;
- water quality and water temperature analyses throughout all seasons;
- impact assessments during hurricanes;
- seasonal wave, tide, and current measurements;
- hydrodynamic modeling of the sanctuary waters;
- migratory bird analyses; flora and fauna review;
- eel grass productivity and location analyses;
- an archaeological resource impact assessment (ARIA);
- terrestrial and marine geotechnical surveys.

Findings of these reports are discussed in posts on the Whale Sanctuary Project website.

A. Environmental Site Assessments (ESA I, II, and III)

Environmental Site Assessments (ESA I, II, and III) were conducted at the site by third party environmental consultants, Strum Consulting. The ESAs showed that a portion of the submerged soil near the shore contains elevated levels of arsenic, as a result of historical gold mining and milling activities that occurred by the site from the 1880s to the 1930s. Gold mining was common around Nova Scotia during this period.

The ESAs indicated elevated levels of arsenic sequestered in a small region of the marine sediments adjacent to the land (an area representing less than 20% of the total sanctuary marine area and located in the shallow nearshore environment), hereafter referred to as the “Area of Interest” or AOI.

Arsenic is found in many forms, or “species.” Inorganic arsenic is known to present toxicity risks to many species when exposure is of a sufficient dosage, while organic arsenic is relatively non-toxic. Speciation of the arsenic in the submerged marine sediments conducted by Brooks Applied Labs indicated that the arsenic present in the submerged sediments in the AOI is mainly present in the inorganic form.

To further assess the environment, and in part because the sanctuary’s future residents will be carnivores, we set out to determine whether there were elevated levels of arsenic in invertebrates living in and around the submerged soil of the sanctuary site, whom whales may consume. Atlantic rock crabs (*Cancer irroratus),* blue mussels (*Mytilus edulis*), and Atlantic soft-shell clams (*Mya arenaria*) were sampled. Of these, only the Atlantic rock crabs were noted to have arsenic levels that merited further investigation.

Due to the locations of the crabs sampled, their noted arsenic levels, and the mobility of the species, there is reason to believe that these arsenic levels are similar to those found in rock crabs throughout the region. Crabs sampled within the AOI did not show total arsenic levels above those sampled outside of the AOI. Through both the results of the literature review and expert consultation (see Section III of this document), we ascertained that crabs have been sampled throughout the area and have been found to predominantly contain the non-toxic, organic form of arsenic. It was therefore determined that the level of total arsenic found in the Atlantic rock crabs we sampled was most likely to be predominately the non-toxic, organic form.

B. Marine Ecological Risk Assessment (MERA) Conclusions

As both part of the WSP due diligence and permitting processes, a Marine Ecological Risk Assessment (MERA) was conducted by a third party, Dillon Consulting Limited, to determine any ecological risk that the site might pose to the sanctuary's future residents, as well as the local marine ecosystem and its native inhabitants. **The MERA concluded that the site poses negligible potential for ecological risk to the future whale residents, and to the local marine environment.**

The report notes that an ERA study is "a systematic process that identifies key chemicals of concern, receptors of concern (e.g., species most likely to be exposed to the chemicals of concern), exposure pathways (how a receptor may come into contact with chemicals in their environment), and a variety of study endpoints and lines of evidence" (Section II, p. viii). An ERA also "estimates current and future chemical exposure and risk to the receptors of concern using a range of techniques that can vary from simple comparisons to detailed quantitative exposure and risk modelling."

Current and historic environmental data gathered at the site – by both independent consultants and WSP researchers – informed this MERA. Data and information included but were not limited to site marine surface water; sediment and marine invertebrate chemistry data; eelgrass chemistry data; site hydrodynamics; marine habitat conditions and ecology; marine flora and fauna types and their diversity and abundance; site benthic communities; potential presence of species-at-risk at the site; and seabird distribution, diversity and abundance. The MERA also included literature reviews of arsenic speciation in marine ecosystems and exposure and toxicity considerations in relation to arsenic and cetaceans.

The MERA concludes:

"… the overall weight of evidence conclusion from the assessment and interpretation of all LOEs [lines of evidence] that were considered for all ROCs [receptors of concern] assessed in the ERA [ecological risk assessment], is that COCs [chemicals of concern, including arsenic] present in site sediments and biota pose a negligible potential for ecological risk. There is a high degree of confidence in this overall conclusion of the ERA, especially given that the ERA utilized TRVs [toxicity reference values] and marine environmental quality guidelines and other benchmarks and toxicity values for inorganic arsenic. It is considered highly likely that most of the arsenic exposure to site resident marine biota (including future sanctuary site cetacean residents) will not consist of inorganic arsenic, but rather, will consist of various organoarsenicals that are widely believed to be of much lower bioavailability and toxicity to most organisms, and tend to be rapidly and efficiently metabolized and excreted by most organisms, relative to inorganic arsenic. As such, there is a high likelihood that even the negligible potential for ecological risk determined in this ERA is probably a substantial overestimate of actual risk" (Section II, p. 101).

The MERA results demonstrate “there is a negligible potential for ecological risk at the whale sanctuary site, for all assessed chemicals, marine receptors and exposure pathways. This includes future cetacean residents of the whale sanctuary” (Section II, p. ix). The MERA indicates there is “no need for remediation or risk management of the arsenic-impacted marine sediments at the sanctuary site.”

The MERA can be found in Section II of this document.

C. Scientific Literature Review

WSP researchers also conducted an exhaustive review of the peer-reviewed scientific literature on the following search terms and topics:

- Known health impacts of arsenic exposure in cetaceans, marine mammals, and terrestrial mammals;
- Free-ranging cetacean exposure to inorganic arsenic;
- Marine mammal metabolism of arsenic;
- Inorganic arsenic metabolism and transfer up the food chain in near-shore marine ecosystems;
- Marine ecological impacts of inorganic arsenic associated with historic mining in Nova Scotia and worldwide;
- Relevant absorption and excretion pathways present in cetaceans and other marine mammals;
- Phytostabilization of inorganic arsenic in marine ecosystems based on natural occurring benthic flora;
- Documented prey species of free-ranging belugas and orcas;
- Arsenic accumulation patterns in potential beluga and orca prey species that have been documented within the sanctuary and regional area.

The scientific literature did not provide data on the impacts and metabolism of inorganic arsenic in cetaceans. However, the review did provide insight in several related areas. First, we found toxicity documented in other (non-cetacean) mammals which could be conservatively extrapolated to the toxicological impacts inorganic arsenic might pose to cetaceans. Second, cetaceans appear to have the necessary metabolic pathways for conversion of inorganic arsenic into organic arsenicals (largely non-toxic) and efficient excretion. Therefore, while not directly bearing on how cetaceans might metabolize arsenic, several lines of evidence in other mammals allow us to make conservative inferences about cetaceans.

D. Marine Expert Consultation

WSP researchers reached out to a wide range of experts in the fields of marine toxicology, marine ecology, biochemistry, marine bioremediation, cetacean biology, chemistry and biochemistry, and cetacean veterinary medicine. Among these experts, nine were identified as having relevant expertise and were engaged in in-depth conversations and/or formal consultation. None of the experts expressed serious concern regarding the risk of inorganic arsenic exposure to future sanctuary residents since the overall level of exposure will likely be very low, both due to the way inorganic arsenic metabolizes up the food chain, and the unlikeliness of the whales foraging in significant volume on other animals at the site given they will be fed to satiation daily.

E. Consultation and Analyses with Arsenic Expert Dr. Ken Reimer

WSP staff contacted Dr. Ken Reimer for advice regarding the potential health effects, if any, of arsenic contamination from arsenic sequestered in the AOI through cetacean ingestion of invertebrates. Dr. Reimer is a foremost expert on the effects of arsenic, bioremediation, and marine chemistry. He is an Emeritus Professor at the Royal Military College of Canada. Prior to his retirement, Dr. Reimer was a Professor in the Chemistry and Chemical Engineering Department, was cross appointed to the Biology and Chemistry Departments at Queen's University and held Adjunct Positions at the University of British Columbia and Memorial University. He has decades-long experience studying arsenic and other biocontaminants and has written several books and over 250 papers in his field.

Dr. Reimer has previously done work analyzing arsenic impacted environments along the Nova Scotia coast. One nearby site in which his team conducted a study, Seal Harbor, is directly comparable to the WSP sanctuary site in Port Hilford Bay. Seal Harbor, like the sanctuary site, is located along the eastern Nova Scotia shoreline and had an adjacent historic gold mine and elevated marine arsenic levels. Dr. Reimer and his team carried out extensive sampling of periwinkles (*Littorina littorea*), a small and abundant snail in Seal Harbor. They found elevated levels of inorganic arsenic present in the periwinkles that was associated with the elevated marine sediment area. This prior research allowed us to gain insight into the inorganic arsenic levels most likely present in any periwinkles at the WSP sanctuary.

Possible prey items of belugas and orcas were determined based on literature review and consultation with experts. Based on abundance estimates from previous transect survey work conducted throughout the nearshore habitat within the sanctuary (which includes covering the AOI), it was determined that periwinkles were most likely to be in high enough abundance in the AOI to warrant further analysis. Periwinkles have been documented to be present in the diet of free-ranging belugas and feed as benthic grazers directly on the bottom substrate. They also have a high level of site fidelity, very small lifetime range, and have been documented to be an abundant species within the entire nearshore sanctuary habitat, as was found in Seal Harbor.

In consultation with Dr. Reimer, WSP researchers calculated the number of periwinkles that an average adult male or female beluga would need to consume daily to reach the level believed to cause adverse health effects. It was determined that the toxicological reference value (TRV) was a more appropriate toxicity threshold than the Health Canada Fish Protein Limit when looking at the potential impact of chronic daily exposure of cetaceans to inorganic arsenic. Based on the known marine sediment arsenic results from both sites, an inorganic arsenic upper level was extrapolated for the periwinkles in the WSP sanctuary AOI. The TRV was then calculated for an adult male and an adult female beluga, based on the reported average weight for each in captivity. After calculating the volume of periwinkle tissue that would need to be consumed at the extrapolated inorganic arsenic level for both the average adult male and average adult female beluga to reach the TRV, the volume was converted into total number of periwinkles based on the average reported weight of a periwinkle. This exercise incorporated the protective assumption that all the arsenic present within the periwinkles was in the inorganic (i.e., most toxic) form in order to arrive at the most conservative risk estimate. The analysis showed that several hundreds of periwinkles would have to be consumed each day to pose a risk to the whales, and this is beyond the range of what is realistic for such animals. Whales at this sanctuary site will also be fed to satiation daily by the sanctuary's human care team.

Dr. Reimer concluded: "**Arsenic has been introduced into the sediments of the WSP proposed sanctuary site but, given the protective assumptions noted above [regarding arsenic being present in its most toxic form], it should not pose any risk to future whale inhabitants"** (Section III, p. 7).

Dr. Reimer's full report can be found in Section III of this document.

Conclusion

The Marine Ecological Risk Assessment (MERA), expert consultation, an exhaustive literature review, and thorough analysis with a prominent arsenic expert all converge on the conclusion that there is **negligible risk associated with the sanctuary site to the whales**. The WSP research team is confident that although elevated levels of inorganic arsenic are present within the sanctuary, sequestered in the marine sediments adjacent to the historic gold mine (an area around the shore), there is no elevated risk posed to the future sanctuary residents based on this limited exposure. The site will undergo regular environmental monitoring to ensure the continued safety for its inhabitants.

II. Marine Ecological Risk Assessment

by Dillon Consulting Limited

WHALE SANCTUARY PROJECT

Marine Ecological Risk Assessment

Whale Sanctuary Project Site

September 2024 - 24-8007

September 24, 2024

Whale Sanctuary Project
https://whalesanctuaryproject.org
Nova Scotia, Canada

Attention: Alexandra Vance, MMM, B.Sc.
Project Manager

Marine Ecological Risk Assessment (ERA) of Nova Scotia Whale Sanctuary Site
Final Report

Please find attached our final report for the Marine Ecological Risk Assessment of the Nova Scotia Whale Sanctuary Site. This report represents final ERA outcomes for all lines of evidence that were considered in the ERA.

Sincerely,

DILLON CONSULTING LIMITED

RWillis

Rob Willis, B.Sc., M.E.S., EP, QP_{RA}, QP_{CA}
Project Manager

RDW:jb
Enclosure

Our file: 24-8007

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Dillon Consulting Limited

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Acronyms, Abbreviations, Definitions

AB	Arsenobetaine
AC	Arsenocholine
As	Arsenic
As(III)	Trivalent Arsenic
As(V)	Pentavalent Arsenic
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BC CSR	British Columbia Contaminated Sites Regulation
BC MOECCS	British Columbia Ministry of Environment and Climate Change Strategies
BSAF	Biota-Sediment Accumulation Factor
CCME	Canadian Council of Ministers of the Environment
CEM	Conceptual Exposure Model
COC	Contaminant (Chemical) of Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSM	Conceptual Site Model
DFO	Department of Fisheries and Oceans (Fisheries and Oceans Canada)
DMA	Dimethylarsinic Acid
dw	Dry Weight
ECx	Effective Concentration
EDx	Effective Dose
EHQ	Ecological Hazard Quotient
EPC	Exposure Point Concentration
EPT	Ephemeroptera, Plecoptera and Tricoptera
ERA	Ecological Risk Assessment
ESA	Environmental Site Assessment

ESL	Environmental (Ecological) Screening Level
IBA	Important Bird Area
ISQG	Interim Sediment Quality Guideline
km	Kilometre
LD50	Median Lethal Dose
LOAEL	Lowest Observed Adverse Effect Level
LOE	Line of Evidence
LOEC(D)	Lowest Observed Effect Concentration (Dose)
MeHg	Methylmercury
MMA	Monomethylarsonic Acid
NOAEL	No Observed Adverse Effect Level
NOEC(D)	No Observed Effect Concentration (Dose)
NS	Nova Scotia
NSECC	Nova Scotia Environment and Climate Change
NSNRR	Nova Scotia Natural and Renewable Resources
PEL	Probable Effect Level
PEL-Q	Probable Effect Level Quotient
PHC	Petroleum Hydrocarbon
PSS	Pathway Specific Standards
QERA	Quantitative Ecological Risk Assessment
RDL	Reported Detection Limit
ROC	Receptor of Concern
SAR	Species at Risk
SARA	Species at Risk Act
TMA	Tetramethylarsonium
TPH	Total Petroleum Hydrocarbons

TRG	Tissue Residue Guideline
TRV	Toxicity Reference Value
UCLM95	95% Upper Confidence Limit on Arithmetic Mean
US EPA	United States Environmental Protection Agency
WL	Wetland
WOE	Weight of Evidence
WSP	Whale Sanctuary Project
ww	Wet Weight

Executive Summary

A marine ecological risk assessment (ERA) was conducted for the site of the Nova Scotia Whale Sanctuary Project. The ERA was a necessary due diligence step in the development of the sanctuary site, given Phase II and III Environmental Site Assessment findings which showed that a small portion of the sanctuary site has sediments that contain elevated levels of arsenic, as a result of historical gold mining and milling activities that occurred near the site. This ERA was conducted to determine the ecological risk that the site may pose to the local marine ecosystem, including future whale sanctuary residents.

An ERA study is a systematic process that identifies key chemicals of concern, receptors of concern (e.g., species most likely to be exposed to the chemicals of concern), exposure pathways (how a receptor may come into contact with chemicals in their environment), and a variety of study endpoints and lines of evidence. An ERA also estimates current and future chemical exposure and risk to the receptors of concern using a range of techniques that can vary from simple comparisons to detailed quantitative exposure and risk modelling.

A variety of site data and other information were available for and used within the ERA (i.e., site marine surface water, sediment and marine invertebrate chemistry data; eelgrass chemistry data; site hydrodynamics; marine habitat conditions and ecology; marine flora and fauna types and their diversity and abundance; site benthic communities; potential presence of species-at-risk at the site; and, seabird distribution, diversity and abundance). Other key information used within the ERA were literature reviews of arsenic speciation in marine ecosystems and exposure and toxicity considerations in relation to arsenic and cetaceans.

For the ERA of the whale sanctuary site, two specific chemicals of concern were identified through a comprehensive screening process (i.e., arsenic and methylmercury, where methylmercury was a potential chemical of concern only in some site benthic invertebrates and in birds or mammals who may consume them). Similarly, specific species of concern were identified through a comprehensive and systematic process and were assessed as representative ecological receptors of concern. These species were then evaluated for all potentially relevant exposure pathways, which mainly included the ingestion of food and prey items as well as ingestion of/contact with marine sediments. The species selected for evaluation in this ERA were:

- Marine benthic invertebrates.
- Marine vegetation (including eelgrass and algae).
- An invertebrate-consuming bird (Greater Scaup).
- A herbivorous bird (Black Duck).
- An invertebrate-consuming aquatic mammal (Northern River Otter).
- Future cetacean residents of the sanctuary site.

The results of this ERA collectively demonstrated that there is a negligible potential for ecological risk at the whale sanctuary site, for all assessed chemicals, marine receptors and exposure pathways. This includes future cetacean residents of the whale sanctuary. As such, the ERA concluded that there is no need for remediation or risk management of the arsenic-impacted marine sediments at the sanctuary site. Given that the sanctuary site clearly has a healthy and diverse marine ecosystem, disturbing the small area of arsenic-impacted sediments is considered to have a greater potential for ecological harm or risk, than leaving the impacted sediments in place, especially given the significant presence of eelgrass in the arsenic-impacted sediment area of the site.

The ERA made a number of recommendations to reduce some areas of uncertainty in the ERA, to confirm some assumptions made in the ERA, and to ensure that there is some means of tracking trends in site media and biota arsenic levels over time. These recommendations could be implemented within the site environmental monitoring program that the Whale Sanctuary Project has committed to undertaking.

1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by the Whale Sanctuary Project (WSP) to conduct a marine aquatic ecological risk assessment (ERA) at the location of the Nova Scotia Whale Sanctuary (hereafter referred to as the “site”). The ERA was undertaken in accordance with Dillon’s proposed scope of work letter dated March 27, 2024.

Figure 1-1 shows the geographical location of the whale sanctuary site and its boundaries. Figure 1-2 shows a ground level view of the site, as shown on the Whale Sanctuary Project website (https://whalesanctuaryproject.org/the-sanctuary/).

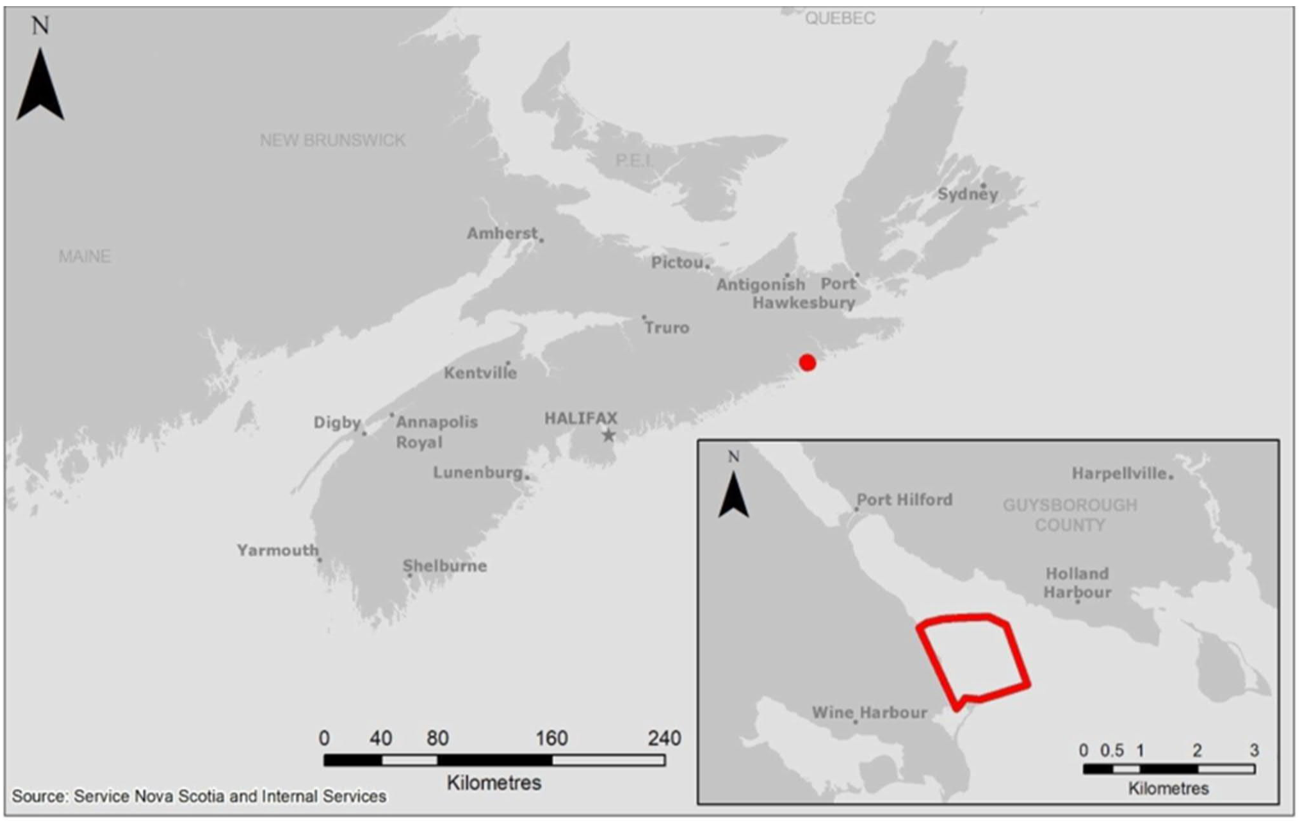

Figure 1-1: Site Location (from Webster et al., 2021).

Figure 1-2: Artist Rendering of Outline of the Whale Sanctuary Project Site. (https://whalesanctuaryproject.org/the-sanctuary/)

The marine ERA builds upon the findings and outcomes of recent Phase II and III ESAs of the site (as well as surrounding land-based properties), conducted by Strum Consulting (Strum, 2024a; 2023). These ESAs identified the presence of chemical contamination impacts (primarily arsenic, and some other metals and metalloids to a lesser extent) in marine sediments at some nearshore locations within the site boundaries. Some of these impacts (e.g., arsenic) are attributed to previous historical land-based gold mining and milling operations that occurred in the vicinity of the site.

The marine whale sanctuary and its associated ancillary facilities and infrastructure (including both the water lot containing the sanctuary and the surrounding crown lands) will be leased from the Province of Nova Scotia for a period of several decades. This lease agreement process triggered a NS licensing, permitting and assessment process which to date, has included numerous studies and programs for site characterization and environmental due diligence purposes. The site has undergone various studies to characterize physical, chemical, biological, ecological and oceanographic features and characteristics over the past few years. Many of these studies focused on determining the suitability of the site for use as a whale sanctuary. However, given the findings of marine sediment contamination related to historical gold mining and milling activities, a number of studies have also focused on environmental due diligence and determining the types and extent of contamination and the potential for contaminant impacts on local resident marine biota, as well as future cetacean residents of the whale sanctuary. Environmental due diligence studies (including Phase II and III ESAs) have been led by Strum Consulting.

Site assessment data collected to date also indicates the significant presence of eelgrass and/or Ascophyllum (a type of brown seaweed) in the same areas that display the highest sediment arsenic concentrations. The recent Phase III ESA (Strum, 2024a) recommended that a Quantitative Ecological Risk Assessment (QERA) be completed to evaluate potential ecological risks that may be posed by sediment metal/metalloid impacts to the local marine biological communities, and to the whales that may be moved to the future sanctuary site.

This ERA report is structured as follows: the remainder of Section 1.0 presents the objectives and scope of work; Section 2.0 presents the relevant background information for the site, including the outcomes of previous assessments; Section 3.0 presents the ERA framework; Section 4.0 through Section 7.0 provides the methods and outcomes of the marine ERA; Section 8.0 presents the uncertainties and assumptions that pertain to the ERA; Section 9.0 provides overall conclusions and recommendations of the ERA. References cited within this report are listed in Section 10.0, and Section 11.0 contains Dillon's closure statement. Supporting technical documentation is provided in the various appendices attached to this report.

1.1 Objectives and Scope of the ERA

The overall objective of the marine ERA was to use a weight of evidence (WOE) approach and a comprehensive multiple lines of evidence (LOE) assessment of available site data to enable the determination of whether or not resident site marine biota are likely to experience adverse ecological effects as a result of marine sediment and/or surface water contamination (attributed to historical gold mining and milling operations on the adjacent lands). The key LOEs that were considered in the ERA included the following:

- Assessment of marine surface water chemistry data (marine water quality guideline and reference area comparisons and potential application (if necessary) of site-specific water quality guidelines (if feasible) and/or marine aquatic toxicity data comparisons).
- Assessment of marine sediment chemistry data (marine sediment quality guideline and reference area comparisons and potential application of PEL-Q and mean PEL-Q approaches to sediment chemistry interpretation).
- Interpretation of aquatic biology/habitat assessment findings.
- Interpretation of benthic community assessment outcomes.
- Outcomes of ERA exposure and risk modelling of representative marine ecological receptors that may occur and/or forage within the impacted marine areas of the site (i.e., ecological hazard quotients); ERA exposure and risk modelling also considers, depending on data availability, key contaminant speciation in marine media and biota and the implications of speciation with respect to contaminant bioavailability and ecotoxicity.
- Consideration of acclimation and adaptation of marine biological communities within the impacted areas of the site to historical gold-mine-related contamination impacts.

The use of multiple lines of evidence and a weight of evidence (WOE) approach is consistent with standard aquatic ERA best practices.

The main tasks within the marine ERA were as follows:

- Previous document and data review and data gap analysis. All existing relevant documentation and data for the site were reviewed, and key marine ERA data gaps (if any) were identified such that efforts could potentially be made to address such data gaps prior to the commencement of the ERA or while the ERA is in progress. This led to some supplemental sampling and analytical programs (i.e., eelgrass and eelgrass root zone marine sediment sampling and analysis), as well as various focused literature searches and reviews to understand arsenic speciation in various marine media and biota, including cetaceans.
- Problem Formulation: This step of the ERA identified chemicals of concern (COCs) via comparison of surface water and sediment chemistry data to applicable marine aquatic benchmarks (guidelines) and reference area chemistry data, and also identified the key receptors and exposure pathways that were focused on in the ERA. This step of the ERA also included development of a conceptual exposure model (CEM) which illustrates the connectivity between the selected receptors, COCs and relevant exposure pathways. Where/if possible or necessary, site-specific water quality guidelines were derived and utilized in the identification of COCs in sea water.
- Exposure Assessment: This step of the ERA quantitatively or qualitatively estimated exposures of the identified receptors of concern to the COCs via the identified exposure pathways. Various models and uptake factors or relationships were used to estimate receptor exposures to COCs. This step of the ERA also required the sourcing of physiological and exposure parameters for some receptors to enable quantitative estimates of exposure to COCs.
- Toxicity Assessment: This step of the ERA identified appropriate toxicological reference values (TRVs) and/or media-specific toxicity-based benchmarks for the COCs and receptors that were selected for assessment. Focused literature reviews were also undertaken in this step in order to better understand potential bioavailability and toxicity of the identified COCs.
- Risk Characterization: This step of the ERA compiled, summarized, interpreted and discussed aquatic ecological LOEs, using a multiple LOE and WOE approach that is consistent with aquatic ERA best practices.
- Development of conclusions and recommendations of the aquatic ERA. Where/if deemed necessary (e.g., if a potential for adverse ecological effects was identified), recommendations were made towards appropriate mitigative measures such as risk management measures, sediment remediation, or, further studies/monitoring to reduce uncertainty and to enable a more accurate determination of the potential for ecological risk.
- Discussion of draft report and aquatic ERA outcomes with WSP personnel (and others, as necessary), and conduct modifications/edits to outcomes and report content as deemed appropriate.

- Discussion and interactions with regulatory authorities regarding the marine ERA (including responding to comments and questions, and if/as necessary, conducting modifications/edits to the ERA report).

Based on the outcomes of these key tasks, and interpretation of the LOEs using an overall WOE approach, the ERA determines whether or not site resident biota are likely to experience adverse ecological effects as a result of historical gold mining/milling operations that occurred adjacent to the site.

A limited ecotoxicological review of site-related contaminants in cetacean species is in progress by WSP personnel and/or their external consultants. The marine ERA reviewed and utilized this information, where deemed appropriate, and also conducted several focused literature searches in an effort to identify key whale receptor parameters that could potentially enable inclusion of whales as a specific receptor type in the ERA. Typically, whales would not be included as receptors in a marine ERA due to their very large foraging ranges, their foraging/feeding patterns, and large body weights, but whales living in the sanctuary enclosure represent a unique exposure scenario. However, as described in subsequent sections of the ERA herein, very little information relevant to enabling an ERA for whales was identified. Thus, it was only possible to evaluate potential chemical exposures and risks to whales within the enclosure in a qualitative manner.

Additional details and methodologies associated with each of the main tasks of the marine ERA are presented in subsequent sections of this report. The marine ERA was conducted using various types of environmental media and biota chemistry data and ecological data collected by WSP, various contractors retained by WSP, and Strum Consulting. Site analytical chemistry data for marine sediments, marine surface water, and marine benthic invertebrate tissues were collected by WSP personnel, and Strum Consulting over a number of sampling events from 2020 to 2023. Eelgrass tissue data and supplemental eelgrass root zone sediment data were collected in June, 2024 by WSP personnel.

The ERA is limited to, and focuses only on, potential exposures that ecological receptors may incur in the characterized marine areas of the site. Freshwater water bodies/courses and terrestrial areas that will comprise some of the land-based whale sanctuary facilities and infrastructure (e.g., whale handling, feeding and veterinary facilities are proposed to be constructed near the shoreline of the site, as well as buildings/facilities for administration and sanctuary maintenance) are not within the scope of this ERA, and are being evaluated under separate contaminated site assessment programs.

In addition, no adjacent areas, sites or regional environmental issues that cannot be clearly associated with the whale sanctuary site are considered or evaluated herein. The ERA also only evaluates current and potential future chemical exposures associated with the site. It does not evaluate potential exposures and risks that may have been present in the past. Typically, ERAs are prospective in nature and focus on current and/or future conditions. Ecological risk assessments of contaminated sites are rarely conducted in a retrospective manner. This reflects the fact that reliable data for historical exposures is typically lacking for most sites. Where such historical data does exist, it is often limited (in both quantity and quality) and can frequently be unreliable due to reporting limitations, sampling and analytical deficiencies, and various other sources of uncertainty.

2.0 Background Information and Site Characterization

The Whale Sanctuary Project (WSP) seeks to establish marine sanctuary areas for whales and dolphins that are being retired from marine entertainment parks or rescued from the wild, and that are in need of rehabilitation or permanent ongoing care (https://whalesanctuaryproject.org/). The site is the first proposed marine whale sanctuary location in North America, and was carefully selected based on numerous physical, chemical and biological features. The primary goal of the Nova Scotia sanctuary site is to offer retired/rescued orcas and/or beluga whales a controlled and safe natural environment that maximizes their opportunities for autonomy, exploration, play, rest, and socializing.

The following information that describes the physical, chemical and biological conditions of the site are taken primarily from Strum (2024a,b; and, Webster et al., 2021; 2022).

The site is located in eastern Nova Scotia, in Indian Harbour, near the community of Port Hilford. Figures 1-1 and 1-2 show the location of the sanctuary. The boundaries of the sanctuary area comprise the site of interest for the marine ERA study presented herein. In some documentation from the various studies conducted to date, the water body where the site is located is also referred to as Wine Harbour and Port Hilford Harbour. The site lies approximately 1 km east of the intersection of Barrachois Road and Walter Cove Road.

The sanctuary site will comprise approximately 100 acres of enclosed marine water space for the whales that will be surrounded by a netted enclosure that is anchored and secured to concrete moorings. A 75 m buffer area around the outside of the marine enclosure will be present to accommodate the anchoring system for the netted enclosure. The sanctuary site also includes Barachois Island. However, the island is not within the scope of work for the marine ERA. Furthermore, there are no indications to date that the island has incurred contamination from historical gold mining and milling activities.

Adjacent areas to the site are coastal ocean and terrestrial lands along the shoreline boundary of the site. The adjacent terrestrial areas are mainly undeveloped coastal woodlands. Much of the coastal and terrestrial areas near the site are undeveloped, however; a wharf is present on the southeast side of the site extending into Barachois Cove (Figure 1-2). This wharf is periodically utilized for commercial marine vessel operations and storage/maintenance. Several commercial buildings are present adjacent to the wharf and shoreline. The shoreline of the site is mostly cobble and gravel-covered beach.

Terrestrial and freshwater areas immediately upland of Barachois Cove are known to have had historical gold mining/milling operations. A pond area (a former tailings pond identified as Barachois Pond) is located adjacent to the marine shoreline. A former stamp mill was reportedly located immediately adjacent to the south/southeast side of this pond. Mill infrastructure is no longer present. Coastal wetland areas are present to the north, northeast, and south of Barachois Pond.

The site is not located within, nor is it immediately adjacent to, any known ecologically protected areas. Neither the site nor the broader harbour the site is located within, are classified as "important bird areas" (IBAs). No currently designated IBAs are located near the site. The closest IBA to the site is located a little over 10 km east of the site (https://www.ibacanada.com/mapviewer.jsp?lang=EN). The Wine Harbour ''significant ecological area" is located approximately 2 km west of the site, while a proposed and pending Cape St. Mary's Nature Reserve, a designated '"Managed Area", lies roughly 3 to 4 km southwest of the site (ACCDC, 2021). The nearest designated terrestrial protected area is 10 km east of the site (ACCDC, 2021). There are no currently designated marine protected areas in the vicinity of the site.

Site substrate, aquatic habitat and resident marine biota observations and conditions are described in Section 2.1, below. Detailed surveys were undertaken to characterize the marine environment of the site. Though described in greater detail in Section 2.1, the south and southwestern portion of the site has a number of areas of eelgrass communities. The eelgrass is particularly abundant in areas that display the greatest degree of sediment contamination from historical gold mining and milling operations.

As noted in Section 1.0, the site has undergone various studies to characterize its physical, chemical, biological, ecological and oceanographic features and characteristics over the past few years. Many of these studies focused on determining suitability of the site for use as a whale sanctuary. Given the findings of marine sediment contamination related to historical gold mining and milling activities, a number of studies have also focused on environmental due diligence and determining the types and extent of contamination and the potential for contaminant impacts on local resident marine biota, as well as future cetacean residents of the whale sanctuary. The studies and other documentation that are most relevant to the marine ERA are listed below.

- Information from various site visits and sampling/observation events reported/recorded by WSP personnel.
- Various scientific papers provided by WSP personnel pertaining to potential effects of arsenic on cetaceans and other marine biota, as well as a WSP-prepared evaluation of potential rock crab

consumption (and associated arsenic exposure) by orcas or belugas that may become sanctuary residents.

- Several site maps and figures provided by WSP personnel pertaining to the area of arsenic-impacted marine sediments at the site, and the locations of significant eelgrass presence in the nearshore marine areas of the site.
- Summary information provided by WSP personnel regarding potential presence at the site of rare, threatened, endangered, or 'at risk' species, including species with such status under Nova Scotia and federal SARA (Species at Risk Act) and COSEWIC (Committee on the Status of Endangered Wildlife in Canada) programs.
- Eelgrass survey results conducted/prepared by Dalhousie University personnel.
- Detailed diver surveys and underwater photography and video conducted/coordinated by Whale Sanctuary Project personnel (reported in: Babin, A. 2021. Whale Sanctuary Project – Diver survey results).
- Atlantic Canada Conservation Data Centre (ACCDC). DATA REPORT 6805: Indian Harbour, NS. Prepared: 5-March-2021.
- Flemming, S. 2021. Seabird Abundance and Spatial Use of Port Hilford Harbour, NS. (January-April 2021). Contract Report for The Whale Sanctuary Project. 31-May-2021.
- Webster,T., Crowell, N., Kodavati, D., Dzafovic, S. 2021. Physical Oceanographic study of the proposed Whale Sanctuary site, Port Hilford, NS. Technical report, Applied Geomatics Research Group, NSCC Middleton, NS.
- Webster, T., Crowell, N., Allen, T., Laskey, E., Dzafovic, S. 2022. Whale Sanctuary Project: Port Hilford Hydrodynamic Model. Technical report, Applied Geomatics Research Group, NSCC Middleton, NS.
- WSP Env Monitoring Review and Summary (WSP, 2023) - a compilation of most available environmental data for the site collected by WSP personnel and various contractors, up to but not including the Phase II and III ESAs prepared by Strum Consulting.
- WSP-supplied seawater, marine sediment, and eelgrass tissue chemistry data for select site locations.
- Strum Consulting. 2024a. Phase III Environmental Site Assessment. Proposed Whale Sanctuary Development. 210 Barrachois Road, Wine Harbour, NS. February 28, 2024. (including all seawater, marine sediment and marine invertebrate tissue chemistry data collected to date by Strum Consulting).
- Strum Consulting. 2024b. Wetland Functional Assessment. March 20, 2024. Proposed Whale Sanctuary Development, 210 Barrachois Road, Wine Harbour, NS. Prepared for: Mr. Charles Vinick, The Whale Sanctuary Project. Project # 22-8552.

To supplement the data obtained from the above studies and investigations, focused scientific literature searches were conducted on the topics of: arsenic effects and cetaceans, arsenic effects and eelgrass, and arsenic speciation in marine ecosystems. Various scientific literature databases and search engines were utilized including: U.S. National Library of Medicine Pubmed, Google Scholar, and the various and numerous library databases accessible via Dalhousie University Novanet. The following additional scientific literature databases were also searched, focusing on information pertaining to arsenic uptake and toxicity and arsenic tissue residue effects in marine biota: US Army Corps of Engineers Environmental Residue-Effects Database (USACE ERED; https://ered.el.erdc.dren.mil/), US Environmental Protection Agency (US EPA) ECOTOX Knowledgebase (https://cfpub.epa.gov/ecotox/), and US Army Corps of Engineers (US ACE) Biota-Sediment-Accumulation Factor Database (https://bsaf.el.erdc.dren.mil/).

In addition, a supplementary evaluation to the Phase III ESA involved the submission of five marine sediment samples for arsenic speciation analysis (data are presented in Appendix A). This analysis determined the proportion of total arsenic measured in sediments that is comprised of trivalent inorganic arsenic (arsenite or As (III)), pentavalent inorganic arsenic (arsenate or As (V)), and the common inorganic arsenic metabolites - dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA). DMA and MMA are well known to be formed in numerous taxa via the methylation of inorganic arsenic.

Section 2.1 provides a summary of the key ERA-relevant findings from the various relevant studies conducted at the site.

2.1 Summary of Key Outcomes and Observations from Site Characterization Studies Relevant to the Marine ERA

The following subsections summarize outcomes and observations of the key site characterization studies that are most relevant to the marine ERA and the contaminated sediments near Barachois Cove.

2.1.1 Physical Oceanographic Study Key Outcomes

The Applied Geomatics Research Group (AGRG) from the Nova Scotia Community College (NSCC) was commissioned to collect physical oceanographic data for the site and to develop a hydrodynamic model for the site and surrounding marine areas. AGRG worked with WSP personnel to supply moorings to attach pressure and temperature sensors, collect substrate samples, take photographs, collect tidal current information through variable tidal cycles, deploy an Acoustic Doppler Current Profiler (ADCP) device on the seabed to collect data on waves, water level, and currents for a month, and conduct a multibeam bathymetric survey of the site. The results of the multibeam survey were integrated with spot soundings to build a mesh for the seabed covering the site, Indian Harbour, and the surrounding bays and coastal areas. This mesh was then used to develop a depth-averaged hydrodynamic model to calculate current speeds and flushing time within the harbour. The hydrodynamic model development and outcomes are described in Webster et al., (2022), and methodological details for the physical oceanographic study are described in Webster et al., (2021). Details of these studies are not reproduced herein. Key outcomes and observations (with respect to the marine ERA) from the physical oceanographic study and hydrodynamic modelling effort were as follows.

- The tidal range for the site was approximately 1.4 m during a spring tide, and 1 m during a neap tide.
- Ice charts from the Canadian Ice Service indicated that the site and surrounding bay remain mostly ice-free during winter seasons.
- Sand is the most dominant sediment type at the site and in the vicinity of the site.
- The sand is present throughout the site but rocky reefs and cobble are present at various locations.
- Thick eelgrass beds were detected near Barachois Cove.
- Fucus seaweed was abundant and common along the site shoreline.
- Much of the site contains the presence of various types of submerged marine vegetation (e.g., numerous algal species, eelgrass), with natural patchiness as a function of site hydrodynamics and substrate types and conditions.
- Water depth increases as one moves out from the shore and intertidal areas and towards the outer boundaries of the site.
- Significant wave height in the harbour was close to 90 cm with an average peak period of 9 seconds. During a hurricane event though (Hurricane Teddy - which made landfall near the site on September 22nd and 23rd, 2020), significant wave height reached 3.19 m and peak period reached 18.29 seconds.
- During the hurricane event, ADCP water level and current velocities showed that there was not a significant storm surge associated with Hurricane Teddy, but current velocity increased significantly as the storm system approached the site.
- The currents in Indian Harbour (and the outer portions of the site) generally have a low velocity but current velocities are higher closer to the shore. The mean and maximum current velocity was highest at the mouth of Barachois Cove (maximum of ~0.36 m/s), while mean and maximum current velocities across the rest of the site were lower, and were lowest in the portions of the site with the greatest water depth. Hydrodynamic model results indicated that current speeds in the shallow water plateau within the proposed netted area of the enclosure remain largely stable and under 0.1 m/s in normal conditions and under 0.2 m/s during storm events.
- The hydrodynamic model effort incorporated site bathymetry, various site measurements (water depth, wave action, current velocities and directions, water temperature) photos and video, lidar survey outcomes, and the associated processing and modelling of key hydrodynamic data and parameters (Webster et al., 2022). Extreme weather scenarios and events were also incorporated into the hydrodynamic model. A high-resolution 2D hydrodynamic (HD) model was developed using the DHI Mike-21 software module. The hydrodynamic model was calibrated for several key parameters against measured parameters from the site, and showed good agreement between predicted and measured values.
- Hydrodynamic modelling outcomes showed that the site has a high flushing rate, and is characterized as ‘well flushed’ to ‘very well flushed’. Modelling indicated that the site would be completely flushed within 15 days. Hydrodynamic modelling outcomes also suggest the site is relatively stable and of moderate hydrodynamic energy.

Collectively, the physical oceanographic study outcomes suggest that site physical features and aquatic habitat and substrate conditions are typical for the region. Lack of significant ice suggests limited potential for ice scour of sediments and subsequent potential translocation and resuspension of contaminated sediments. Hydrodynamic measurements and modelling indicate that any contaminants entering the water column of the site would rapidly mix, disperse and dilute in seawater.

2.1.2 Sanctuary Site Bird Surveys

A comprehensive bird survey program was conducted at the site, and in the vicinity of the site, from January to April, 2021. Methodological details of this survey and detailed survey outcomes are presented in Flemming (2021). Key outcomes relevant to the marine ERA were as follows.

- Molluscivorous (invertevorous) birds typically occurred in rafts just offshore of Port Hilford Beach in the inner harbour. Surf Scoters and Greater Scaup often foraged in close proximity to each other. Most of the other invertevorous species frequented the outer harbour. Invertevorous bird distribution includes the area captured by the proposed whale sanctuary. Greater Scaup occurred in the highest densities and abundance relative to other invertevorous birds. Greater Scaup was the most frequently observed bird species at and near the site.
- Port Hilford is the only consistently used overwintering site for Greater Scaup on the northern end of the Eastern Shore, and may also be a migration staging area for this species.
- Other frequently observed invertevorous birds (though less abundant than Greater Scaup) included Surf Scoters, Black Scoters, White-winged Scoters, Common Eider, Long-tailed Duck and Common Goldeneye.
- Piscivorous species occurred in small numbers on most survey days (single birds or pairs of birds usually). Common Loons accounted for most of the observed piscivorous birds. Typically, only a couple of fish-eating birds were observed on most survey days. Red-necked Grebe, Horned Grebe, Black Guillemot, Red-throated Loon, Razorbill, and Common and Red-breasted Mergansers were the other fish-eating birds observed during the survey, but considerably less frequently than the Common Loon.
- All observed omnivorous species were gulls, particularly Herring Gulls and Great Black-backed Gulls. Gulls appeared to forage mostly within the seaweed wrack or on the sandflats areas of the site and surrounding area.
- Observed waterfowl species were mostly American Black Ducks and Bufflehead.
- The regular use of the inner harbour by Greater Scaup and Scoters suggest a high abundance of shellfish and other invertebrate food items. Likewise, bird species assemblages, distribution and abundances within the sanctuary site boundaries also suggest abundant food resources.
- In general, of the observed bird species during the survey, most were invertevorous species, and these types of birds were also the most abundant (present in the largest numbers) during the survey.
- No avian SAR were observed during the days the bird survey was conducted.

- It was concluded that the site and the wider area of Port Hilford Harbour had bird species diversity and abundance that are fairly typical of Atlantic coastal waters of Nova Scotia, and appear to have good and diverse habitat and food resource conditions for these species.
- It was also found that overall bird diversity and abundance was generally higher at Port Hilford Harbour when compared to three other nearby harbours: Country Harbour, Isaac's Harbour, New Harbour.
- Likely because of the ice-free nature of the site and overall Port Hilford harbour, the site and surrounding areas were more consistently used by a variety of bird species throughout the winter than Country, Isaac's or New Harbours, though waterfowl species were more prevalent at these other harbours than at the sanctuary site.

2.1.3 Phase II and III Environmental Site Assessments (Strum, **2023**; **2024**a)

As part of environmental due diligence activities undertaken by the WSP, and given knowledge of former gold mining and milling operations in the vicinity of the site, Strum Consulting (2023; 2024a) conducted Phase II and Phase III Environmental Site Assessments (ESAs) of land-based, freshwater and marine portions of the overall sanctuary properties that will be leased from the Province of Nova Scotia. The Phase II ESA focused on the terrestrial and freshwater portions, while the Phase III ESA expanded on the Phase II ESA and also included a marine water, sediment and invertebrate tissue sampling program. Key findings (in relation to the marine ERA) from the Phase II and III ESAs are summarized below.

- Land and shoreline drainage patterns and groundwater flow direction were found to occur west to east and towards the marine receiving environment.
- The Phase II ESA (Strum, 2023) identified soil and groundwater metal and metalloid contamination that was attributed to the historical gold mining/milling activities. The highest reported metal and metalloid levels (primarily arsenic) were found to occur in the area of the former gold stamp mill to the south/southeast of the former tailings pond. Many of the collected soil, groundwater, freshwater surface water (including wetland areas), and freshwater sediment samples (including wetland areas) contained metals and metalloids (again, primarily arsenic) at concentrations exceeding applicable Tier 1 NSECC environmental screening levels (ESLs). However, not all exceedances are considered to be due to former gold mining and milling activities. Some may reflect naturally elevated levels of certain metals and metalloids that are commonly associated with gold-bearing mineralogy.
- As the highest levels of gold mining/milling-associated contaminants were found close to the marine shoreline, the Phase III ESA included the objective of determining sediment, surface water and marine invertebrate contaminant concentrations in the proposed whale enclosure area and adjacent to the wharf. The Phase III ESA also further assessed the former tailings pond and wetland areas near the pond, delineated soil contamination impacts, and collected additional groundwater chemistry data.
- For the marine site, the key Phase III ESA activities included the following. Methodological ESA details (including surface water, sediment and marine invertebrate sampling protocols) are provided

in Strum (2024a) and are not reproduced herein. All sampling protocols used were confirmed as being standard methodologies/approaches for the collection of these types of samples.

- Collection and laboratory submission of 33 marine sediment samples (including field duplicates) across the proposed whale enclosure area, along the site shoreline, and adjacent to the wharf structure. Marine sediment samples were collected on July 24/25 and December 14, 2023, by divers (Connors Diving Services).
- Collection and laboratory submission of 21 marine surface water samples (collected July 24th and 25th, 2023), from the whale enclosure area and along the site shoreline. Deeper surface water samples were collected by divers approximately six inches above the seabed, while shoreline surface water samples were collected by a Strum field technician.
- Collection and laboratory submission of 59 marine benthic invertebrate tissue samples (collected on July 24th and 25th, 2023 by divers). To meet analytical sample volume/mass requirements, tissue samples were combined into six total composite samples based on sampling location and species type. The invertebrate species that were sampled were: Atlantic rock crab (*Cancer irroratus*), blue mussel (*Mytilus edulis*), and Atlantic soft-shell clam (*Mya arenaria*).

- All collected marine water, sediment and biota samples were submitted to BV analytical laboratory and were analyzed for various parameters, including metals and metalloids, cyanide, petroleum hydrocarbons and methylmercury (analyzed for in select marine invertebrate samples only). Appendix A presents figures from Strum (2024a) that show surface water, sediment and marine invertebrate sampling locations.
- Key outcomes and observations of the Phase III ESA that pertain to the marine site were as follows:
  - Marine surface water samples did not exceed applicable CCME marine water quality benchmarks with the exception of one sample containing total mercury at a concentration (i.e., 0.017 µg/L) slightly higher than the CCME marine water quality guideline value (0.016 µg/L). This measured concentration is also only marginally higher than the RDL for mercury in seawater (i.e., 0.013 µg/L). However, as no other surface water samples exceeded the water quality benchmark, and given that the sample with the exceedance (SW-E-4) was collected by Barachois Island away from the site shoreline and former stamp mill location, the measured concentration of mercury in this sample was considered by Strum to be naturally occurring and not related to former gold mining/milling activities.
  - Marine sediment samples displayed exceedances over the CCME Probable Effect Level (PEL) marine sediment quality guidelines mostly in the shoreline area east of the former tailings pond, wharf and former stamp mill location, on the southwest side of the proposed whale enclosure area. Sediment quality guideline exceedances were primarily due to arsenic concentrations in this portion of the site, though sediment zinc concentrations also exceeded the CCME PEL in several site sediment samples. However, Strum (2024a) noted that sediment zinc concentrations were unlikely to be attributed to former gold mine/mill operations given the measured concentrations, and the locations and distribution pattern of elevated zinc concentrations. Strum concluded that sediment zinc concentrations at the site are likely naturally occurring and likely do not pose a potential ecological risk. Arsenic PEL exceedances in site sediments were localized

to the areas immediately adjacent to the former tailings pond and stamp mill locations and also correspond to the identified arsenic groundwater plume from the land-based portions of the site.

- Sediment core logs (from Shelby tube samples) indicated that the sampled sediments are characterized as silty or clayey sand, depending on the sample location.
- Strum (2024a) compared marine invertebrate tissue sample data to Health Canada food safety guidelines. However, these guidelines are not valid or appropriate for ERA purposes and exceedances over these guidelines are not considered herein. The marine ERA identifies more appropriate ecological health-based tissue residue benchmarks for the species that were sampled.
- Strum also compared marine invertebrate tissue sample data for methylmercury to the applicable CCME tissue residue guideline. Two rock crab composite tissue samples exceeded this guideline, while the mussel composite sample did not. Due to limited sample volume, the clam composite tissue sample was only analyzed for total mercury and was not compared to the CCME tissue residue guideline for methylmercury. Strum (2024a) noted that the apparently elevated methylmercury as well as arsenic concentrations in the rock crab composite samples may not necessarily reflect an influence of former gold mining and milling activity, as rock crabs are mobile and arsenic is well known to be naturally enriched in bedrock, soils and sediments where gold deposits occur.

Appendix B of this ERA report provides summaries of analytical marine surface water, sediment and invertebrate tissue data collected by Strum for the Phase III ESA. Some additional marine media data collected by WSP personnel prior to the Phase III ESA are also included in these data summaries. Appendix B also provides copies of arsenic sediment quality guideline exceedance figures from Strum (2024a). Laboratory certificates of analysis for the Phase III ESA are also provided in Appendix B.

The following recommendations were made in the Strum (2024a) Phase III ESA report given the outcomes and observations of the ESA.

- While the marine sediment arsenic impacts are delineated (to the CCME PEL) horizontally, it was recommended that further sediment sampling could focus on vertical delineation to determine the thickness of the arsenic-impacted sediment layer. [However, it is the opinion of Dillon's ERA professionals that current sediment chemistry data are sufficient for ERA purposes as the data are surficial and reflect potential arsenic exposures to the majority of infaunal and epibenthic species that are resident in the site sediments, as well as to consumers/predators of benthic species. At this time, vertical delineation of arsenic in sediments is only deemed necessary if the outcomes of the marine ERA herein suggest a need for sediment remediation (such as dredging), whereupon it would become necessary to determine the vertical extent/depth of arsenic impacts prior to the design of a dredging program].

- A marine ERA was recommended to determine if the arsenic-impacted sediments pose an ecological risk to resident marine biota and to the whales that will be sanctuary residents. It is noted that potential arsenic exposures and risks to whales are also being evaluated independently by WSP personnel.
- Though not directly related to the marine ERA herein, Strum also recommended additional groundwater monitor well installation to delineate groundwater metals impacts, additional collection of wetland (freshwater) sediment and surface water samples south of the former tailings pond, and development of a soil and groundwater risk management/remedial plan for the land-based portions of the WSP properties, to guide construction and development plans for sanctuary project land-based facilities and infrastructure.

2.1.4 Diver Survey Outcomes and Observations

The results of the nearshore diver surveys are reported in Babin (2021). Information obtained from the surveys that is relevant to the marine ERA is summarized below. A comprehensive visual diver survey of the site was conducted on July 24th and 25th, 2021, and included surveying of 30 quadrats located along 10 transects. The survey extended roughly 100 m out from the shoreline.

- Across the transects and quadrats that were surveyed, the marine substrate conditions were variable, but the substrate is mainly (predominantly) sand, with widely varying sizes and percent coverage of cobble and boulders and gravel. Silt, clay and mud were also observed to varying degrees at many locations but in much lower proportions than sand. Particle size analysis conducted on select marine sediment samples from the site (reported in WSP, 2023) also indicate that sand dominates the sediment substrate type, relative to silt, clay and gravel/cobble.
- Numerous marine fauna and flora were observed during the diver surveys, and included many common and expected species and/or assemblages for the region of NS that the site is located in. The observed species varied in abundance (as expected) as a function of substrate conditions. Though not a conclusion reported in Babin (2021), review of diver survey outcomes and observations by Dillon ERA personnel determined that marine fauna and flora observations at the site do not suggest impairment of any observable ecological community or assemblage, even in the portions of the site which display the highest sediment arsenic concentrations.
- The types of marine species observed during diver surveys included but were not necessarily limited to: amphipods, clams, barnacles, various seaweed/rockweed algal species (mostly brown algal species), red algal species (including Irish moss and various Coralline algal species), various crab species, green algal species, various other types of algal species, various finfish (most not able to be identified conclusively, but rock gunnel and possibly smelt were observed), hydroids, various annelid worms, isopods, limpets, periwinkles, occasional lobster, mussels, sculpin, mysid shrimp, whelks, hydrozoans, various snails, eelgrass, tunicates, bryozoans, and cordgrass (in the intertidal zone only).
- Species (or genus) richness and abundance estimates are provided in the diver survey notes reported in Babin (2021). Species richness was reported to range from 57 to 63 for the observed quadrats and transects.

2.1.5 Whale Sanctuary Project (2023) Environmental Monitoring Data Compilation

A summary of ERA-relevant data reported in this compilation that was not reported in other available documentation for the site, follows.

- The report presented various references and values for typical seawater and sediment concentrations of metals and metalloids. However, for typical or background seawater metal and metalloid concentrations, the ERA herein uses a consistent and reputable source of such data that differs from some of those that were utilized in the WSP, 2023 compilation report (i.e., Periodic Table of Elements in the Sea, which compiles data for all elements in the periodic table from the CRC Handbook of Chemistry and Physics; https://www.compoundchem.com/wp-content/uploads/2019/12/14-Periodic-Table-of-Elements-in-the-Sea.pdf). In many cases though, the values presented in the WSP compilation report were similar to those presented in the Periodic Table of Elements in the Sea.
- The Centre for Marine Applied Research monitored the site and surrounding area from 2018 to 2020 and collected information on dissolved oxygen. The data showed that the seawater at and near the site was typically fully saturated with oxygen (>100%).
- Low to non-detectable levels of *E. coli* colony-forming units (CFUs) were consistently measured during monitoring activities. CFU measurements were generally within the applicable human health-based criteria for recreational waters. There are no ecological health-based criteria for *E. coli* or any other bacterial pathogen.
- While not directly relevant for the marine ERA, 2020 freshwater invertebrate sampling near the site had relatively high abundance of EPT taxa (i.e., Ephemeroptera, Plecoptera and Tricoptera, which are sensitive orders of freshwater aquatic insects), suggesting that the locations sampled are not displaying benthic impairment despite elevated concentrations of arsenic and some other contaminants in freshwater sediments.
- Marine plankton surveys and sampling events at and near the site occurred from 2020 to the summer of 2022. It was found that numerous planktonic species as well as planktonic life stages of various other marine species were present. The species and assemblages observed are commonly found in western Atlantic waters and would be expected to be found at or near the site at the times of year that the sampling occurred. Most of the observed plankton species are present near the site year-round with seasonal abundances varying as a function of life cycles and nutrient availability. The plankton survey observations were not suggestive of impairment of planktonic species or assemblages at the site or near the site. Rather, plankton survey observations did not reveal any unexpected findings or significant differences from the expected presence, abundance and diversity of such species.
- A visual benthic survey was conducted on September 9th, 2020 by AGRG and the WSP. This survey consisted of 30-60 second photo/video drops (involving a PVC frame with multiple go-pro cameras) and sediment collection at 15 sample points scattered throughout the sanctuary site. The videos were analyzed to identify different substrate types, as well as the identification of any flora and fauna observed. It was found that the substrate type at the 15 sample points was generally sand

with some mud and varying presence of rocks, cobble, rockweed and eelgrass. Resolution of flora and fauna in the videos was not as detailed as the identification of flora and fauna from the diver surveys, but observed species and assemblages were consistent with those observed during the diver surveys.

- To supplement the identification of species occurring within the proposed area of the sanctuary, a desktop inventory of species found in the marine, freshwater, and terrestrial environments that inhabit or visit the sanctuary area and its vicinity, was compiled from a number of information sources, including various federal and provincial databases and reports and websites, various global inventory databases, as well as selected relevant literature (all reported in WSP, 2023). A total of 3468 species were identified as potentially occurring within the site or in the vicinity of the site.

2.1.6 Strum (2024b) Functional Wetland Assessment

Strum (2024b; in progress) is currently conducting a functional wetland assessment of terrestrial portions of the site that will be developed for whale sanctuary facilities and infrastructure. This assessment is occurring under separate cover and under a separate scope of work from the marine ERA. For the identified wetland areas, the draft wetland functional assessment to date indicates a generally high level of functionality and/or ecological service provision for WL1 and WL2, with a smaller more brackish WL3 being assigned a moderate level of functionality and/or service provision.

The draft outcomes of the wetland function assessment suggest that the wetlands near the shoreline may have helped mitigate some of the impacts of former gold mining activities, as wetlands are well known to be able to sequester inorganic contaminants and reduce their bioavailability to aquatic and terrestrial organisms as a function of high organic matter and organic carbon content in wetland water and soil/sediments, as well as by wetland vegetation uptake of aqueous and sediment-associated contaminants.

2.1.7 Arsenic Speciation in Site Sediments

As a supplementary evaluation to the Strum (2024a) Phase III ESA, five marine sediment samples from the site underwent arsenic speciation analysis. The samples were submitted to Brooks Applied Labs on January 22, 2024. The laboratory certificate of analysis noted that the sediment samples were received at a temperature slightly higher than the analytical method stipulates (i.e., the laboratory strongly recommends that all samples submitted for arsenic speciation analysis remain at a temperature of ≤ 6°C to maintain sample integrity prior to analysis). The five sediment samples had a temperature of 7.5°C when received by the laboratory. Consequently, the speciation results were qualified (Z), indicating that the samples were received above the recommended temperature. However, this is not expected to significantly affect the speciation results obtained for the submitted samples.

The five sediment samples were analyzed for trivalent inorganic arsenic (As(III)), pentavalent inorganic arsenic (As(V)), DMA, and MMA. It is well established that these are the main arsenic species that occur in sediments. It is also well established that virtually all of the arsenic present in sediments (and soils as well) occurs as inorganic forms, where the relative proportions of the inorganic species vary as a function of redox, pH and various other sediment and soil factors and conditions. Laboratory QA/C metrics for these samples noted a few issues (e.g., laboratory duplicate imprecision where relative percent difference targets were not met; matrix spike samples having an arsenic recovery below the acceptance limit - possibly due to oxidation of As(III) to As(V) during sodium phosphate extraction which may slightly bias high the measurement of As(V) in the affected sample (SED-G-6-S1)). Despite the noted laboratory QA/QC items, the analytical results for sediment arsenic speciation were considered a reasonable representation of the arsenic species present in site sediments.

Table 2-1 summarizes the site sediment sample arsenic speciation results.

Table 2-1: Site Sediment Sample Arsenic Speciation Analytical Results (mg/kg dw).

Sample ID	Arsenic Species Concentrations (mg/kg dw)				
	As(III)	As(V)	DMA	MMA	% As(V) of Total Quantified As Species (assuming <RDL values = RDL)
SED-G-1-S1	0.873	53.1	0.019	<0.013	98.32%
SED-G-2-S1	0.63	20.2	<0.006	<0.012	96.89%
SED-G-4-S1	0.841	3.64	<0.006	<0.01	80.94%
SED-G-5-S1	0.323	2.56	<0.005	<0.009	88.37%
SED-G-6-S1	0.053	2.12	<0.005	<0.009	96.94%

In all five site sediment samples, the dominant arsenic species was As(V). Much lower and minor amounts of As(III), MMA, and DMA (the latter two being common products of inorganic arsenic metabolism by biota) were present in the site sediment samples. As shown in Table 2-1, the percent of As(V) (out of total arsenic) ranged from roughly 81% to 98%, with an average As(V) content across the five submitted samples of 92%. Though not quantified, the laboratory noted traces of additional unidentified arsenic species in the submitted site sediment samples.

The observation of arsenic speciation in site marine sediment samples being dominated by As(V), is a common finding when marine sediments undergo arsenic speciation analysis. A number of other studies have also found that the dominant arsenic species in marine sediments is As(V), (e.g., Park et al., 2019; Rattanachongkiat, 2004; Kalia and Khambholja, 2023; Zhang et al., 2017; Zhang et al., 2021). Of the species measured in site sediment samples, the most toxic form of arsenic (i.e., As(III); ATSDR, 2007) is present in low to trace amounts. This is also commonly observed in other marine sediments that have undergone arsenic speciation analysis (Kalia and Khambholja, 2023).

2.1.8 Eelgrass Surveys and Analyses

The eelgrass surveys conducted by Dalhousie University, and diver surveys of the site, both observed eelgrass beds between the wharf and Barachois Island, on both sides of the boat channel. The eelgrass beds on either side of the boat channel connect at some locations. Figure 2-1 shows what the surveys classified as western and eastern eelgrass beds.

Figure 2-1: Site Locations of Western (light green) and Eastern (dark green) Eelgrass Beds.

The western eelgrass bed has an approximate area of 21,863 m^2, and the eastern eelgrass bed has an approximate area of 13,341 m^2.

Both the western and eastern eelgrass beds are present within the vicinity of the arsenic-impacted sediment area. In fact, eelgrass bed presence is significant and abundant in the areas of the site that display the highest sediment arsenic concentrations. Figure 2-2 shows additional eelgrass delineation for the site, and Figure 2-3 shows the same eelgrass delineation along with the areas of the site with the highest sediment arsenic concentrations.

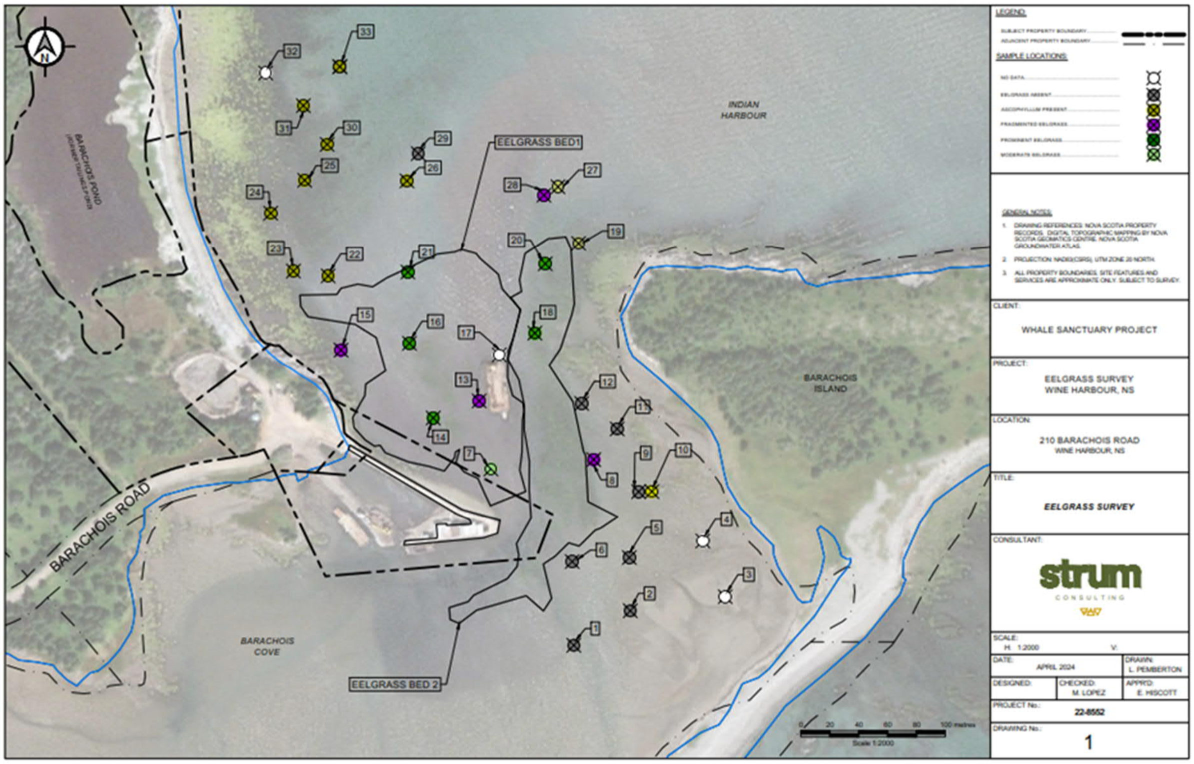

Figure 2-2: Eelgrass Delineation for the Site (Strum, 2024a).

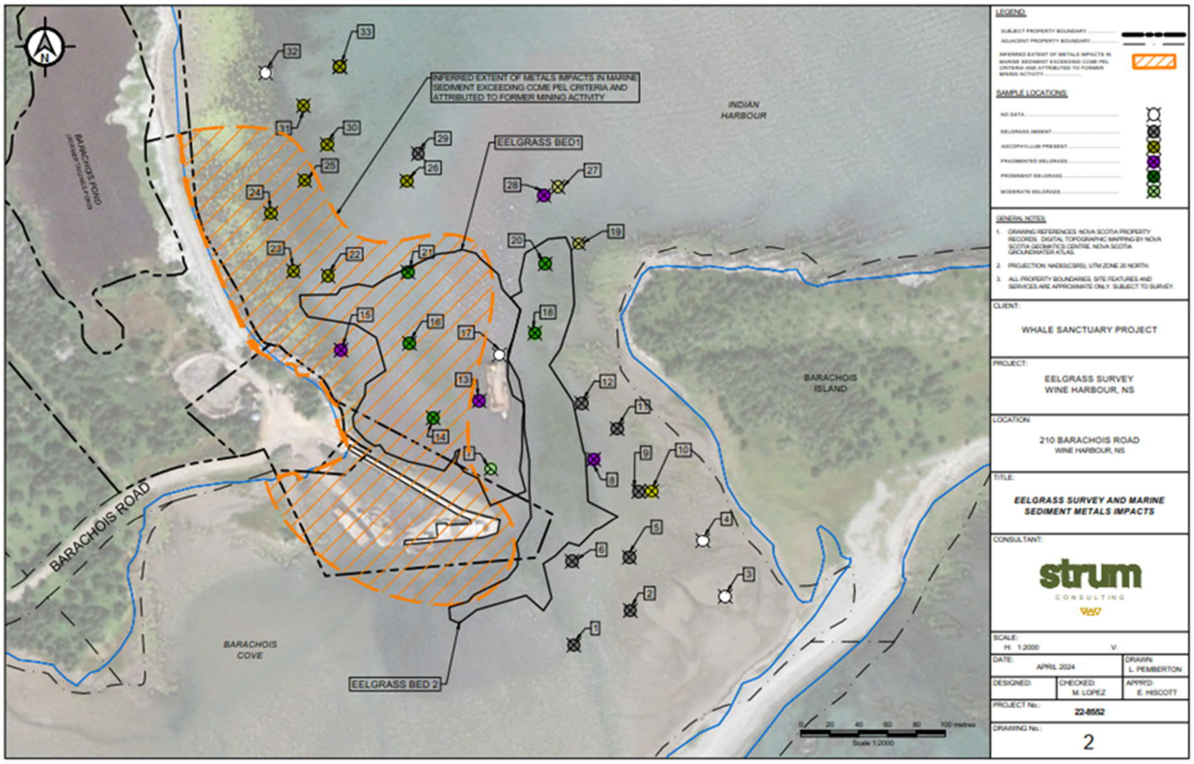

Figure 2-3: **Site Eelgrass Delineation with Site Sediment Arsenic Impacts (Strum, 2024a).**

It is acknowledged that eelgrass meadows and beds are recognized as important marine habitat in Atlantic Canada, and disruption of eelgrass habitat is generally discouraged unless absolutely necessary. Thus, should ERA outcomes determine that site sediments require remediation (e.g., dredging, capping), consultation with and approval from, DFO, NSECC and NSNRR would likely be required.

Given marine substrate and hydrodynamic differences, eelgrass is of low abundance along the 470 m of western shoreline north of Barachois wharf to Rocky Point.

In early June of 2024, WSP personnel conducted an eelgrass tissue sampling and analytical program to determine arsenic (and other metals/metalloids) uptake into eelgrass from impacted site sediments. Seven samples of eelgrass leaves and roots (six from the site and one reference location) were collected, along with root zone sediment samples from each eelgrass sampling location. Tissue analysis (roots and leaves) and root zone sediment samples were analyzed by BV laboratory. As eelgrass may be consumed by some resident marine biota, it was important to collect site-specific data on the relationship between eelgrass contaminant concentrations and eelgrass root zone sediment contaminant concentrations. Further details of this program are provided in Appendix C.

3.0 Ecological Risk Assessment Framework

Ecological risk assessments (ERAs) can involve various levels of detail, complexity, and effort. The initial ERA framework developed by Environment Canada (CCME, 1996) reflects this in its tiered approach, where each successive tier is sequentially more detailed than the previous one, with assessment characteristics ranging from a simple, qualitative and literature-based approach for the first tier (often termed Screening Level Assessment) to complex, predictive and field-based approaches for the second and third tiers (often termed Preliminary Quantitative and Detailed Quantitative Assessments, respectively). While moving from one tier to the next increases the complexity and effort of the ERA, this is typically only required if the results of the previous tier indicate that a more complex and detailed assessment is warranted. The more recent ERA guidance endorsed by Environment Canada for use on federal contaminated sites (i.e., FCSAP, 2012a) does not categorize ERAs according to scope or level of detail/effort (e.g., screening level versus detailed quantitative). Rather, the FCSAP (2012a) ERA guidance suggests that the level of detail and effort for an ERA is dependent on many factors and is often site and assessment-specific. This guidance also recognizes that the level of detail and effort in an ERA may involve a combination of qualitative screening level and quantitative approaches, depending on the chemicals and receptors that are selected for assessment, as well as spatial and temporal factors or boundaries that are associated with the ERA.

In general, if the use of conservative assumptions related to both chemical exposure and toxicity to ecological receptors (as would be commonplace in an initial tier of an ERA) indicates a low potential for ecological risks, there is typically a high degree of confidence in this finding, such that areas and/or receptors with a low risk potential may be excluded from further investigation. However, in situations where the initial tier of an ERA indicates an elevated potential for ecological risk, or identifies key data gaps that preclude the completion of an ERA, further data collection is typically required and/or more detailed ERA approaches are typically applied (i.e., those that are less conservative but more realistic or site-specific).

The current marine ERA is conducted at a combined screening level to detailed quantitative level.
The specific steps used to conduct the ERA are consistent with FCSAP (2012a) and are illustrated in Figure 3-1.

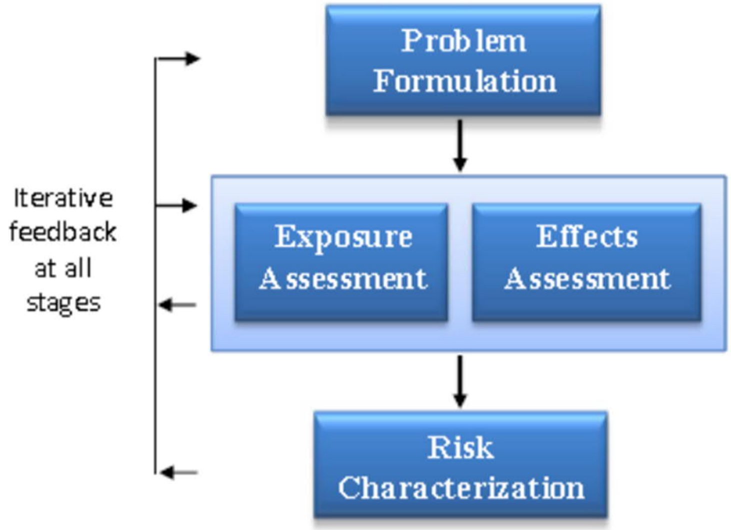

Figure 3-1: Ecological Risk Assessment Steps (FCSAP, 2012a).

Each step is briefly described below, with further details and outcomes of each of these steps being provided in subsequent sections.

3.1 Problem Formulation

The problem formulation step of an ERA acts as an information-gathering and interpretation stage, which serves to plan and focus the approach of the ERA on the most critical areas of concern for the site being evaluated. There are several elements or tasks that comprise problem formulation in an ERA, including:

- site characterization and review of existing site information;
- review of regulatory context;
- establishing the objectives, goals and scope of the ERA;
- selection of study area and reference areas;
- identification of receptors of concern (ROCs);
- identifying assessment and measurement endpoints;
- developing lines of evidence (LOE);
- identification of exposure pathways;
- identification of chemicals of (COCs); and
- developing a conceptual site (exposure) model for the ERA.

The outcomes of these tasks form the basis of the approach taken in the ERA. The outcomes of the various problem formulation tasks can also help identify key uncertainties and data gaps that may limit aspects of the ERA, inform sampling and analytical plan development, and help determine whether or not there is a need to further evaluate certain areas of a site, receptor types, exposure pathways and site-related chemicals.

Methods and outcomes of the problem formulation step of the marine ERA are provided in Section 4.0.

3.2 Exposure Assessment

The exposure assessment step of an ERA involves estimating the amount of a chemical contaminant that is potentially received by each selected ecological receptor or receptor group. For quantitative assessments, exposures are generally estimated using key receptor physiological and ecological characteristics and parameters (e.g., body weight, diet proportions, food intake rates, energy utilization, home ranges, amount of time spent in study area, etc.). For more qualitative (or screening level) assessments, receptor exposures are often assumed to be equal to measured media concentrations (e.g., sediment concentrations are assumed to represent exposure concentrations for benthic invertebrates).

Methods and outcomes of the exposure assessment step of the marine ERA are provided in Section 5.0.

3.3 Effects Assessment

Also called hazard or toxicity assessment in some jurisdictions, this step identifies toxicity reference values (TRVs) or other types of toxicity benchmarks for each receptor or receptor group evaluated, for each chemical identified as being of concern (i.e., chemicals of concern, or COCs).

Methods and outcomes of the effects assessment step of the marine ERA are provided in Section 6.0.

3.4 Risk Characterization and Uncertainty Assessment

Risk characterization typically involves the evaluation and interpretation of each LOE considered in the preceding steps of the ERA. This is done using a WOE approach to make conclusions on the probability and/or potential magnitude of ecological risk. Consideration of the various uncertainties, limitations and conservative assumptions within the ERA is also an important consideration in ecological risk characterization. The outcomes of risk characterization may lead to additional media or biota sampling, other additional site characterization activities, further or supplementary ERA, and/or risk management recommendations or corrective remedial action.

Methods and outcomes of the risk characterization and uncertainty assessment step of the marine ERA are provided in Sections 7.0 and 8.0.

4.0 Problem Formulation

Methods and outcomes of the ERA problem formulation step are provided in the following subsections.

4.1 Site Characterization and Review of Existing Studies

Site characterization details and a summary of previous studies conducted in relation to the marine environment at the WSP site are previously provided in Sections 2.0 and 2.1. Select photos of the site and the surrounding ecological habitat are provided in Appendix D.

4.2 Regulatory Context

Given that the source of the contamination in the marine environment at the WSP site originates from NS provincial lands, and that the project is currently undergoing assessment through the NS provincial review and permitting process, the established standards for NS Department of Environment and Climate Change contaminated sites were preferentially applied (NSECC, 2022). Relevant standards for this marine ERA included the NS Pathway Specific Standards (PSS) for marine sediments and surface water. NSDECC has adopted environmental quality benchmarks derived by the CCME, and other regulatory authorities in Canadian or international jurisdictions as their contaminated sites standards. The sources for the NS PSS were reviewed to ensure the NS PSS guideline referenced was the most recent applicable guideline from the original source. Where no NS PSS was identified, other provincial or federal regulatory benchmarks were used, where available.

Nova Scotia has no established ERA guidance framework; thus, Canadian federal ERA guidance and approaches were utilized (i.e., FCSAP, 2012a and associated modules and supporting documentation).

4.3 ERA Objectives, Goals and Scope

Overall objectives of the ERA are previously provided in Section 1.1.

In many ERA frameworks, it is common to establish management and assessment goals for the ERA of a given site. The FCSAP ERA guidance (FCSAP, 2012a) defines a site management goal as the overall planning objective for a site, which provides a statement about the desired condition of an ecosystem, or its components, within the context of current or future site use. The site management goal for this ERA was to: *determine whether or not marine environmental media at the site warrants risk management for the protection of ecological receptors that may occur on and/or utilize the site (including whales that will become sanctuary residents).*

The assessment goal for an ERA relates to the management goal. In the current ERA, the assessment goal was to: *determine if there are potential ecological risks associated with current site conditions, and* *if so, determine what (if any) management or remedial action is needed to reduce potential ecological risks.*

The scope of the ERA presented herein is limited to the marine media on the site. The scope of the ERA is also limited by the chemistry data that are currently available for site media and biota (i.e., sediment, surface water, marine invertebrates, eelgrass). The ERA herein does not evaluate or consider potential exposures and risks to ecological receptors that may occur on adjacent properties or water lots, nor does it consider terrestrial or freshwater environments.

4.4 Selection of Study Area and Reference Areas, and Spatial and Temporal Boundaries

The spatial boundary for the marine ERA is the marine portions of the WSP sanctuary site, as shown previously on Figures 1-1 and 1-2. As noted previously, land-based portions of the leased areas that will accommodate various WSP facilities and infrastructure, and nearby freshwater features, are not within the scope of the ERA. Temporal boundaries for the marine ERA are current site conditions, where it is assumed that future site conditions are essentially equivalent to current site conditions.

No specific reference areas were selected for the ERA. Where/if necessary, regional reference chemistry data were considered, as were general data on typical levels of metals and metalloids in sea water.

4.5 Identification of Receptors of Concern (ROCs)

A receptor of concern (ROC) is any non-human individual, species, population, community, habitat or ecosystem that is potentially exposed to COCs (FCSAP, 2012a). Consideration of potential ROCs for an ERA is inherently study area or site-specific and must reflect an understanding of the specific ecological attributes of the area being investigated. For example, a location that offers limited or no habitat or food resources for ecological receptors likely does not merit an ERA study. The identification of ROCs is not limited to those that only occur within a given study area of interest, but also considers receptors that may utilize the area for foraging, breeding, nesting, resting and other aspects of their life history.

For the purposes of ERA, it is neither practical nor necessary to assess each and every species that may potentially occupy or utilize a given area. Instead, it is common practice to identify a selected subset of species as the ROCs for the assessment. There are many considerations when identifying ROCs for an ERA, which include the following, if/as applicable:

- General site or study area characteristics (e.g., surface coverings, substrate types, habitat types present, observed species) as determined from environmental investigations;
- Representation from the various trophic levels, habitats, and feeding guilds that are appropriate for the study area or site;

- Behavioural and physiological characteristics that would increase or decrease the potential for chemical exposure (e.g., diet and habitat preferences, feeding behaviour, home/foraging/breeding ranges, mobility, body weights, etc.);
- Habitat quality, suitability and preferences for receptors that may occur within or utilize a study area or site (e.g., does the area or site meet habitat requirements or preferences for receptors of interest?);
- Likely percentage of time spent within potentially impacted areas of a site or study area, and likely fraction of diet obtained from these areas;
- Whether species of interest in relation to a site or study area are resident biota or migratory (and other seasonal factors);
- The availability of biological/ecological data describing receptor characteristics, life history and behaviour for the study area or site;
- The physical-chemical, environmental fate/behaviour, and toxicological properties of COCs (such as persistence and potential to bioaccumulate and/or biomagnify in terrestrial and/or aquatic food webs; known sensitivity of certain wildlife species to certain chemicals);
- Availability of reliable ecotoxicological data for the receptor or receptor group;
- Availability of appropriate measurement endpoints for a ROC;
- Availability of regional and/or local habitat surveys or species inventories;
- Potential or documented presence of species that are at risk (e.g., listed as rare or endangered), or have some similar status within provincial jurisdictions);
- Socioeconomic considerations (such as: is a species commercially important? Is a species valued by humans, or is it considered a pest or invasive?);
- Availability of information from local experts and residents of the area;
- Study area surveys or reconnaissance to visually confirm habitat types, exposure pathways, and the potential for certain wildlife species to be present; and,
- Professional judgment.

The key outcome of the ROC identification step is the consideration of all relevant receptor types that could potentially be included in the ERA, along with rationale or justification for why certain receptor types are included or excluded from the ERA. This is often presented as a tabular or matrix format. Ideally, the ROCs selected for an ERA will be those that occur within/on the study area/site (or would be expected to utilize the area/site on a regular basis), have a high exposure potential to COCs in study area/site media, and/or have a known sensitivity to one or more COCs. When the selected ROCs meet these general conditions, the likelihood for the occurrence of adverse effects in less exposed or less sensitive receptors would be lower than for the assessed receptors.

The level of biological organization at which a ROC is evaluated in an ERA is an important concept that links closely with ecological protection goals for the ROCs. For lower trophic levels, such as aquatic vegetation, benthic invertebrates, and pelagic aquatic life (e.g., fish, invertebrates), the level of biological organization that is evaluated in an ERA is generally community level (FCSAP, 2012a; Suter et al., 2000). The community level is also considered the relevant level of biological organization when a receptor group has limited ecotoxicity data available (e.g., amphibians and reptiles). For higher trophic level receptors (such as birds and mammals), the ROCs are usually evaluated at the population level[1] of biological organization. The individual organism level of biological organization is typically evaluated in an ERA only if the ROC is a rare, threatened or endangered species (FCSAP, 2012a; Suter et al., 2000). In the current ERA however, future sanctuary residents (whales) represent a unique exposure scenario and as such, whales are considered as individuals rather than as populations or some other grouping.

Thus, for most ROCs assessed in an ERA, the relevant level of biological organization is either community or population. The ecological protection goals for ROCs are the same in that the general goal of an ERA is to protect most ROCs at the population or community level (unless there is evidence that the ROCs being evaluated are rare, threatened or endangered, or listed as “species at risk” under SARA, or there are other conditions or scenarios that would lead to certain receptors of interest being assessed as individual organisms). As such, in most ERAs, the focus is not on protecting individual organisms or even groups of individuals (such as breeding pairs) that may occur within a given study area. Rather, the ecological protection goal is typically focused on maintenance of local populations of the ROC (or its surrogate), or maintenance of community ecological structure and function.

The selection of ROCs for the ERA was facilitated to some degree by review of the following documents and information resources:

- Results of the seabird observation report: “Overwintering Seabirds of Port Hilford Harbour – Whale Sanctuary Project” (Flemming, 2021);
- Results of the diver surveys (Babin, 2021);
- Strum (2024a) Phase III ESA;
- US EPA (1993) Wildlife Exposure Factors Handbook;
- FCSAP Ecological Risk Assessment Guidance and associated technical modules; and,
- Various other site characterization documents and reports described in **Section 2.0**.

[1] In the ERA context, the definition of a “population” can vary, and as such, very few ERA guidance documents define this term. In general, a population is a group of individuals of the same species that live together and breed amongst each other. Setting numerical limits on the number of individuals that comprise a population is inherently difficult and would vary greatly depending on the receptor species and its life history characteristics.

Table 4-1 provides the ecological receptors and receptor groups that were considered for selection as ROCs for the ERA, along with rationale for their inclusion/exclusion. Surrogate receptor species are also provided in Table 4-1, where relevant. As noted in FCSAP (2012a) and CCME (1996), surrogate receptor species are used to represent particular feeding guilds or ecological niches, and are selected based on many of the same considerations used to identify ecological ROCs (as noted above).

Table 4-1: Ecological Receptors Included For, and Excluded From Evaluation in the Marine ERA.

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Marine Pelagic Aquatic Life	Exclude	Not applicable	Marine pelagic aquatic life play an important role in the marine ecosystem in nutrient cycling and are a source of food for many marine wildlife species. Marine pelagic aquatic life is in constant direct contact with surface water and have a high exposure potential to COCs that may be present in site surface water. However, as discussed in Section 4.8.2, there were no COCs identified in site surface water. For this reason, marine pelagic aquatic life was not carried forward as a ROC in the ERA.
Marine Benthic Aquatic Life	Include	Not applicable; assessed at the community level	Marine benthic aquatic life play an important role in the marine ecosystem in nutrient cycling and are a source of food for many marine wildlife species. Marine benthic aquatic life is in constant direct contact with sediments and have a high exposure potential to the COCs identified in site sediments.
Marine Vegetation	Include	Not applicable; assessed qualitatively at community level	Marine vegetation (such as eelgrass, algae, rockweed, seaweed, etc.) is abundant at the site and along the site shoreline. Marine vegetation could be exposed to the COCs identified in site sediments.

Receptor Groups		Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Marine Feeding Birds (Including waterfowl)	Piscivorous	Exclude	Not Applicable	While fish at the site could be exposed to contaminants in sea water and sediments, and could potentially accumulate contaminants in their tissues such that piscivorous birds could become exposed to site contaminants by ingesting fish, this receptor group is excluded from the ERA for the following reasons: -there are currently no fish chemistry data available for fish species that occur at the site. -fish are mobile and are unlikely to incur significant COC exposure from the localized area of sediment impacts at the site. -no COCs were identified for marine pelagic aquatic life (which includes fish) in site sea water, which would be the primary exposure medium for most fish. -piscivorous bird presence at the site was noted to be limited during the bird surveys conducted by Flemming (2021); piscivorous birds were generally observed rarely and in small numbers when observed; piscivorous bird observations amounted to a few (at most) individuals, not populations. - the Common Loon was the most frequently observed (albeit in small numbers) piscivorous bird species; loons are migratory and would only be at the site on an occasional basis given consideration of their ecology, life history and seasonal feeding and habitat preferences . -other bird piscivores were observed rarely and in low numbers when observed (Flemming, 2021).

Receptor Groups		Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
	Invertevorous	Include	Greater Scaup (*Aythya marila*)	Marine benthic invertebrates at the site may be exposed to COCs in site sediments. Invertebrate tissue data for the site shows accumulation of arsenic and methylmercury in some species of site benthic invertebrates. These benthic marine invertebrates could be ingested by invertevorous birds. Invertevorous species of birds were observed during bird surveys conducted during the Winter and Spring of 2021 in great abundance and often at high densities at the site, and include Greater Scaup, various Scoter species and others (Flemming, 2021). Greater Scaup were the most abundant and highest density of the invertevorous birds observed, followed by surf scoter. Both species frequently were present as 'rafts' of dozens of birds. Port Hilford is the only consistently used overwintering site for Greater Scaup on the northern end of the Eastern Shore (Flemming, 2021). Greater Scaup diets commonly include benthic marine invertebrates. The regular use of the site and its vicinity by Greater Scaup and scoters suggest a high abundance of shellfish and other invertebrates as food resources for these species.
	Herbivorous	Include	Black Duck (*Anas rubripes*)	The shoreline and near-shore portions of the site have a substantial abundance and variety of marine vegetation (various algal species, eelgrass). Eelgrass and algae are particularly abundant in the areas of the site with sediment arsenic impacts. During the Winter and Spring of 2021, various waterfowl species were observed in and around the site with black ducks being the most common observed waterfowl species (Flemming, 2021). Herbivorous aquatic birds such as the black duck could be exposed to COCs via the consumption of marine vegetation growing in contaminated site sediments.

Receptor Groups		Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Marine Feeding Mammals	Piscivorous	Exclude	Not Applicable	While fish at the site could be exposed to contaminants in sea water and sediments, and could potentially accumulate contaminants in their tissues such that piscivorous mammals could become exposed to site contaminants by ingesting fish, this receptor group is excluded from the ERA for the following reasons: -there are currently no fish chemistry data available for fish species that occur at the site. -fish are mobile and are unlikely to incur significant COC exposure from the localized area of sediment impacts at the site. -no COCs were identified for marine pelagic aquatic life (which includes fish) in site sea water, which would be the primary exposure medium for most fish. -piscivorous mammals have not been observed at the site during any of the numerous field programs to date. -piscivorous mammals that are resident to the eastern shore of Nova Scotia are not strictly marine fish-eaters, but rather, are typically preferential freshwater and terrestrial foragers that have varied diets which include terrestrial birds and small mammals and other food items (e.g., plants, berries, insects, worms etc.). -piscivorous mammals are likely present at or near the site on an occasional basis only, given consideration of their ecology, life history and feeding and habitat preferences.

Receptor Groups		Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
	Invertevorous	Include	Northern River Otter (*Lontra canadensis*)	Marine benthic invertebrates at the site may be exposed to COCs in site sediments. Invertebrate tissue data for the site shows accumulation of arsenic and methylmercury in some species of site benthic invertebrates. These benthic marine invertebrates could be ingested by invertevorous mammals. Though not directly observed at the site to date, suitable habitat for invertevorous mammals (such as the river otter) is present at the site. The river otter diet could include mussels, clams, crabs and other benthic invertebrates that are present in the portion of the site with sediment arsenic impacts.
	Herbivorous	Exclude	Not Applicable	There are essentially no mammals native to Nova Scotia that feed on marine vegetation. While some mammals, such as muskrat, may occasionally consume marine vegetation, their diets are varied, and most foraging occurs in terrestrial and freshwater habitats. Muskrat also have a large foraging range which would reduce their potential time in the impacted portions of the site (which is quite small relative to their typical home or foraging range size).

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Marine Mammals (whales)	Include	Not applicable, assessed qualitatively (at individual level)	Whales (e.g., orcas and belugas) will be present at the site as future residents of the whale sanctuary. While sanctuary residents will be fed frozen fish (that is not harvested from the site), such that the likelihood for consumption of resident marine biota is low, there may be some exposure to COCs due to curiosity-based incidental ingestion of marine organisms present at the site, and/or due to contact with the localized area of site sediment arsenic impacts. Typically, whales would not be considered in an ERA, due to various aspects of their life history, dietary preferences, and physiology (including very large body weights and very large home or foraging ranges). Literature searches revealed no information that could enable quantitative estimation of COC exposures to whales from sea water and sediment contact and consumption of site marine invertebrates (or other resident biota). Thus, potential exposures and risks to whale sanctuary residents, in relation to arsenic-impacted site sediments, are addressed qualitatively in the ERA Risk Characterization section of this report (Section 7.3.4).

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Species at Risk (or other rare, threatened or endangered species)	Include	Not applicable Assessed based on surrogate species (Greater Scaup)	A SAR assessment was conducted for this ERA (Section 4.5.1), and based on the SAR assessment outcomes, and in consideration of exposure potential, it was determined that the Harlequin Duck could potentially be exposed to site COCs if this species is present within the area (no avian SAR were directly observed during the bird surveys conducted by Flemming, 2021). The Harlequin Duck consumes marine invertebrates as part of their diet, and as such, are considered within the assessment of invertevorous marine feeding birds, where the Greater Scaup is considered a reasonable surrogate species for the Harlequin Duck. For any other SAR that can be reasonably expected to occur at the site, surrogate species for the selected receptor types or groups are considered to be representative and protective of potential SAR that are members of such receptor types or groups.
Marine Amphibians and Reptiles	Exclude	Not Applicable	There are no marine amphibians, and there are also no resident amphibian species in Nova Scotia that can tolerate salt water conditions. While marine reptile species (i.e., sea turtles) could potentially be present on site on occasion, they are mobile receptors with very large home ranges (e.g., NatureServe Explorer, 2024) and would not spend a significant amount of time on site given their preference for deeper waters over near-shore areas.

4.5.1 Consideration of Species at Risk

This section focuses on species that have been concluded to be "at risk" either due to being listed under the federal Species at Risk Act (SARA), or listed under specific Government of Nova Scotia (NS) information resources that designate, classify or identify species that are "at risk". It does not specifically address species that are still being considered or assessed for species at risk (SAR) status, either federally (i.e., COSEWIC recommendations) or within Nova Scotia. To assess the potential presence of SAR at the site, federal and provincial SAR resources were initially consulted. The federal SAR public registry was reviewed to obtain a preliminary list of species designated as either endangered, extirpated, of special concern, or threatened within Nova Scotia on Schedules 1, 2, or 3 of SARA. Given that the site is marine in nature, the search included arthropods, birds, marine fishes, marine mammals, molluscs, and vascular plant taxonomic categories (taxa). The resulting list of species was further evaluated to remove species that primarily inhabit and/or forage in terrestrial or freshwater aquatic environments. Table 4-2 lists the common names of the relevant identified species, as well as their scientific name, type of organism, and current SARA status.

Table 4-2: Endangered, Extirpated, Special Concern, and Threatened Species in Nova Scotia (based on SARA Registry Search).

Common Name	Scientific Name	Taxon	SARA Status (Schedule)
Atlantic Mud-piddock	*Barnea truncata*	Molluscs	Threatened (S1)
Atlantic Salmon	*Salmo salar*	Fishes (marine)	Endangered (S1)
Harlequin Duck	*Histrionicus histrionicus*	Birds	Special Concern (S1)
Piping Plover *melodus* subspecies	*Charadrius melodus melodus*	Birds	Endangered (S1)
Red-necked Phalarope	*Phalaropus lobatus*	Birds	Special Concern (S1)
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Birds	Endangered (S1)
Roseate Tern	*Sterna dougallii*	Birds	Endangered (S1)
White Shark	*Carcharodon carcharias*	Fishes (marine)	Endangered (S1)
Yellow Lampmussel	*Lampsilis cariosa*	Molluscs	Special Concern (S1)

Given that the site is marine, the Fisheries and Oceans Canada (DFO) Aquatic Species at Risk Database was also consulted. Several aquatic SAR were identified therein that had not been listed in the SAR registry for Nova Scotia (see Table 4-3).

Table 4-3: Endangered, Extirpated, Special Concern, and Threatened Species in Nova Scotia Based on DFO Aquatic Species at Risk Database Search.

Common Name	Scientific Name	Taxon	SARA Status (Schedule)
Fin Whale	*Balaenoptera physalus*	Mammals (marine)	Special Concern (S1)
Blue Whale	*Balaenoptera musculus*	Mammals (marine)	Endangered (S1)
North Atlantic Right Whale	*Eubalaena glacialis*	Mammals (marine)	Endangered (S1)
Leatherback Sea Turtle	*Dermochelys coriacea*	Reptiles	Endangered (S1)
Northern Wolffish	*Anarhichas denticulatus*	Fishes (marine)	Threatened (S1)

To further characterize the potential SAR that may occur on or near the site, the search results from the federal SAR public registry (Table 4-2) and the DFO Aquatic SAR Database (Table 4-3) were compared with those from the NS Department of Natural Resources website. No additional SAR were identified that had not been listed in the SARA Registry.

To further refine the list of SAR potentially present on or near the site, a custom data report of rare and endangered species from the Atlantic Canada Conservation Data Centre (ACCDC) was reviewed (ACCDC, 2021; see Appendix E). The report includes SAR, ecologically sensitive areas, and managed areas that are documented as being present within a 5 km radius of the site. Although the report was generated in 2021, substantial changes from the original reporting are considered unlikely, and the data contained therein is considered to remain representative of current conditions at and near the site.

Review of the ACCDC report indicated one record of one vascular plant and 14 records of five nonvascular plants, as well as 82 records of 32 vertebrate and one record of one invertebrate species within a 5 km radius of the site. No marine SAR were reported; however, it is important to note that marine species are unlikely to be regularly observed by humans and subsequently reported to ACCDC. Given these circumstances, the lack of marine SAR reported by ACCDC at or near the site was not considered to be sufficient rationale to exclude marine SAR from evaluation. Therefore, SAR identified through the registry searches described above were further evaluated (e.g., distribution, habitat preferences, foraging behaviour, and/or diet) to determine their potential presence at the site, and their potential for exposure to site contaminated sediments.

The site is not located within any migratory bird sanctuaries, Important Bird Areas (IBAs), national wildlife areas, national parks or national historic sites. The Wine Harbour Significant Ecological Area – a terrestrial area rather than a marine area, is the closest designated area of ecological significance and is located approximately 3 km to the southwest of the site.

Table 4-4: Potential Presence at Site and Contaminated Sediment Exposure Potential for Identified Species at Risk in Nova Scotia.

Common Name	Scientific Name	Potential Site Presence and Exposure Potential[1]	
Atlantic Mud-piddock	*Barnea truncata*	Low	The site is dominated by sandy substrates, eelgrass, and various algal species. The Atlantic mud-piddock requires firm substrates for burrowing and survival. Specifically, the mud-piddock depends on red-mudstone substrates, which are associated with specific geological conditions in the Minas Basin and are absent from the site (COSEWIC, 2009). Therefore, the exposure potential for the Atlantic mud-piddock to site contaminated sediments is considered to be low.
Atlantic Salmon	*Salmo salar*	Low	Atlantic salmon are an anadromous species that are born in freshwater, migrate to the marine environment to feed and grow, then return to their home river to spawn (DFO, 2013). At sea, Atlantic salmon may migrate thousands of kilometres from their home river or remain in coastal areas and feed on zooplankton and small pelagic fish. Although Atlantic salmon could potentially be exposed to site-related COCs via the ingestion of smaller fish, the exposures would be expected to be limited, as the area of contaminated sediments within the site is relatively small and localized. In addition, pelagic fish such as the Atlantic salmon would move freely about the site, likely limiting their exposures to contaminated site sediments. As such, Atlantic salmon are considered to have a low potential for exposure to contaminated site sediments.
Harlequin Duck	*Histrionicus histrionicus*	Low to Medium	Harlequin ducks primarily feed on tidal marine invertebrates including crustaceans, mussels, and snails, as well as small pelagic fish (Cornell Lab of Ornithology, 2019a). When inhabiting the marine environment (i.e., overwintering grounds) they are found on rocky coastal shorelines. While harlequin ducks would be expected to move about the site and be unlikely to obtain a large portion of their diet from the vicinity of the impacted site sediments, they could nevertheless be potentially exposed to site COCs given their dietary and habitat preferences appear to be met by site conditions. As such, harlequin ducks were assumed to have a low to medium exposure potential to site contaminated sediments. Harlequin ducks are considered in the ERA via the assessment of other invertevorous marine-feeding birds (i.e., Greater Scaup).

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Common Name	Scientific Name	Potential Site Presence and Exposure Potential[1]	
Piping Plover *melodus* subspecies	*Charadrius melodus melodus*	Low	Piping plovers primarily feed on marine worms, insects, crustaceans, molluscs, and other marine invertebrates on tidal beaches (COSEWIC, 2013). Their breeding habitat has been described as open sandy to gravelled beaches with mixed substrate and sparce vegetation (COSEWIC, 2013). The eastern sub-species on the Atlantic Coast have been reported to nest on sandy beaches (COSEWIC, 2013). The shoreline of the site is mostly cobble and gravel-covered beach. The Piping plover has been the subject of intensive research and monitoring for decades and as such, their distribution and presence in specific areas of Nova Scotia is well-known (Government of Canada, 2019). Piping plovers are not known to be present in the vicinity of the site. Therefore, their exposure potential to site contaminated sediments is considered to be low.
Red-necked Phalarope	*Phalaropus lobatus*	Low	The diet of the red-necked phalarope consists mainly of aquatic invertebrates such as zooplankton and also some flying insects (Cornell Lab of Ornithology, 2019b). During breeding they have been reported to feed on larval flies and fly eggs, beetles and spiders (Baker, 1977). It feeds mainly in deeper waters due to its swimming (rather than wading) behaviour (American Bird Conservancy, n.d.) and as such, would have a very limited exposure potential to contaminated sediments at the site.
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Low	This sub-species breeds in the Canadian Arctic and overwinters in warm areas such as South America, Gulf of Mexico or the Caribbean)(COSEWIC, 2020). While this species could potentially pass through the site during migration, it would be unlikely to spend a significant amount of time in the area, nor would it be expected to obtain a significant portion of its diet from the contaminated sediments area within the site. As such, its exposure potential is considered to be low.

Common Name	Scientific Name	Potential Site Presence and Exposure Potential[1]	
Roseate Tern	*Sterna dougallii*	Low	The roseate tern has been reported to feed primarily on small pelagic fish (Audubon, 1996). In the COSEWIC (2023) rapid review of classification on the roseate tern, the species was reported to be more of a 'specialist', foraging on sand lance (*Ammodytes* spp.) than previously thought (COSEWIC, 2023). While sand lance is a benthic fish which could potentially be exposed to site contaminated sediments, this species was not identified during the diver surveys (Babin, 2021). In addition, fish (including sand lance) are mobile, which would limit exposures of the fish to impacted site sediments. Thus, the exposure potential for the tern to COCs in contaminated site sediments (via fish ingestion) would also be low.
White Shark	*Carcharodon carcharias*	Negligible	The white shark, the noted whale species, and the leatherback sea turtle have very large home ranges and typically do not frequent near-shore shallow waters such as those present at the site. In addition, the site will be enclosed once the sanctuary is constructed and will be inaccessible to large marine fish, large marine mammals and sea turtles. Therefore, the exposure potential for these species to impacted site sediments is considered to be negligible.
Fin Whale	*Balaenoptera physalus*	Negligible	
Blue Whale	*Balaenoptera musculus*	Negligible	
North Atlantic Right Whale	*Eubalaena glacialis*	Negligible	
Leatherback Sea Turtle	*Dermochelys coriacea*	Negligible	
Northern Wolffish	*Anarhichas denticulatus*	Low	The northern wolffish may inhabit near shore areas seasonally; however, they are most often found in deeper, colder waters (COSEWIC, 2012). Their diet in Canadian waters consists primarily of pelagic and benthic fish, as well as shellfish (Simpson et al. 2013). Although they could potentially be exposed to site-related COCs via the ingestion of smaller fish and shellfish, the exposures would be expected to be limited as the area of contaminated sediments within the site is relatively small and localized. Furthermore, both the wolffish and its prey are mobile and unlikely to be in significant contact with site contaminated sediments. As such, Northern Wolffish are considered to have a low potential for exposure to contaminated site sediments.

Common Name	Scientific Name	Potential Site Presence and Exposure Potential[1]

Notes

[1] Exposure potential is assessed by evaluating the dietary and habitat preferences of the species along with other biological, physiological, and life history traits relative to conditions present in impacted areas of the site. The potential for species to forage, breed, or otherwise spend significant time in impacted areas of the site are considered.

4.5.2 Further Considerations Regarding Potential ROCs for the Sanctuary Site

It has long been recognized in ERA guidance and literature that consideration of the spatial scale of impacts at a given contaminated site can be useful in determining if potentially significant exposure conditions exist for ecological receptors, and for determining if risk estimates are ecologically significant (U.S. EPA, 1997; 1998; 1994; ASTM, 2014; MCP, 1996). Ideally, spatial scale issues are discussed at the onset of the ERA process. This can allow small sized sites (or small areas of contamination within a site) that do not/may not require ERA to be excluded early in the ERA process, such that resources are not needlessly allocated to the assessment of these sites. ASTM (2014) notes that the space or size of a contaminated site or area is directly related to the potential for ecological receptor exposure, and that consideration of spatial scale can help focus an ERA on the issues or receptors of greatest ecological relevance, and/or provide a basis for determining that an ERA for a given site is not necessary, for some or all receptors of interest. Similarly, the FCSAP (2012a) guidance identifies home range size, habitat suitability, and off-site habitat characteristics as factors that can affect the degree of exposure to site receptors.

The size of the site is relatively large (approximately 40 ha), though the area of contaminated sediments within the site is much smaller. Nonetheless, species with relatively small home ranges or species that have low to no mobility, could potentially be exposed to impacted site sediments. As such, the site was considered large enough to warrant an ERA.

ASTM (2014) states that if a subject site's habitat quality is approximately equal to that of the site surroundings, the proportion of time that an animal will spend on the site will likely be proportional to the surrounding sites, and bounded by the size of the animal's home range. If the habitat on the subject site is of lower or higher quality than the surrounding sites, then an animal is likely to spend proportionally less or more of its time on the subject site. There is nothing obvious to distinguish the WSP site from other adjacent areas as offering unique or preferred habitat or food resources for any known marine ecological receptor population or community. Therefore, it is not anticipated that ROCs would spend significantly more time at the site, or within the zone of contaminated sediments at the site, than they would spend at numerous adjacent coastal areas.

4.5.3 Summary of ROC Selection

Based on the ROC selection procedure and related considerations described in the preceding sections, the receptors/receptor groups in Table 4-5 were identified as ROCs that warranted further evaluation in the ERA.

Table 4-5: Receptors of Concern (ROC) Selected for Evaluation in the ERA.

Receptor of Concern	Surrogate	Comment
Marine Benthic Aquatic Life	NA	Assessed at the community level
Marine Vegetation	NA	Assessed qualitatively at community level, but with a focus on eelgrass
Marine Feeding Birds - Invertevorous	Greater Scaup (*Aythya marila*) (used data for Lesser Scaup (*Aythya affinis*) where Greater Scaup data were not available).	Assessed at the population level
Marine Feeding Birds - Herbivorous	Black Duck (*Anas rubripes*) (used data for Mallard Duck (*Anas platyrhynchos*) where Black Duck data were not available).	Assessed at the population level
Marine Feeding Mammals – Invertevorous	Northern River Otter (*Lontra canadensis*)	Assessed at the population level
Marine Mammals (sanctuary whale residents)	NA	Assessed qualitatively at individual level
Species at Risk (SAR) Harlequin Duck *(Histrionicus histrionicus)*	Greater Scaup (*Aythya marila*)	Captured by the assessment of the Greater Scaup

Notes:
NA = not applicable.

All subsequent sections of the ERA focus on the selected ROCs. The selected surrogate species, which represent some of the ROC groups, are generally considered “worst case” ecological receptors. The surrogate ROCs would be expected to incur similar or higher exposures to COCs from the site than most other organisms within their receptor groups would, on the basis of body weights, home ranges, feeding and habitat preferences, and behavioural characteristics.

4.6 Selection of Assessment and Measurement Endpoints and Lines of Evidence (LOE)

An assessment endpoint is defined as an explicit expression of what is to be protected, defined by an ecological entity (i.e., receptor or receptor group) and by a characteristic (Suter, 1989; US EPA, 1998; FCSAP, 2012a). The characteristic is a specific attribute or property for the receptor that is important to protect, and which is potentially at risk (e.g., abundance, survival). As noted previously, the ecological entity (or receptor) can be defined at different levels of biological organization. An assessment endpoint must include a receptor (or receptor group) and a specific property or attribute of that receptor (FCSAP, 2012a). Assessment endpoints are quite similar to protection goals with the only notable difference being that the former describes the environmental attribute of interest, whereas the latter articulates the desired state of that attribute (FCSAP, 2012a). It is common practice in ERA that assessment endpoints do not express a direction or desired state (such as: increased, decreased, healthy, or sustainable).

Assessment endpoints may or may not be directly measurable (US EPA, 1998). For example, the abundance of songbirds may be assessed directly if avian surveys have been conducted but would have to be assessed indirectly if survey outcomes are not available. If assessment endpoints are not directly measurable (which is not uncommon due to practical reasons), then other measures, called "measurement endpoints", may be used to evaluate the risk related to the assessment endpoints.

A measurement endpoint is considered to be any measure of exposure or effects for a ROC or any measure of change in the attribute of an assessment endpoint (FCSAP, 2012a). Measurement endpoints form the LOE that are used to estimate risks in an ERA. Measurement endpoints and LOEs are developed at the same time. Similar definitions of measurement endpoints have been provided by others. For example, Suter II (2007) defined measurement endpoints as responses to a chemical stressor that can be measured and quantified. CCME (1996) defines measurement endpoints as "the effects on an ecological component that can be measured and described in some quantitative fashion."

A key consideration in the selection of measurement endpoints is how well a given measurement endpoint represents an assessment endpoint, and its ecological relevance. The greater the strength of association between the measurement and assessment endpoint, the greater the weight that is given to that measurement endpoint in the ERA, so long as the measurement endpoint is considered ecologically relevant.

FCSAP (2012a) defines LOE as any pairing of exposure and effects measures (or measurement endpoints) that provide evidence for the evaluation of a specific assessment endpoint. It is not uncommon for a LOE to involve the use of more than one measurement endpoint.

Essentially, measurement endpoints are tools, and LOE are the way that these tools are used and applied in the ERA. LOEs are directly related to both measurement endpoints and assessment endpoints.

Four main categories of LOE are described in FCSAP (2012a), as follows:

- Site-specific toxicological evidence – Considers measurement endpoints related to studies of test organism exposures to contaminated site media under controlled conditions;
- Indirect toxicology evidence – Considers toxicological information obtained from other sites, or the literature, assuming that the concentration-response relationships between sites are similar;
- Site-specific biological evidence – Considers direct assessment of the site biological conditions; and,

- Indirect biological evidence – Considers indirect assessment of biology, through extrapolation of knowledge obtained at other sites and from the literature.

FCSAP (2012a) also identifies several criteria that are relevant to consider when selecting LOEs. For example:

- Ecological relevance – degree to which the assessment endpoint is represented by the LOE.
- Sensitivity – degree by which the LOE can detect change or differences from reference conditions.
- Specificity – degree to which the LOE is capable of distinguishing effects of COCs from other factors and stressors.
- Spatial representativeness and site specificity – degree to which the LOE provides information that is site (or study area)-specific and at a spatial scale relevant to the selected assessment endpoints.
- Temporal representativeness – degree to which the LOE captures temporal variation relevant to potential ecological risks.
- Expected data quality – degree to which the quality of data generated by the LOE will be acceptable (or not), such that the LOEs utility may be diminished.
- Expected acceptability – consideration of whether or not the LOE has standard test methods available or a long history of use that provides confidence and regulatory acceptance.

Specific assessment and measurement endpoints and LOE were identified for the ROCs that were selected for evaluation in the ERA and are presented in Table 4-6.

Table 4-6: Assessment and Measurement Endpoints and Lines of Evidence for the Selected ROCs.

Receptor of Concern	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
Marine Benthic Aquatic Life	Survival, growth and reproduction of marine benthic communities.	Concentrations of chemicals in site sediments and benthic invertebrate tissues. Marine sediment and marine tissue residue benchmarks. PEL-Q and mean PEL-Q values for marine sediment quality guideline exceedances. Consideration of background/reference sediment concentrations. Consideration of diver survey observations.	Outcomes of the comparison of site sediment and benthic invertebrate tissue chemical concentrations to marine sediment and tissue residue benchmarks, and to background/reference sediment concentrations where available. Outcomes of the diver surveys with respect to potential evidence of benthic community impairment. Outcomes of PEL-Q and mean

Receptor of Concern	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
			PEL-Q calculations.
Marine Vegetation	Survival, growth and reproduction of marine vegetation communities.	Eelgrass survey observations. Concentrations of chemicals in eelgrass tissues. Consideration of diver survey observations.	Outcomes of eelgrass survey data. Outcomes of review of eelgrass tissue concentration data. Outcomes of the diver surveys with respect to potential evidence of marine vegetation community impairment.
Marine Feeding Birds - Invertevorous Greater Scaup (*Aythya marila*)	Survival, growth and reproduction of populations.	Modeled exposure and risk estimates for COCs in food items and sediment. Applicable avian toxicity reference values (TRVs). Site bird survey outcomes. Measured invertebrate tissue concentrations of COCs and applicable ecological health-based tissue residue benchmarks.	Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Application of site bird survey outcomes. Outcomes of comparisons of measured invertebrate COC tissue concentrations to applicable ecological health-based tissue benchmarks.
Marine Feeding Birds - Herbivorous Black Duck (*Anas rubripes*)	Survival, growth and reproduction of populations.	Modeled exposure and risk estimates for COCs in food items and sediment. Applicable avian toxicity reference values (TRVs). Site bird survey outcomes.	Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Application of site bird survey outcomes.
Marine Feeding Mammals – Invertevorous Northern River Otter (*Lontra canadensis*)	Survival, growth and reproduction of populations.	Modeled exposure and risk estimates for COCs in food items and sediment. Applicable mammalian toxicity reference values (TRVs). Measured invertebrate tissue concentrations of COCs and applicable ecological health-based tissue residue benchmarks.	Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Outcomes of comparisons of measured invertebrate COC tissue concentrations to applicable ecological health-based tissue benchmarks.

Receptor of Concern	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
Marine Mammals (sanctuary whale residents)	Overall health and wellness of whales occupying the sanctuary.	Qualitative evaluation of sanctuary resident exposure and risk potential, focused on arsenic, and considering: spatial extent of arsenic-impacted sediments, literature on cetacean tolerance and effects in relation to arsenic, arsenic speciation in cetaceans, as well as pertinent aspects of cetacean life history, dietary preferences and physiology (specific to potential sanctuary resident orcas and belugas).	Outcomes of qualitative evaluation.

Notes
In the ERA context, the definition of a "population" can vary, and as such, very few ERA guidance documents define this term. In general though, a population is a group of individuals of the same species that live together and breed amongst each other. Setting numerical limits on the number of individuals that comprise a population is inherently difficult and would vary greatly depending on the receptor species and its life history characteristics.

4.7 Selection of Exposure Pathways and Routes

Ecological receptors can come into contact with chemicals in a variety of ways, depending on their daily activities, foraging and dietary behaviour and life history characteristics. The means by which an ecological receptor comes into contact with a chemical in an environmental medium are referred to as exposure pathways. The means by which a chemical enters the receptor from the environmental medium are referred to as exposure routes. If there are no possible exposure pathways that link ROCs to COCs that are present in site media, there can be no potential for adverse effects from those chemicals. Therefore, it is important for any ERA to identify the major exposure pathways and routes for each of the selected/identified receptor groups.

For the ROCs selected for evaluation in the current ERA, the following information applies:

- For marine vegetation and benthic aquatic life, the main routes and pathways by which these receptors may be potentially exposed to COCs would include:
  - Direct contact of gills and other respiratory surfaces with surface water and sediments, sediment and surface water ingestion (including sediment pore water for benthos), and ingestion of aquatic prey species and other food items (i.e., detritus, plants, phytoplankton, zooplankton, macroinvertebrate fauna, and fish can all be food items for aquatic organisms depending on the number of trophic levels and aquatic food web structure).
  - Sediment ingestion and pore water ingestion is more prevalent for bottom- dwelling or bottom-feeding species (Schoof, 2003).
  - Aquatic plants are typically exposed to chemicals through root uptake of substances present in sediments and sediment pore water, and surface water uptake.

  - For benthic species, the relative importance of whole (or bulk) sediment versus pore water exposures depends on the individual species, and their feeding and burrowing behaviour. For example, pore water exposure may be insignificant to invertebrates that ingest sediment particles, but may be an important exposure pathway for benthic organisms that burrow, and/or obtain their food by filter feeding.
- For mammalian and avian receptors, it is common ERA practice to evaluate only those pathways that relate to the oral route of exposure (such as consumption of food/prey items, and incidental sediment ingestion). Not only is the oral route the most commonly assessed exposure route in ERAs by far, but it is also almost always the dominant route that drives site-specific exposures and risks to ecological receptors at most sites.
- Dermal and inhalation exposure pathways rarely require evaluation in ERAs (FCSAP, 2012a; BC SAB, 2008; U.S. EPA, 2003). This is considered to be the case in the current ERA as well, given that the avian and mammalian ROCs have either fur or feathers that would limit dermal contact between COCs and skin, and given that the site is a marine aquatic site.

4.7.1 Exposure Pathway Summary for Selected ROCs

With respect to the assessment and measurement endpoints and LOEs noted in Table 4-6 and the exposure pathways and routes selected for the ROCs, there were some inherent conservative assumptions within the ERA that must be acknowledged. It is assumed that the ROCs forage entirely in areas of the site that contain impacted sediments and that their diet consists entirely of food obtained from within the site boundaries. While these are typical assumptions for an ERA of a contaminated site, they are considered highly conservative, and are likely quite unrealistic for the ROCs that were evaluated.

Exposure pathways and routes for each assessed receptor group are summarized in Table 4-7.

Table 4-7: Summary of Exposure Pathways and Routes Selected for the ROCs

Receptor Group	Exposure Pathways
Marine Vegetation	Direct contact with sediment and surface water Root uptake from sediments
Marine Benthic Aquatic Life	Direct sediment and surface water contact with dermal coverings or integument Sediment ingestion
Marine Feeding Birds – invertevorous	Ingestion of benthic invertebrates Incidental sediment ingestion

Receptor Group	Exposure Pathways
Marine Feeding Birds – herbivorous	Ingestion of marine vegetation Incidental sediment ingestion
Marine Feeding Mammals – invertevorous	Ingestion of benthic invertebrates Incidental sediment ingestion
Marine Mammals (whales)	Incidental sediment ingestion Ingestion of benthic invertebrates Fish ingestion *

*Fish will not have site-related contamination as only purchased frozen fish will be fed to the whale residents of the sanctuary.

4.8 Identification of Chemicals of Concern (COCs) for the ERA

The goal of COC selection is to identify those chemicals measured in site media that may pose a potential risk to ecological health. Details regarding the COC identification process for the marine ERA (including the data and statistics, benchmarks that were applied, COC screening tables and screening outcomes) are provided in the following sections and in Appendix F.

The identification of COCs for the marine ERA involved a sequential process, as follows:

1. Comparison of the maximum measured concentrations of chemicals in site surface water and sediments to applicable regulatory marine ecological health-based benchmarks.
2. Chemicals with a maximum concentration that exceeded the applicable ecological health-based benchmark were identified as initial COCs.
3. Initial COCs were further evaluated by determining the frequency, magnitude, and spatial extent of exceedances over the applicable ecological health-based benchmarks.
4. Further considerations (where/if deemed necessary and relevant), such as:
   - Essential nutrient status of certain inorganic elements;
   - Ubiquity of elements in seawater and/or marine sediments;
   - Statistical relationships;
   - Local marine geology and oceanography;
   - Spatial distribution of chemical concentrations in site media;
   - Fate and behaviour properties (including potential to bioaccumulate and biomagnify); and,
   - Speciation of chemicals in site media.

The outcomes of steps 3 and 4 determined whether or not an initial COC became a final COC that underwent assessment in the ERA.

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COC identification in site media was also guided by the following considerations:

- Substances that were non-detectable (below RDLs) in all site media samples were excluded from further consideration unless the RDL was above the applicable benchmark value (further discussion is provided in these instances).
- All site media data were considered, including field duplicate samples.
- With respect to marine sediment quality benchmarks, only probable effect level (PEL) and similarly derived benchmarks were applied (i.e., examples of sediment benchmarks similar to a PEL are effects range median (ERM) and severe effect levels (SEL)). It has become well established in the scientific and regulatory literature over the years that exceedances over PELs and similar benchmarks are often a better or more reliable indicator of potential sediment toxicity (or an increased likelihood for benthic community impairment) than low effect level sediment benchmark exceedances (such as ISQGs (interim sediment quality guidelines) or low-effect level benchmarks). The past experience of Dillon personnel in numerous ERAs of contaminated sediments has shown that exceedance of low effect level benchmarks often does not correlate well with other endpoints that are commonly evaluated in aquatic risk assessments (e.g., sediment bioassay results and benthic community parameters). In practice, exceedance of the PEL (and similar values) is the more realistic indicator of a potential for population or community level adverse effects for benthic organisms and is also typically the most suitable basis for determining when/if further action or assessment is necessary. The use of the PEL is well supported in the literature (e.g., NOAA, 1999; Long et al., 1998; MDEP, 2006). There is also considerable precedent for reliance on PEL exceedances as a means of determining the need for further assessment or action when evaluating contaminated sediments. For example, there are numerous papers in the scientific literature that calculate PEL quotients (not ISQG, or other low effect level quotients) when evaluating sediment contamination and ranking aquatic contaminated sites for further action or no action. This approach is also common to a number of sediment assessment frameworks used within Canada.
- Generally, chemicals having a maximum concentration which exceeded the applicable ecological benchmark value and available local background data, and that were considered to be site-related (i.e., associated with former gold mining and milling activity adjacent to the site) were retained for further assessment as COCs. It is a general assumption in all risk assessment studies that there is a low to negligible likelihood for potential adverse effects when maximum media chemical concentrations are below such benchmarks. Media chemistry data that meets these conditions are typically considered to require no further evaluation or action.
- Chemicals without environmental health-based benchmarks were carried forward for further discussion.

Some of the analytical data collected during marine surface water sampling programs measured parameters that are not generally considered as COCs for an ERA of a contaminated site, regardless of their measured concentrations (e.g., hardness; pH; various common or major ions/essential nutrients including: calcium, magnesium, sodium, potassium, phosphorus, sulphur). While such parameters can inform on surface water quality (where applicable), and may influence or modify the bioavailability, mobility and toxicity of certain COCs, they are not typically considered directly in the COC identification step of an ERA. Also, many of these parameters lack toxicity or risk-based ecological benchmarks that media concentrations can be compared against.

As discussed in Section 4.5, ERAs focus on community level effects for lower trophic levels (e.g., benthic invertebrates) and on population level effects for higher trophic levels (e.g., marine feeding birds and mammals), with the exception of SAR, which are often evaluated at the individual level of biological organization. As such, an exceedance of a maximum concentration over a benchmark is not indicative of potential ecological risk. To assume that ecological exposures occur only to the maximum measured surface water or sediment concentration would be highly conservative and unrealistic. For mobile receptors, FCSAP (2012a) guidance states that if maximum concentrations are exceeded, consideration should be given to other summary statistics (e.g., 95% upper confidence limit on the mean [UCLM95], if sample size is >10), as such statistics are more realistic for determining “true” COCs. Therefore, where deemed necessary or appropriate, the UCLM95 site media concentrations of initial COCs were considered in addition to maximum concentrations before final selection of a chemical as a COC for the ERA.

It should be recognized that published regulatory benchmarks are generic values, with no consideration given to site-specific populations/communities or media conditions that influence bioavailability. Also, they are developed by regulatory agencies to be intentionally conservative and protective. Exceedance of these values does not necessarily imply there is a risk of adverse effects; rather, it suggests that further evaluation is warranted (such as further ecological risk assessment or data collection). This is especially true for metals, many of which have essential nutritional and physiological roles in marine biota. When interpreting screening level (benchmark) exceedances, it is also important to consider the body of literature regarding acclimation and adaptation of marine organisms to metals and other substances in sediment and/or food items. For example, it is well established that populations chronically exposed to metals often show an enhanced tolerance relative to populations with no, or lower exposure (Kapustka et al., 2004). This increased tolerance can be due to either acclimation (shifting of tolerance within the genetically defined limit of the organism) or adaptation (modification of the limits of an organism through changes in heritable genetic material) (International Council on Mining and Metals [ICMM], 2007). Increased metal/metalloid tolerance has been documented for many species of aquatic plants, animals, and microbes. For the most part, acclimation and/or adaptation have been demonstrated primarily at the population level, but studies of pollution-induced community tolerance have also documented these phenomena at the community level at various metals-contaminated sites.

The COC identification processes used herein are consistent with those used in numerous site and risk assessments to identify COCs and to distinguish natural occurring concentrations from those that have been influenced by anthropogenic activities. The approaches used are also widely considered to be conservative in that simple comparisons of maximum media concentrations to benchmarks are prone to a high false positive (type I error) rate. The US EPA (2001) notes that a type I error (false positive) is less serious than a type II error (false negative) when selecting COCs, and the use of approaches that favour type I errors are inherently more protective of environmental health.

The marine environmental quality benchmarks applied in the COC identification process, as well as outcomes of COC identification for site surface water and sediments, are summarized in the following sections with further details provided in Appendix F. A summary of analytical data used in the COC screening is also provided in Appendix F. Laboratory certificates for these data are provided in Appendix B.

4.8.1 Marine Surface Water and Sediment Benchmarks

As discussed further below in Section 4.8.2, the NS PSS were preferentially applied for all site media where available. The PSS are benchmarks developed by source agencies and departments outside of Nova Scotia such as the CCME and BC MOECCS. The original guideline sources were reviewed to ensure the NS PSS guideline referenced was the most recent applicable guideline from the original source, and to check whether guidelines for additional chemicals were available from the source agencies. Where no NS PSS was identified, other provincial or federal regulatory benchmarks were used, where available.

4.8.2 COC Identification in Site Surface Water

Surface water chemical concentration data from the site were compared to NS PSS for marine surface water. The specific source of the NS PSS used in the COC identification process for each chemical is identified in the screening tables presented in Appendix F. The source agency marine surface water quality guidelines that comprise the majority of the NS PSS for marine surface water are briefly described below.

Canadian Council of Ministers of the Environment (CCME)
The Canadian Water Quality Guidelines (CWQG) for the Protection of Marine Aquatic Life (long-term exposure) are intended to protect all forms of aquatic life and all aspects of aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term. Details regarding surface water guideline basis and derivation are provided in fact sheets available from CCME. The CCME Water Quality Guidelines are available at https://ccme.ca/en/resources/protocols-and-reference#.

B.C. Ministry of Environment and Climate Change Strategy (BC MOECCS)

B.C. Ministry of Environment and Climate Change Strategy Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture (2023) and the Working Water Quality Guidelines (2021). Guidelines are available at https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf and https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf, respectively.

British Columbia Contaminated Sites Regulation (BC CSR)

The British Columbia Contaminated Sites Regulation (BC CSR) Schedule 3.2 - Generic Numerical Water Standards for Marine Aquatic Life (current to May 28, 2024; last amended March 1, 2023). BC CSR notes that the aquatic life standards assume that a minimum of 1:10 dilution is available prior to discharge to the aquatic environment. As such, BC CSR guideline values are divided by ten for application to marine surface water. Guidelines are available at https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/375_96_08.

United States Environmental Protection Agency (US EPA)

The United States Environmental Protection Agency (US EPA) Region 4 Surface Water Screening Values for Hazardous Waste Sites (saltwater screening value; chronic) were applied where Canadian guidelines were unavailable. Guidelines are available at https://www.epa.gov/sites/default/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf.

Table 4-8 below provides a comparison of maximum measured marine surface water concentrations of target analytes at the site to their applicable regulatory ecological health-based marine surface water quality benchmarks. The full set of analytical chemistry data for site marine surface water is provided in Appendix B and F, and sample locations are provided in Appendix A. The target analytes in marine surface water samples collected from the site included metals, metalloids, and cyanide, as well as various general chemistry parameters. Applicable guidelines for general chemistry parameters were available for only nitrate and pH, which had reported site seawater concentrations below the applicable benchmark or within their target ranges. These results are not included in the summary tables herein (see Appendix F).

Table 4-8: Comparison of Site Marine Surface Water Metal and Metalloid Concentrations (µg/L; Site Maxima) to Marine Surface Water Quality Benchmarks.

Chemical	RDL (µg/L)	Marine Surface Water Quality Benchmark (µg/L)*		Maximum Measured Site Surface Water Concentration (µg/L)	Exceeds Benchmark? (Y / N)
Metals and Metalloids					
Aluminum	50	1,500	1	540	N
Barium	10	500	2	11	N
Boron	**500**	**1,200**	2	**4,200**	**Y**
Cadmium	**0.10**	**0.12**	3	**0.13**	**Y**
Chromium	10	1.5	3,4	<10	RDL > guideline
Copper	**5.0**	**2**	5	**19**	**Y**
Iron	**500**	**300**	1	**1,200**	**Y**
Lead	5.0	2	5,6	<5	RDL > guideline
Manganese	20	100	1	20	N
Mercury (total)	**0.013**	**0.016**	3	**0.017**	**Y**
Nickel	**20**	**8.3**	7	**55**	**Y**
Selenium	5.0	2	5	<5	RDL > guideline
Strontium	20	NGA		6,800	NA
Thallium	1.0	0.3	2	<1	RDL > guideline
Titanium	20	NGA		23	NA
Uranium	1.0	8.5	2	2.9	N
Zinc	50	10	5	<50	RDL > guideline

Notes

RDL = reportable detection limit; Y = yes; N = no; NGA = no guideline available; NA = not applicable.

Bold indicates that maximum value exceeds the applicable guideline.

Underlined indicates that RDL exceeds the applicable guideline.

Number of samples: n = 31 for all parameters presented in this table except mercury (n = 21).

Guidelines

* Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine surface water. Individual guideline references are provided in footnotes. Accessed online May 2024 from the Government of Nova Scotia website.

[1] United States Environmental Protection Agency Region 4 (US EPA). (2018). Ecological Risk Assessment Supplemental Guidance: Surface Water Screening Values for Hazardous Waste Sites (saltwater screening value; chronic). Accessed online May 2024 from the US EPA Region 4 website.

[2] BC Contaminated Sites Regulation Schedule 3.2 (Current to May 21, 2024; last amended March 1, 2023) Generic Numerical Water Standards for Aquatic Life (Marine). BC CSR notes that the aquatic life standards assume a minimum of 1:10 dilution is available prior to discharge to the aquatic environment. As such, BC CSR guideline values are divided by 10 for application to marine surface water. Accessed online May 2024 from the Government of BC website.

[3] Canadian Council of Ministers of the Environment (CCME). Canadian Water Quality Guidelines for the Protection of Aquatic Life (Marine). Accessed online May 2024 from the CCME website.

[4] Guideline for hexavalent chromium (Cr(VI)) was conservatively selected; however, it is unlikely that chromium in marine waters will be present in the hexavalent form. Rather, the trivalent form (Cr(III)) is most prevalent in marine waters.

[5] B.C. Ministry of Environment and Climate Change Strategy. (2023). Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C. Accessed online May 2024 from the Government of BC website.

[6] Guideline is for average calculated from at least 45 weekly samples within 30 days; maximum value is 140 µg/L.

[7] B.C. Ministry of Environment and Climate Change Strategy. (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Accessed online May 2024 from the Government of BC website.

Several substances had maximum reported concentrations that were below laboratory RDLs (i.e., non-detectable) in all marine surface water samples collected from the site, and detection limits were confirmed to be lower than the applicable surface water quality benchmarks. Therefore, the following chemicals were not considered further in the ERA and were excluded from the summary tables in this report: antimony, arsenic, beryllium, bismuth, cobalt, molybdenum, silver, tin, vanadium, and cyanide. Marine surface water quality benchmarks are not available for bismuth and tin; however, these parameters were non-detectable in all site surface water samples and neither chemical is anticipated to be associated with historic gold mining and milling activities near the site. Therefore, bismuth and tin were not considered further in the ERA and were also excluded from the summary tables in this report.

As shown in Table 4-8, maximum surface water concentrations of chromium, lead, selenium, thallium and zinc were reported below the laboratory RDL in all site samples, but the achieved RDLs were higher than the applicable surface water quality benchmarks. Given that these parameters were not detected and that they are also not considered to be related to former gold mining/milling activities, they were not carried forward for further assessment in the ERA. However, the achieved RDLs for these analytes relative to applicable benchmarks represents an uncertainty in the assessment. Recommendations towards addressing this uncertainty in future site surface water sampling programs, are provided in Section 8.0.

Marine surface water quality benchmarks were not available for some parameters that were detected in site surface water (i.e., strontium and titanium). However, both of these elements are naturally present in marine waters. Concentrations of these elements that would be expected to naturally occur in seawater are as follows (median values of reported measurements based on data from Haynes et al., 2016):

- Strontium: 7,900 µg/L (site maximum = 6,800 µg/L).
- Titanium: 1 µg/L (site maximum = 23 µg/L).

The maximum site surface water strontium concentration is below the natural seawater median concentration. Thus, strontium was not considered further in the ERA. The maximum site surface water concentration of titanium was higher than the natural seawater median concentration. However, titanium was measured at a concentration marginally above the RDL of 20 µg/L in only one site surface water sample (SW-E-4) located near Barachois Island, and titanium concentrations in samples closer to the former mine/mill operations and the wharf were below the RDL. Given these findings, and also considering that titanium is not known to be related to gold mining or milling activities, titanium was therefore not considered further in the ERA. Measured titanium concentrations in site seawater are believed to be either naturally occurring or are due to sources unrelated to the former gold mining and milling operation adjacent to the site.

Based on the comparisons presented in Table 4-8 and Appendix F, several chemicals were carried forward for further evaluation as initial COCs in site surface water, on the basis of maximum site surface water concentrations exceeding applicable ecological health-based surface water quality benchmarks (number of samples that exceeded applicable benchmarks are provided in parentheses).

Initial COCs in Site Surface Water

- Boron (29 of 31);
- Cadmium (1 of 31);
- Copper (2 of 31);
- Iron (1 of 31);
- Mercury (1 of 31); and,
- Nickel (1 of 31).

Boron concentrations in site surface water samples exceeded the applicable benchmark (1200 µg/L) in 29 of 31 samples. However, boron occurs naturally in seawater at concentrations in the same range as the maximum concentration measured in site surface water (i.e., 4200 µg/L). For example, data from Haynes et al. (2016) indicates that the median value of reported boron concentrations in seawater is 4400 µg/L, while CCME (2009) indicates that naturally occurring seawater boron concentrations are 4500 µg/L. Given these considerations, and also considering that boron is not known to be associated with gold mining and milling activities, boron was not carried forward as a COC in site surface water.

Mercury and cadmium concentrations in site surface water samples marginally exceeded their respective benchmarks in only one sample each (i.e., 0.017 µg/L for mercury [1 of 21 samples]; 0.13 µg/L for cadmium [1 of 31 samples]). Given the low frequency and magnitude of exceedance for these parameters, mercury and cadmium were not carried forward as COCs in site surface water.

Copper and iron were measured in site surface water at concentrations exceeding their applicable benchmarks of 2 µg/L and 300 µg/L, in only 2/31 and 1/31 site surface water samples, respectively. While these are low frequencies of exceedance, it was noted that laboratory RDLs for copper and iron were above their respective benchmarks. However, it is considered unlikely that these metals would pose an ecological concern at the site. Both of these metals are well established as being major or common naturally occurring elements in marine environments and tend to have a high natural abundance in marine surface water (US EPA, 2017; Gledhill and Buck, 2012). Furthermore, copper and iron are essential nutrients for all aquatic life. As such, the absorption, metabolism, distribution, and elimination of these elements are physiologically or biochemically regulated such that adverse effects would not be expected to occur except in conditions of extremely high exposure. Ambient environmental exposure to these elements in surface water, even when/if present at elevated concentrations, does not constitute a situation of extreme exposure. Also, in situations of co-exposure to other metals, iron may have a protective effect. It is well known and well established in the scientific literature that iron can reduce the bioavailability and toxicity of various trace metals in water through sorption and competitive binding processes. Given these considerations, iron and copper were not carried forward as COCs in site surface water.

Nickel was detected in only 1 of 31 site surface water samples, and this one sample had a surface water nickel concentration that exceeded the applicable surface water quality benchmark. It was also noted that laboratory RDLs for nickel were above the applicable benchmark, which introduces some uncertainty into the evaluation of nickel. However, the maximum site surface water nickel concentration (55 µg/L) and the achieved RDLs for nickel were within or below the range of what has been reported for naturally occurring nickel concentrations in seawater. Middag et al., (2020) reported that typical nickel concentrations in surficial seawater range from 99.5 to 176 µg/L. Given these considerations and the fact that nickel is not known to be associated with gold mining/milling operations, nickel was not carried forward as a COC in site surface water.

Based on the COC identification steps and considerations described above, no measured parameters in site surface water were identified as COCs to be carried forward for further assessment in the ERA.

Final COCs in Site Surface Water

- None.

4.8.3 COC Identification in Site Sediments

Sediment chemical concentration data from the site were compared to NS PSS for marine sediments. The specific source of the NS PSS used in the COC identification process for each chemical is identified in the screening tables presented in Appendix F. The source agency marine sediment quality guidelines that comprise the majority of the NS PSS for marine sediments are briefly described below.

Canadian Council of Ministers of the Environment (CCME)
The Canadian Sediment Quality Guidelines for the Protection of Marine Aquatic Life are intended to protect all forms of aquatic life and all aspects of aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term. CCME has two types of sediment guidelines: Interim Sediment Quality Guidelines (ISQGs) and Probable Effects Levels (PELs). The ISQGs are essentially threshold level effects (TELs), which represent the concentration of a contaminant below which adverse effects are not anticipated (CCME, 1996). A PEL is defined by CCME (1995) as the concentration of a contaminant above which adverse biological effects are usually or always observed. As noted in Section 4.8, the PEL guidelines were preferentially applied for COC identification purposes. Further details regarding sediment guideline basis and derivation are provided in the respective fact sheets available from CCME (https://ccme.ca/en/resources/protocols-and-reference#).

B.C. Ministry of Environment and Climate Change Strategy (BC MOECCS)
The B.C. Ministry of Environment and Climate Change Strategy (BC MOECCS) Working Sediment Quality Guidelines: Aquatic Life, Wildlife, & Agriculture (2021) were applied in the COC identification process. Guidelines are available at https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf.

Other Regulatory Agencies
Guidelines from regulatory agencies in other jurisdictions have been adopted by NS where Canadian guidelines are not available (i.e., Australian Commonwealth Scientific and Industrial Research Organisation, Simpson et al., 2013; United States National Oceanic and Atmospheric Administration, Buchman, 2008).

Table 4-9 below provides a comparison of maximum measured marine sediment concentrations of target analytes at the site to their applicable regulatory ecological sediment quality benchmarks. The full set of analytical chemistry data for site marine sediments are provided in Appendix B and F, and site sediment sample locations are provided in Appendix A. The target analytes in marine sediment samples collected from the site included: metals, metalloids, petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylenes, and cyanide.

Several substances had maximum measured concentrations that were below laboratory RDLs (i.e., non-detectable) in all marine sediment samples collected from the site, and RDLs were confirmed to be lower than the applicable benchmarks. Therefore, the following chemicals were not considered further in the ERA and are excluded from the summary tables in this report: antimony, beryllium, bismuth, cadmium, selenium, silver, benzene, toluene, ethylbenzene, xylenes, all analyzed PHC fractions (F1 [C6-C10], F2 [C10-C16], and F3 [C16-C32]), modified TPH, and cyanide.

Table 4-9: Comparison of Site Marine Sediment Metal and Metalloid Concentrations (mg/kg; Site Maxima) to Marine Sediment Quality Benchmarks.

Chemical	RDL (mg/kg)	Marine Sediment Quality Benchmark (mg/kg)*		Maximum Measured Site Sediment Concentration (mg/kg)	Exceeds Benchmark? (Y / N)
Metals and Metalloids					
Aluminum	10	NGA		7,700	NA
Arsenic	2.0	41.6	1	1,200	Y
Barium	5.0	130	2	21	N
Boron (total)	50	NGA		52	NA
Chromium (total)	2.0	160	1	13	N
Cobalt	1.0	NGA		6.7	NA
Copper	2.0	108	1	9.3	N

Chemical	RDL (mg/kg)	Marine Sediment Quality Benchmark (mg/kg)*		Maximum Measured Site Sediment Concentration (mg/kg)	Exceeds Benchmark? (Y / N)
Iron	50	NGA		22	NA
Lead	0.50	112	1	8.8	N
Lithium	2.0	NGA		23	NA
Manganese	2.00	NGA		620	NA
Mercury (total)	0.10	0.7	1	0.13	N
Molybdenum	2.0	NGA		5.5	NA
Nickel	2.0	50	3	19	N
Rubidium	2.0	NGA		7.8	NA
Strontium	5.0	NGA		55	NA
Thallium	0.10	NGA		0.15	NA
Tin	1.0	NGA		1.3	NA
Uranium	0.10	NGA		1.6	NA
Vanadium	2.0	NGA		18	NA
Zinc	5.0	271	1	410	Y

Notes:

RDL = reportable detection limit; Y = yes; N = no; NGA = no guideline (benchmark) available; NA = not applicable.

Bold indicates that maximum value exceeds the applicable guideline (benchmark).

Number of samples: *n* = 28 for all parameters presented in this table except arsenic (*n* = 35).

Guidelines (Benchmarks):

* Guidelines (benchmarks) are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine sediments. Individual guideline references are provided in footnotes. Accessed online May 2024 from the Government of Nova Scotia website.

[1] Canadian Council of Ministers of the Environment (CCME). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Accessed online May 2024 from the CCME website.

[2] Buchman, M.F. (2008). NOAA Screening Quick Reference Table, NOAA OR&R Report 08-1, Seattle, WA. Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp. Based on TEL as no PEL or similar value.

[3] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Accessed online May 2024 from the Government of BC website.

As shown in Table 4-9, marine sediment quality benchmarks were not available for a number of parameters that were detected in site sediments: aluminum, boron, cobalt, iron, lithium, manganese, molybdenum, rubidium, strontium, thallium, tin, uranium, and vanadium. These elements are naturally present in marine sediments at varying concentrations depending on regional geological conditions, and many are essential nutrients for marine aquatic life. In addition, the site spatial distribution pattern of detected concentrations of several of these parameters indicates that they are not related to historic activities at the site (i.e., lack of concentration gradient where sediments contain higher concentrations nearest the former gold mine/mill operations). These elements are further discussed below.

Cobalt, lithium, strontium, tin, uranium, and vanadium were measured in site sediments at concentrations within the range of baseline levels reported in the literature for coastal areas of Nova Scotia (where available; Stewart et al., 2019; Loring et al., 1996) or elsewhere in eastern Canada (where Nova Scotia data were unavailable; Bugden et al., 2000). Maximum baseline concentrations reported in the published literature relative to the range of concentrations observed in site sediment samples were as follows:

- Cobalt: 18.2 mg/kg[2] (site range = 3.3 mg/kg to 6.7 mg/kg).
- Lithium: 75 mg/kg[3] (site range = 12 mg/kg to 23 mg/kg).
- Strontium: 156 mg/kg[1] (site range = 6.5 mg/kg to 55 mg/kg).
- Tin: 13 mg/kg[2] (site range = < 1 mg/kg to 1.3 mg/kg).
- Uranium: 2.6 mg/kg[1] (site range = 0.26 mg/kg to 1.6 mg/kg).
- Vanadium: 115 mg/kg[2] (site range = 8.9 mg/kg to 18 mg/kg).

Site sediment concentration ranges of these parameters were below literature-reported maximum baseline (background) concentrations of these parameters in marine sediments. In addition, none of these parameters are known to be related to former gold mining and milling activities. Thus, cobalt, lithium, strontium, tin, uranium and vanadium were not carried forward for further evaluation in the ERA.

Aluminum, iron, and manganese were detected in site sediments at concentrations generally below or within the ranges of baseline levels reported in the literature for coastal areas of Nova Scotia (Stewart et al., 2019; Loring et al., 1996; Bugden et al., 2000), as follows:

- Aluminum: 60,000 to 78,700 mg/kg[2] (site range = 4,500 mg/kg to 7,700 mg/kg).
- Iron: 24,000 to 40,000 mg/kg[2] (site range = 10,000 mg/kg to 22,000 mg/kg).
- Manganese: 375 to 565 mg/kg[2] (site range = 190 mg/kg to 620 mg/kg).

Furthermore, lower concentrations of these parameters at site sediment sample locations closest to the former gold mill (i.e., SED-C-11-S1 = 4,600 mg/kg Al and 11,000 mg/kg Fe; SED-D-2-S1 = 190 mg/kg Mn) relative to locations further away (i.e., SED-B-12-S1 = 7,700 mg/kg Al, 22,000 mg/kg Fe and 620 mg/kg Mn) suggest that aluminum, iron and manganese concentrations in site sediments likely reflect local geology and substrate mineralogical composition. Iron and manganese are also essential nutrients for all aquatic life and their uptake, metabolism and elimination are biochemically and physiologically regulated, such that extreme exposures (much higher than measured site sediment concentrations) would be necessary to produce adverse effects in marine organisms. Aluminum is not an essential nutrient, but is a ubiquitous metal in all marine sediments as aluminosilicates are well known to be key compositional minerals in sands, silts and clays. Thus, aluminum concentrations can vary widely in

[2] Bugden et al., 2000
[3] Stewart et al., 2019; Loring et al., 1996

marine sediments as a function of sand, silt and clay content and relative proportions. Given these considerations, aluminum, iron, and manganese were not carried forward for further evaluation in the ERA.

Boron was detected in only 1 of 28 site sediment samples at a concentration marginally above the RDL (52 mg/kg; RDL = 50 mg/kg). Given the low frequency of detection, and also considering that boron is not known to be associated with gold mine/mill operations, boron was excluded from further assessment in the ERA. Marine sediment baseline or background concentrations of boron were not identified in the literature.

Molybdenum was measured in site sediments at concentrations ranging from non-detectable (<2 mg/kg) to 5.5 mg/kg. Of the 28 site sediment samples analyzed for molybdenum, only 3 had detectable concentrations. While the detected molybdenum concentrations occurred in the vicinity of the wharf, molybdenum is not known to be associated with gold mine/mill operations. Molybdenum can sometimes be higher in marine sediments near freshwater discharge points, and the higher concentrations near the wharf may reflect this. Marine sediment baseline or background concentrations of molybdenum range from 0.6 to 5 mg/kg (Bugden et al., 2000) and site sediment molybdenum concentrations were generally within this range. Given these considerations, molybdenum was not carried forward for further evaluation in the ERA.

Rubidium was detected in all site sediment samples at concentrations ranging from 3 mg/kg to 7.8 mg/kg. Marine sediment baseline or background concentrations of rubidium range from 104 to 137 mg/kg (Bugden et al., 2000), and site sediment rubidium concentrations were well below this range. Furthermore, rubidium is not known to be associated with gold mine/mill operations. Given these considerations, rubidium was not carried forward for further evaluation in the ERA.

Thallium was detected in 7 of 28 site sediment samples at concentrations ranging from 0.1 mg/kg to 0.15 mg/kg. Marine sediment baseline or background concentrations of thallium range from 0.52 to 0.7 mg/kg (Bugden et al., 2000), and site sediment thallium concentrations were well below this range. Furthermore, thallium is not known to be associated with gold mine/mill operations. Given these considerations, thallium was not carried forward for further evaluation in the ERA.

As shown in Table 4-9, barium, chromium, copper, lead, mercury, and nickel were measured at concentrations below their respective benchmarks in all site sediment samples. Thus, these parameters were excluded from further assessment in the ERA.

Based on the comparisons presented in Table 4-9 and Appendix F, only arsenic and zinc were carried forward for further evaluation as initial COCs (on the basis of maximum site sediment concentrations exceeding applicable marine sediment quality benchmarks). Both of these substances are discussed further below.

Initial COCs in Site Sediments

- Arsenic (benchmark exceedance in 11 of 35 site sediment samples); and,
- Zinc (benchmark exceedance in 2 of 28 site sediment samples).

Arsenic concentrations in site sediment samples exceeded the marine sediment quality benchmark of 41.6 mg/kg (in 11 of 35 samples), by up to approximately 29-fold (SED-G-3-S1 = 1,200 mg/kg). Arsenic is well known to be associated with gold mining and milling operations and its presence at elevated concentrations in site sediments is considered attributable to the former gold mine/mill activities adjacent to the site. Given the frequency and degree of benchmark exceedances in the site sediment samples, arsenic was carried forward as a COC for further evaluation in the ERA.

Zinc concentrations in site sediment samples marginally exceeded the marine sediment quality benchmark of 271 mg/kg in only 2 of 28 samples, by up to 1.5-fold (SED-D-6-S1 = 410 mg/kg). The 90th percentile zinc concentration (218 mg/kg) did not exceed the benchmark. The samples with the benchmark exceedances were collected from Area C (Island and central) and Area D (channel) which are not directly adjacent to the land-based source of contamination from the former gold mill. Zinc is not known to be associated with gold mine and mill operations and the pattern of zinc concentrations in site sediment samples shows no decreasing contamination gradient with increasing distance form the former gold mill location. Given these considerations, particularly the low frequency and degree of sediment quality benchmark exceedance, zinc was excluded from further assessment in the ERA.

Based on the COC identification steps and considerations described above, the following parameters were identified as COCs in site sediments, and were carried forward for further evaluation in the ERA.

Final COCs in Site Sediments

- Arsenic

4.8.4 COCs in Marine Invertebrate Tissue

While data were collected from the site for marine benthic invertebrate tissue chemistry (i.e., Strum, 2024a), it is not possible to conduct a COC identification process for tissue chemistry data as very few regulatory tissue benchmarks exist. In fact, the only analyzed parameter in invertebrate tissues for which an ecological tissue benchmark is available for, is methylmercury (i.e., CCME Tissue Residue Guideline of 0.033 mg/kg wet weight [ww] for wildlife consumers of aquatic biota). Invertebrate samples collected closer to the former gold mill had methylmercury concentrations slightly exceeding the guideline (e.g., INV-B-RC-0000102 = 0.0381 mg/kg ww; INV-D-RC-0000104 = 0.0334 mg/kg ww), while samples further away did not exceed the guideline (e.g., INV-E-M-0000105 = 0.0158 mg/kg ww; INV-A-RC-0000101 = 0.0243 mg/kg ww). This spatial distribution suggests that the methylmercury levels

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measured in site invertebrate tissues may be related to the former gold mill. Mercury was historically used in gold milling operations to help separate gold from the ore being processed.

Thus, while mercury was not a COC in either site surface water or sediments, methylmercury was retained as a COC in site benthic invertebrate tissues, and is addressed further in the Risk Characterization section of this ERA.

4.8.5 Final COCs Selected for Evaluation in the Marine ERA

The preceding sections identified COCs for site surface water, sediments, and invertebrate tissues, as follows:

- Site surface water: no COCs.
- Site sediments: arsenic.
- Invertebrate tissues: methylmercury; arsenic.

It is standard ERA best practice to assess, where relevant and applicable in terms of exposure pathways, a COC in all site media or prey items that a ROC may be exposed to, even if a COC was not identified in some media or prey items. Thus, for the ROCs carried forward for evaluation in the ERA, arsenic was assessed for all media and prey items where an operable exposure pathway exists, including the evaluation of benthic invertebrates. Methylmercury was identified as a COC based solely on benthic invertebrate tissue chemistry data (and very limited regulatory tissue benchmarks). As such, it was only assessed in benthic invertebrate tissues.

4.9 Conceptual Site (Exposure) Model

A conceptual site (or exposure) model (CSM or CEM), is a written description and/or a visual representation of the relationships between the source(s) of COCs, the receiving environment(s), and the processes by which ecological receptors may become directly or indirectly exposed to COCs (Barnthouse and Brown, 1994). Conceptual models serve three purposes (Suter, 1999):

- Clarification of assumptions concerning the site, study area or situation being assessed;
- A communication tool for conveying those assumptions; and,
- Providing a basis for organization and completion of the ERA.

The CEM developed for the marine ERA is presented in Figure 4-1, and schematically represents the interactions between the selected receptors and the COCs, via the identified exposure pathways.

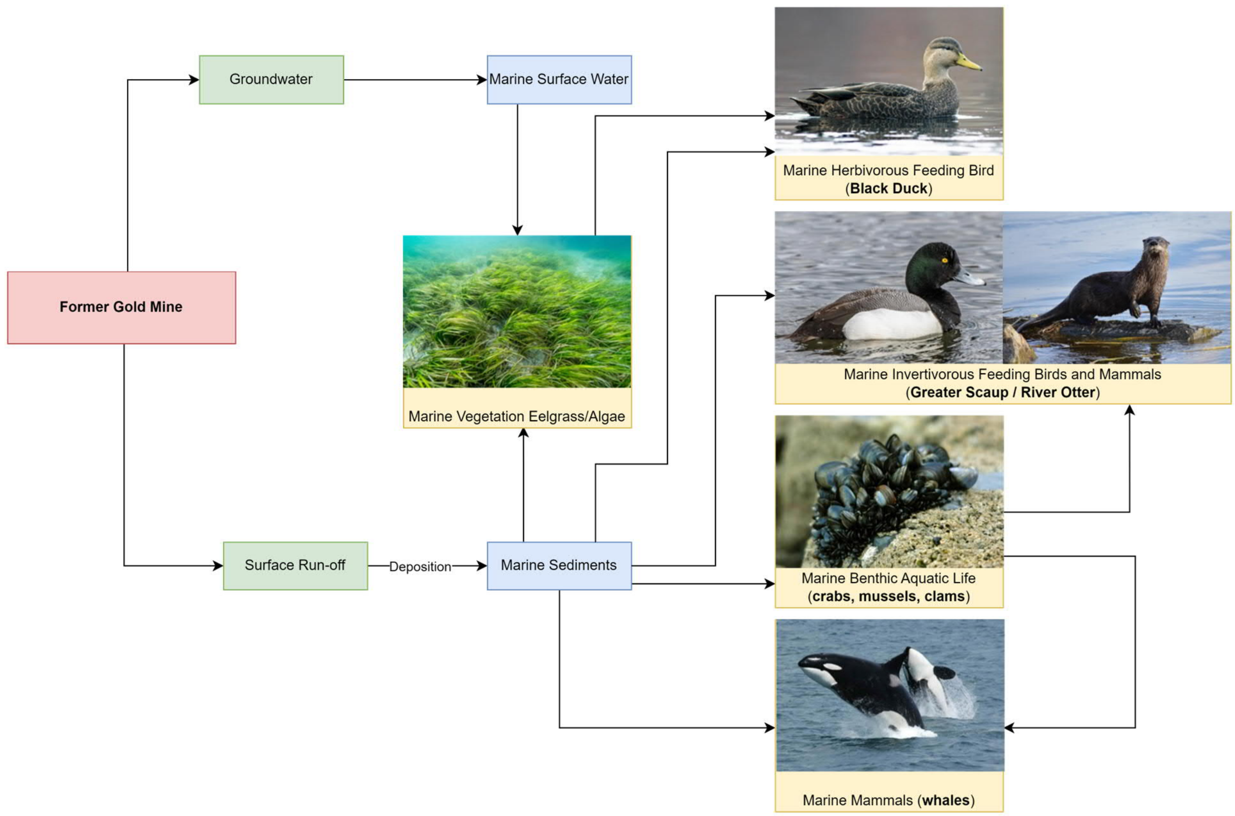

Figure 4-1: Site Conceptual Exposure Model

5.0 Exposure Assessment

The exposure assessment step of an ERA involves estimating the amount (quantity) of chemicals that are received by ecological receptors. Exposure can be calculated using quantitative approaches (e.g., where exposures for a specific receptor are estimated using models and a variety of receptor input parameters), or can be assessed qualitatively (e.g., where exposures are assumed to equal measured concentrations in environmental media). The latter method likely overestimates potential exposure as it ignores an organisms' natural barriers to chemical uptake (i.e., bioavailability considerations), and biochemical transformation processes that may occur within cells, tissues and organs, which may reduce the actual dose that reaches a target site within an organism.

The degree of exposure of ecological receptors to chemicals in the environment depends on the interactions of a number of parameters, including:

- The concentration of chemicals in various environmental media (e.g., sediment, water, food) as determined by the quantities of chemicals entering the environment from various sources, their

persistence in these media, and the normal ambient, or background concentrations that exist independent of a specific source.
- The various exposure pathways for the transfer of the chemicals from the different environmental media to ecological receptors (e.g., ingestion of water, soil/sediment, and food items).
- The physiological and behavioural characteristics of ecological receptors that determine the actual exposures through interactions with the various pathways (e.g., rates of respiration, water intake, food intake, sediment intake, energy utilization).
- The various physical, chemical, and biological factors that determine the ability of the ecological receptors to take the chemicals into their bodies from the exposure pathways (e.g., bioavailability of the chemicals from sediments, foods and surface water).

For the marine vegetation and marine benthic ROCs, potential exposures were assessed qualitatively, wherein these receptors were assessed as broad groups of organisms (community scale) with similar biological and ecological characteristics, and similar exposure potential to chemicals in surface water and/or sediments, and the assumption that COC exposures for these ROCs equal the measured COC concentrations in the applicable site media.

Given a paucity of suitable toxicity and exposure data to evaluate marine mammals (i.e., whale sanctuary residents), potential risks to these receptors were qualitatively discussed (with a focus on arsenic) based on their exposure potential. Key considerations included spatial extent of arsenic-impacted sediments, literature on cetacean tolerance and effects in relation to arsenic, arsenic speciation in cetaceans, as well as pertinent aspects of cetacean life history, dietary preferences, and physiology (specific to potential sanctuary resident orcas and belugas).

For the remaining ROCs (i.e., herbivorous and invertevorous marine feeding birds - American Black Duck and Greater Scaup, respectively, and invertevorous marine feeding mammals - Northern River Otter), COC exposures were assessed quantitatively using various site-specific data (e.g., benthic invertebrate and marine eelgrass tissue data), as well as standard food chain modeling equations and receptor physiological and behavioural parameters from various regulatory agency ERA guidance documentation and/or the scientific literature. The equations, factors, parameters and assumptions used in the exposure modelling are described below and in Appendix G.

Uptake factors and/or bioaccumulation equations from general ERA guidance or the scientific literature were not necessary to use in the marine ERA as site-specific data were available for key site media and key representative site food items for the selected ROCs (i.e., marine benthic invertebrate and eelgrass tissue chemistry data; site sediment chemistry data). These site-specific data were either used directly in the exposure modelling (which was the case for ROCs that are consumers of benthic invertebrates), or were used to develop site-specific uptake relationships for COCs between sediments and biota. This latter approach was taken for estimating COC uptake from sediments to eelgrass tissues, whereupon estimated COC concentrations in eelgrass were then fed to the herbivorous marine-feeding bird ROC. It is a well-established ERA best practice to use site-specific data when estimating ROC exposures to COCs wherever/whenever possible, as uptake factors or equations developed for a different site (which is the case for such values/equations published in ERA guidance documents and in the scientific literature), may not adequately reflect uptake dynamics at the site under assessment. Appendix G presents the calculated exposure and risk estimates for each ROC that was evaluated quantitatively.

For methylmercury, potential exposures and risks were not estimated for ROCs. Rather, measured tissue concentrations in site benthic invertebrates were compared to both the generic and modified CCME tissue residue guidelines for methylmercury.

Within the current ERA, the assumed exposure scenario is current site conditions. At this time, it is also assumed that current site conditions represent likely future conditions with respect to sediment contamination and potential effects on resident site marine biota. The temporal boundaries for the ERA are also current conditions. Spatial boundaries for the ERA are the current areal extent of the sanctuary boundaries.

5.1 Exposure Point Concentrations (EPCs) for ROCs Assessed Quantitatively

The mammalian and avian ROCs that were quantitatively modelled in the ERA are not sedentary and would be expected to move around the site in search of food and suitable habitat. As noted previously, the relevant biological level of organization for these receptors is populations. To assume that populations or even individuals of these ecological receptors would spend their entire time at, and get all their food from, the locations within the site that have the highest concentrations of COCs, while highly conservative, is also highly unrealistic. As such, the COC exposure point concentrations (EPCs) for sediment that were utilized in the exposure and risk modelling equations for these ROCs were the 95% upper confidence limit on the mean (UCML95). The UCLM95 values were calculated using U.S. EPA ProUCL Version 5.2. The UCLM95 statistic is recommended within current Canadian ERA guidance for use as an EPC (e.g., CCME, 2020; FCSAP, 2012a). EPCs used in the ERA are summarized in Table 5-1.

There were no EPCs utilized for ROCs that were assessed qualitatively (i.e., benthic invertebrates and marine vegetation). Rather, the full site sediment chemistry dataset and other LOEs were used in the assessment of these ROCs.

Table 5-1: Summary of Sediment EPCs used in the Marine ERA for ROCs Assessed Quantitatively.

COC	Maximum Reported Concentration (mg/kg)	EPC (mg/kg)	Comment
Arsenic Sediment	1200	317.9	95% Chebyshev (Mean, Sd) UCL.

COC	Maximum Reported Concentration (mg/kg)	EPC (mg/kg)	Comment
Arsenic in Benthic Invertebrates	6.8	6.8	Sample size not adequate for UCLM95 calculation (N=5); maximum concentration used instead.
Arsenic in Eelgrass	Sediment: 260 Root: 120 Leaf: 28	63.6	BSAF-derived EPC based on average ratios of sediment:root and sediment:leaf arsenic concentrations.

Notes:
UCLM95 values were derived using US EPA ProUCL Version 5.2; BSAF=biota-sediment-accumulation factor.

With respect to methylmercury, no EPCs were estimated as methylmercury was only measured in some marine benthic invertebrate samples (N=5), and methylmercury was not assessed quantitatively. Rather, measured tissue concentrations in site benthic invertebrates were compared to both the generic and modified CCME tissue residue guidelines for methylmercury.

In calculating the UCLM95 sediment concentrations for arsenic, the following tasks/conditions were conducted/applied, all of which tend to bias the UCLM95-based EPCs high:

- For site sediment samples with corresponding laboratory or field duplicates, the higher concentrations out of the original and duplicate samples were retained.
- For any site sediment samples with analytical results for total arsenic below the laboratory reported detection limit (i.e., <RDL), the <RDL values were assumed to equal the RDL.
- Prior to calculating UCLM95-based EPCs, Dillon reviewed the laboratory certificates of analysis for relevant data, as well as the accompanying laboratory quality assurance reports for these data. This review focused on laboratory performance with respect to the RDLs that were achieved, % surrogate recoveries, lab and field duplicate results and relative percent difference or absolute difference (when lab duplicates are compared to original sample results), matrix spikes, method blanks, and spiked blanks. No major analytical issues were identified that would affect the use of these data in an ERA. Thus, the site sediment chemistry data were considered to be of adequate quality for use in the ERA and appropriate for the purposes of EPC calculation.
- As the measured total arsenic concentrations in site sediment samples represent potential concentrations that ecological receptors could come into contact with, no attempt was made to conduct statistical outlier tests to remove extreme values (high or low) from the site sediment chemistry datasets. Thus, the EPC calculations for total arsenic in sediments included the presence of potential extreme values.

As the calculated options for a UCLM95 generated by ProUCL 5.2 can vary considerably (as a function of the underlying assumptions in the statistical models, and the data distribution type), some degree of professional judgement is typically necessary in selecting the most appropriate UCLM95 value for use as the EPC in an ERA. Key considerations often include the data distribution type, the significance level associated with the UCLM95 calculation methods (i.e., ProUCL-recommended values are not always at the 95% significance level), any warnings generated by the ProUCL 5.2 software, and the magnitude of the calculated UCLM95 options.

5.2 Equations, Factors, Parameters and Assumptions Used in the Quantitative Exposure Modeling

Table 5-2 presents the receptor parameters and assumptions that were used to estimate COC exposures to the mammalian and avian ROCs that underwent quantitative exposure modelling (i.e., American Black Duck, Greater Scaup and Northern River Otter). Receptor parameters for the American Black Duck and the Greater Scaup were not readily available (i.e., FCSAP does not provide receptor parameters for these species), thus, other sources of such information were consulted (e.g., Beyer, 2008). For parameters where information was not available for these specific receptors, a surrogate species was used (e.g., a Mallard Duck for the American Black Duck and a Lesser Scaup for the Greater Scaup).

Table 5-2: Summary of Receptor and Exposure Parameters for ROCs Assessed Quantitatively in the Marine ERA.

Parameter/ Assumption	American Black Duck (*Ana rubripes*)	Greater Scaup (*Aythya marila*)	Northern River Otter (*Lontra canadensis*)
Body Weight (kg)	1.18 (Cornell Lab of Ornithology, 2019; average of range given)	1.04 (Cornell Lab of Ornithology, 2019; average of range given)	7.5 (FCSAP, 2012b)
Diet Assumptions	Typical diet is 55% vegetation (mostly aquatic plants but also includes berries and seeds), 45% aquatic invertebrates (FCSAP, 2012b) [A] For quantitative assessment, all vegetation consumption was assumed to be eelgrass, and all invertebrates consumed were assumed to be site marine invertebrates.	Typical diet is 10% aquatic plants and seeds, 90% invertebrates (insects, leeches and amphipods) (FCSAP, 2012b) [B] For quantitative assessment, all vegetation consumption was assumed to be eelgrass, and all invertebrates consumed were assumed to be site marine invertebrates.	Typical diet is 100% invertebrates and fish (e.g., clams, mussels etc.) (FCSAP, 2012b). Conservatively assumed diet is 100% marine invertebrates from the site.

Parameter/ Assumption	American Black Duck (*Ana rubripes*)	Greater Scaup (*Aythya marila*)	Northern River Otter (*Lontra canadensis*)
Average Water Content in Food Items (%)	82.95 (Sample and Suter, 1994)	78.9 (Sample and Suter, 1994)	78 (Sample and Suter, 1994; average of marine bivalves, crabs and shrimp)
Food Ingestion Rate (kg ww/day)	0.346 [A] (FCSAP, 2012b)	0.346 [B] (FCSAP, 2012b)	1.023 (FCSAP, 2012b)
Sediment Ingestion Rate (% of dw food consumption rate)	4 [A] (Beyer, 2008)	3.8 [B] (Beyer, 2008)	2 (FCSAP, 2012b)
Home Range (ha)	9.2 (FCSAP, 2012b)	10 (FCSAP, 2012b)	900 (FCSAP, 2012b)
Temporal Use Factor	1 (Assumed; black ducks can be year-round residents)	0.58 (Assumed; Greater Scaup migrate away from coastal areas for 5 months of the year)	1 (Assumed)
Residency Factor - R	1 (Assumed; black duck home range size is less than site areal extent)	1 (Assumed; Greater Scaup home range size is less than site areal extent)	0.4 (Assumed; based on dividing site area by typical otter home range area (size) and applying a 10-fold uncertainty factor for conservatism)

Notes:
A - Value for the American Black Duck not available, used a Mallard Duck as a surrogate.
B - Value for the Greater Scaup not available, used the Lesser Scaup as a surrogate.
Water content percentages were used to convert intake rates or concentrations between dry weight (dw) and wet weight (ww) units as necessary for ERA exposure calculations.

The following equations (Section 5.2.1) illustrate how total COC exposures were estimated for the mammalian and avian ROCs in the ERA via the selected exposure pathways and routes. Arsenic exposure for the Greater Scaup is used as the example.

5.2.1 Arsenic Uptake and Exposure Calculations for Mammalian and Avian ROCs

Total Arsenic Uptake from Sediment by Marine Vegetation (uptake based on site-specific BSAF determined from paired eelgrass tissue and eelgrass root zone sediment chemistry data)

$$C_p = BSAF * C_{Sed}$$

Where:

C_P	=	Concentration of arsenic in eelgrass tissue (mg/kg ww)
BSAF	=	0.2; site-specific biota-sediment-accumulation factor determined from site eelgrass tissue and site eelgrass root zone sediment chemistry data; unitless
C_{Sed}	=	Concentration of arsenic in sediment (mg/kg)

Total Marine Invertebrate Uptake from Sediment (maximum measured tissue concentration)

$$C_I = Maximum\ reported\ concentration\ in\ marine\ invertebrates$$

Where:

C_I	=	Concentration of arsenic in marine invertebrates (mg/kg ww)

Exposure via Marine Vegetation Ingestion

$$E_{Plant} = \frac{C_P \cdot IR_{Food} \cdot P_{Plant}}{BW}$$

Where:

C_P	=	Concentration of arsenic in vegetation (mg/kg ww)	95.37
IR_{Food}	=	Food Ingestion Rate (kg ww/day)	0.346
P_{Plant}	=	Marine Vegetation Diet Proportion (%)	10%
BW	=	Body Weight (kg)	1.043
E_{Plant}	=	Exposure from marine vegetation ingestion (mg/kg-BW/day)	3.164

Exposure via Marine Invertebrate Ingestion

$$E_{Inv} = \frac{C_{Inv} \cdot IR_{Food} \cdot P_{Inv}}{BW}$$

Where:

C_I	=	Concentration of arsenic in marine invertebrates (mg/kg ww)	6.8
IR_{Food}	=	Food Ingestion Rate (kg ww/day)	0.346
P_{Inv}	=	Marine invertebrate Diet Proportion (%)	90%
BW	=	Body Weight (kg)	1.043
E_{Inv}	=	Exposure from marine invertebrate ingestion (mg/kg-BW/day)	2.03

Exposure via Incidental Sediment Ingestion

$$E_{Sed} = \frac{C_{Sed} \cdot IR_{Sed}}{BW}$$

Where:

C_{Sed}	=	Concentration of arsenic in sediment (mg/kg)	318
IR_{Sed}	=	Sediment Ingestion Rate (kg dw/day)	0.00277
BW	=	Body Weight (kg)	1.043
E_{Sed}	=	Exposure from marine sediment ingestion (mg/kg-BW/day)	0.846

Total Exposure

$$E_{Total} = (E_{Sed} + E_{Inv} + E_{Plant}) \cdot TUF \cdot R$$

Where:

E_{Sed}	=	Exposure from marine sediment ingestion (mg/kg-BW/day)	0.846
E_{Inv}	=	Exposure from marine invertebrate ingestion (mg/kg-BW/day)	2.03
E_{Plant}	=	Exposure from marine plant ingestion (mg/kg-BW/day)	3.164
TUF	=	Temporal Use Factor (unitless; assumed)	1
R	=	Residency Factor (unitless; assumed)	1
E_{Total}	=	Total Exposure (mg/kg-BW/day)	6.03

6.0 Hazard/Effects Assessment

The effects assessment (also commonly referred to as the hazard or toxicity assessment) step of ERA evaluates the potential for chemical exposure to elicit an adverse effect, or a toxic response, in the ROCs. The toxicity of a chemical depends on the amount taken into an organism or its tissues and the duration of the exposure (i.e., the length of time the receptor is exposed to the chemical). For every chemical, there is an exposure level or dose, and a duration of exposure, which is necessary to produce a toxic effect in the ROCs (this is referred to as the exposure–response or dose-response relationship). In the effects assessment step of an ERA, information relating to the exposure-response or dose-response relationships of COCs is evaluated in order to determine an exposure or dose that is acceptable (unlikely to cause harm) in the ROCs selected for evaluation. Such exposures or doses are commonly referred to as toxicity reference values (TRVs). Such values may exist for a number of biological endpoints but the most commonly evaluated endpoints in ERA are effects on growth, reproduction, and survival. This is consistent with the fact that for most ROCs evaluated in an ERA, the relevant level of biological organization is populations or communities. TRVs for a given COC may vary depending on the ROC that is under evaluation. The major outcome of the effects assessment step in an ERA is the identification of TRVs for each receptor-COC combination that is assessed.

TRVs can be expressed in different ways depending on the COC (and its properties), and the receptor or receptor group. Many TRVs are expressed as a dose (e.g., mg/kg body weight/day) and are commonly used to evaluate risks to mammalian and avian receptors via ingestion-based exposure pathways (and occasionally dermal and inhalation-based pathways). TRVs can also be expressed as environmental media or tissue concentrations (although few tissue-based TRVs have been developed to date). Such TRVs are often used in the ERA of receptors that are assessed as communities, and that are in direct contact with an exposure medium (such as marine aquatic life in contact with surface water and sediments). For such receptor groups, the selected TRVs are generally regulatory environmental quality benchmarks that considered these types of organisms in their derivation (e.g., CCME surface water and sediment quality guidelines).

It is important to recognize that when/if ecological TRVs are exceeded by estimated exposures, it does not necessarily imply that there is a risk of adverse ecological effects. Rather, it suggests that further evaluation or consideration of additional lines of evidence may be warranted before reaching final conclusions on the potential for ecological risk. This is discussed further in the risk characterization section below (Section 7.1).

For receptors that were quantitatively modelled (i.e., American Black Duck, Greater Scaup and Northern River Otter), published regulatory TRVs were preferentially used, where available (i.e., FCSAP, 2021).

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The FCSAP (2021) mammalian and avian TRVs for arsenic (the sole COC in the ERA) are based on no-observed-adverse-effect-levels (NOAELs) for reproduction, growth and/or survival. These NOAEL-based TRVs were selected for use in the ERA modelling. As these TRVs are based on no effect concentrations (generally the lowest no effect concentration of those identified), an exceedance of the TRVs does not indicate a potential ecological risk. Rather it indicates that further evaluation/discussion is warranted. The mammalian and avian TRVs selected for the marine ERA are provided in Table 6-1.

Table 6-1: Summary of TRVs Used in the Marine ERA

COC	Avian TRV (Reference); mg/kg-BW/day	Basis for Avian TRV	Mammalian TRV (Reference); mg/kg-BW/day	Basis for Mammalian TRV
Arsenic	4.4 (FCSAP, 2021)	Reduced growth rate in chickens (second lowest EC_{20} of eight studies).	1.04 (FCSAP, 2021; US EPA, 2005)	Growth inhibition in beagle dogs (highest bounded NOAEL of 55 studies)

6.1 Marine Invertebrate Tissue Residue Benchmarks and Toxicity Values

Strum (2024a) compared site marine invertebrate tissue concentrations of arsenic and methylmercury (MeHg), to Health Canada Maximum Levels and to the CCME (2000) tissue residue guideline (TRG) for MeHg. The Health Canada Maximum Levels are based on human health and the scenario of human consumption of seafood products. As such, these values are not appropriate for ERA purposes and are not considered further herein. The CCME TRG for MeHg is only for protection of avian and mammalian consumers of prey items that contain MeHg, and is not appropriate for determining potential effects in the tissues of the prey organisms that are consumed by birds or mammals.

Given these issues and observations, selected relevant scientific literature and the US ACE ERED database (U.S. Army Corps of Engineers Environmental Residue-Effects Database; https://ered.el.erdc.dren.mil/index.cfm) were searched and reviewed in an attempt to identify more appropriate ecological health-based tissue residue benchmarks for both the site-sampled marine invertebrates (e.g., clams, mussels, crabs), and for potential avian and mammalian consumers of these marine invertebrates sampled from the site. ERED is the largest and most comprehensive database that exists for tissue residue effects data for both marine and freshwater aquatic organisms.

It should be recognized that the tissue residue toxicity values for the COCs in marine invertebrates that were summarized from ERED, are based almost entirely on aqueous exposure studies in laboratories. These exposure conditions may not represent sediment-based exposures. Although, it is likely that tissue residue effects concentrations that were determined using aqueous exposure conditions would be more conservative than tissue residue effects that are based on sediment exposure conditions. This is because aqueous exposures tend to be considerably more bioavailable to biota than exposures incurred from a more complex sediment matrix, where sorption and sequestration occur to a much greater degree than in the water column. However, regardless of the exposure route used in the derivation of tissue or whole body residue toxicity values, such values are generally viewed as being independent of exposure route as they are the tissue or whole body concentrations associated with some effect, and these concentrations could be reached via various exposure routes including aqueous, dietary and sediment-based routes.

While some benchmarks and/or toxicity values for tissue or whole body concentrations of the COCs in marine invertebrates are available within the scientific literature, and in the ERED database, such values should be applied with caution. This is because given the diversity of life history strategies, diet/food preferences, behavioural ecology, physiology, and biochemistry between marine aquatic invertebrate taxa, the amount of metal/metalloid in tissues or whole body of marine invertebrates that may result in toxicity, is highly variable (Rainbow and Luoma, 2011). These authors also state that a tissue or whole body concentration that is high in one aquatic invertebrate species may be typical in another with no suggestion or indication of local contamination or a potential for toxicity. For example, a very high zinc concentration in the mussel *Mytilus edulis* would be considered a typical zinc concentration in another bivalve, the tellinid clam, *Scrobicularia plana* (Rainbow and Luoma, 2011).

The only two COCs that were considered in the ERA with respect to tissue residues in site marine invertebrates are arsenic and mercury (including methylmercury). Identified tissue residue benchmarks and/or toxicity values for these COCs are briefly described below.

Arsenic

Despite the noted caution by Rainbow and Luoma (2011) on the application and interpretation of aquatic invertebrate tissue concentrations of metals/metalloids, these authors identified typical and high ranges for arsenic (in µg/g dw), where 'high' values may be suggestive of a potential for adverse effects (though not necessarily), and 'typical' values reflect commonly observed tissue and/or whole body concentrations that are unlikely to be associated with any apparent manifestation of toxicity. 'High' values also indicate an atypically elevated bioavailability of a given metal/metalloid to an aquatic invertebrate, at a given aquatic site.

For potentially relevant species for the whale sanctuary site, the following typical and high arsenic tissue values were reported by Rainbow and Luoma (2011). Tissue values for the other COCs considered for marine invertebrates in the ERA (i.e., methylmercury) were not reported by these authors. The typical and high values for arsenic, as reported by the authors, are expressed as dry weight concentrations. However, the site marine invertebrate tissue chemistry data are expressed as wet weight concentrations. As such, the typical and high levels from Rainbow and Luoma (2011) are provided both 'as-reported' and converted to wet weight concentrations, using standard invertebrate water content data from U.S. EPA (1993; i.e., 75% based on reported water content data for several aquatic invertebrate species).

- *Scrobicularia plana* (tellinid clam): typical arsenic concentration of 5 to 31 µg/g dw in soft tissues; high arsenic concentration of 98 to 191 µg/g dw in soft tissues. In wet weight concentration units, these values become **1.3 to 7.8 µg/g ww for typical arsenic concentrations**, and 24.5 to 47.8 µg/g **ww for high arsenic concentrations**.
- *Balanus amphitrite* (barnacle): typical arsenic concentration of 10 to 71 µg/g dw in soft tissues; high arsenic concentration of 457 µg/g dw in soft tissues. In wet weight concentration units, these values become **2.5 to 17.8 µg/g ww for typical arsenic concentrations**, and 114 µg/g ww for a high arsenic **concentration.**

Tissue residue toxicity values for arsenic that were identified from ERED are summarized below. All such values identified from ERED apply directly to marine aquatic invertebrate organisms and not to avian or mammalian or other predator consumers of marine invertebrates.

- In adult blue mussels exposed in situ for 90 days, whole body NOEC/NOED values for growth and mortality endpoints were 3.6 µg/g ww.
- In juvenile daggerblade grass shrimp (crustaceans) that underwent aqueous and dietary exposure for 28 days, whole body NOEDs ranged from 1.0 to 1.3 µg/g ww, based on growth endpoints.

Mercury/Methylmercury

Tissue residue toxicity values for mercury/methylmercury that were identified from ERED are summarized below. All such values identified from ERED apply directly to benthic marine aquatic invertebrate organisms and not to avian or mammalian or other predator consumers of marine invertebrates.

It is noted that mercury in marine biota will consist of a mix of inorganic mercury compounds and methylmercury. Marine invertebrates can vary greatly with respect to the proportion of total mercury that is inorganic mercury or methylmercury. For example, in various marine shellfish species, the range of means for proportion of methylmercury out of total mercury was 14% to 98% methylmercury (EFSA, 2012). The studies compiled in the ERED utilized a mix of laboratory aqueous exposures to inorganic mercury, methylmercury and often unspecified forms of mercury.

- In marine snails (adult and larval stages of common slipper shell snail, and adult banded mystery snail), effects-based tissue residue toxicity values mercury were as follows. All values are based on aqueous exposure studies, and all are based on mercury concentrations measured in either whole body or soft tissues of snails. In these studies, the snails were exposed from 35 to 112 days.
  - NOEC/NOED values ranged from 5.4 to 22 µg/g ww – for reproductive and mortality endpoints.
  - LOEC/LOED values ranged from 8 to 16 µg/g ww – for reproductive and developmental endpoints.

  - Effects-level toxicity values (i.e., EC/ED 20; EC/ED25; EC/ED34) ranged from 8 to 23.4 µg/g ww – for growth and reproductive endpoints.
- In adult marsh clams (aqueous exposure to mercury chloride for 4 to 8.75 days), the whole body LD50 was 20 µg/g ww, and the LOEC was 73 µg/g ww – both for the mortality endpoint.
- In mussels (three different species including *M. edulis* – which occurs on the site), adults that incurred aqueous exposure to mercury (unspecified) for durations up to 5 days had NOEC/NOED values ranging from 1.12 to 73.4 µg/g ww - for mortality and physiological endpoints in several mussel tissue types (including: adductor muscle, gills, plasma, digestive tract). Various ED values (for % effects ranging from 41% to 83% for the same or similar endpoints that the NOECs/NOEDs were reported for), were also reported for mussels, and ranged from 0.6 µg/g ww (based on reduced filtration rate) to 213 µg/g ww (based on enzyme activity changes).
- In adult daggerblade grass shrimp (aqueous exposure for 30 days), a whole body NOEC/NOED of 1.64 µg/g ww was reported, based on mortality. A LOEC/LOED of 1.64 µg/g ww was also reported, based on behavioural endpoints.
- In adult Atlantic marsh fiddler crabs (aqueous exposure for 22 days), LOECs/LOEDs ranged from 12.3 to 19.4 µg/g ww – for developmental endpoints.

CCME Tissue Residue Guideline (TRG) for Methylmercury

CCME (2000) developed a tissue residue guideline (TRG) for methylmercury of 0.033 µg/g ww. This TRG is the lowest of calculated mammalian and avian tissue residue concentration values, and was recommended as the Canadian TRG for the protection of wildlife that consume freshwater, marine and estuarine biota. The CCME TRG cannot be used as a point of comparison for determining potential effects in aquatic prey organisms (e.g., fish, invertebrates). The CCME TRG for methylmercury is known to be inappropriately conservative to apply at most locations as it is based on protection of the storm petrel, an offshore piscivorous bird that consumes nearly its entire body weight each day in terms of food consumption. The storm petrel is not known to occur near or on the site and this species was not identified in the site bird survey (Flemming, 2021). As such, the CCME TRG for birds was recalculated using the CCME approach, but for a species more representative of the birds known to occur at the site, and evaluated within the marine ERA (i.e., mallard duck).

CCME (2000) also calculated a TRG for mammals that consume aquatic organisms. This CCME TRG (i.e., 0.092 µg/g ww - based on mink) was considered appropriate for use in the ERA without modification.

Recalculation of the avian TRG was conducted for a mallard duck (which occur on site and are a reasonable surrogate for the black duck, which was assessed as a ROC in the marine ERA), using the same approach the CCME used to derive the TRG for the storm petrel. By substituting food ingestion and body weight values for the storm petrel with those for the mallard duck (obtained from FCSAP, 2012b), and keeping the avian TDI value the same as that used in the storm petrel calculation (the TDI used by CCME (2000) is actually based on effects in mallard ducks), a revised mallard duck TRG of 0.106

µg/g ww was determined. Appendix G provides the calculation for the mallard duck-based TRG for methylmercury.

7.0 Risk Characterization

In an ERA, the risk characterization step is the process by which the probability, magnitude, and extent of adverse ecological effects (based on the information obtained from the exposure and effects assessments for each LOE) are estimated (FCSAP, 2012a). These risks are then integrated and interpreted across multiple lines of evidence to determine the overall potential for ecological risks using a weight of evidence (WOE) approach. LOE for each ROC can be found in Table 4-6.

The risk characterization step also serves to translate the complex scientific information that comprises the previous steps of the ERA process into a format that is useful, unambiguous and understandable for risk managers. Another key element of risk characterization in an ERA is to acknowledge, evaluate, and/or discuss the major strengths, limitations, conservative assumptions and uncertainties arising from the information used to estimate exposure and potential risk to the ROCs (FCSAP, 2012a; CCME, 1996).

The risk characterization of all ROCs in the ERA utilized a simple qualitative weight of evidence (WOE) approach. FCSAP (2012a) defines a WOE approach as “any process used to aggregate information from different lines of scientific evidence to render a conclusion regarding the probability and magnitude of harm”. The BC SAB (2008) similarly defines WOE as, “the process by which measurement endpoints, which are closely linked to LOE, are integrated to evaluate the likelihood and magnitude of ecological risks for each assessment endpoint”. These definitions encompass a wide range of potential techniques and practices, ranging from those that are qualitative, and/or based on professional judgment, to those that involve complex quantitative and/or statistical methods. The type of WOE approach used generally reflects the scale/scope, the level of effort, and the numbers and types of LOE considered in the ERA. Irrespective of how the WOE assessment is conducted, key principles are objectivity, transparency, clarity, consistency, reasonableness and scientific rigor (BCSAB, 2008; FCSAP, 2012a).

Prior to risk characterization, a relevance check was conducted between the ERA objectives and goals with respect to the selected ROCs, and it was determined that the selected assessment and measurement endpoints and LOE for these receptors and receptor groups were consistent with the ERA goals and objectives.

7.1 Ecological Hazard Quotients

The ecological hazard quotient (EHQ) is calculated for receptors that are quantitatively modelled in the ERA and consists of a simple ratio between the estimated exposure rate for a given ROC (i.e., EXP_{Total}), and the applicable TRV, as follows:

$$HQ = \frac{EXP_{Total}(mg/kg\ BW/day)}{TRV\ (mg/kg\ BW/day)}$$

It is standard ERA practice to utilize a target EHQ value of 1.0. Thus, if the calculated EHQ is less than 1.0, exposures are lower than the TRV, and it is typically concluded that the potential for adverse effects is low or negligible. However, if the calculated EHQ exceeds 1.0, meaning exposure is potentially greater than the TRV, it does not necessarily indicate that adverse effects are likely. Rather, the assumptions and data used in the ERA, for all LOEs, are reviewed prior to determining whether or not there is a potential for ecological risk for a particular ROC, and if further assessment appears warranted. Consideration of the key uncertainties, limitations and conservative assumptions within the ERA are also important factors in ecological risk characterization.

It has become relatively common among ERA practitioners in recent years to consider traditional quantitative ERA modeling outcomes (i.e., ecological hazard quotients) as a means to rule out certain chemicals, receptors and exposure pathways from further evaluation, rather than relying on such outcomes as definitive or representative estimates of potential ecological risk. The current FCSAP ERA guidance (FCSAP, 2012a) notes that hazard quotients are simple ratios, and that situations where an EHQ exceeds 1.0 only indicate an adverse response is possible, and that more precise or accurate evaluation of ecological risks may be warranted to address uncertainty. This guidance further notes that where EHQs are calculated, care must be taken not to infer more information from the ratio than is warranted. While EHQs are relatively easy to derive, they are often misinterpreted (Allard et al. 2010), with common errors including the belief that an EHQ is directly proportional to the magnitude of risk. EHQs neither contain information about the specific probability that an adverse effect will occur, nor do they convey any information about the magnitude of a potential adverse effect (FCSAP, 2012a). The FCSAP ERA guidance further elaborates on key items that must be considered to put EHQs in perspective and use them as meaningful lines of evidence in ERAs.

7.2 PEL-Quotients (PEL-Q) and Mean PEL-Qs

To provide additional context beyond sediment quality benchmark comparisons in the assessment of marine benthic invertebrates, the PEL-Q and mean PEL-Q approach was applied. This approach applies only to benthic invertebrates.

The PEL-Q and mean PEL-Q approach is commonly used in many regulatory sediment assessment programs and within the contaminated sediments scientific literature.

The approach can provide a simple integrative index that allows for meaningful “normalized” comparisons of sediment chemistry data to PEL or similar types of sediment quality benchmarks. PEL-Q and mean PEL-Q values can only be calculated for those parameters that have PEL or similar types of sediment quality benchmarks available. Thus, any target analytes in site sediments that lack a PEL or similar value were excluded from PEL-Q and mean PEL-Q calculations. While CCME PELs exist for most parameters of interest in site sediments, there are some parameters that lack CCME PELs. As noted previously in Section 4.8.3, where CCME PELs were lacking, similar sediment quality benchmarks from other jurisdictions were utilized.

Mean PEL-Q values for sediment samples were obtained as follows (using a generalized example of the calculation based on Long et al., 1995):

$$\text{mean PEL} - \text{Q} = \sum_{i=1}^{n} \frac{\left(\frac{C_i}{PEL_i}\right)}{n}$$

Where:

C_i = sediment concentration of each contaminant of interest (mg/kg);

PEL_i = PEL (or similar benchmark) for each contaminant of interest (mg/kg); and

n = total number of analytes in the sample that have a PEL or similar sediment quality benchmark.

In other words, each parameter in a sample has its sediment concentration divided by its applicable PEL (or similar benchmark) to yield a PEL quotient (PEL-Q). Each PEL-Q for each parameter in the sample is then summed together, and this total summed value is then divided by the total number of parameters that have a PEL or similar benchmark available, to yield the mean PEL-Q for a given sample. Using this approach, mean PEL-Q values were determined for each marine sediment sample at the site.

For the calculation of PEL-Qs and mean PEL-Qs, the following occurred.

- It was conservatively assumed that any substances reported to have a sediment concentration <RDL were actually present in site sediments at the RDL value.
- For any site sediment samples with a field duplicate, the higher parameter concentrations between the original sample and its duplicate were retained.
- Calculation of PEL-Qs and mean PEL-Qs occurred for all substances among the sediment target analytes that had a PEL or similar benchmark available. This included a number of substances that were excluded as sediment COCs (See **Section 4.8.3**).

7.3 Risk Characterization Results

7.3.1 Mammalian and Avian ROCs

Table 7-1 presents the EHQs for the mammalian and avian ROCs that were quantitatively evaluated in the ERA, based on the initial NOAEL-based TRVs from Table 6-1. Appendix G provides further information on the exposure and risk estimates for these ROCs, including the food chain modelling calculations and assumptions used to derive the EHQs.

Table 7-1: Summary of EHQs for Mammalian and Avian ROCs

COC	EHQ		
	American Black Duck	Greater Scaup	Northern River Otter
Arsenic	**2.6**	0.58	0.35

Notes:
Bold values denote an exceedance over the target EHQ of 1.0.

The EHQ results for arsenic (the sole COC) for the otter and scaup were less than the target EHQ of 1.0. Given the conservatism inherent in the TRVs selected for the derivation of these EHQs, as well as the conservatism within the ERA exposure modelling methods, arsenic in site sediments and biota is not of ecological concern to populations of these ROCs, and does not pose an ecological risk. The EHQ for the black duck was 2.6. Low EHQ values such as this also suggest an ecological risk is unlikely, given the conservatism inherent to the TRVs and the ERA exposure modelling. There are not many reliable alternative arsenic TRVs for birds that could be used in place of the selected FCSAP avian TRV. However, U.S. EPA (2005) cites mallard duck LOAELs that range up to 17.3 mg/kg BW/day for biochemical, pathology, and growth endpoints, and a LOAEL of 46 mg/kg BW/day for behavioural endpoints. If the lower of these LOAELs is used in place of the FCSAP NOAEL-based TRV, the EHQ for the black duck drops below the target EHQ of 1.0 (i.e., EHQ=0.66), which suggests ecological risk is unlikely for this ROC. It is a common and even preferred ERA practice to utilize LOAEL or other effects-based TRVs when assessing avian and mammalian ROCs at a population level. NOAEL-based TRVs are best used in initial exposure and risk modelling, given their high inherent conservatism, as they are not based on doses associated with adverse toxicological effects, but rather, are based on doses associated with no observed adverse toxicological effects.

Support for a lack of ecological risk posed by arsenic in site sediments and marine biota to the black duck and greater scaup comes from bird survey observations reported in Flemming (2021). In this survey, Greater Scaup occurred in the highest densities and abundance relative to other invertevorous birds, and was the most frequently observed bird species at and near the site. Black ducks were the most commonly observed waterfowl species at and near the site and were also present in abundance during the survey. Frequent survey observations of black ducks and Greater Scaup at relatively high abundance and densities at the site does not indicate any population level impairment to these species.

As noted previously, while EHQs can provide a conservative indication of whether or not the assessed exposure conditions pose a potential for ecological risks, they are not necessarily definitive or even accurate representations of true ecological risk, and cannot predict the specific probability that an adverse effect will occur in a given ROC, or convey information about the possible magnitude of a potential adverse effect. As such, it has become common in ERAs to rely equally or more on other LOE relative to EHQ values, when using an overall WOE approach, to determine if the potential for ecological risk is significant enough, and reliable enough to merit further study or corrective action. For the current assessment, more weight was given to the other LOE than the EHQs. Thus, bird survey observations in relation to the assessed species are considered more meaningful indications of population ecological risk and overall health, relative to the predicted EHQ values.

Summary

In summary, ERA exposure and risk modelling of the avian and mammalian ROCs suggests that arsenic in site sediments and biota does not pose an ecological risk to populations of Black Duck, Greater Scaup or Northern River Otter. The EHQs also suggest that potential ecological risks to individuals of these species would also be unlikely. As these ROCs are considered conservative surrogate species for their feeding guilds, it follows that potential risks to other marine-feeding invertevorous and herbivorous bird and mammal populations would also not be at risk, due to the presence of arsenic in site sediments and biota.

7.3.2 Marine Vegetation

The assessment of the marine vegetation ROC is based largely on eelgrass as a surrogate for other marine vegetation.

As noted in previous sections of the ERA, eelgrass is present and abundant at many locations within the site and is particularly abundant and of good apparent health (based on visual observation) in the vicinity of the arsenic-impacted sediment area. Figure 7-1 shows the eelgrass delineation for the site, and Figure 7-2 shows the eelgrass delineation with the areas of site sediment arsenic impacts.

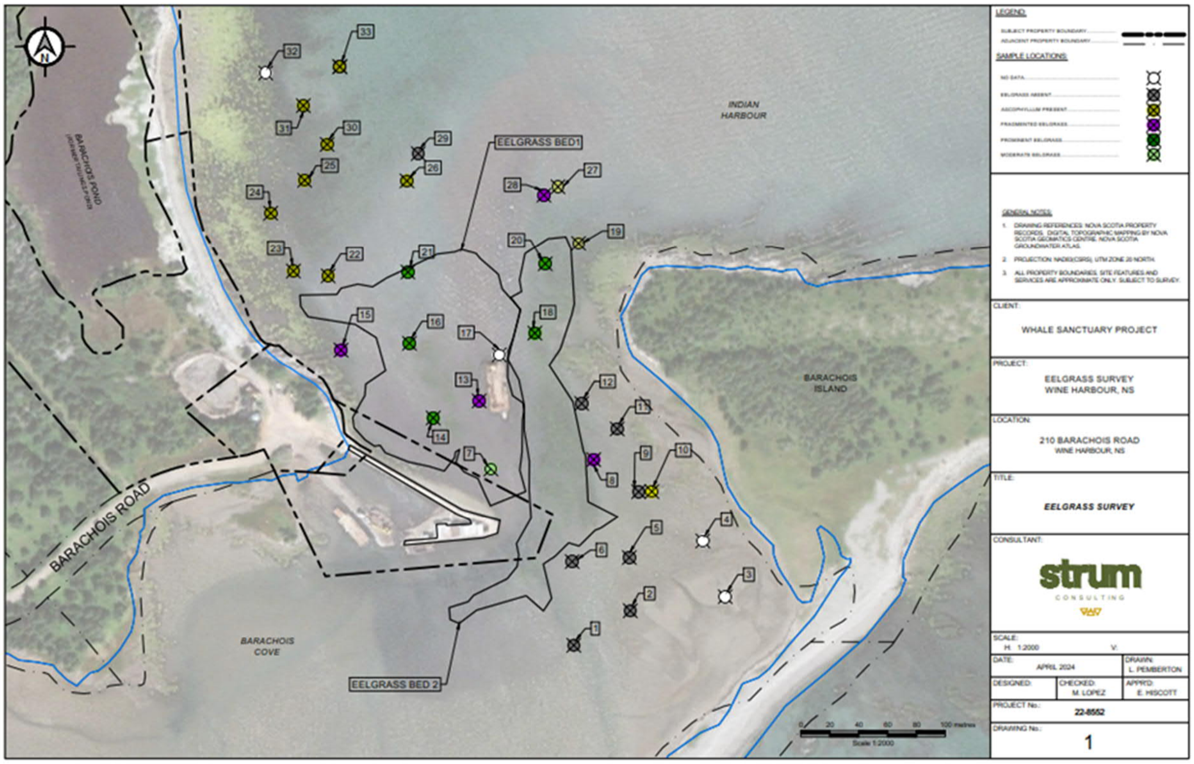

Figure 7-1: Site Eelgrass Delineation (Strum, 2024a).

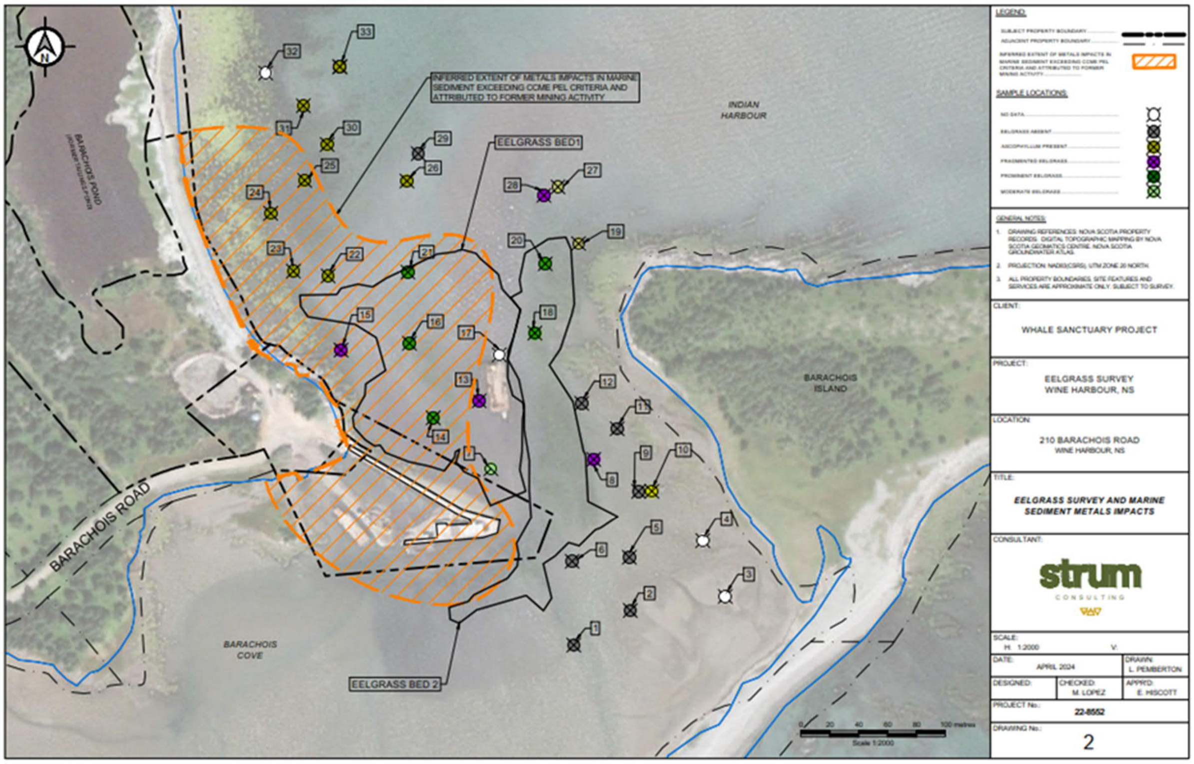

Figure 7-2: Site Eelgrass Delineation with Area of Sediment Arsenic Impacts (Strum, 2024a).

Given that eelgrass is apparently healthy and abundant in the areas of the site with the highest sediment arsenic concentrations, the arsenic-impacted sediments do not appear to be causing any impairment to the site eelgrass population and community. Other biological surveys of the site, including diver surveys, identified a number of other marine vegetation types of high diversity and abundance within the arsenic-impacted areas of the site. The diver survey outcomes (as reported by Babin, 2021) revealed the following with respect to marine vegetation:

- Numerous marine flora were observed during the diver surveys, and included many common and expected species and/or assemblages for the region of NS that the site is located in. The observed species varied in abundance (as expected) as a function of substrate conditions. Though not a conclusion reported in Babin (2021), review of diver survey outcomes and observations by Dillon ERA personnel determined that marine flora observations at the site do not suggest impairment of any observable ecological community or assemblage, even in the portions of the site which display the highest sediment arsenic concentrations.
- The types of marine vegetation species observed during diver surveys included but were not necessarily limited to: various seaweed/rockweed algal species (mostly brown algal species), red algal species (including Irish moss and various Coralline algal species), green algal species, various other types of algal species, and cordgrass (in the intertidal zone only).

The site locations where eelgrass beds occur appear to be independent of sediment arsenic contamination and more a reflection of substrate types and conditions, water depth, and tidal cycles. For example, eelgrass is not typically found in deeper water and tends to only occur where water depth is <10 m (though most commonly <3 to 4 m) (DFO, 2009; Vercaemer et al., 2022). This is mainly a function of light penetration through the water column to enable photosynthesis. Eelgrass also tends to be absent in areas that are exposed (not covered by water) during tidal cycles (Vercaemer et al., 2022). Eelgrass also tends to prefer growing in sediments composed of fine sand/silt, and locations with higher clay content and/or coarser sand and gravel/cobble substrate tend to have no or limited eelgrass presence (Vercaemer et al., 2022).

Site eelgrass tissue (root and leafy portion) sampling and analyses occurred in June, 2024, along with paired root zone sediment sampling and analyses. This program enabled development of a BSAF for arsenic that was assumed to represent other marine vegetation at the site as well. Appendix C provides a summary of the sampling program and the data. Site eelgrass was found to preferentially take up arsenic in roots more so than leafy tissues. Similar findings were reported by Ferrat et al., (2012), Lin et al., (2016), and Vercaemer et al., (2022) where arsenic tended to associate with eelgrass root tissues and lower stems to a much greater extent than the shoots and other leafy portions in the water column.

The fact that eelgrass accumulates metals and metalloids from sediments has led to some recent research exploring the phytoremediation and bioindicator potential of eelgrass (e.g., Lee et al., 2019). However, eelgrass may not be suitable for phytoremediation of some substances, including arsenic. Lee et al., (2019) found no significant correlations between arsenic (and some metals) concentrations in eelgrass tissues and sediments where eelgrass was growing.

In a recent study of eelgrass communities affected by former gold mine and mill operations in Nova Scotia, Vercaemer et al., (2022) noted findings similar to what was observed at the sanctuary site. That is, while eelgrass accumulates arsenic from sediments, the overall condition of eelgrass plants in the surveyed areas were considered healthy, despite the magnitude of the root or leafy tissue arsenic concentrations. Thus, eelgrass appears quite tolerant of sediment arsenic contamination. Literature searches were conducted to identify water or sediment or tissue levels of arsenic that may be associated with adverse effects in eelgrass, but no relevant data were identified. Vercaemer et al., (2022) also noted a paucity of available data on arsenic effects in eelgrass.

Summary

In summary, the discussion above collectively indicates that site eelgrass communities are not impaired by the presence of arsenic in site sediments. In fact, they appear to be thriving in the areas of the site with the highest sediment arsenic concentrations. All LOEs considered for site marine vegetation communities (i.e., eelgrass survey outcomes; visual observations of abundance, diversity and health of site marine flora, including eelgrass; observations of expected marine flora species and assemblages for the site habitat conditions with no apparent visual indications of impairment; eelgrass tissue chemistry results; and, observations that eelgrass abundance is highest in areas of highest sediment arsenic impacts - suggesting high eelgrass tolerance to arsenic in sediments), indicate a negligible potential for ecological risk.

While remediation of contaminated sediments to protect eelgrass is certainly not required at the site, sediment remediation in areas of eelgrass presence merits caution regardless of the contaminants present or the degree of contamination present. This is because eelgrass is the dominant seagrass species in Atlantic Canada and has been designated an Ecologically Significant Species (ESS) by the Department of Fisheries and Oceans (DFO, 2009) and an environmental sustainability indicator by Environment and Climate Change Canada (ECCC, 2020). Consequently, it is recognized by DFO as important fish habitat and has been prioritized for conservation, as eelgrass beds provide many critical ecosystem services, such as fisheries maintenance, shoreline protection, nutrient cycling and storage, and water filtration (Barbier et al. 2011, Fourqurean et al. 2012, Duffy et al. 2015). Furthermore, in recent decades, eelgrass abundance and distribution has been declining due to various ecological stressors and changes (Vercaemer et al., 2022). Thus, any contaminated sediment areas where eelgrass is present must carefully weigh ecological protection achieved via remediation, against potential damage to existing eelgrass communities, and any proposed sediment remediation program in eelgrass areas would require consultation with and approval from DFO, ECCC, NSECC and NSNRR.

7.3.3 Marine Benthic Aquatic Life

The only COC identified in site marine sediments (based on comparisons to sediment quality benchmarks) was arsenic. As previously noted, the areas of the site with PEL sediment quality benchmark exceedances for arsenic were localized to the nearshore vicinity of the former gold stamp mill, and represent a small portion of the overall site area (roughly 15 to 20% of the site area). Figure 7-2 (above) shows the area of the site with exceedances over the PEL for arsenic. The majority of site sediment samples did not display marine sediment quality benchmark exceedances for arsenic.

As noted in Section 7.2, the PEL-Q and mean PEL-Q approach was applied to provide additional context beyond sediment quality benchmark comparisons in the assessment of marine benthic invertebrates. In the interpretation of mean PEL-Q values, a target mean PEL-Q of 1.0 is considered reasonable given that such values are analogous to an ecological hazard quotient or ecological hazard index. It is very common for ERAs to use a value of 1.0 as the target ecological hazard quotient or index value, wherein ecological risk estimates <1.0 are routinely considered to be insignificant and not requiring action. Thus, site sediment samples with a mean PEL-Q below 1.0 are not considered to pose a potential for ecological risk. The same reasoning applies to site-wide average mean PEL-Q values.

Calculation of PEL-Qs and mean PEL-Qs for the site marine sediment samples revealed the following outcomes (Appendix H provides the calculated PEL-Q and mean PEL-Q values for all site sediment samples).

- Mean PEL-Q values ranged from 0.13 to 29 across the site sediment samples. The average (arithmetic mean) mean PEL-Q across all marine site sediment samples was 1.5.
- The average mean PEL-Q across all sediment samples is biased high by one sample (SED-G-3-S1), which had a reported arsenic concentration of 1200 mg/kg. Excluding this one sample yielded an average site-wide mean PEL-Q of 0.67.
- Only 7 site sediment samples (out of 35 samples; 20%) had a mean PEL-Q that exceeded 1.0, and the exceedances were marginal in 4 of these 7 samples.

Diver surveys of the site (reported by Babin, 2021) indicate that the arsenic-impacted site sediments do not appear to be causing any impairment to the site benthic invertebrate communities. Surveys identified numerous types of benthic invertebrates that displayed a high diversity and abundance within the arsenic-impacted areas of the site, and the remainder of the site as well. More specifically, the diver survey outcomes (as reported by Babin, 2021) revealed the following with respect to site marine benthic invertebrate communities.

- Numerous marine benthic fauna were observed during the diver surveys, and included many common and expected species and/or assemblages for the region of NS that the site is located in. The observed species varied in abundance (as expected) as a function of substrate conditions. Though not a conclusion reported in Babin (2021), review of diver survey outcomes and observations by Dillon ERA personnel determined that marine benthic fauna observations at the site do not suggest impairment of any observable ecological community or assemblage, even in the portions of the site which display the highest sediment arsenic concentrations.
- The types of marine benthic species observed during diver surveys included but were not necessarily limited to: amphipods, clams, barnacles, various crab species, various finfish (most not able to be identified conclusively, but rock gunnel and possibly smelt were observed), hydroids, various annelid worms, isopods, limpets, periwinkles, occasional lobster, mussels, sculpin, mysid shrimp, whelks, hydrozoans, various snails, tunicates, and bryozoans.
- Species (or genus) richness and abundance estimates are provided in the diver survey notes reported in Babin (2021). Species richness was reported to range from 57 to 63 for the observed site quadrats and transects.

In addition, bird survey outcomes from Flemming (2021) indicated large numbers of bird species at and near the site that predate upon a variety of benthic invertebrates. These bird survey outcomes suggest that benthic invertebrate food items for these bird species are abundant at and near the site.

Marine Invertebrate Tissue Concentrations of COCs

A limited number of site marine benthic invertebrates were sampled and analyzed (N=6, including one laboratory duplicate; the 6 samples were composite samples of 59 individual specimens) for metals and metalloids by Strum (2024a). The two COCs of interest in marine invertebrate tissues were arsenic and methylmercury (where methylmercury is a COC solely on the basis of minor exceedances of two rock crab composite samples over the CCME (2000) TRG). This section compares measured concentrations of arsenic and methylmercury in site benthic invertebrates to the benchmarks and toxicity values previously presented in Section 6.1.

Arsenic

Site benthic invertebrate total arsenic concentrations ranged from 2.9 to 6.8 mg/kg ww in the composite samples (N=6).

These concentrations are within the range of 'typical' total arsenic concentrations reported by Rainbow and Luoma (2011) for tellinid clam and barnacle tissue arsenic levels (i.e., 1.3 to 17.8 mg/kg ww), and below the range of 'high' arsenic concentrations reported by Rainbow and Luoma (2011) for these same species (i.e., 24.5 to 114 mg/kg ww). As noted in Section 6.1, 'high' values may be suggestive of a potential for adverse effects and/or elevated bioavailability (though not necessarily), and 'typical' values reflect commonly observed tissue and/or whole body concentrations that are unlikely to be associated with any apparent manifestation of toxicity. The measured site benthic invertebrate arsenic concentrations are also within the range of, or slightly above, NOEC/NOED toxicity values identified from ERED for blue mussels and daggerblade grass shrimp (i.e., 1 to 3.6 mg/kg ww). However, as NOEC/NOED values correspond to no-effects levels, the significance of exceeding these values is uncertain and is likely inconsequential.

Collectively, the comparison of measured total arsenic concentrations in site benthic invertebrate tissues to the identified benchmarks and toxicity values suggests that total arsenic concentrations in site benthic invertebrates are unlikely to be associated with toxicity in the species that were sampled.

Mercury/Methylmercury

Site benthic invertebrate total mercury (which includes the proportion of mercury that is methylmercury) concentrations ranged from 0.019 to 0.05 mg/kg ww in the composite samples (N=6). Methylmercury concentrations in the benthic invertebrate tissue samples that were analyzed for this parameter (N=7, including two laboratory duplicates) ranged from 0.0095 to 0.038 mg/kg ww.

The site invertebrate total mercury and methylmercury concentration ranges are well below the tissue residue benchmarks and toxicity values compiled from ERED for relevant marine invertebrate species (Section 6.1; overall range of NOEC/NOED, LOEC/LOED, EDx/ECx, and LD50 values: 0.6 to 213 mg/kg ww).

With respect to the CCME TRG for methylmercury, and as noted above, two rock crab composite samples analyzed for methylmercury slightly exceeded the TRG of 0.033 mg/kg ww. This TRG is the lowest of calculated mammalian and avian tissue residue concentration values, and was recommended as the Canadian TRG for the protection of wildlife that consume freshwater, marine and estuarine biota. The CCME TRG cannot be used as a point of comparison for determining potential effects in aquatic prey organisms (e.g., fish, invertebrates). The CCME TRG for methylmercury is known to be inappropriately conservative to apply at most locations as it is based on protection of the storm petrel, an offshore piscivorous bird that consumes nearly its entire body weight each day in terms of food consumption. The storm petrel is not known to occur near or on the site and this species was not identified in the site bird survey (Flemming, 2021). As such, the CCME TRG for birds was recalculated using the CCME approach, but for a species more representative of the birds known to occur at the site, and evaluated within the marine ERA (i.e., mallard duck). The mallard duck-based recalculated TRG (described further in Section 6.1 and in Appendix G) is 0.106 mg/kg ww. All site benthic invertebrate samples contained methylmercury concentrations (range: 0.0095 to 0.038 mg/kg ww) that were well below this more appropriate and realistic TRG value.

CCME (2000) also calculated a TRG for mammals that consume aquatic organisms. This CCME TRG (i.e., 0.092 µg/g ww - based on mink) was considered appropriate for use in the ERA without modification. All site benthic invertebrate samples contained methylmercury concentrations that were well below this mammalian TRG.

Collectively, the comparison of measured total mercury and methylmercury concentrations in site benthic invertebrate tissues to the identified benchmarks and toxicity values suggests that neither total mercury nor methylmercury concentrations in site benthic invertebrates are likely to be associated with toxicity in the species that were sampled. Similarly, methylmercury concentrations in site benthic invertebrate tissues are unlikely to be associated with toxicity in mammalian or avian consumers of site benthic invertebrates (with respect to methylmercury and the CCME TRG values).

Summary

All LOEs considered for site marine benthic invertebrates (i.e., marine sediment quality benchmark exceedances and spatial extent of exceedances (which was small); outcomes of PEL-Q and mean PEL-Q calculations; visual observations of abundance, diversity and health of site marine benthic fauna; observations of expected marine benthic species and assemblages for the site habitat conditions with no apparent visual indications of impairment; observations of large numbers of avian consumers of benthic invertebrates; and, outcomes of comparisons of site marine invertebrate tissue chemistry data to tissue residue benchmarks/toxicity values), indicate a negligible potential for ecological risk, both in site benthic invertebrate communities, and in populations of mammalian and avian invertevores that may consume site benthic invertebrates.

7.3.4 Qualitative Evaluation of Potential Exposure and Risk for Cetaceans at the Whale Sanctuary Site

Whales (e.g., orcas and belugas) will be present at the site as future residents of the whale sanctuary. While sanctuary residents will be fed frozen fish (that is not harvested from the site), such that the likelihood for consumption of resident marine biota is low, there may be some exposure to COCs due to curiosity-based incidental ingestion of marine organisms present at the site, and/or due to contact with the localized area of site sediment arsenic impacts.

Typically, whales would not be considered in an ERA, due to various aspects of their life history, dietary preferences, and physiology (including very large body weights and very large home or foraging ranges). Literature searches revealed no information that could enable quantitative estimation of COC exposures to whales from sea water and sediment contact and consumption of site marine invertebrates (or other resident biota).

Thus, potential exposures and risks to whale sanctuary residents, in relation to arsenic-impacted site sediments, were addressed qualitatively in the ERA. Arsenic is the focus of this section as the main COC in site media is arsenic, due to historical gold mining/milling operations adjacent to the site. Arsenic impacts in site sediments are localized to the area near the former location of the gold stamp mill.

Literature searches were conducted in an effort to identify information on the potential effects of arsenic exposure in cetacean species. The searches revealed that there is paucity of available data that can inform on the potential effects of arsenic exposure in cetaceans. There is also an overall paucity of data on cetacean exposures to contaminated sediments, regardless of the specific contaminants of concern. The searches also revealed that there is generally very limited toxicological data (for any contaminant) in the scientific literature that can be reliably extrapolated to cetaceans.

Given the extremely limited published data/documentation that is available on the effects of cetacean exposures to contaminants in marine media, potential exposure and risk for future sanctuary residents in relation to arsenic in nearshore site sediments could only be addressed qualitatively. This qualitative evaluation herein considers various features and characteristics of likely future sanctuary residents that relate to their potential exposure to arsenic in site sediments, and also considers the limited available information on the potential effects of arsenic exposure in cetaceans.

Exposure Potential, Exposure Pathways and Exposure Routes

As future sanctuary residents would be whales coming from a life in captivity where they are fed on a regular schedule, rather than foraging for their own food, the whales will continue to be fed a similarly nutritious and satiating diet on a schedule they have become accustomed to, while in captivity. As the whales that will reside at the sanctuary are not accustomed to foraging for food/prey, there is a generally low likelihood that they would consume marine biota they encounter within the sanctuary.

While some site biota may be consumed periodically out of curiosity, consumption of marine biota within the sanctuary is expected to be limited to experimentation with local biota that the whales encounter. Whales who have spent their lives in captivity have no experience with consuming native marine organisms, which suggests that long-term consumption of native marine biota within the sanctuary is unlikely.

Potential whale residents will be orcas and/or belugas. In the wild, orcas mainly consume various fish, squid, other cetaceans, seabirds, and marine mammals such as seals (https://www.fisheries.noaa.gov/species/killer-whale). Thus, there is a low likelihood that orca residents of the sanctuary would consume site marine invertebrates (such as crabs and bivalves) to any significant extent, other than out of occasional curiosity. Such invertebrate species are not typical orca prey items. Orcas are also unlikely to spend much time in nearshore shallow sediment areas of the site (which would reduce the potential for contact with arsenic-impacted sediments), though they may access such areas occasionally (e.g., pursuit of prey, rubbing skin on rocks or pebbles to remove algae and other adhered organisms). Belugas have a more varied diet in the wild than orcas. Their diet may include octopus, squid, crabs, shrimp, clams, snails, and sandworms, as well as wide variety of fish species (https://www.fisheries.noaa.gov/species/beluga-whale). Thus, for belugas, it may be more likely that they would occasionally consume native marine biota within the site, although this would likely be sporadic and curiosity-based, and not based on any need to obtain sustenance on their own. Even if beluga sanctuary residents occasionally consume site invertebrates from the arsenic-impacted portion of the site, the forms of arsenic they would be exposed to are mainly organoarsenicals (see Appendix I, which provides a summary of scientific literature indicating that inorganic arsenic is readily biotransformed to organic forms of arsenic at all marine trophic levels, such that marine organism exposures to arsenic are mainly comprised of organoarsenical exposure), rather than inorganic arsenic, which is the most toxic form of arsenic. Organoarsenicals are well known to be of much lower bioavailability and toxicity than inorganic arsenic to mammals, and also tend to be more readily metabolized and eliminated from the body than inorganic arsenic (ATSDR, 2007;2016).

Even if sanctuary residents occasionally access the nearshore sediment areas of the site that contain the arsenic-impacted sediments, the probability of significant exposure is low given that the arsenic-impacted sediments comprise a relatively small proportion of the site (~15-20% of total site area).

In terms of exposure pathways and routes, it is well established that whales receive nearly the entirety of their metal and metalloid exposure via their diets (e.g., Bowles, 1999). Other exposure pathways make only minor to negligible contributions relative to dietary exposure. Thus, should sanctuary residents spend time in the arsenic-impacted area of the site, the potential for dermal uptake of arsenic due to skin contact with sediments would be negligible. Cetacean skin is known to be an effective barrier to contaminant entry into organism, unless wounds or lesions are present on the skin surface (Andre et al., 1990; Bowles, 1999).

The WSP has consulted with a number of marine mammal experts and veterinarians on the potential for sanctuary residents to consume resident native marine biota (see Appendix J). These consultation efforts have resulted in the consensus opinion that whales fed a nutritious and satiating diet are unlikely to consume site native marine organisms to any significant extent.

Thus, overall, it is deemed unlikely that sanctuary residents would consume native marine organisms, with the possible exception of infrequent and episodic curiosity-based experimentation or play with the native biota present within the sanctuary site.

If whales were to ingest local marine invertebrates from the arsenic-impacted portion of the site, consumption would include the shells of bivalves, other mollusks and crustaceans. This would result in lower arsenic exposure rates than if only soft tissues were consumed, because it is well established in the literature that arsenic (and every other metal and metalloid) concentrations are highest in hepatopancreas and other soft tissues such as muscle, and generally much lower in shell and carapace materials.

Arsenic Toxicology, Essentiality, and Speciation in Cetaceans

In a review of available information on metal/metalloid effects in cetacean species (i.e., O'Hara et al., (2011), it was concluded that very little reliable cetacean toxicology data exist for any metal or metalloid, that is expressed as a dose or a tissue concentration. Much of the available data in the scientific literature that pertains to metals/metalloids and cetaceans comprises tissue monitoring data that is often collected opportunistically from deceased cetaceans (e.g., from beached whales or porpoises). Tissue levels of metals and metalloids without corresponding data on effects that are attributed to or associated with such tissue levels, cannot be used to predict the potential for adverse effects in cetaceans.

Despite the paucity of reliable cetacean metal/metalloid toxicology data, cetaceans appear to have a high tolerance to metals and metalloids in their diets and in their overall environment (Decataldo et al., 2004). These authors suggest that the high tolerance may be related to cetacean biochemical and physiological processes that detoxify metals and metalloids, and/or sequester them in tissues where they are unable to exert a toxic effect. Thus, while some cetacean tissues may contain elevated levels of some metals and metalloids, the elevated levels in those tissues may actually be preventing metals/metalloids from causing toxicity in other tissues or organs.

Extrapolation of other mammal or human toxicology data to cetaceans, while potentially valid, is subject to considerable uncertainty and must be done with a high degree of caution. This is because standard laboratory mammals and humans may differ greatly from cetaceans in terms of their sensitivity to a given substance, and the toxicokinetics of a substance within their bodies and tissues. The differences across mammals in relation to taxonomic diversity, ecology, life history, behaviour, anatomy (particularly body weight differences), physiology, and biochemistry may limit the ability to reliably extrapolate toxicity data from other mammals to cetaceans.

From the available limited published information on arsenic presence in cetacean tissues, the following general observations have been made.

- Cetaceans (and other marine mammals) feeding on cephalopods and crustaceans tend to contain higher arsenic concentrations than those feeding on fishes. There are no clear trends or apparent patterns of arsenic accumulation by gender or age or size (body weight) (Kubota et al., 2001), although larger, older marine mammals tend to sometimes have higher tissue total arsenic concentrations than younger, smaller animals.
- Most of the studies on arsenic concentrations in cetaceans find that tissue levels of total arsenic, and the types of arsenic species (or chemical forms of arsenic) do not vary widely across cetacean species. This apparent broad global consistency in the magnitude of arsenic concentrations may suggest that arsenic in cetaceans is physiologically and biochemically regulated such that levels that would be high enough to cause toxicity do not typically occur (Parsons, 1999).
- Arsenic and a variety of arsenic species occur in numerous cetacean tissues, organs and fluids, which is consistent with arsenic distribution in terrestrial mammals and humans (ATSDR, 2007; Eisler, 1988). While variability is often high among the literature reports of arsenic concentrations in cetacean tissues/organs, there are commonly no major differences in the overall magnitude of arsenic concentrations across the evaluated tissues and organs. A number of studies have found that arsenic can be present at higher amounts in heart, liver, kidney, muscle, blubber, and skin of cetaceans (relative to other tissues) (e.g., Shoham-Frider et al., 2016, Kubota et al., 2005; Bellante et al., 2021; Page et al., 2024; Bellante et al., 2010). In these studies, juvenile cetaceans tend to have higher arsenic levels in liver relative to adults, but this pattern varies by species and geographic location. Many of these same studies also show that there are frequently not substantial differences in arsenic concentrations across different cetacean tissue and organ types.
- In studies where cetacean feces was examined in addition to other biological tissues and fluids, fecal arsenic concentrations are often considerably higher than in any other measured biological tissue or fluid (up to an order of magnitude higher). This suggests that absorbed arsenic is readily eliminated via the fecal excretion route in cetaceans (Page et al., 2024).
- Kubota et al., (2005) reported that arsenic can be transferred from the mother to the fetus in cetaceans, but that fetal tissue arsenic concentrations (in liver, kidney, muscle, and blubber) are lower than maternal arsenic concentrations in these same tissues [as whale sanctuary residents will not have the opportunity to mate and reproduce, maternal-fetal transfers of arsenic are not of concern].

While it has not been confirmed that arsenic is an essential regulated micronutrient in cetaceans (and in other higher mammals), there has long been evidence to suggest that arsenic does have some essential physiological and biochemical functions in many organisms, including some mammals (Uthus, 1992;

Neff, 1997; Fattorini et al., 2005). An essential micronutrient role for arsenic in many organisms may help explain the high tolerance some organisms appear to have to elevated arsenic exposures.

It is important to recognize that whales that will reside at the sanctuary will not be solely exposed to arsenic in local resident marine biota they may consume. Rather, they would be simultaneously exposed to numerous other metals and metalloids, and numerous other substances, which may interact in ways that could either reduce or increase arsenic bioavailability and toxicity. With respect to metals and metalloids in aquatic ecosystems, it is most common that chemical mixtures exposure tends to reduce the bioavailability and toxicity of any single given metal or metalloid present in the mixture, but the specific mechanisms and direction of toxicological interactions are not well understood or even known for the vast majority of substances. Arsenic and selenium are one example of a toxicological interaction that tends to reduce arsenic toxicity, where selenium appears to diminish arsenic toxicity via selenium-dependent enzyme action which converts arsenic species into less biologically active complexes (Zwolak, 2020).

Evaluation of Arsenic in Sanctuary Site Rock Crabs

Given concerns about the presence of arsenic in rock crab tissues sampled from the sanctuary site, and potential consumption of rock crabs by sanctuary residents, WSP personnel conducted an evaluation which estimated the number of rock crabs containing the maximum measured arsenic concentration, that a sanctuary resident could consume each day, without exceeding a specific arsenic toxicological threshold. This evaluation is provided in Appendix J. It is not relied upon as a LOE in the ERA for the following reasons: a number of assumptions were made, which while conservative, are likely not realistic; the approach taken is not entirely in keeping with current ERA approaches; the approach utilized a human-health based toxicity value for inorganic arsenic that is likely not appropriate to apply to cetaceans, though it would appear to be a highly conservative toxicity value to apply to marine mammals; and, uncertainty in the evaluation is high. Consideration was given to modifying the evaluation to be more aligned with standard ERA approaches, but the reduction in uncertainty was deemed to be negligible, and it was decided to not undertake a modified evaluation.

Nonetheless, the WSP estimated that 1 to 3 rock crabs (containing the maximum measured arsenic concentration to date) could be consumed each day before reaching the selected arsenic toxicity threshold dose. It is unlikely that rock crab consumption would occur at this rate by sanctuary residents.

If nearly everything in the WSP evaluation is held constant and just the toxicity value used by WSP (i.e., a U.S. EPA NOAEL of 0.0008 mg/kg BW/day – which is based on hyperpigmentation, keratosis and possible vascular complications from human epidemiological studies of arsenic-exposed Taiwanese populations in the 1960s, a value that is likely not relevant to cetaceans) is substituted with the current recommended mammalian ecological TRV of 1.04 mg/kg BW/day (from FCSAP, 2021), which is based on reproduction, growth and survival effects in laboratory mammals (including: rat, mouse, rabbit, guinea pig, dog and goat), the number of crabs that could be consumed each day would increase massively (up to 3 orders of magnitude), to a level that would never be anticipated to occur, even if crabs were the sole preferred dietary item of the whales that will reside at the sanctuary (i.e., roughly 1000 to 4000 crabs could potentially be consumed daily, before exposure would exceed the TRV). While the FCSAP TRV is also of high uncertainty to extrapolate to cetaceans, it is based on standard endpoints that are widely considered to be of greatest relevance in ERAs, and likely represents a conservative toxicity estimate for cetaceans.

Given both the WSP findings and the change to those findings that would occur if the FCSAP TRV were utilized instead of the U.S. EPA NOAEL, it appears that there would be no health-related concerns to sanctuary residents associated with potential rock crab consumption.

Arsenic Speciation in Cetaceans

Most ERAs and other assessments of arsenic exposure assume that inorganic arsenic is the primary form of arsenic that an organism is exposed to, and virtually all ecological TRVs, and ecological health-based environmental quality benchmarks for arsenic are developed for only inorganic arsenic. While arsenic in seawater and sediments is primarily present as inorganic arsenic, the vast majority of arsenic present in marine organisms (at all trophic levels) is comprised of a variety of organoarsenicals (See Appendix I). These organic arsenic compounds are widely known to be of much lower bioavailability and toxicity than inorganic arsenic, and tend to be more rapidly and efficiently metabolized and eliminated than inorganic arsenic as well (ATSDR, 2007). For example, in crabs, most of the arsenic (often >90%) is present as arsenobetaine, an essentially biologically inert compound.

Most food items whales would consume would have total arsenic levels that are dominated by organoarsenical species, with generally low to negligible amounts of inorganic arsenic content (See Appendix I). Thus, it follows that in whale tissues, organs, and biological fluids, organoarsenicals are also the dominant arsenic species. While data on arsenic species in cetaceans are limited, a number of studies indicate that the principal form of arsenic that is present in cetacean liver, kidney, muscle, lung and blubber tissues (the cetacean species evaluated include porpoises, dolphins, pilot whales, melon-headed whales, beluga whales, and sperm whales) is arsenobetaine (AB) (Kubota et al., 2009; 2002; 2005; 2003; Goessler et al., 1998; Kuenstl et al., 2009: Geiszinger et al., 2002). The per cent of total arsenic that is comprised of AB in cetacean tissues and fluids is typically in the mid-70% to high 90% range, but can be highly variable, and may be considerably lower in some whale species (e.g., AB content of total As was found to be 46% in beluga liver, 29% in Dalls porpoise liver, 76% in long-finned pilot whale liver, 86% in short-finned pilot whale liver, and 73% in sperm whale liver; Kubota et al., 2003). These studies also reported a variety of other organoarsenicals, in addition to AB, in cetaceans.

Other organoarsenical species commonly detected in cetacean tissues, organs and fluids include: dimethylarsinic acid (DMA), methylarsonic acid (MMA), arsenocholine (AC), tetramethylarsonium ion

(TMA), thio-dimethylarsinic acid, and also various unidentified organoarsenical compounds. Some studies have found that the tetramethylarsonium cation does not appear to occur in most cetaceans but is detected at trace levels in other marine mammals such as pinnipeds (Goessler, et al., 1998; Kubota et al., 2005). One study (Geiszinger et al., 2002) reported a unique organoarsenical in sperm whale lung, liver, kidney and muscle tissue – trimethylarsoniopropionate. This particular arsenic species has been reported only infrequently in cetacean tissues (Geiszinger et al., 2002).

Inorganic forms of arsenic such as arsenate and arsenite are typically present in trace amounts in cetacean tissues, if detectable at all. Most of the noted organoarsenicals, other than AB, are also typically present in minor or trace amounts, though DMA, AC and TMA can be present at percentages of total arsenic that range up to 26% (Kubota et al., 2003). These authors also report that MMA and inorganic arsenic species, and TMA in most cetacean species, typically comprise low proportions of total arsenic (a couple or few percent at most), and are often present near or below RDLs in cetacean tissues and fluids. The cetacean tissue and fluid types that are most commonly evaluated with respect to arsenic speciation are liver, urine, kidney, muscle and blubber.

A few of the cited studies above also tested other marine mammal tissues and fluids and found similar organoarsenical profiles and relative proportions of organoarsenicals. The specific organoarsenical concentrations in tissues and fluids expectedly vary, as do their relative proportions, which likely reflects the different food items that were consumed, as well as the different degrees of metabolism since food items containing arsenic were last ingested.

In a study of 20 harvested Minke whales where meat samples were analyzed for inorganic arsenic and total arsenic (organoarsenicals were not specifically determined in this study), Maage et al., (2017) found that inorganic arsenic compounds were non-detectable (below RDL of 0.003 mg/kg ww in all samples), whereas total arsenic was measurable in all 20 samples (ranging from 0.08 to 0.65 mg/kg ww). This suggests that virtually all of the arsenic present in Minke whale muscle samples was comprised of organoarsenicals.

It appears that organoarsenicals are the primary arsenic species that undergo maternal transfer to developing cetacean fetuses. For example, Kubota et al., (2005) found that AB was the primary arsenic species in both maternal and fetal tissues, suggesting that AB and organoarsenical precursors to AB, or metabolites of AB, are the main arsenic species that are transferred to developing cetacean fetuses, rather than inorganic arsenic species. These authors also reported some other organoarsenicals in fetal tissues, including DMA, MMA, and arsenocholine. However, as noted previously, maternal-fetal transfer of arsenic will not be of concern for whale sanctuary residents as they will not have the opportunity to mate and reproduce.

Summary and Conclusions

Given the discussion presented above, the following can be concluded about the potential for sanctuary whale residents to become exposed to arsenic-impacted site sediments, as well as site resident marine biota containing arsenic, and to potentially experience adverse effects as a result of such exposures.

- While some resident site biota may be consumed periodically by whale sanctuary residents out of curiosity, consumption of marine biota within the sanctuary is expected to be very limited. Whales who have spent their lives in captivity have no experience with consuming native marine organisms, which suggests that long-term consumption of native marine biota within the sanctuary is unlikely.
- Beluga sanctuary residents may be more likely to consume resident site marine biota than orcas (based on review of orca and beluga typical dietary preferences), but significant consumption of site biota is still considered to be unlikely.
- Overall, it is deemed unlikely that sanctuary residents would consume site resident marine organisms, with the possible exception of infrequent and episodic curiosity-based experimentation or play with the native biota present within the sanctuary site.
- Even if sanctuary residents occasionally consume site invertebrates from the arsenic-impacted portion of the site, the forms of arsenic they would be exposed to are mainly organoarsenicals, rather than inorganic arsenic, which is the most toxic form of arsenic. Organoarsenicals are well known to be of much lower bioavailability and toxicity to mammals than inorganic arsenic, and also tend to be more readily metabolized and eliminated from the body than inorganic arsenic.
- Neither orcas nor belugas would be expected to access the nearshore shallow areas of the site (where arsenic impacts in sediments occur) other than on a periodic or transient basis.
- The area of the site with sediment arsenic impacts is relatively small compared to the overall site (~15 to 20% of total site area), which suggests a low probability of significant exposure to arsenic in sediments.
- Despite the paucity of reliable cetacean metal/metalloid toxicology data, cetaceans appear to have a high tolerance to metals and metalloids in their diets and in their overall environment.
- While it has not been confirmed that arsenic is an essential regulated micronutrient in cetaceans (and in other higher mammals), there has long been evidence to suggest that arsenic does have some essential physiological and biochemical functions in many organisms, including some mammals (Uthus, 1992; Neff, 1997; Fattorini et al., 2005). An essential micronutrient role for arsenic may help explain the high tolerance some organisms (including cetaceans) appear to have to elevated arsenic exposures.
- Arsenic occurs in most cetacean tissues (primarily as various organoarsenicals), and it appears that arsenic in cetaceans is physiologically and biochemically regulated such that levels that would be high enough to cause toxicity do not typically accumulate, but rather, are sequestered in tissues less critical for physiological function, and/or are readily metabolized and eliminated from their bodies.
- In studies where cetacean feces was examined in addition to other biological tissues and fluids, fecal arsenic concentrations are often considerably higher relative to any other measured biological tissue

or fluid (up to an order of magnitude higher). This suggests that absorbed arsenic is readily eliminated via the fecal excretion route in cetaceans.

- Given both the WSP evaluation of rock crab consumption and potential effects on sanctuary residents, and the change to those findings that would occur if the FCSAP TRV were utilized instead of the U.S. EPA NOAEL (where the FCSAP TRV is orders of magnitude higher than the NOAEL), it appears that there would be no health-related concerns to sanctuary residents associated with potential rock crab consumption from the site. Rather, when the more appropriate FCSAP ecological TRV is utilized, there is likely no limit on the number of rock crabs (containing arsenic) that sanctuary residents could potentially consume.
- Most arsenic in cetacean food items is comprised of organoarsenical species that are of much lower bioavailability and toxicity than inorganic arsenic species, and that are also more readily metabolized and eliminated than inorganic arsenic species. The same is true for the forms of arsenic present in a variety of cetacean tissues, organs, biological fluids and feces.

Collectively, the above information suggests that whale sanctuary resident exposure to arsenic in site sediments and/or native resident marine biota is likely to be insignificant, and even if some exposure to arsenic does occur, such exposures are unlikely to result in adverse health effects among the sanctuary residents. Overall, the LOEs considered for cetacean sanctuary site residents indicate a negligible potential for ecological risk.

8.0 Uncertainties and Conservative Assumptions

In any risk assessment, the findings are based on available data from the specific study area or site, and the scientific literature, in conjunction with a number of assumptions. Every effort is made to ensure that the assumptions and data adequately represent the conditions under evaluation. However, data are often limited, resulting in uncertainty in the assessment. Where uncertainty exists, assumptions are made, and data are selected so as to err on the conservative side. The major sources of uncertainty, limitations and conservatism associated with the current ERA are described below. Overall, given the conservative and protective assumptions and approaches applied within the ERA, it is believed that the ERA results provide a reasonably realistic yet conservative evaluation of potential COC exposures and risks to ecological receptors at the site.

Receptor Selection. Receptors selected for assessment were either known to be present or can reasonably be expected to be present within the site boundary. These receptors are also known to be conservatively representative of other species that may be present within the site boundary and exposed to COCs. While the selection of receptors of concern (ROCs) is believed to be reasonable and appropriate for this site, there is always some possibility that there are species living on (or possibly extirpated from) the area that may be more sensitive to one or more of the COCs, than those receptors that were evaluated in the ERA.

Utilization of Receptors as Surrogates to Represent Other Receptors. The use of receptors as surrogates for other receptors typically reflects the availability of receptor parameters that can reliably enable ERA of a given receptor species. The surrogate receptors selected are considered to be sensitive, likely present within the site boundary, and exposed to the COCs present within site media via relevant exposure pathways. Therefore, it is reasonable to assume that ERA outcomes for surrogate receptors can be extrapolated to similar species that were not or could not be directly assessed in the ERA.

Species at Risk. Species at risk (SAR) could potentially occur within the site boundary, particularly avian SAR. While avian SAR were not quantitatively modelled within the ERA (due to the lack of specific receptor parameters for such species), the selected surrogate species (i.e., Greater Scaup and black duck) are conservative surrogates for the SAR species that may be present at the site, given their similar body weights, diets, and home ranges. In addition, the TRVs that were used in the ERA for avian receptors were developed to be protective of rare, threatened and endangered species (U.S EPA, 2005).

Receptor-Specific Toxicity Data. Toxicity data and/or TRVs are not necessarily available for particular receptor species under consideration in ERAs. Also, available toxicity values are not necessarily relevant to the endpoints of greatest interest in an ERA (i.e., growth, reproduction, mortality). As a result, there is often uncertainty associated with the extrapolations that may be used to translate toxicity data from one species to another.

Exposure Point Concentrations. The ERA utilized deterministic (or point estimate) exposure analysis techniques. This approach tends to overestimate potential exposures and risks. In deterministic exposure analysis, single concentrations representing reasonable maximum or upper bound exposure are typically used to represent media or biota contaminant concentrations. This was the case in the current ERA (i.e., UCLM95 sediment concentrations of the COCs were evaluated as the exposure point concentrations (EPCs) for the exposure pathway of sediment ingestion). Also, the maximum concentrations of COCs in benthic invertebrate tissue were used as EPCs for the invertebrate ingestion pathway. A biota-sediment accumulation factor (BSAF) was derived from eelgrass tissue and eelgrass root zone sediment data collected from the site. While this is representative of site conditions, there is uncertainty as to whether or not eelgrass-sediment relationships reflect uptake of COCs from sediment for other marine site vegetation. Limited scientific literature suggests that eelgrass is an efficient accumulator of metals and metalloids from marine sediments; thus, the relationship determined between sediment and eelgrass tissue COC concentrations is considered to be a conservative representation of potential COC uptake from sediments in other site marine vegetation.

No fish tissue data was available for the site; however, it was assumed that fish exposure to impacted site sediments would be negligible as fish are mobile and would not spend all their time on the site or within the arsenic-impacted areas of the site. For receptors that may consume some finfish from the site in addition to benthic invertebrates (e.g., the Northern River Otter), it was assumed that 100% of the diet was marine invertebrates. This is a conservative assumption as marine invertebrates are anticipated to have higher tissue levels of COCs than fish. This is commonly observed at contaminated sediment sites where both benthic invertebrate and fish tissue chemistry data are available, and reflects the fact that many benthic invertebrates are sessile or of limited mobility relative to fish, and tend to incur higher COC exposures from sediment-based exposure pathways than fish generally do.

Data Limitations. Sediment is considered the most likely media to be impacted from historical gold mining and milling activities. The site sediments are considered to be adequately characterized for potential contaminants that are related to gold mining/milling operations. To date, a limited number of site benthic invertebrate and site eelgrass samples have been collected. While the data for these samples are considered representative of the site, there is always some uncertainty associated with small sample sizes in terms of representativeness and data variability.

Other Stressors. The current ERA only assesses chemical stressors present in site sediments, surface water and biota. While other common ecological stressors such as predation, disease, habitat disruption, competition, climate change etc. are likely having some influence on the resident biota within the site boundary, these stressors were not evaluated in either a quantitative or qualitative manner. On any given site, non-chemical stressors may interact with chemical stressors in complex ways and can often be of greater biological or ecological significance than the presence of chemical contaminants in environmental media.

Chemical Speciation. The environmental fate and behaviour, and toxicity, of inorganic contaminants depends to a large extent upon their chemical form or species. Oral TRVs are typically based on chemical forms that have high bioavailability. The TRVs used in the ERA for arsenic are all for inorganic arsenic and the ERA therefore inherently assumes that 100% of the total arsenic in site media and biota is present in the inorganic form. However, less toxic, less bioavailable, and more readily eliminated organoarsenicals likely make up a large proportion of the measured total arsenic in site media and biota (see Appendix I). It is widely stated in the scientific literature that organoarsenicals are believed to be of little toxicological concern in marine ecosystems. Consequently, the estimated ecological risks associated with arsenic in the ERA are likely substantially overestimated. In the ERA, arsenic was speciated in sediments only and not in site marine biota. While the scientific literature is highly consistent in reporting that the majority of arsenic present in marine biota comprises various organoarsenicals and very little inorganic arsenic, site data for organoarsenical content and types in local marine biota has not been collected to date.

Foraging Behaviour. The ERA assumed that the ROCs forage entirely (or at least extensively) within the impacted areas of the site and that their respective diets consisted entirely of food items from the site (i.e., aquatic vegetation, marine invertebrates, prey). While these are typical assumptions for an ERA, they are considered to be unrealistic and highly conservative.

Wildlife Exposure Factors. Ecological receptor body weights and other key physiological and behavioural parameters were obtained from reliable regulatory agency guidance documents or scientific literature sources. There is some uncertainty associated with these values though, as they are not specific to the site, or necessarily representative of what occurs within the local receptor populations.

Data on wildlife food ingestion rates are only available for a few species, primarily due to the difficulties in measuring such intakes for free-ranging wildlife. As such, for specific receptors, it is often necessary to use allometric equations to estimate food ingestion rates for ROCs. Allometric equations assume food intake is proportional to body weight, which may not necessarily be the case.

Published sediment ingestion rates do not exist for many mammalian and avian receptors. Thus, it is common ERA practice to assume (based on literature and/or regulatory guidance) that a certain percentage of the receptor's overall food ingestion rate represents a given receptors' sediment ingestion rate.

In any ERA, it is inherently difficult to assign representative diets with fixed proportions of dietary items to the assessed ROCs. For any ROC, even those with a narrow range of dietary preferences, diets can be highly variable and difficult to estimate with accuracy (for example, the proportion of dietary items for a ROC may vary between locations, between individuals, and seasonally). ERAs typically account for this uncertainty by making conservative assumptions about receptor diets such that worst-case diets are frequently assumed for the ROCs evaluated in an ERA. This was the case in the current ERA as well.

9.0 Conclusions Summary and Recommendations

9.1 Conclusions Summary

Based on the risk characterization results and conclusions presented in Sections 7.3.1 to 7.3.4, the overall weight of evidence conclusion from the assessment and interpretation of all LOEs that were considered for all ROCs assessed in the ERA, is that COCs present in site sediments and biota pose a negligible potential for ecological risk. There is a high degree of confidence in this overall conclusion of the ERA, especially given that the ERA utilized TRVs and marine environmental quality guidelines and other benchmarks and toxicity values for inorganic arsenic. It is considered highly likely that most of the arsenic exposure to site resident marine biota (including future sanctuary site cetacean residents) will not consist of inorganic arsenic, but rather, will consist of various organoarsenicals that are widely believed to be of much lower bioavailability and toxicity to most organisms, and also tend to be rapidly and efficiently metabolized and excreted by most organisms, relative to inorganic arsenic. As such, there is a high likelihood that even the negligible potential for ecological risk determined in this ERA is probably a substantial overestimate of actual risk.

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9.2 Recommendations

It is acknowledged that the WSP is committed to conducting long term environmental monitoring of the sanctuary site. A specific monitoring plan and program is to be developed in the near future. Recommendations that stem from the ERA could easily be accommodated within the planned site environmental monitoring program. The following recommendations could be considered for inclusion within this program.

- When the next site seawater sampling event occurs, the analytical laboratory should be notified prior to analysis that lower RDLs need to be achieved in the seawater metals and metalloids analyses.
- At some future monitoring event when site marine biota are sampled and analyzed for arsenic, consideration should be given to conducting arsenic speciation analysis on certain site biota samples to confirm what has been assumed within the ERA in terms of organoarsenical content and proportion of total arsenic that is comprised of organoarsenicals, relative to inorganic arsenic.
- While it is anticipated that the site environmental monitoring plan and program would have some scheduled or regular events for certain media and certain parameters, it is suggested that additional and specific monitoring events occur following site activities or weather events that significantly disrupt or disturb site sediments and/or the nearshore areas impacted by former gold milling operations.
- Because the ERA predicted a negligible potential for ecological risk to the assessed ROCs, there are no recommendations that relate to site sediment remediation or risk management to reduce potential arsenic exposure. Rather, the arsenic-impacted sediments at the site should be left undisturbed. Leaving contaminated sediments in place and minimizing disturbance to such sediments is a well known effective contaminated sediment management strategy that often prevents or reduces the potential for further contamination of the aquatic environment at or near an aquatic contaminated site. Furthermore, the arsenic-impacted sediment area of the site has a thriving and abundant eelgrass community, and any actions that might disturb or disrupt this community are strongly recommended against.

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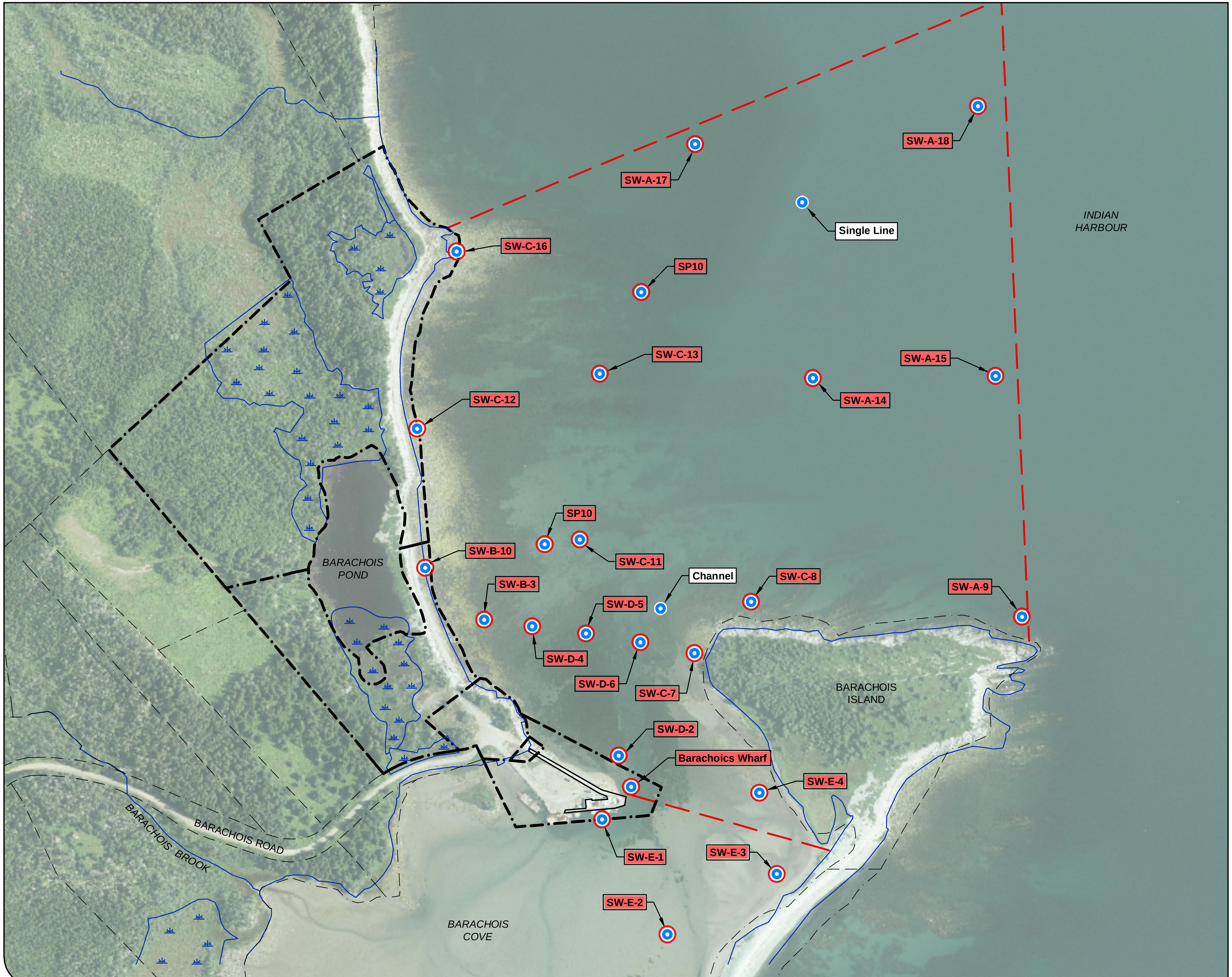
11.0 Closure

This report was prepared exclusively for the purposes, project, and Site location outlined in the report. The report is based on information provided to, or obtained by Dillon as indicated in the report, and applies solely to Site conditions existing at the time of the assessment. Dillon's report represents a reasonable review of available information within an agreed work scope, schedule, and budget. It is therefore possible that currently unrecognized contamination or potentially hazardous materials may exist at the Site, and that the levels of contamination or hazardous materials may vary across the Site. Further review and updating of the report may be required as local and Site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the benefit of the Whale Sanctuary Project. The material in this report reflects Dillon's judgment in light of the information available to Dillon at the time of preparation. Any use which a third party (i.e., a party other than the Whale Sanctuary Project) makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix A

Site Data Summaries and Figures



STRUM CONSULTING
MARINE AQUATIC ECOLOGICAL RISK ASSESSMENT OF WHALE SANCTUARY PROJECT NOVA SCOTIA LOCATION

SURFACE WATER EXCEEDANCES ABOVE ECOLOGICAL HEALTH-BASED GUIDELINES
FIGURE 1

APPROXIMATE PROPOSED WHALE SANCTUARY ENCLOSURE AREA/THE SITE
SUBJECT PROPERTY BOUNDARY
ADJACENT PROPERTY BOUNDARY
WATER
WETLAND
SURFACE WATER SAMPLE
EXCEEDS SURFACE WATER GUIDELINES

Notes:
1. 'Single Line' 'Channel', "SP10', 'SP12' and 'Barachois Wharf' data are from 2020-2022, all other data are from Strum, 2023.
2. 'Single Line' is also the sampling location for Winter and Summer Line samples.

Ecological Health Screening Criteria	
Surface Water	
Boron (µg/L)	1,200
Cadmium (µg/L)	0.12
Copper (µg/L)	2
Iron (µg/L)	300
Mercury (total) (µg/L	0.016
Nickel (µg/L)	8.3

100 0 100
SCALE 1:4,000 METRES

N W E S

MAP/DRAWING INFORMATION
Google Earth Pro (May 2024), Strum Consulting Phase III ESA, Investigation Locations, Drawing 2 (December 2023), and Dillon Consulting Limited Site visit. Site features are approximate only. This is not a legal survey.

CREATED BY: TLR
CHECKED BY: RDW
DESIGNED BY: JKD

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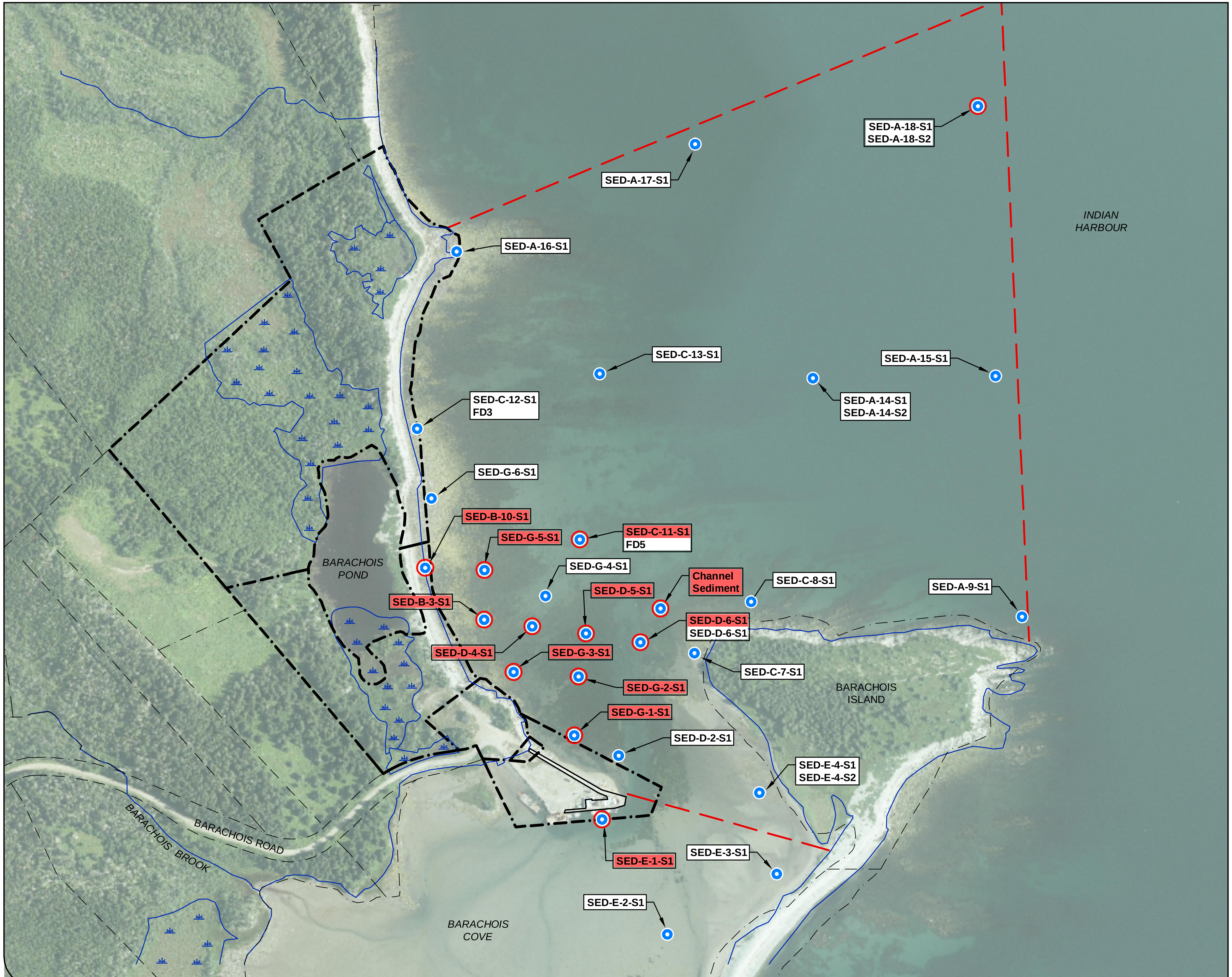
DILLON CONSULTING

PROJECT: 24-8007
DATE: JULY 2024



STRUM CONSULTING
MARINE AQUATIC ECOLOGICAL RISK ASSESSMENT OF WHALE SANCTUARY PROJECT NOVA SCOTIA LOCATION

SEDIMENT EXCEEDANCES ABOVE ECOLOGICAL HEALTH-BASED GUIDLINES
FIGURE 2

APPROXIMATE PROPOSED WHALE SANCTUARY ENCLOSURE AREA/THE SITE
SUBJECT PROPERTY BOUNDARY
ADJACENT PROPERTY BOUNDARY
WATER
WETLAND
SEDIMENT SAMPLE
EXCEEDS SEDIMENT GUIDELINES

Note:
1. 'Channel' sample is from 2020, all other samples are from Strum, 2023.

Ecological Health Screening Criteria	
Sediment	
Arsenic (mg/kg)	42
Zinc (mg/kg)	271

100 0 100
SCALE 1:4,000 METRES

MAP/DRAWING INFORMATION
Google Earth Pro (May 2024), Strum Consulting Phase III ESA, Investigation Locations, Drawing 2 (December 2023), and Dillon Consulting Limited Site visit. Site features are approximate only. This is not a legal survey.

CREATED BY: TLR
CHECKED BY: RDW
DESIGNED BY: JKD

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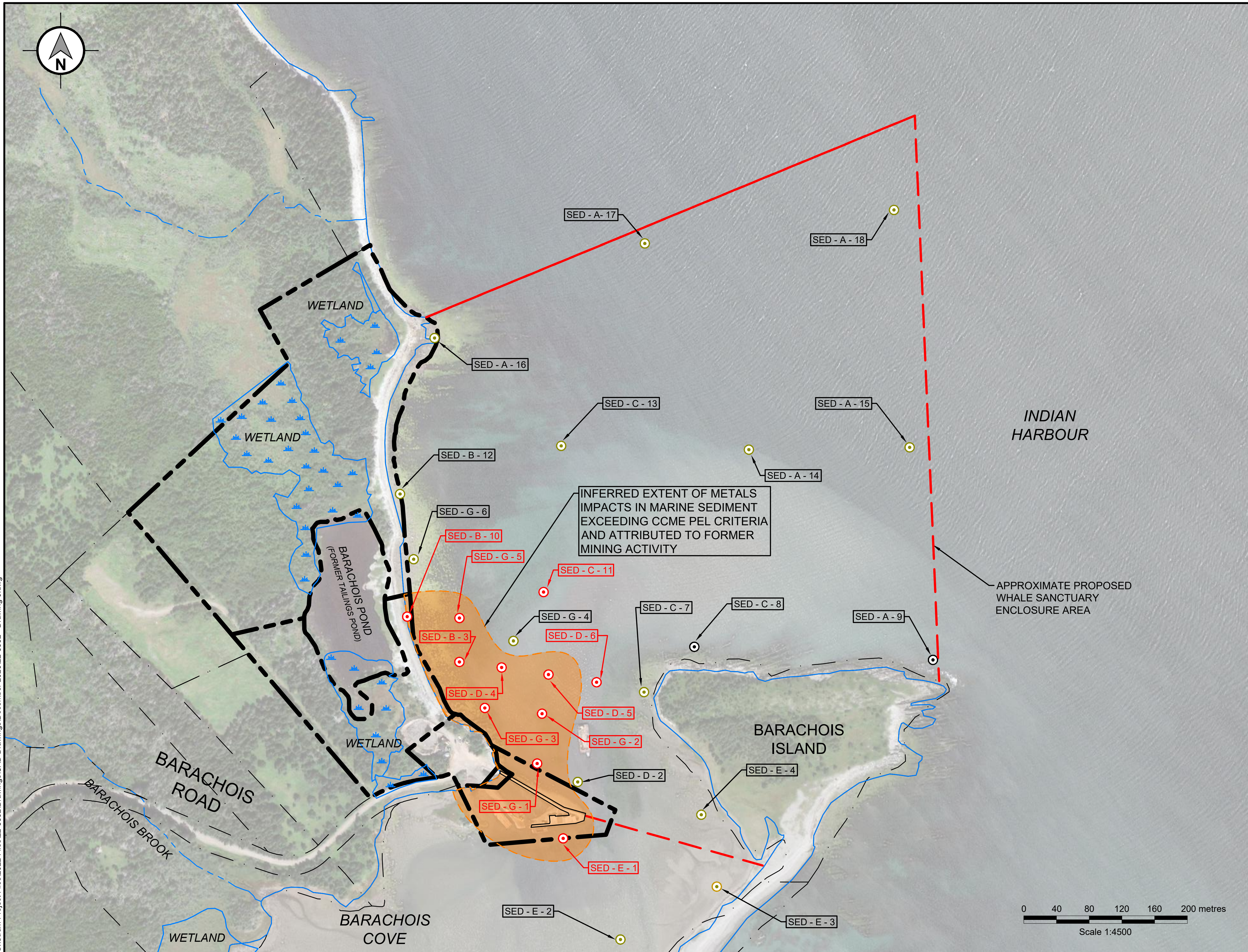
CONSULTING

PROJECT: 24-8007
DATE: JULY 2024



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LEGEND:

SUBJECT PROPERTY BOUNDARY..........

ADJACENT PROPERTY BOUNDARY........

MARINE SEDIMENT SAMPLE...................

INFERRED EXTENT OF METALS IMPACTS IN MARINE SEDIMENT EXCEEDING CCME PEL CRITERIA AND ATTRIBUTED TO FORMER MINING ACTIVITY.........................

RED SYMBOL INDICATES EXCEEDENCE OF APPLICABLE CCME PEL CRITERIA CRITERIA

YELLOW SYMBOL INDICATES EXCEEDENCE OF APPLICABLE CCME ISQG CRITERIA CRITERIA

GENERAL NOTES:

1. DRAWING REFERENCES: NOVA SCOTIA PROPERTY RECORDS. DIGITAL TOPOGRAPHIC MAPPING BY NOVA SCOTIA GEOMATICS CENTRE. NOVA SCOTIA GROUNDWATER ATLAS.
2. PROJECTION: NAD83(CSRS), UTM ZONE 20 NORTH.
3. ALL PROPERTY BOUNDARIES, SITE FEATURES AND SERVICES ARE APPROXIMATE ONLY. SUBJECT TO SURVEY.
4. ELEVATED ZINC CONCENTRATIONS IN SAMPLES A-15, A-18, C-7, C-11, D-5, D-6, E-3 AND E-4 NOT ATTRIBUTED TO FORMER MINING ACTIVITIES.
5. CCME PEL GUIDELINE CRITERIA USED AS PRIMARY INDICATOR OF AREAS OF CONTAMINATED SEDIMENT. CCME ISQG CRITERIA CONSIDERED OVERLY CONSERVATIVE.
6. PRIMARY CONTAMINANT OF CONCERN IN MARINE SEDIMENT IS ARSENIC.

CLIENT:
WHALE SANCTUARY PROJECT

PROJECT:
PHASE III ESA

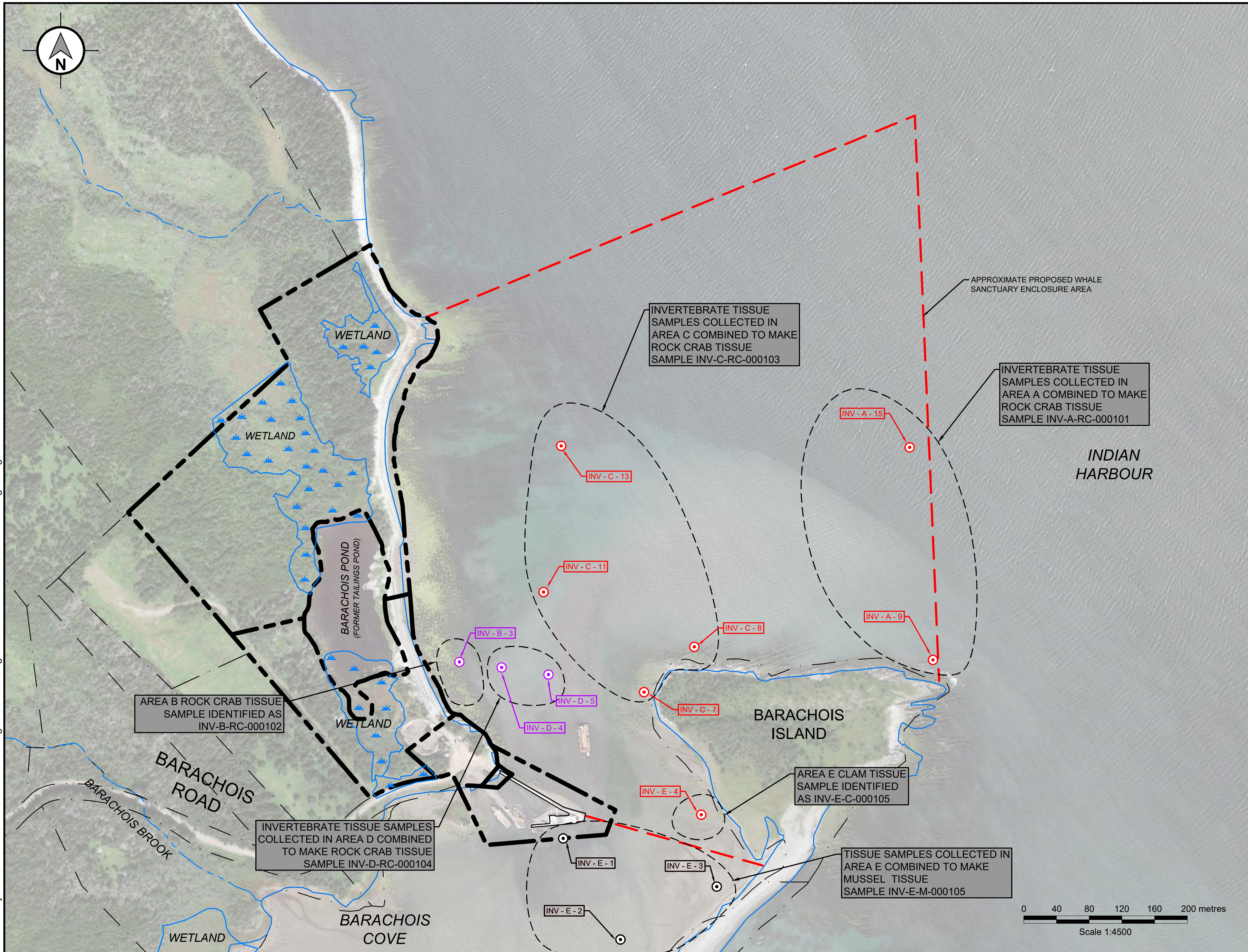
LOCATION:
BARACHOIS ROAD
WINE HARBOUR, NS

TITLE:
MARINE SEDIMENT METALS IMPACTS

CONSULTANT:
strum
CONSULTING

SCALE: H: 1:4500	V:

DATE: DECEMBER 2023		DRAWN: L. PEMBERTON
DESIGNED:	CHECKED: M. LOPEZ	APPR'D: E. HISCOTT
PROJECT No.: 22-8552		
DRAWING No.: 6		



LEGEND:

SUBJECT PROPERTY BOUNDARY..........
ADJACENT PROPERTY BOUNDARY........
MARINE INVERTEBRATE SAMPLE..........

RED SYMBOL INDICATES ARSENIC CONCENTRATIONS EXCEEDS HEALTH CANADA GUIDELINES

PURPLE SYMBOL INDICATES BOTH ARSENIC AND METHYL MERCURY EXCEED APPLICABLE CRITERIA

GENERAL NOTES:

1. DRAWING REFERENCES: NOVA SCOTIA PROPERTY RECORDS. DIGITAL TOPOGRAPHIC MAPPING BY NOVA SCOTIA GEOMATICS CENTRE. NOVA SCOTIA GROUNDWATER ATLAS.
2. PROJECTION: NAD83(CSRS), UTM ZONE 20 NORTH.
3. ALL PROPERTY BOUNDARIES, SITE FEATURES AND SERVICES ARE APPROXIMATE ONLY. SUBJECT TO SURVEY.
4. INVERTEBRATE TISSUE SAMPLED ID NUMBERS CORRESPOND TO DFO TAG TRACKING NUMBERS

CLIENT:
WHALE SANCTUARY PROJECT

PROJECT:
PHASE III ESA

LOCATION:
BARACHOIS ROAD
WINE HARBOUR, NS

TITLE:
MARINE INVERTEBRATES METALS IMPACTS

CONSULTANT:
strum
CONSULTING

SCALE:
H: 1:4500 V:

DATE: DECEMBER 2023
DRAWN: L. PEMBERTON
DESIGNED:
CHECKED: M. LOPEZ
APPR'D: E. HISCOTT
PROJECT No.: 22-8552
DRAWING No.: 9

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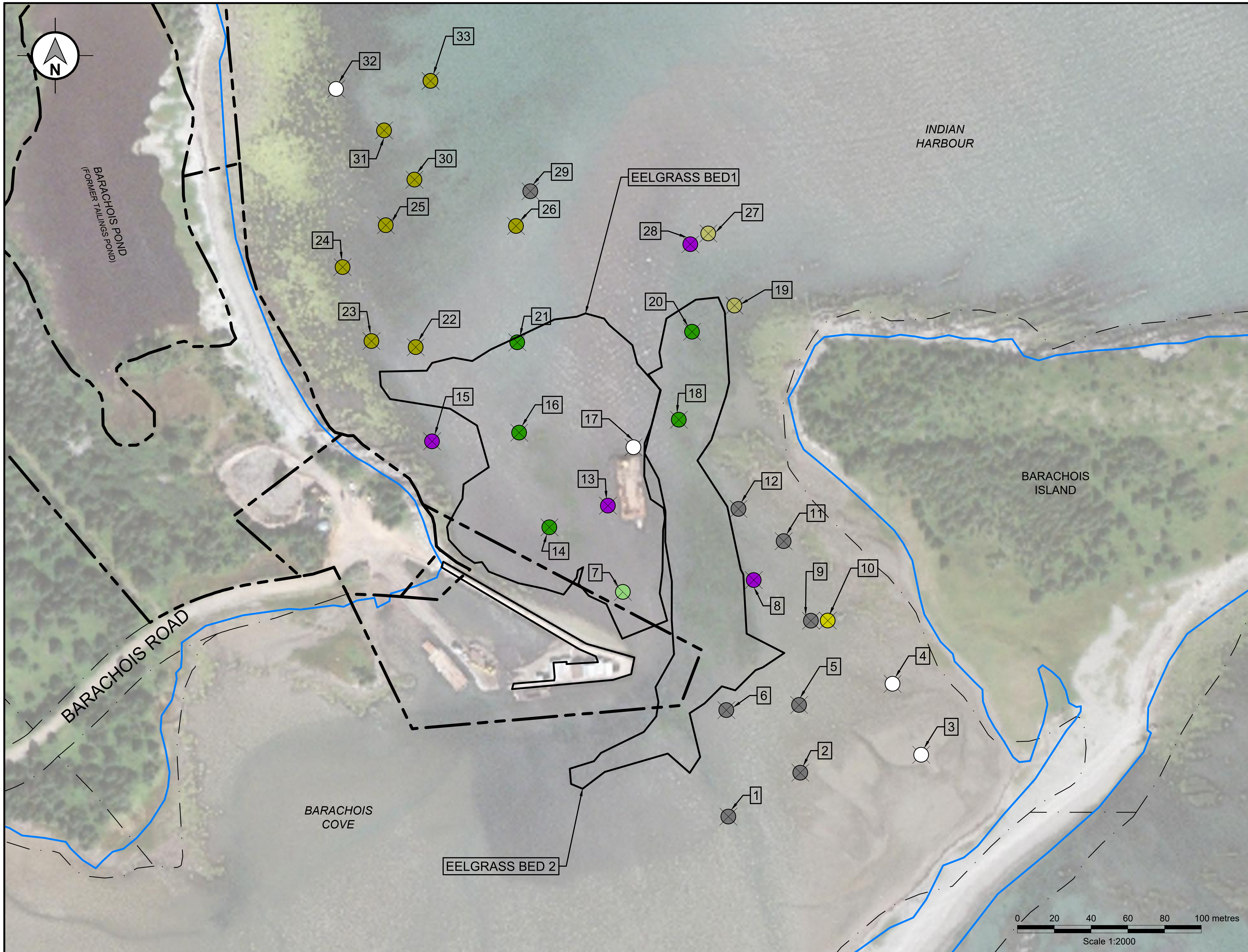


LEGEND:

SUBJECT PROPERTY BOUNDARY..................

ADJACENT PROPERTY BOUNDARY..................

SAMPLE LOCATIONS:

NO DATA..

EELGRASS ABSENT...

ASCOPHYLLUM PRESENT.......................................

FRAGMENTED EELGRASS.......................................

PROMINENT EELGRASS..

MODERATE EELGRASS...

GENERAL NOTES:

1. DRAWING REFERENCES: NOVA SCOTIA PROPERTY RECORDS. DIGITAL TOPOGRAPHIC MAPPING BY NOVA SCOTIA GEOMATICS CENTRE. NOVA SCOTIA GROUNDWATER ATLAS.
2. PROJECTION: NAD83(CSRS), UTM ZONE 20 NORTH.
3. ALL PROPERTY BOUNDARIES, SITE FEATURES AND SERVICES ARE APPROXIMATE ONLY. SUBJECT TO SURVEY.

CLIENT:

WHALE SANCTUARY PROJECT

PROJECT:

EELGRASS SURVEY
WINE HARBOUR, NS

LOCATION:

210 BARACHOIS ROAD
WINE HARBOUR, NS

TITLE:

EELGRASS SURVEY

CONSULTANT:

strum
CONSULTING

SCALE:
H: 1:2000 V:

DATE: APRIL 2024

DRAWN: L. PEMBERTON

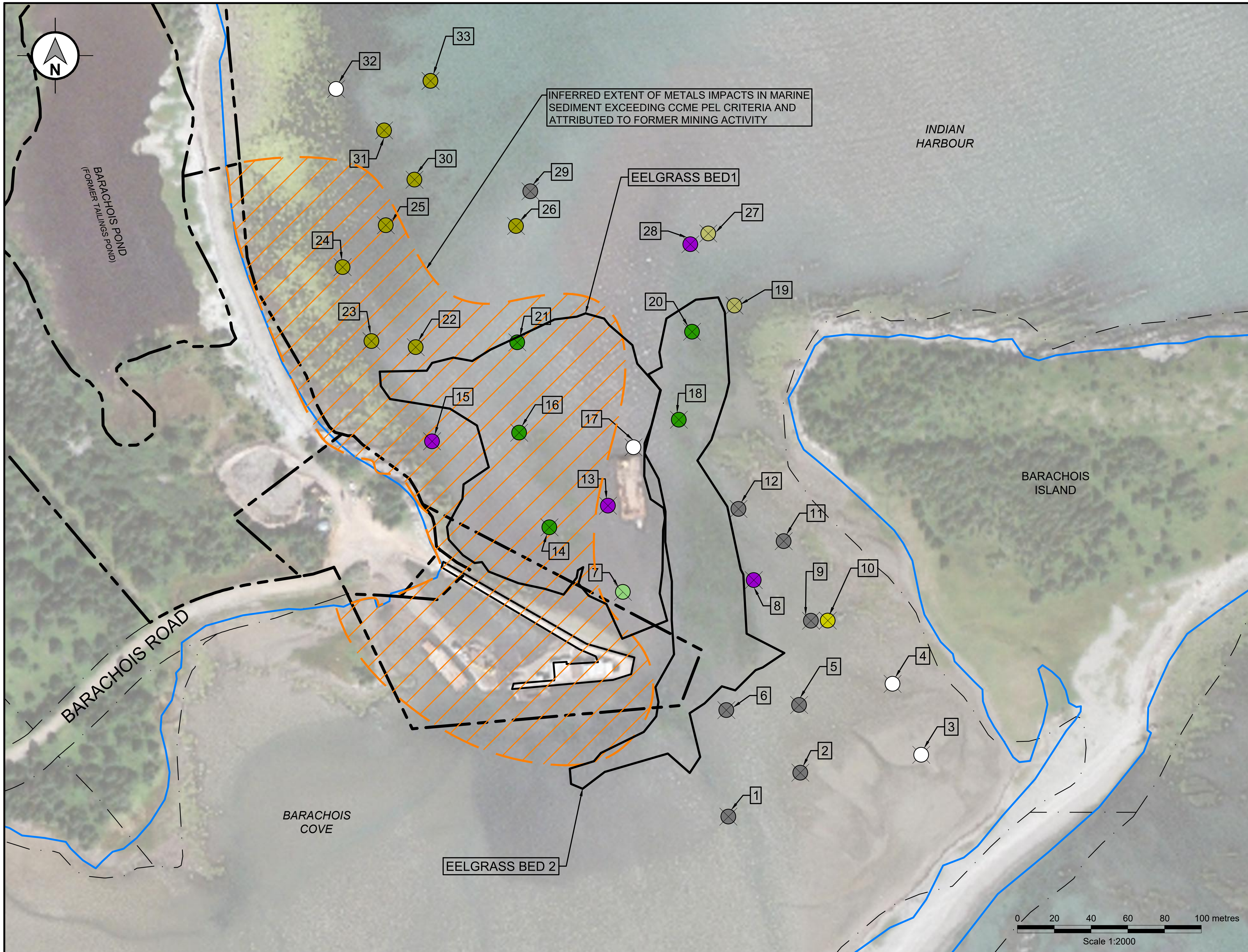
DESIGNED:

CHECKED: M. LOPEZ

APPR'D: E. HISCOTT

PROJECT No.: 22-8552

DRAWING No.: 1



LEGEND:

SUBJECT PROPERTY BOUNDARY..................

ADJACENT PROPERTY BOUNDARY..................

INFERRED EXTENT OF METALS IMPACTS IN MARINE SEDIMENT EXCEEDING CCME PEL CRITERIA AND ATTRIBUTED TO FORMER MINING ACTIVITY........................

SAMPLE LOCATIONS:

NO DATA..

EELGRASS ABSENT..

ASCOPHYLLUM PRESENT..

FRAGMENTED EELGRASS..

PROMINENT EELGRASS..

MODERATE EELGRASS..

GENERAL NOTES:

1. DRAWING REFERENCES: NOVA SCOTIA PROPERTY RECORDS. DIGITAL TOPOGRAPHIC MAPPING BY NOVA SCOTIA GEOMATICS CENTRE. NOVA SCOTIA GROUNDWATER ATLAS.
2. PROJECTION: NAD83(CSRS), UTM ZONE 20 NORTH.
3. ALL PROPERTY BOUNDARIES, SITE FEATURES AND SERVICES ARE APPROXIMATE ONLY. SUBJECT TO SURVEY.

CLIENT:

WHALE SANCTUARY PROJECT

PROJECT:

EELGRASS SURVEY
WINE HARBOUR, NS

LOCATION:

210 BARACHOIS ROAD
WINE HARBOUR, NS

TITLE:

EELGRASS SURVEY AND MARINE SEDIMENT METALS IMPACTS

CONSULTANT:

strum
CONSULTING

SCALE:
H: 1:2000 V:

DATE: APRIL 2024		DRAWN: L. PEMBERTON
DESIGNED:	CHECKED: M. LOPEZ	APPR'D: E. HISCOTT
PROJECT No.: 22-8552		
DRAWING No.: 2		

TABLE 4 (page 1): Marine Sediment Analytical Results - Available Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS — *Project #22-8552*

Parameter	Units	RDL	Criteria: CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment	Criteria: CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment	Area A: SED-A-18-S1 WQA294 23/07/24	SED-A-18-S2 WQA295 23/07/24	SED-A-17-S1 WQA296 23/07/24	SED-A-16-S1 WOO439 23/07/25	SED-A-15-S1 WQA297 23/07/24	SED-A-14-S1 WQA298 23/07/24	SED-A-14-S2 WQA299 23/07/24	SED-A-9-S1 WOO440 23/07/24	Area B: SED-B-12-S1 WOO441 23/07/25	FD3 WOO455 23/07/25	SED-B-10-S1 WOO442 23/07/25	SED-B-10-S1 XXC928 23/12/14	SED-B-3-S1 WOO443 23/07/25
Aluminum	mg/kg	10	-	-	6000	5900	6600	6500	6700	5700	5100	5700	7700	7700	6700	-	6600
Antimony	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Arsenic	mg/kg	2	7.24	41.6	6.8	**8.1**	**22**	**11**	**13**	**15**	**9.9**	4.2	**14**	**14**	**<u>630</u>**	**<u>49</u>**	**<u>120</u>**
Barium	mg/kg	5	-	-	21	20	17	6.7	19	10	8.3	7	13	14	7.6	-	9
Beryllium	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Bismuth	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Boron (total)	mg/kg	50	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Cadmium	mg/kg	0.3	0.7	4.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Chromium (total)	mg/kg	2	52.3	160	12	11	12	11	12	9.9	8.8	9.4	13	13	11	-	11
Cobalt	mg/kg	1	-	-	4.5	4.4	4.8	5.1	4.8	4.4	3.9	4.2	6.7	6.7	5.2	-	5
Copper	mg/kg	2	18.7	108	6.5	6.5	7.5	4.6	7.8	5.3	4.8	3.4	8	8.6	5.4	-	5.7
Iron	mg/kg	50	-	-	12000	12000	14000	14000	13000	13000	11000	14000	21000	22000	15000	-	18000
Lead	mg/kg	0.5	30.2	112	5.6	5.2	6.9	3.1	6.6	4.9	3.5	3.1	5.4	7	5	-	6
Lithium	mg/kg	2	-	-	16	16	17	16	16	15	13	16	23	23	22	-	19
Manganese	mg/kg	2	-	-	300	290	320	260	310	320	310	330	620	620	260	-	240
Mercury (total)	mg/kg	0.1	0.13	0.7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Molybdenum	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Nickel	mg/kg	2	-	-	14	12	15	19	13	12	10	12	15	15	13	-	14
Rubidium	mg/kg	2	-	-	7.8	7.2	6.7	4	6.8	4.7	4	3.5	4.8	4.9	4.5	-	5
Selenium	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Silver	mg/kg	0.5	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd
Strontium	mg/kg	5	-	-	37	34	29	55	37	18	13	20	20	20	13	-	19
Thallium	mg/kg	0.1	-	-	0.1	0.1	0.1	nd	0.11	nd	nd	nd	nd	nd	nd	-	nd
Tin	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.3	nd	-	nd
Uranium	mg/kg	0.1	-	-	0.66	0.67	0.64	0.35	0.8	0.74	0.48	0.33	0.54	0.6	1.2	-	0.49
Vanadium	mg/kg	2	-	-	15	14	16	11	16	13	11	12	18	18	12	-	13
Zinc	mg/kg	5	124	271	**190**	**210**	32	83	**130**	100	83	25	32	33	30	-	29

Notes:
Shading/bold indicates exceedance of: CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment
Underlining/bold indicates exceedance of: CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment
m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)

TABLE 4 (page 2): Marine Sediment Analytical Results - Available Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS — *Project #22-8552*

Parameter	Units	RDL	Criteria		Sample ID								
					Area C						Area D		
			CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment	CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment	SED-C-13-S1	SED-C-11-S1	FD5	FD5 Lab-Dup	SED-C-8-S1	SED-C-7-S1	SED-D-6-S1	SED-D-6-S1 Lab-Dup	SED-D-6-S2
					WOO444	WQA300	WOO445		WOO446	WQA301	WQA302		WQA303
					23/07/24	23/07/25			23/07/24	23/07/25	23/07/25		23/07/25
Aluminum	mg/kg	10	-	-	5600	4600	4500	4500	5500	4800	4700	4800	4700
Antimony	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Arsenic	mg/kg	2	7.24	41.6	**9.2**	**26**	**9.6**	**7.8**	4.8	5.8	**11**	**12**	**12**
Barium	mg/kg	5	-	-	6.2	5.3	5.8	5.7	6	5.6	5.9	8.3	5.4
Beryllium	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bismuth	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Boron (total)	mg/kg	50	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cadmium	mg/kg	0.3	0.7	4.2	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chromium (total)	mg/kg	2	52.3	160	8.9	7.4	7.4	7.3	8.6	8.1	7.8	8.3	7.6
Cobalt	mg/kg	1	-	-	4.1	3.4	3.3	3.4	4.2	3.6	3.6	3.6	3.7
Copper	mg/kg	2	18.7	108	3.4	2.4	2.5	2.4	3.4	3.1	3.3	3.2	3
Iron	mg/kg	50	-	-	13000	11000	10000	10000	13000	11000	10000	11000	11000
Lead	mg/kg	0.5	30.2	112	2.9	2.4	2.3	2.3	2.8	2.5	2.7	2.7	2.4
Lithium	mg/kg	2	-	-	18	12	13	14	14	14	13	14	13
Manganese	mg/kg	2	-	-	220	250	220	200	350	280	270	270	260
Mercury (total)	mg/kg	0.1	0.13	0.7	nd	nd	nd	nd	nd	nd	nd	nd	nd
Molybdenum	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Nickel	mg/kg	2	-	-	11	8.9	8.7	8.9	11	11	9.7	10	9.2
Rubidium	mg/kg	2	-	-	3.7	3	3	3.2	3.5	3.7	3.5	3.9	3.2
Selenium	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Silver	mg/kg	0.5	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Strontium	mg/kg	5	-	-	13	6.8	7.3	8.2	13	16	11	12	6.5
Thallium	mg/kg	0.1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tin	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Uranium	mg/kg	0.1	-	-	0.33	0.27	0.26	0.28	0.29	0.36	0.34	0.36	0.34
Vanadium	mg/kg	2	-	-	11	9.4	8.9	8.8	12	9.1	9.2	9.9	8.9
Zinc	mg/kg	5	124	271	25	**290**	20	20	23	**150**	**410**	**430**	**230**

Notes:

Shading/bold indicates exceedance of: CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment
Underlining/bold indicates exceedance of: CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment
m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
\- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)

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TABLE 4 (page 3): Marine Sediment Analytical Results - Available Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS

Project # 22-8552

Parameter	Units	RDL	Criteria		Sample ID														
					Area D			Area E					Area G						
			CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment	CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment	SED-D-5-S1	SED-D-4-S1	SED-D-2-S1	SED-E-4-S1	SED-E-4-S2	SED-E-3-S1	SED-E-2-S1	SED-E-1-S1	SED-G-6-S1	SED-G-6-S1 Lab-Dup	SED-G-5-S1	SED-G-4-S1	SED-G-3-S1	SED-G-2-S1	SED-G-1-S1
					WQA304	WOO447	WQA305	WQA306	WQA307	WQA308	WQA309	WOO448	XXC927	XXC927	XXC926	XXC925	XXC924	XXC923	XXC922
					23/07/25	23/07/25	23/07/25	23/07/24	23/07/24	23/07/25	23/07/25	23/07/25	23/12/14	23/12/14	23/12/14	23/12/14	23/12/14	23/12/14	23/12/14
Aluminum	mg/kg	10	-	-	5100	5600	6200	7500	5600	5300	5200	7600	-	-	-	-	-	-	-
Antimony	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Arsenic	mg/kg	2	7.24	41.6	**130**	**840**	**24**	**20**	5.9	4.3	**15**	**61**	**7.6**	**21**	**70**	**35**	**1200**	**170**	**260**
Barium	mg/kg	5	-	-	6.7	7	8.1	14	8.8	5.6	8.8	17	-	-	-	-	-	-	-
Beryllium	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Bismuth	mg/kg	2	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Boron (total)	mg/kg	50	-	-	nd	nd	nd	nd	nd	nd	nd	52	-	-	-	-	-	-	-
Cadmium	mg/kg	0.3	0.7	4.2	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Chromium (total)	mg/kg	2	52.3	160	8.8	10	9.8	13	9.7	8.6	9.2	13	-	-	-	-	-	-	-
Cobalt	mg/kg	1	-	-	3.9	4.2	4.2	5.1	3.9	3.8	3.9	5.4	-	-	-	-	-	-	-
Copper	mg/kg	2	18.7	108	3.7	3.9	5.3	9	4.5	3.1	4.5	9.3	-	-	-	-	-	-	-
Iron	mg/kg	50	-	-	11000	17000	13000	16000	11000	11000	11000	16000	-	-	-	-	-	-	-
Lead	mg/kg	0.5	30.2	112	3.2	3.5	4.4	5.8	2.9	3.2	4.7	8.8	-	-	-	-	-	-	-
Lithium	mg/kg	2	-	-	15	16	18	18	15	15	15	21	-	-	-	-	-	-	-
Manganese	mg/kg	2	-	-	210	280	190	250	200	200	190	250	-	-	-	-	-	-	-
Mercury (total)	mg/kg	0.1	0.13	0.7	nd	nd	nd	nd	nd	nd	nd	0.13	-	-	-	-	-	-	-
Molybdenum	mg/kg	2	-	-	nd	nd	nd	5.5	3.2	nd	nd	3.2	-	-	-	-	-	-	-
Nickel	mg/kg	2	-	-	11	12	12	15	13	11	12	15	-	-	-	-	-	-	-
Rubidium	mg/kg	2	-	-	4.1	3.4	4.5	7.7	5.1	4.1	4.6	7.5	-	-	-	-	-	-	-
Selenium	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Silver	mg/kg	0.5	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Strontium	mg/kg	5	-	-	8.8	11	13	22	11	13	10	31	-	-	-	-	-	-	-
Thallium	mg/kg	0.1	-	-	nd	nd	nd	0.13	0.1	nd	nd	0.15	-	-	-	-	-	-	-
Tin	mg/kg	1	-	-	nd	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-
Uranium	mg/kg	0.1	-	-	0.52	0.37	0.59	1.6	1	0.47	0.68	0.93	-	-	-	-	-	-	-
Vanadium	mg/kg	2	-	-	9.9	14	10	18	11	9.1	11	18	-	-	-	-	-	-	-
Zinc	mg/kg	5	124	271	**130**	25	78	**210**	110	**140**	74	38	-	-	-	-	-	-	-

Notes:

Shading/bold indicates exceedance of: CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment

Underlining/bold indicates exceedance of: CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment

m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)

TABLE 5: Marine Sediment Analytical Results - Cyanide - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS ***Project #22-8552***

Parameter	Units	RDL	Criteria		Sample ID						
					Area B	Area C	Area D			Area E	
			CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment	CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment	SED-B-3-S1	SED-C-13-S1	SED-D-6-S1	SED-D-6-S2	SED-D-2-S1	SED-E-4-S1	SED-E-4-S2
					WOO443	WOO444	WQA302	WQA303	WQA305	WQA306	WQA307
					23/07/25	23/07/24	2023-07-25	2023-07-25	2023-07-25	2023-07-24	2023-07-24
Cyanide (total)	mg/kg	0.5	-	-	nd	nd	nd	nd	nd	nd	nd

Notes:

Shading/bold indicates exceedance of: CCME Interim Sediment Quality Guidelines (ISQG) for the Protection of Aquatic Life - Marine Sediment
Underlining/bold indicates exceedance of: CCME Sediment Probable Effects Levels (PEL) for the Protection of Aquatic Life - Marine Sediment
m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)

TABLE 6 (page 1): Marine Sediment Analytical Results - Petroleum Hydrocarbons - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS — ***Project # 22-8552***

Sample ID	Lab ID	Date	VOC	Benzene	Toluene	Ethylbenzene	Xylenes	Petroleum Hydrocarbon Fractions					Modified TPH	Type	Comments
								F1	F2	F3		F4			
				B	T	E	X	C_6-C_{10}	C_{10}-C_{16}	C_{16}-C_{21}	C_{21}-C_{32}	C_{32}-C_{50}			
		(yy/mm/dd)	(ppm)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
Marine Sediment Sampling															
SED-D-2-S1	WQA305	23/07/25	0	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	-	
SED E-1-S1	WOO448	23/07/25	0	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	-	
RDL				0.005	0.05	0.01	0.05	2.5	10	10	15	-	15	-	
Guideline Criteria	**NS Tier I EQS - Marine Sediment (Oct. 2022)**			1.2	1.4	1.2	1.3	-	-	-	-	-	15	G	
													25	F	
													43	L	

Notes: Value — NS Tier I EQS - Marine Sediment (Oct. 2022)

m = metres below bottom of water body	nd = non-detect	nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed	ppm = parts per million	mg/kg = milligrams per kilogram
RDL = Reportable Detection Limit	%LEL = Percentage of Lower Explosive Limit	TPH = Total Petroleum Hydrocarbons
RBCA = Atlantic Risk Based Corrective Action	EQS = Environmental Quality Standards	PSS = Pathway Specific Standards
Modified TPH = mTPH	VOC = Volatile Organic Compound screening results in sample headspace	

Type = hydrocarbon resemblance based on lab comments and/or distribution of hydrocarbon ranges. G = gasoline; F = fuel oil/diesel; L = lube oil

Hydrocarbon concentrations in RBCA fraction format can be combined to be reported as the CCME F1 to F4 fractions and compared directly to the values in this table.

Analysis of CCME F4 fraction C32-C50 is not part of standard RBCA lab analysis package. Where provided, analysis of F4 fraction specifically requested.

For comparison purposes the combined RBCA fractions C16-C21 and C21-C32 are equivalent to CCME F3 fraction C16-C34.

For comparison purposes RBCA fraction C32-C50 is equivalent to CCME F4 fraction C34-C50.

Sediment criteria for mTPH vary based on fraction of organic carbon (foc) value. Default foc value of 0.01 is used where foc value not available.

Where foc value is available, mTPH criteria is increased by the ratio of actual foc divided by 0.01, to a maximum of 500 mg/kg (e.g., for foc = 0.04, mTPH criteria is multiplied by 4x, up to 500 mg/kg maximum).

Samples collected on the dates indicated (yy/mm/dd)

Lab analysis by Bureau Veritas, Bedford, NS

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TABLE 6 (page 2): Marine Sediment Analytical Results - Petroleum Hydrocarbons - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS — ***Project # 22-8552***

Sample ID	Lab ID	Date	VOC	Benzene	Toluene	Ethylbenzene	Xylenes	Petroleum Hydrocarbon Fractions					Modified TPH	Type	Comments
								F1	F2	F3		F4			
				B	T	E	X	C_6-C_{10}	C_{10}-C_{16}	C_{16}-C_{21}	C_{21}-C_{32}	C_{32}-C_{50}			
		(yy/mm/dd)	(ppm)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
Marine Sediment Sampling															
SED-D-2-S1	WQA305	23/07/25	0	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	-	
SED E-1-S1	WOO448	23/07/25	0	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	-	
RDL				0.005	0.05	0.01	0.05	2.5	10	10	15	-	15	-	
Guideline Criteria	**Atlantic RBCA Tier I EQS - Marine Sediment (July 2022)**			1.2	1.4	1.2	1.3	-	-	-	-	-	15	G	
													25	F	
													43	L	

Notes: Value — Atlantic RBCA Tier I EQS - Marine Sediment (July 2022)

m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
ppm = parts per million
mg/kg = milligrams per kilogram
RDL = Reportable Detection Limit
%LEL = Percentage of Lower Explosive Limit
TPH = Total Petroleum Hydrocarbons
RBCA = Atlantic Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards
Modified TPH = mTPH
VOC = Volatile Organic Compound screening results in sample headspace
Type = hydrocarbon resemblance based on lab comments and/or distribution of hydrocarbon ranges. G = gasoline; F = fuel oil/diesel; L = lube oil
Hydrocarbon concentrations in RBCA fraction format can be combined to be reported as the CCME F1 to F4 fractions and compared directly to the values in this table.
Analysis of CCME F4 fraction C32-C50 is not part of standard RBCA lab analysis package. Where provided, analysis of F4 fraction specifically requested.
For comparison purposes the combined RBCA fractions C16-C21 and C21-C32 are equivalent to CCME F3 fraction C16-C34.
For comparison purposes RBCA fraction C32-C50 is equivalent to CCME F4 fraction C34-C50.
Sediment criteria for mTPH vary based on fraction of organic carbon (foc) value. Default foc value of 0.01 is used where foc value not available.
Where foc value is available, mTPH criteria is increased by the ratio of actual foc divided by 0.01, to a maximum of 500 mg/kg (e.g., for foc = 0.04, mTPH criteria is multiplied by 4x, up to 500 mg/kg maximum).
Samples collected on the dates indicated (yy/mm/dd)
Lab analysis by Bureau Veritas, Bedford, NS

TABLE 8 (page 1): Marine Surface Water Analytical Results - Total Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS | Project #22-8552

Parameter (total)	Units	RDL	Criteria	Sample ID											
				Area A							Area B			Area C	
			CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)	SW-A-18	SW-A-18 Lab-Dup	SW-A-17	SW-A-16	SW-A-15	SW-A-14	SW-A-9	SW-B-12	SW-B-10	SW-B-3	SW-C-13	SW-C-11
				SW		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
				WOO309		WOO310	WOO311	WOO312	WOO313	WOO314	WOO315	WOO316	WOO317	WOO318	WOO319
				23/07/24		23/07/24	23/07/25	23/07/24	23/07/24	23/07/24	23/07/25	23/07/25	23/07/25	23/07/24	23/07/25
General Chemistry/Inorganic Parameters															
Anion Sum	me/L	-	-	-	-	-	-	502	-	-	-	467	-	-	-
Bicarb. Alkalinity (as CaCO3)	mg/L	1	-	-	-	-	-	97	-	-	-	83	-	-	-
Calculated TDS	mg/L	1	-	-	-	-	-	29000	-	-	-	27000	-	-	-
Carb. Alkalinity (as CaCO3)	mg/L	1	-	-	-	-	-	nd	-	-	-	1.5	-	-	-
Cation Sum	me/L	-	-	-	-	-	-	506	-	-	-	466	-	-	-
Hardness (CaCO3)	mg/L	1	-	-	-	-	-	5200	-	-	-	4800	-	-	-
Ion Balance (% Difference)	%	-	-	-	-	-	-	0.39	-	-	-	0.07	-	-	-
Langelier Index (@ 20C)	-	-	-	-	-	-	-	0.491	-	-	-	0.841	-	-	-
Langelier Index (@ 4C)	-	-	-	-	-	-	-	0.252	-	-	-	0.603	-	-	-
Nitrate (N)	mg/L	0.05	200	-	-	-	-	nd	-	-	-	nd	-	-	-
Saturation pH (@ 20C)	-	-	-	-	-	-	-	7.31	-	-	-	7.43	-	-	-
Saturation pH (@ 4C)	-	-	-	-	-	-	-	7.55	-	-	-	7.67	-	-	-
Total Alkalinity (as CaCO3)	mg/L	25	-	-	-	-	-	98	-	-	-	85	-	-	-
Dissolved Chloride (Cl-)	mg/L	5	-	-	-	-	-	16000	-	-	-	15000	-	-	-
Colour	TCU	5	-	-	-	-	-	nd	-	-	-	14	-	-	-
Nitrate + Nitrite (N)	mg/L	0.05	-	-	-	-	-	nd	-	-	-	nd	-	-	-
Nitrite (N)	mg/L	0.01	-	-	-	-	-	nd	-	-	-	nd	-	-	-
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	-	nd	-	-	-	0.055	-	-	-	0.062	-	-	-
Total Organic Carbon (C)	mg/L	0.5	-	nd (5)	-	-	-	1.3	-	-	-	nd (5)	-	-	-
Orthophosphate (P)	mg/L	0.01	-	-	-	-	-	0.012	-	-	-	0.014	-	-	-
pH	pH	-	7.0-8.7	-	-	-	-	7.8	-	-	-	8.27	-	-	-
Reactive Silica (SiO2)	mg/L	0.5	-	-	-	-	-	nd	-	-	-	0.52	-	-	-
Dissolved Sulphate (SO4)	mg/L	10	-	-	-	-	-	2300	-	-	-	2100	-	-	-
Turbidity	NTU	0.1	-	-	-	-	-	1.6	-	-	-	0.43	-	-	-
Conductivity	µS/cm	1	-	-	-	-	-	46000	-	-	-	42000	-	-	-
Metals Parameters															
Aluminum	µg/L	5	-	nd	nd	nd	73	nd	nd	nd	nd	120	nd	nd	nd
Antimony	µg/L	1	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Arsenic	µg/L	1	12.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Barium	µg/L	1	-	nd	nd	nd	11	nd	nd	nd	10	nd	nd	nd	nd
Beryllium	µg/L	1	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bismuth	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Boron	µg/L	50	-	3900	4000	4000	3400	4100	4100	4200	3900	3800	3900	4000	3900
Cadmium	µg/L	0.01	0.12	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Calcium	µg/L	100	-	330000	330000	330000	280000	340000	340000	350000	320000	320000	330000	340000	330000
Chromium	µg/L	1	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cobalt	µg/L	0.4	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Copper	µg/L	0.5	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Iron	µg/L	50	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Lead	µg/L	0.5	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Magnesium	µg/L	100	-	1000000	1000000	1000000	890000	1100000	1100000	1100000	1000000	970000	1100000	1100000	1100000
Manganese	µg/L	2	-	nd	-	nd	nd	0.013	nd	0.013	nd	0.013	nd	nd	nd
Mercury (total)	µg/L	0.013	0.016	nd	nd	nd	nd	0.013	nd	0.013	nd	0.013	nd	nd	nd
Molybdenum	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Nickel	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phosphorus	µg/L	100	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Potassium	µg/L	100	-	320000	320000	320000	260000	320000	330000	330000	310000	300000	320000	320000	320000
Selenium	µg/L	0.5	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Silver	µg/L	0.1	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sodium	µg/L	100	-	8900000	8900000	9000000	7500000	9000000	9000000	9100000	8600000	8300000	8800000	8900000	8900000
Strontium	µg/L	2	-	6300	6400	6400	5100	6600	6800	6800	6300	6100	6500	6500	6400
Thallium	µg/L	0.1	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tin	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Titanium	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Uranium	µg/L	0.1	-	2.7	2.7	2.8	2.2	2.6	2.7	2.8	2.4	2.5	2.6	2.8	2.5
Vanadium	µg/L	2	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Zinc	µg/L	5	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes:

Shading/bold indicates exceedance of: CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)

SW = Surface Water
nd = non-detect
nd( ) = non-detect at elevated detection limit
\- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/L = milligrams per litre
µg/L = micrograms per litre
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
CCME = Canadian Council of Ministers of the Environment
WQGs = Water Quality Guidelines
Unless otherwise indicated, metals results for surface water samples are total metals (i.e. not filtered).
Samples collected on the dates indicated (yy/mm/dd).
Lab analysis by Bureau Veritas, Bedford, NS

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TABLE 8 (page 2): Marine Surface Water Analytical Results - Total Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS **Project #22-8552**

Parameter (total)	Units	RDL	Criteria: CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)	SW-C-8	SW-C-8 Lab-Dup	SW-C-7	SW-D-6	SW-D-5	SW-D-5 Lab-Dup	SW-D-4	SW-D-2	SW-D-2 Lab-Dup	SW-E-4	SW-E-3	SW-E-2	SW-E-1
Sample ID: Area				Area C			Area D						Area E			
				SW		SW	SW	SW		SW	SW		SW	SW	SW	SW
				WOO320		WOO321	WOO322	WOO323		WOO324	WOO325		WOO326	WOO327	WOO328	WOO329
				23/07/24		23/07/25	23/07/25	23/07/25		23/07/25	23/07/25		23/07/25	23/07/25	23/07/25	23/07/25
General Chemistry/Inorganic Parameters																
Anion Sum	me/L	-	-	497	-	-	-	512	-	-	-	-	-	-	-	498
Bicarb. Alkalinity (as CaCO3)	mg/L	1	-	99	-	-	-	94	-	-	-	-	-	-	-	77
Calculated TDS	mg/L	1	-	29000	-	-	-	29000	-	-	-	-	-	-	-	29000
Carb. Alkalinity (as CaCO3)	mg/L	1	-	nd	-	-	-	nd	-	-	-	-	-	-	-	nd
Cation Sum	me/L	-	-	494	-	-	-	494	-	-	-	-	-	-	-	495
Hardness (CaCO3)	mg/L	1	-	5100	-	-	-	5100	-	-	-	-	-	-	-	5200
Ion Balance (% Difference)	%	-	-	0.33	-	-	-	1.79	-	-	-	-	-	-	-	0.23
Langelier Index (@ 20C)	-	-	-	0.537	-	-	-	0.489	-	-	-	-	-	-	-	0.325
Langelier Index (@ 4C)	-	-	-	0.298	-	-	-	0.25	-	-	-	-	-	-	-	0.086
Nitrate (N)	mg/L	0.05	200	nd	-	-	-	nd	-	-	-	-	-	-	-	0.49
Saturation pH (@ 20C)	-	-	-	7.33	-	-	-	7.35	-	-	-	-	-	-	-	7.44
Saturation pH (@ 4C)	-	-	-	7.57	-	-	-	7.59	-	-	-	-	-	-	-	7.68
Total Alkalinity (as CaCO3)	mg/L	25	-	100	-	-	-	95	-	-	-	-	-	-	-	77
Dissolved Chloride (Cl-)	mg/L	5	-	16000	-	-	-	16000	-	-	-	-	-	-	-	16000
Colour	TCU	5	-	nd	-	-	-	nd	-	-	-	-	-	-	-	nd
Nitrate + Nitrite (N)	mg/L	0.05	-	nd	-	-	-	nd	-	-	-	-	-	-	-	0.51
Nitrite (N)	mg/L	0.01	-	nd	-	-	-	nd	-	-	-	-	-	-	-	0.011
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	-	0.052	0.055	-	-	nd	-	-	-	-	-	-	-	nd
Total Organic Carbon (C)	mg/L	0.5	-	nd (5)	-	-	-	nd (5)	-	-	-	-	-	-	-	nd (5)
Orthophosphate (P)	mg/L	0.01	-	0.016	-	-	-	0.016	-	-	-	-	-	-	-	0.014
pH	pH	-	7.0-8.7	7.86	-	-	-	7.84	-	-	-	-	-	-	-	7.76
Reactive Silica (SiO2)	mg/L	0.5	-	nd	-	-	-	nd	-	-	-	-	-	-	-	nd
Dissolved Sulphate (SO4)	mg/L	10	-	2200	-	-	-	2200	-	-	-	-	-	-	-	2200
Turbidity	NTU	0.1	-	0.21	-	-	-	nd	-	-	-	-	-	-	-	3.5
Conductivity	µS/cm	1	-	45000	-	-	-	45000	-	-	-	-	-	-	-	44000
Metals Parameters																
Aluminum	µg/L	5	-	nd	-	nd	nd	150	-	nd	nd	nd	540	nd	54	nd
Antimony	µg/L	1	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Arsenic	µg/L	1	12.5	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Barium	µg/L	1	-	10	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Beryllium	µg/L	1	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Bismuth	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Boron	µg/L	50	-	3800	-	3900	3800	3900	-	4100	4200	4000	4100	3900	3800	3800
Cadmium	µg/L	0.01	0.12	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Calcium	µg/L	100	-	330000	-	320000	320000	320000	-	340000	350000	340000	340000	330000	320000	330000
Chromium	µg/L	1	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Cobalt	µg/L	0.4	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Copper	µg/L	0.5	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Iron	µg/L	50	-	nd	-	nd	nd	nd	-	nd	nd	nd	1200	nd	nd	nd
Lead	µg/L	0.5	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Magnesium	µg/L	100	-	1000000	-	1000000	1000000	1100000	-	1100000	1100000	1100000	1100000	1000000	1000000	1100000
Manganese	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	43	nd	nd	nd
Mercury (total)	µg/L	0.013	0.016	nd	-	nd	nd	0.013	nd	nd	nd	-	**0.017**	nd	nd	nd
Molybdenum	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Nickel	µg/L	2	-	55	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Phosphorus	µg/L	100	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Potassium	µg/L	100	-	320000	-	310000	300000	320000	-	330000	320000	310000	320000	310000	310000	320000
Selenium	µg/L	0.5	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Silver	µg/L	0.1	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Sodium	µg/L	100	-	8800000	-	8700000	8600000	8800000	-	9100000	9100000	8700000	8900000	8700000	8600000	8800000
Strontium	µg/L	2	-	6400	-	6300	6200	6300	-	6600	6400	6200	6700	6400	6200	6300
Thallium	µg/L	0.1	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Tin	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Titanium	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	23	nd	nd	nd
Uranium	µg/L	0.1	-	2.8	-	2.6	2.5	2.7	-	2.6	2.8	2.6	2.9	2.5	2.4	2.6
Vanadium	µg/L	2	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Zinc	µg/L	5	-	nd	-	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd

Notes:

Shading/bold indicates exceedance of: CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)

SW = Surface Water
nd = non-detect
nd( ) = non-detect at elevated detection limit
\- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/L = milligrams per litre
µg/L = micrograms per litre
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
CCME = Canadian Council of Ministers of the Environment
WQGs = Water Quality Guidelines
Unless otherwise indicated, metals results for surface water samples are total metals (i.e. not filtered).
Samples collected on the dates indicated (yy/mm/dd).
Lab analysis by Bureau Veritas, Bedford, NS

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TABLE 9: Marine Surface Water Analytical Results - Total Cyanide - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS *Project #: 22-8552*

Parameter	Units	RDL	Criteria		Sample ID						
			NS Tier I EQS - Marine Surface Water (Oct. 2022) (<10m from Water Body)	CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)	SW-A-18	SW-A-18 Lab-Dup	SW-B-10	SW-C-8	SW-C-8 Lab-Dup	SW-D-5	SW-E-1
					SW	SW	SW	SW	SW	SW	SW
					WOO309	WOO309	WOO316	WOO320	WOO320	WOO323	WOO329
					23/07/24	23/07/24	23/07/25	23/07/24	23/07/24	23/07/25	23/07/25
Cyanide (total)	ug/L	0.005	1	-	nd	nd	nd	nd	nd	nd	nd

Notes:

Shading/bold indicates exceedance of: NS Tier I EQS - Marine Surface Water (Oct. 2022) (<10m from Water Body)

Underlining/bold indicates exceedance of: CCME WQGs for the Protection of Marine Aquatic Life (MAL) (1999 w/ available updates)

GW = groundwater
DW = drinking water
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/L = milligrams per litre
µg/L = micrograms per litre
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Unless otherwise indicated, metals results for monitoring well samples are dissolved metals (i.e. field filtered).
Unless otherwise indicated, metals results for potable water wells are total metals (i.e. not filtered).
Samples collected on the dates indicated (yy/mm/dd).

Lab analysis by Bureau Veritas, Bedford, NS

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TABLE 12 (page 1): Invertebrate Tissue Analysis Results - Available Metals - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS — *Project #22-8552*

Parameter	Units	RDL	Criteria	Sample ID						
				Area A	Area B	Area C	Area D	Area E		
			Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)	INV-A-RC-0000101	INV-B-RC-0000102	INV-C-RC-0000103	INV-D-RC-0000104	INV-E-M-0000105	INV-E-M-0000105 Lab-Dup	INV-E-C-0000105
				WOV113	WOV114	WOV115	WOV116	WOV118		WOV117
				23/07/24	23/07/25	23/07/24	23/07/25	23/07/25		23/07/25
Aluminum	mg/kg	2.5	-	62	3.4	8.7	5.6	13	13	-
Antimony	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Arsenic	mg/kg	0.5	3.5	**6.8**	**5.1**	**4.9**	**3.6**	2.9	2.9	-
Barium	mg/kg	1.5	-	nd	nd	nd	nd	nd	nd	-
Beryllium	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Bismuth	mg/kg	-	-	-	-	-	-	-	-	-
Boron (total)	mg/kg	1.5	-	1.5	1.5	2.1	nd	4.3	4.4	-
Cadmium	mg/kg	0.05	-	13	0.53	0.31	0.37	0.37	0.38	-
Chromium (total)	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Cobalt	mg/kg	0.2	-	nd	nd	nd	nd	nd	nd	-
Copper	mg/kg	0.5	-	8.5	20	9.5	11	1.4	1.3	-
Iron	mg/kg	15	-	160	27	25	28	85	74	-
Lead	mg/kg	0.18	0.5	nd	nd	nd	nd	0.29	0.29	-
Lithium	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Manganese	mg/kg	0.5	-	5	2.1	3.3	4.4	2.3	2.2	-
Mercury (total)	mg/kg	0.01	0.5	0.048	0.043	0.019	0.05	0.036	0.05	nd
Molybdenum	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Nickel	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Rubidium	mg/kg	-	-	-	-	-	-	-	-	-
Selenium	mg/kg	0.5	-	1.4	0.66	0.63	0.7	0.65	0.65	-
Silver	mg/kg	0.12	-	0.83	0.33	0.22	0.38	nd	nd	-
Strontium	mg/kg	1.5	-	75	110	170	140	12	12	-
Thallium	mg/kg	0.02	-	nd	nd	nd	nd	nd	nd	-
Tin	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Uranium	mg/kg	0.02	-	0.047	nd	nd	nd	0.041	0.053	-
Vanadium	mg/kg	0.5	-	nd	nd	nd	nd	nd	nd	-
Zinc	mg/kg	1.5	-	22	18	14	14	17	19	-

Notes:
Shading/bold indicates exceedance of: Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)
m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards

Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)
RC = rock crab tissue sample
M = mussel tissue sample
C = clam tissue sample

TABLE 12 (page 2): Invertebrate Analysis Results - Methylmercury - Whale Sanctuary Project, Barachois Road, Wine Harbour, NS *Project #22-8552*

Parameter	Units	RDL	Criteria		Sample ID						
					Area A	Area B	Area C	Area D		Area E	
			CCME Tissue Residue Quality Guidelines for the Protection of Wildlife Consumer of Aquatic Biota	Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)	INV-A-RC-0000101	INV-B-RC-0000102	INV-C-RC-0000103	INV-D-RC-0000104	INV-D-RC-0000104 (Lab-dup)	INV-E-M-0000105	INV-E-M-0000105 (Lab-dup)
					115322	115323	115324	115325	115325	115326	115326
					23/07/24	23/07/25	23/07/24	23/07/25	23/07/25	23/07/25	23/07/25
					Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated	Net CH3Hg as Hg in the sample (mg/g wet wt.) As calculated
Methylmercury (organic)	mg/kg	0.4	0.033	0.5	0.0243	**0.0381**	0.0095	**0.0334**	**0.0350**	0.0158	0.0160

Notes:
Shading/bold indicates exceedance of: CCME Tissue Residue Quality Guidelines for the Protection of Wildlife Consumer of Aquatic Biota
Underlining/bold indicates exceedance of: Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)
m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards
Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)
Health Canada uses same concentration limit for total mecury and methylmercury since total mercury results combines total mercury and methylmecury, and most mercury in fish tissue exists in the form of methylmercury.
RC = rock crab tissue sample
M = mussel tissue sample

Clam tissue sample INV-E-C-0000105 could not be analyzed for methylmercury due to limited sample mass

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February 28, 2024

Strum Consulting
ATTN: Mauricio Lopez
211 Horseshoe Lake Drive, Suite 210
Halifax, Nova Scotia, Canada B3S 0B9
mlopez@strum.com

RE: Project SRM-AL2301 Client Project: 22-8552

Dear Mauricio Lopez,

On January 22, 2024, Brooks Applied Labs (BAL) received five (5) marine sediment samples at a temperature of 7.5°C. The samples were logged-in for the analyses of arsenic speciation [As(III), As(V), DMA, and MMA] and % total solids (%TS) according to the chain-of-custody form. All samples were received and stored according to BAL SOPs and EPA methodology.

BAL strongly recommends that all samples submitted for arsenic speciation remain at a temperature of ≤ 6°C to maintain sample integrity prior to analysis. Consequently, the As speciation results were qualified (**Z**), indicating that the samples were received above the recommended temperature.

Arsenic Speciation Quantitation by IC-ICP-CRC-MS

Aliquots of each sample were subjected to two separate extractions: a H3PO4 extraction designed to solubilize adsorbed As(III) and an alkaline Na3PO4 extraction designed to solubilize adsorbed As(V), MMAs, and DMAs. Each extract was analyzed for arsenic species by ion chromatography inductively coupled plasma collision reaction cell mass spectrometry (IC-ICP-CRC-MS).

In instances where the native sample result and/or the associated duplicate (DUP) result were below the MDL the RPD was not calculated (**N/C**).

The duplicate (DUP) B240236-DUP1 performed on sample 2401240-05 (SED-G-6-S1) had a relative percent difference (RPD) for As(III) above the acceptance limit (50%). The As(III) result for sample 2401240-05 (SED-G-6-S1) was qualified **M** for duplicate imprecision.

The matrix spike (MS) B240236-MS2 performed on sample 2401240-05 (SED-G-6-S1) had an As(III) recovery below the acceptance limit. The As (III) result for sample 2401240-05 (SED-G-6-S1) was qualified **N** for low bias.

The duplicate (DUP) B240301-DUP1 performed on sample 2401240-05 (SED-G-6-S1) had a relative percent difference (RPD) for As(V) above the acceptance limit (42%). The As(V) result for sample 2401240-05 (SED-G-6-S1) was qualified **M** for duplicate imprecision.

It should be noted that the matrix spikes which were prepared with As(III) oxidized to As(V) during the Na3PO4 extraction, although no significant oxidation was observed in the corresponding blank spike prepared with arsenite (data not shown/reported). This suggests that As(III) in the sample identified as SED-G-6-S1 (upon which the matrix spike set was performed) may have converted to As(V) during the extraction process and produced a high bias in the measured As(V) results. This should be taken into consideration when evaluating the reported sample results.

Traces of additional, unidentified arsenic species were observed in the submitted samples. Although the quoted methods were not designed for unknown arsenic species, please contact Brooks Applied Labs should there be additional questions regarding the significance of their presence.

Total Solids
Solid samples were homogenized, and an aliquot of each sample was measured into a pre-weighed vessel and dried in an oven for at least 12 hours. The vessels were removed from the oven, weighed again, and the percent of dried solid material was calculated.

The absolute value of the blanks was greater than the MRL. All samples had results greater than 10x the absolute value of the highest blank and no further action was required.

The results were not method blank corrected, as described in the calculations section of the relevant BAL SOP(s), and were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

All data was reported without further qualification and all other associated quality control sample results met the acceptance criteria.

BAL verifies that the reported results of all analyses for which the laboratory is accredited meet the requirements of the accrediting body, unless otherwise noted in the report narrative. For more information regarding accreditations please see the *Report Information* and *Batch Summary* pages. This report must be used in its entirety for interpretation of results.

Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Amy Goodall

Amy Goodall
Project Manager
Brooks Applied Labs
amy@brooksapplied.com

Report Information

General Disclaimers

Test results are based solely upon the sample submitted to Brooks Applied Labs in the condition it was received . This report shall not be reproduced or copied, except in full, without written approval of the laboratory. Brooks Applied Labs is not responsible for the consequences arising from the use of a partial report.

Laboratory Accreditation

BAL maintains accreditation with various state and national agencies for select test methods. For a current list of BAL accreditations, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. The reported analyte/matrix/method combination shall be considered outside BAL's scopes of accreditation unless otherwise identified as ISO, TNI, or ISO,TNI in the tables. It is the responsibility of the client to verify whether a specific accreditation is required for the intended data use.

ISO: ISO/IEC 17025:2017 accredited test method. Issued by ANSI National Accreditation Board (ANAB), #ADE-1447.02

TNI: NELAP accredited test method. Issued by the State of Florida Department of Health, #E87982.

ISO,TNI: Test method is accredited under both the ISO/IEC 17025:2017 and NELAP accreditations referenced above.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Please see narrative for explanation.
J	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
J-1	Estimated value. A full explanation is presented in the narrative.
M	Duplicate precision (RPD) was not within acceptance criteria. Please see narrative for explanation.
N	Spike recovery was not within acceptance criteria. Please see narrative for explanation.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.
Z	Holding time and/or preservation requirements not established for this method; however, BAL recommendations for holding time were not followed. Please see narrative for explanation.

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Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
SED-G-1-S1	2401240-01	Sediment	Sample	12/14/2023	01/22/2024
SED-G-2-S1	2401240-02	Sediment	Sample	12/14/2023	01/22/2024
SED-G-4-S1	2401240-03	Sediment	Sample	12/14/2023	01/22/2024
SED-G-5-S1	2401240-04	Sediment	Sample	12/14/2023	01/22/2024
SED-G-6-S1	2401240-05	Sediment	Sample	12/14/2023	01/22/2024

Batch Summary

Analyte	Lab Matrix	Method	Accred.	Prepared	Analyzed	Batch	Sequence
%TS	Soil/Sediment	SOP BAL-0501	ISO	01/29/24	01/30/24	B240228	N/A
As(III)	Soil/Sediment	SOP BAL-4100		02/05/24	02/08/24	B240236	S240124
As(V)	Soil/Sediment	SOP BAL-4100		02/05/24	02/21/24	B240301	S240157
DMAs	Soil/Sediment	SOP BAL-4100		02/05/24	02/21/24	B240301	S240157
MMAs	Soil/Sediment	SOP BAL-4100		02/05/24	02/21/24	B240301	S240157

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Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
SED-G-1-S1										
2401240-01	%TS	Sediment	NA	64.36		0.009	0.03	%	B240228	N/A
2401240-01	As(III)	Sediment	dry	0.873	Z	0.002	0.018	mg/kg	B240236	S240124
2401240-01	As(V)	Sediment	dry	53.1	Z	0.042	0.084	mg/kg	B240301	S240157
2401240-01	DMAs	Sediment	dry	0.019	Z J	0.007	0.075	mg/kg	B240301	S240157
2401240-01	MMAs	Sediment	dry	≤ 0.013	U Z	0.013	0.067	mg/kg	B240301	S240157
SED-G-2-S1										
2401240-02	%TS	Sediment	NA	76.30		0.008	0.03	%	B240228	N/A
2401240-02	As(III)	Sediment	dry	0.630	Z	0.002	0.015	mg/kg	B240236	S240124
2401240-02	As(V)	Sediment	dry	20.2	Z	0.036	0.072	mg/kg	B240301	S240157
2401240-02	DMAs	Sediment	dry	≤ 0.006	U Z	0.006	0.064	mg/kg	B240301	S240157
2401240-02	MMAs	Sediment	dry	≤ 0.012	U Z	0.012	0.058	mg/kg	B240301	S240157
SED-G-4-S1										
2401240-03	%TS	Sediment	NA	79.10		0.008	0.03	%	B240228	N/A
2401240-03	As(III)	Sediment	dry	0.841	Z	0.002	0.014	mg/kg	B240236	S240124
2401240-03	As(V)	Sediment	dry	3.64	Z	0.032	0.064	mg/kg	B240301	S240157
2401240-03	DMAs	Sediment	dry	≤ 0.006	U Z	0.006	0.058	mg/kg	B240301	S240157
2401240-03	MMAs	Sediment	dry	≤ 0.010	U Z	0.010	0.052	mg/kg	B240301	S240157
SED-G-5-S1										
2401240-04	%TS	Sediment	NA	86.62		0.007	0.02	%	B240228	N/A
2401240-04	As(III)	Sediment	dry	0.323	Z	0.002	0.013	mg/kg	B240236	S240124
2401240-04	As(V)	Sediment	dry	2.56	Z	0.029	0.058	mg/kg	B240301	S240157
2401240-04	DMAs	Sediment	dry	≤ 0.005	U Z	0.005	0.052	mg/kg	B240301	S240157
2401240-04	MMAs	Sediment	dry	≤ 0.009	U Z	0.009	0.047	mg/kg	B240301	S240157
SED-G-6-S1										
2401240-05	%TS	Sediment	NA	95.67		0.006	0.02	%	B240228	N/A
2401240-05	As(III)	Sediment	dry	0.053	M N Z	0.002	0.012	mg/kg	B240236	S240124
2401240-05	As(V)	Sediment	dry	2.12	N Z	0.028	0.055	mg/kg	B240301	S240157
2401240-05	DMAs	Sediment	dry	≤ 0.005	U Z	0.005	0.049	mg/kg	B240301	S240157
2401240-05	MMAs	Sediment	dry	≤ 0.009	U Z	0.009	0.044	mg/kg	B240301	S240157

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Accuracy & Precision Summary

Batch: B240228
Lab Matrix: Soil/Sediment
Method: SOP BAL-0501

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B240228-DUP1	**Duplicate, (2401226-02)**								
	%TS	89.69		89.81	%			0.1%	15

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Accuracy & Precision Summary

Batch: B240236
Lab Matrix: Soil/Sediment
Method: SOP BAL-4100

Sample	Analyte	Native	Spike	Result	Units	REC & Limits		RPD & Limits	
B240236-BS2	**Blank Spike, As(III), MMA, DMA (2406003)**								
	As(III)		100.0	104.8	mg/kg	105%	75-125		
B240236-DUP1	**Duplicate, (2401240-05)**								
	As(III)	0.053		0.089	mg/kg			*50%*	25
B240236-DUP2	**Duplicate, Analytical (2401240-05)**								
	As(III)	0.053		0.055	mg/kg			4%	25
B240236-MS2	**Matrix Spike, As(III), MMA, DMA (2401240-05)**								
	As(III)	0.053	104.0	71.97	mg/kg	*69%*	75-125		
B240236-MSD2	**Matrix Spike Duplicate, As(III), MMA, DMA (2401240-05)**								
	As(III)	0.053	97.06	73.12	mg/kg	75%	75-125	8%	25
B240236-PS1	**Post Spike, (2401240-05)**								
	As(III)	0.053	0.6595	0.660	mg/kg	92%	75-125		

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Accuracy & Precision Summary

Batch: B240301
Lab Matrix: Soil/Sediment
Method: SOP BAL-4100

Sample	Analyte	Native	Spike	Result	Units	REC	Limits	RPD	Limits
B240301-BS1	**Blank Spike, As(V) 1000ppm (2330019)**								
	As(V)		100.0	85.44	mg/kg	85%	75-125		
B240301-BS2	**Blank Spike, As(III) MMA DMA 1000ppm combined (2406003)**								
	DMAs		111.1	107.7	mg/kg	97%	75-125		
	MMAs		100.0	95.76	mg/kg	96%	75-125		
B240301-DUP1	**Duplicate, (2401240-05)**								
	As(V)	2.121		1.390	mg/kg			*42%*	25
	DMAs	ND		ND	mg/kg			N/C	25
	MMAs	ND		ND	mg/kg			N/C	25
B240301-DUP2	**Duplicate, Analytical (2401240-05)**								
	As(V)	2.121		2.166	mg/kg			2%	25
	DMAs	ND		ND	mg/kg			N/C	25
	MMAs	ND		ND	mg/kg			N/C	25
B240301-MS1	**Matrix Spike, (2401240-05)**								
	As(V)	2.121	95.39	87.31	mg/kg	89%	75-125		
B240301-MS2	**Matrix Spike, (2401240-05)**								
	DMAs	ND	105.9	102.5	mg/kg	97%	75-125		
	MMAs	ND	95.36	91.55	mg/kg	96%	75-125		
B240301-MSD1	**Matrix Spike Duplicate, (2401240-05)**								
	As(V)	2.121	100.9	88.66	mg/kg	86%	75-125	4%	25
B240301-MSD2	**Matrix Spike Duplicate, (2401240-05)**								
	DMAs	ND	107.2	102.0	mg/kg	95%	75-125	2%	25
	MMAs	ND	96.48	91.23	mg/kg	95%	75-125	2%	25
B240301-PS1	**Post Spike, (2401240-05)**								
	As(V)	2.121	2.399	4.537	mg/kg	101%	75-125		
	DMAs	ND	2.745	2.726	mg/kg	99%	75-125		
	MMAs	ND	2.470	2.436	mg/kg	99%	75-125		

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Method Blanks & Reporting Limits

Batch: B240228
Matrix: Soil/Sediment
Method: SOP BAL-0501
Analyte: %TS

Sample	Result	Units
B240228-BLK1	-0.11	%

Average: *-0.11*
Limit: 0.10

MDL: 0.03
MRL: 0.10

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Method Blanks & Reporting Limits

Batch: B240236
Matrix: Soil/Sediment
Method: SOP BAL-4100
Analyte: As(III)

Sample	Result	Units
B240236-BLK1	0.00	mg/kg
B240236-BLK2	0.00	mg/kg
B240236-BLK3	0.00	mg/kg
B240236-BLK4	0.00	mg/kg

Average: 0.000 **MDL:** 0.002
Limit: 0.012 **MRL:** 0.012

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Method Blanks & Reporting Limits

Batch: B240301
Matrix: Soil/Sediment
Method: SOP BAL-4100
Analyte: As(V)

Sample	Result	Units
B240301-BLK1	0.004	mg/kg
B240301-BLK2	0.0002	mg/kg
B240301-BLK3	0.0008	mg/kg
B240301-BLK4	0.00007	mg/kg

Average: 0.001 **MDL:** 0.007
Limit: 0.014 **MRL:** 0.014

Analyte: DMAs

Sample	Result	Units
B240301-BLK1	0.00	mg/kg
B240301-BLK2	0.00	mg/kg
B240301-BLK3	0.00	mg/kg
B240301-BLK4	0.00	mg/kg

Average: 0.000 **MDL:** 0.001
Limit: 0.013 **MRL:** 0.012

Analyte: MMAs

Sample	Result	Units
B240301-BLK1	0.00	mg/kg
B240301-BLK2	0.00	mg/kg
B240301-BLK3	0.00	mg/kg
B240301-BLK4	0.00	mg/kg

Average: 0.000 **Standard Deviation:** 0.000 **MDL:** 0.002
Limit: 0.011 **Limit:** 0.002 **MRL:** 0.011

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Sample Containers

Lab ID: 2401240-01
Sample: SED-G-1-S1
Report Matrix: Sediment
Sample Type: Sample
Collected: 12/14/2023
Received: 01/22/2024

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	na	na	None	na	na	Cooler - 2401240

Lab ID: 2401240-02
Sample: SED-G-2-S1
Report Matrix: Sediment
Sample Type: Sample
Collected: 12/14/2023
Received: 01/22/2024

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	na	na	None	na	na	Cooler - 2401240

Lab ID: 2401240-03
Sample: SED-G-4-S1
Report Matrix: Sediment
Sample Type: Sample
Collected: 12/14/2023
Received: 01/22/2024

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	na	na	None	na	na	Cooler - 2401240

Lab ID: 2401240-04
Sample: SED-G-5-S1
Report Matrix: Sediment
Sample Type: Sample
Collected: 12/14/2023
Received: 01/22/2024

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	na	na	None	na	na	Cooler - 2401240

Lab ID: 2401240-05
Sample: SED-G-6-S1
Report Matrix: Sediment
Sample Type: Sample
Collected: 12/14/2023
Received: 01/22/2024

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Client-Provided	na	na	None	na	na	Cooler - 2401240

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Project ID: SRM-AL2301
PM: Amy Goodall

Client PM: Mauricio Lopez
Client Project: 22-8552

Shipping Containers

Cooler - 2401240

Received: January 22, 2024 10:47
Tracking No: 789393787559 via FedEx
Coolant Type: Blue Ice
Temperature: 7.5 °C

Description: cooler
Damaged in transit? No
Returned to client? No

Custody seals present? No
Custody seals intact? No
COC present? Yes

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Chain-of-Custody Form

Ship samples to:
13751 Lake City Way NE, Suite 108
Seattle, WA 98125

BAL Report 2401240

For BAL use only

Received by: AU *Date:* 1/22/24
Work Order ID: ______ *Time:* 10:47
Project ID: ______

Client: Strum Consulting
Contact: Mauricio Lopez
Client Project ID: 22-8552
Samples Collected By: Mauricio Lopez

PO Number: SRM-AL2301
Phone: 902-835-5560
Email: mlopez@strum.com
e.hiscott@strum.com

Mailing Address: 211 Horseshoe Lake Drive unit 210, Halifax NS, Canada, B3S 0B9

Email Receipt Confirmation? Yes
BAL PM: Ben Wozniak

Requested TAT (business days)
- ☑ 20 (standard)
- ☐ 15*
- ☐ 10*
- ☐ 5*
- ☐ Other ____

*Surcharges may apply to expedited TATs

	Sample ID	Collection: Date	Collection: Time	Client Sample Info: Matrix Type	Client Sample Info: Number of Containers	Client Sample Info: Field Filtered?	Client Sample Info: Preservation Type	BAL Analyses Required: Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As Species (specify)	Se Species (specify)	Filtration	Other (specify here)	Other (specify here)	Comments: Specify Here
1	SED-G-1-S1	23/12/14	AM	Sediment	1	No	None				✔					Marine sediment
2	SED-G-2-S1	23/12/14	AM	Sediment	1	No	None				✔					Marine Sediment
3	SED-G-4-S1	23/12/14	PM	Sediment	1	No	None				✔					Marine Sediment
4	SED-G-5-S1	23/12/14	PM	Sediment	1	No	None				✔					Marine Sediment
5	SED-G-6-S1	23/12/14	PM	Sediment	1	No	None				✔					Marine Sediment
6																
7																
8																
9																
10																
	Trip Blank (specify)															

Relinquished By: Mauricio Lopez	Date: 24/01/17	Time:	Relinquished By:	Date:	Time:
Received By:	Date:	Time:	Total Number of Packages:		

Page 1 of 1

List Hazardous Contaminants: Metals contaminants (Arsenic/Mercury)

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Appendix B

Analytical Laboratory Certificates of Analysis

Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO301	WOO302	WOO302		WOO303		WOO304		
Sampling Date		2023/07/27	2023/07/27	2023/07/27		2023/07/27		2023/07/27		
COC Number		n/a	n/a	n/a		n/a		n/a		
	UNITS	MW1	MW2	MW2 Lab-Dup	RDL	MW3	RDL	MW4	RDL	QC Batch
Metals										
Dissolved Aluminum (Al)	ug/L	5.6	13	13	5.0	27	5.0	29	5.0	8841480
Dissolved Antimony (Sb)	ug/L	ND	1.1	1.2	1.0	ND	1.0	ND	1.0	8841480
Dissolved Arsenic (As)	ug/L	ND	100	100	1.0	1500	10	58	1.0	8841480
Dissolved Barium (Ba)	ug/L	12	12	12	1.0	91	1.0	8.4	1.0	8841480
Dissolved Beryllium (Be)	ug/L	ND	ND	ND	0.10	ND	0.10	ND	0.10	8841480
Dissolved Bismuth (Bi)	ug/L	ND	ND	ND	2.0	ND	2.0	ND	2.0	8841480
Dissolved Boron (B)	ug/L	ND	330	330	50	630	50	68	50	8841480
Dissolved Cadmium (Cd)	ug/L	0.024	0.026	0.029	0.010	ND	0.010	0.028	0.010	8841480
Dissolved Calcium (Ca)	ug/L	17000	72000	71000	100	74000	100	14000	100	8841480
Dissolved Chromium (Cr)	ug/L	ND	ND	ND	1.0	ND	1.0	ND	1.0	8841480
Dissolved Cobalt (Co)	ug/L	ND	ND	ND	0.40	21	0.40	1.5	0.40	8841480
Dissolved Copper (Cu)	ug/L	1.3	1.9	2.0	0.50	ND	0.50	7.1	0.50	8841480
Dissolved Iron (Fe)	ug/L	ND	ND	ND	50	4900	50	ND	50	8841480
Dissolved Lead (Pb)	ug/L	ND	ND	ND	0.50	ND	0.50	ND	0.50	8841480
Dissolved Magnesium (Mg)	ug/L	4700	17000	17000	100	180000	1000	4200	100	8841480
Dissolved Manganese (Mn)	ug/L	37	85	85	2.0	9300	2.0	680	2.0	8841480
Dissolved Molybdenum (Mo)	ug/L	ND	ND	ND	2.0	ND	2.0	ND	2.0	8841480
Dissolved Nickel (Ni)	ug/L	3.7	ND	ND	2.0	28	2.0	4.6	2.0	8841480
Dissolved Phosphorus (P)	ug/L	ND	ND	ND	100	ND	100	ND	100	8841480
Dissolved Potassium (K)	ug/L	4000	4400	4500	100	54000	100	1800	100	8841480
Dissolved Selenium (Se)	ug/L	ND	ND	ND	0.50	ND	0.50	ND	0.50	8841480
Dissolved Silver (Ag)	ug/L	ND	ND	ND	0.10	ND	0.10	ND	0.10	8841480
Dissolved Sodium (Na)	ug/L	40000	98000	99000	100	1400000	1000	26000	100	8841480
Dissolved Strontium (Sr)	ug/L	120	420	410	2.0	1500	2.0	120	2.0	8841480
Dissolved Thallium (Tl)	ug/L	ND	ND	ND	0.10	ND	0.10	ND	0.10	8841480
Dissolved Tin (Sn)	ug/L	ND	ND	ND	2.0	ND	2.0	ND	2.0	8841480
Dissolved Titanium (Ti)	ug/L	ND	ND	ND	2.0	ND	2.0	ND	2.0	8841480
Dissolved Uranium (U)	ug/L	ND	1.4	1.4	0.10	0.35	0.10	ND	0.10	8841480
Dissolved Vanadium (V)	ug/L	ND	ND	ND	2.0	ND	2.0	ND	2.0	8841480
Dissolved Zinc (Zn)	ug/L	7.6	19	21	5.0	9.2	5.0	10	5.0	8841480

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WO0305		WO0306	WO0307			WO0309	WO0309		
Sampling Date		2023/07/27		2023/07/27	2023/07/27			2023/07/24	2023/07/24		
COC Number		n/a		n/a	n/a			n/a	n/a		
	UNITS	MW5	RDL	MW7	MW9	RDL	QC Batch	SW-A-18	SW-A-18 Lab-Dup	RDL	QC Batch
Metals											
Dissolved Aluminum (Al)	ug/L	270	5.0	260	58	5.0	8841480				
Total Aluminum (Al)	ug/L							ND	ND	50	8855409
Dissolved Antimony (Sb)	ug/L	1.9	1.0	ND	ND	1.0	8841480				
Total Antimony (Sb)	ug/L							ND	ND	10	8855409
Dissolved Arsenic (As)	ug/L	3500	10	80	ND	1.0	8841480				
Total Arsenic (As)	ug/L							ND	ND	10	8855409
Dissolved Barium (Ba)	ug/L	2.1	1.0	14	13	1.0	8841480				
Total Barium (Ba)	ug/L							ND	ND	10	8855409
Dissolved Beryllium (Be)	ug/L	ND	0.10	ND	ND	0.10	8841480				
Total Beryllium (Be)	ug/L							ND	ND	1.0	8855409
Dissolved Bismuth (Bi)	ug/L	ND	2.0	ND	ND	2.0	8841480				
Total Bismuth (Bi)	ug/L							ND	ND	20	8855409
Dissolved Boron (B)	ug/L	300	50	160	ND	50	8841480				
Total Boron (B)	ug/L							3900	4000	500	8855409
Dissolved Cadmium (Cd)	ug/L	0.022	0.010	ND	0.038	0.010	8841480				
Total Cadmium (Cd)	ug/L							ND	ND	0.10	8855409
Dissolved Calcium (Ca)	ug/L	9800	100	10000	1600	100	8841480				
Total Calcium (Ca)	ug/L							330000	330000	1000	8855409
Dissolved Chromium (Cr)	ug/L	ND	1.0	ND	ND	1.0	8841480				
Total Chromium (Cr)	ug/L							ND	ND	10	8855409
Dissolved Cobalt (Co)	ug/L	2.0	0.40	0.63	0.58	0.40	8841480				
Total Cobalt (Co)	ug/L							ND	ND	4.0	8855409
Dissolved Copper (Cu)	ug/L	7.4	0.50	ND	ND	0.50	8841480				
Total Copper (Cu)	ug/L							ND	ND	5.0	8855409
Dissolved Iron (Fe)	ug/L	2800	50	1200	ND	50	8841480				
Total Iron (Fe)	ug/L							ND	ND	500	8855409
Dissolved Lead (Pb)	ug/L	1.1	0.50	ND	ND	0.50	8841480				
Total Lead (Pb)	ug/L							ND	ND	5.0	8855409
Dissolved Magnesium (Mg)	ug/L	20000	100	26000	1300	100	8841480				
Total Magnesium (Mg)	ug/L							1000000	1000000	1000	8855409
Dissolved Manganese (Mn)	ug/L	200	2.0	800	300	2.0	8841480				
Total Manganese (Mn)	ug/L							ND	ND	20	8855409
Dissolved Molybdenum (Mo)	ug/L	2.1	2.0	ND	ND	2.0	8841480				
Total Molybdenum (Mo)	ug/L							ND	ND	20	8855409

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO305		WOO306	WOO307			WOO309	WOO309		
Sampling Date		2023/07/27		2023/07/27	2023/07/27			2023/07/24	2023/07/24		
COC Number		n/a		n/a	n/a			n/a	n/a		
	UNITS	MW5	RDL	MW7	MW9	RDL	QC Batch	SW-A-18	SW-A-18 Lab-Dup	RDL	QC Batch
Dissolved Nickel (Ni)	ug/L	6.4	2.0	ND	2.1	2.0	8841480				
Total Nickel (Ni)	ug/L							ND	ND	20	8855409
Dissolved Phosphorus (P)	ug/L	250	100	ND	ND	100	8841480				
Total Phosphorus (P)	ug/L							ND	ND	1000	8855409
Dissolved Potassium (K)	ug/L	14000	100	8500	880	100	8841480				
Total Potassium (K)	ug/L							320000	320000	1000	8855409
Dissolved Selenium (Se)	ug/L	ND	0.50	1.3	ND	0.50	8841480				
Total Selenium (Se)	ug/L							ND	ND	5.0	8855409
Dissolved Silver (Ag)	ug/L	ND	0.10	ND	ND	0.10	8841480				
Total Silver (Ag)	ug/L							ND	ND	1.0	8855409
Dissolved Sodium (Na)	ug/L	210000	100	210000	10000	100	8841480				
Total Sodium (Na)	ug/L							8900000	8900000	10000	8855409
Dissolved Strontium (Sr)	ug/L	160	2.0	170	26	2.0	8841480				
Total Strontium (Sr)	ug/L							6300	6400	20	8855409
Dissolved Thallium (Tl)	ug/L	ND	0.10	ND	ND	0.10	8841480				
Total Thallium (Tl)	ug/L							ND	ND	1.0	8855409
Dissolved Tin (Sn)	ug/L	ND	2.0	ND	ND	2.0	8841480				
Total Tin (Sn)	ug/L							ND	ND	20	8855409
Dissolved Titanium (Ti)	ug/L	4.4	2.0	4.2	ND	2.0	8841480				
Total Titanium (Ti)	ug/L							ND	ND	20	8855409
Dissolved Uranium (U)	ug/L	0.75	0.10	0.14	ND	0.10	8841480				
Total Uranium (U)	ug/L							2.7	2.7	1.0	8855409
Dissolved Vanadium (V)	ug/L	2.8	2.0	2.6	ND	2.0	8841480				
Total Vanadium (V)	ug/L							ND	ND	20	8855409
Dissolved Zinc (Zn)	ug/L	9.8	5.0	ND	5.2	5.0	8841480				
Total Zinc (Zn)	ug/L							ND	ND	50	8855409

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

MERCURY BY COLD VAPOUR AA (WATER)

Bureau Veritas ID		WO0301	WO0302	WO0303	WO0303	WO0304	WO0305	WO0306		
Sampling Date		2023/07/27	2023/07/27	2023/07/27	2023/07/27	2023/07/27	2023/07/27	2023/07/27		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	MW1	MW2	MW3	MW3 Lab-Dup	MW4	MW5	MW7	RDL	QC Batch
Metals										
Dissolved Mercury (Hg)	ug/L	ND	ND	ND	0.013	0.017	0.32	ND	0.013	8850979

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas ID		WO0307	WO0308			WO0309	WO0310	WO0311	WO0312		
Sampling Date		2023/07/27	2023/07/27			2023/07/24	2023/07/24	2023/07/25	2023/07/24		
COC Number		n/a	n/a			n/a	n/a	n/a	n/a		
	UNITS	MW9	FD2	RDL	QC Batch	SW-A-18	SW-A-17	SW-A-16	SW-A-15	RDL	QC Batch
Metals											
Dissolved Mercury (Hg)	ug/L	ND	ND	0.013	8850979						
Total Mercury (Hg)	ug/L					ND	ND	ND	0.013	0.013	8850703

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas ID		WO0313	WO0314	WO0315	WO0316	WO0317		WO0318		
Sampling Date		2023/07/24	2023/07/24	2023/07/25	2023/07/25	2023/07/25		2023/07/24		
COC Number		n/a	n/a	n/a	n/a	n/a		n/a		
	UNITS	SW-A-14	SW-A-9	SW-B-12	SW-B-10	SW-B-3	QC Batch	SW-C-13	RDL	QC Batch
Metals										
Total Mercury (Hg)	ug/L	ND	0.013	ND	0.013	ND	8850703	ND	0.013	8865262

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas ID		WO0319	WO0320		WO0321	WO0322	WO0323	WO0323		
Sampling Date		2023/07/25	2023/07/24		2023/07/25	2023/07/25	2023/07/25	2023/07/25		
COC Number		n/a	n/a		n/a	n/a	n/a	n/a		
	UNITS	SW-C-11	SW-C-8	QC Batch	SW-C-7	SW-D-6	SW-D-5	SW-D-5 Lab-Dup	RDL	QC Batch
Metals										
Total Mercury (Hg)	ug/L	ND	ND	8865262	ND	ND	0.013	ND	0.013	8850646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

MERCURY BY COLD VAPOUR AA (WATER)

Bureau Veritas ID		WOO324	WOO325	WOO326	WOO327	WOO328	WOO329	WOO330		
Sampling Date		2023/07/25	2023/07/25	2023/07/25	2023/07/25	2023/07/25	2023/07/25	2023/07/26		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	SW-D-4	SW-D-2	SW-E-4	SW-E-3	SW-E-2	SW-E-1	SW-F-26	RDL	QC Batch
Metals										
Total Mercury (Hg)	ug/L	ND	ND	0.017	ND	ND	ND	0.025	0.013	8850646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas ID		WOO331	WOO332	WOO333	WOO334	WOO335	WOO336	WOO337		
Sampling Date		2023/07/26	2023/07/26	2023/07/26	2023/07/26	2023/07/26	2023/07/26	2023/07/26		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	SW-F-25	SW-F-24	SW-F-23	SW-F-22	SW-F-21	SW-F-20	SW-F-19	RDL	QC Batch
Metals										
Total Mercury (Hg)	ug/L	0.022	0.15	0.050	0.028	0.025	0.14	0.71	0.013	8850646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		WOO338		
Sampling Date		2023/07/26		
COC Number		n/a		
	UNITS	FD1	RDL	QC Batch
Metals				
Total Mercury (Hg)	ug/L	0.030	0.013	8850646

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WO0439		WO0440	WO0441		WO0442		
Sampling Date		2023/07/25		2023/07/24	2023/07/25		2023/07/25		
COC Number		n/a		n/a	n/a		n/a		
	UNITS	SED-A-16-S1	QC Batch	SED-A-9-S1	SED-B12-S1	RDL	SED-B-10-S1	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	6500	8852852	5700	7700	10	6700	10	8852522
Acid Extractable Antimony (Sb)	mg/kg	ND	8852852	ND	ND	2.0	ND	2.0	8852522
Acid Extractable Arsenic (As)	mg/kg	11	8852852	4.2	14	2.0	630	20	8852522
Acid Extractable Barium (Ba)	mg/kg	6.7	8852852	7.0	13	5.0	7.6	5.0	8852522
Acid Extractable Beryllium (Be)	mg/kg	ND	8852852	ND	ND	1.0	ND	1.0	8852522
Acid Extractable Bismuth (Bi)	mg/kg	ND	8852852	ND	ND	2.0	ND	2.0	8852522
Acid Extractable Boron (B)	mg/kg	ND	8852852	ND	ND	50	ND	50	8852522
Acid Extractable Cadmium (Cd)	mg/kg	ND	8852852	ND	ND	0.30	ND	0.30	8852522
Acid Extractable Chromium (Cr)	mg/kg	11	8852852	9.4	13	2.0	11	2.0	8852522
Acid Extractable Cobalt (Co)	mg/kg	5.1	8852852	4.2	6.7	1.0	5.2	1.0	8852522
Acid Extractable Copper (Cu)	mg/kg	4.6	8852852	3.4	8.0	2.0	5.4	2.0	8852522
Acid Extractable Iron (Fe)	mg/kg	14000	8852852	14000	21000	50	15000	50	8852522
Acid Extractable Lead (Pb)	mg/kg	3.1	8852852	3.1	5.4	0.50	5.0	0.50	8852522
Acid Extractable Lithium (Li)	mg/kg	16	8852852	16	23	2.0	22	2.0	8852522
Acid Extractable Manganese (Mn)	mg/kg	260	8852852	330	620	2.0	260	2.0	8852522
Acid Extractable Mercury (Hg)	mg/kg	ND	8852852	ND	ND	0.10	ND	0.10	8852522
Acid Extractable Molybdenum (Mo)	mg/kg	ND	8852852	ND	ND	2.0	ND	2.0	8852522
Acid Extractable Nickel (Ni)	mg/kg	19	8852852	12	15	2.0	13	2.0	8852522
Acid Extractable Rubidium (Rb)	mg/kg	4.0	8852852	3.5	4.8	2.0	4.5	2.0	8852522
Acid Extractable Selenium (Se)	mg/kg	ND	8852852	ND	ND	0.50	ND	0.50	8852522
Acid Extractable Silver (Ag)	mg/kg	ND	8852852	ND	ND	0.50	ND	0.50	8852522
Acid Extractable Strontium (Sr)	mg/kg	55	8852852	20	20	5.0	13	5.0	8852522
Acid Extractable Thallium (Tl)	mg/kg	ND	8852852	ND	ND	0.10	ND	0.10	8852522
Acid Extractable Tin (Sn)	mg/kg	ND	8852852	ND	ND	1.0	ND	1.0	8852522
Acid Extractable Uranium (U)	mg/kg	0.35	8852852	0.33	0.54	0.10	1.2	0.10	8852522
Acid Extractable Vanadium (V)	mg/kg	11	8852852	12	18	2.0	12	2.0	8852522
Acid Extractable Zinc (Zn)	mg/kg	83	8852852	25	32	5.0	30	5.0	8852522

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WO0443		WO0444	WO0445	WO0445	WO0446		
Sampling Date		2023/07/25		2023/07/24	2023/07/25	2023/07/25	2023/07/24		
COC Number		n/a		n/a	n/a	n/a	n/a		
	UNITS	SED-B-3-S1	QC Batch	SED-C-13-S1	SED-C-11-S1	SED-C-11-S1 Lab-Dup	SED-C-8-S1	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	6600	8855578	5600	4500	4500	5500	10	8852522
Acid Extractable Antimony (Sb)	mg/kg	ND	8855578	ND	ND	ND	ND	2.0	8852522
Acid Extractable Arsenic (As)	mg/kg	120	8855578	9.2	9.6	7.8	4.8	2.0	8852522
Acid Extractable Barium (Ba)	mg/kg	9.0	8855578	6.2	5.8	5.7	6.0	5.0	8852522
Acid Extractable Beryllium (Be)	mg/kg	ND	8855578	ND	ND	ND	ND	1.0	8852522
Acid Extractable Bismuth (Bi)	mg/kg	ND	8855578	ND	ND	ND	ND	2.0	8852522
Acid Extractable Boron (B)	mg/kg	ND	8855578	ND	ND	ND	ND	50	8852522
Acid Extractable Cadmium (Cd)	mg/kg	ND	8855578	ND	ND	ND	ND	0.30	8852522
Acid Extractable Chromium (Cr)	mg/kg	11	8855578	8.9	7.4	7.3	8.6	2.0	8852522
Acid Extractable Cobalt (Co)	mg/kg	5.0	8855578	4.1	3.3	3.4	4.2	1.0	8852522
Acid Extractable Copper (Cu)	mg/kg	5.7	8855578	3.4	2.5	2.4	3.4	2.0	8852522
Acid Extractable Iron (Fe)	mg/kg	18000	8855578	13000	10000	10000	13000	50	8852522
Acid Extractable Lead (Pb)	mg/kg	6.0	8855578	2.9	2.3	2.3	2.8	0.50	8852522
Acid Extractable Lithium (Li)	mg/kg	19	8855578	18	13	14	14	2.0	8852522
Acid Extractable Manganese (Mn)	mg/kg	240	8855578	220	220	200	350	2.0	8852522
Acid Extractable Mercury (Hg)	mg/kg	ND	8855578	ND	ND	ND	ND	0.10	8852522
Acid Extractable Molybdenum (Mo)	mg/kg	ND	8855578	ND	ND	ND	ND	2.0	8852522
Acid Extractable Nickel (Ni)	mg/kg	14	8855578	11	8.7	8.9	11	2.0	8852522
Acid Extractable Rubidium (Rb)	mg/kg	5.0	8855578	3.7	3.0	3.2	3.5	2.0	8852522
Acid Extractable Selenium (Se)	mg/kg	ND	8855578	ND	ND	ND	ND	0.50	8852522
Acid Extractable Silver (Ag)	mg/kg	ND	8855578	ND	ND	ND	ND	0.50	8852522
Acid Extractable Strontium (Sr)	mg/kg	19	8855578	13	7.3	8.2	13	5.0	8852522
Acid Extractable Thallium (Tl)	mg/kg	ND	8855578	ND	ND	ND	ND	0.10	8852522
Acid Extractable Tin (Sn)	mg/kg	ND	8855578	ND	ND	ND	ND	1.0	8852522
Acid Extractable Uranium (U)	mg/kg	0.49	8855578	0.33	0.26	0.28	0.29	0.10	8852522
Acid Extractable Vanadium (V)	mg/kg	13	8855578	11	8.9	8.8	12	2.0	8852522
Acid Extractable Zinc (Zn)	mg/kg	29	8855578	25	20	20	23	5.0	8852522

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WO0447		WO0448	WO0449		WO0450		
Sampling Date		2023/07/25		2023/07/25	2023/07/26		2023/07/26		
COC Number		n/a		n/a	n/a		n/a		
	UNITS	SED-D-4-S1	RDL	SED E-1-S1	SED-F-26	QC Batch	SED-F-25	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	5600	10	7600	8800	8852522	8100	10	8855578
Acid Extractable Antimony (Sb)	mg/kg	ND	2.0	ND	ND	8852522	ND	2.0	8855578
Acid Extractable Arsenic (As)	mg/kg	840	20	61	37	8852522	15	2.0	8855578
Acid Extractable Barium (Ba)	mg/kg	7.0	5.0	17	22	8852522	9.8	5.0	8855578
Acid Extractable Beryllium (Be)	mg/kg	ND	1.0	ND	ND	8852522	ND	1.0	8855578
Acid Extractable Bismuth (Bi)	mg/kg	ND	2.0	ND	ND	8852522	ND	2.0	8855578
Acid Extractable Boron (B)	mg/kg	ND	50	52	ND	8852522	ND	50	8855578
Acid Extractable Cadmium (Cd)	mg/kg	ND	0.30	ND	ND	8852522	ND	0.30	8855578
Acid Extractable Chromium (Cr)	mg/kg	10	2.0	13	14	8852522	12	2.0	8855578
Acid Extractable Cobalt (Co)	mg/kg	4.2	1.0	5.4	45	8852522	8.4	1.0	8855578
Acid Extractable Copper (Cu)	mg/kg	3.9	2.0	9.3	5.8	8852522	3.8	2.0	8855578
Acid Extractable Iron (Fe)	mg/kg	17000	50	16000	32000	8852522	21000	50	8855578
Acid Extractable Lead (Pb)	mg/kg	3.5	0.50	8.8	22	8852522	5.8	0.50	8855578
Acid Extractable Lithium (Li)	mg/kg	16	2.0	21	19	8852522	20	2.0	8855578
Acid Extractable Manganese (Mn)	mg/kg	280	2.0	250	9100	8852522	1000	2.0	8855578
Acid Extractable Mercury (Hg)	mg/kg	ND	0.10	0.13	ND	8852522	ND	0.10	8855578
Acid Extractable Molybdenum (Mo)	mg/kg	ND	2.0	3.2	ND	8852522	ND	2.0	8855578
Acid Extractable Nickel (Ni)	mg/kg	12	2.0	15	15	8852522	16	2.0	8855578
Acid Extractable Rubidium (Rb)	mg/kg	3.4	2.0	7.5	5.8	8852522	3.9	2.0	8855578
Acid Extractable Selenium (Se)	mg/kg	ND	0.50	ND	0.56	8852522	ND	0.50	8855578
Acid Extractable Silver (Ag)	mg/kg	ND	0.50	ND	ND	8852522	ND	0.50	8855578
Acid Extractable Strontium (Sr)	mg/kg	11	5.0	31	8.5	8852522	ND	5.0	8855578
Acid Extractable Thallium (Tl)	mg/kg	ND	0.10	0.15	ND	8852522	ND	0.10	8855578
Acid Extractable Tin (Sn)	mg/kg	ND	1.0	ND	ND	8852522	ND	1.0	8855578
Acid Extractable Uranium (U)	mg/kg	0.37	0.10	0.93	0.42	8852522	0.41	0.10	8855578
Acid Extractable Vanadium (V)	mg/kg	14	2.0	18	21	8852522	13	2.0	8855578
Acid Extractable Zinc (Zn)	mg/kg	25	5.0	38	36	8852522	31	5.0	8855578

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C3N8436
Report Date: 2023/08/28

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WQA294		WQA295		WQA296		WQA297		
Sampling Date		2023/07/24		2023/07/24		2023/07/24		2023/07/24		
COC Number		N/A		N/A		N/A		N/A		
	UNITS	SED-A-18-S1	QC Batch	SED-A-18-S2	QC Batch	SED-A-17-S1	QC Batch	SED-A-15-S1	RDL	QC Batch
Metals										
Acid Extractable Aluminum (Al)	mg/kg	6000	8855578	5900	8855438	6600	8855578	6700	10	8855438
Acid Extractable Antimony (Sb)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Arsenic (As)	mg/kg	6.8	8855578	8.1	8855438	22	8855578	13	2.0	8855438
Acid Extractable Barium (Ba)	mg/kg	21	8855578	20	8855438	17	8855578	19	5.0	8855438
Acid Extractable Beryllium (Be)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	1.0	8855438
Acid Extractable Bismuth (Bi)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Boron (B)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	50	8855438
Acid Extractable Cadmium (Cd)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	0.30	8855438
Acid Extractable Chromium (Cr)	mg/kg	12	8855578	11	8855438	12	8855578	12	2.0	8855438
Acid Extractable Cobalt (Co)	mg/kg	4.5	8855578	4.4	8855438	4.8	8855578	4.8	1.0	8855438
Acid Extractable Copper (Cu)	mg/kg	6.5	8855578	6.5	8855438	7.5	8855578	7.8	2.0	8855438
Acid Extractable Iron (Fe)	mg/kg	12000	8855578	12000	8855438	14000	8855578	13000	50	8855438
Acid Extractable Lead (Pb)	mg/kg	5.6	8855578	5.2	8855438	6.9	8855578	6.6	0.50	8855438
Acid Extractable Lithium (Li)	mg/kg	16	8855578	16	8855438	17	8855578	16	2.0	8855438
Acid Extractable Manganese (Mn)	mg/kg	300	8855578	290	8855438	320	8855578	310	2.0	8855438
Acid Extractable Mercury (Hg)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	0.10	8855438
Acid Extractable Molybdenum (Mo)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Nickel (Ni)	mg/kg	14	8855578	12	8855438	15	8855578	13	2.0	8855438
Acid Extractable Rubidium (Rb)	mg/kg	7.8	8855578	7.2	8855438	6.7	8855578	6.8	2.0	8855438
Acid Extractable Selenium (Se)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	0.50	8855438
Acid Extractable Silver (Ag)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	0.50	8855438
Acid Extractable Strontium (Sr)	mg/kg	37	8855578	34	8855438	29	8855578	37	5.0	8855438
Acid Extractable Thallium (Tl)	mg/kg	0.10	8855578	0.10	8855438	0.10	8855578	0.11	0.10	8855438
Acid Extractable Tin (Sn)	mg/kg	ND	8855578	ND	8855438	ND	8855578	ND	1.0	8855438
Acid Extractable Uranium (U)	mg/kg	0.66	8855578	0.67	8855438	0.64	8855578	0.80	0.10	8855438
Acid Extractable Vanadium (V)	mg/kg	15	8855578	14	8855438	16	8855578	16	2.0	8855438
Acid Extractable Zinc (Zn)	mg/kg	190	8855578	210	8855438	32	8855578	130	5.0	8855438

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C3N8436
Report Date: 2023/08/28

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WQA298	WQA299	WQA300		WQA301		WQA302		
Sampling Date		2023/07/24	2023/07/24	2023/07/25		2023/07/25		2023/07/25		
COC Number		N/A	N/A	N/A		N/A		N/A		
	UNITS	SED-A-14-S1	SED-A-14-S2	SED-C-11-S1	QC Batch	SED-C-7-S1	QC Batch	SED-D-6-S1	RDL	QC Batch
Metals										
Acid Extractable Aluminum (Al)	mg/kg	5700	5100	4600	8855438	4800	8855578	4700	10	8855450
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	2.0	8855450
Acid Extractable Arsenic (As)	mg/kg	15	9.9	26	8855438	5.8	8855578	11	2.0	8855450
Acid Extractable Barium (Ba)	mg/kg	10	8.3	5.3	8855438	5.6	8855578	5.9	5.0	8855450
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	1.0	8855450
Acid Extractable Bismuth (Bi)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	2.0	8855450
Acid Extractable Boron (B)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	50	8855450
Acid Extractable Cadmium (Cd)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	0.30	8855450
Acid Extractable Chromium (Cr)	mg/kg	9.9	8.8	7.4	8855438	8.1	8855578	7.8	2.0	8855450
Acid Extractable Cobalt (Co)	mg/kg	4.4	3.9	3.4	8855438	3.6	8855578	3.6	1.0	8855450
Acid Extractable Copper (Cu)	mg/kg	5.3	4.8	2.4	8855438	3.1	8855578	3.3	2.0	8855450
Acid Extractable Iron (Fe)	mg/kg	13000	11000	11000	8855438	11000	8855578	10000	50	8855450
Acid Extractable Lead (Pb)	mg/kg	4.9	3.5	2.4	8855438	2.5	8855578	2.7	0.50	8855450
Acid Extractable Lithium (Li)	mg/kg	15	13	12	8855438	14	8855578	13	2.0	8855450
Acid Extractable Manganese (Mn)	mg/kg	320	310	250	8855438	280	8855578	270	2.0	8855450
Acid Extractable Mercury (Hg)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	0.10	8855450
Acid Extractable Molybdenum (Mo)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	2.0	8855450
Acid Extractable Nickel (Ni)	mg/kg	12	10	8.9	8855438	11	8855578	9.7	2.0	8855450
Acid Extractable Rubidium (Rb)	mg/kg	4.7	4.0	3.0	8855438	3.7	8855578	3.5	2.0	8855450
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	0.50	8855450
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	0.50	8855450
Acid Extractable Strontium (Sr)	mg/kg	18	13	6.8	8855438	16	8855578	11	5.0	8855450
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	0.10	8855450
Acid Extractable Tin (Sn)	mg/kg	ND	ND	ND	8855438	ND	8855578	ND	1.0	8855450
Acid Extractable Uranium (U)	mg/kg	0.74	0.48	0.27	8855438	0.36	8855578	0.34	0.10	8855450
Acid Extractable Vanadium (V)	mg/kg	13	11	9.4	8855438	9.1	8855578	9.2	2.0	8855450
Acid Extractable Zinc (Zn)	mg/kg	100	83	290	8855438	150	8855578	410	5.0	8855450

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WQA302		WQA303		WQA304		WQA305		
Sampling Date		2023/07/25		2023/07/25		2023/07/25		2023/07/25		
COC Number		N/A		N/A		N/A		N/A		
	UNITS	SED-D-6-S1 Lab-Dup	QC Batch	SED-D-6-S2	QC Batch	SED-D-5-S1	QC Batch	SED-D-2-S1	RDL	QC Batch
Metals										
Acid Extractable Aluminum (Al)	mg/kg	4800	8855450	4700	8855438	5100	8855578	6200	10	8855438
Acid Extractable Antimony (Sb)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Arsenic (As)	mg/kg	12	8855450	12	8855438	130	8855578	24	2.0	8855438
Acid Extractable Barium (Ba)	mg/kg	8.3	8855450	5.4	8855438	6.7	8855578	8.1	5.0	8855438
Acid Extractable Beryllium (Be)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	1.0	8855438
Acid Extractable Bismuth (Bi)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Boron (B)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	50	8855438
Acid Extractable Cadmium (Cd)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	0.30	8855438
Acid Extractable Chromium (Cr)	mg/kg	8.3	8855450	7.6	8855438	8.8	8855578	9.8	2.0	8855438
Acid Extractable Cobalt (Co)	mg/kg	3.6	8855450	3.7	8855438	3.9	8855578	4.2	1.0	8855438
Acid Extractable Copper (Cu)	mg/kg	3.2	8855450	3.0	8855438	3.7	8855578	5.3	2.0	8855438
Acid Extractable Iron (Fe)	mg/kg	11000	8855450	11000	8855438	11000	8855578	13000	50	8855438
Acid Extractable Lead (Pb)	mg/kg	2.7	8855450	2.4	8855438	3.2	8855578	4.4	0.50	8855438
Acid Extractable Lithium (Li)	mg/kg	14	8855450	13	8855438	15	8855578	18	2.0	8855438
Acid Extractable Manganese (Mn)	mg/kg	270	8855450	260	8855438	210	8855578	190	2.0	8855438
Acid Extractable Mercury (Hg)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	0.10	8855438
Acid Extractable Molybdenum (Mo)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	2.0	8855438
Acid Extractable Nickel (Ni)	mg/kg	10	8855450	9.2	8855438	11	8855578	12	2.0	8855438
Acid Extractable Rubidium (Rb)	mg/kg	3.9	8855450	3.2	8855438	4.1	8855578	4.5	2.0	8855438
Acid Extractable Selenium (Se)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	0.50	8855438
Acid Extractable Silver (Ag)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	0.50	8855438
Acid Extractable Strontium (Sr)	mg/kg	12	8855450	6.5	8855438	8.8	8855578	13	5.0	8855438
Acid Extractable Thallium (Tl)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	0.10	8855438
Acid Extractable Tin (Sn)	mg/kg	ND	8855450	ND	8855438	ND	8855578	ND	1.0	8855438
Acid Extractable Uranium (U)	mg/kg	0.36	8855450	0.34	8855438	0.52	8855578	0.59	0.10	8855438
Acid Extractable Vanadium (V)	mg/kg	9.9	8855450	8.9	8855438	9.9	8855578	10	2.0	8855438
Acid Extractable Zinc (Zn)	mg/kg	430	8855450	230	8855438	130	8855578	78	5.0	8855438

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WQA306		WQA307	WQA308		WQA309		
Sampling Date		2023/07/24		2023/07/24	2023/07/25		2023/07/25		
COC Number		N/A		N/A	N/A		N/A		
	UNITS	SED-E-4-S1	QC Batch	SED-E-4-S2	SED-E-3-S1	QC Batch	SED-E-2-S1	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	7500	8855438	5600	5300	8855578	5200	10	8858316
Acid Extractable Antimony (Sb)	mg/kg	ND	8855438	ND	ND	8855578	ND	2.0	8858316
Acid Extractable Arsenic (As)	mg/kg	20	8855438	5.9	4.3	8855578	15	2.0	8858316
Acid Extractable Barium (Ba)	mg/kg	14	8855438	8.8	5.6	8855578	8.8	5.0	8858316
Acid Extractable Beryllium (Be)	mg/kg	ND	8855438	ND	ND	8855578	ND	1.0	8858316
Acid Extractable Bismuth (Bi)	mg/kg	ND	8855438	ND	ND	8855578	ND	2.0	8858316
Acid Extractable Boron (B)	mg/kg	ND	8855438	ND	ND	8855578	ND	50	8858316
Acid Extractable Cadmium (Cd)	mg/kg	ND	8855438	ND	ND	8855578	ND	0.30	8858316
Acid Extractable Chromium (Cr)	mg/kg	13	8855438	9.7	8.6	8855578	9.2	2.0	8858316
Acid Extractable Cobalt (Co)	mg/kg	5.1	8855438	3.9	3.8	8855578	3.9	1.0	8858316
Acid Extractable Copper (Cu)	mg/kg	9.0	8855438	4.5	3.1	8855578	4.5	2.0	8858316
Acid Extractable Iron (Fe)	mg/kg	16000	8855438	11000	11000	8855578	11000	50	8858316
Acid Extractable Lead (Pb)	mg/kg	5.8	8855438	2.9	3.2	8855578	4.7	0.50	8858316
Acid Extractable Lithium (Li)	mg/kg	18	8855438	15	15	8855578	15	2.0	8858316
Acid Extractable Manganese (Mn)	mg/kg	250	8855438	200	200	8855578	190	2.0	8858316
Acid Extractable Mercury (Hg)	mg/kg	ND	8855438	ND	ND	8855578	ND	0.10	8858316
Acid Extractable Molybdenum (Mo)	mg/kg	5.5	8855438	3.2	ND	8855578	ND	2.0	8858316
Acid Extractable Nickel (Ni)	mg/kg	15	8855438	13	11	8855578	12	2.0	8858316
Acid Extractable Rubidium (Rb)	mg/kg	7.7	8855438	5.1	4.1	8855578	4.6	2.0	8858316
Acid Extractable Selenium (Se)	mg/kg	ND	8855438	ND	ND	8855578	ND	0.50	8858316
Acid Extractable Silver (Ag)	mg/kg	ND	8855438	ND	ND	8855578	ND	0.50	8858316
Acid Extractable Strontium (Sr)	mg/kg	22	8855438	11	13	8855578	10	5.0	8858316
Acid Extractable Thallium (Tl)	mg/kg	0.13	8855438	0.10	ND	8855578	ND	0.10	8858316
Acid Extractable Tin (Sn)	mg/kg	ND	8855438	ND	ND	8855578	ND	1.0	8858316
Acid Extractable Uranium (U)	mg/kg	1.6	8855438	1.0	0.47	8855578	0.68	0.10	8858316
Acid Extractable Vanadium (V)	mg/kg	18	8855438	11	9.1	8855578	11	2.0	8858316
Acid Extractable Zinc (Zn)	mg/kg	210	8855438	110	140	8855578	74	5.0	8858316

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

CONVENTIONALS (SEDIMENT)

Bureau Veritas ID		WOO443	WOO444		
Sampling Date		2023/07/25	2023/07/24		
COC Number		n/a	n/a		
	UNITS	SED-B-3-S1	SED-C-13-S1	RDL	QC Batch
Inorganics					
Total Cyanide (CN)	mg/kg	ND	ND	0.50	8880627

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

CONVENTIONALS (SEDIMENT)

Bureau Veritas ID		WQA302	WQA303		WQA305		WQA306	WQA307		
Sampling Date		2023/07/25	2023/07/25		2023/07/25		2023/07/24	2023/07/24		
COC Number		N/A	N/A		N/A		N/A	N/A		
	UNITS	**SED-D-6-S1**	**SED-D-6-S2**	**QC Batch**	**SED-D-2-S1**	**QC Batch**	**SED-E-4-S1**	**SED-E-4-S2**	**RDL**	**QC Batch**
Inorganics										
Total Cyanide (CN)	mg/kg	ND	ND	8880666	ND	8880668	ND	ND	0.50	8880666

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ATLANTIC RBCA HYDROCARBONS (SEDIMENT)

Bureau Veritas ID		WOO448		
Sampling Date		2023/07/25		
COC Number		n/a		
	UNITS	SED E-1-S1	RDL	QC Batch
Petroleum Hydrocarbons				
Benzene	mg/kg	ND	0.0050	8838132
Toluene	mg/kg	ND	0.050	8838132
Ethylbenzene	mg/kg	ND	0.010	8838132
Total Xylenes	mg/kg	ND	0.050	8838132
C6 - C10 (less BTEX)	mg/kg	ND	2.5	8838132
>C10-C16 Hydrocarbons	mg/kg	ND	10	8838015
>C16-C21 Hydrocarbons	mg/kg	ND	10	8838015
>C21-<C32 Hydrocarbons	mg/kg	ND	15	8838015
Modified TPH (Tier1)	mg/kg	ND	15	8830423
Reached Baseline at C32	mg/kg	NA	N/A	8838015
Hydrocarbon Resemblance	mg/kg	NA	N/A	8838015
Surrogate Recovery (%)				
Isobutylbenzene - Extractable	%	86		8838015
n-Dotriacontane - Extractable	%	122		8838015
Isobutylbenzene - Volatile	%	114		8838132

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
N/A = Not Applicable

ATLANTIC RBCA HYDROCARBONS (SEDIMENT)

Bureau Veritas ID		WQA305		
Sampling Date		2023/07/25		
COC Number		N/A		
	UNITS	SED-D-2-S1	RDL	QC Batch
Petroleum Hydrocarbons				
Benzene	mg/kg	ND	0.0050	8850157
Toluene	mg/kg	ND	0.050	8850157
Ethylbenzene	mg/kg	ND	0.010	8850157
Total Xylenes	mg/kg	ND	0.050	8850157
C6 - C10 (less BTEX)	mg/kg	ND	2.5	8850157
>C10-C16 Hydrocarbons	mg/kg	ND	10	8850222
>C16-C21 Hydrocarbons	mg/kg	ND	10	8850222
>C21-<C32 Hydrocarbons	mg/kg	ND	15	8850222
Modified TPH (Tier1)	mg/kg	ND	15	8840573
Reached Baseline at C32	mg/kg	NA	N/A	8850222
Hydrocarbon Resemblance	mg/kg	NA	N/A	8850222
Surrogate Recovery (%)				
Isobutylbenzene - Extractable	%	104		8850222
n-Dotriacontane - Extractable	%	129		8850222
Isobutylbenzene - Volatile	%	110		8850157

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
N/A = Not Applicable

Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		WO0451	WO0452	WO0453	WO0454	WO0455		WO0456		
Sampling Date		2023/07/26	2023/07/26	2023/07/26	2023/07/26	2023/07/26		2023/07/26		
COC Number		n/a	n/a	n/a	n/a	n/a		n/a		
	UNITS	SED-F24	SED-F-23	SED-F-22	SED-F-21	FD3	QC Batch	FD4	RDL	QC Batch
Metals										
Acid Extractable Aluminum (Al)	mg/kg	5200	6300	8300	8400	7700	8852522	8200	10	8852852
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	2.0	8852852
Acid Extractable Arsenic (As)	mg/kg	6.6	ND	18	83	14	8852522	12	2.0	8852852
Acid Extractable Barium (Ba)	mg/kg	16	25	29	9.5	14	8852522	15	5.0	8852852
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	1.0	8852852
Acid Extractable Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	2.0	8852852
Acid Extractable Boron (B)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	50	8852852
Acid Extractable Cadmium (Cd)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	0.30	8852852
Acid Extractable Chromium (Cr)	mg/kg	3.1	2.6	14	12	13	8852522	12	2.0	8852852
Acid Extractable Cobalt (Co)	mg/kg	1.3	1.1	7.5	6.1	6.7	8852522	7.6	1.0	8852852
Acid Extractable Copper (Cu)	mg/kg	5.6	3.9	13	6.9	8.6	8852522	4.3	2.0	8852852
Acid Extractable Iron (Fe)	mg/kg	9400	1600	23000	21000	22000	8852522	20000	50	8852852
Acid Extractable Lead (Pb)	mg/kg	21	29	7.0	8.0	7.0	8852522	4.9	0.50	8852852
Acid Extractable Lithium (Li)	mg/kg	ND	ND	24	23	23	8852522	18	2.0	8852852
Acid Extractable Manganese (Mn)	mg/kg	200	56	1400	420	620	8852522	800	2.0	8852852
Acid Extractable Mercury (Hg)	mg/kg	0.34	0.37	ND	ND	ND	8852522	ND	0.10	8852852
Acid Extractable Molybdenum (Mo)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	2.0	8852852
Acid Extractable Nickel (Ni)	mg/kg	3.5	4.1	18	16	15	8852522	14	2.0	8852852
Acid Extractable Rubidium (Rb)	mg/kg	ND	ND	5.2	4.5	4.9	8852522	3.8	2.0	8852852
Acid Extractable Selenium (Se)	mg/kg	1.7	1.4	ND	ND	ND	8852522	ND	0.50	8852852
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	0.50	8852852
Acid Extractable Strontium (Sr)	mg/kg	26	18	7.6	10	20	8852522	5.8	5.0	8852852
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	8852522	ND	0.10	8852852
Acid Extractable Tin (Sn)	mg/kg	ND	ND	ND	ND	1.3	8852522	ND	1.0	8852852
Acid Extractable Uranium (U)	mg/kg	0.49	0.53	0.54	0.63	0.60	8852522	0.46	0.10	8852852
Acid Extractable Vanadium (V)	mg/kg	9.5	7.1	17	15	18	8852522	14	2.0	8852852
Acid Extractable Zinc (Zn)	mg/kg	9.5	7.1	38	39	33	8852522	31	5.0	8852852

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		WOO309			WOO309			WOO312		
Sampling Date		2023/07/24			2023/07/24			2023/07/24		
COC Number		n/a			n/a			n/a		
	UNITS	SW-A-18	RDL	QC Batch	SW-A-18 Lab-Dup	RDL	QC Batch	SW-A-15	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L							502	N/A	8830532
Bicarb. Alkalinity (calc. as CaCO3)	mg/L							97	1.0	8830528
Calculated TDS	mg/L							29000	1.0	8830540
Carb. Alkalinity (calc. as CaCO3)	mg/L							ND	1.0	8830528
Cation Sum	me/L							506	N/A	8830532
Hardness (CaCO3)	mg/L							5200	1.0	8830529
Ion Balance (% Difference)	%							0.390	N/A	8830531
Langelier Index (@ 20C)	N/A							0.491		8830534
Langelier Index (@ 4C)	N/A							0.252		8830537
Nitrate (N)	mg/L							ND	0.050	8830533
Saturation pH (@ 20C)	N/A							7.31		8830534
Saturation pH (@ 4C)	N/A							7.55		8830537
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L							98	2.0	8873404
Dissolved Chloride (Cl-)	mg/L							16000	300	8873445
Colour	TCU							ND	5.0	8873441
Nitrate + Nitrite (N)	mg/L							ND	0.050	8873438
Nitrite (N)	mg/L							ND	0.010	8871700
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.050	8847633				0.055	0.050	8871328
Total Organic Carbon (C)	mg/L	ND (1)	5.0	8841674				1.3	0.50	8871318
Orthophosphate (P)	mg/L							0.012	0.010	8873439
pH	pH							7.80		8873401
Reactive Silica (SiO2)	mg/L							ND	0.50	8873443
Dissolved Sulphate (SO4)	mg/L							2300	100	8873444
Total Cyanide (CN)	mg/L	ND	0.0050	8846465	ND	0.0050	8846465			
Turbidity	NTU							1.6	0.10	8871696
Conductivity	uS/cm							46000	1.0	8873403

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
(1) Elevated reporting limit due to sample matrix.

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		WOO316		WOO320			WOO320		
Sampling Date		2023/07/25		2023/07/24			2023/07/24		
COC Number		n/a		n/a			n/a		
	UNITS	SW-B-10	QC Batch	SW-C-8	RDL	QC Batch	SW-C-8 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	467	8830532	497	N/A	8830532			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	83	8830528	99	1.0	8830528			
Calculated TDS	mg/L	27000	8830540	29000	1.0	8830540			
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.5	8830528	ND	1.0	8830528			
Cation Sum	me/L	466	8830532	494	N/A	8830532			
Hardness (CaCO3)	mg/L	4800	8830529	5100	1.0	8830529			
Ion Balance (% Difference)	%	0.0700	8830531	0.330	N/A	8830531			
Langelier Index (@ 20C)	N/A	0.841	8830534	0.537		8830534			
Langelier Index (@ 4C)	N/A	0.603	8830537	0.298		8830537			
Nitrate (N)	mg/L	ND	8830533	ND	0.050	8830533			
Saturation pH (@ 20C)	N/A	7.43	8830534	7.33		8830534			
Saturation pH (@ 4C)	N/A	7.67	8830537	7.57		8830537			
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	85	8873404	100	2.0	8873404			
Dissolved Chloride (Cl-)	mg/L	15000	8873445	16000	300	8873445			
Colour	TCU	14	8873441	ND	5.0	8873441			
Nitrate + Nitrite (N)	mg/L	ND	8873438	ND	0.050	8873438			
Nitrite (N)	mg/L	ND	8871700	ND	0.010	8871700			
Nitrogen (Ammonia Nitrogen)	mg/L	0.062	8847633	0.052	0.050	8847638	0.055	0.050	8847638
Total Organic Carbon (C)	mg/L	ND (1)	8841552	ND (2)	5.0	8841674			
Orthophosphate (P)	mg/L	0.014	8873439	0.016	0.010	8873439			
pH	pH	8.27	8873401	7.86		8873401			
Reactive Silica (SiO2)	mg/L	0.52	8873443	ND	0.50	8873443			
Dissolved Sulphate (SO4)	mg/L	2100	8873444	2200	100	8873444			
Total Cyanide (CN)	mg/L	ND	8846465	ND	0.0050	8853040	ND	0.0050	8853040
Turbidity	NTU	0.43	8871696	0.21	0.10	8871696			
Conductivity	uS/cm	42000	8873403	45000	1.0	8873403			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
(1) Elevated reporting limit due to sample matrix.
(2) Elevated reporting limit due to turbidity.

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Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		WO0323		WO0329			WO0335		
Sampling Date		2023/07/25		2023/07/25			2023/07/26		
COC Number		n/a		n/a			n/a		
	UNITS	SW-D-5	QC Batch	SW-E-1	RDL	QC Batch	SW-F-21	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	512	8830532	498	N/A	8830532	2.56	N/A	8830532
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	94	8830528	77	1.0	8830528	5.1	1.0	8830528
Calculated TDS	mg/L	29000	8830540	29000	1.0	8830540	150	1.0	8830540
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	8830528	ND	1.0	8830528	ND	1.0	8830528
Cation Sum	me/L	494	8830532	495	N/A	8830532	2.62	N/A	8830532
Hardness (CaCO3)	mg/L	5100	8830529	5200	1.0	8830529	26	1.0	8830529
Ion Balance (% Difference)	%	1.79	8830531	0.230	N/A	8830531	1.16	N/A	8830531
Langelier Index (@ 20C)	N/A	0.489	8830534	0.325		8830534	-3.61		8830534
Langelier Index (@ 4C)	N/A	0.250	8830537	0.0860		8830537	-3.86		8830537
Nitrate (N)	mg/L	ND	8830533	0.49	0.050	8830533	ND	0.050	8830533
Saturation pH (@ 20C)	N/A	7.35	8830534	7.44		8830534	10.3		8830534
Saturation pH (@ 4C)	N/A	7.59	8830537	7.68		8830537	10.6		8830537
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	95	8873404	77	2.0	8873404	5.1	2.0	8873404
Dissolved Chloride (Cl-)	mg/L	16000	8873445	16000	300	8873445	77	1.0	8873445
Colour	TCU	ND	8873441	ND	5.0	8873441	260	50	8873441
Nitrate + Nitrite (N)	mg/L	ND	8873438	0.51	0.050	8873438	0.051	0.050	8873438
Nitrite (N)	mg/L	ND	8871700	0.011	0.010	8871700	0.011	0.010	8871700
Nitrogen (Ammonia Nitrogen)	mg/L	ND	8847633	ND	0.050	8847633	0.086	0.050	8847633
Total Organic Carbon (C)	mg/L	ND (1)	8841552	ND (1)	5.0	8841674	22	0.50	8841674
Orthophosphate (P)	mg/L	0.016	8873439	0.014	0.010	8873439	0.019	0.010	8873439
pH	pH	7.84	8873401	7.76		8873401	6.73		8873401
Reactive Silica (SiO2)	mg/L	ND	8873443	ND	0.50	8873443	1.2	0.50	8873443
Dissolved Sulphate (SO4)	mg/L	2200	8873444	2200	100	8873444	13	2.0	8873444
Total Cyanide (CN)	mg/L	ND	8846465	ND	0.0050	8853040	ND	0.0050	8853040
Turbidity	NTU	ND	8871696	3.5	0.10	8871503	3.6	0.10	8873550
Conductivity	uS/cm	45000	8873403	44000	1.0	8873403	300	1.0	8873403

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
(1) Elevated reporting limit due to sample matrix.

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ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO310	WOO311			WOO312	WOO313	WOO314		
Sampling Date		2023/07/24	2023/07/25			2023/07/24	2023/07/24	2023/07/24		
COC Number		n/a	n/a			n/a	n/a	n/a		
	UNITS	SW-A-17	SW-A-16	RDL	QC Batch	SW-A-15	SW-A-14	SW-A-9	RDL	QC Batch
Metals										
Total Aluminum (Al)	ug/L	ND	73	50	8855409	ND	ND	ND	50	8855406
Total Antimony (Sb)	ug/L	ND	ND	10	8855409	ND	ND	ND	10	8855406
Total Arsenic (As)	ug/L	ND	ND	10	8855409	ND	ND	ND	10	8855406
Total Barium (Ba)	ug/L	ND	11	10	8855409	ND	ND	ND	10	8855406
Total Beryllium (Be)	ug/L	ND	ND	1.0	8855409	ND	ND	ND	1.0	8855406
Total Bismuth (Bi)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Boron (B)	ug/L	4000	3400	500	8855409	4100	4100	4200	500	8855406
Total Cadmium (Cd)	ug/L	ND	ND	0.10	8855409	ND	ND	ND	0.10	8855406
Total Calcium (Ca)	ug/L	330000	280000	1000	8855409	340000	340000	350000	1000	8855406
Total Chromium (Cr)	ug/L	ND	ND	10	8855409	ND	ND	ND	10	8855406
Total Cobalt (Co)	ug/L	ND	ND	4.0	8855409	ND	ND	ND	4.0	8855406
Total Copper (Cu)	ug/L	ND	ND	5.0	8855409	ND	ND	ND	5.0	8855406
Total Iron (Fe)	ug/L	ND	ND	500	8855409	ND	ND	ND	500	8855406
Total Lead (Pb)	ug/L	ND	ND	5.0	8855409	ND	ND	ND	5.0	8855406
Total Magnesium (Mg)	ug/L	1000000	890000	1000	8855409	1100000	1100000	1100000	1000	8855406
Total Manganese (Mn)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Molybdenum (Mo)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Nickel (Ni)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Phosphorus (P)	ug/L	ND	ND	1000	8855409	ND	ND	ND	1000	8855406
Total Potassium (K)	ug/L	320000	260000	1000	8855409	320000	330000	330000	1000	8855406
Total Selenium (Se)	ug/L	ND	ND	5.0	8855409	ND	ND	ND	5.0	8855406
Total Silver (Ag)	ug/L	ND	ND	1.0	8855409	ND	ND	ND	1.0	8855406
Total Sodium (Na)	ug/L	9000000	7500000	10000	8855409	9000000	9000000	9100000	1000	8855406
Total Strontium (Sr)	ug/L	6400	5100	20	8855409	6600	6800	6800	20	8855406
Total Thallium (Tl)	ug/L	ND	ND	1.0	8855409	ND	ND	ND	1.0	8855406
Total Tin (Sn)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Titanium (Ti)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Uranium (U)	ug/L	2.8	2.2	1.0	8855409	2.6	2.7	2.8	1.0	8855406
Total Vanadium (V)	ug/L	ND	ND	20	8855409	ND	ND	ND	20	8855406
Total Zinc (Zn)	ug/L	ND	ND	50	8855409	ND	ND	ND	50	8855406

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WO0315	WO0316	WO0317	WO0318			WO0319		
Sampling Date		2023/07/25	2023/07/25	2023/07/25	2023/07/24			2023/07/25		
COC Number		n/a	n/a	n/a	n/a			n/a		
	UNITS	**SW-B-12**	**SW-B-10**	**SW-B-3**	**SW-C-13**	**RDL**	**QC Batch**	**SW-C-11**	**RDL**	**QC Batch**
Metals										
Total Aluminum (Al)	ug/L	ND	120	ND	ND	50	8855406	ND	50	8855409
Total Antimony (Sb)	ug/L	ND	ND	ND	ND	10	8855406	ND	10	8855409
Total Arsenic (As)	ug/L	ND	ND	ND	ND	10	8855406	ND	10	8855409
Total Barium (Ba)	ug/L	10	ND	ND	ND	10	8855406	ND	10	8855409
Total Beryllium (Be)	ug/L	ND	ND	ND	ND	1.0	8855406	ND	1.0	8855409
Total Bismuth (Bi)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Boron (B)	ug/L	3900	3800	3900	4000	500	8855406	3900	500	8855409
Total Cadmium (Cd)	ug/L	ND	ND	ND	ND	0.10	8855406	ND	0.10	8855409
Total Calcium (Ca)	ug/L	320000	320000	330000	340000	1000	8855406	330000	1000	8855409
Total Chromium (Cr)	ug/L	ND	ND	ND	ND	10	8855406	ND	10	8855409
Total Cobalt (Co)	ug/L	ND	ND	ND	ND	4.0	8855406	ND	4.0	8855409
Total Copper (Cu)	ug/L	ND	ND	ND	ND	5.0	8855406	ND	5.0	8855409
Total Iron (Fe)	ug/L	ND	ND	ND	ND	500	8855406	ND	500	8855409
Total Lead (Pb)	ug/L	ND	ND	ND	ND	5.0	8855406	ND	5.0	8855409
Total Magnesium (Mg)	ug/L	1000000	970000	1100000	1100000	1000	8855406	1100000	1000	8855409
Total Manganese (Mn)	ug/L	ND	25	ND	ND	20	8855406	ND	20	8855409
Total Molybdenum (Mo)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Nickel (Ni)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Phosphorus (P)	ug/L	ND	ND	ND	ND	1000	8855406	ND	1000	8855409
Total Potassium (K)	ug/L	310000	300000	320000	320000	1000	8855406	320000	1000	8855409
Total Selenium (Se)	ug/L	ND	ND	ND	ND	5.0	8855406	ND	5.0	8855409
Total Silver (Ag)	ug/L	ND	ND	ND	ND	1.0	8855406	ND	1.0	8855409
Total Sodium (Na)	ug/L	8600000	8300000	8800000	8900000	1000	8855406	8900000	10000	8855409
Total Strontium (Sr)	ug/L	6300	6100	6500	6500	20	8855406	6400	20	8855409
Total Thallium (Tl)	ug/L	ND	ND	ND	ND	1.0	8855406	ND	1.0	8855409
Total Tin (Sn)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Titanium (Ti)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Uranium (U)	ug/L	2.4	2.5	2.6	2.8	1.0	8855406	2.5	1.0	8855409
Total Vanadium (V)	ug/L	ND	ND	ND	ND	20	8855406	ND	20	8855409
Total Zinc (Zn)	ug/L	ND	ND	ND	ND	50	8855406	ND	50	8855409

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WO0320	WO0321	WO0322	WO0323	WO0324		
Sampling Date		2023/07/24	2023/07/25	2023/07/25	2023/07/25	2023/07/25		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	SW-C-8	SW-C-7	SW-D-6	SW-D-5	SW-D-4	RDL	QC Batch
Metals								
Total Aluminum (Al)	ug/L	ND	ND	ND	150	ND	50	8855409
Total Antimony (Sb)	ug/L	ND	ND	ND	ND	ND	10	8855409
Total Arsenic (As)	ug/L	ND	ND	ND	ND	ND	10	8855409
Total Barium (Ba)	ug/L	10	ND	ND	ND	ND	10	8855409
Total Beryllium (Be)	ug/L	ND	ND	ND	ND	ND	1.0	8855409
Total Bismuth (Bi)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Boron (B)	ug/L	3800	3900	3800	3900	4100	500	8855409
Total Cadmium (Cd)	ug/L	ND	ND	ND	ND	ND	0.10	8855409
Total Calcium (Ca)	ug/L	330000	320000	320000	320000	340000	1000	8855409
Total Chromium (Cr)	ug/L	ND	ND	ND	ND	ND	10	8855409
Total Cobalt (Co)	ug/L	ND	ND	ND	ND	ND	4.0	8855409
Total Copper (Cu)	ug/L	ND	ND	ND	ND	ND	5.0	8855409
Total Iron (Fe)	ug/L	ND	ND	ND	ND	ND	500	8855409
Total Lead (Pb)	ug/L	ND	ND	ND	ND	ND	5.0	8855409
Total Magnesium (Mg)	ug/L	1000000	1000000	1000000	1100000	1100000	1000	8855409
Total Manganese (Mn)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Molybdenum (Mo)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Nickel (Ni)	ug/L	55	ND	ND	ND	ND	20	8855409
Total Phosphorus (P)	ug/L	ND	ND	ND	ND	ND	1000	8855409
Total Potassium (K)	ug/L	320000	310000	300000	320000	330000	1000	8855409
Total Selenium (Se)	ug/L	ND	ND	ND	ND	ND	5.0	8855409
Total Silver (Ag)	ug/L	ND	ND	ND	ND	ND	1.0	8855409
Total Sodium (Na)	ug/L	8800000	8700000	8600000	8800000	9100000	10000	8855409
Total Strontium (Sr)	ug/L	6400	6300	6200	6300	6600	20	8855409
Total Thallium (Tl)	ug/L	ND	ND	ND	ND	ND	1.0	8855409
Total Tin (Sn)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Titanium (Ti)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Uranium (U)	ug/L	2.8	2.6	2.5	2.7	2.6	1.0	8855409
Total Vanadium (V)	ug/L	ND	ND	ND	ND	ND	20	8855409
Total Zinc (Zn)	ug/L	ND	ND	ND	ND	ND	50	8855409

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO325	WOO325			WOO326	WOO327	WOO328		
Sampling Date		2023/07/25	2023/07/25			2023/07/25	2023/07/25	2023/07/25		
COC Number		n/a	n/a			n/a	n/a	n/a		
	UNITS	SW-D-2	SW-D-2 Lab-Dup	RDL	QC Batch	SW-E-4	SW-E-3	SW-E-2	RDL	QC Batch
Metals										
Total Aluminum (Al)	ug/L	ND	ND	50	8853498	540	ND	54	50	8855409
Total Antimony (Sb)	ug/L	ND	ND	10	8853498	ND	ND	ND	10	8855409
Total Arsenic (As)	ug/L	ND	ND	10	8853498	ND	ND	ND	10	8855409
Total Barium (Ba)	ug/L	ND	ND	10	8853498	ND	ND	ND	10	8855409
Total Beryllium (Be)	ug/L	ND	ND	1.0	8853498	ND	ND	ND	1.0	8855409
Total Bismuth (Bi)	ug/L	ND	ND	20	8853498	ND	ND	ND	20	8855409
Total Boron (B)	ug/L	4200	4000	500	8853498	4100	3900	3800	500	8855409
Total Cadmium (Cd)	ug/L	ND	ND	0.10	8853498	ND	ND	ND	0.10	8855409
Total Calcium (Ca)	ug/L	350000	340000	1000	8853498	340000	330000	320000	1000	8855409
Total Chromium (Cr)	ug/L	ND	ND	10	8853498	ND	ND	ND	10	8855409
Total Cobalt (Co)	ug/L	ND	ND	4.0	8853498	ND	ND	ND	4.0	8855409
Total Copper (Cu)	ug/L	ND	ND	5.0	8853498	ND	ND	ND	5.0	8855409
Total Iron (Fe)	ug/L	ND	ND	500	8853498	1200	ND	ND	500	8855409
Total Lead (Pb)	ug/L	ND	ND	5.0	8853498	ND	ND	ND	5.0	8855409
Total Magnesium (Mg)	ug/L	1100000	1100000	1000	8853498	1100000	1000000	1000000	1000	8855409
Total Manganese (Mn)	ug/L	ND	ND	20	8853498	43	ND	ND	20	8855409
Total Molybdenum (Mo)	ug/L	ND	ND	20	8853498	ND	ND	ND	20	8855409
Total Nickel (Ni)	ug/L	ND	ND	20	8853498	ND	ND	ND	20	8855409
Total Phosphorus (P)	ug/L	ND	ND	1000	8853498	ND	ND	ND	1000	8855409
Total Potassium (K)	ug/L	320000	310000	1000	8853498	320000	310000	310000	1000	8855409
Total Selenium (Se)	ug/L	ND	ND	5.0	8853498	ND	ND	ND	5.0	8855409
Total Silver (Ag)	ug/L	ND	ND	1.0	8853498	ND	ND	ND	1.0	8855409
Total Sodium (Na)	ug/L	9100000	8700000	1000	8853498	8900000	8700000	8600000	10000	8855409
Total Strontium (Sr)	ug/L	6400	6200	20	8853498	6700	6400	6200	20	8855409
Total Thallium (Tl)	ug/L	ND	ND	1.0	8853498	ND	ND	ND	1.0	8855409
Total Tin (Sn)	ug/L	ND	ND	20	8853498	ND	ND	ND	20	8855409
Total Titanium (Ti)	ug/L	ND	ND	20	8853498	23	ND	ND	20	8855409
Total Uranium (U)	ug/L	2.8	2.6	1.0	8853498	2.9	2.5	2.4	1.0	8855409
Total Vanadium (V)	ug/L	ND	ND	20	8853498	ND	ND	ND	20	8855409
Total Zinc (Zn)	ug/L	ND	ND	50	8853498	ND	ND	ND	50	8855409

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO329		WOO330	WOO331	WOO332		WOO333		
Sampling Date		2023/07/25		2023/07/26	2023/07/26	2023/07/26		2023/07/26		
COC Number		n/a		n/a	n/a	n/a		n/a		
	UNITS	SW-E-1	RDL	SW-F-26	SW-F-25	SW-F-24	QC Batch	SW-F-23	RDL	QC Batch
Metals										
Total Aluminum (Al)	ug/L	ND	50	680	660	3100	8855409	1800	5.0	8855322
Total Antimony (Sb)	ug/L	ND	10	ND	ND	ND	8855409	ND	1.0	8855322
Total Arsenic (As)	ug/L	ND	10	1.6	1.5	15	8855409	1.5	1.0	8855322
Total Barium (Ba)	ug/L	ND	10	2.8	2.3	63	8855409	13	1.0	8855322
Total Beryllium (Be)	ug/L	ND	1.0	ND	ND	0.11	8855409	ND	0.10	8855322
Total Bismuth (Bi)	ug/L	ND	20	ND	ND	ND	8855409	ND	2.0	8855322
Total Boron (B)	ug/L	3800	500	ND	ND	ND	8855409	ND	50	8855322
Total Cadmium (Cd)	ug/L	ND	0.10	0.017	0.017	0.097	8855409	0.065	0.010	8855322
Total Calcium (Ca)	ug/L	330000	1000	890	840	3100	8855409	1200	100	8855322
Total Chromium (Cr)	ug/L	ND	10	1.0	1.1	4.1	8855409	1.7	1.0	8855322
Total Cobalt (Co)	ug/L	ND	4.0	1.0	1.1	2.3	8855409	0.89	0.40	8855322
Total Copper (Cu)	ug/L	ND	5.0	0.52	0.53	5.4	8855409	1.9	0.50	8855322
Total Iron (Fe)	ug/L	ND	500	2300	2100	21000	8855409	4300	50	8855322
Total Lead (Pb)	ug/L	ND	5.0	0.79	0.73	15	8855409	8.8	0.50	8855322
Total Magnesium (Mg)	ug/L	1100000	1000	840	840	2600	8855409	1300	100	8855322
Total Manganese (Mn)	ug/L	ND	20	310	300	410	8855409	68	2.0	8855322
Total Molybdenum (Mo)	ug/L	ND	20	ND	ND	ND	8855409	ND	2.0	8855322
Total Nickel (Ni)	ug/L	ND	20	ND	ND	4.7	8855409	2.4	2.0	8855322
Total Phosphorus (P)	ug/L	ND	1000	ND	ND	950	8855409	420	100	8855322
Total Potassium (K)	ug/L	320000	1000	210	450	1800	8855409	1400	100	8855322
Total Selenium (Se)	ug/L	ND	5.0	ND	ND	1.1	8855409	0.56	0.50	8855322
Total Silver (Ag)	ug/L	ND	1.0	ND	ND	ND	8855409	ND	0.10	8855322
Total Sodium (Na)	ug/L	8800000	10000	7300	7500	14000	8855409	15000	100	8855322
Total Strontium (Sr)	ug/L	6300	20	9.9	9.6	46	8855409	20	2.0	8855322
Total Thallium (Tl)	ug/L	ND	1.0	ND	ND	ND	8855409	ND	0.10	8855322
Total Tin (Sn)	ug/L	ND	20	ND	ND	ND	8855409	ND	2.0	8855322
Total Titanium (Ti)	ug/L	ND	20	10	9.4	73	8855409	43	2.0	8855322
Total Uranium (U)	ug/L	2.6	1.0	ND	ND	0.31	8855409	0.10	0.10	8855322
Total Vanadium (V)	ug/L	ND	20	ND	ND	6.7	8855409	2.3	2.0	8855322
Total Zinc (Zn)	ug/L	ND	50	5.2	ND	24	8855409	10	5.0	8855322

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		WOO334		WOO335			WOO336	WOO337		
Sampling Date		2023/07/26		2023/07/26			2023/07/26	2023/07/26		
COC Number		n/a		n/a			n/a	n/a		
	UNITS	SW-F-22	QC Batch	SW-F-21	RDL	QC Batch	SW-F-20	SW-F-19	RDL	QC Batch
Metals										
Total Aluminum (Al)	ug/L	280	8855409	300	5.0	8855322	150	860	5.0	8855409
Total Antimony (Sb)	ug/L	ND	8855409	ND	1.0	8855322	1.0	ND	1.0	8855409
Total Arsenic (As)	ug/L	82	8855409	84	1.0	8855322	770	2800	10	8855409
Total Barium (Ba)	ug/L	1.6	8855409	4.3	1.0	8855322	7.0	5.4	1.0	8855409
Total Beryllium (Be)	ug/L	ND	8855409	ND	0.10	8855322	ND	ND	0.10	8855409
Total Bismuth (Bi)	ug/L	ND	8855409	ND	2.0	8855322	ND	ND	2.0	8855409
Total Boron (B)	ug/L	ND	8855409	52	50	8855322	150	ND	50	8855409
Total Cadmium (Cd)	ug/L	0.012	8855409	0.012	0.010	8855322	ND	0.015	0.010	8855409
Total Calcium (Ca)	ug/L	2000	8855409	2100	100	8855322	11000	5300	100	8855409
Total Chromium (Cr)	ug/L	ND	8855409	ND	1.0	8855322	ND	2.3	1.0	8855409
Total Cobalt (Co)	ug/L	ND	8855409	ND	0.40	8855322	2.6	4.5	0.40	8855409
Total Copper (Cu)	ug/L	ND	8855409	0.51	0.50	8855322	2.2	21	0.50	8855409
Total Iron (Fe)	ug/L	1700	8855409	1700	50	8855322	8200	14000	50	8855409
Total Lead (Pb)	ug/L	0.63	8855409	0.63	0.50	8855322	ND	6.5	0.50	8855409
Total Magnesium (Mg)	ug/L	5300	8855409	4900	100	8855322	26000	6400	100	8855409
Total Manganese (Mn)	ug/L	73	8855409	72	2.0	8855322	830	230	2.0	8855409
Total Molybdenum (Mo)	ug/L	ND	8855409	ND	2.0	8855322	ND	ND	2.0	8855409
Total Nickel (Ni)	ug/L	ND	8855409	ND	2.0	8855322	3.5	10	2.0	8855409
Total Phosphorus (P)	ug/L	ND	8855409	ND	100	8855322	170	570	100	8855409
Total Potassium (K)	ug/L	1900	8855409	2000	100	8855322	12000	3900	100	8855409
Total Selenium (Se)	ug/L	ND	8855409	ND	0.50	8855322	ND	0.65	0.50	8855409
Total Silver (Ag)	ug/L	ND	8855409	ND	0.10	8855322	ND	ND	0.10	8855409
Total Sodium (Na)	ug/L	48000	8855409	46000	100	8855322	240000	44000	100	8855409
Total Strontium (Sr)	ug/L	34	8855409	35	2.0	8855322	210	87	2.0	8855409
Total Thallium (Tl)	ug/L	ND	8855409	ND	0.10	8855322	ND	ND	0.10	8855409
Total Tin (Sn)	ug/L	ND	8855409	ND	2.0	8855322	ND	ND	2.0	8855409
Total Titanium (Ti)	ug/L	4.5	8855409	5.7	2.0	8855322	4.6	28	2.0	8855409
Total Uranium (U)	ug/L	0.11	8855409	0.11	0.10	8855322	0.24	0.40	0.10	8855409
Total Vanadium (V)	ug/L	ND	8855409	ND	2.0	8855322	ND	2.6	2.0	8855409
Total Zinc (Zn)	ug/L	ND	8855409	5.1	5.0	8855322	ND	15	5.0	8855409

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

MERCURY BY COLD VAPOUR AA (TISSUE)

Bureau Veritas ID		WOV113	WOV114	WOV115	WOV116		
Sampling Date		2023/07/24	2023/07/25	2023/07/24	2023/07/25		
COC Number		n/a	n/a	n/a	n/a		
	UNITS	**INV-A-RC-0000101**	**INV-B-RC-0000102**	**INV-C-RC-0000103**	**INV-D-RC-0000104**	**RDL**	**QC Batch**
Metals							
Mercury (Hg)	mg/kg	0.048	0.043	0.019	0.050	0.010	8901001

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		WOV117	WOV118	WOV118		
Sampling Date		2023/07/25	2023/07/25	2023/07/25		
COC Number		n/a	n/a	n/a		
	UNITS	**INV-E-C-0000105**	**INV-E-M-0000105**	**INV-E-M-0000105 Lab-Dup**	**RDL**	**QC Batch**
Metals						
Mercury (Hg)	mg/kg	ND	0.036	0.050	0.010	8901001

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ICP/MS (TISSUE)

Bureau Veritas ID		WOV113	WOV114	WOV115	WOV116		
Sampling Date		2023/07/24	2023/07/25	2023/07/24	2023/07/25		
COC Number		n/a	n/a	n/a	n/a		
	UNITS	INV-A-RC-0000101	INV-B-RC-0000102	INV-C-RC-0000103	INV-D-RC-0000104	RDL	QC Batch
Metals							
Aluminum (Al)	mg/kg	62	3.4	8.7	5.6	2.5	8917139
Antimony (Sb)	mg/kg	ND	ND	ND	ND	0.50	8917139
Arsenic (As)	mg/kg	6.8	5.1	4.9	3.6	0.50	8917139
Barium (Ba)	mg/kg	ND	ND	ND	ND	1.5	8917139
Beryllium (Be)	mg/kg	ND	ND	ND	ND	0.50	8917139
Boron (B)	mg/kg	1.5	1.5	2.1	ND	1.5	8917139
Cadmium (Cd)	mg/kg	13	0.53	0.31	0.37	0.050	8917139
Chromium (Cr)	mg/kg	ND	ND	ND	ND	0.50	8917139
Cobalt (Co)	mg/kg	ND	ND	ND	ND	0.20	8917139
Copper (Cu)	mg/kg	8.5	20	9.5	11	0.50	8917139
Iron (Fe)	mg/kg	160	27	25	28	15	8917139
Lead (Pb)	mg/kg	ND	ND	ND	ND	0.18	8917139
Lithium (Li)	mg/kg	ND	ND	ND	ND	0.50	8917139
Manganese (Mn)	mg/kg	5.0	2.1	3.3	4.4	0.50	8917139
Molybdenum (Mo)	mg/kg	ND	ND	ND	ND	0.50	8917139
Nickel (Ni)	mg/kg	ND	ND	ND	ND	0.50	8917139
Selenium (Se)	mg/kg	1.4	0.66	0.63	0.70	0.50	8917139
Silver (Ag)	mg/kg	0.83	0.33	0.22	0.38	0.12	8917139
Strontium (Sr)	mg/kg	75	110	170	140	1.5	8917139
Thallium (Tl)	mg/kg	ND	ND	ND	ND	0.020	8917139
Tin (Sn)	mg/kg	ND	ND	ND	ND	0.50	8917139
Uranium (U)	mg/kg	0.047	ND	ND	ND	0.020	8917139
Vanadium (V)	mg/kg	ND	ND	ND	ND	0.50	8917139
Zinc (Zn)	mg/kg	22	18	14	14	1.5	8917139

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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Bureau Veritas Job #: C3N1498
Report Date: 2023/10/04

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ICP/MS (TISSUE)

Bureau Veritas ID		WOV118	WOV118		
Sampling Date		2023/07/25	2023/07/25		
COC Number		n/a	n/a		
	UNITS	INV-E-M-0000105	INV-E-M-0000105 Lab-Dup	RDL	QC Batch
Metals					
Aluminum (Al)	mg/kg	13	13	2.5	8869077
Antimony (Sb)	mg/kg	ND	ND	0.50	8869077
Arsenic (As)	mg/kg	2.9	2.9	0.50	8869077
Barium (Ba)	mg/kg	ND	ND	1.5	8869077
Beryllium (Be)	mg/kg	ND	ND	0.50	8869077
Boron (B)	mg/kg	4.3	4.4	1.5	8869077
Cadmium (Cd)	mg/kg	0.37	0.38	0.050	8869077
Chromium (Cr)	mg/kg	ND	ND	0.50	8869077
Cobalt (Co)	mg/kg	ND	ND	0.20	8869077
Copper (Cu)	mg/kg	1.4	1.3	0.50	8869077
Iron (Fe)	mg/kg	85	74	15	8869077
Lead (Pb)	mg/kg	0.29	0.29	0.18	8869077
Lithium (Li)	mg/kg	ND	ND	0.50	8869077
Manganese (Mn)	mg/kg	2.3	2.2	0.50	8869077
Molybdenum (Mo)	mg/kg	ND	ND	0.50	8869077
Nickel (Ni)	mg/kg	ND	ND	0.50	8869077
Selenium (Se)	mg/kg	0.65	0.65	0.50	8869077
Silver (Ag)	mg/kg	ND	ND	0.12	8869077
Strontium (Sr)	mg/kg	12	12	1.5	8869077
Thallium (Tl)	mg/kg	ND	ND	0.020	8869077
Tin (Sn)	mg/kg	ND	ND	0.50	8869077
Uranium (U)	mg/kg	0.041	0.053	0.020	8869077
Vanadium (V)	mg/kg	ND	ND	0.50	8869077
Zinc (Zn)	mg/kg	17	19	1.5	8869077

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Methyl Mercury Results

Flett Research Ltd.
440 DeSalaberry Ave. Winnipeg, MB R2L 0Y7
Fax/Phone (204) 667-2505
E-mail: flett@flettresearch.ca Webpage: http://www.flettresearch.ca

CLIENT: Bureau Veritas - Bedford: C3N1498
200 Bluewater Road, Suite 105
Bedford, NS B4B 1G9

Date Received: September 15, 2023
Sampling Date: July 24, 2023 to July 25, 2023
Date Issued: October 2, 2023

Matrix: Tissue (dry)
Transaction ID: 1004
PO/Contract No.:
Date Analysed: September 30, 2023
Analyst(s): Jason S.

Analytical Method: M10221: Methyl Mercury in Tissue by Digestion, Aqueous Ethylation, Purge & Trap, and CVAFS - Tekran 2700 Mercury Analyser (Version 2)

Comments: Prior to analysis, all samples where freeze-dried and ground to create homogeneous powders at Flett.

The jar received for sample INV-E_M-0000105 appeared to contain more than one type of tissue. A representative sub-sample was removed into a 40mL purge and trap vial for freeze-drying.

The other samples in the batch were freeze dried as received.

Detection Limit: The method detection limit (MDL) for this method is 0.4 ng/g. The MDL is the minimum concentration that can be reported with 99% confidence that the measured concentration exceeds zero and is based on the digestion of 20mg of dry sample and the analysis of 30uL of a 4mL digest.

For reporting purpose samples are flagged when the dry concentration is below the methods minimum level (ML= 1.4 ng/g).
As concentration rises above the MDL confidence that the analyte is present approaches 100% at and above the ML.

Estimated Uncertainty: Overall method uncertainty is expected to decrease as analyte concentration increases. When methyl mercury concentrations exceed 5 ng/g the estimated uncertainty is ±27%. Method uncertainty is expressed at a 95% confidence level of (k=2)

Results authorized by Dr. Robert J. Flett, Chief Scientist

QUALITY DATA

Blanks		Pg of CH_3Hg in the Ethylation Blank	Mean Gross Peak Area			CH_3Hg in the Ethylation Blank (ng/L)
	Ethylation blank (H_2O+Reagents)	0.20	7.78			0.007
	Mean Eth. Blank (last 30 runs)	0.22				
		Net Pg CH_3Hg in the Method Blank (Eth. Blank subtracted)	Gross Peak Area	Volume of Method Blank Digest added to the Ethylation EPA Vial (mL)	Total Volume of Digest (mL)	Equivalent CH_3Hg in the Method Blank (ng/g) (Eth. Blank subtracted) Uses the Mean Weight of all the samples in the batch
	Method Blank 1	0.23	16.75	0.03	3.989	1.128
	Method Blank 2	0.21	15.90	0.03	3.964	1.014
	Method Blank 3	0.19	15.11	0.03	4.011	0.927
	Mean Method Blank					1.023

Mean Calibration Factor (area units / pg)	39.08 ± 4.3 %RSD

Spike Recovery Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	Sample ID (Details)	Sample Type	Gross Peak Area	Volume of Digest added to the Ethylation EPA Vial (mL)	Total Volume of Digest (mL)	Weight of Sample added to the digestion vial (g)	Percent Weight Lost on Drying (%LOD)	Dry Weight of Reference Material	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg as Hg (ng/g)	CH_3Hg Recovery (%)
	WOV113-01R (INV-A-RC-0000101)	MS1	1661.53	0.030	4.082	0.02511	-	-	100%	228.16	85.2
		MS1D	1630.06	0.030	4.089	0.02568	-	-	100%	219.24	79.5
	Mean of Spike Recoveries										82.4
QC Samples Reference Material (RM)	DORM4 (355 ng/g)	(beginning of run)	2032.83	0.030	4.008	0.02369	5.790	0.022	100%	309	87.0
		(end of run)	2014.31	0.030	4.008	0.02369	5.790	0.022	100%	306	86.2
	DORM4 (355 ng/g)	(beginning of run)	1658.52	0.030	4.008	0.02130	5.790	0.020	100%	314	88.4
		(end of run)	1770.61	0.030	4.008	0.02130	5.790	0.020	100%	299	84.2
	Mean of RM Recoveries										86.5
Alternate Source Standard (ASS)	A.S.S.-Alfa 101301 (1000 ng/L)		1094.69						Net CH3Hg as Hg (ng/L) ->	927	92.7

LAB ID	Sampling Details	Sample ID	Date Sampled	Time Sampled	Sample Type	Gross Peak Area	Volume of Digest added to EPA Vial (mL) =Vpd	Total Volume of Digest (mL) = VTd	Weight of Dry Sample added to the Digestion vial (g)	Percent Weight Lost on Drying (%LOD)	Wet Sample Weight by Calculation (g)	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg as Hg in the sample (ng/g dry wt.) [Ethylation & Method Blank subtracted] [Recovery corrected] As Analyzed	Net CH_3Hg as Hg in the sample (ng/g wet wt.) [Ethylation & Method Blank subtracted] [Recovery corrected] As Calculated
115322	WOV113-01R	INV-A-RC-0000101	July 24, 2023			1133.61	0.030	4.058	0.03062	84.2	0.193	82.4%	153	24.3
115323	WOV114-01R	INV-B-RC-0000102	July 25, 2023			1115.20	0.030	4.064	0.02051	83.1	0.122	82.4%	226	38.1
115324	WOV115-01R	INV-C-RC-0000103	July 24, 2023			654.87	0.030	4.040	0.02835	90.0	0.283	82.4%	94.3	9.46
115325	WOV116-01R	INV-D-RC-0000104	July 25, 2023		DupA1	2726.73	0.030	4.055	0.03254	90.5	0.341	82.4%	350	33.4
115325	WOV116-01R	INV-D-RC-0000104	July 25, 2023		DupA2	2596.27	0.030	4.027	0.02934	90.5	0.307	82.4%	367	35.0
115326	WOV118-01R	INV-E-M-0000105	July 25, 2023		DupB1	608.54	0.030	4.014	0.02533	83.7	0.156	82.4%	97.3	15.8
115326	WOV118-01R	INV-E-M-0000105	July 25, 2023		DupB2	550.44	0.030	4.019	0.02262	83.7	0.139	82.4%	98.4	16.0

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* : See 'Comments' section above for discussion

Note: Results relate only to the samples tested and as received.

Dup : Duplicate - two subsamples of the same sample carried through the analytical procedure in an identical manner.

CALA Accredited No. A3309

ISO/IEC 17025:2017 Accredited with the Canadian Association of Laboratory Accreditation

Bureau Veritas Job #: C3BI448
Report Date: 2024/01/03

Strum Environmental
Client Project #: 22-8552
Sampler Initials: ML

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		XXC922	XXC923		XXC924		XXC925		XXC926		
Sampling Date		2023/12/14	2023/12/14		2023/12/14		2023/12/14		2023/12/14		
COC Number		N/A	N/A		N/A		N/A		N/A		
	UNITS	**SED-G-1-S1**	**SED-G-2-S1**	**RDL**	**SED-G-3-S1**	**RDL**	**SED-G-4-S1**	**QC Batch**	**SED-G-5-S1**	**RDL**	**QC Batch**
Metals											
Acid Extractable Arsenic (As)	mg/kg	260	170	2.0	1200	20	35	9128308	70	2.0	9138934

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		XXC927	XXC927	XXC928		
Sampling Date		2023/12/14	2023/12/14	2023/12/14		
COC Number		N/A	N/A	N/A		
	UNITS	**SED-G-6-S1**	**SED-G-6-S1 Lab-Dup**	**SED-B-10-S1**	**RDL**	**QC Batch**
Metals						
Acid Extractable Arsenic (As)	mg/kg	7.6	21 (1)	49	2.0	9138934

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Poor RPD due to sample inhomogeneity. Verified by repeat digestion and analysis.

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Your C.O.C. #: 836365-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/07/26
Report #: R6737205
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1K0600
Received: 2021/07/19, 09:17

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	2	N/A	2021/07/23	N/A	SM 23 4500-CO2 D
Alkalinity	2	N/A	2021/07/23	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	1	N/A	2021/07/22	ATL SOP 00014	SM 23 4500-Cl- E m
Chloride	1	N/A	2021/07/23	ATL SOP 00014	SM 23 4500-Cl- E m
Colour	2	N/A	2021/07/23	ATL SOP 00020	SM 23 2120C m
Conductance - water	2	N/A	2021/07/22	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	2	N/A	2021/07/21	ATL SOP 00048	Auto Calc
Metals Water Total MS	2	2021/07/20	2021/07/21	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	2	N/A	2021/07/26	N/A	Auto Calc.
Anion and Cation Sum	2	N/A	2021/07/23	N/A	Auto Calc.
Nitrogen Ammonia - water	2	N/A	2021/07/22	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	2	N/A	2021/07/22	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	2	N/A	2021/07/22	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	2	N/A	2021/07/23	ATL SOP 00018	ASTM D3867-16
pH (1)	2	N/A	2021/07/22	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	2	N/A	2021/07/22	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	2	N/A	2021/07/26	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	2	N/A	2021/07/26	ATL SOP 00049	Auto Calc.
Reactive Silica	2	N/A	2021/07/22	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2021/07/22	ATL SOP 00023	ASTM D516-16 m
Sulphate	1	N/A	2021/07/23	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	2	N/A	2021/07/26	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	2	N/A	2021/07/26	ATL SOP 00203	SM 23 5310B m
Turbidity	2	N/A	2021/07/21	ATL SOP 00011	EPA 180.1 R2 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas 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 Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

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Your C.O.C. #: 836365-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/07/26
Report #: R6737205
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1K0600
Received: 2021/07/19, 09:17

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, 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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas
26 Jul 2021 15:44:21

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bureauveritas.com
Phone# (902)420-0203 Ext:252
==
This report has been generated and distributed using a secure automated process.
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.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		QDE293		
Sampling Date		2021/07/16 10:20		
COC Number		836365-01-01		
	UNITS	**SUMMER LINE**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	me/L	451	N/A	7469726
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	91	1.0	7469722
Calculated TDS	mg/L	27000	1.0	7469731
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	7469722
Cation Sum	me/L	494	N/A	7469726
Hardness (CaCO3)	mg/L	5300	1.0	7469724
Ion Balance (% Difference)	%	4.59	N/A	7469725
Langelier Index (@ 20C)	N/A	0.614		7469729
Langelier Index (@ 4C)	N/A	0.375		7469730
Nitrate (N)	mg/L	ND	0.050	7469727
Saturation pH (@ 20C)	N/A	7.36		7469729
Saturation pH (@ 4C)	N/A	7.60		7469730
Inorganics				
Total Alkalinity (Total as CaCO3)	mg/L	92	5.0	7475371
Dissolved Chloride (Cl-)	mg/L	14000	250	7477134
Colour	TCU	ND	5.0	7477142
Nitrate + Nitrite (N)	mg/L	ND	0.050	7477144
Nitrite (N)	mg/L	ND	0.010	7477145
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.050	7477393
Total Organic Carbon (C)	mg/L	1.6	0.50	7479624
Orthophosphate (P)	mg/L	0.015	0.010	7477143
pH	pH	7.97		7476909
Reactive Silica (SiO2)	mg/L	ND	0.50	7477136
Dissolved Sulphate (SO4)	mg/L	2400	100	7477135
Turbidity	NTU	0.46	0.10	7474927
Conductivity	uS/cm	46000	1.0	7476907
Metals				
Total Aluminum (Al)	ug/L	ND	50	7472177
Total Antimony (Sb)	ug/L	ND	10	7472177
Total Arsenic (As)	ug/L	ND	10	7472177
Total Barium (Ba)	ug/L	ND	10	7472177
Total Beryllium (Be)	ug/L	ND	10	7472177
Total Bismuth (Bi)	ug/L	ND	20	7472177
Total Boron (B)	ug/L	3800	500	7472177
Total Cadmium (Cd)	ug/L	ND	0.10	7472177

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		QDE293		
Sampling Date		2021/07/16 10:20		
COC Number		836365-01-01		
	UNITS	**SUMMER LINE**	**RDL**	**QC Batch**
Total Calcium (Ca)	ug/L	340000	1000	7472177
Total Chromium (Cr)	ug/L	ND	10	7472177
Total Cobalt (Co)	ug/L	ND	4.0	7472177
Total Copper (Cu)	ug/L	ND	5.0	7472177
Total Iron (Fe)	ug/L	ND	500	7472177
Total Lead (Pb)	ug/L	ND	5.0	7472177
Total Magnesium (Mg)	ug/L	1100000	1000	7472177
Total Manganese (Mn)	ug/L	ND	20	7472177
Total Molybdenum (Mo)	ug/L	ND	20	7472177
Total Nickel (Ni)	ug/L	ND	20	7472177
Total Phosphorus (P)	ug/L	ND	1000	7472177
Total Potassium (K)	ug/L	330000	1000	7472177
Total Selenium (Se)	ug/L	ND	5.0	7472177
Total Silver (Ag)	ug/L	ND	1.0	7472177
Total Sodium (Na)	ug/L	8700000	1000	7472177
Total Strontium (Sr)	ug/L	6200	20	7472177
Total Thallium (Tl)	ug/L	ND	1.0	7472177
Total Tin (Sn)	ug/L	ND	20	7472177
Total Titanium (Ti)	ug/L	ND	20	7472177
Total Uranium (U)	ug/L	2.6	1.0	7472177
Total Vanadium (V)	ug/L	ND	20	7472177
Total Zinc (Zn)	ug/L	ND	50	7472177

RDL = Reportable Detection Limit
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ND = Not detected

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		QDE294		
Sampling Date		2021/07/16 03:50		
COC Number		836365-01-01		
	UNITS	**POND SURFACE**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	me/L	14.6	N/A	7469726
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	14	1.0	7469722
Calculated TDS	mg/L	850	1.0	7469731
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	7469722
Cation Sum	me/L	14.4	N/A	7469726
Hardness (CaCO3)	mg/L	130	1.0	7469724
Ion Balance (% Difference)	%	0.760	N/A	7469725
Langelier Index (@ 20C)	N/A	-2.28		7469729
Langelier Index (@ 4C)	N/A	-2.53		7469730
Nitrate (N)	mg/L	ND	0.050	7469727
Saturation pH (@ 20C)	N/A	9.43		7469729
Saturation pH (@ 4C)	N/A	9.68		7469730
Inorganics				
Total Alkalinity (Total as CaCO3)	mg/L	14	5.0	7475371
Dissolved Chloride (Cl-)	mg/L	460	5.0	7477134
Colour	TCU	130	25	7477142
Nitrate + Nitrite (N)	mg/L	ND	0.050	7477144
Nitrite (N)	mg/L	ND	0.010	7477145
Nitrogen (Ammonia Nitrogen)	mg/L	0.065	0.050	7477393
Total Organic Carbon (C)	mg/L	17	0.50	7479624
Orthophosphate (P)	mg/L	0.020	0.010	7477143
pH	pH	7.15		7476909
Reactive Silica (SiO2)	mg/L	ND	0.50	7477136
Dissolved Sulphate (SO4)	mg/L	69	2.0	7477135
Turbidity	NTU	1.8	0.10	7474927
Conductivity	uS/cm	1800	1.0	7476907
Metals				
Total Aluminum (Al)	ug/L	180	5.0	7472177
Total Antimony (Sb)	ug/L	1.0	1.0	7472177
Total Arsenic (As)	ug/L	66	1.0	7472177
Total Barium (Ba)	ug/L	3.6	1.0	7472177
Total Beryllium (Be)	ug/L	ND	1.0	7472177
Total Bismuth (Bi)	ug/L	ND	2.0	7472177
Total Boron (B)	ug/L	160	50	7472177
Total Cadmium (Cd)	ug/L	ND	0.010	7472177

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		QDE294		
Sampling Date		2021/07/16 03:50		
COC Number		836365-01-01		
	UNITS	**POND SURFACE**	**RDL**	**QC Batch**
Total Calcium (Ca)	ug/L	9000	100	7472177
Total Chromium (Cr)	ug/L	ND	1.0	7472177
Total Cobalt (Co)	ug/L	ND	0.40	7472177
Total Copper (Cu)	ug/L	28	0.50	7472177
Total Iron (Fe)	ug/L	560	50	7472177
Total Lead (Pb)	ug/L	0.67	0.50	7472177
Total Magnesium (Mg)	ug/L	27000	100	7472177
Total Manganese (Mn)	ug/L	38	2.0	7472177
Total Molybdenum (Mo)	ug/L	ND	2.0	7472177
Total Nickel (Ni)	ug/L	ND	2.0	7472177
Total Phosphorus (P)	ug/L	ND	100	7472177
Total Potassium (K)	ug/L	11000	100	7472177
Total Selenium (Se)	ug/L	ND	0.50	7472177
Total Silver (Ag)	ug/L	ND	0.10	7472177
Total Sodium (Na)	ug/L	260000	100	7472177
Total Strontium (Sr)	ug/L	170	2.0	7472177
Total Thallium (Tl)	ug/L	ND	0.10	7472177
Total Tin (Sn)	ug/L	ND	2.0	7472177
Total Titanium (Ti)	ug/L	2.7	2.0	7472177
Total Uranium (U)	ug/L	ND	0.10	7472177
Total Vanadium (V)	ug/L	ND	2.0	7472177
Total Zinc (Zn)	ug/L	7.7	5.0	7472177

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	0.3°C

Sample QDE293 [SUMMER LINE] : Elevated reporting limits for trace metals due to sample matrix. ortho-Phosphate > Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Sample QDE294 [POND SURFACE] : ortho-Phosphate > Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7472177	BAN	Matrix Spike [QDE293-02]	Total Aluminum (Al)	2021/07/21		100	%	80 - 120
			Total Antimony (Sb)	2021/07/21		113	%	80 - 120
			Total Arsenic (As)	2021/07/21		90	%	80 - 120
			Total Barium (Ba)	2021/07/21		102	%	80 - 120
			Total Beryllium (Be)	2021/07/21		95	%	80 - 120
			Total Bismuth (Bi)	2021/07/21		89	%	80 - 120
			Total Boron (B)	2021/07/21		NC	%	80 - 120
			Total Cadmium (Cd)	2021/07/21		91	%	80 - 120
			Total Calcium (Ca)	2021/07/21		NC	%	80 - 120
			Total Chromium (Cr)	2021/07/21		95	%	80 - 120
			Total Cobalt (Co)	2021/07/21		91	%	80 - 120
			Total Copper (Cu)	2021/07/21		87	%	80 - 120
			Total Iron (Fe)	2021/07/21		93	%	80 - 120
			Total Lead (Pb)	2021/07/21		94	%	80 - 120
			Total Magnesium (Mg)	2021/07/21		NC	%	80 - 120
			Total Manganese (Mn)	2021/07/21		96	%	80 - 120
			Total Molybdenum (Mo)	2021/07/21		114	%	80 - 120
			Total Nickel (Ni)	2021/07/21		89	%	80 - 120
			Total Phosphorus (P)	2021/07/21		100	%	80 - 120
			Total Potassium (K)	2021/07/21		NC	%	80 - 120
			Total Selenium (Se)	2021/07/21		91	%	80 - 120
			Total Silver (Ag)	2021/07/21		92	%	80 - 120
			Total Sodium (Na)	2021/07/21		NC	%	80 - 120
			Total Strontium (Sr)	2021/07/21		NC	%	80 - 120
			Total Thallium (Tl)	2021/07/21		94	%	80 - 120
			Total Tin (Sn)	2021/07/21		107	%	80 - 120
			Total Titanium (Ti)	2021/07/21		97	%	80 - 120
			Total Uranium (U)	2021/07/21		99	%	80 - 120
			Total Vanadium (V)	2021/07/21		98	%	80 - 120
			Total Zinc (Zn)	2021/07/21		89	%	80 - 120
7472177	BAN	Spiked Blank	Total Aluminum (Al)	2021/07/21		101	%	80 - 120
			Total Antimony (Sb)	2021/07/21		106	%	80 - 120
			Total Arsenic (As)	2021/07/21		90	%	80 - 120
			Total Barium (Ba)	2021/07/21		101	%	80 - 120
			Total Beryllium (Be)	2021/07/21		95	%	80 - 120
			Total Bismuth (Bi)	2021/07/21		100	%	80 - 120
			Total Boron (B)	2021/07/21		96	%	80 - 120
			Total Cadmium (Cd)	2021/07/21		95	%	80 - 120
			Total Calcium (Ca)	2021/07/21		98	%	80 - 120
			Total Chromium (Cr)	2021/07/21		94	%	80 - 120
			Total Cobalt (Co)	2021/07/21		95	%	80 - 120
			Total Copper (Cu)	2021/07/21		94	%	80 - 120
			Total Iron (Fe)	2021/07/21		100	%	80 - 120
			Total Lead (Pb)	2021/07/21		99	%	80 - 120
			Total Magnesium (Mg)	2021/07/21		99	%	80 - 120
			Total Manganese (Mn)	2021/07/21		96	%	80 - 120
			Total Molybdenum (Mo)	2021/07/21		102	%	80 - 120
			Total Nickel (Ni)	2021/07/21		96	%	80 - 120
			Total Phosphorus (P)	2021/07/21		102	%	80 - 120
			Total Potassium (K)	2021/07/21		98	%	80 - 120
			Total Selenium (Se)	2021/07/21		93	%	80 - 120
			Total Silver (Ag)	2021/07/21		99	%	80 - 120
			Total Sodium (Na)	2021/07/21		96	%	80 - 120
			Total Strontium (Sr)	2021/07/21		97	%	80 - 120
			Total Thallium (Tl)	2021/07/21		100	%	80 - 120

BV Labs Job #: C1K0600
Report Date: 2021/07/26

Whale Sanctuary

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2021/07/21		104	%	80 - 120
			Total Titanium (Ti)	2021/07/21		98	%	80 - 120
			Total Uranium (U)	2021/07/21		103	%	80 - 120
			Total Vanadium (V)	2021/07/21		95	%	80 - 120
			Total Zinc (Zn)	2021/07/21		95	%	80 - 120
7472177	BAN	Method Blank	Total Aluminum (Al)	2021/07/21	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2021/07/21	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2021/07/21	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2021/07/21	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2021/07/21	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Boron (B)	2021/07/21	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2021/07/21	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2021/07/21	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2021/07/21	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2021/07/21	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2021/07/21	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2021/07/21	ND, RDL=50		ug/L	
			Total Lead (Pb)	2021/07/21	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2021/07/21	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2021/07/21	ND, RDL=100		ug/L	
			Total Potassium (K)	2021/07/21	ND, RDL=100		ug/L	
			Total Selenium (Se)	2021/07/21	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2021/07/21	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2021/07/21	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2021/07/21	ND, RDL=0.10		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2021/07/21	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2021/07/21	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2021/07/21	ND, RDL=5.0		ug/L	
7472177	BAN	RPD	Total Lead (Pb)	2021/07/21	0.89		%	20
7474927	SHW	QC Standard	Turbidity	2021/07/21		105	%	80 - 120
7474927	SHW	Spiked Blank	Turbidity	2021/07/21		106	%	80 - 120
7474927	SHW	Method Blank	Turbidity	2021/07/21	ND, RDL=0.10		NTU	
7474927	SHW	RPD	Turbidity	2021/07/21	14		%	20
7475371	EMT	Matrix Spike	Total Alkalinity (Total as CaCO3)	2021/07/23		NC (1)	%	80 - 120
7475371	EMT	Spiked Blank	Total Alkalinity (Total as CaCO3)	2021/07/23		98	%	80 - 120
7475371	EMT	Method Blank	Total Alkalinity (Total as CaCO3)	2021/07/23	ND, RDL=5.0		mg/L	
7475371	EMT	RPD	Total Alkalinity (Total as CaCO3)	2021/07/23	10		%	20
7476907	SHW	Spiked Blank	Conductivity	2021/07/22		101	%	80 - 120
7476907	SHW	Method Blank	Conductivity	2021/07/22	ND, RDL=1.0		uS/cm	
7476907	SHW	RPD	Conductivity	2021/07/22	0		%	10
7476909	SHW	Spiked Blank	pH	2021/07/22		100	%	97 - 103
7476909	SHW	RPD	pH	2021/07/22	1.4		%	N/A
7477134	EMT	Matrix Spike	Dissolved Chloride (Cl-)	2021/07/22		89	%	80 - 120
7477134	EMT	Spiked Blank	Dissolved Chloride (Cl-)	2021/07/22		97	%	80 - 120
7477134	EMT	Method Blank	Dissolved Chloride (Cl-)	2021/07/22	ND, RDL=1.0		mg/L	
7477134	EMT	RPD	Dissolved Chloride (Cl-)	2021/07/22	NC		%	20
7477135	EMT	Matrix Spike	Dissolved Sulphate (SO4)	2021/07/22		94	%	80 - 120
7477135	EMT	Spiked Blank	Dissolved Sulphate (SO4)	2021/07/23		105	%	80 - 120
7477135	EMT	Method Blank	Dissolved Sulphate (SO4)	2021/07/22	ND, RDL=2.0		mg/L	
7477135	EMT	RPD	Dissolved Sulphate (SO4)	2021/07/22	0.11		%	20
7477136	EMT	Matrix Spike	Reactive Silica (SiO2)	2021/07/22		NC	%	80 - 120
7477136	EMT	Spiked Blank	Reactive Silica (SiO2)	2021/07/23		104	%	80 - 120
7477136	EMT	Method Blank	Reactive Silica (SiO2)	2021/07/22	ND, RDL=0.50		mg/L	
7477136	EMT	RPD	Reactive Silica (SiO2)	2021/07/22	1.9		%	20
7477142	EMT	Spiked Blank	Colour	2021/07/23		92	%	80 - 120
7477142	EMT	Method Blank	Colour	2021/07/23	ND, RDL=5.0		TCU	
7477142	EMT	RPD	Colour	2021/07/23	NC		%	20
7477143	EMT	Matrix Spike	Orthophosphate (P)	2021/07/22		94	%	80 - 120
7477143	EMT	Spiked Blank	Orthophosphate (P)	2021/07/22		95	%	80 - 120
7477143	EMT	Method Blank	Orthophosphate (P)	2021/07/22	ND, RDL=0.010		mg/L	
7477143	EMT	RPD	Orthophosphate (P)	2021/07/22	2.8		%	20
7477144	EMT	Matrix Spike	Nitrate + Nitrite (N)	2021/07/22		114	%	80 - 120
7477144	EMT	Spiked Blank	Nitrate + Nitrite (N)	2021/07/22		88	%	80 - 120
7477144	EMT	Method Blank	Nitrate + Nitrite (N)	2021/07/22	ND, RDL=0.050		mg/L	
7477144	EMT	RPD	Nitrate + Nitrite (N)	2021/07/22	1.4		%	20

Bureau Veritas Laboratories 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7477145	EMT	Matrix Spike	Nitrite (N)	2021/07/22		117	%	80 - 120
7477145	EMT	Spiked Blank	Nitrite (N)	2021/07/22		115	%	80 - 120
7477145	EMT	Method Blank	Nitrite (N)	2021/07/22	ND, RDL=0.010		mg/L	
7477145	EMT	RPD	Nitrite (N)	2021/07/22	NC		%	20
7477393	EMT	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2021/07/22		95	%	80 - 120
7477393	EMT	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2021/07/22		104	%	80 - 120
7477393	EMT	Method Blank	Nitrogen (Ammonia Nitrogen)	2021/07/22	ND, RDL=0.050		mg/L	
7477393	EMT	RPD	Nitrogen (Ammonia Nitrogen)	2021/07/22	NC		%	20
7479624	NGI	Matrix Spike	Total Organic Carbon (C)	2021/07/26		NC	%	85 - 115
7479624	NGI	Spiked Blank	Total Organic Carbon (C)	2021/07/26		98	%	80 - 120
7479624	NGI	Method Blank	Total Organic Carbon (C)	2021/07/26	ND, RDL=0.50		mg/L	
7479624	NGI	RPD	Total Organic Carbon (C)	2021/07/26	0.047		%	15

N/A = Not Applicable

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) Poor spike recovery due to sample matrix

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Mike MacGillivray, Scientific Specialist (Inorganics)

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 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

Your C.O.C. #: D52446

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/04/22
Report #: R6604951
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1A0569
Received: 2021/04/15, 16:58

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	1	N/A	2021/04/21	N/A	SM 23 4500-CO2 D
Alkalinity	1	N/A	2021/04/21	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	1	N/A	2021/04/20	ATL SOP 00014	SM 23 4500-Cl- E m
TC/EC Non Drinking Water CFU/100mL	1	N/A	2021/04/16	ATL SOP 00096	MOE E3407 R2
Colour	1	N/A	2021/04/20	ATL SOP 00020	SM 23 2120C m
Conductance - water	1	N/A	2021/04/21	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	1	N/A	2021/04/20	ATL SOP 00048	Auto Calc
Metals Water Total MS	1	2021/04/16	2021/04/19	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	1	N/A	2021/04/22	N/A	Auto Calc.
Anion and Cation Sum	1	N/A	2021/04/22	N/A	Auto Calc.
Nitrogen Ammonia - water	1	N/A	2021/04/21	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2021/04/20	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2021/04/20	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2021/04/21	ATL SOP 00018	ASTM D3867-16
pH (1)	1	N/A	2021/04/21	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	1	N/A	2021/04/20	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2021/04/22	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	1	N/A	2021/04/22	ATL SOP 00049	Auto Calc.
Reactive Silica	1	N/A	2021/04/20	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2021/04/20	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	1	N/A	2021/04/22	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	1	N/A	2021/04/16	ATL SOP 00203	SM 23 5310B m
Turbidity	1	N/A	2021/04/16	ATL SOP 00011	EPA 180.1 R2 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas 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 Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

Your C.O.C. #: D52446

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/04/22
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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1A0569
Received: 2021/04/15, 16:58

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, 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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas
22 Apr 2021 10:50:33

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bureauveritas.com
Phone# (902)420-0203 Ext:252
==
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.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				PIH931		
Sampling Date				2021/04/15 12:30		
COC Number				D52446		
	UNITS	**MAC**	**AO**	**WINTER 2020 LINE**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	-	-	510	N/A	7302277
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	92	1.0	7302273
Calculated TDS	mg/L	-	500	29000	1.0	7302281
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	7302273
Cation Sum	me/L	-	-	485	N/A	7302277
Hardness (CaCO3)	mg/L	-	-	5300	1.0	7302275
Ion Balance (% Difference)	%	-	-	2.45	N/A	7302276
Langelier Index (@ 20C)	N/A	-	-	0.528		7302279
Langelier Index (@ 4C)	N/A	-	-	0.290		7302280
Nitrate (N)	mg/L	**10**	-	ND	0.050	7302278
Saturation pH (@ 20C)	N/A	-	-	7.34		7302279
Saturation pH (@ 4C)	N/A	-	-	7.58		7302280
Inorganics						
Total Alkalinity (Total as CaCO3)	mg/L	-	-	92	5.0	7307221
Dissolved Chloride (Cl-)	mg/L	-	250	16000	500	7307222
Colour	TCU	-	15	ND	5.0	7307225
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.050	7307227
Nitrite (N)	mg/L	**1**	-	ND	0.010	7307228

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

N/A = Not Applicable

ND = Not detected

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				PIH931		
Sampling Date				2021/04/15 12:30		
COC Number				D52446		
	UNITS	**MAC**	**AO**	**WINTER 2020 LINE**	**RDL**	**QC Batch**
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	ND	0.050	7309952
Total Organic Carbon (C)	mg/L	-	-	1.7	0.50	7302678
Orthophosphate (P)	mg/L	-	-	ND	0.010	7307226
pH	pH	-	7.0 : 10.5	7.87		7309724
Reactive Silica (SiO2)	mg/L	-	-	0.50	0.50	7307224
Dissolved Sulphate (SO4)	mg/L	-	500	2200	100	7307223
Turbidity	NTU	-	0.3	2.8	0.10	7302788
Conductivity	uS/cm	-	-	44000	1.0	7309720
Metals						
Total Aluminum (Al)	ug/L	**2900**	100	91	50	7302556
Total Antimony (Sb)	ug/L	**6**	-	**ND (1)**	10	7302556
Total Arsenic (As)	ug/L	**10**	-	ND	10	7302556
Total Barium (Ba)	ug/L	**2000**	-	ND	10	7302556
Total Beryllium (Be)	ug/L	-	-	ND	10	7302556
Total Bismuth (Bi)	ug/L	-	-	ND	20	7302556
Total Boron (B)	ug/L	**5000**	-	3700	500	7302556
Total Cadmium (Cd)	ug/L	**7**	-	ND	0.10	7302556
Total Calcium (Ca)	ug/L	-	-	350000	1000	7302556
Total Chromium (Cr)	ug/L	**50**	-	ND	10	7302556

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

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AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

(1) RDL exceeds criteria

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				PIH931		
Sampling Date				2021/04/15 12:30		
COC Number				D52446		
	UNITS	**MAC**	**AO**	**WINTER 2020 LINE**	**RDL**	**QC Batch**
Total Cobalt (Co)	ug/L	-	-	ND	4.0	7302556
Total Copper (Cu)	ug/L	**2000**	1000	19	5.0	7302556
Total Iron (Fe)	ug/L	-	300	**ND (1)**	500	7302556
Total Lead (Pb)	ug/L	**5**	-	ND	5.0	7302556
Total Magnesium (Mg)	ug/L	-	-	1100000	10000	7302556
Total Manganese (Mn)	ug/L	**120**	20	ND	20	7302556
Total Molybdenum (Mo)	ug/L	-	-	ND	20	7302556
Total Nickel (Ni)	ug/L	-	-	ND	20	7302556
Total Phosphorus (P)	ug/L	-	-	ND	1000	7302556
Total Potassium (K)	ug/L	-	-	320000	1000	7302556
Total Selenium (Se)	ug/L	**50**	-	ND	5.0	7302556
Total Silver (Ag)	ug/L	-	-	ND	1.0	7302556
Total Sodium (Na)	ug/L	-	200000	8500000	10000	7302556
Total Strontium (Sr)	ug/L	**7000**	-	6300	20	7302556
Total Thallium (Tl)	ug/L	-	-	ND	1.0	7302556
Total Tin (Sn)	ug/L	-	-	ND	20	7302556
Total Titanium (Ti)	ug/L	-	-	ND	20	7302556
Total Uranium (U)	ug/L	**20**	-	2.8	1.0	7302556
Total Vanadium (V)	ug/L	-	-	ND	20	7302556

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

(1) RDL exceeds criteria

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				PIH931		
Sampling Date				2021/04/15 12:30		
COC Number				D52446		
	UNITS	**MAC**	**AO**	**WINTER 2020 LINE**	**RDL**	**QC Batch**
Total Zinc (Zn)	ug/L	-	5000	ND	50	7302556

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

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AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

MICROBIOLOGY (WATER)

BV Labs ID			PIH931		
Sampling Date			2021/04/15 12:30		
COC Number			D52446		
	UNITS	MAC	WINTER 2020 LINE	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	**0:0**	ND	1.0	7302539
Total Coliforms	CFU/100mL	**0:0**	ND	1.0	7302539

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.7°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7302539	MAA	Method Blank	Escherichia coli	2021/04/16	ND, RDL=1.0		CFU/100mL	
			Total Coliforms	2021/04/16	ND, RDL=1.0		CFU/100mL	
7302556	MLB	Matrix Spike	Total Aluminum (Al)	2021/04/19		100	%	80 - 120
			Total Antimony (Sb)	2021/04/19		103	%	80 - 120
			Total Arsenic (As)	2021/04/19		95	%	80 - 120
			Total Barium (Ba)	2021/04/19		NC	%	80 - 120
			Total Beryllium (Be)	2021/04/19		92	%	80 - 120
			Total Bismuth (Bi)	2021/04/19		95	%	80 - 120
			Total Boron (B)	2021/04/19		89	%	80 - 120
			Total Cadmium (Cd)	2021/04/19		100	%	80 - 120
			Total Calcium (Ca)	2021/04/19		NC	%	80 - 120
			Total Chromium (Cr)	2021/04/19		92	%	80 - 120
			Total Cobalt (Co)	2021/04/19		93	%	80 - 120
			Total Copper (Cu)	2021/04/19		NC	%	80 - 120
			Total Iron (Fe)	2021/04/19		100	%	80 - 120
			Total Lead (Pb)	2021/04/19		94	%	80 - 120
			Total Magnesium (Mg)	2021/04/19		95	%	80 - 120
			Total Manganese (Mn)	2021/04/19		NC	%	80 - 120
			Total Molybdenum (Mo)	2021/04/19		104	%	80 - 120
			Total Nickel (Ni)	2021/04/19		94	%	80 - 120
			Total Phosphorus (P)	2021/04/19		101	%	80 - 120
			Total Potassium (K)	2021/04/19		101	%	80 - 120
			Total Selenium (Se)	2021/04/19		98	%	80 - 120
			Total Silver (Ag)	2021/04/19		98	%	80 - 120
			Total Sodium (Na)	2021/04/19		94	%	80 - 120
			Total Strontium (Sr)	2021/04/19		NC	%	80 - 120
			Total Thallium (Tl)	2021/04/19		97	%	80 - 120
			Total Tin (Sn)	2021/04/19		102	%	80 - 120
			Total Titanium (Ti)	2021/04/19		98	%	80 - 120
			Total Uranium (U)	2021/04/19		101	%	80 - 120
			Total Vanadium (V)	2021/04/19		92	%	80 - 120
			Total Zinc (Zn)	2021/04/19		94	%	80 - 120
7302556	MLB	Spiked Blank	Total Aluminum (Al)	2021/04/17		105	%	80 - 120
			Total Antimony (Sb)	2021/04/17		102	%	80 - 120
			Total Arsenic (As)	2021/04/17		94	%	80 - 120
			Total Barium (Ba)	2021/04/17		93	%	80 - 120
			Total Beryllium (Be)	2021/04/17		91	%	80 - 120
			Total Bismuth (Bi)	2021/04/17		98	%	80 - 120
			Total Boron (B)	2021/04/17		94	%	80 - 120
			Total Cadmium (Cd)	2021/04/17		94	%	80 - 120
			Total Calcium (Ca)	2021/04/17		97	%	80 - 120
			Total Chromium (Cr)	2021/04/17		95	%	80 - 120
			Total Cobalt (Co)	2021/04/17		96	%	80 - 120
			Total Copper (Cu)	2021/04/17		96	%	80 - 120
			Total Iron (Fe)	2021/04/17		102	%	80 - 120
			Total Lead (Pb)	2021/04/17		97	%	80 - 120
			Total Magnesium (Mg)	2021/04/17		103	%	80 - 120
			Total Manganese (Mn)	2021/04/17		100	%	80 - 120
			Total Molybdenum (Mo)	2021/04/17		102	%	80 - 120
			Total Nickel (Ni)	2021/04/17		98	%	80 - 120
			Total Phosphorus (P)	2021/04/17		102	%	80 - 120
			Total Potassium (K)	2021/04/17		104	%	80 - 120
			Total Selenium (Se)	2021/04/17		96	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2021/04/17		95	%	80 - 120
			Total Sodium (Na)	2021/04/17		99	%	80 - 120
			Total Strontium (Sr)	2021/04/17		101	%	80 - 120
			Total Thallium (Tl)	2021/04/17		98	%	80 - 120
			Total Tin (Sn)	2021/04/17		101	%	80 - 120
			Total Titanium (Ti)	2021/04/17		100	%	80 - 120
			Total Uranium (U)	2021/04/17		102	%	80 - 120
			Total Vanadium (V)	2021/04/17		93	%	80 - 120
			Total Zinc (Zn)	2021/04/17		97	%	80 - 120
7302556	MLB	Method Blank	Total Aluminum (Al)	2021/04/17	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2021/04/17	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2021/04/17	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2021/04/17	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2021/04/17	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Boron (B)	2021/04/17	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2021/04/17	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2021/04/17	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2021/04/17	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2021/04/17	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2021/04/17	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2021/04/17	ND, RDL=50		ug/L	
			Total Lead (Pb)	2021/04/17	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2021/04/17	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2021/04/17	ND, RDL=100		ug/L	
			Total Potassium (K)	2021/04/17	ND, RDL=100		ug/L	
			Total Selenium (Se)	2021/04/17	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2021/04/17	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2021/04/17	ND, RDL=100		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Strontium (Sr)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2021/04/17	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2021/04/17	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2021/04/17	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2021/04/17	ND, RDL=5.0		ug/L	
7302556	MLB	RPD	Total Aluminum (Al)	2021/04/17	NC		%	20
			Total Antimony (Sb)	2021/04/17	NC		%	20
			Total Arsenic (As)	2021/04/17	NC		%	20
			Total Barium (Ba)	2021/04/17	1.4		%	20
			Total Beryllium (Be)	2021/04/17	NC		%	20
			Total Bismuth (Bi)	2021/04/17	NC		%	20
			Total Boron (B)	2021/04/17	NC		%	20
			Total Cadmium (Cd)	2021/04/17	NC		%	20
			Total Calcium (Ca)	2021/04/17	0.90		%	20
			Total Chromium (Cr)	2021/04/17	NC		%	20
			Total Cobalt (Co)	2021/04/17	NC		%	20
			Total Copper (Cu)	2021/04/17	3.9		%	20
			Total Iron (Fe)	2021/04/17	1.6		%	20
			Total Lead (Pb)	2021/04/17	1.1		%	20
			Total Magnesium (Mg)	2021/04/17	0.82		%	20
			Total Manganese (Mn)	2021/04/17	2.1		%	20
			Total Molybdenum (Mo)	2021/04/17	NC		%	20
			Total Nickel (Ni)	2021/04/17	NC		%	20
			Total Phosphorus (P)	2021/04/17	NC		%	20
			Total Potassium (K)	2021/04/17	5.0		%	20
			Total Selenium (Se)	2021/04/17	NC		%	20
			Total Silver (Ag)	2021/04/17	NC		%	20
			Total Sodium (Na)	2021/04/17	0.79		%	20
			Total Strontium (Sr)	2021/04/17	1.4		%	20
			Total Thallium (Tl)	2021/04/17	NC		%	20
			Total Tin (Sn)	2021/04/17	NC		%	20
			Total Titanium (Ti)	2021/04/17	NC		%	20
			Total Uranium (U)	2021/04/17	NC		%	20
			Total Vanadium (V)	2021/04/17	NC		%	20
			Total Zinc (Zn)	2021/04/17	5.3		%	20
7302678	YLG	Matrix Spike	Total Organic Carbon (C)	2021/04/16		NC	%	85 - 115
7302678	YLG	Spiked Blank	Total Organic Carbon (C)	2021/04/16		99	%	80 - 120
7302678	YLG	Method Blank	Total Organic Carbon (C)	2021/04/16	ND, RDL=0.50		mg/L	
7302678	YLG	RPD	Total Organic Carbon (C)	2021/04/16	0.88		%	15
7302788	SHW	QC Standard	Turbidity	2021/04/16		103	%	80 - 120
7302788	SHW	Spiked Blank	Turbidity	2021/04/16		100	%	80 - 120
7302788	SHW	Method Blank	Turbidity	2021/04/16	ND, RDL=0.10		NTU	
7302788	SHW	RPD	Turbidity	2021/04/16	2.3		%	20
7307221	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2021/04/20		101	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7307221	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2021/04/20		106	%	80 - 120
7307221	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2021/04/20	ND, RDL=5.0		mg/L	
7307221	MCN	RPD	Total Alkalinity (Total as CaCO3)	2021/04/20	NC		%	20
7307222	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2021/04/20		102	%	80 - 120
7307222	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2021/04/20		101	%	80 - 120
7307222	MCN	Method Blank	Dissolved Chloride (Cl-)	2021/04/20	ND, RDL=1.0		mg/L	
7307222	MCN	RPD	Dissolved Chloride (Cl-)	2021/04/20	NC		%	20
7307223	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2021/04/20		112	%	80 - 120
7307223	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2021/04/20		111	%	80 - 120
7307223	MCN	Method Blank	Dissolved Sulphate (SO4)	2021/04/20	ND, RDL=2.0		mg/L	
7307223	MCN	RPD	Dissolved Sulphate (SO4)	2021/04/20	NC		%	20
7307224	MCN	Matrix Spike	Reactive Silica (SiO2)	2021/04/20		92	%	80 - 120
7307224	MCN	Spiked Blank	Reactive Silica (SiO2)	2021/04/20		99	%	80 - 120
7307224	MCN	Method Blank	Reactive Silica (SiO2)	2021/04/20	ND, RDL=0.50		mg/L	
7307224	MCN	RPD	Reactive Silica (SiO2)	2021/04/20	NC		%	20
7307225	MCN	Spiked Blank	Colour	2021/04/20		103	%	80 - 120
7307225	MCN	Method Blank	Colour	2021/04/20	ND, RDL=5.0		TCU	
7307225	MCN	RPD	Colour	2021/04/20	NC		%	20
7307226	MCN	Matrix Spike	Orthophosphate (P)	2021/04/20		96	%	80 - 120
7307226	MCN	Spiked Blank	Orthophosphate (P)	2021/04/20		93	%	80 - 120
7307226	MCN	Method Blank	Orthophosphate (P)	2021/04/20	ND, RDL=0.010		mg/L	
7307226	MCN	RPD	Orthophosphate (P)	2021/04/20	NC		%	20
7307227	MCN	Matrix Spike	Nitrate + Nitrite (N)	2021/04/20		96	%	80 - 120
7307227	MCN	Spiked Blank	Nitrate + Nitrite (N)	2021/04/20		100	%	80 - 120
7307227	MCN	Method Blank	Nitrate + Nitrite (N)	2021/04/20	ND, RDL=0.050		mg/L	
7307227	MCN	RPD	Nitrate + Nitrite (N)	2021/04/20	NC		%	20
7307228	MCN	Matrix Spike	Nitrite (N)	2021/04/20		101	%	80 - 120
7307228	MCN	Spiked Blank	Nitrite (N)	2021/04/20		103	%	80 - 120
7307228	MCN	Method Blank	Nitrite (N)	2021/04/20	ND, RDL=0.010		mg/L	
7307228	MCN	RPD	Nitrite (N)	2021/04/20	NC		%	20
7309720	SHW	Spiked Blank	Conductivity	2021/04/21		99	%	80 - 120
7309720	SHW	Method Blank	Conductivity	2021/04/21	1.2, RDL=1.0		uS/cm	
7309720	SHW	RPD	Conductivity	2021/04/21	4.2		%	10
7309724	SHW	Spiked Blank	pH	2021/04/21		100	%	97 - 103
7309724	SHW	RPD	pH	2021/04/21	0.71		%	N/A
7309952	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2021/04/21		99	%	80 - 120
7309952	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2021/04/21		101	%	80 - 120
7309952	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2021/04/21	ND, RDL=0.050		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7309952	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2021/04/21	NC		%	20

N/A = Not Applicable

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).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Mike MacGillivray, Scientific Specialist (Inorganics)

Robyn Edwards, Bedford Micro Supervisor

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.

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Your C.O.C. #: D53583

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/11/10
Report #: R6894853
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1V3800
Received: 2021/10/27, 09:17

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	1	N/A	2021/11/08	N/A	SM 23 4500-CO2 D
Alkalinity	1	N/A	2021/11/08	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	1	N/A	2021/11/08	ATL SOP 00014	SM 23 4500-Cl- E m
TC/EC Non Drinking Water CFU/100mL	1	N/A	2021/10/27	ATL SOP 00096	MOE E3407 R2
Colour	1	N/A	2021/11/09	ATL SOP 00020	SM 23 2120C m
Conductance - water	1	N/A	2021/11/09	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	1	N/A	2021/11/01	ATL SOP 00048	Auto Calc
Metals Water Total MS	1	2021/10/28	2021/10/29	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	1	N/A	2021/11/09	N/A	Auto Calc.
Anion and Cation Sum	1	N/A	2021/11/08	N/A	Auto Calc.
Nitrogen Ammonia - water	1	N/A	2021/11/02	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2021/11/08	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2021/11/08	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2021/11/09	ATL SOP 00018	ASTM D3867-16
pH (1)	1	N/A	2021/11/09	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	1	N/A	2021/11/08	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2021/11/09	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	1	N/A	2021/11/09	ATL SOP 00049	Auto Calc.
Reactive Silica	1	N/A	2021/11/08	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2021/11/08	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	1	N/A	2021/11/09	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	1	N/A	2021/11/01	ATL SOP 00203	SM 23 5310B m
Turbidity	1	N/A	2021/11/09	ATL SOP 00011	EPA 180.1 R2 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas 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 Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

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Your C.O.C. #: D53583

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2021/11/10
Report #: R6894853
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1V3800

Received: 2021/10/27, 09:17

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, 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.

(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas
10 Nov 2021 11:32:52

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bureauveritas.com
Phone# (902)420-0203 Ext:252

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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.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Bureau Veritas ID		RBC359		
Sampling Date		2021/10/26 11:14		
COC Number		D53583		
	UNITS	WINTER 2021	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	476	N/A	7686255
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	160	1.0	7686251
Calculated TDS	mg/L	29000	1.0	7686260
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	7686251
Cation Sum	me/L	536	N/A	7686255
Hardness (CaCO3)	mg/L	5400	1.0	7663023
Ion Balance (% Difference)	%	5.94	N/A	7686254
Langelier Index (@ 20C)	N/A	0.117		7686258
Langelier Index (@ 4C)	N/A	-0.122		7686259
Nitrate (N)	mg/L	ND	0.050	7686256
Saturation pH (@ 20C)	N/A	7.07		7686258
Saturation pH (@ 4C)	N/A	7.31		7686259
Inorganics				
Total Alkalinity (Total as CaCO3)	mg/L	160	25	7686152
Dissolved Chloride (Cl-)	mg/L	15000	500	7686158
Colour	TCU	6.2	5.0	7688588
Nitrate + Nitrite (N)	mg/L	ND	0.050	7686169
Nitrite (N)	mg/L	ND	0.010	7686171
Nitrogen (Ammonia Nitrogen)	mg/L	0.44	0.050	7674424
Total Organic Carbon (C)	mg/L	ND (1)	5.0	7668461
Orthophosphate (P)	mg/L	0.64	0.010	7686165
pH	pH	7.18		7688560
Reactive Silica (SiO2)	mg/L	ND	0.50	7686161
Dissolved Sulphate (SO4)	mg/L	2400	100	7686160
Turbidity	NTU	21	0.10	7688648
Conductivity	uS/cm	46000	1.0	7688559
Metals				
Total Aluminum (Al)	ug/L	ND	50	7665593
Total Antimony (Sb)	ug/L	ND	10	7665593
Total Arsenic (As)	ug/L	ND	10	7665593
Total Barium (Ba)	ug/L	ND	10	7665593
Total Beryllium (Be)	ug/L	ND	1.0	7665593
Total Bismuth (Bi)	ug/L	ND	20	7665593
Total Boron (B)	ug/L	4200	500	7665593

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
N/A = Not Applicable
(1) Elevated reporting limit due to sample matrix.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Bureau Veritas ID		RBC359		
Sampling Date		2021/10/26 11:14		
COC Number		D53583		
	UNITS	**WINTER 2021**	**RDL**	**QC Batch**
Total Cadmium (Cd)	ug/L	0.13	0.10	7665593
Total Calcium (Ca)	ug/L	360000	1000	7665593
Total Chromium (Cr)	ug/L	ND	10	7665593
Total Cobalt (Co)	ug/L	ND	4.0	7665593
Total Copper (Cu)	ug/L	ND	5.0	7665593
Total Iron (Fe)	ug/L	ND	500	7665593
Total Lead (Pb)	ug/L	ND	5.0	7665593
Total Magnesium (Mg)	ug/L	1100000	10000	7665593
Total Manganese (Mn)	ug/L	ND	20	7665593
Total Molybdenum (Mo)	ug/L	ND	20	7665593
Total Nickel (Ni)	ug/L	ND	20	7665593
Total Phosphorus (P)	ug/L	ND	1000	7665593
Total Potassium (K)	ug/L	340000	1000	7665593
Total Selenium (Se)	ug/L	ND	5.0	7665593
Total Silver (Ag)	ug/L	ND	1.0	7665593
Total Sodium (Na)	ug/L	9600000	1000	7665593
Total Strontium (Sr)	ug/L	6800	20	7665593
Total Thallium (Tl)	ug/L	ND	1.0	7665593
Total Tin (Sn)	ug/L	ND	20	7665593
Total Titanium (Ti)	ug/L	ND	20	7665593
Total Uranium (U)	ug/L	2.6	1.0	7665593
Total Vanadium (V)	ug/L	ND	20	7665593
Total Zinc (Zn)	ug/L	ND	50	7665593

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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MICROBIOLOGY (WATER)

Bureau Veritas ID		RBC359		
Sampling Date		2021/10/26 11:14		
COC Number		D53583		
	UNITS	WINTER 2021	RDL	QC Batch
Microbiological				
Escherichia coli	CFU/100mL	ND	1.0	7663148
Total Coliforms	CFU/100mL	6.0	1.0	7663148

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	4.0°C

Sample RBC359 [WINTER 2021] : Elevated reporting limits for trace metals due to sample matrix.
Background growth observed on Coliform/E.coli plate ortho-Phosphate > Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Poor RCAp Ion Balance due to sample matrix.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7663148	JWA	Method Blank	Escherichia coli	2021/10/27	ND, RDL=1.0		CFU/100mL	
			Total Coliforms	2021/10/27	ND, RDL=1.0		CFU/100mL	
7665593	MLB	Matrix Spike	Total Aluminum (Al)	2021/10/29		102	%	80 - 120
			Total Antimony (Sb)	2021/10/29		110	%	80 - 120
			Total Arsenic (As)	2021/10/29		98	%	80 - 120
			Total Barium (Ba)	2021/10/29		98	%	80 - 120
			Total Beryllium (Be)	2021/10/29		107	%	80 - 120
			Total Bismuth (Bi)	2021/10/29		98	%	80 - 120
			Total Boron (B)	2021/10/29		104	%	80 - 120
			Total Cadmium (Cd)	2021/10/29		101	%	80 - 120
			Total Calcium (Ca)	2021/10/29		NC	%	80 - 120
			Total Chromium (Cr)	2021/10/29		102	%	80 - 120
			Total Cobalt (Co)	2021/10/29		NC	%	80 - 120
			Total Copper (Cu)	2021/10/29		94	%	80 - 120
			Total Iron (Fe)	2021/10/29		NC	%	80 - 120
			Total Lead (Pb)	2021/10/29		99	%	80 - 120
			Total Magnesium (Mg)	2021/10/29		NC	%	80 - 120
			Total Manganese (Mn)	2021/10/29		NC	%	80 - 120
			Total Molybdenum (Mo)	2021/10/29		114	%	80 - 120
			Total Nickel (Ni)	2021/10/29		NC	%	80 - 120
			Total Phosphorus (P)	2021/10/29		109	%	80 - 120
			Total Potassium (K)	2021/10/29		NC	%	80 - 120
			Total Selenium (Se)	2021/10/29		104	%	80 - 120
			Total Silver (Ag)	2021/10/29		100	%	80 - 120
			Total Sodium (Na)	2021/10/29		NC	%	80 - 120
			Total Strontium (Sr)	2021/10/29		NC	%	80 - 120
			Total Thallium (Tl)	2021/10/29		99	%	80 - 120
			Total Tin (Sn)	2021/10/29		108	%	80 - 120
			Total Titanium (Ti)	2021/10/29		105	%	80 - 120
			Total Uranium (U)	2021/10/29		106	%	80 - 120
			Total Vanadium (V)	2021/10/29		107	%	80 - 120
			Total Zinc (Zn)	2021/10/29		97	%	80 - 120
7665593	MLB	Spiked Blank	Total Aluminum (Al)	2021/10/28		104	%	80 - 120
			Total Antimony (Sb)	2021/10/28		102	%	80 - 120
			Total Arsenic (As)	2021/10/28		95	%	80 - 120
			Total Barium (Ba)	2021/10/28		97	%	80 - 120
			Total Beryllium (Be)	2021/10/28		98	%	80 - 120
			Total Bismuth (Bi)	2021/10/28		99	%	80 - 120
			Total Boron (B)	2021/10/28		98	%	80 - 120
			Total Cadmium (Cd)	2021/10/28		97	%	80 - 120
			Total Calcium (Ca)	2021/10/28		103	%	80 - 120
			Total Chromium (Cr)	2021/10/28		100	%	80 - 120
			Total Cobalt (Co)	2021/10/28		101	%	80 - 120
			Total Copper (Cu)	2021/10/28		101	%	80 - 120
			Total Iron (Fe)	2021/10/28		107	%	80 - 120
			Total Lead (Pb)	2021/10/28		98	%	80 - 120
			Total Magnesium (Mg)	2021/10/28		108	%	80 - 120
			Total Manganese (Mn)	2021/10/28		100	%	80 - 120
			Total Molybdenum (Mo)	2021/10/28		103	%	80 - 120
			Total Nickel (Ni)	2021/10/28		103	%	80 - 120
			Total Phosphorus (P)	2021/10/28		107	%	80 - 120
			Total Potassium (K)	2021/10/28		107	%	80 - 120
			Total Selenium (Se)	2021/10/28		100	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2021/10/28		98	%	80 - 120
			Total Sodium (Na)	2021/10/28		105	%	80 - 120
			Total Strontium (Sr)	2021/10/28		100	%	80 - 120
			Total Thallium (Tl)	2021/10/28		99	%	80 - 120
			Total Tin (Sn)	2021/10/28		99	%	80 - 120
			Total Titanium (Ti)	2021/10/28		101	%	80 - 120
			Total Uranium (U)	2021/10/28		102	%	80 - 120
			Total Vanadium (V)	2021/10/28		101	%	80 - 120
			Total Zinc (Zn)	2021/10/28		102	%	80 - 120
7665593	MLB	Method Blank	Total Aluminum (Al)	2021/10/28	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2021/10/28	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2021/10/28	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2021/10/28	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2021/10/28	ND, RDL=0.10		ug/L	
			Total Bismuth (Bi)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Boron (B)	2021/10/28	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2021/10/28	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2021/10/28	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2021/10/28	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2021/10/28	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2021/10/28	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2021/10/28	ND, RDL=50		ug/L	
			Total Lead (Pb)	2021/10/28	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2021/10/28	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2021/10/28	ND, RDL=100		ug/L	
			Total Potassium (K)	2021/10/28	ND, RDL=100		ug/L	
			Total Selenium (Se)	2021/10/28	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2021/10/28	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2021/10/28	ND, RDL=100		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Strontium (Sr)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2021/10/28	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2021/10/28	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2021/10/28	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2021/10/28	ND, RDL=5.0		ug/L	
7665593	MLB	RPD	Total Aluminum (Al)	2021/10/28	1.2		%	20
			Total Antimony (Sb)	2021/10/28	NC		%	20
			Total Arsenic (As)	2021/10/28	NC		%	20
			Total Barium (Ba)	2021/10/28	1.3		%	20
			Total Beryllium (Be)	2021/10/28	2.4		%	20
			Total Bismuth (Bi)	2021/10/28	NC		%	20
			Total Boron (B)	2021/10/28	NC		%	20
			Total Cadmium (Cd)	2021/10/28	3.9		%	20
			Total Calcium (Ca)	2021/10/28	0.24		%	20
			Total Chromium (Cr)	2021/10/28	NC		%	20
			Total Cobalt (Co)	2021/10/28	1.8		%	20
			Total Copper (Cu)	2021/10/28	3.2		%	20
			Total Iron (Fe)	2021/10/28	4.4		%	20
			Total Lead (Pb)	2021/10/28	3.4		%	20
			Total Magnesium (Mg)	2021/10/28	1.2		%	20
			Total Manganese (Mn)	2021/10/28	1.9		%	20
			Total Molybdenum (Mo)	2021/10/28	NC		%	20
			Total Nickel (Ni)	2021/10/28	1.9		%	20
			Total Phosphorus (P)	2021/10/28	NC		%	20
			Total Potassium (K)	2021/10/28	0.76		%	20
			Total Selenium (Se)	2021/10/28	NC		%	20
			Total Silver (Ag)	2021/10/28	NC		%	20
			Total Sodium (Na)	2021/10/28	2.1		%	20
			Total Strontium (Sr)	2021/10/28	1.6		%	20
			Total Thallium (Tl)	2021/10/28	NC		%	20
			Total Tin (Sn)	2021/10/28	NC		%	20
			Total Titanium (Ti)	2021/10/28	NC		%	20
			Total Uranium (U)	2021/10/28	0.58		%	20
			Total Vanadium (V)	2021/10/28	NC		%	20
			Total Zinc (Zn)	2021/10/28	0.81		%	20
7668461	NGI	Matrix Spike	Total Organic Carbon (C)	2021/11/01		91	%	85 - 115
7668461	NGI	Spiked Blank	Total Organic Carbon (C)	2021/11/01		98	%	80 - 120
7668461	NGI	Method Blank	Total Organic Carbon (C)	2021/11/01	ND, RDL=0.50		mg/L	
7668461	NGI	RPD	Total Organic Carbon (C)	2021/11/01	0.80		%	15
7674424	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2021/11/02		103	%	80 - 120
7674424	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2021/11/03		109	%	80 - 120
7674424	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2021/11/03	ND, RDL=0.050		mg/L	
7674424	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2021/11/02	NC		%	20
7686152	EMT	Matrix Spike	Total Alkalinity (Total as CaCO3)	2021/11/08		NC	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7686152	EMT	Spiked Blank	Total Alkalinity (Total as CaCO3)	2021/11/08		112	%	80 - 120
7686152	EMT	Method Blank	Total Alkalinity (Total as CaCO3)	2021/11/08	ND, RDL=5.0		mg/L	
7686152	EMT	RPD	Total Alkalinity (Total as CaCO3)	2021/11/08	8.8		%	20
7686158	EMT	Matrix Spike	Dissolved Chloride (Cl-)	2021/11/08		96	%	80 - 120
7686158	EMT	Spiked Blank	Dissolved Chloride (Cl-)	2021/11/08		97	%	80 - 120
7686158	EMT	Method Blank	Dissolved Chloride (Cl-)	2021/11/08	ND, RDL=1.0		mg/L	
7686158	EMT	RPD	Dissolved Chloride (Cl-)	2021/11/08	0.31		%	20
7686160	EMT	Matrix Spike	Dissolved Sulphate (SO4)	2021/11/08		96	%	80 - 120
7686160	EMT	Spiked Blank	Dissolved Sulphate (SO4)	2021/11/08		98	%	80 - 120
7686160	EMT	Method Blank	Dissolved Sulphate (SO4)	2021/11/08	ND, RDL=2.0		mg/L	
7686160	EMT	RPD	Dissolved Sulphate (SO4)	2021/11/08	2.0		%	20
7686161	EMT	Matrix Spike	Reactive Silica (SiO2)	2021/11/08		92	%	80 - 120
7686161	EMT	Spiked Blank	Reactive Silica (SiO2)	2021/11/08		97	%	80 - 120
7686161	EMT	Method Blank	Reactive Silica (SiO2)	2021/11/08	ND, RDL=0.50		mg/L	
7686161	EMT	RPD	Reactive Silica (SiO2)	2021/11/08	0.098		%	20
7686165	EMT	Matrix Spike	Orthophosphate (P)	2021/11/08		90	%	80 - 120
7686165	EMT	Spiked Blank	Orthophosphate (P)	2021/11/08		99	%	80 - 120
7686165	EMT	Method Blank	Orthophosphate (P)	2021/11/08	ND, RDL=0.010		mg/L	
7686165	EMT	RPD	Orthophosphate (P)	2021/11/08	5.8		%	20
7686169	EMT	Matrix Spike	Nitrate + Nitrite (N)	2021/11/08		94	%	80 - 120
7686169	EMT	Spiked Blank	Nitrate + Nitrite (N)	2021/11/08		95	%	80 - 120
7686169	EMT	Method Blank	Nitrate + Nitrite (N)	2021/11/08	ND, RDL=0.050		mg/L	
7686169	EMT	RPD	Nitrate + Nitrite (N)	2021/11/08	NC		%	20
7686171	EMT	Matrix Spike	Nitrite (N)	2021/11/08		100	%	80 - 120
7686171	EMT	Spiked Blank	Nitrite (N)	2021/11/08		105	%	80 - 120
7686171	EMT	Method Blank	Nitrite (N)	2021/11/08	ND, RDL=0.010		mg/L	
7686171	EMT	RPD	Nitrite (N)	2021/11/08	NC		%	20
7688559	SHW	Spiked Blank	Conductivity	2021/11/09		100	%	80 - 120
7688559	SHW	Method Blank	Conductivity	2021/11/09	1.2, RDL=1.0		uS/cm	
7688559	SHW	RPD	Conductivity	2021/11/09	1.0		%	10
7688560	SHW	Spiked Blank	pH	2021/11/09		101	%	97 - 103
7688560	SHW	RPD	pH	2021/11/09	0.29		%	N/A
7688588	EMT	Spiked Blank	Colour	2021/11/09		102	%	80 - 120
7688588	EMT	Method Blank	Colour	2021/11/09	ND, RDL=5.0		TCU	
7688588	EMT	RPD	Colour	2021/11/09	NC		%	20
7688648	SHW	QC Standard	Turbidity	2021/11/09		99	%	80 - 120
7688648	SHW	Spiked Blank	Turbidity	2021/11/09		102	%	80 - 120
7688648	SHW	Method Blank	Turbidity	2021/11/09	ND, RDL=0.10		NTU	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7688648	SHW	RPD	Turbidity	2021/11/09	14		%	20

N/A = Not Applicable

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).

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Mike MacGillivray, Scientific Specialist (Inorganics)

Robyn Edwards, Bedford Micro Supervisor

Bureau Veritas Proprietary Software
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Site#: .
Your C.O.C. #: 872521-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2022/06/29
Report #: R7190634
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2G7303
Received: 2022/06/17, 08:13

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	1	N/A	2022/06/22	N/A	SM 23 4500-CO2 D
Alkalinity	1	N/A	2022/06/22	ATL SOP 00142	SM 23 2320 B
Chloride	1	N/A	2022/06/23	ATL SOP 00014	SM 23 4500-Cl- E m
TC/EC Non Drinking Water CFU/100mL	1	N/A	2022/06/17	ATL SOP 00096	MOE E3407 R2
Colour	1	N/A	2022/06/23	ATL SOP 00020	SM 23 2120C m
Conductance - water	1	N/A	2022/06/22	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	1	N/A	2022/06/24	ATL SOP 00048	Auto Calc
Metals Water Total MS	1	2022/06/22	2022/06/23	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	1	N/A	2022/06/24	N/A	Auto Calc.
Anion and Cation Sum	1	N/A	2022/06/24	N/A	Auto Calc.
Nitrogen Ammonia - water	1	N/A	2022/06/22	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2022/06/23	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2022/06/23	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2022/06/23	ATL SOP 00018	ASTM D3867-16
pH (1)	1	N/A	2022/06/22	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	1	N/A	2022/06/23	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2022/06/24	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	1	N/A	2022/06/24	ATL SOP 00049	Auto Calc.
Reactive Silica	1	N/A	2022/06/23	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2022/06/23	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	1	N/A	2022/06/24	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	1	N/A	2022/06/28	ATL SOP 00203	SM 23 5310B m
Turbidity	1	N/A	2022/06/22	ATL SOP 00011	EPA 180.1 R2 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas 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 Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

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Site#: .
Your C.O.C. #: 872521-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2022/06/29
Report #: R7190634
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2G7303
Received: 2022/06/17, 08:13

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, 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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Tyler Travers
Project Manager Assistant
29 Jun 2022 17:00:16

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bureauveritas.com
Phone# (902)420-0203 Ext:252
==
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For Service Group specific validation please refer to the Validation Signature Page.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Bureau Veritas ID		SXT419		
Sampling Date		2022/06/16 15:51		
COC Number		872521-01-01		
	UNITS	SUMMER 2022	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	472	N/A	8058714
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	100	1.0	8058710
Calculated TDS	mg/L	28000	1.0	8058719
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	8058710
Cation Sum	me/L	485	N/A	8058714
Hardness (CaCO3)	mg/L	5000	1.0	8058712
Ion Balance (% Difference)	%	1.28	N/A	8058713
Langelier Index (@ 20C)	N/A	0.588		8058717
Langelier Index (@ 4C)	N/A	0.349		8058718
Nitrate (N)	mg/L	ND	0.050	8058715
Saturation pH (@ 20C)	N/A	7.31		8058717
Saturation pH (@ 4C)	N/A	7.55		8058718
Inorganics				
Total Alkalinity (Total as CaCO3)	mg/L	100	2.0	8065912
Dissolved Chloride (Cl-)	mg/L	15000	500	8069692
Colour	TCU	5.6	5.0	8069736
Nitrate + Nitrite (N)	mg/L	ND	0.050	8069738
Nitrite (N)	mg/L	0.010	0.010	8069739
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.050	8067157
Total Organic Carbon (C)	mg/L	2.0	0.50	8078862
Orthophosphate (P)	mg/L	0.010	0.010	8069737
pH	pH	7.90		8065900
Reactive Silica (SiO2)	mg/L	ND	0.50	8069735
Dissolved Sulphate (SO4)	mg/L	2100	200	8069734
Turbidity	NTU	0.23	0.10	8067171
Conductivity	uS/cm	46000	1.0	8065908
Metals				
Total Aluminum (Al)	ug/L	ND	50	8068358
Total Antimony (Sb)	ug/L	ND	10	8068358
Total Arsenic (As)	ug/L	ND	10	8068358
Total Barium (Ba)	ug/L	ND	10	8068358
Total Beryllium (Be)	ug/L	ND	1.0	8068358
Total Bismuth (Bi)	ug/L	ND	20	8068358
Total Boron (B)	ug/L	3900	500	8068358
Total Cadmium (Cd)	ug/L	ND	0.10	8068358

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.
N/A = Not Applicable

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

Bureau Veritas ID		SXT419		
Sampling Date		2022/06/16 15:51		
COC Number		872521-01-01		
	UNITS	SUMMER 2022	RDL	QC Batch
Total Calcium (Ca)	ug/L	340000	1000	8068358
Total Chromium (Cr)	ug/L	ND	10	8068358
Total Cobalt (Co)	ug/L	ND	4.0	8068358
Total Copper (Cu)	ug/L	ND	5.0	8068358
Total Iron (Fe)	ug/L	ND	500	8068358
Total Lead (Pb)	ug/L	ND	5.0	8068358
Total Magnesium (Mg)	ug/L	1000000	1000	8068358
Total Manganese (Mn)	ug/L	ND	20	8068358
Total Molybdenum (Mo)	ug/L	ND	20	8068358
Total Nickel (Ni)	ug/L	ND	20	8068358
Total Phosphorus (P)	ug/L	ND	1000	8068358
Total Potassium (K)	ug/L	310000	1000	8068358
Total Selenium (Se)	ug/L	ND	5.0	8068358
Total Silver (Ag)	ug/L	ND	1.0	8068358
Total Sodium (Na)	ug/L	8600000	1000	8068358
Total Strontium (Sr)	ug/L	6300	20	8068358
Total Thallium (Tl)	ug/L	ND	1.0	8068358
Total Tin (Sn)	ug/L	ND	20	8068358
Total Titanium (Ti)	ug/L	ND	20	8068358
Total Uranium (U)	ug/L	2.5	1.0	8068358
Total Vanadium (V)	ug/L	ND	20	8068358
Total Zinc (Zn)	ug/L	ND	50	8068358

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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MICROBIOLOGY (WATER)

Bureau Veritas ID		SXT419		
Sampling Date		2022/06/16 15:51		
COC Number		872521-01-01		
	UNITS	**SUMMER 2022**	**RDL**	**QC Batch**
Microbiological				
Escherichia coli	CFU/100mL	ND	1.0	8059364
Total Coliforms	CFU/100mL	5.0	1.0	8059364

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.0°C

Sample SXT419 [SUMMER 2022] : NOX < NO2 : Both values fall within the method uncertainty for duplicates and are likely equivalent.
Elevated reporting limits for trace metals due to sample matrix. ortho-Phosphate > Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8059364	MAA	Method Blank	Escherichia coli	2022/06/17	ND, RDL=1.0		CFU/100mL	
			Total Coliforms	2022/06/17	ND, RDL=1.0		CFU/100mL	
8065900	KMC	Spiked Blank	pH	2022/06/22		99	%	97 - 103
8065900	KMC	RPD	pH	2022/06/22	1.7		%	N/A
8065908	KMC	Spiked Blank	Conductivity	2022/06/22		100	%	80 - 120
8065908	KMC	Method Blank	Conductivity	2022/06/22	1.2, RDL=1.0		uS/cm	
8065908	KMC	RPD	Conductivity	2022/06/22	0.36		%	10
8065912	KMC	Spiked Blank	Total Alkalinity (Total as CaCO3)	2022/06/22		98	%	80 - 120
8065912	KMC	Method Blank	Total Alkalinity (Total as CaCO3)	2022/06/22	ND, RDL=2.0		mg/L	
8065912	KMC	RPD	Total Alkalinity (Total as CaCO3)	2022/06/22	0.16		%	20
8067157	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2022/06/22		93	%	80 - 120
8067157	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2022/06/22		96	%	80 - 120
8067157	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2022/06/22	ND, RDL=0.050		mg/L	
8067157	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2022/06/22	15		%	20
8067171	NGI	QC Standard	Turbidity	2022/06/22		103	%	80 - 120
8067171	NGI	Spiked Blank	Turbidity	2022/06/22		100	%	80 - 120
8067171	NGI	Method Blank	Turbidity	2022/06/22	ND, RDL=0.10		NTU	
8067171	NGI	RPD	Turbidity	2022/06/22	0		%	20
8068358	JHY	Matrix Spike	Total Aluminum (Al)	2022/06/23		99	%	80 - 120
			Total Antimony (Sb)	2022/06/23		102	%	80 - 120
			Total Arsenic (As)	2022/06/23		91	%	80 - 120
			Total Barium (Ba)	2022/06/23		91	%	80 - 120
			Total Beryllium (Be)	2022/06/23		97	%	80 - 120
			Total Bismuth (Bi)	2022/06/23		95	%	80 - 120
			Total Boron (B)	2022/06/23		97	%	80 - 120
			Total Cadmium (Cd)	2022/06/23		97	%	80 - 120
			Total Calcium (Ca)	2022/06/23		NC	%	80 - 120
			Total Chromium (Cr)	2022/06/23		92	%	80 - 120
			Total Cobalt (Co)	2022/06/23		93	%	80 - 120
			Total Copper (Cu)	2022/06/23		93	%	80 - 120
			Total Iron (Fe)	2022/06/23		97	%	80 - 120
			Total Lead (Pb)	2022/06/23		94	%	80 - 120
			Total Magnesium (Mg)	2022/06/23		98	%	80 - 120
			Total Manganese (Mn)	2022/06/23		NC	%	80 - 120
			Total Molybdenum (Mo)	2022/06/23		101	%	80 - 120
			Total Nickel (Ni)	2022/06/23		94	%	80 - 120
			Total Phosphorus (P)	2022/06/23		102	%	80 - 120
			Total Potassium (K)	2022/06/23		97	%	80 - 120
			Total Selenium (Se)	2022/06/23		97	%	80 - 120
			Total Silver (Ag)	2022/06/23		96	%	80 - 120
			Total Sodium (Na)	2022/06/23		94	%	80 - 120
			Total Strontium (Sr)	2022/06/23		NC	%	80 - 120
			Total Thallium (Tl)	2022/06/23		96	%	80 - 120
			Total Tin (Sn)	2022/06/23		97	%	80 - 120
			Total Titanium (Ti)	2022/06/23		97	%	80 - 120
			Total Uranium (U)	2022/06/23		102	%	80 - 120
			Total Vanadium (V)	2022/06/23		95	%	80 - 120
			Total Zinc (Zn)	2022/06/23		94	%	80 - 120
8068358	JHY	Spiked Blank	Total Aluminum (Al)	2022/06/23		99	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Antimony (Sb)	2022/06/23		99	%	80 - 120
			Total Arsenic (As)	2022/06/23		90	%	80 - 120
			Total Barium (Ba)	2022/06/23		93	%	80 - 120
			Total Beryllium (Be)	2022/06/23		96	%	80 - 120
			Total Bismuth (Bi)	2022/06/23		98	%	80 - 120
			Total Boron (B)	2022/06/23		97	%	80 - 120
			Total Cadmium (Cd)	2022/06/23		96	%	80 - 120
			Total Calcium (Ca)	2022/06/23		100	%	80 - 120
			Total Chromium (Cr)	2022/06/23		93	%	80 - 120
			Total Cobalt (Co)	2022/06/23		94	%	80 - 120
			Total Copper (Cu)	2022/06/23		94	%	80 - 120
			Total Iron (Fe)	2022/06/23		99	%	80 - 120
			Total Lead (Pb)	2022/06/23		95	%	80 - 120
			Total Magnesium (Mg)	2022/06/23		101	%	80 - 120
			Total Manganese (Mn)	2022/06/23		97	%	80 - 120
			Total Molybdenum (Mo)	2022/06/23		99	%	80 - 120
			Total Nickel (Ni)	2022/06/23		95	%	80 - 120
			Total Phosphorus (P)	2022/06/23		100	%	80 - 120
			Total Potassium (K)	2022/06/23		98	%	80 - 120
			Total Selenium (Se)	2022/06/23		97	%	80 - 120
			Total Silver (Ag)	2022/06/23		95	%	80 - 120
			Total Sodium (Na)	2022/06/23		98	%	80 - 120
			Total Strontium (Sr)	2022/06/23		94	%	80 - 120
			Total Thallium (Tl)	2022/06/23		98	%	80 - 120
			Total Tin (Sn)	2022/06/23		100	%	80 - 120
			Total Titanium (Ti)	2022/06/23		96	%	80 - 120
			Total Uranium (U)	2022/06/23		102	%	80 - 120
			Total Vanadium (V)	2022/06/23		96	%	80 - 120
			Total Zinc (Zn)	2022/06/23		95	%	80 - 120
8068358	JHY	Method Blank	Total Aluminum (Al)	2022/06/23	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2022/06/23	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2022/06/23	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2022/06/23	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2022/06/23	ND, RDL=0.10		ug/L	
			Total Bismuth (Bi)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Boron (B)	2022/06/23	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2022/06/23	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2022/06/23	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2022/06/23	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2022/06/23	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2022/06/23	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2022/06/23	ND, RDL=50		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Lead (Pb)	2022/06/23	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2022/06/23	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2022/06/23	ND, RDL=100		ug/L	
			Total Potassium (K)	2022/06/23	ND, RDL=100		ug/L	
			Total Selenium (Se)	2022/06/23	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2022/06/23	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2022/06/23	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2022/06/23	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2022/06/23	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2022/06/23	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2022/06/23	ND, RDL=5.0		ug/L	
8068358	JHY	RPD	Total Aluminum (Al)	2022/06/23	NC		%	20
			Total Antimony (Sb)	2022/06/23	NC		%	20
			Total Arsenic (As)	2022/06/23	NC		%	20
			Total Barium (Ba)	2022/06/23	0.36		%	20
			Total Boron (B)	2022/06/23	NC		%	20
			Total Cadmium (Cd)	2022/06/23	NC		%	20
			Total Calcium (Ca)	2022/06/23	0.23		%	20
			Total Chromium (Cr)	2022/06/23	NC		%	20
			Total Copper (Cu)	2022/06/23	16		%	20
			Total Iron (Fe)	2022/06/23	1.2		%	20
			Total Lead (Pb)	2022/06/23	3.4		%	20
			Total Magnesium (Mg)	2022/06/23	0.41		%	20
			Total Manganese (Mn)	2022/06/23	0.54 (1)		%	20
			Total Potassium (K)	2022/06/23	2.3		%	20
			Total Selenium (Se)	2022/06/23	NC		%	20
			Total Sodium (Na)	2022/06/23	0.26		%	20
			Total Strontium (Sr)	2022/06/23	0.54		%	20
			Total Uranium (U)	2022/06/23	NC		%	20
			Total Zinc (Zn)	2022/06/23	NC		%	20
8069692	EMT	Matrix Spike [SXT419-05]	Dissolved Chloride (Cl-)	2022/06/23		NC	%	80 - 120
8069692	EMT	Spiked Blank	Dissolved Chloride (Cl-)	2022/06/23		96	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8069692	EMT	Method Blank	Dissolved Chloride (Cl-)	2022/06/23	ND, RDL=1.0		mg/L	
8069692	EMT	RPD [SXT419-05]	Dissolved Chloride (Cl-)	2022/06/23	3.9		%	20
8069734	EMT	Matrix Spike [SXT419-05]	Dissolved Sulphate (SO4)	2022/06/23		NC	%	80 - 120
8069734	EMT	Spiked Blank	Dissolved Sulphate (SO4)	2022/06/23		101	%	80 - 120
8069734	EMT	Method Blank	Dissolved Sulphate (SO4)	2022/06/23	ND, RDL=2.0		mg/L	
8069734	EMT	RPD [SXT419-05]	Dissolved Sulphate (SO4)	2022/06/23	3.3		%	20
8069735	EMT	Matrix Spike [SXT419-05]	Reactive Silica (SiO2)	2022/06/23		87	%	80 - 120
8069735	EMT	Spiked Blank	Reactive Silica (SiO2)	2022/06/23		96	%	80 - 120
8069735	EMT	Method Blank	Reactive Silica (SiO2)	2022/06/23	ND, RDL=0.50		mg/L	
8069735	EMT	RPD [SXT419-05]	Reactive Silica (SiO2)	2022/06/23	NC		%	20
8069736	EMT	Spiked Blank	Colour	2022/06/23		98	%	80 - 120
8069736	EMT	Method Blank	Colour	2022/06/23	ND, RDL=5.0		TCU	
8069736	EMT	RPD [SXT419-05]	Colour	2022/06/23	NC		%	20
8069737	EMT	Matrix Spike [SXT419-05]	Orthophosphate (P)	2022/06/23		95	%	80 - 120
8069737	EMT	Spiked Blank	Orthophosphate (P)	2022/06/23		98	%	80 - 120
8069737	EMT	Method Blank	Orthophosphate (P)	2022/06/23	ND, RDL=0.010		mg/L	
8069737	EMT	RPD [SXT419-05]	Orthophosphate (P)	2022/06/23	9.4		%	20
8069738	EMT	Matrix Spike [SXT419-05]	Nitrate + Nitrite (N)	2022/06/23		99	%	80 - 120
8069738	EMT	Spiked Blank	Nitrate + Nitrite (N)	2022/06/23		103	%	80 - 120
8069738	EMT	Method Blank	Nitrate + Nitrite (N)	2022/06/23	ND, RDL=0.050		mg/L	
8069738	EMT	RPD [SXT419-05]	Nitrate + Nitrite (N)	2022/06/23	NC		%	20
8069739	EMT	Matrix Spike [SXT419-05]	Nitrite (N)	2022/06/23		101	%	80 - 120
8069739	EMT	Spiked Blank	Nitrite (N)	2022/06/23		103	%	80 - 120
8069739	EMT	Method Blank	Nitrite (N)	2022/06/23	ND, RDL=0.010		mg/L	
8069739	EMT	RPD [SXT419-05]	Nitrite (N)	2022/06/23	NC		%	20
8078862	JHH	Matrix Spike	Total Organic Carbon (C)	2022/06/28		99	%	85 - 115
8078862	JHH	Spiked Blank	Total Organic Carbon (C)	2022/06/28		102	%	80 - 120
8078862	JHH	Method Blank	Total Organic Carbon (C)	2022/06/28	ND, RDL=0.50		mg/L	
8078862	JHH	RPD	Total Organic Carbon (C)	2022/06/28	2.3		%	15

N/A = Not Applicable

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) POTENTIAL EXCEEDANCE FOR PARAMETER

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

CAcker

Colleen Acker, B.Sc, Scientific Service Specialist

Robyn Edwards

Robyn Edwards, Bedford Micro Supervisor

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Your C.O.C. #: D 52920

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/10/05
Report #: R6357546
Version: 3 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0O8800
Received: 2020/09/24, 15:41

Sample Matrix: Drinking Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	1	N/A	2020/09/29	N/A	SM 23 4500-CO2 D
Alkalinity	1	N/A	2020/10/01	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	1	N/A	2020/10/01	ATL SOP 00014	SM 23 4500-Cl- E m
TC/EC Drinking Water CFU/100mL	1	N/A	2020/09/24	ATL SOP 00096	MOE E3407 R2
Colour	1	N/A	2020/10/01	ATL SOP 00020	SM 23 2120C m
Conductance - water	1	N/A	2020/09/29	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	1	N/A	2020/09/28	ATL SOP 00048	Auto Calc
Metals Water Total MS	1	2020/09/25	2020/09/25	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	1	N/A	2020/10/01	N/A	Auto Calc.
Anion and Cation Sum	1	N/A	2020/10/01	N/A	Auto Calc.
Nitrogen Ammonia - water	1	N/A	2020/09/30	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2020/09/30	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2020/09/30	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2020/10/01	ATL SOP 00018	ASTM D3867-16
pH (1)	1	N/A	2020/09/29	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	1	N/A	2020/10/01	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2020/10/01	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	1	N/A	2020/10/01	ATL SOP 00049	Auto Calc.
Reactive Silica	1	N/A	2020/10/01	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2020/10/01	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	1	N/A	2020/10/01	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	1	N/A	2020/10/03	ATL SOP 00203	SM 23 5310B m
Turbidity	1	N/A	2020/09/28	ATL SOP 00011	EPA 180.1 R2 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.

Your C.O.C. #: D 52920

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/10/05
Report #: R6357546
Version: 3 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0O8800
Received: 2020/09/24, 15:41

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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Sam Sherker
Project Manager Assistant
05 Oct 2020 12:16:57

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bvlabs.com
Phone# (902)420-0203 Ext:252
==
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.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (DRINKING WATER)

BV Labs ID				NSF857		
Sampling Date				2020/09/24 11:20		
COC Number				D 52920		
	UNITS	**MAC**	**AO**	**ADCP LOCATION**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	-	-	551	N/A	6962949
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	92	1.0	6962942
Calculated TDS	mg/L	-	500	31000	1.0	6962953
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6962942
Cation Sum	me/L	-	-	483	N/A	6962949
Hardness (CaCO3)	mg/L	-	-	5200	1.0	6962945
Ion Balance (% Difference)	%	-	-	6.61	N/A	6962947
Langelier Index (@ 20C)	N/A	-	-	0.538		6962950
Langelier Index (@ 4C)	N/A	-	-	0.299		6962952
Nitrate (N)	mg/L	**10**	-	ND	0.050	6962701
Saturation pH (@ 20C)	N/A	-	-	7.32		6962950
Saturation pH (@ 4C)	N/A	-	-	7.56		6962952
Inorganics						
Total Alkalinity (Total as CaCO3)	mg/L	-	-	92	5.0	6974189
Dissolved Chloride (Cl-)	mg/L	-	250	16000	500	6974205
Colour	TCU	-	15	10	5.0	6974239
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.050	6974289
Nitrite (N)	mg/L	**1**	-	ND	0.010	6974290
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	0.11	0.050	6973927

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

N/A = Not Applicable

ND = Not detected

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (DRINKING WATER)

BV Labs ID				NSF857		
Sampling Date				2020/09/24 11:20		
COC Number				D 52920		
	UNITS	MAC	AO	ADCP LOCATION	RDL	QC Batch
Total Organic Carbon (C)	mg/L	-	-	1.6	0.50	6979444
Orthophosphate (P)	mg/L	-	-	ND	0.010	6974240
pH	pH	-	7.0 : 10.5	7.86		6970602
Reactive Silica (SiO2)	mg/L	-	-	0.57	0.50	6974237
Dissolved Sulphate (SO4)	mg/L	-	500	4100	200	6974214
Turbidity	NTU	-	0.3	5.0	0.10	6968478
Conductivity	uS/cm	-	-	46000	1.0	6970601
Metals						
Total Aluminum (Al)	ug/L	-	100	160	50	6964509
Total Antimony (Sb)	ug/L	**6**	-	**ND (1)**	10	6964509
Total Arsenic (As)	ug/L	**10**	-	ND	10	6964509
Total Barium (Ba)	ug/L	**2000**	-	ND	10	6964509
Total Beryllium (Be)	ug/L	-	-	ND	10	6964509
Total Bismuth (Bi)	ug/L	-	-	ND	20	6964509
Total Boron (B)	ug/L	**5000**	-	3800	500	6964509
Total Cadmium (Cd)	ug/L	**7**	-	ND	0.10	6964509
Total Calcium (Ca)	ug/L	-	-	340000	1000	6964509
Total Chromium (Cr)	ug/L	**50**	-	ND	10	6964509
Total Cobalt (Co)	ug/L	-	-	ND	4.0	6964509
Total Copper (Cu)	ug/L	**2000**	1000	5.1	5.0	6964509

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

(1) RDL exceeds criteria

ATLANTIC RCAP-MS TOTAL METALS IN WATER (DRINKING WATER)

BV Labs ID				NSF857		
Sampling Date				2020/09/24 11:20		
COC Number				D 52920		
	UNITS	**MAC**	**AO**	**ADCP LOCATION**	**RDL**	**QC Batch**
Total Iron (Fe)	ug/L	-	300	**ND (1)**	500	6964509
Total Lead (Pb)	ug/L	**5**	-	ND	5.0	6964509
Total Magnesium (Mg)	ug/L	-	-	1000000	1000	6964509
Total Manganese (Mn)	ug/L	**120**	20	40	20	6964509
Total Molybdenum (Mo)	ug/L	-	-	ND	20	6964509
Total Nickel (Ni)	ug/L	-	-	ND	20	6964509
Total Phosphorus (P)	ug/L	-	-	ND	1000	6964509
Total Potassium (K)	ug/L	-	-	310000	1000	6964509
Total Selenium (Se)	ug/L	**50**	-	ND	5.0	6964509
Total Silver (Ag)	ug/L	-	-	ND	1.0	6964509
Total Sodium (Na)	ug/L	-	200000	8500000	1000	6964509
Total Strontium (Sr)	ug/L	**7000**	-	6500	20	6964509
Total Thallium (Tl)	ug/L	-	-	ND	1.0	6964509
Total Tin (Sn)	ug/L	-	-	ND	20	6964509
Total Titanium (Ti)	ug/L	-	-	ND	20	6964509
Total Uranium (U)	ug/L	**20**	-	3.0	1.0	6964509
Total Vanadium (V)	ug/L	-	-	ND	20	6964509
Total Zinc (Zn)	ug/L	-	5000	ND	50	6964509

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

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ND = Not detected

(1) RDL exceeds criteria

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MICROBIOLOGY COLILERT (DRINKING WATER)

BV Labs ID			NSF857		
Sampling Date			2020/09/24 11:20		
COC Number			D 52920		
	UNITS	**MAC**	**ADCP LOCATION**	**RDL**	**QC Batch**
Microbiological					
Escherichia coli	CFU/100mL	**0:0**	**3.0**	1.0	6963258
Total Coliforms	CFU/100mL	**0:0**	**27**	1.0	6963258

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, September 2020.

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.0°C

Sample NSF857 [ADCP LOCATION] : Elevated reporting limits for trace metals due to sample matrix.

Poor RCAp Ion Balance due to sample matrix.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6963258	JWA	Method Blank	Escherichia coli	2020/09/24	ND, RDL=1.0		CFU/100mL	
			Total Coliforms	2020/09/24	ND, RDL=1.0		CFU/100mL	
6964509	MLB	Matrix Spike	Total Aluminum (Al)	2020/09/25		94	%	80 - 120
			Total Antimony (Sb)	2020/09/25		96	%	80 - 120
			Total Arsenic (As)	2020/09/25		95	%	80 - 120
			Total Barium (Ba)	2020/09/25		94	%	80 - 120
			Total Beryllium (Be)	2020/09/25		96	%	80 - 120
			Total Bismuth (Bi)	2020/09/25		92	%	80 - 120
			Total Boron (B)	2020/09/25		87	%	80 - 120
			Total Cadmium (Cd)	2020/09/25		96	%	80 - 120
			Total Calcium (Ca)	2020/09/25		91	%	80 - 120
			Total Chromium (Cr)	2020/09/25		96	%	80 - 120
			Total Cobalt (Co)	2020/09/25		94	%	80 - 120
			Total Copper (Cu)	2020/09/25		94	%	80 - 120
			Total Iron (Fe)	2020/09/25		94	%	80 - 120
			Total Lead (Pb)	2020/09/25		98	%	80 - 120
			Total Magnesium (Mg)	2020/09/25		96	%	80 - 120
			Total Manganese (Mn)	2020/09/25		98	%	80 - 120
			Total Molybdenum (Mo)	2020/09/25		96	%	80 - 120
			Total Nickel (Ni)	2020/09/25		96	%	80 - 120
			Total Phosphorus (P)	2020/09/25		94	%	80 - 120
			Total Potassium (K)	2020/09/25		95	%	80 - 120
			Total Selenium (Se)	2020/09/25		96	%	80 - 120
			Total Silver (Ag)	2020/09/25		96	%	80 - 120
			Total Sodium (Na)	2020/09/25		NC	%	80 - 120
			Total Strontium (Sr)	2020/09/25		99	%	80 - 120
			Total Thallium (Tl)	2020/09/25		92	%	80 - 120
			Total Tin (Sn)	2020/09/25		94	%	80 - 120
			Total Titanium (Ti)	2020/09/25		102	%	80 - 120
			Total Uranium (U)	2020/09/25		101	%	80 - 120
			Total Vanadium (V)	2020/09/25		97	%	80 - 120
			Total Zinc (Zn)	2020/09/25		93	%	80 - 120
6964509	MLB	Spiked Blank	Total Aluminum (Al)	2020/09/25		95	%	80 - 120
			Total Antimony (Sb)	2020/09/25		97	%	80 - 120
			Total Arsenic (As)	2020/09/25		96	%	80 - 120
			Total Barium (Ba)	2020/09/25		96	%	80 - 120
			Total Beryllium (Be)	2020/09/25		96	%	80 - 120
			Total Bismuth (Bi)	2020/09/25		95	%	80 - 120
			Total Boron (B)	2020/09/25		87	%	80 - 120
			Total Cadmium (Cd)	2020/09/25		98	%	80 - 120
			Total Calcium (Ca)	2020/09/25		92	%	80 - 120
			Total Chromium (Cr)	2020/09/25		99	%	80 - 120
			Total Cobalt (Co)	2020/09/25		97	%	80 - 120
			Total Copper (Cu)	2020/09/25		97	%	80 - 120
			Total Iron (Fe)	2020/09/25		96	%	80 - 120
			Total Lead (Pb)	2020/09/25		101	%	80 - 120
			Total Magnesium (Mg)	2020/09/25		96	%	80 - 120
			Total Manganese (Mn)	2020/09/25		102	%	80 - 120
			Total Molybdenum (Mo)	2020/09/25		98	%	80 - 120
			Total Nickel (Ni)	2020/09/25		101	%	80 - 120
			Total Phosphorus (P)	2020/09/25		96	%	80 - 120
			Total Potassium (K)	2020/09/25		96	%	80 - 120
			Total Selenium (Se)	2020/09/25		99	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2020/09/25		96	%	80 - 120
			Total Sodium (Na)	2020/09/25		93	%	80 - 120
			Total Strontium (Sr)	2020/09/25		101	%	80 - 120
			Total Thallium (Tl)	2020/09/25		94	%	80 - 120
			Total Tin (Sn)	2020/09/25		96	%	80 - 120
			Total Titanium (Ti)	2020/09/25		102	%	80 - 120
			Total Uranium (U)	2020/09/25		104	%	80 - 120
			Total Vanadium (V)	2020/09/25		98	%	80 - 120
			Total Zinc (Zn)	2020/09/25		95	%	80 - 120
6964509	MLB	Method Blank	Total Aluminum (Al)	2020/09/25	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/09/25	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/09/25	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/09/25	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/09/25	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/09/25	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/09/25	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/09/25	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/09/25	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/09/25	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/09/25	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/09/25	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/09/25	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/09/25	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/09/25	ND, RDL=100		ug/L	
			Total Potassium (K)	2020/09/25	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/09/25	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2020/09/25	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/09/25	ND, RDL=100		ug/L	

BV Labs Job #: C0O8800
Report Date: 2020/10/05

Whale Sanctuary

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Strontium (Sr)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/09/25	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/09/25	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/09/25	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/09/25	ND, RDL=5.0		ug/L	
6964509	MLB	RPD [NSF857-03]	Total Aluminum (Al)	2020/09/25	1.7		%	20
			Total Antimony (Sb)	2020/09/25	NC		%	20
			Total Arsenic (As)	2020/09/25	NC		%	20
			Total Barium (Ba)	2020/09/25	NC		%	20
			Total Beryllium (Be)	2020/09/25	NC		%	20
			Total Bismuth (Bi)	2020/09/25	NC		%	20
			Total Boron (B)	2020/09/25	1.8		%	20
			Total Cadmium (Cd)	2020/09/25	NC		%	20
			Total Calcium (Ca)	2020/09/25	1.9		%	20
			Total Chromium (Cr)	2020/09/25	NC		%	20
			Total Cobalt (Co)	2020/09/25	NC		%	20
			Total Copper (Cu)	2020/09/25	20		%	20
			Total Iron (Fe)	2020/09/25	NC		%	20
			Total Lead (Pb)	2020/09/25	NC		%	20
			Total Magnesium (Mg)	2020/09/25	0.35		%	20
			Total Manganese (Mn)	2020/09/25	2.0		%	20
			Total Molybdenum (Mo)	2020/09/25	NC		%	20
			Total Nickel (Ni)	2020/09/25	NC		%	20
			Total Phosphorus (P)	2020/09/25	NC		%	20
			Total Potassium (K)	2020/09/25	2.0		%	20
			Total Selenium (Se)	2020/09/25	NC		%	20
			Total Silver (Ag)	2020/09/25	NC		%	20
			Total Sodium (Na)	2020/09/25	0.14		%	20
			Total Strontium (Sr)	2020/09/25	0.22		%	20
			Total Thallium (Tl)	2020/09/25	NC		%	20
			Total Tin (Sn)	2020/09/25	NC		%	20
			Total Titanium (Ti)	2020/09/25	NC		%	20
			Total Uranium (U)	2020/09/25	0.85		%	20
			Total Vanadium (V)	2020/09/25	NC		%	20
			Total Zinc (Zn)	2020/09/25	NC		%	20
6968478	SHW	QC Standard	Turbidity	2020/09/28		97	%	80 - 120
6968478	SHW	Spiked Blank	Turbidity	2020/09/28		93	%	80 - 120
6968478	SHW	Method Blank	Turbidity	2020/09/28	ND, RDL=0.10		NTU	
6968478	SHW	RPD	Turbidity	2020/09/28	19		%	20
6970601	SHW	Spiked Blank	Conductivity	2020/09/29		99	%	80 - 120
6970601	SHW	Method Blank	Conductivity	2020/09/29	ND, RDL=1.0		uS/cm	
6970601	SHW	RPD	Conductivity	2020/09/29	0.58		%	10
6970602	SHW	Spiked Blank	pH	2020/09/29		100	%	97 - 103
6970602	SHW	RPD	pH	2020/09/29	0.037		%	N/A

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6973927	EMT	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2020/09/30		95	%	80 - 120
6973927	EMT	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/09/30		100	%	80 - 120
6973927	EMT	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/09/30	ND, RDL=0.050		mg/L	
6973927	EMT	RPD	Nitrogen (Ammonia Nitrogen)	2020/09/30	NC		%	20
6974189	EMT	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/10/01		NC	%	80 - 120
6974189	EMT	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/10/01		104	%	80 - 120
6974189	EMT	Method Blank	Total Alkalinity (Total as CaCO3)	2020/10/01	ND, RDL=5.0		mg/L	
6974189	EMT	RPD	Total Alkalinity (Total as CaCO3)	2020/10/01	1.5		%	20
6974205	EMT	Matrix Spike	Dissolved Chloride (Cl-)	2020/10/01		99	%	80 - 120
6974205	EMT	Spiked Blank	Dissolved Chloride (Cl-)	2020/10/01		101	%	80 - 120
6974205	EMT	Method Blank	Dissolved Chloride (Cl-)	2020/10/01	ND, RDL=1.0		mg/L	
6974205	EMT	RPD	Dissolved Chloride (Cl-)	2020/10/01	11		%	20
6974214	EMT	Matrix Spike	Dissolved Sulphate (SO4)	2020/10/01		NC	%	80 - 120
6974214	EMT	Spiked Blank	Dissolved Sulphate (SO4)	2020/10/01		109	%	80 - 120
6974214	EMT	Method Blank	Dissolved Sulphate (SO4)	2020/10/01	ND, RDL=2.0		mg/L	
6974214	EMT	RPD	Dissolved Sulphate (SO4)	2020/10/01	0.98		%	20
6974237	EMT	Matrix Spike	Reactive Silica (SiO2)	2020/10/01		NC	%	80 - 120
6974237	EMT	Spiked Blank	Reactive Silica (SiO2)	2020/09/30		100	%	80 - 120
6974237	EMT	Method Blank	Reactive Silica (SiO2)	2020/09/30	ND, RDL=0.50		mg/L	
6974237	EMT	RPD	Reactive Silica (SiO2)	2020/09/30	0.70		%	20
6974239	EMT	Spiked Blank	Colour	2020/10/01		97	%	80 - 120
6974239	EMT	Method Blank	Colour	2020/10/01	ND, RDL=5.0		TCU	
6974239	EMT	RPD	Colour	2020/10/01	0.74		%	20
6974240	EMT	Matrix Spike	Orthophosphate (P)	2020/10/01		95	%	80 - 120
6974240	EMT	Spiked Blank	Orthophosphate (P)	2020/10/01		97	%	80 - 120
6974240	EMT	Method Blank	Orthophosphate (P)	2020/10/01	ND, RDL=0.010		mg/L	
6974240	EMT	RPD	Orthophosphate (P)	2020/10/01	NC		%	20
6974289	EMT	Matrix Spike	Nitrate + Nitrite (N)	2020/09/30		96	%	80 - 120
6974289	EMT	Spiked Blank	Nitrate + Nitrite (N)	2020/09/30		96	%	80 - 120
6974289	EMT	Method Blank	Nitrate + Nitrite (N)	2020/09/30	ND, RDL=0.050		mg/L	
6974289	EMT	RPD	Nitrate + Nitrite (N)	2020/09/30	NC		%	20
6974290	EMT	Matrix Spike	Nitrite (N)	2020/09/30		99	%	80 - 120
6974290	EMT	Spiked Blank	Nitrite (N)	2020/09/30		108	%	80 - 120
6974290	EMT	Method Blank	Nitrite (N)	2020/09/30	ND, RDL=0.010		mg/L	
6974290	EMT	RPD	Nitrite (N)	2020/09/30	NC		%	20
6979444	YLG	Matrix Spike	Total Organic Carbon (C)	2020/10/03		118 (1)	%	85 - 115
6979444	YLG	Spiked Blank	Total Organic Carbon (C)	2020/10/03		100	%	80 - 120
6979444	YLG	Method Blank	Total Organic Carbon (C)	2020/10/03	ND, RDL=0.50		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6979444	YLG	RPD	Total Organic Carbon (C)	2020/10/03	NC		%	15

N/A = Not Applicable

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) Elevated spike recovery due to sample matrix.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Mike MacGillivray, Scientific Specialist (Inorganics)

Robyn Edwards, Bedford Micro Supervisor

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 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

Your C.O.C. #: 763050-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/06/11
Report #: R6206268
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0D4511
Received: 2020/06/02, 16:28

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	1	N/A	2020/06/08	N/A	SM 23 4500-CO2 D
Alkalinity	1	N/A	2020/06/09	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	1	N/A	2020/06/09	ATL SOP 00014	SM 23 4500-Cl- E m
Colour	1	N/A	2020/06/10	ATL SOP 00020	SM 23 2120C m
Conductance - water	1	N/A	2020/06/08	ATL SOP 00004	SM 23 2510B m
Fecal coliform in water (CFU/100 mL)	1	N/A	2020/06/03	ATL SOP 00071	SM 23 9222D
Hardness (calculated as CaCO3)	1	N/A	2020/06/11	ATL SOP 00048	Auto Calc
Metals Water Total MS	1	2020/06/05	2020/06/10	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	1	N/A	2020/06/11	N/A	Auto Calc.
Anion and Cation Sum	1	N/A	2020/06/11	N/A	Auto Calc.
Nitrogen Ammonia - water	1	N/A	2020/06/09	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2020/06/09	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2020/06/09	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2020/06/10	ATL SOP 00018	ASTM D3867-16
pH (1)	1	N/A	2020/06/08	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	1	N/A	2020/06/09	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2020/06/11	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	1	N/A	2020/06/11	ATL SOP 00049	Auto Calc.
Reactive Silica	1	N/A	2020/06/09	ATL SOP 00022	EPA 366.0 m
Sulphate	1	N/A	2020/06/10	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	1	N/A	2020/06/11	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	1	N/A	2020/06/08	ATL SOP 00203	SM 23 5310B m
Turbidity	1	N/A	2020/06/03	ATL SOP 00011	EPA 180.1 R2 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.

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Your C.O.C. #: 763050-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
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Report Date: 2020/06/11
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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0D4511
Received: 2020/06/02, 16:28

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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Tyler Travers
Project Manager Assistant
11 Jun 2020 15:01:30

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bvlabs.com
Phone# (902) 420-0203
==
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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MTR301		
Sampling Date				2020/06/02 13:02		
COC Number				763050-01-01		
	UNITS	**MAC**	**AO**	**BARACHOIS WHARF**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	-	-	483	N/A	6765087
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	92	1.0	6765084
Calculated TDS	mg/L	-	500	28000	1.0	6765096
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6765084
Cation Sum	me/L	-	-	491	N/A	6765087
Hardness (CaCO3)	mg/L	-	-	5300	1.0	6765085
Ion Balance (% Difference)	%	-	-	0.780	N/A	6765086
Langelier Index (@ 20C)	N/A	-	-	0.287		6765092
Langelier Index (@ 4C)	N/A	-	-	0.0490		6765094
Nitrate (N)	mg/L	**10**	-	ND	0.050	6765089
Saturation pH (@ 20C)	N/A	-	-	7.37		6765092
Saturation pH (@ 4C)	N/A	-	-	7.61		6765094
Inorganics						
Total Alkalinity (Total as CaCO3)	mg/L	-	-	93	5.0	6776616
Dissolved Chloride (Cl-)	mg/L	-	250	15000	500	6776619
Colour	TCU	-	15	5.5	5.0	6776625
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.050	6776629
Nitrite (N)	mg/L	**1**	-	ND	0.010	6776630
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	ND	0.050	6771878

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, June 2019

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

N/A = Not Applicable

ND = Not detected

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MTR301		
Sampling Date				2020/06/02 13:02		
COC Number				763050-01-01		
	UNITS	**MAC**	**AO**	**BARACHOIS WHARF**	**RDL**	**QC Batch**
Total Organic Carbon (C)	mg/L	-	-	ND (1)	5.0	6774806
Orthophosphate (P)	mg/L	-	-	ND	0.010	6776626
pH	pH	-	7.0 : 10.5	7.66		6774663
Reactive Silica (SiO2)	mg/L	-	-	ND	0.50	6776622
Dissolved Sulphate (SO4)	mg/L	-	500	2300	200	6776621
Turbidity	NTU	-	0.3	5.0	0.10	6767382
Conductivity	uS/cm	-	-	45000	1.0	6774661
Metals						
Total Aluminum (Al)	ug/L	-	100	180	50	6772575
Total Antimony (Sb)	ug/L	**6**	-	**ND (2)**	10	6772575
Total Arsenic (As)	ug/L	**10**	-	ND	10	6772575
Total Barium (Ba)	ug/L	**2000**	-	ND	10	6772575
Total Beryllium (Be)	ug/L	-	-	ND	10	6772575
Total Bismuth (Bi)	ug/L	-	-	ND	20	6772575
Total Boron (B)	ug/L	**5000**	-	3900	500	6772575
Total Cadmium (Cd)	ug/L	**5**	-	ND	0.10	6772575
Total Calcium (Ca)	ug/L	-	-	320000	1000	6772575
Total Chromium (Cr)	ug/L	**50**	-	ND	10	6772575
Total Cobalt (Co)	ug/L	-	-	ND	4.0	6772575

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, June 2019

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.
Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

(1) Elevated reporting limit due to sample matrix.

(2) RDL exceeds criteria

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MTR301		
Sampling Date				2020/06/02 13:02		
COC Number				763050-01-01		
	UNITS	**MAC**	**AO**	**BARACHOIS WHARF**	**RDL**	**QC Batch**
Total Copper (Cu)	ug/L	**2000**	1000	16	5.0	6772575
Total Iron (Fe)	ug/L	-	300	**ND (1)**	500	6772575
Total Lead (Pb)	ug/L	**5**	-	ND	5.0	6772575
Total Magnesium (Mg)	ug/L	-	-	1100000	1000	6772575
Total Manganese (Mn)	ug/L	**120**	20	20	20	6772575
Total Molybdenum (Mo)	ug/L	-	-	ND	20	6772575
Total Nickel (Ni)	ug/L	-	-	ND	20	6772575
Total Phosphorus (P)	ug/L	-	-	ND	1000	6772575
Total Potassium (K)	ug/L	-	-	310000	1000	6772575
Total Selenium (Se)	ug/L	**50**	-	ND	5.0	6772575
Total Silver (Ag)	ug/L	-	-	ND	1.0	6772575
Total Sodium (Na)	ug/L	-	200000	8700000	1000	6772575
Total Strontium (Sr)	ug/L	**7000**	-	6000	20	6772575
Total Thallium (Tl)	ug/L	-	-	ND	1.0	6772575
Total Tin (Sn)	ug/L	-	-	ND	20	6772575
Total Titanium (Ti)	ug/L	-	-	ND	20	6772575
Total Uranium (U)	ug/L	**20**	-	2.5	1.0	6772575
Total Vanadium (V)	ug/L	-	-	ND	20	6772575
Total Zinc (Zn)	ug/L	-	5000	ND	50	6772575

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, June 2019

MAC= Maximum Acceptable Concentration (MAC) - established for substances that are known or suspected to cause adverse effects on health.

AO= Aesthetic Objectives (AO) - apply to characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good quality water.

If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

(1) RDL exceeds criteria

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MICROBIOLOGY (WATER)

BV Labs ID		MTR301		
Sampling Date		2020/06/02 13:02		
COC Number		763050-01-01		
	UNITS	BARACHOIS WHARF	RDL	QC Batch
Microbiological				
Fecal coliform	CFU/100mL	ND	10	6767607

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Sample MTR301 [BARACHOIS WHARF] : Elevated reportingl imits for trace metals due to samples matrix.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6767382	SHW	QC Standard	Turbidity	2020/06/03		95	%	80 - 120
6767382	SHW	Spiked Blank	Turbidity	2020/06/03		97	%	80 - 120
6767382	SHW	Method Blank	Turbidity	2020/06/03	ND, RDL=0.10		NTU	
6767382	SHW	RPD	Turbidity	2020/06/03	NC		%	20
6767607	SDN	Method Blank	Fecal coliform	2020/06/03	ND, RDL=1.0		CFU/100mL	
6771878	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2020/06/09		107	%	80 - 120
6771878	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/06/09		113	%	80 - 120
6771878	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/06/09	ND, RDL=0.050		mg/L	
6771878	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2020/06/09	NC		%	20
6772575	BAN	Matrix Spike	Total Aluminum (Al)	2020/06/10		96	%	80 - 120
			Total Antimony (Sb)	2020/06/10		97	%	80 - 120
			Total Arsenic (As)	2020/06/10		90	%	80 - 120
			Total Barium (Ba)	2020/06/10		91	%	80 - 120
			Total Beryllium (Be)	2020/06/10		96	%	80 - 120
			Total Bismuth (Bi)	2020/06/10		94	%	80 - 120
			Total Boron (B)	2020/06/10		97	%	80 - 120
			Total Cadmium (Cd)	2020/06/10		93	%	80 - 120
			Total Calcium (Ca)	2020/06/10		NC	%	80 - 120
			Total Chromium (Cr)	2020/06/10		93	%	80 - 120
			Total Cobalt (Co)	2020/06/10		91	%	80 - 120
			Total Copper (Cu)	2020/06/10		91	%	80 - 120
			Total Iron (Fe)	2020/06/10		99	%	80 - 120
			Total Lead (Pb)	2020/06/10		94	%	80 - 120
			Total Magnesium (Mg)	2020/06/10		NC	%	80 - 120
			Total Manganese (Mn)	2020/06/10		NC	%	80 - 120
			Total Molybdenum (Mo)	2020/06/10		99	%	80 - 120
			Total Nickel (Ni)	2020/06/10		93	%	80 - 120
			Total Phosphorus (P)	2020/06/10		99	%	80 - 120
			Total Potassium (K)	2020/06/10		NC	%	80 - 120
			Total Selenium (Se)	2020/06/10		95	%	80 - 120
			Total Silver (Ag)	2020/06/10		96	%	80 - 120
			Total Sodium (Na)	2020/06/10		88	%	80 - 120
			Total Strontium (Sr)	2020/06/10		NC	%	80 - 120
			Total Thallium (Tl)	2020/06/10		96	%	80 - 120
			Total Tin (Sn)	2020/06/10		98	%	80 - 120
			Total Titanium (Ti)	2020/06/10		100	%	80 - 120
			Total Uranium (U)	2020/06/10		104	%	80 - 120
			Total Vanadium (V)	2020/06/10		99	%	80 - 120
			Total Zinc (Zn)	2020/06/10		91	%	80 - 120
6772575	BAN	Spiked Blank	Total Aluminum (Al)	2020/06/10		97	%	80 - 120
			Total Antimony (Sb)	2020/06/10		95	%	80 - 120
			Total Arsenic (As)	2020/06/10		94	%	80 - 120
			Total Barium (Ba)	2020/06/10		92	%	80 - 120
			Total Beryllium (Be)	2020/06/10		92	%	80 - 120
			Total Bismuth (Bi)	2020/06/10		95	%	80 - 120
			Total Boron (B)	2020/06/10		97	%	80 - 120
			Total Cadmium (Cd)	2020/06/10		92	%	80 - 120
			Total Calcium (Ca)	2020/06/10		97	%	80 - 120
			Total Chromium (Cr)	2020/06/10		95	%	80 - 120
			Total Cobalt (Co)	2020/06/10		95	%	80 - 120
			Total Copper (Cu)	2020/06/10		94	%	80 - 120
			Total Iron (Fe)	2020/06/10		103	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Lead (Pb)	2020/06/10		95	%	80 - 120
			Total Magnesium (Mg)	2020/06/10		105	%	80 - 120
			Total Manganese (Mn)	2020/06/10		97	%	80 - 120
			Total Molybdenum (Mo)	2020/06/10		98	%	80 - 120
			Total Nickel (Ni)	2020/06/10		97	%	80 - 120
			Total Phosphorus (P)	2020/06/10		98	%	80 - 120
			Total Potassium (K)	2020/06/10		93	%	80 - 120
			Total Selenium (Se)	2020/06/10		92	%	80 - 120
			Total Silver (Ag)	2020/06/10		95	%	80 - 120
			Total Sodium (Na)	2020/06/10		97	%	80 - 120
			Total Strontium (Sr)	2020/06/10		97	%	80 - 120
			Total Thallium (Tl)	2020/06/10		97	%	80 - 120
			Total Tin (Sn)	2020/06/10		99	%	80 - 120
			Total Titanium (Ti)	2020/06/10		99	%	80 - 120
			Total Uranium (U)	2020/06/10		103	%	80 - 120
			Total Vanadium (V)	2020/06/10		99	%	80 - 120
			Total Zinc (Zn)	2020/06/10		94	%	80 - 120
6772575	BAN	Method Blank	Total Aluminum (Al)	2020/06/10	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/06/10	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/06/10	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/06/10	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/06/10	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/06/10	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/06/10	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/06/10	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/06/10	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/06/10	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/06/10	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/06/10	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/06/10	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/06/10	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/06/10	ND, RDL=100		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Potassium (K)	2020/06/10	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/06/10	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2020/06/10	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/06/10	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/06/10	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/06/10	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/06/10	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/06/10	ND, RDL=5.0		ug/L	
6772575	BAN	RPD	Total Aluminum (Al)	2020/06/10	3.3		%	20
			Total Antimony (Sb)	2020/06/10	NC		%	20
			Total Arsenic (As)	2020/06/10	3.7		%	20
			Total Barium (Ba)	2020/06/10	4.2		%	20
			Total Beryllium (Be)	2020/06/10	NC		%	20
			Total Bismuth (Bi)	2020/06/10	NC		%	20
			Total Boron (B)	2020/06/10	NC		%	20
			Total Cadmium (Cd)	2020/06/10	1.6		%	20
			Total Calcium (Ca)	2020/06/10	3.8		%	20
			Total Chromium (Cr)	2020/06/10	NC		%	20
			Total Cobalt (Co)	2020/06/10	1.2		%	20
			Total Copper (Cu)	2020/06/10	9.5		%	20
			Total Iron (Fe)	2020/06/10	2.7		%	20
			Total Lead (Pb)	2020/06/10	NC		%	20
			Total Magnesium (Mg)	2020/06/10	2.4		%	20
			Total Manganese (Mn)	2020/06/10	2.5		%	20
			Total Molybdenum (Mo)	2020/06/10	NC		%	20
			Total Nickel (Ni)	2020/06/10	2.8		%	20
			Total Phosphorus (P)	2020/06/10	NC		%	20
			Total Potassium (K)	2020/06/10	2.9		%	20
			Total Selenium (Se)	2020/06/10	NC		%	20
			Total Silver (Ag)	2020/06/10	NC		%	20
			Total Sodium (Na)	2020/06/10	2.7		%	20
			Total Strontium (Sr)	2020/06/10	2.4		%	20
			Total Thallium (Tl)	2020/06/10	NC		%	20
			Total Tin (Sn)	2020/06/10	NC		%	20
			Total Titanium (Ti)	2020/06/10	NC		%	20
			Total Uranium (U)	2020/06/10	1.9		%	20
			Total Vanadium (V)	2020/06/10	NC		%	20
			Total Zinc (Zn)	2020/06/10	NC		%	20
6774661	SHW	Spiked Blank	Conductivity	2020/06/08		101	%	80 - 120
6774661	SHW	Method Blank	Conductivity	2020/06/08	ND, RDL=1.0		uS/cm	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6774661	SHW	RPD	Conductivity	2020/06/08	0.64		%	10
6774663	SHW	Spiked Blank	pH	2020/06/08		100	%	97 - 103
6774663	SHW	RPD	pH	2020/06/08	0.89		%	N/A
6774806	SSI	Matrix Spike	Total Organic Carbon (C)	2020/06/08		95	%	85 - 115
6774806	SSI	Spiked Blank	Total Organic Carbon (C)	2020/06/08		93	%	80 - 120
6774806	SSI	Method Blank	Total Organic Carbon (C)	2020/06/08	ND, RDL=0.50		mg/L	
6774806	SSI	RPD	Total Organic Carbon (C)	2020/06/08	4.7		%	15
6776616	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/06/09		84	%	80 - 120
6776616	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/06/09		105	%	80 - 120
6776616	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/06/09	ND, RDL=5.0		mg/L	
6776616	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/06/09	9.0		%	20
6776619	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2020/06/09		98	%	80 - 120
6776619	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/06/09		100	%	80 - 120
6776619	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/06/09	ND, RDL=1.0		mg/L	
6776619	MCN	RPD	Dissolved Chloride (Cl-)	2020/06/09	1.7		%	20
6776621	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2020/06/09		110	%	80 - 120
6776621	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/06/09		104	%	80 - 120
6776621	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/06/09	ND, RDL=2.0		mg/L	
6776621	MCN	RPD	Dissolved Sulphate (SO4)	2020/06/09	NC		%	20
6776622	MCN	Matrix Spike	Reactive Silica (SiO2)	2020/06/09		94	%	80 - 120
6776622	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/06/09		97	%	80 - 120
6776622	MCN	Method Blank	Reactive Silica (SiO2)	2020/06/09	ND, RDL=0.50		mg/L	
6776622	MCN	RPD	Reactive Silica (SiO2)	2020/06/09	2.3		%	20
6776625	MCN	Spiked Blank	Colour	2020/06/10		104	%	80 - 120
6776625	MCN	Method Blank	Colour	2020/06/10	ND, RDL=5.0		TCU	
6776625	MCN	RPD	Colour	2020/06/10	NC		%	20
6776626	MCN	Matrix Spike	Orthophosphate (P)	2020/06/09		95	%	80 - 120
6776626	MCN	Spiked Blank	Orthophosphate (P)	2020/06/09		98	%	80 - 120
6776626	MCN	Method Blank	Orthophosphate (P)	2020/06/09	ND, RDL=0.010		mg/L	
6776626	MCN	RPD	Orthophosphate (P)	2020/06/09	NC		%	20
6776629	MCN	Matrix Spike	Nitrate + Nitrite (N)	2020/06/09		98	%	80 - 120
6776629	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/06/09		102	%	80 - 120
6776629	MCN	Method Blank	Nitrate + Nitrite (N)	2020/06/09	ND, RDL=0.050		mg/L	
6776629	MCN	RPD	Nitrate + Nitrite (N)	2020/06/09	0.12		%	20
6776630	MCN	Matrix Spike	Nitrite (N)	2020/06/09		108	%	80 - 120
6776630	MCN	Spiked Blank	Nitrite (N)	2020/06/09		111	%	80 - 120
6776630	MCN	Method Blank	Nitrite (N)	2020/06/09	ND, RDL=0.010		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6776630	MCN	RPD	Nitrite (N)	2020/06/09	NC		%	20

N/A = Not Applicable

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).

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Jason Wang, Bedford Micro

Mike MacGillivray, Scientific Specialist (Inorganics)

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.

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Your C.O.C. #: D 52677

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/10/26
Report #: R6384519
Version: 3 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0P9895
Received: 2020/10/05, 16:39

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride in Soil by Auto. Colourimetry	1	N/A	2020/10/14	ATL SOP 00014	SM 23 4500-Cl- E m
Conductance - soil	1	2020/10/08	2020/10/09	ATL SOP 00004	SM 23 2510B m
Metals Solids Acid Extr. ICPMS	1	2020/10/08	2020/10/09	ATL SOP 00058	EPA 6020B R2 m
Moisture	1	N/A	2020/10/08	ATL SOP 00001	OMOE Handbook 1983 m
Nitrogen Ammonia - soil (as N)	1	2020/10/09	2020/10/14	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	2020/10/13	2020/10/14	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite by auto colourimetry	1	2020/10/13	2020/10/13	ATL SOP 00017	SM 23 4500-NO2- B m
pH (5:1 DI Water Extract)	1	2020/10/08	2020/10/09	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho by auto Colourimetry	1	2020/10/13	2020/10/13	ATL SOP 00021	SM 23 4500-P E m
Particle size in solids (pipette&sieve) (1)	1	N/A	2020/10/22	ATL SOP 00012	MSAMS'78/WREP-125R3m
Sulphate in Soil by Auto Colourimetry	1	2020/10/13	2020/10/13	ATL SOP 00023	ASTM D516-16 m

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	6	N/A	2020/10/13	N/A	SM 23 4500-CO2 D
Alkalinity	6	N/A	2020/10/13	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	3	N/A	2020/10/13	ATL SOP 00014	SM 23 4500-Cl- E m
Chloride	3	N/A	2020/10/14	ATL SOP 00014	SM 23 4500-Cl- E m
TC/EC Non Drinking Water CFU/100mL	6	N/A	2020/10/06	ATL SOP 00096	MOE E3407 R2
Colour	6	N/A	2020/10/14	ATL SOP 00020	SM 23 2120C m
Conductance - water	6	N/A	2020/10/13	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	6	N/A	2020/10/09	ATL SOP 00048	Auto Calc
Metals Water Total MS	6	2020/10/06	2020/10/08	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	6	N/A	2020/10/14	N/A	Auto Calc.
Anion and Cation Sum	6	N/A	2020/10/14	N/A	Auto Calc.
Nitrogen Ammonia - water	6	N/A	2020/10/13	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	6	N/A	2020/10/13	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	6	N/A	2020/10/13	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	6	N/A	2020/10/14	ATL SOP 00018	ASTM D3867-16
pH (2)	6	N/A	2020/10/13	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	6	N/A	2020/10/13	ATL SOP 00021	SM 23 4500-P E m

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Your C.O.C. #: D 52677

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/10/26
Report #: R6384519
Version: 3 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0P9895
Received: 2020/10/05, 16:39

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sat. pH and Langelier Index (@ 20C)	6	N/A	2020/10/14	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	6	N/A	2020/10/14	ATL SOP 00049	Auto Calc.
Reactive Silica	6	N/A	2020/10/13	ATL SOP 00022	EPA 366.0 m
Sulphate	3	N/A	2020/10/13	ATL SOP 00023	ASTM D516-16 m
Sulphate	3	N/A	2020/10/14	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	6	N/A	2020/10/14	N/A	Auto Calc.
Organic carbon - Total (TOC) (3)	6	N/A	2020/10/13	ATL SOP 00203	SM 23 5310B m
Turbidity	6	N/A	2020/10/07	ATL SOP 00011	EPA 180.1 R2 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.
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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.
(1) Note: Graphical representation of larger fractions (PHI-4, PHI -3 and PHI -2) not applicable unless these optional parameters are specifically requested.
(2) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(3) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

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Your C.O.C. #: D 52677

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/10/26
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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0P9895
Received: 2020/10/05, 16:39

Encryption Key

Sam Sherker
Project Manager Assistant
26 Oct 2020 16:06:15

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bvlabs.com
Phone# (902)420-0203 Ext:252
==
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.

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP788			NUP789		
Sampling Date		2020/10/05 09:08			2020/10/05 09:20		
COC Number		D 52677			D 52677		
	UNITS	BARACHOIS BROOK	RDL	QC Batch	BARACHOIS POND	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	0.630	N/A	6982160	75.5	N/A	6982160
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	7.0	1.0	6982153	16	1.0	6982153
Calculated TDS	mg/L	40	1.0	6982170	4300	1.0	6982170
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	6982153	ND	1.0	6982153
Cation Sum	me/L	0.630	N/A	6982160	73.8	N/A	6982160
Hardness (CaCO3)	mg/L	9.5	1.0	6982156	830	1.0	6982156
Ion Balance (% Difference)	%	0.00	N/A	6982158	1.15	N/A	6982158
Langelier Index (@ 20C)	N/A	-3.90		6982166	-2.27		6982166
Langelier Index (@ 4C)	N/A	-4.15		6982169	-2.51		6982169
Nitrate (N)	mg/L	0.078	0.050	6982162	0.064	0.050	6982162
Saturation pH (@ 20C)	N/A	10.2		6982166	8.81		6982166
Saturation pH (@ 4C)	N/A	10.4		6982169	9.05		6982169
Inorganics							
Total Alkalinity (Total as CaCO3)	mg/L	7.0	5.0	6996142	16	5.0	6996164
Dissolved Chloride (Cl-)	mg/L	17	1.0	6996147	2400	50	6996166
Colour	TCU	140	25	6996158	78	25	6996175
Nitrate + Nitrite (N)	mg/L	0.078	0.050	6996161	0.064	0.050	6996181
Nitrite (N)	mg/L	ND	0.010	6996162	ND	0.010	6996183
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.050	6996516	0.052	0.050	6996516
Total Organic Carbon (C)	mg/L	14 (1)	5.0	6992980	10 (1)	5.0	6992980
Orthophosphate (P)	mg/L	0.012	0.010	6996159	ND	0.010	6996176
pH	pH	6.28		6996094	6.53		6996094
Reactive Silica (SiO2)	mg/L	4.2	0.50	6996151	0.51	0.50	6996171
Dissolved Sulphate (SO4)	mg/L	ND	2.0	6996149	310	10	6996168
Turbidity	NTU	1.5	0.10	6987394	2.0	0.10	6987390
Conductivity	uS/cm	68	1.0	6996092	7900	1.0	6996092
Metals							
Total Aluminum (Al)	ug/L	270	5.0	6984428	98	5.0	6984428
Total Antimony (Sb)	ug/L	ND	1.0	6984428	ND	1.0	6984428
Total Arsenic (As)	ug/L	24	1.0	6984428	24	1.0	6984428
Total Barium (Ba)	ug/L	3.8	1.0	6984428	24	1.0	6984428
Total Beryllium (Be)	ug/L	ND	1.0	6984428	ND	1.0	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected
(1) Elevated reporting limit due to sample matrix.

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP788			NUP789		
Sampling Date		2020/10/05 09:08			2020/10/05 09:20		
COC Number		D 52677			D 52677		
	UNITS	BARACHOIS BROOK	RDL	QC Batch	BARACHOIS POND	RDL	QC Batch
Total Bismuth (Bi)	ug/L	ND	2.0	6984428	ND	2.0	6984428
Total Boron (B)	ug/L	ND	50	6984428	540	50	6984428
Total Cadmium (Cd)	ug/L	0.013	0.010	6984428	0.025	0.010	6984428
Total Calcium (Ca)	ug/L	1900	100	6984428	57000	100	6984428
Total Chromium (Cr)	ug/L	ND	1.0	6984428	ND	1.0	6984428
Total Cobalt (Co)	ug/L	1.1	0.40	6984428	ND	0.40	6984428
Total Copper (Cu)	ug/L	ND	0.50	6984428	ND	0.50	6984428
Total Iron (Fe)	ug/L	1600	50	6984428	380	50	6984428
Total Lead (Pb)	ug/L	ND	0.50	6984428	ND	0.50	6984428
Total Magnesium (Mg)	ug/L	1100	100	6984428	170000	1000	6984428
Total Manganese (Mn)	ug/L	540	2.0	6984428	270	2.0	6984428
Total Molybdenum (Mo)	ug/L	ND	2.0	6984428	ND	2.0	6984428
Total Nickel (Ni)	ug/L	ND	2.0	6984428	ND	2.0	6984428
Total Phosphorus (P)	ug/L	ND	100	6984428	ND	100	6984428
Total Potassium (K)	ug/L	340	100	6984428	46000	100	6984428
Total Selenium (Se)	ug/L	ND	0.50	6984428	ND	0.50	6984428
Total Silver (Ag)	ug/L	ND	0.10	6984428	ND	0.10	6984428
Total Sodium (Na)	ug/L	8700	100	6984428	1300000	1000	6984428
Total Strontium (Sr)	ug/L	18	2.0	6984428	1100	2.0	6984428
Total Thallium (Tl)	ug/L	ND	0.10	6984428	ND	0.10	6984428
Total Tin (Sn)	ug/L	ND	2.0	6984428	ND	2.0	6984428
Total Titanium (Ti)	ug/L	3.6	2.0	6984428	ND	2.0	6984428
Total Uranium (U)	ug/L	ND	0.10	6984428	ND	0.10	6984428
Total Vanadium (V)	ug/L	ND	2.0	6984428	ND	2.0	6984428
Total Zinc (Zn)	ug/L	ND	5.0	6984428	ND	5.0	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP790			NUP791		NUP793		
Sampling Date		2020/10/05 09:30			2020/10/05 12:29		2020/10/05 13:20		
COC Number		D 52677			D 52677		D 52677		
	UNITS	**ROCKY POINT POND**	**RDL**	**QC Batch**	**CHANNEL (WATER)**	**QC Batch**	**SP10**	**RDL**	**QC Batch**
Calculated Parameters									
Anion Sum	me/L	0.590	N/A	6982160	535	6982160	537	N/A	6982160
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	6982153	93	6982153	92	1.0	6982153
Calculated TDS	mg/L	40	1.0	6982170	30000	6982170	30000	1.0	6982170
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	6982153	ND	6982153	ND	1.0	6982153
Cation Sum	me/L	0.640	N/A	6982160	503	6982160	488	N/A	6982160
Hardness (CaCO3)	mg/L	7.4	1.0	6982156	5400	6982156	5200	1.0	6982156
Ion Balance (% Difference)	%	4.07	N/A	6982158	3.05	6982158	4.74	N/A	6982158
Langelier Index (@ 20C)	N/A	NC		6982166	0.500	6982166	0.620		6982166
Langelier Index (@ 4C)	N/A	NC		6982169	0.261	6982169	0.381		6982169
Nitrate (N)	mg/L	ND	0.050	6982162	ND	6982162	0.068	0.050	6982162
Saturation pH (@ 20C)	N/A	NC		6982166	7.32	6982166	7.33		6982166
Saturation pH (@ 4C)	N/A	NC		6982169	7.56	6982169	7.57		6982169
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	ND	5.0	6996164	94	6996107	93	5.0	6996164
Dissolved Chloride (Cl-)	mg/L	18	1.0	6996166	17000	6996108	17000	500	6996166
Colour	TCU	190	25	6996175	ND	6996112	ND	5.0	6996175
Nitrate + Nitrite (N)	mg/L	ND	0.050	6996181	ND	6996115	0.068	0.050	6996181
Nitrite (N)	mg/L	ND	0.010	6996183	ND	6996118	ND	0.010	6996183
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.050	6996516	ND	6996516	ND	0.050	6996516
Total Organic Carbon (C)	mg/L	19 (1)	5.0	6992980	3.0	6992980	1.0	0.50	6992980
Orthophosphate (P)	mg/L	ND	0.010	6996176	0.011	6996113	ND	0.010	6996176
pH	pH	5.48		6996094	7.82	6996094	7.95		6996094
Reactive Silica (SiO2)	mg/L	4.1	0.50	6996171	ND	6996110	ND	0.50	6996171
Dissolved Sulphate (SO4)	mg/L	3.6	2.0	6996168	2400	6996109	2500	100	6996168
Turbidity	NTU	3.9	0.10	6987394	0.89	6987394	0.64	0.10	6987390
Conductivity	uS/cm	73	1.0	6996092	47000	6996092	47000	1.0	6996092
Metals									
Total Aluminum (Al)	ug/L	540	5.0	6984428	ND	6984428	ND	50	6984428
Total Antimony (Sb)	ug/L	ND	1.0	6984428	ND	6984428	ND	10	6984428
Total Arsenic (As)	ug/L	2.0	1.0	6984428	ND	6984428	ND	10	6984428
Total Barium (Ba)	ug/L	6.6	1.0	6984428	ND	6984428	ND	10	6984428
Total Beryllium (Be)	ug/L	ND	1.0	6984428	ND	6984428	ND	10	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected
(1) Elevated reporting limit due to turbidity.

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP790			NUP791		NUP793		
Sampling Date		2020/10/05 09:30			2020/10/05 12:29		2020/10/05 13:20		
COC Number		D 52677			D 52677		D 52677		
	UNITS	**ROCKY POINT POND**	**RDL**	**QC Batch**	**CHANNEL (WATER)**	**QC Batch**	**SP10**	**RDL**	**QC Batch**
Total Bismuth (Bi)	ug/L	ND	2.0	6984428	ND	6984428	ND	20	6984428
Total Boron (B)	ug/L	ND	50	6984428	3900	6984428	3900	500	6984428
Total Cadmium (Cd)	ug/L	0.019	0.010	6984428	ND	6984428	ND	0.10	6984428
Total Calcium (Ca)	ug/L	1200	100	6984428	350000	6984428	340000	1000	6984428
Total Chromium (Cr)	ug/L	ND	1.0	6984428	ND	6984428	ND	10	6984428
Total Cobalt (Co)	ug/L	1.7	0.40	6984428	ND	6984428	ND	4.0	6984428
Total Copper (Cu)	ug/L	0.53	0.50	6984428	ND	6984428	ND	5.0	6984428
Total Iron (Fe)	ug/L	2400	50	6984428	ND	6984428	ND	500	6984428
Total Lead (Pb)	ug/L	1.1	0.50	6984428	ND	6984428	ND	5.0	6984428
Total Magnesium (Mg)	ug/L	1100	100	6984428	1100000	6984428	1100000	1000	6984428
Total Manganese (Mn)	ug/L	560	2.0	6984428	ND	6984428	ND	20	6984428
Total Molybdenum (Mo)	ug/L	ND	2.0	6984428	ND	6984428	ND	20	6984428
Total Nickel (Ni)	ug/L	ND	2.0	6984428	ND	6984428	ND	20	6984428
Total Phosphorus (P)	ug/L	120	100	6984428	ND	6984428	ND	1000	6984428
Total Potassium (K)	ug/L	410	100	6984428	320000	6984428	310000	1000	6984428
Total Selenium (Se)	ug/L	ND	0.50	6984428	ND	6984428	ND	5.0	6984428
Total Silver (Ag)	ug/L	ND	0.10	6984428	ND	6984428	ND	1.0	6984428
Total Sodium (Na)	ug/L	9000	100	6984428	8900000	6984428	8600000	1000	6984428
Total Strontium (Sr)	ug/L	13	2.0	6984428	6400	6984428	6200	20	6984428
Total Thallium (Tl)	ug/L	ND	0.10	6984428	ND	6984428	ND	1.0	6984428
Total Tin (Sn)	ug/L	ND	2.0	6984428	ND	6984428	ND	20	6984428
Total Titanium (Ti)	ug/L	9.5	2.0	6984428	ND	6984428	ND	20	6984428
Total Uranium (U)	ug/L	ND	0.10	6984428	2.7	6984428	2.7	1.0	6984428
Total Vanadium (V)	ug/L	ND	2.0	6984428	ND	6984428	ND	20	6984428
Total Zinc (Zn)	ug/L	ND	5.0	6984428	ND	6984428	ND	50	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP794		
Sampling Date		2020/10/05 13:27		
COC Number		D 52677		
	UNITS	SP12	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	547	N/A	6982160
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	89	1.0	6982153
Calculated TDS	mg/L	31000	1.0	6982170
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1.0	6982153
Cation Sum	me/L	524	N/A	6982160
Hardness (CaCO3)	mg/L	5400	1.0	6982156
Ion Balance (% Difference)	%	2.14	N/A	6982158
Langelier Index (@ 20C)	N/A	0.671		6982166
Langelier Index (@ 4C)	N/A	0.432		6982169
Nitrate (N)	mg/L	ND	0.050	6982162
Saturation pH (@ 20C)	N/A	7.31		6982166
Saturation pH (@ 4C)	N/A	7.55		6982169
Inorganics				
Total Alkalinity (Total as CaCO3)	mg/L	90	5.0	6996164
Dissolved Chloride (Cl-)	mg/L	18000	500	6996166
Colour	TCU	ND	5.0	6996175
Nitrate + Nitrite (N)	mg/L	ND	0.050	6996181
Nitrite (N)	mg/L	ND	0.010	6996183
Nitrogen (Ammonia Nitrogen)	mg/L	0.17	0.050	6996516
Total Organic Carbon (C)	mg/L	1.0	0.50	6992981
Orthophosphate (P)	mg/L	ND	0.010	6996176
pH	pH	7.98		6996094
Reactive Silica (SiO2)	mg/L	ND	0.50	6996171
Dissolved Sulphate (SO4)	mg/L	2400	100	6996168
Turbidity	NTU	0.72	0.10	6987394
Conductivity	uS/cm	47000	1.0	6996092
Metals				
Total Aluminum (Al)	ug/L	ND	50	6984428
Total Antimony (Sb)	ug/L	ND	10	6984428
Total Arsenic (As)	ug/L	ND	10	6984428
Total Barium (Ba)	ug/L	ND	10	6984428
Total Beryllium (Be)	ug/L	ND	10	6984428
Total Bismuth (Bi)	ug/L	ND	20	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID		NUP794		
Sampling Date		2020/10/05 13:27		
COC Number		D 52677		
	UNITS	SP12	RDL	QC Batch
Total Boron (B)	ug/L	4200	500	6984428
Total Cadmium (Cd)	ug/L	ND	0.10	6984428
Total Calcium (Ca)	ug/L	360000	1000	6984428
Total Chromium (Cr)	ug/L	ND	10	6984428
Total Cobalt (Co)	ug/L	ND	4.0	6984428
Total Copper (Cu)	ug/L	ND	5.0	6984428
Total Iron (Fe)	ug/L	ND	500	6984428
Total Lead (Pb)	ug/L	ND	5.0	6984428
Total Magnesium (Mg)	ug/L	1100000	10000	6984428
Total Manganese (Mn)	ug/L	ND	20	6984428
Total Molybdenum (Mo)	ug/L	ND	20	6984428
Total Nickel (Ni)	ug/L	ND	20	6984428
Total Phosphorus (P)	ug/L	ND	1000	6984428
Total Potassium (K)	ug/L	340000	1000	6984428
Total Selenium (Se)	ug/L	ND	5.0	6984428
Total Silver (Ag)	ug/L	ND	1.0	6984428
Total Sodium (Na)	ug/L	9400000	1000	6984428
Total Strontium (Sr)	ug/L	6700	20	6984428
Total Thallium (Tl)	ug/L	ND	1.0	6984428
Total Tin (Sn)	ug/L	ND	20	6984428
Total Titanium (Ti)	ug/L	ND	20	6984428
Total Uranium (U)	ug/L	2.9	1.0	6984428
Total Vanadium (V)	ug/L	ND	20	6984428
Total Zinc (Zn)	ug/L	ND	50	6984428

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

RESULTS OF ANALYSES OF SOIL

BV Labs ID		NUP837		
Sampling Date		2020/10/05 12:29		
COC Number		D 52677		
	UNITS	CHANNEL (SOIL)	RDL	QC Batch
Inorganics				
Ammonia-N	mg/kg	15 (1)	0.49	6996554
Chloride (Cl-)	mg/kg	9700	250	6996201
Conductivity	uS/cm	6000	1.0	6993101
Moisture	%	43	1.0	6987464
Nitrate + Nitrite (N)	mg/kg	3.7 (2)	0.25	6996206
Nitrite (N)	mg/kg	ND	0.050	6996207
Orthophosphate (P)	mg/kg	1.6	0.050	6996205
Soluble (5:1) pH	pH	7.68	N/A	6993100
Sulphate (SO4)	mg/kg	1200	100	6996204
< -1 Phi (2 mm)	%	100	0.10	6998701
< 0 Phi (1 mm)	%	100	0.10	6998701
< +1 Phi (0.5 mm)	%	99	0.10	6998701
< +2 Phi (0.25 mm)	%	94	0.10	6998701
< +3 Phi (0.12 mm)	%	58	0.10	6998701
< +4 Phi (0.062 mm)	%	31	0.10	6998701
< +5 Phi (0.031 mm)	%	25	0.10	6998701
< +6 Phi (0.016 mm)	%	17	0.10	6998701
< +7 Phi (0.0078 mm)	%	11	0.10	6998701
< +8 Phi (0.0039 mm)	%	9.7	0.10	6998701
< +9 Phi (0.0020 mm)	%	8.1	0.10	6998701
Gravel	%	ND	0.10	6998701
Sand	%	69	0.10	6998701
Silt	%	22	0.10	6998701
Clay	%	9.7	0.10	6998701

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable
(1) Duplicate results exceeded RPD acceptance criteria. This may be due to sample heterogeneity. Results confirmed by repeat analysis.
(2) Poor duplicate agreement due to sample matrix, results confirmed by repeat analysis.

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ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		NUP837		
Sampling Date		2020/10/05 12:29		
COC Number		D 52677		
	UNITS	**CHANNEL (SOIL)**	**RDL**	**QC Batch**
Metals				
Acid Extractable Aluminum (Al)	mg/kg	6400	10	6989829
Acid Extractable Antimony (Sb)	mg/kg	ND	2.0	6989829
Acid Extractable Arsenic (As)	mg/kg	58	2.0	6989829
Acid Extractable Barium (Ba)	mg/kg	15	5.0	6989829
Acid Extractable Beryllium (Be)	mg/kg	ND	2.0	6989829
Acid Extractable Bismuth (Bi)	mg/kg	ND	2.0	6989829
Acid Extractable Boron (B)	mg/kg	ND	50	6989829
Acid Extractable Cadmium (Cd)	mg/kg	ND	0.30	6989829
Acid Extractable Chromium (Cr)	mg/kg	11	2.0	6989829
Acid Extractable Cobalt (Co)	mg/kg	5.4	1.0	6989829
Acid Extractable Copper (Cu)	mg/kg	7.2	2.0	6989829
Acid Extractable Iron (Fe)	mg/kg	14000	50	6989829
Acid Extractable Lead (Pb)	mg/kg	5.7	0.50	6989829
Acid Extractable Lithium (Li)	mg/kg	18	2.0	6989829
Acid Extractable Manganese (Mn)	mg/kg	290	2.0	6989829
Acid Extractable Mercury (Hg)	mg/kg	ND	0.10	6989829
Acid Extractable Molybdenum (Mo)	mg/kg	ND	2.0	6989829
Acid Extractable Nickel (Ni)	mg/kg	12	2.0	6989829
Acid Extractable Rubidium (Rb)	mg/kg	6.5	2.0	6989829
Acid Extractable Selenium (Se)	mg/kg	ND	0.50	6989829
Acid Extractable Silver (Ag)	mg/kg	ND	0.50	6989829
Acid Extractable Strontium (Sr)	mg/kg	24	5.0	6989829
Acid Extractable Thallium (Tl)	mg/kg	ND	0.10	6989829
Acid Extractable Tin (Sn)	mg/kg	ND	1.0	6989829
Acid Extractable Uranium (U)	mg/kg	0.72	0.10	6989829
Acid Extractable Vanadium (V)	mg/kg	15	2.0	6989829
Acid Extractable Zinc (Zn)	mg/kg	30	5.0	6989829

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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MICROBIOLOGY (WATER)

BV Labs ID		NUP788	NUP789	NUP790		NUP791		
Sampling Date		2020/10/05 09:08	2020/10/05 09:20	2020/10/05 09:30		2020/10/05 12:29		
COC Number		D 52677	D 52677	D 52677		D 52677		
	UNITS	BARACHOIS BROOK	BARACHOIS POND	ROCKY POINT POND	RDL	CHANNEL (WATER)	RDL	QC Batch
Microbiological								
Escherichia coli	CFU/100mL	80	20	40	10	ND	1.0	6984550
Total Coliforms	CFU/100mL	960	>2500	1100	10	ND	1.0	6984550

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

BV Labs ID		NUP793	NUP794		
Sampling Date		2020/10/05 13:20	2020/10/05 13:27		
COC Number		D 52677	D 52677		
	UNITS	SP10	SP12	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	ND	ND	1.0	6984550
Total Coliforms	CFU/100mL	1.0	ND	1.0	6984550

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.3°C

High background growth on Coliform/E.coli plates for samples Channel (Wtaer), SP10 and SP12

Sample NUP788 [BARACHOIS BROOK] : ortho-Phosphate > Total Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Sample NUP791 [CHANNEL (WATER)] : Elevated reporting limits for trace metals due to sample matrix. ortho-Phosphate > Total Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Sample NUP793 [SP10] : Elevated reporting limits for trace metals due to sample matrix.

Sample NUP794 [SP12] : Elevated reporting limits for trace metals due to sample matrix.

Results relate only to the items tested.

BUREAU VERITAS

BV Labs Job #: C0P9895
Report Date: 2020/10/26

Whale Sanctuary

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6984428	BAN	Matrix Spike	Total Aluminum (Al)	2020/10/07		97	%	80 - 120
			Total Antimony (Sb)	2020/10/07		99	%	80 - 120
			Total Arsenic (As)	2020/10/07		95	%	80 - 120
			Total Barium (Ba)	2020/10/07		93	%	80 - 120
			Total Beryllium (Be)	2020/10/07		98	%	80 - 120
			Total Bismuth (Bi)	2020/10/07		96	%	80 - 120
			Total Boron (B)	2020/10/07		98	%	80 - 120
			Total Cadmium (Cd)	2020/10/07		95	%	80 - 120
			Total Calcium (Ca)	2020/10/07		99	%	80 - 120
			Total Chromium (Cr)	2020/10/07		94	%	80 - 120
			Total Cobalt (Co)	2020/10/07		95	%	80 - 120
			Total Copper (Cu)	2020/10/07		92	%	80 - 120
			Total Iron (Fe)	2020/10/07		98	%	80 - 120
			Total Lead (Pb)	2020/10/07		95	%	80 - 120
			Total Magnesium (Mg)	2020/10/07		98	%	80 - 120
			Total Manganese (Mn)	2020/10/07		99	%	80 - 120
			Total Molybdenum (Mo)	2020/10/07		99	%	80 - 120
			Total Nickel (Ni)	2020/10/07		96	%	80 - 120
			Total Phosphorus (P)	2020/10/07		99	%	80 - 120
			Total Potassium (K)	2020/10/07		99	%	80 - 120
			Total Selenium (Se)	2020/10/07		99	%	80 - 120
			Total Silver (Ag)	2020/10/07		95	%	80 - 120
			Total Sodium (Na)	2020/10/07		93	%	80 - 120
			Total Strontium (Sr)	2020/10/07		98	%	80 - 120
			Total Thallium (Tl)	2020/10/07		96	%	80 - 120
			Total Tin (Sn)	2020/10/07		100	%	80 - 120
			Total Titanium (Ti)	2020/10/07		100	%	80 - 120
			Total Uranium (U)	2020/10/07		102	%	80 - 120
			Total Vanadium (V)	2020/10/07		94	%	80 - 120
			Total Zinc (Zn)	2020/10/07		94	%	80 - 120
6984428	BAN	Spiked Blank	Total Aluminum (Al)	2020/10/07		99	%	80 - 120
			Total Antimony (Sb)	2020/10/07		97	%	80 - 120
			Total Arsenic (As)	2020/10/07		93	%	80 - 120
			Total Barium (Ba)	2020/10/07		93	%	80 - 120
			Total Beryllium (Be)	2020/10/07		98	%	80 - 120
			Total Bismuth (Bi)	2020/10/07		97	%	80 - 120
			Total Boron (B)	2020/10/07		96	%	80 - 120
			Total Cadmium (Cd)	2020/10/07		93	%	80 - 120
			Total Calcium (Ca)	2020/10/07		101	%	80 - 120
			Total Chromium (Cr)	2020/10/07		92	%	80 - 120
			Total Cobalt (Co)	2020/10/07		94	%	80 - 120
			Total Copper (Cu)	2020/10/07		91	%	80 - 120
			Total Iron (Fe)	2020/10/07		101	%	80 - 120
			Total Lead (Pb)	2020/10/07		94	%	80 - 120
			Total Magnesium (Mg)	2020/10/07		100	%	80 - 120
			Total Manganese (Mn)	2020/10/07		98	%	80 - 120
			Total Molybdenum (Mo)	2020/10/07		96	%	80 - 120
			Total Nickel (Ni)	2020/10/07		97	%	80 - 120
			Total Phosphorus (P)	2020/10/07		100	%	80 - 120
			Total Potassium (K)	2020/10/07		102	%	80 - 120
			Total Selenium (Se)	2020/10/07		97	%	80 - 120
			Total Silver (Ag)	2020/10/07		94	%	80 - 120
			Total Sodium (Na)	2020/10/07		96	%	80 - 120
			Total Strontium (Sr)	2020/10/07		98	%	80 - 120
			Total Thallium (Tl)	2020/10/07		95	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2020/10/07		97	%	80 - 120
			Total Titanium (Ti)	2020/10/07		99	%	80 - 120
			Total Uranium (U)	2020/10/07		102	%	80 - 120
			Total Vanadium (V)	2020/10/07		92	%	80 - 120
			Total Zinc (Zn)	2020/10/07		96	%	80 - 120
6984428	BAN	Method Blank	Total Aluminum (Al)	2020/10/07	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/10/07	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/10/07	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/10/07	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/10/07	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/10/07	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/10/07	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/10/07	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/10/07	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/10/07	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/10/07	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/10/07	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/10/07	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/10/07	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/10/07	ND, RDL=100		ug/L	
			Total Potassium (K)	2020/10/07	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/10/07	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2020/10/07	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/10/07	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/10/07	ND, RDL=0.10		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/10/07	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/10/07	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/10/07	ND, RDL=5.0		ug/L	
6984428	BAN	RPD	Total Aluminum (Al)	2020/10/07	2.1		%	20
6984550	RED	Method Blank	Escherichia coli		ND, RDL=1.0		CFU/100mL	
			Total Coliforms		ND, RDL=1.0		CFU/100mL	
6987390	SHW	QC Standard	Turbidity	2020/10/07		101	%	80 - 120
6987390	SHW	Spiked Blank	Turbidity	2020/10/07		94	%	80 - 120
6987390	SHW	Method Blank	Turbidity	2020/10/07	ND, RDL=0.10		NTU	
6987390	SHW	RPD	Turbidity	2020/10/07	8.0		%	20
6987394	SHW	QC Standard	Turbidity	2020/10/07		101	%	80 - 120
6987394	SHW	Spiked Blank	Turbidity	2020/10/07		93	%	80 - 120
6987394	SHW	Method Blank	Turbidity	2020/10/07	ND, RDL=0.10		NTU	
6987394	SHW	RPD	Turbidity	2020/10/07	2.7		%	20
6987464	MGN	RPD	Moisture	2020/10/08	10		%	25
6989829	BAN	Matrix Spike	Acid Extractable Antimony (Sb)	2020/10/09		95	%	75 - 125
			Acid Extractable Arsenic (As)	2020/10/09		103	%	75 - 125
			Acid Extractable Barium (Ba)	2020/10/09		NC	%	75 - 125
			Acid Extractable Beryllium (Be)	2020/10/09		98	%	75 - 125
			Acid Extractable Bismuth (Bi)	2020/10/09		102	%	75 - 125
			Acid Extractable Boron (B)	2020/10/09		86	%	75 - 125
			Acid Extractable Cadmium (Cd)	2020/10/09		95	%	75 - 125
			Acid Extractable Chromium (Cr)	2020/10/09		85	%	75 - 125
			Acid Extractable Cobalt (Co)	2020/10/09		96	%	75 - 125
			Acid Extractable Copper (Cu)	2020/10/09		93	%	75 - 125
			Acid Extractable Lead (Pb)	2020/10/09		NC	%	75 - 125
			Acid Extractable Lithium (Li)	2020/10/09		104	%	75 - 125
			Acid Extractable Manganese (Mn)	2020/10/09		NC	%	75 - 125
			Acid Extractable Mercury (Hg)	2020/10/09		95	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2020/10/09		83	%	75 - 125
			Acid Extractable Nickel (Ni)	2020/10/09		96	%	75 - 125
			Acid Extractable Rubidium (Rb)	2020/10/09		94	%	75 - 125
			Acid Extractable Selenium (Se)	2020/10/09		93	%	75 - 125
			Acid Extractable Silver (Ag)	2020/10/09		101	%	75 - 125
			Acid Extractable Strontium (Sr)	2020/10/09		104	%	75 - 125
			Acid Extractable Thallium (Tl)	2020/10/09		101	%	75 - 125
			Acid Extractable Tin (Sn)	2020/10/09		106	%	75 - 125
			Acid Extractable Uranium (U)	2020/10/09		101	%	75 - 125
			Acid Extractable Vanadium (V)	2020/10/09		101	%	75 - 125
			Acid Extractable Zinc (Zn)	2020/10/09		NC	%	75 - 125
6989829	BAN	Spiked Blank	Acid Extractable Antimony (Sb)	2020/10/09		112	%	75 - 125
			Acid Extractable Arsenic (As)	2020/10/09		101	%	75 - 125
			Acid Extractable Barium (Ba)	2020/10/09		105	%	75 - 125
			Acid Extractable Beryllium (Be)	2020/10/09		99	%	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Bismuth (Bi)	2020/10/09		103	%	75 - 125
			Acid Extractable Boron (B)	2020/10/09		98	%	75 - 125
			Acid Extractable Cadmium (Cd)	2020/10/09		96	%	75 - 125
			Acid Extractable Chromium (Cr)	2020/10/09		100	%	75 - 125
			Acid Extractable Cobalt (Co)	2020/10/09		99	%	75 - 125
			Acid Extractable Copper (Cu)	2020/10/09		96	%	75 - 125
			Acid Extractable Lead (Pb)	2020/10/09		102	%	75 - 125
			Acid Extractable Lithium (Li)	2020/10/09		106	%	75 - 125
			Acid Extractable Manganese (Mn)	2020/10/09		101	%	75 - 125
			Acid Extractable Mercury (Hg)	2020/10/09		105	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2020/10/09		108	%	75 - 125
			Acid Extractable Nickel (Ni)	2020/10/09		98	%	75 - 125
			Acid Extractable Rubidium (Rb)	2020/10/09		100	%	75 - 125
			Acid Extractable Selenium (Se)	2020/10/09		99	%	75 - 125
			Acid Extractable Silver (Ag)	2020/10/09		99	%	75 - 125
			Acid Extractable Strontium (Sr)	2020/10/09		105	%	75 - 125
			Acid Extractable Thallium (Tl)	2020/10/09		104	%	75 - 125
			Acid Extractable Tin (Sn)	2020/10/09		104	%	75 - 125
			Acid Extractable Uranium (U)	2020/10/09		103	%	75 - 125
			Acid Extractable Vanadium (V)	2020/10/09		103	%	75 - 125
			Acid Extractable Zinc (Zn)	2020/10/09		98	%	75 - 125
6989829	BAN	Method Blank	Acid Extractable Aluminum (Al)	2020/10/09	ND, RDL=10		mg/kg	
			Acid Extractable Antimony (Sb)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Arsenic (As)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Barium (Ba)	2020/10/09	ND, RDL=5.0		mg/kg	
			Acid Extractable Beryllium (Be)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Bismuth (Bi)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Boron (B)	2020/10/09	ND, RDL=50		mg/kg	
			Acid Extractable Cadmium (Cd)	2020/10/09	ND, RDL=0.30		mg/kg	
			Acid Extractable Chromium (Cr)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Cobalt (Co)	2020/10/09	ND, RDL=1.0		mg/kg	
			Acid Extractable Copper (Cu)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Iron (Fe)	2020/10/09	ND, RDL=50		mg/kg	
			Acid Extractable Lead (Pb)	2020/10/09	ND, RDL=0.50		mg/kg	
			Acid Extractable Lithium (Li)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Manganese (Mn)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Mercury (Hg)	2020/10/09	ND, RDL=0.10		mg/kg	
			Acid Extractable Molybdenum (Mo)	2020/10/09	ND, RDL=2.0		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Nickel (Ni)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Rubidium (Rb)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Selenium (Se)	2020/10/09	ND, RDL=0.50		mg/kg	
			Acid Extractable Silver (Ag)	2020/10/09	ND, RDL=0.50		mg/kg	
			Acid Extractable Strontium (Sr)	2020/10/09	ND, RDL=5.0		mg/kg	
			Acid Extractable Thallium (Tl)	2020/10/09	ND, RDL=0.10		mg/kg	
			Acid Extractable Tin (Sn)	2020/10/09	ND, RDL=1.0		mg/kg	
			Acid Extractable Uranium (U)	2020/10/09	ND, RDL=0.10		mg/kg	
			Acid Extractable Vanadium (V)	2020/10/09	ND, RDL=2.0		mg/kg	
			Acid Extractable Zinc (Zn)	2020/10/09	ND, RDL=5.0		mg/kg	
6989829	BAN	RPD	Acid Extractable Aluminum (Al)	2020/10/09	1.7		%	35
			Acid Extractable Antimony (Sb)	2020/10/09	NC		%	35
			Acid Extractable Arsenic (As)	2020/10/09	15		%	35
			Acid Extractable Barium (Ba)	2020/10/09	3.0		%	35
			Acid Extractable Beryllium (Be)	2020/10/09	NC		%	35
			Acid Extractable Bismuth (Bi)	2020/10/09	NC		%	35
			Acid Extractable Boron (B)	2020/10/09	NC		%	35
			Acid Extractable Cadmium (Cd)	2020/10/09	NC		%	35
			Acid Extractable Chromium (Cr)	2020/10/09	2.0		%	35
			Acid Extractable Cobalt (Co)	2020/10/09	2.1		%	35
			Acid Extractable Copper (Cu)	2020/10/09	8.3		%	35
			Acid Extractable Iron (Fe)	2020/10/09	0.46		%	35
			Acid Extractable Lead (Pb)	2020/10/09	2.4		%	35
			Acid Extractable Lithium (Li)	2020/10/09	3.1		%	35
			Acid Extractable Manganese (Mn)	2020/10/09	7.9		%	35
			Acid Extractable Mercury (Hg)	2020/10/09	3.2		%	35
			Acid Extractable Molybdenum (Mo)	2020/10/09	8.9		%	35
			Acid Extractable Nickel (Ni)	2020/10/09	3.7		%	35
			Acid Extractable Rubidium (Rb)	2020/10/09	3.5		%	35
			Acid Extractable Selenium (Se)	2020/10/09	5.7		%	35
			Acid Extractable Silver (Ag)	2020/10/09	NC		%	35
			Acid Extractable Strontium (Sr)	2020/10/09	14		%	35
			Acid Extractable Thallium (Tl)	2020/10/09	0.26		%	35
			Acid Extractable Tin (Sn)	2020/10/09	NC		%	35
			Acid Extractable Uranium (U)	2020/10/09	1.0		%	35
			Acid Extractable Vanadium (V)	2020/10/09	0.94		%	35
			Acid Extractable Zinc (Zn)	2020/10/09	3.2		%	35
6992980	YLG	Matrix Spike	Total Organic Carbon (C)	2020/10/13		95	%	85 - 115
6992980	YLG	Spiked Blank	Total Organic Carbon (C)	2020/10/13		97	%	80 - 120
6992980	YLG	Method Blank	Total Organic Carbon (C)	2020/10/13	ND, RDL=0.50		mg/L	
6992980	YLG	RPD	Total Organic Carbon (C)	2020/10/13	2.6		%	15
6992981	YLG	Matrix Spike	Total Organic Carbon (C)	2020/10/13		96	%	85 - 115
6992981	YLG	Spiked Blank	Total Organic Carbon (C)	2020/10/13		93	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6992981	YLG	Method Blank	Total Organic Carbon (C)	2020/10/13	ND, RDL=0.50		mg/L	
6992981	YLG	RPD	Total Organic Carbon (C)	2020/10/13	NC		%	15
6993100	SSI	RPD [NUP837-01]	Soluble (5:1) pH	2020/10/09	1.3		%	N/A
6993101	SSI	RPD [NUP837-01]	Conductivity	2020/10/09	6.9		%	20
6996092	SHW	Spiked Blank	Conductivity	2020/10/13		102	%	80 - 120
6996092	SHW	Method Blank	Conductivity	2020/10/13	1.2, RDL=1.0		uS/cm	
6996092	SHW	RPD	Conductivity	2020/10/13	0.76		%	10
6996094	SHW	Spiked Blank	pH	2020/10/13		100	%	97 - 103
6996094	SHW	RPD	pH	2020/10/13	1.1		%	N/A
6996107	MCN	Matrix Spike [NUP791-02]	Total Alkalinity (Total as CaCO3)	2020/10/13		NC	%	80 - 120
6996107	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/10/13		109	%	80 - 120
6996107	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/10/13	ND, RDL=5.0		mg/L	
6996107	MCN	RPD [NUP791-02]	Total Alkalinity (Total as CaCO3)	2020/10/13	3.2		%	20
6996108	MCN	Matrix Spike [NUP791-02]	Dissolved Chloride (Cl-)	2020/10/13		NC	%	80 - 120
6996108	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/10/13		99	%	80 - 120
6996108	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/10/13	ND, RDL=1.0		mg/L	
6996108	MCN	RPD [NUP791-02]	Dissolved Chloride (Cl-)	2020/10/13	3.2		%	20
6996109	MCN	Matrix Spike [NUP791-02]	Dissolved Sulphate (SO4)	2020/10/14		NC	%	80 - 120
6996109	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/10/13		107	%	80 - 120
6996109	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/10/13	ND, RDL=2.0		mg/L	
6996109	MCN	RPD [NUP791-02]	Dissolved Sulphate (SO4)	2020/10/14	1.2		%	20
6996110	MCN	Matrix Spike [NUP791-02]	Reactive Silica (SiO2)	2020/10/13		90	%	80 - 120
6996110	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/10/13		87	%	80 - 120
6996110	MCN	Method Blank	Reactive Silica (SiO2)	2020/10/13	ND, RDL=0.50		mg/L	
6996110	MCN	RPD [NUP791-02]	Reactive Silica (SiO2)	2020/10/13	NC		%	20
6996112	MCN	Spiked Blank	Colour	2020/10/14		93	%	80 - 120
6996112	MCN	Method Blank	Colour	2020/10/14	ND, RDL=5.0		TCU	
6996112	MCN	RPD [NUP791-02]	Colour	2020/10/14	NC		%	20
6996113	MCN	Matrix Spike [NUP791-02]	Orthophosphate (P)	2020/10/13		98	%	80 - 120
6996113	MCN	Spiked Blank	Orthophosphate (P)	2020/10/13		105	%	80 - 120
6996113	MCN	Method Blank	Orthophosphate (P)	2020/10/13	ND, RDL=0.010		mg/L	
6996113	MCN	RPD [NUP791-02]	Orthophosphate (P)	2020/10/13	8.6		%	20
6996115	MCN	Matrix Spike [NUP791-02]	Nitrate + Nitrite (N)	2020/10/13		105	%	80 - 120
6996115	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/10/13		104	%	80 - 120
6996115	MCN	Method Blank	Nitrate + Nitrite (N)	2020/10/13	ND, RDL=0.050		mg/L	
6996115	MCN	RPD [NUP791-02]	Nitrate + Nitrite (N)	2020/10/13	NC		%	20
6996118	MCN	Matrix Spike [NUP791-02]	Nitrite (N)	2020/10/13		105	%	80 - 120
6996118	MCN	Spiked Blank	Nitrite (N)	2020/10/13		104	%	80 - 120
6996118	MCN	Method Blank	Nitrite (N)	2020/10/13	ND, RDL=0.010		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6996118	MCN	RPD [NUP791-02]	Nitrite (N)	2020/10/13	NC		%	20
6996142	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/10/13		NC	%	80 - 120
6996142	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/10/13		103	%	80 - 120
6996142	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/10/13	ND, RDL=5.0		mg/L	
6996142	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/10/13	2.7		%	20
6996147	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2020/10/13		93	%	80 - 120
6996147	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/10/13		100	%	80 - 120
6996147	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/10/13	ND, RDL=1.0		mg/L	
6996147	MCN	RPD	Dissolved Chloride (Cl-)	2020/10/13	0.13		%	20
6996149	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2020/10/13		NC	%	80 - 120
6996149	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/10/13		105	%	80 - 120
6996149	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/10/13	ND, RDL=2.0		mg/L	
6996149	MCN	RPD	Dissolved Sulphate (SO4)	2020/10/13	2.3		%	20
6996151	MCN	Matrix Spike	Reactive Silica (SiO2)	2020/10/13		96	%	80 - 120
6996151	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/10/13		101	%	80 - 120
6996151	MCN	Method Blank	Reactive Silica (SiO2)	2020/10/13	ND, RDL=0.50		mg/L	
6996151	MCN	RPD	Reactive Silica (SiO2)	2020/10/13	NC		%	20
6996158	MCN	Spiked Blank	Colour	2020/10/14		96	%	80 - 120
6996158	MCN	Method Blank	Colour	2020/10/14	ND, RDL=5.0		TCU	
6996158	MCN	RPD	Colour	2020/10/14	4.1		%	20
6996159	MCN	Matrix Spike	Orthophosphate (P)	2020/10/13		102	%	80 - 120
6996159	MCN	Spiked Blank	Orthophosphate (P)	2020/10/13		105	%	80 - 120
6996159	MCN	Method Blank	Orthophosphate (P)	2020/10/13	ND, RDL=0.010		mg/L	
6996159	MCN	RPD	Orthophosphate (P)	2020/10/13	4.9		%	20
6996161	MCN	Matrix Spike	Nitrate + Nitrite (N)	2020/10/13		103	%	80 - 120
6996161	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/10/13		108	%	80 - 120
6996161	MCN	Method Blank	Nitrate + Nitrite (N)	2020/10/14	ND, RDL=0.050		mg/L	
6996161	MCN	RPD	Nitrate + Nitrite (N)	2020/10/13	5.4		%	20
6996162	MCN	Matrix Spike	Nitrite (N)	2020/10/13		101	%	80 - 120
6996162	MCN	Spiked Blank	Nitrite (N)	2020/10/13		104	%	80 - 120
6996162	MCN	Method Blank	Nitrite (N)	2020/10/13	ND, RDL=0.010		mg/L	
6996162	MCN	RPD	Nitrite (N)	2020/10/13	NC		%	20
6996164	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/10/13		NC	%	80 - 120
6996164	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/10/13		103	%	80 - 120
6996164	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/10/13	ND, RDL=5.0		mg/L	
6996164	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/10/13	1.0		%	20
6996166	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2020/10/14		NC	%	80 - 120
6996166	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/10/13		99	%	80 - 120
6996166	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/10/13	ND, RDL=1.0		mg/L	
6996166	MCN	RPD	Dissolved Chloride (Cl-)	2020/10/14	6.4		%	20
6996168	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2020/10/13		NC	%	80 - 120
6996168	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/10/13		96	%	80 - 120
6996168	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/10/13	ND, RDL=2.0		mg/L	
6996168	MCN	RPD	Dissolved Sulphate (SO4)	2020/10/13	1.6		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6996171	MCN	Matrix Spike	Reactive Silica (SiO2)	2020/10/13		82	%	80 - 120
6996171	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/10/13		98	%	80 - 120
6996171	MCN	Method Blank	Reactive Silica (SiO2)	2020/10/13	ND, RDL=0.50		mg/L	
6996171	MCN	RPD	Reactive Silica (SiO2)	2020/10/13	7.8		%	20
6996175	MCN	Spiked Blank	Colour	2020/10/14		92	%	80 - 120
6996175	MCN	Method Blank	Colour	2020/10/14	ND, RDL=5.0		TCU	
6996175	MCN	RPD	Colour	2020/10/14	8.3		%	20
6996176	MCN	Matrix Spike	Orthophosphate (P)	2020/10/13		97	%	80 - 120
6996176	MCN	Spiked Blank	Orthophosphate (P)	2020/10/13		106	%	80 - 120
6996176	MCN	Method Blank	Orthophosphate (P)	2020/10/13	ND, RDL=0.010		mg/L	
6996176	MCN	RPD	Orthophosphate (P)	2020/10/13	NC		%	20
6996181	MCN	Matrix Spike	Nitrate + Nitrite (N)	2020/10/13		93	%	80 - 120
6996181	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/10/13		106	%	80 - 120
6996181	MCN	Method Blank	Nitrate + Nitrite (N)	2020/10/14	ND, RDL=0.050		mg/L	
6996181	MCN	RPD	Nitrate + Nitrite (N)	2020/10/13	3.1		%	20
6996183	MCN	Matrix Spike	Nitrite (N)	2020/10/13		105	%	80 - 120
6996183	MCN	Spiked Blank	Nitrite (N)	2020/10/13		86	%	80 - 120
6996183	MCN	Method Blank	Nitrite (N)	2020/10/13	ND, RDL=0.010		mg/L	
6996183	MCN	RPD	Nitrite (N)	2020/10/13	NC		%	20
6996201	MCN	Matrix Spike [NUP837-01]	Chloride (Cl-)	2020/10/14		0 (1)	%	80 - 120
6996201	MCN	Spiked Blank	Chloride (Cl-)	2020/10/14		98	%	80 - 120
6996201	MCN	Method Blank	Chloride (Cl-)	2020/10/14	ND, RDL=5.0		mg/kg	
6996201	MCN	RPD [NUP837-01]	Chloride (Cl-)	2020/10/14	6.9		%	30
6996204	MCN	Matrix Spike [NUP837-01]	Sulphate (SO4)	2020/10/13		NC	%	80 - 120
6996204	MCN	Spiked Blank	Sulphate (SO4)	2020/10/13		112	%	80 - 120
6996204	MCN	Method Blank	Sulphate (SO4)	2020/10/14	ND, RDL=20		mg/kg	
6996204	MCN	RPD [NUP837-01]	Sulphate (SO4)	2020/10/13	11		%	30
6996205	MCN	Matrix Spike [NUP837-01]	Orthophosphate (P)	2020/10/13		94	%	80 - 120
6996205	MCN	Spiked Blank	Orthophosphate (P)	2020/10/13		108	%	80 - 120
6996205	MCN	Method Blank	Orthophosphate (P)	2020/10/13	ND, RDL=0.050		mg/kg	
6996205	MCN	RPD [NUP837-01]	Orthophosphate (P)	2020/10/13	0.16		%	30
6996206	MCN	Matrix Spike [NUP837-01]	Nitrate + Nitrite (N)	2020/10/13		100	%	75 - 125
6996206	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/10/13		102	%	80 - 120
6996206	MCN	Method Blank	Nitrate + Nitrite (N)	2020/10/13	ND, RDL=0.25		mg/kg	
6996206	MCN	RPD [NUP837-01]	Nitrate + Nitrite (N)	2020/10/14	40 (2)		%	30
6996207	MCN	Matrix Spike [NUP837-01]	Nitrite (N)	2020/10/13		79	%	70 - 130
6996207	MCN	Spiked Blank	Nitrite (N)	2020/10/13		105	%	70 - 130
6996207	MCN	Method Blank	Nitrite (N)	2020/10/13	ND, RDL=0.050		mg/kg	
6996207	MCN	RPD [NUP837-01]	Nitrite (N)	2020/10/13	NC		%	30
6996516	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2020/10/13		97	%	80 - 120
6996516	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/10/13		96	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6996516	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/10/13	ND, RDL=0.050		mg/L	
6996516	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2020/10/13	NC		%	20
6996554	MCN	Matrix Spike [NUP837-01]	Ammonia-N	2020/10/14		NC (3)	%	75 - 125
6996554	MCN	Spiked Blank	Ammonia-N	2020/10/14		98	%	80 - 120
6996554	MCN	Method Blank	Ammonia-N	2020/10/14	ND, RDL=0.25		mg/kg	
6996554	MCN	RPD [NUP837-01]	Ammonia-N	2020/10/14	84 (4)		%	30
6998701	TPE	RPD	Gravel	2020/10/22	115 (5)		%	35
			Sand	2020/10/22	1.8		%	35
			Silt	2020/10/22	2.1		%	35
			Clay	2020/10/22	3.8		%	35

N/A = Not Applicable

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) Poor spike recoevry due to sample matrix.

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(3) Poor spike recovery due to sample matrix.

(4) Duplicate results exceeded RPD acceptance criteria. This may be due to sample heterogeneity. Results confirmed by repeat analysis.

(5) Duplicate % RPD violation not applicable. Absolute % Difference within 10%.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Eric Dearman, Scientific Specialist

Gina Thompson, Inorganics General Chemistry Supervisor

Robyn Edwards, Bedford Micro Supervisor

Rosemarie MacDonald, Scientific Specialist (Organics)

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Your C.O.C. #: 783320-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/08/17
Report #: R6295342
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0I8207
Received: 2020/07/27, 10:04

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	5	N/A	2020/08/04	N/A	SM 23 4500-CO2 D
Alkalinity	5	N/A	2020/08/04	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	3	N/A	2020/08/04	ATL SOP 00014	SM 23 4500-Cl- E m
Chloride	2	N/A	2020/08/05	ATL SOP 00014	SM 23 4500-Cl- E m
Colour	5	N/A	2020/08/04	ATL SOP 00020	SM 23 2120C m
Conductance - water	5	N/A	2020/08/04	ATL SOP 00004	SM 23 2510B m
Hardness (calculated as CaCO3)	5	N/A	2020/08/04	ATL SOP 00048	Auto Calc
Metals Water Total MS	5	2020/07/28	2020/08/01	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	5	N/A	2020/08/05	N/A	Auto Calc.
Anion and Cation Sum	5	N/A	2020/08/04	N/A	Auto Calc.
Nitrogen Ammonia - water	5	N/A	2020/07/29	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	3	N/A	2020/08/04	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrate + Nitrite	2	N/A	2020/08/05	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	5	N/A	2020/08/04	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	5	N/A	2020/08/05	ATL SOP 00018	ASTM D3867-16
pH (2)	5	N/A	2020/08/04	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	5	N/A	2020/08/04	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	5	N/A	2020/08/05	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	5	N/A	2020/08/05	ATL SOP 00049	Auto Calc.
Reactive Silica	5	N/A	2020/08/04	ATL SOP 00022	EPA 366.0 m
Sulphate	2	N/A	2020/08/04	ATL SOP 00023	ASTM D516-16 m
Sulphate	3	N/A	2020/08/05	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	5	N/A	2020/08/05	N/A	Auto Calc.
Total Organic Carbon (TOC) (1, 3)	1	N/A	2020/08/14	CAM SOP-00446	SM 23 5310B m
Total Organic Carbon (TOC) (1, 3)	4	N/A	2020/08/15	CAM SOP-00446	SM 23 5310B m
Turbidity	5	N/A	2020/07/29	ATL SOP 00011	EPA 180.1 R2 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

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Your C.O.C. #: 783320-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/08/17
Report #: R6295342
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0I8207
Received: 2020/07/27, 10:04

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.
(1) This test was performed by Bureau Veritas Laboratories Mississauga
(2) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(3) Total Organic Carbon (TOC) present in the sample should be considered as non-purgeable TOC.

Encryption Key

Sam Sherker
Project Manager Assistant
17 Aug 2020 17:10:38

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bvlabs.com
Phone# (902) 420-0203
==
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.

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC061			NFC062		
Sampling Date				2020/07/24 13:10			2020/07/24 13:14		
COC Number				783320-01-01			783320-01-01		
	UNITS	MAC	AO	BARACHOIS BROOK	RDL	QC Batch	BARACHOIS POND	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	-	-	0.350	N/A	6856531	14.2	N/A	6856531
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6856523	18	1.0	6856523
Calculated TDS	mg/L	-	500	26	1.0	6856539	800	1.0	6856539
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6856523	ND	1.0	6856523
Cation Sum	me/L	-	-	0.470	N/A	6856531	12.9	N/A	6856531
Hardness (CaCO3)	mg/L	-	-	7.1	1.0	6856527	130	1.0	6856527
Ion Balance (% Difference)	%	-	-	14.6	N/A	6856529	4.94	N/A	6856529
Langelier Index (@ 20C)	N/A	-	-	NC		6856535	-2.37		6856535
Langelier Index (@ 4C)	N/A	-	-	NC		6856537	-2.62		6856537
Nitrate (N)	mg/L	**10**	-	ND	0.050	6856533	0.076	0.050	6856533
Saturation pH (@ 20C)	N/A	-	-	NC		6856535	9.31		6856535
Saturation pH (@ 4C)	N/A	-	-	NC		6856537	9.55		6856537
Inorganics									
Total Alkalinity (Total as CaCO3)	mg/L	-	-	ND	5.0	6869055	18	5.0	6869055
Dissolved Chloride (Cl-)	mg/L	-	250	13	1.0	6869057	450	5.0	6869057
Colour	TCU	-	15	210	25	6869067	120	25	6869067
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.050	6869070	0.076	0.050	6869070
Nitrite (N)	mg/L	**1**	-	ND	0.010	6869072	ND	0.010	6869072
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	0.071	0.050	6861102	ND	0.050	6861102

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC061			NFC062		
Sampling Date				2020/07/24 13:10			2020/07/24 13:14		
COC Number				783320-01-01			783320-01-01		
	UNITS	**MAC**	**AO**	**BARACHOIS BROOK**	**RDL**	**QC Batch**	**BARACHOIS POND**	**RDL**	**QC Batch**
Orthophosphate (P)	mg/L	-	-	ND	0.010	6869069	0.019	0.010	6869069
pH	pH	-	7.0 : 10.5	5.95		6869046	6.94		6869048
Reactive Silica (SiO2)	mg/L	-	-	3.3	0.50	6869065	1.0	0.50	6869065
Dissolved Sulphate (SO4)	mg/L	-	500	ND	2.0	6869060	63	2.0	6869060
Turbidity	NTU	-	0.3	1.4	0.10	6860955	2.2	0.10	6860955
Conductivity	uS/cm	-	-	56	1.0	6869045	1600	1.0	6869047
Metals									
Total Aluminum (Al)	ug/L	-	100	470	5.0	6858617	130	5.0	6858617
Total Antimony (Sb)	ug/L	**6**	-	ND	1.0	6858617	ND	1.0	6858617
Total Arsenic (As)	ug/L	**10**	-	**15**	1.0	6858617	**89**	1.0	6858617
Total Barium (Ba)	ug/L	**2000**	-	5.9	1.0	6858617	4.3	1.0	6858617
Total Beryllium (Be)	ug/L	-	-	ND	1.0	6858617	ND	1.0	6858617
Total Bismuth (Bi)	ug/L	-	-	ND	2.0	6858617	ND	2.0	6858617
Total Boron (B)	ug/L	**5000**	-	ND	50	6858617	170	50	6858617
Total Cadmium (Cd)	ug/L	**7**	-	0.027	0.010	6858617	0.012	0.010	6858617
Total Calcium (Ca)	ug/L	-	-	1400	100	6858617	9100	100	6858617
Total Chromium (Cr)	ug/L	**50**	-	ND	1.0	6858617	ND	1.0	6858617
Total Cobalt (Co)	ug/L	-	-	0.82	0.40	6858617	ND	0.40	6858617
Total Copper (Cu)	ug/L	**2000**	1000	0.71	0.50	6858617	0.58	0.50	6858617
Total Iron (Fe)	ug/L	-	300	1300	50	6858617	600	50	6858617
Total Lead (Pb)	ug/L	**5**	-	ND	0.50	6858617	ND	0.50	6858617

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC061			NFC062		
Sampling Date				2020/07/24 13:10			2020/07/24 13:14		
COC Number				783320-01-01			783320-01-01		
	UNITS	MAC	AO	BARACHOIS BROOK	RDL	QC Batch	BARACHOIS POND	RDL	QC Batch
Total Magnesium (Mg)	ug/L	-	-	860	100	6858617	25000	100	6858617
Total Manganese (Mn)	ug/L	**120**	20	300	2.0	6858617	110	2.0	6858617
Total Molybdenum (Mo)	ug/L	-	-	ND	2.0	6858617	ND	2.0	6858617
Total Nickel (Ni)	ug/L	-	-	ND	2.0	6858617	ND	2.0	6858617
Total Phosphorus (P)	ug/L	-	-	ND	100	6858617	ND	100	6858617
Total Potassium (K)	ug/L	-	-	210	100	6858617	9600	100	6858617
Total Selenium (Se)	ug/L	**50**	-	ND	0.50	6858617	ND	0.50	6858617
Total Silver (Ag)	ug/L	-	-	ND	0.10	6858617	ND	0.10	6858617
Total Sodium (Na)	ug/L	-	200000	6300	100	6858617	230000	100	6858617
Total Strontium (Sr)	ug/L	**7000**	-	15	2.0	6858617	170	2.0	6858617
Total Thallium (Tl)	ug/L	-	-	ND	0.10	6858617	ND	0.10	6858617
Total Tin (Sn)	ug/L	-	-	ND	2.0	6858617	ND	2.0	6858617
Total Titanium (Ti)	ug/L	-	-	5.2	2.0	6858617	2.3	2.0	6858617
Total Uranium (U)	ug/L	**20**	-	ND	0.10	6858617	ND	0.10	6858617
Total Vanadium (V)	ug/L	-	-	ND	2.0	6858617	ND	2.0	6858617
Total Zinc (Zn)	ug/L	-	5000	ND	5.0	6858617	ND	5.0	6858617

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC063			NFC064	NFC065		
Sampling Date				2020/07/24 13:32			2020/07/24 13:08	2020/07/24 13:18		
COC Number				783320-01-01			783320-01-01	783320-01-01		
	UNITS	MAC	AO	ROCKY POINT POND	RDL	QC Batch	CHANNEL	SINGLE LINE	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	-	-	0.410	N/A	6856531	508	511	N/A	6856531
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6856523	91	90	1.0	6856523
Calculated TDS	mg/L	-	500	30	1.0	6856539	28000	28000	1.0	6856539
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	1.0	6856523	ND	ND	1.0	6856523
Cation Sum	me/L	-	-	0.530	N/A	6856531	440	437	N/A	6856531
Hardness (CaCO3)	mg/L	-	-	6.6	1.0	6856527	4900	4800	1.0	6856527
Ion Balance (% Difference)	%	-	-	12.8	N/A	6856529	7.20	7.80	N/A	6856529
Langelier Index (@ 20C)	N/A	-	-	NC		6856535	0.301	0.397		6856535
Langelier Index (@ 4C)	N/A	-	-	NC		6856537	0.0630	0.158		6856537
Nitrate (N)	mg/L	**10**	-	ND	0.050	6856533	ND	ND	0.050	6856533
Saturation pH (@ 20C)	N/A	-	-	NC		6856535	7.37	7.38		6856535
Saturation pH (@ 4C)	N/A	-	-	NC		6856537	7.61	7.62		6856537
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L	-	-	ND	5.0	6869103	92	90	5.0	6869103
Dissolved Chloride (Cl-)	mg/L	-	250	15	1.0	6869104	16000	16000	500	6869104
Colour	TCU	-	15	300	50	6869108	ND	ND	5.0	6869108
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.050	6869114	ND	ND	0.050	6869114
Nitrite (N)	mg/L	**1**	-	ND	0.010	6869115	ND	ND	0.010	6869115
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	ND	0.050	6861102	ND	ND	0.050	6861102
Orthophosphate (P)	mg/L	-	-	ND	0.010	6869110	ND	ND	0.010	6869110

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC063			NFC064	NFC065		
Sampling Date				2020/07/24 13:32			2020/07/24 13:08	2020/07/24 13:18		
COC Number				783320-01-01			783320-01-01	783320-01-01		
	UNITS	**MAC**	**AO**	**ROCKY POINT POND**	**RDL**	**QC Batch**	**CHANNEL**	**SINGLE LINE**	**RDL**	**QC Batch**
pH	pH	-	7.0 : 10.5	5.67		6869048	7.67	7.78		6869048
Reactive Silica (SiO2)	mg/L	-	-	3.7	0.50	6869107	0.51	0.55	0.50	6869107
Dissolved Sulphate (SO4)	mg/L	-	500	ND	2.0	6869106	2200	2200	200	6869106
Turbidity	NTU	-	0.3	2.5	0.10	6860955	0.26	0.28	0.10	6860955
Conductivity	uS/cm	-	-	62	1.0	6869047	46000	45000	1.0	6869047
Metals										
Total Aluminum (Al)	ug/L	-	100	710	5.0	6858617	**ND (1)**	**ND (1)**	500	6858622
Total Antimony (Sb)	ug/L	**6**	-	ND	1.0	6858617	**ND (1)**	**ND (1)**	100	6858622
Total Arsenic (As)	ug/L	**10**	-	1.9	1.0	6858617	**ND (1)**	**ND (1)**	100	6858622
Total Barium (Ba)	ug/L	**2000**	-	7.0	1.0	6858617	ND	ND	100	6858622
Total Beryllium (Be)	ug/L	-	-	ND	1.0	6858617	ND	ND	100	6858622
Total Bismuth (Bi)	ug/L	-	-	ND	2.0	6858617	ND	ND	200	6858622
Total Boron (B)	ug/L	**5000**	-	ND	50	6858617	ND	ND	5000	6858622
Total Cadmium (Cd)	ug/L	**7**	-	0.034	0.010	6858617	ND	ND	1.0	6858622
Total Calcium (Ca)	ug/L	-	-	1100	100	6858617	330000	330000	10000	6858622
Total Chromium (Cr)	ug/L	**50**	-	ND	1.0	6858617	**ND (1)**	**ND (1)**	100	6858622
Total Cobalt (Co)	ug/L	-	-	1.1	0.40	6858617	ND	ND	40	6858622
Total Copper (Cu)	ug/L	**2000**	1000	0.74	0.50	6858617	ND	ND	50	6858622
Total Iron (Fe)	ug/L	-	300	1800	50	6858617	**ND (1)**	**ND (1)**	5000	6858622
Total Lead (Pb)	ug/L	**5**	-	1.2	0.50	6858617	**ND (1)**	**ND (1)**	50	6858622
Total Magnesium (Mg)	ug/L	-	-	920	100	6858617	990000	980000	10000	6858622

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ND = Not detected

(1) RDL exceeds criteria

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				NFC063			NFC064	NFC065		
Sampling Date				2020/07/24 13:32			2020/07/24 13:08	2020/07/24 13:18		
COC Number				783320-01-01			783320-01-01	783320-01-01		
	UNITS	**MAC**	**AO**	**ROCKY POINT POND**	**RDL**	**QC Batch**	**CHANNEL**	**SINGLE LINE**	**RDL**	**QC Batch**
Total Manganese (Mn)	ug/L	**120**	20	310	2.0	6858617	**ND (1)**	**ND (1)**	200	6858622
Total Molybdenum (Mo)	ug/L	-	-	ND	2.0	6858617	ND	ND	200	6858622
Total Nickel (Ni)	ug/L	-	-	ND	2.0	6858617	ND	ND	200	6858622
Total Phosphorus (P)	ug/L	-	-	ND	100	6858617	ND	ND	10000	6858622
Total Potassium (K)	ug/L	-	-	230	100	6858617	290000	290000	10000	6858622
Total Selenium (Se)	ug/L	**50**	-	ND	0.50	6858617	ND	ND	50	6858622
Total Silver (Ag)	ug/L	-	-	ND	0.10	6858617	ND	ND	10	6858622
Total Sodium (Na)	ug/L	-	200000	7500	100	6858617	7700000	7700000	10000	6858622
Total Strontium (Sr)	ug/L	**7000**	-	13	2.0	6858617	5900	5900	200	6858622
Total Thallium (Tl)	ug/L	-	-	ND	0.10	6858617	ND	ND	10	6858622
Total Tin (Sn)	ug/L	-	-	ND	2.0	6858617	ND	ND	200	6858622
Total Titanium (Ti)	ug/L	-	-	9.4	2.0	6858617	ND	ND	200	6858622
Total Uranium (U)	ug/L	**20**	-	ND	0.10	6858617	ND	ND	10	6858622
Total Vanadium (V)	ug/L	-	-	ND	2.0	6858617	ND	ND	200	6858622
Total Zinc (Zn)	ug/L	-	5000	ND	5.0	6858617	ND	ND	500	6858622

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(1) RDL exceeds criteria

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RESULTS OF ANALYSES OF WATER

BV Labs ID		NFC061		NFC062	NFC063	NFC064		
Sampling Date		2020/07/24 13:10		2020/07/24 13:14	2020/07/24 13:32	2020/07/24 13:08		
COC Number		783320-01-01		783320-01-01	783320-01-01	783320-01-01		
	UNITS	BARACHOIS BROOK	QC Batch	BARACHOIS POND	ROCKY POINT POND	CHANNEL	RDL	QC Batch
Inorganics								
Total Organic Carbon (TOC)	mg/L	27	6888310	15	35	1.6	0.40	6888207

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BV Labs ID		NFC065		
Sampling Date		2020/07/24 13:18		
COC Number		783320-01-01		
	UNITS	SINGLE LINE	RDL	QC Batch
Inorganics				
Total Organic Carbon (TOC)	mg/L	1.6	0.40	6888207

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.7°C

Sample NFC061 [BARACHOIS BROOK] : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample NFC062 [BARACHOIS POND] : ortho-Phosphate > Total Phosphorus: Both values fall within the method uncertainty for duplicates and are likely equivalent.

Sample NFC063 [ROCKY POINT POND] : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample NFC064 [CHANNEL] : Elevated reporting limits for trace metals due to sample matrix.
Poor RCAp Ion Balance due to sample matrix. Cation sum does not include contribution from Sr and B.

Sample NFC065 [SINGLE LINE] : Elevated reporting limits for trace metals due to sample matrix.
Poor RCAp Ion Balance due to sample matrix. Cation sum does not include contribution from Sr and B.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6858617	BAN	Matrix Spike	Total Aluminum (Al)	2020/08/01		95	%	80 - 120
			Total Antimony (Sb)	2020/08/01		100	%	80 - 120
			Total Arsenic (As)	2020/08/01		94	%	80 - 120
			Total Barium (Ba)	2020/08/01		96	%	80 - 120
			Total Beryllium (Be)	2020/08/01		97	%	80 - 120
			Total Bismuth (Bi)	2020/08/01		99	%	80 - 120
			Total Boron (B)	2020/08/01		97	%	80 - 120
			Total Cadmium (Cd)	2020/08/01		95	%	80 - 120
			Total Calcium (Ca)	2020/08/01		102	%	80 - 120
			Total Chromium (Cr)	2020/08/01		93	%	80 - 120
			Total Cobalt (Co)	2020/08/01		95	%	80 - 120
			Total Copper (Cu)	2020/08/01		94	%	80 - 120
			Total Iron (Fe)	2020/08/01		101	%	80 - 120
			Total Lead (Pb)	2020/08/01		97	%	80 - 120
			Total Magnesium (Mg)	2020/08/01		100	%	80 - 120
			Total Manganese (Mn)	2020/08/01		98	%	80 - 120
			Total Molybdenum (Mo)	2020/08/01		100	%	80 - 120
			Total Nickel (Ni)	2020/08/01		97	%	80 - 120
			Total Phosphorus (P)	2020/08/01		102	%	80 - 120
			Total Potassium (K)	2020/08/01		99	%	80 - 120
			Total Selenium (Se)	2020/08/01		95	%	80 - 120
			Total Silver (Ag)	2020/08/01		97	%	80 - 120
			Total Sodium (Na)	2020/08/01		94	%	80 - 120
			Total Strontium (Sr)	2020/08/01		101	%	80 - 120
			Total Thallium (Tl)	2020/08/01		99	%	80 - 120
			Total Tin (Sn)	2020/08/01		103	%	80 - 120
			Total Titanium (Ti)	2020/08/01		99	%	80 - 120
			Total Uranium (U)	2020/08/01		104	%	80 - 120
			Total Vanadium (V)	2020/08/01		98	%	80 - 120
			Total Zinc (Zn)	2020/08/01		95	%	80 - 120
6858617	BAN	Spiked Blank	Total Aluminum (Al)	2020/08/01		101	%	80 - 120
			Total Antimony (Sb)	2020/08/01		101	%	80 - 120
			Total Arsenic (As)	2020/08/01		94	%	80 - 120
			Total Barium (Ba)	2020/08/01		97	%	80 - 120
			Total Beryllium (Be)	2020/08/01		100	%	80 - 120
			Total Bismuth (Bi)	2020/08/01		101	%	80 - 120
			Total Boron (B)	2020/08/01		100	%	80 - 120
			Total Cadmium (Cd)	2020/08/01		96	%	80 - 120
			Total Calcium (Ca)	2020/08/01		104	%	80 - 120
			Total Chromium (Cr)	2020/08/01		95	%	80 - 120
			Total Cobalt (Co)	2020/08/01		98	%	80 - 120
			Total Copper (Cu)	2020/08/01		95	%	80 - 120
			Total Iron (Fe)	2020/08/01		103	%	80 - 120
			Total Lead (Pb)	2020/08/01		98	%	80 - 120
			Total Magnesium (Mg)	2020/08/01		102	%	80 - 120
			Total Manganese (Mn)	2020/08/01		99	%	80 - 120
			Total Molybdenum (Mo)	2020/08/01		100	%	80 - 120
			Total Nickel (Ni)	2020/08/01		99	%	80 - 120
			Total Phosphorus (P)	2020/08/01		102	%	80 - 120
			Total Potassium (K)	2020/08/01		97	%	80 - 120
			Total Selenium (Se)	2020/08/01		97	%	80 - 120
			Total Silver (Ag)	2020/08/01		97	%	80 - 120
			Total Sodium (Na)	2020/08/01		94	%	80 - 120
			Total Strontium (Sr)	2020/08/01		101	%	80 - 120
			Total Thallium (Tl)	2020/08/01		100	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2020/08/01		103	%	80 - 120
			Total Titanium (Ti)	2020/08/01		103	%	80 - 120
			Total Uranium (U)	2020/08/01		104	%	80 - 120
			Total Vanadium (V)	2020/08/01		100	%	80 - 120
			Total Zinc (Zn)	2020/08/01		96	%	80 - 120
6858617	BAN	Method Blank	Total Aluminum (Al)	2020/07/30	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/07/30	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/07/30	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/07/30	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/07/30	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/07/30	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/07/30	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/07/30	ND, RDL=100		ug/L	
			Total Potassium (K)	2020/07/30	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2020/07/30	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/07/30	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/07/30	ND, RDL=0.10		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Tin (Sn)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/07/30	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/07/30	ND, RDL=5.0		ug/L	
6858617	BAN	RPD	Total Aluminum (Al)	2020/08/01	0.60		%	20
			Total Antimony (Sb)	2020/08/01	NC		%	20
			Total Arsenic (As)	2020/08/01	NC		%	20
			Total Barium (Ba)	2020/08/01	1.1		%	20
			Total Beryllium (Be)	2020/08/01	NC		%	20
			Total Bismuth (Bi)	2020/08/01	NC		%	20
			Total Boron (B)	2020/08/01	NC		%	20
			Total Cadmium (Cd)	2020/08/01	12		%	20
			Total Calcium (Ca)	2020/08/01	0.59		%	20
			Total Chromium (Cr)	2020/08/01	NC		%	20
			Total Cobalt (Co)	2020/08/01	NC		%	20
			Total Copper (Cu)	2020/08/01	7.6		%	20
			Total Iron (Fe)	2020/08/01	NC		%	20
			Total Lead (Pb)	2020/08/01	NC		%	20
			Total Magnesium (Mg)	2020/08/01	1.6		%	20
			Total Manganese (Mn)	2020/08/01	NC		%	20
			Total Molybdenum (Mo)	2020/08/01	NC		%	20
			Total Nickel (Ni)	2020/08/01	NC		%	20
			Total Phosphorus (P)	2020/08/01	3.0		%	20
			Total Potassium (K)	2020/08/01	1.7		%	20
			Total Selenium (Se)	2020/08/01	NC		%	20
			Total Silver (Ag)	2020/08/01	NC		%	20
			Total Sodium (Na)	2020/08/01	0.32		%	20
			Total Strontium (Sr)	2020/08/01	3.7		%	20
			Total Thallium (Tl)	2020/08/01	NC		%	20
			Total Tin (Sn)	2020/08/01	NC		%	20
			Total Titanium (Ti)	2020/08/01	NC		%	20
			Total Uranium (U)	2020/08/01	NC		%	20
			Total Vanadium (V)	2020/08/01	NC		%	20
			Total Zinc (Zn)	2020/08/01	1.7		%	20
6858622	BAN	Matrix Spike [NFC065-02]	Total Aluminum (Al)	2020/08/01		92	%	80 - 120
			Total Antimony (Sb)	2020/08/01		88	%	80 - 120
			Total Arsenic (As)	2020/08/01		96	%	80 - 120
			Total Barium (Ba)	2020/08/01		91	%	80 - 120
			Total Beryllium (Be)	2020/08/01		97	%	80 - 120
			Total Bismuth (Bi)	2020/08/01		88	%	80 - 120
			Total Boron (B)	2020/08/01		NC	%	80 - 120
			Total Cadmium (Cd)	2020/08/01		98	%	80 - 120
			Total Calcium (Ca)	2020/08/01		NC	%	80 - 120
			Total Chromium (Cr)	2020/08/01		96	%	80 - 120
			Total Cobalt (Co)	2020/08/01		89	%	80 - 120
			Total Copper (Cu)	2020/08/01		90	%	80 - 120
			Total Iron (Fe)	2020/08/01		88	%	80 - 120
			Total Lead (Pb)	2020/08/01		96	%	80 - 120
			Total Magnesium (Mg)	2020/08/01		NC	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Manganese (Mn)	2020/08/01		99	%	80 - 120
			Total Molybdenum (Mo)	2020/08/01		111	%	80 - 120
			Total Nickel (Ni)	2020/08/01		100	%	80 - 120
			Total Phosphorus (P)	2020/08/01		92	%	80 - 120
			Total Potassium (K)	2020/08/01		NC	%	80 - 120
			Total Selenium (Se)	2020/08/01		106	%	80 - 120
			Total Silver (Ag)	2020/08/01		91	%	80 - 120
			Total Sodium (Na)	2020/08/01		NC	%	80 - 120
			Total Strontium (Sr)	2020/08/01		NC	%	80 - 120
			Total Thallium (Tl)	2020/08/01		98	%	80 - 120
			Total Tin (Sn)	2020/08/01		93	%	80 - 120
			Total Titanium (Ti)	2020/08/01		109	%	80 - 120
			Total Uranium (U)	2020/08/01		95	%	80 - 120
			Total Vanadium (V)	2020/08/01		111	%	80 - 120
			Total Zinc (Zn)	2020/08/01		78 (1)	%	80 - 120
6858622	BAN	Spiked Blank	Total Aluminum (Al)	2020/07/30		102	%	80 - 120
			Total Antimony (Sb)	2020/07/30		99	%	80 - 120
			Total Arsenic (As)	2020/07/30		98	%	80 - 120
			Total Barium (Ba)	2020/07/30		98	%	80 - 120
			Total Beryllium (Be)	2020/07/30		102	%	80 - 120
			Total Bismuth (Bi)	2020/07/30		101	%	80 - 120
			Total Boron (B)	2020/07/30		101	%	80 - 120
			Total Cadmium (Cd)	2020/07/30		100	%	80 - 120
			Total Calcium (Ca)	2020/07/30		102	%	80 - 120
			Total Chromium (Cr)	2020/07/30		100	%	80 - 120
			Total Cobalt (Co)	2020/07/30		103	%	80 - 120
			Total Copper (Cu)	2020/07/30		99	%	80 - 120
			Total Iron (Fe)	2020/07/30		103	%	80 - 120
			Total Lead (Pb)	2020/07/30		101	%	80 - 120
			Total Magnesium (Mg)	2020/07/30		102	%	80 - 120
			Total Manganese (Mn)	2020/07/30		102	%	80 - 120
			Total Molybdenum (Mo)	2020/07/30		101	%	80 - 120
			Total Nickel (Ni)	2020/07/30		103	%	80 - 120
			Total Phosphorus (P)	2020/07/30		101	%	80 - 120
			Total Potassium (K)	2020/07/30		104	%	80 - 120
			Total Selenium (Se)	2020/07/30		101	%	80 - 120
			Total Silver (Ag)	2020/07/30		99	%	80 - 120
			Total Sodium (Na)	2020/07/30		99	%	80 - 120
			Total Strontium (Sr)	2020/07/30		104	%	80 - 120
			Total Thallium (Tl)	2020/07/30		101	%	80 - 120
			Total Tin (Sn)	2020/07/30		100	%	80 - 120
			Total Titanium (Ti)	2020/07/30		103	%	80 - 120
			Total Uranium (U)	2020/07/30		108	%	80 - 120
			Total Vanadium (V)	2020/07/30		103	%	80 - 120
			Total Zinc (Zn)	2020/07/30		100	%	80 - 120
6858622	BAN	Method Blank	Total Aluminum (Al)	2020/07/30	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/07/30	ND, RDL=1.0		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Bismuth (Bi)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/07/30	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/07/30	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/07/30	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/07/30	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/07/30	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/07/30	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/07/30	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/07/30	ND, RDL=100		ug/L	
			Total Potassium (K)	2020/07/30	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/07/30	ND, RDL=0.50		ug/L	
			Total Silver (Ag)	2020/07/30	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/07/30	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/07/30	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/07/30	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/07/30	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/07/30	ND, RDL=5.0		ug/L	
6858622	BAN	RPD [NFC064-02]	Total Aluminum (Al)	2020/08/01	NC		%	20
			Total Antimony (Sb)	2020/08/01	NC		%	20
			Total Arsenic (As)	2020/08/01	NC		%	20
			Total Barium (Ba)	2020/08/01	NC		%	20
			Total Beryllium (Be)	2020/08/01	NC		%	20
			Total Bismuth (Bi)	2020/08/01	NC		%	20

BUREAU VERITAS

BV Labs Job #: C0I8207
Report Date: 2020/08/17

Whale Sanctuary

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Boron (B)	2020/08/01	NC		%	20
			Total Cadmium (Cd)	2020/08/01	NC		%	20
			Total Calcium (Ca)	2020/08/01	0.00099		%	20
			Total Chromium (Cr)	2020/08/01	NC		%	20
			Total Cobalt (Co)	2020/08/01	NC		%	20
			Total Copper (Cu)	2020/08/01	NC		%	20
			Total Iron (Fe)	2020/08/01	NC		%	20
			Total Lead (Pb)	2020/08/01	NC		%	20
			Total Magnesium (Mg)	2020/08/01	0.72		%	20
			Total Manganese (Mn)	2020/08/01	NC		%	20
			Total Molybdenum (Mo)	2020/08/01	NC		%	20
			Total Nickel (Ni)	2020/08/01	NC		%	20
			Total Phosphorus (P)	2020/08/01	NC		%	20
			Total Potassium (K)	2020/08/01	0.071		%	20
			Total Selenium (Se)	2020/08/01	NC		%	20
			Total Silver (Ag)	2020/08/01	NC		%	20
			Total Sodium (Na)	2020/08/01	1.4		%	20
			Total Strontium (Sr)	2020/08/01	1.2		%	20
			Total Thallium (Tl)	2020/08/01	NC		%	20
			Total Tin (Sn)	2020/08/01	NC		%	20
			Total Titanium (Ti)	2020/08/01	NC		%	20
			Total Uranium (U)	2020/08/01	NC		%	20
			Total Vanadium (V)	2020/08/01	NC		%	20
			Total Zinc (Zn)	2020/08/01	NC		%	20
6860955	SHW	QC Standard	Turbidity	2020/07/29		112	%	80 - 120
6860955	SHW	Spiked Blank	Turbidity	2020/07/29		101	%	80 - 120
6860955	SHW	Method Blank	Turbidity	2020/07/29	ND, RDL=0.10		NTU	
6860955	SHW	RPD	Turbidity	2020/07/29	NC		%	20
6861102	EMT	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2020/07/29		98	%	80 - 120
6861102	EMT	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/07/29		101	%	80 - 120
6861102	EMT	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/07/29	ND, RDL=0.050		mg/L	
6861102	EMT	RPD	Nitrogen (Ammonia Nitrogen)	2020/07/29	NC		%	20
6869045	SHW	Spiked Blank	Conductivity	2020/08/04		101	%	80 - 120
6869045	SHW	Method Blank	Conductivity	2020/08/04	ND, RDL=1.0		uS/cm	
6869045	SHW	RPD	Conductivity	2020/08/04	0		%	10
6869046	SHW	Spiked Blank	pH	2020/08/04		100	%	97 - 103
6869046	SHW	RPD	pH	2020/08/04	2.2		%	N/A
6869047	SHW	Spiked Blank	Conductivity	2020/08/04		101	%	80 - 120
6869047	SHW	Method Blank	Conductivity	2020/08/04	ND, RDL=1.0		uS/cm	
6869047	SHW	RPD	Conductivity	2020/08/04	8.4		%	10
6869048	SHW	Spiked Blank	pH	2020/08/04		100	%	97 - 103
6869048	SHW	RPD	pH	2020/08/04	6.2 (2)		%	N/A
6869055	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/08/04		99	%	80 - 120
6869055	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/08/04		101	%	80 - 120
6869055	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/08/04	ND, RDL=5.0		mg/L	
6869055	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/08/04	NC		%	20
6869057	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2020/08/04		102	%	80 - 120
6869057	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/08/04		105	%	80 - 120
6869057	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/08/05	ND, RDL=1.0		mg/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6869057	MCN	RPD	Dissolved Chloride (Cl-)	2020/08/04	6.6		%	20
6869060	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2020/08/04		109	%	80 - 120
6869060	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/08/04		110	%	80 - 120
6869060	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/08/04	ND, RDL=2.0		mg/L	
6869060	MCN	RPD	Dissolved Sulphate (SO4)	2020/08/04	NC		%	20
6869065	MCN	Matrix Spike	Reactive Silica (SiO2)	2020/08/04		94	%	80 - 120
6869065	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/08/04		94	%	80 - 120
6869065	MCN	Method Blank	Reactive Silica (SiO2)	2020/08/04	ND, RDL=0.50		mg/L	
6869065	MCN	RPD	Reactive Silica (SiO2)	2020/08/04	7.5		%	20
6869067	MCN	Spiked Blank	Colour	2020/08/04		93	%	80 - 120
6869067	MCN	Method Blank	Colour	2020/08/04	ND, RDL=5.0		TCU	
6869067	MCN	RPD	Colour	2020/08/04	NC		%	20
6869069	MCN	Matrix Spike	Orthophosphate (P)	2020/08/04		93	%	80 - 120
6869069	MCN	Spiked Blank	Orthophosphate (P)	2020/08/04		97	%	80 - 120
6869069	MCN	Method Blank	Orthophosphate (P)	2020/08/04	ND, RDL=0.010		mg/L	
6869069	MCN	RPD	Orthophosphate (P)	2020/08/04	NC		%	20
6869070	MCN	Matrix Spike	Nitrate + Nitrite (N)	2020/08/04		96	%	80 - 120
6869070	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/08/04		98	%	80 - 120
6869070	MCN	Method Blank	Nitrate + Nitrite (N)	2020/08/04	ND, RDL=0.050		mg/L	
6869070	MCN	RPD	Nitrate + Nitrite (N)	2020/08/04	NC		%	20
6869072	MCN	Matrix Spike	Nitrite (N)	2020/08/04		99	%	80 - 120
6869072	MCN	Spiked Blank	Nitrite (N)	2020/08/04		104	%	80 - 120
6869072	MCN	Method Blank	Nitrite (N)	2020/08/04	ND, RDL=0.010		mg/L	
6869072	MCN	RPD	Nitrite (N)	2020/08/04	NC		%	20
6869103	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/08/04		100	%	80 - 120
6869103	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/08/04		104	%	80 - 120
6869103	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/08/04	ND, RDL=5.0		mg/L	
6869103	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/08/04	NC		%	20
6869104	MCN	Matrix Spike	Dissolved Chloride (Cl-)	2020/08/04		102	%	80 - 120
6869104	MCN	Spiked Blank	Dissolved Chloride (Cl-)	2020/08/04		105	%	80 - 120
6869104	MCN	Method Blank	Dissolved Chloride (Cl-)	2020/08/05	ND, RDL=1.0		mg/L	
6869104	MCN	RPD	Dissolved Chloride (Cl-)	2020/08/04	6.6		%	20
6869106	MCN	Matrix Spike	Dissolved Sulphate (SO4)	2020/08/05		108	%	80 - 120
6869106	MCN	Spiked Blank	Dissolved Sulphate (SO4)	2020/08/05		110	%	80 - 120
6869106	MCN	Method Blank	Dissolved Sulphate (SO4)	2020/08/05	ND, RDL=2.0		mg/L	
6869106	MCN	RPD	Dissolved Sulphate (SO4)	2020/08/05	NC		%	20
6869107	MCN	Matrix Spike	Reactive Silica (SiO2)	2020/08/04		93	%	80 - 120
6869107	MCN	Spiked Blank	Reactive Silica (SiO2)	2020/08/04		97	%	80 - 120
6869107	MCN	Method Blank	Reactive Silica (SiO2)	2020/08/04	ND, RDL=0.50		mg/L	
6869107	MCN	RPD	Reactive Silica (SiO2)	2020/08/04	NC		%	20
6869108	MCN	Spiked Blank	Colour	2020/08/04		95	%	80 - 120
6869108	MCN	Method Blank	Colour	2020/08/04	ND, RDL=5.0		TCU	
6869108	MCN	RPD	Colour	2020/08/04	NC		%	20
6869110	MCN	Matrix Spike	Orthophosphate (P)	2020/08/04		93	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6869110	MCN	Spiked Blank	Orthophosphate (P)	2020/08/04		97	%	80 - 120
6869110	MCN	Method Blank	Orthophosphate (P)	2020/08/04	ND, RDL=0.010		mg/L	
6869110	MCN	RPD	Orthophosphate (P)	2020/08/04	NC		%	20
6869114	MCN	Matrix Spike	Nitrate + Nitrite (N)	2020/08/05		96	%	80 - 120
6869114	MCN	Spiked Blank	Nitrate + Nitrite (N)	2020/08/05		103	%	80 - 120
6869114	MCN	Method Blank	Nitrate + Nitrite (N)	2020/08/05	ND, RDL=0.050		mg/L	
6869114	MCN	RPD	Nitrate + Nitrite (N)	2020/08/05	NC		%	20
6869115	MCN	Matrix Spike	Nitrite (N)	2020/08/04		101	%	80 - 120
6869115	MCN	Spiked Blank	Nitrite (N)	2020/08/04		104	%	80 - 120
6869115	MCN	Method Blank	Nitrite (N)	2020/08/04	ND, RDL=0.010		mg/L	
6869115	MCN	RPD	Nitrite (N)	2020/08/04	NC		%	20
6888207	NS3	Matrix Spike	Total Organic Carbon (TOC)	2020/08/14		95	%	80 - 120
6888207	NS3	Spiked Blank	Total Organic Carbon (TOC)	2020/08/14		98	%	80 - 120
6888207	NS3	Method Blank	Total Organic Carbon (TOC)	2020/08/14	ND, RDL=0.40		mg/L	
6888207	NS3	RPD	Total Organic Carbon (TOC)	2020/08/14	1.7		%	20
6888310	NS3	Matrix Spike	Total Organic Carbon (TOC)	2020/08/14		89	%	80 - 120
6888310	NS3	Spiked Blank	Total Organic Carbon (TOC)	2020/08/14		94	%	80 - 120
6888310	NS3	Method Blank	Total Organic Carbon (TOC)	2020/08/14	ND, RDL=0.40		mg/L	
6888310	NS3	RPD	Total Organic Carbon (TOC)	2020/08/14	5.5		%	20

N/A = Not Applicable

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) Recovery is within QC acceptance limits. < 10 % of compounds in multi-component analysis in violation.

(2) Poor duplicate agreement due to sample matrix, results confirmed by repeat analysis

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

Mike MacGillivray, Scientific Specialist (Inorganics)

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.

Your C.O.C. #: 763050-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/03/25
Report #: R6123217
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C071751
Received: 2020/03/18, 09:00

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonate, Bicarbonate and Hydroxide	3	N/A	2020/03/20	N/A	SM 23 4500-CO2 D
Alkalinity	3	N/A	2020/03/24	ATL SOP 00013	EPA 310.2 R1974 m
Chloride	3	N/A	2020/03/25	ATL SOP 00014	SM 23 4500-Cl- E m
Colour	3	N/A	2020/03/25	ATL SOP 00020	SM 23 2120C m
Conductance - water	3	N/A	2020/03/20	ATL SOP 00004	SM 23 2510B m
Fecal coliform in water (CFU/100 mL)	3	N/A	2020/03/18	ATL SOP 00071	SM 23 9222D
Hardness (calculated as CaCO3)	3	N/A	2020/03/20	ATL SOP 00048	Auto Calc
Metals Water Total MS	3	2020/03/19	2020/03/19	ATL SOP 00058	EPA 6020B R2 m
Ion Balance (% Difference)	3	N/A	2020/03/25	N/A	Auto Calc.
Anion and Cation Sum	3	N/A	2020/03/24	N/A	Auto Calc.
Nitrogen Ammonia - water	3	N/A	2020/03/23	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	3	N/A	2020/03/25	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	3	N/A	2020/03/24	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	3	N/A	2020/03/25	ATL SOP 00018	ASTM D3867-16
pH (1)	3	N/A	2020/03/20	ATL SOP 00003	SM 23 4500-H+ B m
Phosphorus - ortho	3	N/A	2020/03/24	ATL SOP 00021	SM 23 4500-P E m
Sat. pH and Langelier Index (@ 20C)	3	N/A	2020/03/25	ATL SOP 00049	Auto Calc.
Sat. pH and Langelier Index (@ 4C)	3	N/A	2020/03/25	ATL SOP 00049	Auto Calc.
Reactive Silica	3	N/A	2020/03/24	ATL SOP 00022	EPA 366.0 m
Sulphate	3	N/A	2020/03/24	ATL SOP 00023	ASTM D516-16 m
Total Dissolved Solids (TDS calc)	3	N/A	2020/03/25	N/A	Auto Calc.
Organic carbon - Total (TOC) (2)	3	N/A	2020/03/19	ATL SOP 00203	SM 23 5310B m
Turbidity	3	N/A	2020/03/18	ATL SOP 00011	EPA 180.1 R2 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.

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Your C.O.C. #: 763050-01-01

Attention: Amanda Babin

Whale Sanctuary
ON
Canada

Report Date: 2020/03/25
Report #: R6123217
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C071751

Received: 2020/03/18, 09:00

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.
(1) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Tyler Travers
Project Manager Assistant
25 Mar 2020 14:14:40

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Preeti Kapadia, Project Manager
Email: Preeti.Kapadia@bvlabs.com
Phone# (902) 420-0203

==

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.

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MGQ671		MGQ673		MGQ675		
Sampling Date				2020/03/17 11:50		2020/03/17 11:22		2020/03/17 10:50		
COC Number				763050-01-01		763050-01-01		763050-01-01		
	UNITS	**MAC**	**AO**	**NORTH_2**	**QC Batch**	**WEST_2**	**QC Batch**	**SOUTH_2**	**RDL**	**QC Batch**
Calculated Parameters										
Anion Sum	me/L	-	-	512	6641463	494	6641463	502	N/A	6641463
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	92	6641455	90	6641455	90	1.0	6641455
Calculated TDS	mg/L	-	500	29000	6641473	28000	6641473	29000	1.0	6641473
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	ND	6641455	ND	6641455	ND	1.0	6641455
Cation Sum	me/L	-	-	503	6641463	482	6641463	493	N/A	6641463
Hardness (CaCO3)	mg/L	-	-	5200	6641459	5000	6641459	5100	1.0	6641459
Ion Balance (% Difference)	%	-	-	0.960	6641461	1.26	6641461	0.830	N/A	6641461
Langelier Index (@ 20C)	N/A	-	-	0.327	6641469	0.385	6641469	0.348		6641469
Langelier Index (@ 4C)	N/A	-	-	0.0880	6641472	0.146	6641472	0.110		6641472
Nitrate (N)	mg/L	**10**	-	0.077	6641465	ND	6641465	0.053	0.050	6641465
Saturation pH (@ 20C)	N/A	-	-	7.34	6641469	7.38	6641469	7.37		6641469
Saturation pH (@ 4C)	N/A	-	-	7.58	6641472	7.62	6641472	7.61		6641472
Inorganics										
Total Alkalinity (Total as CaCO3)	mg/L	-	-	93	6649387	91	6649387	91	5.0	6649387
Dissolved Chloride (Cl-)	mg/L	-	250	16000	6649395	16000	6649395	16000	250	6649395
Colour	TCU	-	15	ND	6649405	ND	6649405	ND	5.0	6649405
Nitrate + Nitrite (N)	mg/L	-	-	0.087	6649411	ND	6649411	0.063	0.050	6649411
Nitrite (N)	mg/L	**1**	-	0.010	6649412	0.010	6649412	0.011	0.010	6649412
Nitrogen (Ammonia Nitrogen)	mg/L	-	-	ND	6645975	ND	6645975	ND	0.050	6645976
Total Organic Carbon (C)	mg/L	-	-	ND (1)	6643775	ND (1)	6643775	ND (1)	5.0	6643775

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,AO: Guideline - Summary of Guidelines for Canadian Drinking Water Quality (SGCDWQ), Health Canada, June 2019

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If Screening Levels (SL) for gross alpha or gross beta are exceeded then concentration of the specific radionuclides of the CWQG should be analyzed.

Note 1 Turbidity guideline value of 0.3 NTU based on conventional treatment system. For slow sand or diatomaceous earth filtration 1.0 NTU and for membrane filtration 0.1 NTU.

Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

N/A = Not Applicable

ND = Not detected

(1) Elevated reporting limit due to sample matrix.

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ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MGQ671		MGQ673		MGQ675		
Sampling Date				2020/03/17 11:50		2020/03/17 11:22		2020/03/17 10:50		
COC Number				763050-01-01		763050-01-01		763050-01-01		
	UNITS	**MAC**	**AO**	**NORTH_2**	**QC Batch**	**WEST_2**	**QC Batch**	**SOUTH_2**	**RDL**	**QC Batch**
Orthophosphate (P)	mg/L	-	-	0.019	6649409	0.016	6649409	0.018	0.010	6649409
pH	pH	-	7.0 : 10.5	7.67	6645810	7.77	6645806	7.72	N/A	6645806
Reactive Silica (SiO2)	mg/L	-	-	0.79	6649400	0.83	6649400	0.81	0.50	6649400
Dissolved Sulphate (SO4)	mg/L	-	500	2300	6649399	2300	6649399	2400	100	6649399
Turbidity	NTU	-	0.3	2.2	6641535	1.8	6641535	2.1	0.10	6641535
Conductivity	uS/cm	-	-	46000	6645812	45000	6645809	45000	1.0	6645809
Metals										
Total Aluminum (Al)	ug/L	-	100	57	6642111	57	6642111	71	50	6642111
Total Antimony (Sb)	ug/L	**6**	-	**ND (1)**	6642111	**ND (1)**	6642111	**ND (1)**	10	6642111
Total Arsenic (As)	ug/L	**10**	-	ND	6642111	ND	6642111	ND	10	6642111
Total Barium (Ba)	ug/L	**2000**	-	ND	6642111	ND	6642111	ND	10	6642111
Total Beryllium (Be)	ug/L	-	-	ND	6642111	ND	6642111	ND	10	6642111
Total Bismuth (Bi)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Boron (B)	ug/L	**5000**	-	4000	6642111	3900	6642111	4000	500	6642111
Total Cadmium (Cd)	ug/L	**5**	-	ND	6642111	ND	6642111	ND	0.10	6642111
Total Calcium (Ca)	ug/L	-	-	330000	6642111	320000	6642111	330000	1000	6642111
Total Chromium (Cr)	ug/L	**50**	-	ND	6642111	ND	6642111	ND	10	6642111
Total Cobalt (Co)	ug/L	-	-	ND	6642111	ND	6642111	ND	4.0	6642111
Total Copper (Cu)	ug/L	**2000**	1000	ND	6642111	ND	6642111	7.3	5.0	6642111
Total Iron (Fe)	ug/L	-	300	**ND (1)**	6642111	**ND (1)**	6642111	**ND (1)**	500	6642111
Total Lead (Pb)	ug/L	**5**	-	ND	6642111	ND	6642111	ND	5.0	6642111

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ND = Not detected

(1) RDL exceeds criteria

ATLANTIC RCAP-MS TOTAL METALS IN WATER (WATER)

BV Labs ID				MGQ671		MGQ673		MGQ675		
Sampling Date				2020/03/17 11:50		2020/03/17 11:22		2020/03/17 10:50		
COC Number				763050-01-01		763050-01-01		763050-01-01		
	UNITS	**MAC**	**AO**	**NORTH_2**	**QC Batch**	**WEST_2**	**QC Batch**	**SOUTH_2**	**RDL**	**QC Batch**
Total Magnesium (Mg)	ug/L	-	-	1100000	6642111	1000000	6642111	1000000	1000	6642111
Total Manganese (Mn)	ug/L	**120**	20	ND	6642111	ND	6642111	ND	20	6642111
Total Molybdenum (Mo)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Nickel (Ni)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Phosphorus (P)	ug/L	-	-	ND	6642111	ND	6642111	ND	1000	6642111
Total Potassium (K)	ug/L	-	-	320000	6642111	300000	6642111	310000	1000	6642111
Total Selenium (Se)	ug/L	**50**	-	ND	6642111	ND	6642111	ND	5.0	6642111
Total Silver (Ag)	ug/L	-	-	ND	6642111	ND	6642111	ND	1.0	6642111
Total Sodium (Na)	ug/L	-	200000	9000000	6642111	8600000	6642111	8800000	1000	6642111
Total Strontium (Sr)	ug/L	**7000**	-	6200	6642111	5900	6642111	6100	20	6642111
Total Thallium (Tl)	ug/L	-	-	ND	6642111	ND	6642111	ND	1.0	6642111
Total Tin (Sn)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Titanium (Ti)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Uranium (U)	ug/L	**20**	-	2.6	6642111	2.5	6642111	2.6	1.0	6642111
Total Vanadium (V)	ug/L	-	-	ND	6642111	ND	6642111	ND	20	6642111
Total Zinc (Zn)	ug/L	-	5000	ND	6642111	ND	6642111	ND	50	6642111

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

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Note 2 Aluminium guideline value of 0.1 mg/L is for treatment plants using aluminium-based coagulants, 0.2mg/L applies to other types of treatment systems.

ND = Not detected

MICROBIOLOGY (WATER)

BV Labs ID		MGQ670	MGQ672		MGQ674		
Sampling Date		2020/03/17 11:50	2020/03/17 11:22		2020/03/17 10:50		
COC Number		763050-01-01	763050-01-01		763050-01-01		
	UNITS	**NORTH_1**	**WEST_1**	**QC Batch**	**SOUTH_1**	**RDL**	**QC Batch**
Microbiological							
Fecal coliform	CFU/100mL	ND	ND	6641602	ND	10	6641617

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.3°C

Sample MGQ671 [NORTH_2] : Elevated reporting limits for trace metals due to sample matrix.

Sample MGQ673 [WEST_2] : Elevated reporting limits for trace metals due to sample matrix.

Sample MGQ675 [SOUTH_2] : Elevated reporting limits for trace metals due to sample matrix.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6641535	SHW	QC Standard	Turbidity	2020/03/18		104	%	80 - 120
6641535	SHW	Spiked Blank	Turbidity	2020/03/18		105	%	80 - 120
6641535	SHW	Method Blank	Turbidity	2020/03/18	ND, RDL=0.10		NTU	
6641535	SHW	RPD	Turbidity	2020/03/18	1.2		%	20
6641602	SDN	Method Blank	Fecal coliform	2020/03/18	ND, RDL=1.0		CFU/100mL	
6641617	SDN	Method Blank	Fecal coliform	2020/03/18	ND, RDL=1.0		CFU/100mL	
6642111	MLB	Matrix Spike	Total Aluminum (Al)	2020/03/20		93	%	80 - 120
			Total Antimony (Sb)	2020/03/20		100	%	80 - 120
			Total Arsenic (As)	2020/03/20		96	%	80 - 120
			Total Barium (Ba)	2020/03/20		93	%	80 - 120
			Total Beryllium (Be)	2020/03/20		95	%	80 - 120
			Total Bismuth (Bi)	2020/03/20		97	%	80 - 120
			Total Boron (B)	2020/03/20		92	%	80 - 120
			Total Cadmium (Cd)	2020/03/20		94	%	80 - 120
			Total Calcium (Ca)	2020/03/20		92	%	80 - 120
			Total Chromium (Cr)	2020/03/20		95	%	80 - 120
			Total Cobalt (Co)	2020/03/20		97	%	80 - 120
			Total Copper (Cu)	2020/03/20		93	%	80 - 120
			Total Iron (Fe)	2020/03/20		97	%	80 - 120
			Total Lead (Pb)	2020/03/20		97	%	80 - 120
			Total Magnesium (Mg)	2020/03/20		100	%	80 - 120
			Total Manganese (Mn)	2020/03/20		NC	%	80 - 120
			Total Molybdenum (Mo)	2020/03/20		100	%	80 - 120
			Total Nickel (Ni)	2020/03/20		96	%	80 - 120
			Total Phosphorus (P)	2020/03/20		99	%	80 - 120
			Total Potassium (K)	2020/03/20		101	%	80 - 120
			Total Selenium (Se)	2020/03/20		97	%	80 - 120
			Total Silver (Ag)	2020/03/20		98	%	80 - 120
			Total Sodium (Na)	2020/03/20		95	%	80 - 120
			Total Strontium (Sr)	2020/03/20		99	%	80 - 120
			Total Thallium (Tl)	2020/03/20		98	%	80 - 120
			Total Tin (Sn)	2020/03/20		98	%	80 - 120
			Total Titanium (Ti)	2020/03/20		97	%	80 - 120
			Total Uranium (U)	2020/03/20		104	%	80 - 120
			Total Vanadium (V)	2020/03/20		96	%	80 - 120
			Total Zinc (Zn)	2020/03/20		96	%	80 - 120
6642111	MLB	Spiked Blank	Total Aluminum (Al)	2020/03/19		97	%	80 - 120
			Total Antimony (Sb)	2020/03/19		98	%	80 - 120
			Total Arsenic (As)	2020/03/19		94	%	80 - 120
			Total Barium (Ba)	2020/03/19		93	%	80 - 120
			Total Beryllium (Be)	2020/03/19		99	%	80 - 120
			Total Bismuth (Bi)	2020/03/19		96	%	80 - 120
			Total Boron (B)	2020/03/19		97	%	80 - 120
			Total Cadmium (Cd)	2020/03/19		95	%	80 - 120
			Total Calcium (Ca)	2020/03/19		95	%	80 - 120
			Total Chromium (Cr)	2020/03/19		94	%	80 - 120
			Total Cobalt (Co)	2020/03/19		95	%	80 - 120
			Total Copper (Cu)	2020/03/19		93	%	80 - 120
			Total Iron (Fe)	2020/03/19		98	%	80 - 120
			Total Lead (Pb)	2020/03/19		96	%	80 - 120
			Total Magnesium (Mg)	2020/03/19		101	%	80 - 120
			Total Manganese (Mn)	2020/03/19		96	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Molybdenum (Mo)	2020/03/19		100	%	80 - 120
			Total Nickel (Ni)	2020/03/19		95	%	80 - 120
			Total Phosphorus (P)	2020/03/19		98	%	80 - 120
			Total Potassium (K)	2020/03/19		99	%	80 - 120
			Total Selenium (Se)	2020/03/19		94	%	80 - 120
			Total Silver (Ag)	2020/03/19		93	%	80 - 120
			Total Sodium (Na)	2020/03/19		97	%	80 - 120
			Total Strontium (Sr)	2020/03/19		94	%	80 - 120
			Total Thallium (Tl)	2020/03/19		96	%	80 - 120
			Total Tin (Sn)	2020/03/19		95	%	80 - 120
			Total Titanium (Ti)	2020/03/19		99	%	80 - 120
			Total Uranium (U)	2020/03/19		103	%	80 - 120
			Total Vanadium (V)	2020/03/19		94	%	80 - 120
			Total Zinc (Zn)	2020/03/19		95	%	80 - 120
6642111	MLB	Method Blank	Total Aluminum (Al)	2020/03/19	ND, RDL=5.0		ug/L	
			Total Antimony (Sb)	2020/03/19	ND, RDL=1.0		ug/L	
			Total Arsenic (As)	2020/03/19	ND, RDL=1.0		ug/L	
			Total Barium (Ba)	2020/03/19	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2020/03/19	ND, RDL=1.0		ug/L	
			Total Bismuth (Bi)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Boron (B)	2020/03/19	ND, RDL=50		ug/L	
			Total Cadmium (Cd)	2020/03/19	ND, RDL=0.010		ug/L	
			Total Calcium (Ca)	2020/03/19	ND, RDL=100		ug/L	
			Total Chromium (Cr)	2020/03/19	ND, RDL=1.0		ug/L	
			Total Cobalt (Co)	2020/03/19	ND, RDL=0.40		ug/L	
			Total Copper (Cu)	2020/03/19	ND, RDL=0.50		ug/L	
			Total Iron (Fe)	2020/03/19	ND, RDL=50		ug/L	
			Total Lead (Pb)	2020/03/19	ND, RDL=0.50		ug/L	
			Total Magnesium (Mg)	2020/03/19	ND, RDL=100		ug/L	
			Total Manganese (Mn)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Molybdenum (Mo)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Nickel (Ni)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Phosphorus (P)	2020/03/19	ND, RDL=100		ug/L	
			Total Potassium (K)	2020/03/19	ND, RDL=100		ug/L	
			Total Selenium (Se)	2020/03/19	ND, RDL=0.50		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2020/03/19	ND, RDL=0.10		ug/L	
			Total Sodium (Na)	2020/03/19	ND, RDL=100		ug/L	
			Total Strontium (Sr)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Thallium (Tl)	2020/03/19	ND, RDL=0.10		ug/L	
			Total Tin (Sn)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Titanium (Ti)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Uranium (U)	2020/03/19	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2020/03/19	ND, RDL=2.0		ug/L	
			Total Zinc (Zn)	2020/03/19	ND, RDL=5.0		ug/L	
6642111	MLB	RPD	Total Aluminum (Al)	2020/03/20	2.9		%	20
			Total Antimony (Sb)	2020/03/20	NC		%	20
			Total Arsenic (As)	2020/03/20	10		%	20
			Total Barium (Ba)	2020/03/20	6.7		%	20
			Total Beryllium (Be)	2020/03/20	NC		%	20
			Total Bismuth (Bi)	2020/03/20	NC		%	20
			Total Boron (B)	2020/03/20	NC		%	20
			Total Cadmium (Cd)	2020/03/20	15		%	20
			Total Calcium (Ca)	2020/03/20	13		%	20
			Total Chromium (Cr)	2020/03/20	NC		%	20
			Total Cobalt (Co)	2020/03/20	NC		%	20
			Total Copper (Cu)	2020/03/20	7.9		%	20
			Total Iron (Fe)	2020/03/20	7.5		%	20
			Total Lead (Pb)	2020/03/20	8.7		%	20
			Total Magnesium (Mg)	2020/03/20	5.9		%	20
			Total Manganese (Mn)	2020/03/20	8.2		%	20
			Total Molybdenum (Mo)	2020/03/20	NC		%	20
			Total Nickel (Ni)	2020/03/20	NC		%	20
			Total Phosphorus (P)	2020/03/20	NC		%	20
			Total Potassium (K)	2020/03/20	14		%	20
			Total Selenium (Se)	2020/03/20	NC		%	20
			Total Silver (Ag)	2020/03/20	NC		%	20
			Total Sodium (Na)	2020/03/20	16		%	20
			Total Strontium (Sr)	2020/03/20	7.9		%	20
			Total Thallium (Tl)	2020/03/20	NC		%	20
			Total Tin (Sn)	2020/03/20	NC		%	20
			Total Titanium (Ti)	2020/03/20	1.2		%	20
			Total Uranium (U)	2020/03/20	5.9		%	20
			Total Vanadium (V)	2020/03/20	NC		%	20
6643775	SSI	Matrix Spike	Total Organic Carbon (C)	2020/03/19		103	%	85 - 115
6643775	SSI	Spiked Blank	Total Organic Carbon (C)	2020/03/19		100	%	80 - 120
6643775	SSI	Method Blank	Total Organic Carbon (C)	2020/03/19	ND, RDL=0.50		mg/L	
6643775	SSI	RPD	Total Organic Carbon (C)	2020/03/19	NC		%	15
6645806	SHW	QC Standard	pH	2020/03/20		100	%	97 - 103
6645806	SHW	RPD	pH	2020/03/20	0.13		%	N/A
6645809	SHW	Spiked Blank	Conductivity	2020/03/20		101	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6645809	SHW	Method Blank	Conductivity	2020/03/20	1.2, RDL=1.0		uS/cm	
6645809	SHW	RPD	Conductivity	2020/03/20	1.1		%	10
6645810	SHW	QC Standard	pH	2020/03/20		101	%	97 - 103
6645810	SHW	RPD [MGQ671-01]	pH	2020/03/20	1.5		%	N/A
6645812	SHW	Spiked Blank	Conductivity	2020/03/20		100	%	80 - 120
6645812	SHW	Method Blank	Conductivity	2020/03/20	ND, RDL=1.0		uS/cm	
6645812	SHW	RPD [MGQ671-01]	Conductivity	2020/03/20	0.44		%	10
6645975	MCN	Matrix Spike [MGQ671-04]	Nitrogen (Ammonia Nitrogen)	2020/03/23		112	%	80 - 120
6645975	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/03/23		106	%	80 - 120
6645975	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/03/23	ND, RDL=0.050		mg/L	
6645975	MCN	RPD [MGQ671-04]	Nitrogen (Ammonia Nitrogen)	2020/03/23	NC		%	20
6645976	MCN	Matrix Spike	Nitrogen (Ammonia Nitrogen)	2020/03/24		97	%	80 - 120
6645976	MCN	Spiked Blank	Nitrogen (Ammonia Nitrogen)	2020/03/23		106	%	80 - 120
6645976	MCN	Method Blank	Nitrogen (Ammonia Nitrogen)	2020/03/23	ND, RDL=0.050		mg/L	
6645976	MCN	RPD	Nitrogen (Ammonia Nitrogen)	2020/03/24	NC		%	20
6649387	MCN	Matrix Spike	Total Alkalinity (Total as CaCO3)	2020/03/24		98	%	80 - 120
6649387	MCN	Spiked Blank	Total Alkalinity (Total as CaCO3)	2020/03/24		103	%	80 - 120
6649387	MCN	Method Blank	Total Alkalinity (Total as CaCO3)	2020/03/24	ND, RDL=5.0		mg/L	
6649387	MCN	RPD	Total Alkalinity (Total as CaCO3)	2020/03/24	NC		%	25
6649395	EMT	Matrix Spike	Dissolved Chloride (Cl-)	2020/03/24		96	%	80 - 120
6649395	EMT	Spiked Blank	Dissolved Chloride (Cl-)	2020/03/24		99	%	80 - 120
6649395	EMT	Method Blank	Dissolved Chloride (Cl-)	2020/03/24	ND, RDL=1.0		mg/L	
6649395	EMT	RPD	Dissolved Chloride (Cl-)	2020/03/24	5.9		%	25
6649399	EMT	Matrix Spike	Dissolved Sulphate (SO4)	2020/03/24		107	%	80 - 120
6649399	EMT	Spiked Blank	Dissolved Sulphate (SO4)	2020/03/24		107	%	80 - 120
6649399	EMT	Method Blank	Dissolved Sulphate (SO4)	2020/03/24	ND, RDL=2.0		mg/L	
6649399	EMT	RPD	Dissolved Sulphate (SO4)	2020/03/24	NC		%	25
6649400	EMT	Matrix Spike	Reactive Silica (SiO2)	2020/03/24		95	%	80 - 120
6649400	EMT	Spiked Blank	Reactive Silica (SiO2)	2020/03/24		100	%	80 - 120
6649400	EMT	Method Blank	Reactive Silica (SiO2)	2020/03/24	ND, RDL=0.50		mg/L	
6649400	EMT	RPD	Reactive Silica (SiO2)	2020/03/24	3.4		%	25
6649405	EMT	Spiked Blank	Colour	2020/03/25		101	%	80 - 120
6649405	EMT	Method Blank	Colour	2020/03/25	ND, RDL=5.0		TCU	
6649405	EMT	RPD	Colour	2020/03/25	4.1 (1)		%	20
6649409	MCN	Matrix Spike	Orthophosphate (P)	2020/03/24		96	%	80 - 120
6649409	MCN	Spiked Blank	Orthophosphate (P)	2020/03/24		100	%	80 - 120
6649409	MCN	Method Blank	Orthophosphate (P)	2020/03/24	ND, RDL=0.010		mg/L	
6649409	MCN	RPD	Orthophosphate (P)	2020/03/24	NC		%	25
6649411	EMT	Matrix Spike	Nitrate + Nitrite (N)	2020/03/25		98	%	80 - 120
6649411	EMT	Spiked Blank	Nitrate + Nitrite (N)	2020/03/25		98	%	80 - 120
6649411	EMT	Method Blank	Nitrate + Nitrite (N)	2020/03/25	ND, RDL=0.050		mg/L	
6649411	EMT	RPD	Nitrate + Nitrite (N)	2020/03/25	6.2		%	25
6649412	EMT	Matrix Spike	Nitrite (N)	2020/03/24		102	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6649412	EMT	Spiked Blank	Nitrite (N)	2020/03/24		113	%	80 - 120
6649412	EMT	Method Blank	Nitrite (N)	2020/03/24	ND, RDL=0.010		mg/L	
6649412	EMT	RPD	Nitrite (N)	2020/03/24	NC		%	20

N/A = Not Applicable

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) Elevated reporting limit due to sample matrix.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Eric Dearman, Scientific Specialist

Robyn Edwards, Bedford Micro Supervisor

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.

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VALORÉS
INSTITUT DE RECHERCHE SUR LES ZONES CÔTIÈRES
COASTAL ZONES RESEARCH INSTITUTE

CALA Testing Accreditation No. A2743

RAPPORT D'ANALYSES / ANALYTICAL REPORT

Client:	Whale Sanctuary Project	**Adresse / Adress:**	4100, Kanab Road Kanab, Utah 84741	**# de Requête / Job # :** **# de Projet / Project # :**	9969 WSP_Nutrients_1
Contact:	Amanda Babin	**Téléphone / Telephone:**	902-580-1230	**Échantillon(s) reçu(s) / Sample(s) received:**	2020-02-28
Date: **Version:**	2020-03-20 1 (Original)	**Courriel / E-mail :**	amandab@whalesanctuary.org	**Échantillon(s) / Sample(s):**	Eau usée / Wastewater (2)
Copie(s) / Copy(ies):	-			**Échantillonné par / Sampled by:**	C.L.

ANALYSE / ANALYSIS		**LQ / QL**	**CODE DU LAB / LAB CODE** 9969-1 **ÉCHANTILLON / SAMPLE** Surface seawater from south line in >7x rinsed jar ~of sulfuric acid grade added 2020-02-27 (10h30)	**CODE DU LAB / LAB CODE** 9969-2 **ÉCHANTILLON / SAMPLE** Surface seawater from south line in >7x rinsed ~ 2020-02-27 (10h30)
TKN (méthode modifiée de / method modified from 4500-Norg B)[1]	mg / L	0.50	<0.50	-
Azote ammoniacal (NH3-N) / Ammonia (NH3-N) (méthode modifiée de / method modified from 4500-NH3 D)[1]	mg / L	0.14	0.14	-
Phosphore total / Total Phosphorus (méthode modifiée de / method modified from 4500-P E)[1]	mg / L	0.03	0.05	-
Nitrates-N (NO_3-N)*†	mg / L	0.05	-	< 2.5
Nitrites-N (NO_3-N)*†	mg / L	0.05	-	< 2.5
Carbone Organique Total / Total Organic Carbon*†	mg / L	0.5	-	1.6

Ces résultats se rapportent exclusivement aux échantillons analysés et sont représentatifs des échantillons tel qu'ils ont été reçus. Ce rapport ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite de VALORĒS. / Results in this report apply solely to samples tested and are representative of the samples as received. This report shall not be reproduced, except in full, without the written approval of the VALORĒS.

DocuSigned by:
Claude J. Pelletier
689C13B662724C6...
Claude Pelletier
Responsable du Laboratoire de Chimie /
Head of Chemistry Laboratory

DocuSigned by:
Annick Comeau
C09A89837483454...
Annick Comeau
Technicienne du laboratoire de microbiologie /
Technician of the microbiology laboratory

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Contact:	Amanda Babin	**Téléphone / Telephone:**	902-580-1230	**Échantillon(s) reçu(s) / Sample(s) received:**	2020-02-28
Date: **Version:**	2020-03-20 1 (Original)	**Courriel / E-mail :**	amandab@whalesanctuary.org	**Échantillon(s) / Sample(s):**	Eau usée / Wastewater (2)
Copie(s) / Copy(ies):	-			**Échantillonné par / Sampled by:**	C.L.

Commentaires / comments :

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**Ce laboratoire n'est pas accrédité pour les analyses indiquées par un astérisque. / This laboratory is not accredited for those tests marked by an asterisk.*

[1]Déterminations effectuées selon "Standard Methods for the Examination of Water and Wastewater", 23^{e} édition. / Determinations done in accordance with "Standard Methods for the Examination of Water and Wastewater", 23nd edition.

[†]Analyse sous-traitée. / Subcontracted analysis.

Légende / Legend:

LQ / QL = limite de quantification / quantification limit
< = inférieur à la valeur indiquée / lower than indicated value

DocuSigned by:
Claude J. Pelletier
689C13B662724C6...
Claude Pelletier
Responsable du Laboratoire de Chimie /
Head of Chemistry Laboratory

DocuSigned by:
Annick Comeau
C09A8983748345A...
Annick Comeau
Technicienne du laboratoire de microbiologie /
Technician of the microbiology laboratory

Your C.O.C. #: N/A

Attention: Alexandra Vance

Whale Sanctuary Project
220 Back Rd
Seaforth, NS
Canada

Report Date: 2024/06/19
Report #: R8198067
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4G5838
Received: 2024/06/03, 14:17

Sample Matrix: Sediment
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Metals Solids Acid Extr. ICPMS	5	2024/06/06	2024/06/06	ATL SOP 00058	EPA 6020B R2 m
Metals Solids Acid Extr. ICPMS	2	2024/06/06	2024/06/07	ATL SOP 00058	EPA 6020B R2 m

Sample Matrix: Tissue
Samples Received: 14

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in biota	14	2024/06/17	2024/06/18	ATL SOP 00026	EPA 245.6 R2.3 m
Metals in Terrestrial Biota	14	2024/06/13	2024/06/14	ATL SOP 00058	EPA 6020B R3 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, 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.

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Your C.O.C. #: N/A

Attention: Alexandra Vance
Whale Sanctuary Project
220 Back Rd
Seaforth, NS
Canada

Report Date: 2024/06/19
Report #: R8198067
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4G5838
Received: 2024/06/03, 14:17

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Michelle Huth, Project Manager
Email: michelle.brescacin@bureauveritas.com
Phone# (902) 420-0203
==
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ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		ZIK873	ZIK874	ZIK875	ZIK876	ZIK877	ZIK878		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	**SED - 1**	**SED - 2**	**SED - 3**	**SED - 4**	**SED - 5**	**SED - 6**	**RDL**	**QC Batch**
Metals									
Acid Extractable Aluminum (Al)	mg/kg	7100	6500	6500	6400	6900	6900	10	9437732
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9437732
Acid Extractable Arsenic (As)	mg/kg	260	220	230	250	140	98	2.0	9437732
Acid Extractable Barium (Ba)	mg/kg	16	13	14	12	14	14	5.0	9437732
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	1.0	9437732
Acid Extractable Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9437732
Acid Extractable Boron (B)	mg/kg	ND	ND	ND	ND	ND	ND	50	9437732
Acid Extractable Cadmium (Cd)	mg/kg	ND	ND	ND	ND	ND	ND	0.30	9437732
Acid Extractable Chromium (Cr)	mg/kg	12	11	11	11	12	12	2.0	9437732
Acid Extractable Cobalt (Co)	mg/kg	5.5	4.9	4.9	4.8	5.5	5.3	1.0	9437732
Acid Extractable Copper (Cu)	mg/kg	9.1	7.7	7.9	6.9	11	9.1	2.0	9437732
Acid Extractable Iron (Fe)	mg/kg	15000	14000	14000	14000	15000	15000	50	9437732
Acid Extractable Lead (Pb)	mg/kg	6.7	6.4	6.4	6.0	6.3	6.4	0.50	9437732
Acid Extractable Lithium (Li)	mg/kg	18	17	17	17	18	18	2.0	9437732
Acid Extractable Manganese (Mn)	mg/kg	240	220	230	220	260	240	2.0	9437732
Acid Extractable Mercury (Hg)	mg/kg	0.22	0.18	0.23	0.21	0.16	0.12	0.10	9437732
Acid Extractable Molybdenum (Mo)	mg/kg	3.4	4.0	2.1	2.8	2.5	2.7	2.0	9437732
Acid Extractable Nickel (Ni)	mg/kg	14	14	13	12	14	14	2.0	9437732
Acid Extractable Rubidium (Rb)	mg/kg	7.3	6.7	6.5	6.4	7.1	6.9	2.0	9437732
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9437732
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9437732
Acid Extractable Strontium (Sr)	mg/kg	18	20	22	20	20	21	5.0	9437732
Acid Extractable Thallium (Tl)	mg/kg	0.11	ND	ND	ND	ND	0.11	0.10	9437732
Acid Extractable Tin (Sn)	mg/kg	ND	ND	ND	ND	ND	ND	1.0	9437732
Acid Extractable Uranium (U)	mg/kg	1.2	1.2	0.91	1.1	0.94	0.97	0.10	9437732
Acid Extractable Vanadium (V)	mg/kg	16	15	16	15	15	15	2.0	9437732
Acid Extractable Zinc (Zn)	mg/kg	34	34	30	30	35	34	5.0	9437732

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		ZIK879		
Sampling Date		2024/06/02 12:26		
COC Number		N/A		
	UNITS	**SED - 7 * REF**	**RDL**	**QC Batch**
Metals				
Acid Extractable Aluminum (Al)	mg/kg	7400	10	9437732
Acid Extractable Antimony (Sb)	mg/kg	ND	2.0	9437732
Acid Extractable Arsenic (As)	mg/kg	78	2.0	9437732
Acid Extractable Barium (Ba)	mg/kg	15	5.0	9437732
Acid Extractable Beryllium (Be)	mg/kg	ND	1.0	9437732
Acid Extractable Bismuth (Bi)	mg/kg	ND	2.0	9437732
Acid Extractable Boron (B)	mg/kg	ND	50	9437732
Acid Extractable Cadmium (Cd)	mg/kg	ND	0.30	9437732
Acid Extractable Chromium (Cr)	mg/kg	12	2.0	9437732
Acid Extractable Cobalt (Co)	mg/kg	5.7	1.0	9437732
Acid Extractable Copper (Cu)	mg/kg	14	2.0	9437732
Acid Extractable Iron (Fe)	mg/kg	16000	50	9437732
Acid Extractable Lead (Pb)	mg/kg	7.3	0.50	9437732
Acid Extractable Lithium (Li)	mg/kg	19	2.0	9437732
Acid Extractable Manganese (Mn)	mg/kg	280	2.0	9437732
Acid Extractable Mercury (Hg)	mg/kg	0.12	0.10	9437732
Acid Extractable Molybdenum (Mo)	mg/kg	3.9	2.0	9437732
Acid Extractable Nickel (Ni)	mg/kg	15	2.0	9437732
Acid Extractable Rubidium (Rb)	mg/kg	7.6	2.0	9437732
Acid Extractable Selenium (Se)	mg/kg	ND	0.50	9437732
Acid Extractable Silver (Ag)	mg/kg	ND	0.50	9437732
Acid Extractable Strontium (Sr)	mg/kg	20	5.0	9437732
Acid Extractable Thallium (Tl)	mg/kg	0.11	0.10	9437732
Acid Extractable Tin (Sn)	mg/kg	ND	1.0	9437732
Acid Extractable Uranium (U)	mg/kg	1.2	0.10	9437732
Acid Extractable Vanadium (V)	mg/kg	17	2.0	9437732
Acid Extractable Zinc (Zn)	mg/kg	36	5.0	9437732

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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MERCURY BY COLD VAPOUR AA (TISSUE)

Bureau Veritas ID		ZIK880	ZIK881	ZIK882	ZIK883	ZIK884	ZIK885	ZIK886		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	**ROOT - 1**	**ROOT - 2**	**ROOT - 3**	**ROOT - 4**	**ROOT - 5**	**ROOT - 6**	**ROOT - 7 * REF**	**RDL**	**QC Batch**
Metals										
Mercury (Hg)	mg/kg	0.14	0.046	0.033	0.050	0.050	0.039	0.024	0.010	9460093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		ZIK887	ZIK888	ZIK889	ZIK890	ZIK891	ZIK892	ZIK893		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	**LEAF - 1**	**LEAF - 2**	**LEAF - 3**	**LEAF - 4**	**LEAF - 5**	**LEAF - 6**	**LEAF - 7 * REF**	**RDL**	**QC Batch**
Metals										
Mercury (Hg)	mg/kg	0.013	ND	ND	ND	ND	ND	ND	0.010	9460093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK880	ZIK881	ZIK882	ZIK883	ZIK884	ZIK885		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	ROOT - 1	ROOT - 2	ROOT - 3	ROOT - 4	ROOT - 5	ROOT - 6	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	2300	4800	2400	3300	1300	3700	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	71	120	92	92	36	52	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	9.1	16	14	13	11	12	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	1100	890	1000	880	980	910	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.37	0.40	0.42	0.44	0.44	0.41	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	8.1	12	8.0	12	3.5	13	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	2.5	4.0	2.3	2.8	1.1	3.0	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	4.8	7.8	6.2	6.6	4.2	6.6	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	6500	11000	6500	8200	3900	8100	50	9452152
Acid Extractable Lead (Pb)	mg/kg	7.5	8.1	5.8	6.4	3.3	7.2	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	6.2	12	6.1	8.3	4.0	8.9	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	89	170	140	140	64	120	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	19	17	9.0	10	12	15	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	5.6	10	6.1	7.4	3.2	7.7	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	210	150	170	170	220	160	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	2.5	3.1	2.3	2.3	2.4	2.4	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	9.7	16	13	14	8.1	12	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	20	29	21	27	15	23	5.0	9452152

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK886	ZIK887	ZIK888	ZIK889	ZIK890	ZIK891		
Sampling Date		2024/06/02 12:26	2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	**ROOT - 7 * REF**	**LEAF - 1**	**LEAF - 2**	**LEAF - 3**	**LEAF - 4**	**LEAF - 5**	**RDL**	**QC Batch**
Metals									
Acid Extractable Aluminum (Al)	mg/kg	1900	480	170	540	28	150	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	13	17	5.1	28	ND	4.7	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	8.1	ND	ND	ND	ND	ND	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	1200	340	360	370	390	560	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.58	0.33	0.60	0.46	0.37	0.82	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	6.1	4.1	ND	3.5	ND	ND	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	1.5	ND	ND	ND	ND	ND	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	3.8	2.5	2.1	2.4	ND	2.3	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	4200	1200	450	1300	130	480	50	9452152
Acid Extractable Lead (Pb)	mg/kg	4.1	1.3	0.63	0.85	ND	0.52	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	5.1	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	61	130	110	110	73	180	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	19	3.2	4.4	3.8	3.3	5.0	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	4.2	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	220	84	110	110	94	140	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	3.3	0.33	0.28	0.35	0.22	0.41	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	7.3	2.0	ND	2.5	ND	ND	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	14	18	25	16	14	18	5.0	9452152

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK892	ZIK893		
Sampling Date		2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A		
	UNITS	**LEAF - 6**	**LEAF - 7 * REF**	**RDL**	**QC Batch**
Metals					
Acid Extractable Aluminum (Al)	mg/kg	67	1000	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	2.3	10	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	ND	ND	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	630	460	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.68	0.77	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	ND	7.2	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	ND	1.2	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	2.8	2.8	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	240	2400	50	9452152
Acid Extractable Lead (Pb)	mg/kg	ND	1.8	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	ND	3.2	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	140	200	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	6.7	5.0	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	ND	2.7	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	140	110	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	0.61	0.42	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	ND	4.5	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	19	16	5.0	9452152

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.7°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9437732	MOA	Matrix Spike [ZIK879-01]	Acid Extractable Antimony (Sb)	2024/06/06		111	%	75 - 125
			Acid Extractable Arsenic (As)	2024/06/06		NC	%	75 - 125
			Acid Extractable Barium (Ba)	2024/06/06		109	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/06/06		106	%	75 - 125
			Acid Extractable Bismuth (Bi)	2024/06/06		106	%	75 - 125
			Acid Extractable Boron (B)	2024/06/06		106	%	75 - 125
			Acid Extractable Cadmium (Cd)	2024/06/06		107	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/06/06		110	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/06/06		108	%	75 - 125
			Acid Extractable Copper (Cu)	2024/06/06		101	%	75 - 125
			Acid Extractable Lead (Pb)	2024/06/06		110	%	75 - 125
			Acid Extractable Lithium (Li)	2024/06/06		110	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/06/06		NC	%	75 - 125
			Acid Extractable Mercury (Hg)	2024/06/06		107	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/06/06		120	%	75 - 125
			Acid Extractable Nickel (Ni)	2024/06/06		113	%	75 - 125
			Acid Extractable Rubidium (Rb)	2024/06/06		109	%	75 - 125
			Acid Extractable Selenium (Se)	2024/06/06		111	%	75 - 125
			Acid Extractable Silver (Ag)	2024/06/06		113	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/06/06		118	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/06/06		109	%	75 - 125
			Acid Extractable Tin (Sn)	2024/06/06		110	%	75 - 125
			Acid Extractable Uranium (U)	2024/06/06		114	%	75 - 125
			Acid Extractable Vanadium (V)	2024/06/06		113	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/06/06		112	%	75 - 125
9437732	MOA	Spiked Blank	Acid Extractable Antimony (Sb)	2024/06/06		106	%	75 - 125
			Acid Extractable Arsenic (As)	2024/06/06		103	%	75 - 125
			Acid Extractable Barium (Ba)	2024/06/06		98	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/06/06		100	%	75 - 125
			Acid Extractable Bismuth (Bi)	2024/06/06		100	%	75 - 125
			Acid Extractable Boron (B)	2024/06/06		105	%	75 - 125
			Acid Extractable Cadmium (Cd)	2024/06/06		101	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/06/06		103	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/06/06		101	%	75 - 125
			Acid Extractable Copper (Cu)	2024/06/06		102	%	75 - 125
			Acid Extractable Lead (Pb)	2024/06/06		100	%	75 - 125
			Acid Extractable Lithium (Li)	2024/06/06		102	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/06/06		101	%	75 - 125
			Acid Extractable Mercury (Hg)	2024/06/06		102	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/06/06		107	%	75 - 125
			Acid Extractable Nickel (Ni)	2024/06/06		106	%	75 - 125
			Acid Extractable Rubidium (Rb)	2024/06/06		100	%	75 - 125
			Acid Extractable Selenium (Se)	2024/06/06		106	%	75 - 125
			Acid Extractable Silver (Ag)	2024/06/06		106	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/06/06		103	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/06/06		103	%	75 - 125
			Acid Extractable Tin (Sn)	2024/06/06		106	%	75 - 125
			Acid Extractable Uranium (U)	2024/06/06		104	%	75 - 125
			Acid Extractable Vanadium (V)	2024/06/06		102	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/06/06		103	%	75 - 125
9437732	MOA	Method Blank	Acid Extractable Aluminum (Al)	2024/06/06	ND, RDL=10		mg/kg	
			Acid Extractable Antimony (Sb)	2024/06/06	ND, RDL=2.0		mg/kg	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Arsenic (As)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Barium (Ba)	2024/06/06	ND, RDL=5.0		mg/kg	
			Acid Extractable Beryllium (Be)	2024/06/06	ND, RDL=1.0		mg/kg	
			Acid Extractable Bismuth (Bi)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Boron (B)	2024/06/06	ND, RDL=50		mg/kg	
			Acid Extractable Cadmium (Cd)	2024/06/06	ND, RDL=0.30		mg/kg	
			Acid Extractable Chromium (Cr)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Cobalt (Co)	2024/06/06	ND, RDL=1.0		mg/kg	
			Acid Extractable Copper (Cu)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Iron (Fe)	2024/06/06	ND, RDL=50		mg/kg	
			Acid Extractable Lead (Pb)	2024/06/06	ND, RDL=0.50		mg/kg	
			Acid Extractable Lithium (Li)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Manganese (Mn)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Mercury (Hg)	2024/06/06	ND, RDL=0.10		mg/kg	
			Acid Extractable Molybdenum (Mo)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Nickel (Ni)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Rubidium (Rb)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Selenium (Se)	2024/06/06	ND, RDL=0.50		mg/kg	
			Acid Extractable Silver (Ag)	2024/06/06	ND, RDL=0.50		mg/kg	
			Acid Extractable Strontium (Sr)	2024/06/06	ND, RDL=5.0		mg/kg	
			Acid Extractable Thallium (Tl)	2024/06/06	ND, RDL=0.10		mg/kg	
			Acid Extractable Tin (Sn)	2024/06/06	ND, RDL=1.0		mg/kg	
			Acid Extractable Uranium (U)	2024/06/06	ND, RDL=0.10		mg/kg	
			Acid Extractable Vanadium (V)	2024/06/06	ND, RDL=2.0		mg/kg	
			Acid Extractable Zinc (Zn)	2024/06/06	ND, RDL=5.0		mg/kg	
9437732	MOA	RPD [ZIK879-01]	Acid Extractable Aluminum (Al)	2024/06/06	1.6		%	35
			Acid Extractable Antimony (Sb)	2024/06/06	NC		%	35
			Acid Extractable Arsenic (As)	2024/06/06	9.2		%	35
			Acid Extractable Barium (Ba)	2024/06/06	2.3		%	35
			Acid Extractable Beryllium (Be)	2024/06/06	NC		%	35
			Acid Extractable Bismuth (Bi)	2024/06/06	NC		%	35

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Boron (B)	2024/06/06	NC		%	35
			Acid Extractable Cadmium (Cd)	2024/06/06	NC		%	35
			Acid Extractable Chromium (Cr)	2024/06/06	2.9		%	35
			Acid Extractable Cobalt (Co)	2024/06/06	4.6		%	35
			Acid Extractable Copper (Cu)	2024/06/06	37 (1)		%	35
			Acid Extractable Iron (Fe)	2024/06/06	1.0		%	35
			Acid Extractable Lead (Pb)	2024/06/06	7.9		%	35
			Acid Extractable Lithium (Li)	2024/06/06	0.48		%	35
			Acid Extractable Manganese (Mn)	2024/06/06	2.6		%	35
			Acid Extractable Mercury (Hg)	2024/06/06	5.4		%	35
			Acid Extractable Molybdenum (Mo)	2024/06/06	3.0		%	35
			Acid Extractable Nickel (Ni)	2024/06/06	1.2		%	35
			Acid Extractable Rubidium (Rb)	2024/06/06	3.9		%	35
			Acid Extractable Selenium (Se)	2024/06/06	NC		%	35
			Acid Extractable Silver (Ag)	2024/06/06	NC		%	35
			Acid Extractable Strontium (Sr)	2024/06/06	2.0		%	35
			Acid Extractable Thallium (Tl)	2024/06/06	0.27		%	35
			Acid Extractable Tin (Sn)	2024/06/06	NC		%	35
			Acid Extractable Uranium (U)	2024/06/06	5.2		%	35
			Acid Extractable Vanadium (V)	2024/06/06	0.86		%	35
			Acid Extractable Zinc (Zn)	2024/06/06	1.4		%	35
9452152	MOA	Matrix Spike [ZIK892-01]	Acid Extractable Antimony (Sb)	2024/06/14		110	%	75 - 125
			Acid Extractable Arsenic (As)	2024/06/14		106	%	75 - 125
			Acid Extractable Barium (Ba)	2024/06/14		108	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/06/14		103	%	75 - 125
			Acid Extractable Boron (B)	2024/06/14		NC	%	75 - 125
			Acid Extractable Cadmium (Cd)	2024/06/14		108	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/06/14		107	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/06/14		105	%	75 - 125
			Acid Extractable Copper (Cu)	2024/06/14		104	%	75 - 125
			Acid Extractable Lead (Pb)	2024/06/14		106	%	75 - 125
			Acid Extractable Lithium (Li)	2024/06/14		105	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/06/14		NC	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/06/14		NC	%	75 - 125
			Acid Extractable Nickel (Ni)	2024/06/14		106	%	75 - 125
			Acid Extractable Selenium (Se)	2024/06/14		105	%	75 - 125
			Acid Extractable Silver (Ag)	2024/06/14		107	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/06/14		NC	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/06/14		109	%	75 - 125
			Acid Extractable Uranium (U)	2024/06/14		111	%	75 - 125
			Acid Extractable Vanadium (V)	2024/06/14		107	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/06/14		95	%	75 - 125
9452152	MOA	Spiked Blank	Acid Extractable Antimony (Sb)	2024/06/14		106	%	75 - 125
			Acid Extractable Arsenic (As)	2024/06/14		108	%	75 - 125
			Acid Extractable Barium (Ba)	2024/06/14		105	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/06/14		104	%	75 - 125
			Acid Extractable Boron (B)	2024/06/14		111	%	75 - 125
			Acid Extractable Cadmium (Cd)	2024/06/14		106	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/06/14		106	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/06/14		105	%	75 - 125
			Acid Extractable Copper (Cu)	2024/06/14		105	%	75 - 125
			Acid Extractable Lead (Pb)	2024/06/14		104	%	75 - 125
			Acid Extractable Lithium (Li)	2024/06/14		105	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/06/14		108	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/06/14		110	%	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Nickel (Ni)	2024/06/14		106	%	75 - 125
			Acid Extractable Selenium (Se)	2024/06/14		107	%	75 - 125
			Acid Extractable Silver (Ag)	2024/06/14		105	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/06/14		103	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/06/14		108	%	75 - 125
			Acid Extractable Uranium (U)	2024/06/14		106	%	75 - 125
			Acid Extractable Vanadium (V)	2024/06/14		107	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/06/14		102	%	75 - 125
9452152	MOA	Method Blank	Acid Extractable Aluminum (Al)	2024/06/14	ND, RDL=10		mg/kg	
			Acid Extractable Antimony (Sb)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Arsenic (As)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Barium (Ba)	2024/06/14	ND, RDL=5.0		mg/kg	
			Acid Extractable Beryllium (Be)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Boron (B)	2024/06/14	ND, RDL=5.0		mg/kg	
			Acid Extractable Cadmium (Cd)	2024/06/14	ND, RDL=0.30		mg/kg	
			Acid Extractable Chromium (Cr)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Cobalt (Co)	2024/06/14	ND, RDL=1.0		mg/kg	
			Acid Extractable Copper (Cu)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Iron (Fe)	2024/06/14	ND, RDL=50		mg/kg	
			Acid Extractable Lead (Pb)	2024/06/14	ND, RDL=0.50		mg/kg	
			Acid Extractable Lithium (Li)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Manganese (Mn)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Molybdenum (Mo)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Nickel (Ni)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Selenium (Se)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Silver (Ag)	2024/06/14	ND, RDL=0.50		mg/kg	
			Acid Extractable Strontium (Sr)	2024/06/14	ND, RDL=5.0		mg/kg	
			Acid Extractable Thallium (Tl)	2024/06/14	ND, RDL=0.10		mg/kg	
			Acid Extractable Uranium (U)	2024/06/14	ND, RDL=0.10		mg/kg	
			Acid Extractable Vanadium (V)	2024/06/14	ND, RDL=2.0		mg/kg	
			Acid Extractable Zinc (Zn)	2024/06/14	ND, RDL=5.0		mg/kg	
9452152	MOA	RPD [ZIK892-01]	Acid Extractable Aluminum (Al)	2024/06/14	4.3		%	35
			Acid Extractable Antimony (Sb)	2024/06/14	NC		%	35

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Arsenic (As)	2024/06/14	8.2		%	35
			Acid Extractable Barium (Ba)	2024/06/14	NC		%	35
			Acid Extractable Beryllium (Be)	2024/06/14	NC		%	35
			Acid Extractable Boron (B)	2024/06/14	0.36		%	35
			Acid Extractable Cadmium (Cd)	2024/06/14	8.1		%	35
			Acid Extractable Chromium (Cr)	2024/06/14	NC		%	35
			Acid Extractable Cobalt (Co)	2024/06/14	NC		%	35
			Acid Extractable Copper (Cu)	2024/06/14	1.9		%	35
			Acid Extractable Iron (Fe)	2024/06/14	2.2		%	35
			Acid Extractable Lead (Pb)	2024/06/14	NC		%	35
			Acid Extractable Lithium (Li)	2024/06/14	NC		%	35
			Acid Extractable Manganese (Mn)	2024/06/14	0.39		%	35
			Acid Extractable Molybdenum (Mo)	2024/06/14	0.19		%	35
			Acid Extractable Nickel (Ni)	2024/06/14	NC		%	35
			Acid Extractable Selenium (Se)	2024/06/14	NC		%	35
			Acid Extractable Silver (Ag)	2024/06/14	NC		%	35
			Acid Extractable Strontium (Sr)	2024/06/14	13		%	35
			Acid Extractable Thallium (Tl)	2024/06/14	NC		%	35
			Acid Extractable Uranium (U)	2024/06/14	9.7		%	35
			Acid Extractable Vanadium (V)	2024/06/14	NC		%	35
			Acid Extractable Zinc (Zn)	2024/06/14	6.3		%	35
9460093	EPU	Matrix Spike [ZIK893-01]	Mercury (Hg)	2024/06/18		65 (2)	%	75 - 125
9460093	EPU	QC Standard	Mercury (Hg)	2024/06/18		62 (3)	%	75 - 125
9460093	EPU	Spiked Blank	Mercury (Hg)	2024/06/18		105	%	80 - 120
9460093	EPU	Method Blank	Mercury (Hg)	2024/06/18	ND, RDL=0.010		mg/kg	
9460093	EPU	RPD [ZIK893-01]	Mercury (Hg)	2024/06/18	NC		%	30

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) Poor RPD due to sample inhomogeneity. Verified by repeat digestion and analysis.

(2) Matrix Spike exceeds acceptance limits, probable matrix interference.

(3) Reference material acceptable using control chart criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Colleen Acker, B.Sc, Scientific Service Specialist

Janah Rhyno, Scientific Specialist

Bureau Veritas Proprietary Software
Logiciel Propriétaire de Bureau Veritas

Automated Statchk

Appendix C

*June 2024 Site Eelgrass and Eelgrass Root **Zone Sediment Sampling and Analytical** Program*

June 2024 Eelgrass Sampling Overview Report
Whale Sanctuary Project

210 Barachois Road, Port Hilford Bay
July 2, 2024

Prepared by Alexandra Vance

Purpose

To sample the eelgrass (*Zostera marina*) meadow at the WSP site for methylmercury and metals to complete eco-toxicology analysis. Eelgrass was sampled at seven locations throughout the meadow and with particular focus on the area that overlapped with the known arsenic plume previously identified (ESA III results) in the marine sediments. Of these seven sampling sites, six were within the plume and one was collected outside of the plume to serve as a control sample (reference site). Samples included one root (15cm depth), one frond (leaf) (min. 100 grams), and one marine sediment sample (15cm depth) at each location. The site was sampled on June 2, 2024 and was led by Alexandra Vance, WSP NS Project Manager, and with the support of three OceanX interns from St FX University. Samples were submitted to Bureau Veritas on June 3, 2024, after having been kept refrigerated for 24 hours. Results were received from BV on June 19, 2024, and relayed to the eco-toxicologist on June 24, 2024. This report serves as an overview of both the sampling process and laboratory results.

Sampling Overview

On Sunday, June 2, 2024, WSP lead biologist Alexandra Vance and three volunteer interns from St FX University attended the WSP site at 10:00 AM and began with a safety briefing. The conditions were overcast, relatively warm, 20 kts N wind, with relatively smooth sea-state (approx. 0.25m) with a low tide at noon. These conditions were deemed safe enough to proceed with sampling, which commenced at 10:45AM and concluded at 12:30PM.

Of the 11 sites that were pre-selected (eight sampling sites within the known arsenic plume and three reference/control sites), a total of seven sites were sampled (six sites within the known arsenic plume and one reference/control site) due to safety considerations given the quick change in the weather and increasing winds. Samples included one root (15cm depth), one frond (leaf) (min. 100 grams), and one marine sediment sample (15cm depth) at each location. A total of 21 samples were collected, labeled, and photographed prior to being refrigerated on Sunday, June 2, 2024; all samples were submitted to Bureau-Veritas Laboratory on Monday, June 3, 2024, approximately 24 hours post collection and still refrigerated. Samples were analyzed and the BV report was produced on June 19, 2024.

Sampling Locations

Table 1. Coordinates of the seven eelgrass sampling sites (in DD); samples collected are annotated as ROOT, SED (sediment), and L (leaf) for each sampling site.

Site No.	Latitude (N)	Longitude (W)	Time (ATD)	Samples	Notes
1	45.0776883333	-61.8242166667	10:53 AM	ROOT-1, L-1, SED-1	
2	45.0778666667	-61.8242683333	11:03 AM	ROOT-2, L-2, SED-2	
3	45.0778216667	-61.8244716667	11:20 AM	ROOT-3, L-3, SED-3	
4	45.077975	-61.8245033333	11:33 AM	ROOT-4, L-4, SED-4	
5	45.0781533333	-61.8240433333	11: 47 AM	ROOT-5, L-5, SED-5	
6	45.0777466667	-61.8238633333	12:02 PM	ROOT-6, L-6, SED-6	
7	45.0776183333	-61.8234516667	12:15 PM	ROOT-7-REF, L-7-REF, SED-7-REF	Reference site

Figure 1. Sampling sites no.1-7 mapped using red icons; coordinates and number for site no. 3 not displayed due to spacing issues but is the only one missing. Sites no.1-6 are within the known arsenic plume; site no. 7 is the reference site (across the channel). Plotted using Google Maps.

Sampling Photos

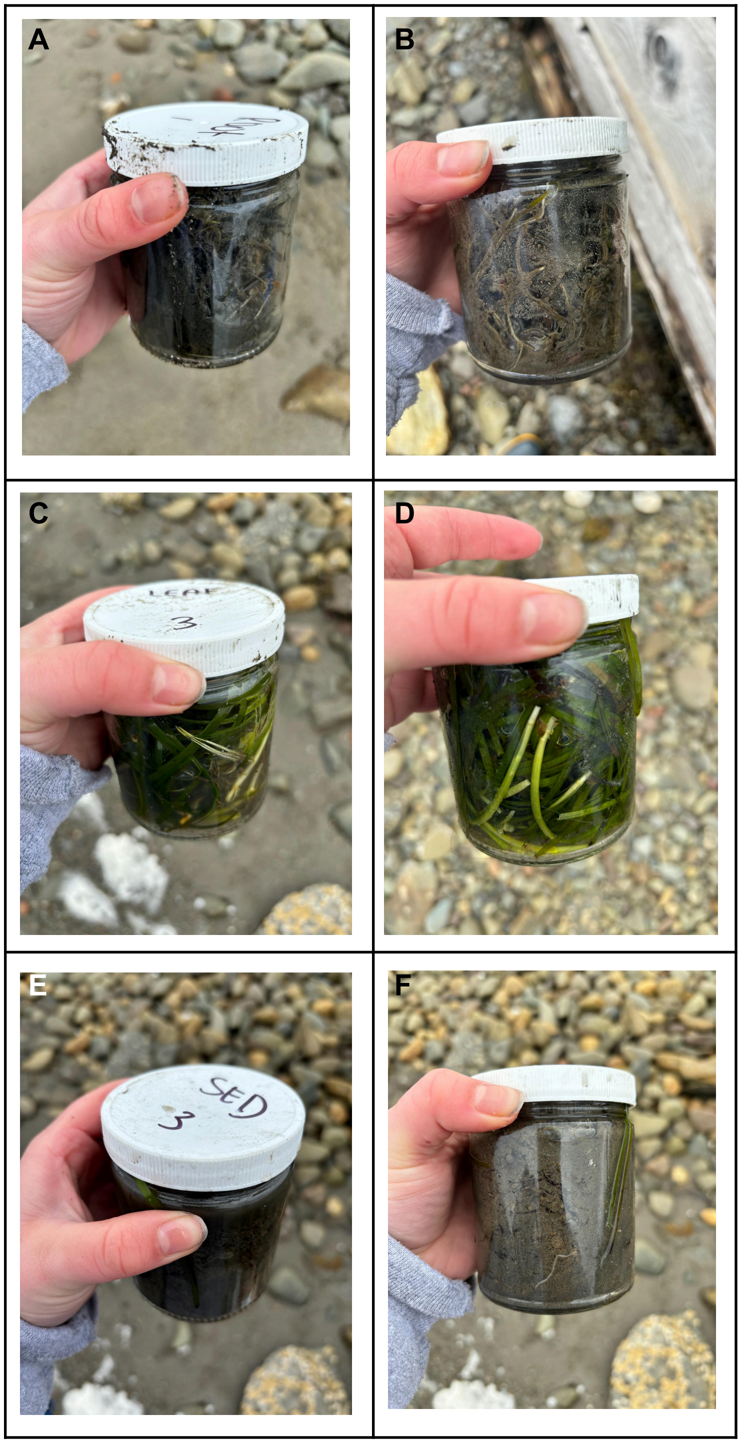


Figure 2. Representative photos of eelgrass *(Zostera marina)* samples taken from each sampling site; photos A-B are of root samples; photos C-D are of leaf samples; photos E-F are sediment samples.

Laboratory Results

All 21 samples were processed by BV laboratory for mercury and metals (Appendix A, table 3), with site no.7 samples representing a control site (located outside of the known arsenic plume); these samples are labeled as -REF accordingly. Where arsenic and mercury are the two elements of primary concern, emphasis will be placed on these results specifically in this report; other metals are beyond the scope of this report.

Results from the sediment samples showcase that arsenic was found in all seven sediment samples. The reference site, sample SED-7-REF, was found to have the lowest arsenic values with sample SED-6, the second most eastern sample site (ie, furthest from the arsenic hotspots), having the second lowest arsenic values. Sample sites further west and closer to the shoreline, which correspond with the sites found with the highest arsenic values from the ESA III report, are reported here with 2-3x more arsenic (ranging from 98-260 mg/kg per sample) than the reference site.

In the root samples, arsenic was found in all seven samples with the reference site ROOT-7-REF being the lowest value (13 mg/kg) with other samples being 3-10x greater (ranging from 36-120 mg/kg per sample, with the highest value found in sample ROOT-2. Interestingly, with the leaf samples, arsenic was non-detect in sample LEAF-4 with the second lowest arsenic level found in sample LEAF-6 (2.3 mg/kg). The reference sample, LEAF-7-REF, was found to be the fifth highest arsenic level (10 mg/kg) with the greatest reading being sample LEAF-3 (28 mg/kg). These results potentially suggest an anomaly whereby the arsenic values at the reference site for both the sediment and root samples were the lowest of all samples, but the arsenic uptake in the leaves at the same location was among the highest of all samples. Greater consideration is required to resolve this potential anomaly.

Mercury was found in all sediment samples, with SED-6 and SED-7-REF both being found to be equal in value (ie both reported 0.12mg/kg) and the lowest readings of all samples; the greatest value for mercury in sediment was found to be in SED-3 sample (0.23 mg/kg). Root sample ROOT-1 was found to have the highest mercury level by an order of magnitude greater than all other samples (eg, 0.14mg/kg in ROOT-1 vs 0.024mg/kg in ROOT-7-REF). With the leaf samples, LEAF-1 was the only sample with detectable mercury whereas all other samples were found to be non-detect (nd).

Ultimately, these sediment results largely coincide with the ESA III marine sediment results where sample sites closer to the western shoreline were found to have higher values than those more easterly located, closer to Barachois Island. Samples SED-1 through SED-4, which are more centrally overlapped with the known arsenic plume, revealed the highest values for arsenic, with samples SED-5 through SED-7-REF decreasing in arsenic values. The same pattern was found to be true of the root samples. However, this pattern was found to be broken with respect to the leaf results as arsenic values appeared more random, with the highest value being close to the western shoreline (LEAF-3) and its neighbouring site reporting non-detect values (LEAF-4). It would appear that the three most northern sites (LEAF-2, LEAF-4, LEAF-5) have the lowest arsenic values whereas the more southern sampling sites (LEAF-1, LEAF-3, LEAF-6, LEAF-7-REF) appear to be greatest in arsenic values. It remains unclear at this time why uptake into the leaves would present a different pattern than uptake into the roots.

Appendix A

Table 3. Results from Bureau Veritas Laboratory for the 21 eelgrass samples consisting of sediment, root, and leaf samples across seven sample sites; all samples were tested for metals and mercury.

Bureau Veritas Job #: C4G5838
Report Date: 2024/06/19

Whale Sanctuary Project

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		ZIK873	ZIK874	ZIK875	ZIK876	ZIK877	ZIK878		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	SED - 1	SED - 2	SED - 3	SED - 4	SED - 5	SED - 6	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	7100	6500	6500	6400	6900	6900	10	9437732
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9437732
Acid Extractable Arsenic (As)	mg/kg	260	220	230	250	140	98	2.0	9437732
Acid Extractable Barium (Ba)	mg/kg	16	13	14	12	14	14	5.0	9437732
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	1.0	9437732
Acid Extractable Bismuth (Bi)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9437732
Acid Extractable Boron (B)	mg/kg	ND	ND	ND	ND	ND	ND	50	9437732
Acid Extractable Cadmium (Cd)	mg/kg	ND	ND	ND	ND	ND	ND	0.30	9437732
Acid Extractable Chromium (Cr)	mg/kg	12	11	11	11	12	12	2.0	9437732
Acid Extractable Cobalt (Co)	mg/kg	5.5	4.9	4.9	4.8	5.5	5.3	1.0	9437732
Acid Extractable Copper (Cu)	mg/kg	9.1	7.7	7.9	6.9	11	9.1	2.0	9437732
Acid Extractable Iron (Fe)	mg/kg	15000	14000	14000	14000	15000	15000	50	9437732
Acid Extractable Lead (Pb)	mg/kg	6.7	6.4	6.4	6.0	6.3	6.4	0.50	9437732
Acid Extractable Lithium (Li)	mg/kg	18	17	17	17	18	18	2.0	9437732
Acid Extractable Manganese (Mn)	mg/kg	240	220	230	220	260	240	2.0	9437732
Acid Extractable Mercury (Hg)	mg/kg	0.22	0.18	0.23	0.21	0.16	0.12	0.10	9437732
Acid Extractable Molybdenum (Mo)	mg/kg	3.4	4.0	2.1	2.8	2.5	2.7	2.0	9437732
Acid Extractable Nickel (Ni)	mg/kg	14	14	13	12	14	14	2.0	9437732
Acid Extractable Rubidium (Rb)	mg/kg	7.3	6.7	6.5	6.4	7.1	6.9	2.0	9437732
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9437732
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9437732
Acid Extractable Strontium (Sr)	mg/kg	18	20	22	20	20	21	5.0	9437732
Acid Extractable Thallium (Tl)	mg/kg	0.11	ND	ND	ND	ND	0.11	0.10	9437732
Acid Extractable Tin (Sn)	mg/kg	ND	ND	ND	ND	ND	ND	1.0	9437732
Acid Extractable Uranium (U)	mg/kg	1.2	1.2	0.91	1.1	0.94	0.97	0.10	9437732
Acid Extractable Vanadium (V)	mg/kg	16	15	16	15	15	15	2.0	9437732
Acid Extractable Zinc (Zn)	mg/kg	34	34	30	30	35	34	5.0	9437732

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C4G5838
Report Date: 2024/06/19

Whale Sanctuary Project

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Bureau Veritas ID		ZIK879		
Sampling Date		2024/06/02 12:26		
COC Number		N/A		
	UNITS	SED - 7 * REF	RDL	QC Batch
Metals				
Acid Extractable Aluminum (Al)	mg/kg	7400	10	9437732
Acid Extractable Antimony (Sb)	mg/kg	ND	2.0	9437732
Acid Extractable Arsenic (As)	mg/kg	78	2.0	9437732
Acid Extractable Barium (Ba)	mg/kg	15	5.0	9437732
Acid Extractable Beryllium (Be)	mg/kg	ND	1.0	9437732
Acid Extractable Bismuth (Bi)	mg/kg	ND	2.0	9437732
Acid Extractable Boron (B)	mg/kg	ND	50	9437732
Acid Extractable Cadmium (Cd)	mg/kg	ND	0.30	9437732
Acid Extractable Chromium (Cr)	mg/kg	12	2.0	9437732
Acid Extractable Cobalt (Co)	mg/kg	5.7	1.0	9437732
Acid Extractable Copper (Cu)	mg/kg	14	2.0	9437732
Acid Extractable Iron (Fe)	mg/kg	16000	50	9437732
Acid Extractable Lead (Pb)	mg/kg	7.3	0.50	9437732
Acid Extractable Lithium (Li)	mg/kg	19	2.0	9437732
Acid Extractable Manganese (Mn)	mg/kg	280	2.0	9437732
Acid Extractable Mercury (Hg)	mg/kg	0.12	0.10	9437732
Acid Extractable Molybdenum (Mo)	mg/kg	3.9	2.0	9437732
Acid Extractable Nickel (Ni)	mg/kg	15	2.0	9437732
Acid Extractable Rubidium (Rb)	mg/kg	7.6	2.0	9437732
Acid Extractable Selenium (Se)	mg/kg	ND	0.50	9437732
Acid Extractable Silver (Ag)	mg/kg	ND	0.50	9437732
Acid Extractable Strontium (Sr)	mg/kg	20	5.0	9437732
Acid Extractable Thallium (Tl)	mg/kg	0.11	0.10	9437732
Acid Extractable Tin (Sn)	mg/kg	ND	1.0	9437732
Acid Extractable Uranium (U)	mg/kg	1.2	0.10	9437732
Acid Extractable Vanadium (V)	mg/kg	17	2.0	9437732
Acid Extractable Zinc (Zn)	mg/kg	36	5.0	9437732

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C4G5838
Report Date: 2024/06/19

Whale Sanctuary Project

MERCURY BY COLD VAPOUR AA (TISSUE)

Bureau Veritas ID		ZIK880	ZIK881	ZIK882	ZIK883	ZIK884	ZIK885	ZIK886		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	ROOT - 1	ROOT - 2	ROOT - 3	ROOT - 4	ROOT - 5	ROOT - 6	ROOT - 7 * REF	RDL	QC Batch
Metals										
Mercury (Hg)	mg/kg	0.14	0.046	0.033	0.050	0.050	0.039	0.024	0.010	9460093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		ZIK887	ZIK888	ZIK889	ZIK890	ZIK891	ZIK892	ZIK893		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	LEAF - 1	LEAF - 2	LEAF - 3	LEAF - 4	LEAF - 5	LEAF - 6	LEAF - 7 * REF	RDL	QC Batch
Metals										
Mercury (Hg)	mg/kg	0.013	ND	ND	ND	ND	ND	ND	0.010	9460093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C4G5838
Report Date: 2024/06/19

Whale Sanctuary Project

ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK880	ZIK881	ZIK882	ZIK883	ZIK884	ZIK885		
Sampling Date		2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00	2024/06/02 12:09		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	ROOT - 1	ROOT - 2	ROOT - 3	ROOT - 4	ROOT - 5	ROOT - 6	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	2300	4800	2400	3300	1300	3700	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	71	120	92	92	36	52	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	9.1	16	14	13	11	12	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	1100	890	1000	880	980	910	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.37	0.40	0.42	0.44	0.44	0.41	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	8.1	12	8.0	12	3.5	13	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	2.5	4.0	2.3	2.8	1.1	3.0	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	4.8	7.8	6.2	6.6	4.2	6.6	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	6500	11000	6500	8200	3900	8100	50	9452152
Acid Extractable Lead (Pb)	mg/kg	7.5	8.1	5.8	6.4	3.3	7.2	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	6.2	12	6.1	8.3	4.0	8.9	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	89	170	140	140	64	120	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	19	17	9.0	10	12	15	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	5.6	10	6.1	7.4	3.2	7.7	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	210	150	170	170	220	160	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	2.5	3.1	2.3	2.3	2.4	2.4	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	9.7	16	13	14	8.1	12	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	20	29	21	27	15	23	5.0	9452152

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK886	ZIK887	ZIK888	ZIK889	ZIK890	ZIK891		
Sampling Date		2024/06/02 12:26	2024/06/02 10:53	2024/06/02 11:03	2024/06/02 11:20	2024/06/02 11:43	2024/06/02 12:00		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	UNITS	ROOT - 7 * REF	LEAF - 1	LEAF - 2	LEAF - 3	LEAF - 4	LEAF - 5	RDL	QC Batch
Metals									
Acid Extractable Aluminum (Al)	mg/kg	1900	480	170	540	28	150	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	13	17	5.1	28	ND	4.7	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	8.1	ND	ND	ND	ND	ND	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	1200	340	360	370	390	560	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.58	0.33	0.60	0.46	0.37	0.82	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	6.1	4.1	ND	3.5	ND	ND	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	1.5	ND	ND	ND	ND	ND	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	3.8	2.5	2.1	2.4	ND	2.3	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	4200	1200	450	1300	130	480	50	9452152
Acid Extractable Lead (Pb)	mg/kg	4.1	1.3	0.63	0.85	ND	0.52	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	5.1	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	61	130	110	110	73	180	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	19	3.2	4.4	3.8	3.3	5.0	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	4.2	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	ND	ND	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	ND	ND	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	220	84	110	110	94	140	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	ND	ND	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	3.3	0.33	0.28	0.35	0.22	0.41	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	7.3	2.0	ND	2.5	ND	ND	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	14	18	25	16	14	18	5.0	9452152

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Bureau Veritas Job #: C4G5838
Report Date: 2024/06/19

Whale Sanctuary Project

ELEMENTS BY ATOMIC SPECTROSCOPY (TISSUE)

Bureau Veritas ID		ZIK892	ZIK893		
Sampling Date		2024/06/02 12:09	2024/06/02 12:26		
COC Number		N/A	N/A		
	UNITS	LEAF - 6	LEAF - 7 * REF	RDL	QC Batch
Metals					
Acid Extractable Aluminum (Al)	mg/kg	67	1000	10	9452152
Acid Extractable Antimony (Sb)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Arsenic (As)	mg/kg	2.3	10	2.0	9452152
Acid Extractable Barium (Ba)	mg/kg	ND	ND	5.0	9452152
Acid Extractable Beryllium (Be)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Boron (B)	mg/kg	630	460	5.0	9452152
Acid Extractable Cadmium (Cd)	mg/kg	0.68	0.77	0.30	9452152
Acid Extractable Chromium (Cr)	mg/kg	ND	7.2	2.0	9452152
Acid Extractable Cobalt (Co)	mg/kg	ND	1.2	1.0	9452152
Acid Extractable Copper (Cu)	mg/kg	2.8	2.8	2.0	9452152
Acid Extractable Iron (Fe)	mg/kg	240	2400	50	9452152
Acid Extractable Lead (Pb)	mg/kg	ND	1.8	0.50	9452152
Acid Extractable Lithium (Li)	mg/kg	ND	3.2	2.0	9452152
Acid Extractable Manganese (Mn)	mg/kg	140	200	2.0	9452152
Acid Extractable Molybdenum (Mo)	mg/kg	6.7	5.0	2.0	9452152
Acid Extractable Nickel (Ni)	mg/kg	ND	2.7	2.0	9452152
Acid Extractable Selenium (Se)	mg/kg	ND	ND	2.0	9452152
Acid Extractable Silver (Ag)	mg/kg	ND	ND	0.50	9452152
Acid Extractable Strontium (Sr)	mg/kg	140	110	5.0	9452152
Acid Extractable Thallium (Tl)	mg/kg	ND	ND	0.10	9452152
Acid Extractable Uranium (U)	mg/kg	0.61	0.42	0.10	9452152
Acid Extractable Vanadium (V)	mg/kg	ND	4.5	2.0	9452152
Acid Extractable Zinc (Zn)	mg/kg	19	16	5.0	9452152

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not Detected at a concentration equal or greater than the indicated Detection Limit.

Appendix D

Site Photos

View of the proposed marine whale enclosure area, looking north from the whard. Photo taken on July 24, 2023. **Photo 1**

View of the marine enclosure and wharf, looking northwest. Photo taken on July 24, 2023. **Photo 2**

View of the marine enclosure and Barachois Island, looking east from the shore. Photo taken on July 24, 2023. **Photo 3**

Photo of diving vrew completing marine surface water, sediment, and invertebrate sampling. Photo taken on July 24, 2023. **Photo 4**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 24-8007
August, 2024	**Whale Sanctuary Project** **Marine ERA - August, 2024**	PHOTO NO. 1,2,3,4

Photo of invertebrate tissue sampling of a rock crab. Photo taken on July 24, 2023. **Photo 5**

Photo of eelgrass sample taken as part of the eelgrass sampling program. Photo taken June 2, 2024. **Photo 6**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 24-8007
August, 2024	**Whale Sanctuary Project** **Marine ERA - August, 2024**	PHOTO NO. 5,6

Appendix E

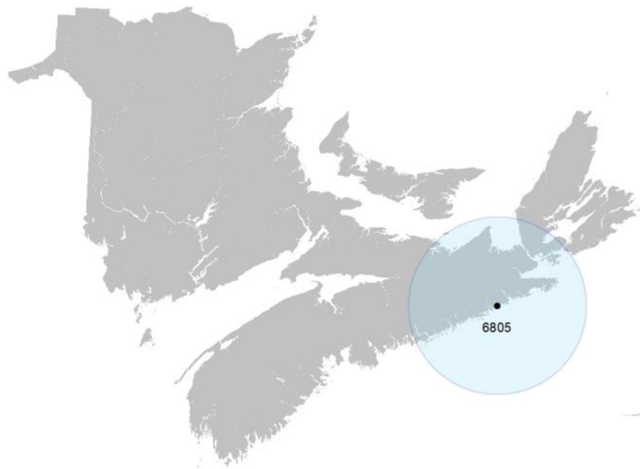
ACCDC Report

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 6805: Indian Harbour, NS

Prepared 5 March 2021
by J. Churchill, Data Manager

CONTENTS OF REPORT



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
IndianHrNS_6805ob.xls	Rare or legally-protected Flora and Fauna in your study area
IndianHrNS_6805ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
IndianHrNS_6805msa.xls	Managed and Biologically Significant Areas in your study area

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
john.klymko@accdc.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
sarah.robinson@accdc.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Tel: (506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 541-0081
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-0816
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

Eastern: Maureen Cameron-MacMillan
(902) 295-2554
Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

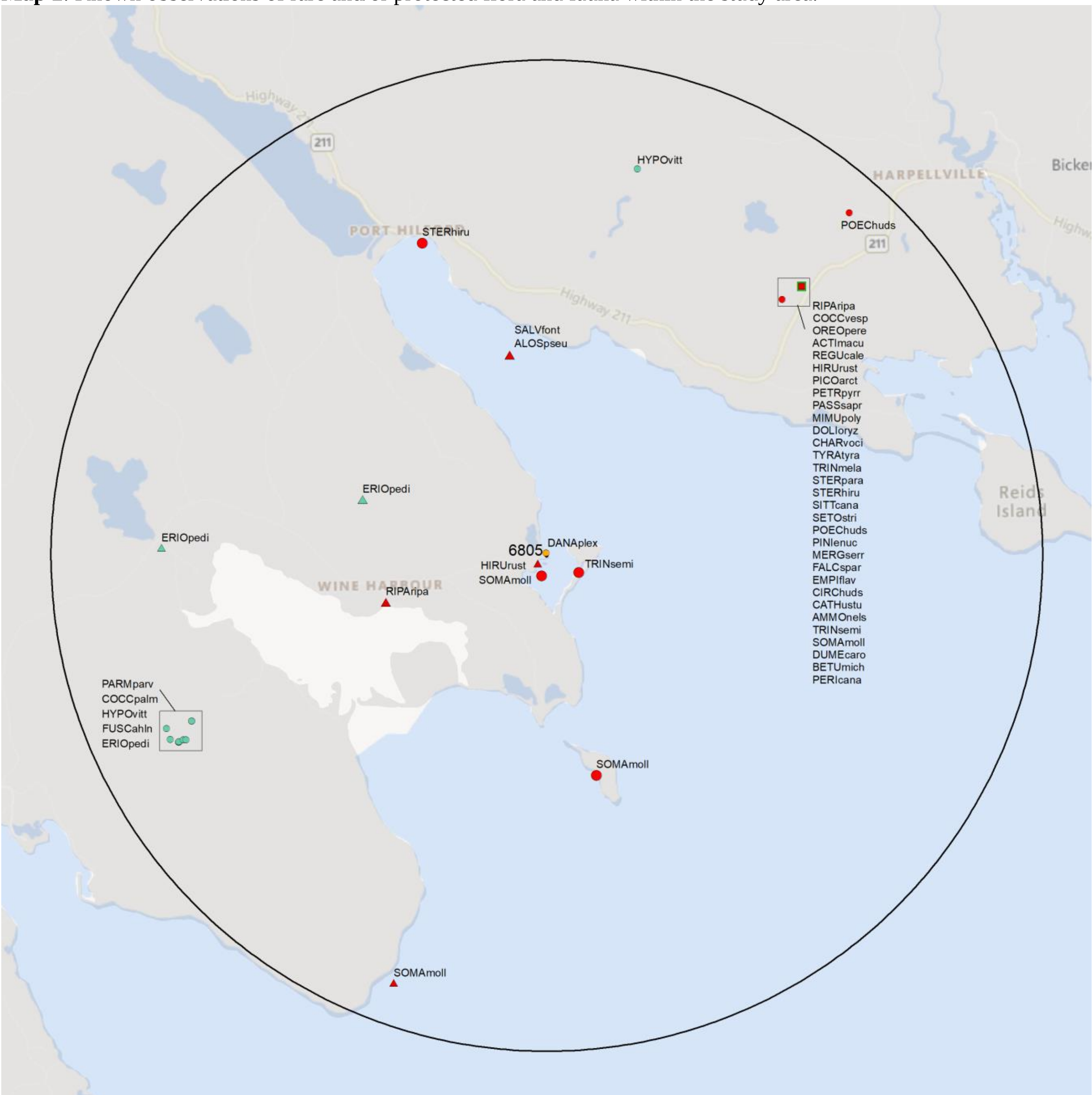
For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

2.1 FLORA
The study area contains 1 record of 1 vascular, 14 records of 5 nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA
The study area contains 82 records of 32 vertebrate, 1 record of 1 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION
- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- 3.0 within kilometers
- 2.7 within 500s of meters
- 2.0 within 100s of meters
- 1.7 within 10s of meters

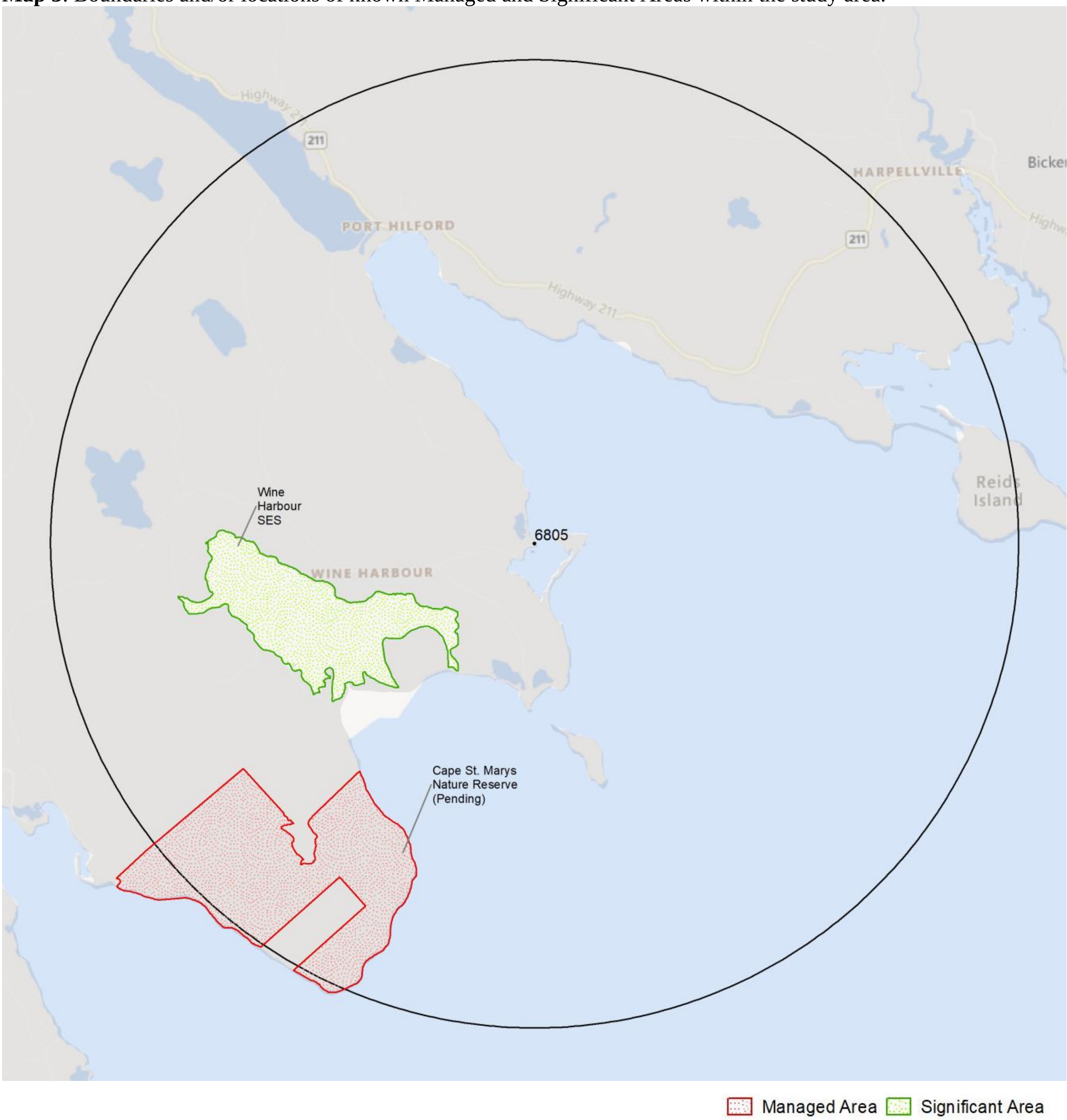
HIGHER TAXON
- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified 1 managed area in the vicinity of the study area (Map 3 and attached file: *msa.xls).

3.2 SIGNIFICANT AREAS
The GIS scan identified 1 biologically significant site in the vicinity of the study area (Map 3 and attached file: *msa.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	4	1.9 ± 1.0
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1?	2	4.0 ± 0.0
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	1	4.2 ± 0.0
N	*Hypogymnia vittata*	Slender Monk's Hood Lichen				S3S4	3	4.0 ± 0.0
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	4	4.1 ± 0.0
P	*Betula michauxii*	Michaux's Dwarf Birch				S2S3	1	3.7 ± 7.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2S3B	3	1.7 ± 2.0
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Endangered	S2S3B	8	0.1 ± 0.0
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Vulnerable	S3S4B	1	3.7 ± 7.0
A	*Passerculus sandwichensis princeps*	Savannah Sparrow princeps ssp	Special Concern	Special Concern		S1B	1	3.7 ± 7.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3S4B,S3N	2	3.7 ± 7.0
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	4	3.4 ± 0.0
A	*Circus hudsonius*	Northern Harrier	Not At Risk			S3S4B	1	3.7 ± 7.0
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	1	3.7 ± 7.0
A	*Mimus polyglottos*	Northern Mockingbird				S1B	1	3.7 ± 7.0
A	*Tringa semipalmata*	Willet				S2S3B	5	0.4 ± 0.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	1	3.7 ± 7.0
A	*Pinicola enucleator*	Pine Grosbeak				S2S3B,S5N	2	3.7 ± 7.0
A	*Perisoreus canadensis*	Canada Jay				S3	4	3.5 ± 0.0
A	*Poecile hudsonicus*	Boreal Chickadee				S3	6	3.7 ± 7.0
A	*Sitta canadensis*	Red-breasted Nuthatch				S3	3	3.7 ± 7.0
A	*Alosa pseudoharengus*	Alewife				S3	1	2.1 ± 1.0
A	*Salvelinus fontinalis*	Brook Trout				S3	1	2.1 ± 1.0
A	*Falco sparverius*	American Kestrel				S3B	2	3.7 ± 7.0
A	*Charadrius vociferus*	Killdeer				S3B	1	3.7 ± 7.0
A	*Sterna paradisaea*	Arctic Tern				S3B	1	3.7 ± 7.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	2	3.7 ± 7.0
A	*Dumetella carolinensis*	Gray Catbird				S3B	4	3.7 ± 7.0
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S3S4M	1	3.7 ± 7.0
A	*Somateria mollissima*	Common Eider				S3S4	6	0.2 ± 0.0
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	1	3.7 ± 7.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B	3	3.7 ± 7.0
A	*Empidonax flaviventris*	Yellow-bellied Flycatcher				S3S4B	1	3.7 ± 7.0
A	*Regulus calendula*	Ruby-crowned Kinglet				S3S4B	7	3.7 ± 7.0
A	*Catharus ustulatus*	Swainson's Thrush				S3S4B	3	3.7 ± 7.0
A	*Oreothlypis peregrina*	Tennessee Warbler				S3S4B	3	3.7 ± 7.0
A	*Setophaga striata*	Blackpoll Warbler				S3S4B	1	3.7 ± 7.0
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5N	1	3.7 ± 7.0
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2B	1	0.0 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with “YES”.

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Vulnerable	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
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2	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
2	iNaturalist. 2020. iNaturalist Data Export 2020. iNaturalist.org and iNaturalist.ca, Web site: 128728 recs.
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1	eBird. 2020. eBird Basic Dataset. Version: EBD_relNov-2019. Ithaca, New York. Nov 2019, Cape Breton Bras d'Or Lakes Watershed subset. Cornell Lab of Ornithology.
1	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
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1	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
1	Nova Scotia Department of Lands and Forestry. 2020. NS Lands Proposed or Pending Protection. NSDLF, 231 features. Received via email.
1	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 19997 records of 141 vertebrate and 411 records of 43 invertebrate fauna; 2335 records of 205 vascular, 1768 records of 81 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including "location-sensitive" species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	42	11.6 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1	95.6 ± 0.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered		S1	1	85.7 ± 0.0	NS
A	*Salmo salar pop. 4*	Atlantic Salmon - Eastern Cape Breton pop.	Endangered			S1	5	75.4 ± 0.0	NS
A	*Salmo salar pop. 6*	Altantic Salmon - Nova Scotia Southern Upland pop.	Endangered			S1	39	7.6 ± 1.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B	672	35.0 ± 7.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	78	11.6 ± 0.0	NS
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered		S1S2N	2	70.2 ± 0.0	NS
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered	Endangered	Endangered	S2M	18	22.4 ± 0.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S1?B	2	65.1 ± 7.0	NS
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Endangered	S1S2B	1	95.9 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S1S2M	4	63.9 ± 0.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	3881	7.9 ± 10.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S2	2	62.7 ± 0.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2B,S1M	138	18.9 ± 7.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2S3B	531	1.7 ± 2.0	NS
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Endangered	S2S3B	452	0.1 ± 0.0	NS
A	*Cardellina canadensis*	Canada Warbler	Threatened	Threatened	Endangered	S3B	504	7.9 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Vulnerable	S3S4B	205	3.7 ± 7.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	2	42.9 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	13	32.0 ± 7.0	NS
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St Lawrence pop.	Special Concern			S1	25	51.1 ± 1.0	NS
A	*Passerculus sandwichensis princeps*	Savannah Sparrow princeps ssp	Special Concern	Special Concern		S1B	2	3.7 ± 7.0	NS
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern		S1N	2	86.8 ± 0.0	NS
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern		S1S2B	4	17.9 ± 7.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	171	21.0 ± 0.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S2B	215	7.7 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S2B	614	11.7 ± 1.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S2N	41	22.4 ± 0.0	NS
A	*Morone saxatilis pop. 1*	Striped Bass- Southern Gulf of St Lawrence pop.	Special Concern			S2S3N	1	62.3 ± 1.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	32	19.3 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	233	7.7 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3S4B,S3N	237	3.7 ± 7.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern			S4	1	70.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S4N	4	69.7 ± 0.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern			S4S5	2	48.4 ± 1.0	NS
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S1	5	87.7 ± 1.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B	2	92.0 ± 0.0	NS
A	*Chlidonias niger*	Black Tern	Not At Risk			S1B	3	22.4 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Vulnerable	S1B,SNAM	3	70.4 ± 0.0	NS
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B	5	42.8 ± 7.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	1	92.9 ± 100.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	11	23.4 ± 5.0	NS
A	*Megaptera novaeangliae*	Humpback Whale (NW Atlantic pop.)	Not At Risk			S3	2	70.4 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	329	3.4 ± 0.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	18	13.0 ± 7.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	4	45.2 ± 6.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	50	18.9 ± 7.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	4	70.5 ± 0.0	NS
A	*Circus hudsonius*	Northern Harrier	Not At Risk			S3S4B	192	3.7 ± 7.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	74	3.7 ± 7.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3	1	67.8 ± 0.0	NS
A	*Alces americanus*	Moose			Endangered	S1	63	17.8 ± 0.0	NS
A	*Picoides dorsalis*	American Three-toed Woodpecker				S1?	4	18.9 ± 7.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B	4	18.9 ± 7.0	NS
A	*Uria aalge*	Common Murre				S1?B,S5N	1	98.4 ± 0.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	1	73.1 ± 7.0	NS
A	*Anas acuta*	Northern Pintail				S1B	2	18.9 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	2	55.5 ± 7.0	NS
A	*Haematopus palliatus*	American Oystercatcher				S1B	7	70.6 ± 7.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	1	93.7 ± 7.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	17	3.7 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	4	61.4 ± 0.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B	7	63.2 ± 7.0	NS
A	*Setophaga pinus*	Pine Warbler				S1B	5	70.3 ± 0.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S3M	140	22.4 ± 0.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S3S4M	230	10.6 ± 0.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	59	5.6 ± 0.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S1S2M	19	63.9 ± 0.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B	21	22.4 ± 0.0	NS
A	*Mareca strepera*	Gadwall				S2B	4	60.4 ± 0.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	4	18.9 ± 7.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S2B	75	13.0 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B	6	50.8 ± 7.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S2B	5	32.8 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	34	7.9 ± 7.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2B,S5N	110	5.5 ± 9.0	NS
A	*Branta bernicla*	Brant				S2M	1	56.0 ± 16.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3	68	22.4 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	24	17.9 ± 7.0	NS
A	*Spinus pinus*	Pine Siskin				S2S3	220	7.9 ± 7.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B	1	92.0 ± 0.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	9	54.2 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S2S3B	536	0.4 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	106	3.7 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S2S3B	160	7.9 ± 7.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B	27	37.1 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S2S3B,S5N	69	3.7 ± 7.0	NS
A	*Numenius phaeopus*	Hudsonian Whimbrel				S2S3M	52	22.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
	hudsonicus								
A	*Calidris melanotos*	Pectoral Sandpiper				S2S3M	25	22.4 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	319	3.5 ± 0.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	628	3.7 ± 7.0	NS
A	*Sitta canadensis*	Red-breasted Nuthatch				S3	433	3.7 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3	15	2.1 ± 1.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	41	2.1 ± 1.0	NS
A	*Salvelinus namaycush*	Lake Trout				S3	1	67.6 ± 0.0	NS
A	*Menidia menidia*	Atlantic Silverside				S3	2	80.2 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	5	27.2 ± 7.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3?N	34	5.5 ± 9.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N	2	60.6 ± 0.0	NS
A	*Falco sparverius*	American Kestrel				S3B	220	3.7 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	172	3.7 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B	232	7.9 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	99	3.7 ± 7.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	50	7.9 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	91	3.7 ± 7.0	NS
A	*Dumetella carolinensis*	Gray Catbird				S3B	177	3.7 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B	65	7.9 ± 7.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S3S4M	306	3.7 ± 7.0	NS
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S3B,S5M	72	22.4 ± 0.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S3B,S5N	2	22.5 ± 0.0	NS
A	*Fratercula arctica*	Atlantic Puffin				S3B,S5N	4	22.4 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	180	10.2 ± 0.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs				S3M	223	22.4 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	75	22.4 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	185	22.4 ± 0.0	NS
A	*Calidris fuscicollis*	White-rumped Sandpiper				S3M	49	69.4 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	114	22.4 ± 0.0	NS
A	*Calidris alba*	Sanderling				S3M,S2N	96	22.4 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	9	61.9 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3S4	534	0.2 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	95	3.7 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	69	18.9 ± 7.0	NS
A	*Botaurus lentiginosus*	American Bittern				S3S4B	150	7.5 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3S4B	61	17.7 ± 0.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B	481	3.7 ± 7.0	NS
A	*Empidonax flaviventris*	Yellow-bellied Flycatcher				S3S4B	521	3.7 ± 7.0	NS
A	*Regulus calendula*	Ruby-crowned Kinglet				S3S4B	1172	3.7 ± 7.0	NS
A	*Catharus fuscescens*	Veery				S3S4B	218	7.9 ± 7.0	NS
A	*Catharus ustulatus*	Swainson's Thrush				S3S4B	942	3.7 ± 7.0	NS
A	*Oreothlypis peregrina*	Tennessee Warbler				S3S4B	167	3.7 ± 7.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B	331	13.0 ± 7.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3S4B	91	3.7 ± 7.0	NS
A	*Passerella iliaca*	Fox Sparrow				S3S4B	93	5.3 ± 0.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5N	100	3.7 ± 7.0	NS
A	*Bucephala albeola*	Bufflehead				S3S4N	37	5.5 ± 9.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	1	98.8 ± 1.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	3	22.4 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	4	14.1 ± 0.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N	1	63.6 ± 7.0	NS
A	*Morus bassanus*	Northern Gannet				SHB,S5M	21	22.4 ± 0.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2B	25	0.0 ± 0.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S1S2	8	39.3 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern	Special Concern	Vulnerable	S3	2	5.4 ± 0.0	NS
I	*Satyrium acadica*	Acadian Hairstreak				S1	4	96.8 ± 2.0	NS
I	*Neurocordulia michaeli*	Broadtailed Shadowdragon				S1	26	14.2 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
I	*Strymon melinus*	Grey Hairstreak				S1S2	2	91.4 ± 0.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S1S2	1	85.3 ± 2.0	NS
I	*Lycaena hyllus*	Bronze Copper				S2	2	41.8 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S2	1	85.6 ± 2.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2	1	85.3 ± 2.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	64	21.3 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	1	24.9 ± 1.0	NS
I	*Thorybes pylades*	Northern Cloudywing				S2S3	20	34.3 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S2S3	8	23.7 ± 0.0	NS
I	*Satyrium liparops*	Striped Hairstreak				S2S3	5	84.1 ± 1.0	NS
I	*Euphydryas phaeton*	Baltimore Checkerspot				S2S3	25	36.2 ± 0.0	NS
I	*Gomphus descriptus*	Harpoon Clubtail				S2S3	13	87.4 ± 0.0	NS
I	*Ophiogomphus aspersus*	Brook Snaketail				S2S3	4	87.4 ± 0.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S2S3	14	44.1 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S2S3	36	14.2 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	7	38.2 ± 0.0	NS
I	*Naemia seriata*	a Ladybird beetle				S3	1	62.0 ± 0.0	NS
I	*Monochamus marmorator*	a Longhorned Beetle				S3	2	5.3 ± 0.0	NS
I	*Callophrys henrici*	Henry's Elfin				S3	2	19.3 ± 0.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	2	58.0 ± 1.0	NS
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4	49.9 ± 100.0	NS
I	*Polygonia faunus*	Green Comma				S3	7	41.8 ± 0.0	NS
I	*Megisto cymela*	Little Wood-satyr				S3	1	99.4 ± 1.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3	4	38.3 ± 0.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3	3	27.0 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3	1	96.1 ± 1.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3	7	14.0 ± 0.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3	2	75.2 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3	3	75.2 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3	8	11.5 ± 1.0	NS
I	*Enallagma vernale*	Vernal Bluet				S3	2	81.9 ± 0.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3?	1	56.4 ± 0.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	21	25.4 ± 0.0	NS
I	*Erynnis juvenalis*	Juvenal's Duskywing				S3S4	1	58.8 ± 1.0	NS
I	*Amblyscirtes vialis*	Common Roadside-Skipper				S3S4	20	11.7 ± 1.0	NS
I	*Polygonia progne*	Grey Comma				S3S4	24	38.7 ± 0.0	NS
I	*Lanthus parvulus*	Northern Pygmy Clubtail				S3S4	10	18.8 ± 0.0	NS
I	*Lampsilis radiata*	Eastern Lampmussel				S3S4	16	31.9 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	476	1.9 ± 1.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1S2	15	27.3 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	6	34.4 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S2S3	6	50.9 ± 0.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	14	35.6 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S1?	24	5.3 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	116	18.0 ± 0.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S1S2	4	52.6 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	5	18.3 ± 0.0	NS
N	*Tortula obtusifolia*	a Moss				S1?	1	87.8 ± 0.0	NS
N	*Lichina confinis*	Marine Seaweed Lichen				S1?	2	69.7 ± 2.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1?	2	63.7 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1?	5	4.0 ± 0.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1S2	1	62.8 ± 0.0	NS
N	*Catapyrenium squamulosum*	Limy Soil Stipplescale Lichen				S1S2	1	89.2 ± 6.0	NS

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N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	1	59.7 ± 0.0	NS
N	*Riccardia multifida*	Delicate Germanderwort				S2?	2	5.3 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2?	1	62.8 ± 0.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	1	62.1 ± 3.0	NS
N	*Campylium polygamum*	a Moss				S2?	1	33.5 ± 0.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S2?	1	94.4 ± 0.0	NS
N	*Platydictya jungermannioides*	False Willow Moss				S2?	1	68.7 ± 0.0	NS
N	*Pohlia sphagnicola*	a moss				S2?	1	54.6 ± 0.0	NS
N	*Racomitrium affine*	a Moss				S2?	1	88.7 ± 0.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2?	1	92.2 ± 2.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S2?	4	26.8 ± 0.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S2?	1	85.3 ± 0.0	NS
N	*Leptogium teretiusculum*	Beaded Jellyskin Lichen				S2?	4	65.5 ± 0.0	NS
N	*Cladonia labradorica*	Labrador Lichen				S2?	1	25.0 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S2?	21	12.1 ± 45.0	NS
N	*Tetraplodon mnioides*	Entire-leaved Nitrogen Moss				S2S3	1	70.1 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	1	59.7 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S2S3	5	60.7 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	4	53.3 ± 0.0	NS
N	*Cetraria muricata*	Spiny Heath Lichen				S2S3	1	24.8 ± 1.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	35.4 ± 0.0	NS
N	*Leptogium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	13	21.0 ± 0.0	NS
N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	1	78.4 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	1	99.4 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	2	5.3 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	4	62.9 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	2	38.9 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S3	1	90.4 ± 0.0	NS
N	*Collema tenax*	Soil Tarpaper Lichen				S3	1	61.2 ± 0.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	6	41.7 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3	21	14.2 ± 0.0	NS
N	*Leptogium subtile*	Appressed Jellyskin Lichen				S3	6	48.7 ± 0.0	NS
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	50	4.2 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3	8	23.7 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S3	1	28.4 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3	26	29.6 ± 0.0	NS
N	*Leptogium lichenoides*	Tattered Jellyskin Lichen				S3	10	59.2 ± 0.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	3	62.1 ± 0.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	2	46.3 ± 10.0	NS
N	*Platismatia norvegica*	Oldgrowth Rag Lichen				S3	1	29.5 ± 0.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S3	42	10.4 ± 0.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S3	7	20.0 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	2	56.6 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3?	3	38.0 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	1	72.4 ± 0.0	NS
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3?	3	62.2 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	4	25.8 ± 0.0	NS
N	*Dicranum leioneuron*	a Dicranum Moss				S3S4	1	77.2 ± 0.0	NS
N	*Encalypta procera*	Slender Extinguisher Moss				S3S4	4	65.5 ± 0.0	NS

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N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S3S4	4	54.6 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	1	50.2 ± 0.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	2	14.1 ± 3.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	4	70.4 ± 0.0	NS
N	*Hypogymnia vittata*	Slender Monk's Hood Lichen				S3S4	100	4.0 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	7	20.4 ± 0.0	NS
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	1	62.2 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	2	72.9 ± 0.0	NS
N	*Parmotrema chinense*	Powdered Ruffle Lichen				S3S4	1	28.0 ± 0.0	NS
N	*Physconia detersa*	Bottlebrush Frost Lichen				S3S4	2	35.6 ± 0.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	1	70.7 ± 0.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	625	4.1 ± 0.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	1	26.3 ± 3.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	24	17.8 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	2	68.4 ± 0.0	NS
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	6	18.8 ± 8.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	26	18.0 ± 0.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	51	48.0 ± 0.0	NS
P	*Bartonia paniculata ssp. paniculata*	Branched Bartonia	Threatened	Threatened		SNA	1	78.5 ± 10.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2	9	53.2 ± 1.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S1	1	62.6 ± 0.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1	4	89.0 ± 0.0	NS
P	*Zizia aurea*	Golden Alexanders				S1	20	36.7 ± 0.0	NS
P	*Arnica lonchophylla*	Northern Arnica				S1	1	88.6 ± 7.0	NS
P	*Bidens hyperborea*	Estuary Beggarticks				S1	1	63.9 ± 1.0	NS
P	*Ageratina altissima*	White Snakeroot				S1	2	63.2 ± 7.0	NS
P	*Cardamine dentata*	Toothed Bittercress				S1	1	100.0 ± 0.0	NS
P	*Cochlearia tridactylites*	Limestone Scurvy-grass				S1	12	29.7 ± 0.0	NS
P	*Hudsonia tomentosa*	Woolly Beach-heath				S1	6	63.3 ± 1.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S1	10	81.8 ± 0.0	NS
P	*Fraxinus pennsylvanica*	Red Ash				S1	1	55.2 ± 0.0	NS
P	*Bistorta vivipara*	Alpine Bistort				S1	1	97.3 ± 1.0	NS
P	*Montia fontana*	Water Blinks				S1	2	70.0 ± 3.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S1	1	90.8 ± 0.0	NS
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S1	1	46.7 ± 1.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S1	1	72.3 ± 6.0	NS
P	*Carex alopecoidea*	Foxtail Sedge				S1	2	62.2 ± 0.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1	1	64.1 ± 5.0	NS
P	*Carex pellita*	Woolly Sedge				S1	8	82.2 ± 0.0	NS
P	*Carex plantaginea*	Plantain-Leaved Sedge				S1	2	85.2 ± 0.0	NS
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S1	1	37.1 ± 1.0	NS
P	*Carex tincta*	Tinged Sedge				S1	1	62.2 ± 1.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	4	71.4 ± 0.0	NS
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	6	58.4 ± 0.0	NS
P	*Cyperus lupulinus*	Hop Flatsedge				S1	5	62.9 ± 0.0	NS
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	10	63.3 ± 1.0	NS
P	*Iris prismatica*	Slender Blue Flag				S1	2	28.6 ± 7.0	NS
P	*Luzula spicata*	Spiked Woodrush				S1	1	58.7 ± 0.0	NS
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	1	57.3 ± 7.0	NS
P	*Bromus latiglumis*	Broad-Glumed Brome				S1	36	80.4 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S1	11	72.3 ± 0.0	NS

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P	*Elymus hystrix*	Spreading Wild Rye				S1	1	71.2 ± 1.0	NS
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	1	16.2 ± 5.0	NS
P	*Sparganium androcladum*	Branching Bur-Reed				S1	1	70.6 ± 1.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	1	58.8 ± 7.0	NS
P	*Dichanthelium lindheimeri*	Lindheimer's Panicgrass				S1?	1	82.3 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S1S2	2	33.2 ± 0.0	NS
P	*Cornus suecica*	Swedish Bunchberry				S1S2	2	72.0 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S1S2	3	100.0 ± 1.0	NS
P	*Parnassia parviflora*	Small-flowered Grass-of-Parnassus				S1S2	1	80.4 ± 1.0	NS
P	*Carex livida*	Livid Sedge				S1S2	13	57.7 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S1S2	1	63.3 ± 1.0	NS
P	*Juncus alpinoarticulatus ssp. americanus*	Northern Green Rush				S1S2	3	70.2 ± 5.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	1	59.4 ± 10.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1S2	42	80.4 ± 0.0	NS
P	*Sparganium hyperboreum*	Northern Burreed				S1S2	2	18.8 ± 0.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	4	41.8 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S2	1	98.2 ± 5.0	NS
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2	14	48.0 ± 0.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2	3	65.1 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S2	4	37.1 ± 7.0	NS
P	*Impatiens pallida*	Pale Jewelweed				S2	4	33.6 ± 7.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2	30	48.0 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S2	4	75.4 ± 0.0	NS
P	*Lobelia kalmii*	Brook Lobelia				S2	2	96.6 ± 0.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2	5	16.5 ± 0.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S2	4	83.5 ± 0.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2	5	73.1 ± 7.0	NS
P	*Crassula aquatica*	Water Pygmyweed				S2	1	95.9 ± 7.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2	6	24.5 ± 0.0	NS
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S2	1	95.4 ± 0.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2	1	99.2 ± 7.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S2	8	39.5 ± 0.0	NS
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2	3	80.3 ± 6.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S2	2	90.3 ± 7.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	2	70.2 ± 1.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2	6	16.3 ± 0.0	NS
P	*Anemone virginiana*	Virginia Anemone				S2	23	59.2 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2	2	59.9 ± 0.0	NS
P	*Galium labradoricum*	Labrador Bedstraw				S2	24	87.8 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S2	46	87.8 ± 0.0	NS
P	*Comandra umbellata*	Bastard's Toadflax				S2	30	62.6 ± 5.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2	3	74.0 ± 3.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S2	5	82.0 ± 0.0	NS
P	*Carex bebbii*	Bebb's Sedge				S2	4	53.2 ± 10.0	NS
P	*Carex castanea*	Chestnut Sedge				S2	2	99.9 ± 0.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2	2	62.5 ± 0.0	NS
P	*Carex tenera*	Tender Sedge				S2	5	66.7 ± 1.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S2	1	97.1 ± 0.0	NS
P	*Allium schoenoprasum*	Wild Chives				S2	1	96.8 ± 3.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S2	1	81.8 ± 7.0	NS
P	*Lilium canadense*	Canada Lily				S2	47	15.2 ± 2.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	25	59.3 ± 0.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	6	70.2 ± 0.0	NS

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P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	1	48.5 ± 1.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	6	82.3 ± 0.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	1	85.6 ± 7.0	NS
P	*Potamogeton friesii*	Fries' Pondweed				S2	3	84.1 ± 0.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S2	5	27.6 ± 0.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S2	3	13.5 ± 0.0	NS
P	*Polystichum lonchitis*	Northern Holly Fern				S2	1	97.9 ± 5.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	7	58.6 ± 0.0	NS
P	*Epilobium coloratum*	Purple-veined Willowherb				S2?	3	66.1 ± 0.0	NS
P	*Crataegus submollis*	Quebec Hawthorn				S2?	2	68.5 ± 7.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2?	1	33.0 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2?	6	81.0 ± 0.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S2S3	3	88.6 ± 2.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S2S3	21	22.7 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S2S3	27	3.7 ± 7.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S2S3	9	16.7 ± 1.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2S3	7	70.1 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S2S3	2	97.0 ± 0.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	1	39.9 ± 1.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S2S3	88	47.8 ± 0.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	1	71.2 ± 3.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	9	63.1 ± 0.0	NS
P	*Halenia deflexa*	Spurred Gentian				S2S3	22	15.6 ± 1.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	3	80.9 ± 5.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	1	86.7 ± 0.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	3	41.9 ± 1.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	1	39.8 ± 1.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	1	72.3 ± 2.0	NS
P	*Galium aparine*	Common Bedstraw				S2S3	15	42.8 ± 0.0	NS
P	*Salix pellita*	Satiny Willow				S2S3	1	66.3 ± 1.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	1	22.3 ± 5.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S2S3	21	47.9 ± 0.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S2S3	5	51.0 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S2S3	1	20.7 ± 1.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S2S3	29	59.2 ± 0.0	NS
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S2S3	2	80.4 ± 0.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	3	75.1 ± 0.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	2	75.1 ± 0.0	NS
P	*Angelica atropurpurea*	Purple-stemmed Angelica				S3	11	79.8 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	15	56.8 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3	6	47.6 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3	47	59.2 ± 0.0	NS
P	*Campanula aparinoides*	Marsh Bellflower				S3	10	30.5 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3	5	23.5 ± 1.0	NS
P	*Vaccinium cespitosum*	dwarf bilberry				S3	46	16.3 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3	1	98.8 ± 0.0	NS
P	*Proserpinaca palustris*	Marsh Mermaidweed				S3	28	56.5 ± 0.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3	2	75.2 ± 1.0	NS
P	*Teucrium canadense*	Canada Germander				S3	25	58.6 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	2	51.7 ± 0.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	4	24.6 ± 0.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3	15	52.8 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Fallopia scandens*	Climbing False Buckwheat				S3	33	20.1 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	2	89.7 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	10	58.6 ± 0.0	NS
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	31	37.1 ± 2.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3	26	55.9 ± 0.0	NS
P	*Agrimonia gryposepala*	Hooked Agrimony				S3	127	47.7 ± 0.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3	5	33.7 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3	65	19.3 ± 0.0	NS
P	*Limosella australis*	Southern Mudwort				S3	1	99.0 ± 5.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	11	53.7 ± 0.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	15	47.6 ± 3.0	NS
P	*Verbena hastata*	Blue Vervain				S3	48	42.2 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	7	61.9 ± 1.0	NS
P	*Carex eburnea*	Bristle-leaved Sedge				S3	23	61.2 ± 0.0	NS
P	*Carex lupulina*	Hop Sedge				S3	15	48.8 ± 6.0	NS
P	*Carex rosea*	Rosy Sedge				S3	5	28.0 ± 4.0	NS
P	*Carex tribuloides*	Blunt Broom Sedge				S3	11	26.7 ± 5.0	NS
P	*Carex wiegandii*	Wiegand's Sedge				S3	2	67.0 ± 0.0	NS
P	*Carex foenea*	Fernald's Hay Sedge				S3	1	71.9 ± 0.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	1	58.7 ± 0.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3	12	33.1 ± 0.0	NS
P	*Juncus dudleyi*	Dudley's Rush				S3	31	23.8 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3	4	69.7 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	46	22.4 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	69	28.3 ± 1.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	2	65.6 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3	1	53.9 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3	5	59.8 ± 1.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3	81	17.0 ± 0.0	NS
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	11	47.9 ± 0.0	NS
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	9	33.5 ± 10.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	4	79.3 ± 7.0	NS
P	*Sparganium natans*	Small Burreed				S3	5	32.4 ± 0.0	NS
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S3	1	65.6 ± 0.0	NS
P	*Asplenium viride*	Green Spleenwort				S3	1	80.3 ± 0.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3	14	97.4 ± 0.0	NS
P	*Equisetum variegatum*	Variegated Horsetail				S3	10	62.7 ± 0.0	NS
P	*Isoetes tuckermanii ssp. acadiensis*	Acadian Quillwort				S3	3	36.1 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3	18	28.3 ± 1.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	3	48.0 ± 1.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4	88.4 ± 0.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3?	1	72.6 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	1	53.6 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	2	57.5 ± 1.0	NS
P	*Atriplex glabriuscula var. franktonii*	Frankton's Saltbush				S3S4	1	65.5 ± 0.0	NS
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	6	47.1 ± 0.0	NS
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3S4	7	63.6 ± 0.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	1	90.0 ± 2.0	NS
P	*Sanguinaria canadensis*	Bloodroot				S3S4	105	41.4 ± 0.0	NS
P	*Polygonum fowleri*	Fowler's Knotweed				S3S4	4	63.8 ± 0.0	NS
P	*Rumex fueginus*	Tierra del Fuego Dock				S3S4	17	68.7 ± 0.0	NS
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	20	61.2 ± 0.0	NS
P	*Salix petiolaris*	Meadow Willow				S3S4	12	94.9 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S3S4	3	19.5 ± 4.0	NS
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	6	27.0 ± 5.0	NS
P	*Triglochin gaspensis*	Gasp├⌐ Arrowgrass				S3S4	22	69.1 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	1	55.7 ± 0.0	NS
P	*Luzula parviflora*	Small-flowered Woodrush				S3S4	3	37.0 ± 0.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	3	59.5 ± 0.0	NS
P	*Panicum philadelphicum*	Philadelphia Panicgrass				S3S4	1	96.8 ± 0.0	NS
P	*Trisetum spicatum*	Narrow False Oats				S3S4	1	82.0 ± 0.0	NS
P	*Cystopteris bulbifera*	Bulblet Bladder Fern				S3S4	93	59.2 ± 0.0	NS
P	*Equisetum hyemale ssp. affine*	Common Scouring-rush				S3S4	29	59.6 ± 0.0	NS
P	*Equisetum scirpoides*	Dwarf Scouring-Rush				S3S4	49	97.9 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	2	79.1 ± 0.0	NS
P	*Schizaea pusilla*	Little Curlygrass Fern				S3S4	8	11.8 ± 0.0	NS

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The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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Appendix F

COC Identification

Table F1. Surface water general chemistry and cyanide data from the WSP site compared to applicable surface water quality guidelines.

			Area	Area A - OFF SHORE						Area B - NEAR SHORE			Area C - ISLAND AND CENTRAL				Area D - CHANNEL				Area E - WHARF			
			Sample ID	SW-A-18	SW-A-17	SW-A-16	SW-A-15	SW-A-14	SW-A-9	SW-B-12	SW-B-10	SW-B-3	SW-C-13	SW-C-11	SW-C-8	SW-C-7	SW-D-6	SW-D-5	SW-D-4	SW-D-2	SW-E-4	SW-E-3	SW-E-2	SW-E-1
			Date	7/24/2023	7/24/2023	7/25/2023	7/24/2023	7/24/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	7/24/2023	7/25/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023
Parameters	Units	RDL	Surface Water Guideline																					
Anion Sum	me/L	-	-	-	-	-	502	-	-	-	467	-	-	-	497	-	-	512	-	-	-	-	-	498
Bicarb. Alkalinity (as $CaCO_3$)	mg/L	1.0	-	-	-	-	97	-	-	-	83	-	-	-	99	-	-	94	-	-	-	-	-	77
Calculated TDS	mg/L	1.0	-	-	-	-	29000	-	-	-	27000	-	-	-	29000	-	-	29000	-	-	-	-	-	29000
Carb. Alkalinity (as $CaCO_3$)	mg/L	1.0	-	-	-	-	<1	-	-	-	1.5	-	-	-	<1	-	-	<1	-	-	-	-	-	<1
Cation Sum	me/L	-	-	-	-	-	506	-	-	-	466	-	-	-	494	-	-	494	-	-	-	-	-	495
Hardness ($CaCO_3$)	mg/L	1.0	-	-	-	-	5200	-	-	-	4800	-	-	-	5100	-	-	5100	-	-	-	-	-	5200
Ion Balance (% Difference)	%	-	-	-	-	-	0.39	-	-	-	0.07	-	-	-	0.33	-	-	1.79	-	-	-	-	-	0.23
Langelier Index (@ 20°C)	-	-	-	-	-	-	0.491	-	-	-	0.841	-	-	-	0.537	-	-	0.489	-	-	-	-	-	0.325
Langelier Index (@ 4°C)	-	-	-	-	-	-	0.252	-	-	-	0.603	-	-	-	0.298	-	-	0.25	-	-	-	-	-	0.086
Nitrate (N)	mg/L	0.050	45 [a]	-	-	-	<0.05	-	-	-	<0.05	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	0.49
Saturation pH (@ 20°C)	-	-	-	-	-	-	7.31	-	-	-	7.43	-	-	-	7.33	-	-	7.35	-	-	-	-	-	7.44
Saturation pH (@ 4°C)	-	-	-	-	-	-	7.55	-	-	-	7.67	-	-	-	7.57	-	-	7.59	-	-	-	-	-	7.68
Total Alkalinity (as $CaCO_3$)*	mg/L	2.0	-	-	-	-	98	-	-	-	85	-	-	-	100	-	-	95	-	-	-	-	-	77
Dissolved Chloride (Cl-)*	mg/L	300	-	-	-	-	16000	-	-	-	15000	-	-	-	16000	-	-	16000	-	-	-	-	-	16000
Colour	TCU	5.0	-	-	-	-	<5	-	-	-	14	-	-	-	<5	-	-	<5	-	-	-	-	-	<5
Nitrate + Nitrite (N)	mg/L	0.050	-	-	-	-	<0.05	-	-	-	<0.05	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	0.51
Nitrite (N)	mg/L	0.010	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	<0.01	-	-	-	-	-	0.011
Nitrogen (Ammonia Nitrogen)*	mg/L	0.050	-	<0.05	-	-	0.055	-	-	-	0.062	-	-	-	0.052	-	-	<0.05	-	-	-	-	-	<0.05
Total Organic Carbon (C)	mg/L	0.5	-	<5	-	-	1.3	-	-	-	<5	-	-	-	<5	-	-	<5	-	-	-	-	-	<5
Orthophosphate (P)	mg/L	0.010	-	-	-	-	0.012	-	-	-	0.014	-	-	-	0.016	-	-	0.016	-	-	-	-	-	0.014
pH	pH	-	7.0 - 8.7 [a]	-	-	-	7.8	-	-	-	8.27	-	-	-	7.86	-	-	7.84	-	-	-	-	-	7.76
Reactive Silica (SiO_2)	mg/L	0.50	-	-	-	-	<0.5	-	-	-	0.52	-	-	-	<0.5	-	-	<0.5	-	-	-	-	-	<0.5
Dissolved Sulphate (SO_4)	mg/L	100	-	-	-	-	2300	-	-	-	2100	-	-	-	2200	-	-	2200	-	-	-	-	-	2200
Turbidity	NTU	0.10	-	-	-	-	1.6	-	-	-	0.43	-	-	-	0.21	-	-	<0.1	-	-	-	-	-	3.5
Conductivity	µS/cm	1	-	-	-	-	46000	-	-	-	42000	-	-	-	45000	-	-	45000	-	-	-	-	-	44000
Cyanide (total)	µg/L	0.005	1 [b]	<0.005	-	-	-	-	-	-	<0.005	-	-	-	<0.005	-	-	<0.005	-	-	-	-	-	<0.005

Notes

RDL = reportable detection limit.

Value exceeds guideline

RDL exceeds guideline

Elevated RDL due to matrix interference.

Elevated RDL due to sample turbidity.

* RDL for 2020 samples differed from 2023 samples as follows: dissolved chloride (Cl-) RDL = 250 mg/L; nitrogen (ammonia nitrogen) RDL = 0.05 mg/L; total alkalinity (as $CaCO_3$) RDL = 5.0 mg/L.

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine surface water. Individual guideline references are provided in footnotes.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Water Quality Guidelines for the Protection of Aquatic Life (Marine). Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[b] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2023). Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.

Table F1. Surface water general chemistry and cyanide data from the WSP site compared to applicable surface water quality guidelines.

Area				2020, 2021, 2022 Sampling Data										Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Sample ID				Barachois Wharf	Channel	Single Line	Channel	SP12	SP10	Winter 2020 Line	Summer 2021 Line	Winter 2021 Line	Summer 2022 Line								
Date				6/2/2020	7/24/2020	7/24/2020	10/5/2020	10/5/2020	10/5/2020	4/15/2021	7/16/2021	10/26/2021	6/16/2022								
Parameters	Units	RDL	Surface Water Guideline																		
Anion Sum	me/L	-	-	483	508	511	535	547	537	510	451	476	472	15	0	15	451	451	547	547	0
Bicarb. Alkalinity (as $CaCO_3$)	mg/L	1.0	-	92	91	90	93	89	92	92	91	160	100	15	0	15	77	77	160	160	0
Calculated TDS	mg/L	1.0	-	28000	28000	28000	30000	31000	30000	29000	27000	29000	28000	15	0	15	27000	27000	31000	31000	0
Carb. Alkalinity (as $CaCO_3$)	mg/L	1.0	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	15	14	1	<1	1.5	1.5	1.5	0
Cation Sum	me/L	-	-	491	440	437	503	524	488	485	494	536	485	15	0	15	437	437	536	536	0
Hardness ($CaCO_3$)	mg/L	1.0	-	5300	4900	4800	5400	5400	5200	5300	5300	5400	5000	15	0	15	4800	4800	5400	5400	0
Ion Balance (% Difference)	%	-	-	0.78	7.2	7.8	3.05	2.14	4.74	2.45	4.59	5.94	1.28	15	0	15	0.07	0.07	7.8	7.8	0
Langelier Index (@ 20°C)	-	-	-	0.287	0.301	0.397	0.5	0.671	0.62	0.528	0.614	0.117	0.588	15	0	15	0.117	0.117	0.841	0.841	0
Langelier Index (@ 4°C)	-	-	-	0.049	0.063	0.158	0.261	0.432	0.381	0.29	0.375	-0.122	0.349	15	0	15	-0.122	-0.122	0.603	0.603	0
Nitrate (N)	mg/L	0.050	45 [a]	<0.05	<0.05	<0.05	<0.05	<0.05	0.068	<0.05	<0.05	<0.05	<0.05	15	13	2	<0.05	0.068	0.49	0.49	0
Saturation pH (@ 20°C)	-	-	-	7.37	7.37	7.38	7.32	7.31	7.33	7.34	7.36	7.07	7.31	15	0	15	7.07	7.07	7.44	7.44	0
Saturation pH (@ 4°C)	-	-	-	7.61	7.61	7.62	7.56	7.55	7.57	7.58	7.6	7.31	7.55	15	0	15	7.31	7.31	7.68	7.68	0
Total Alkalinity (as $CaCO_3$)*	mg/L	2.0	-	93	92	90	94	90	93	92	92	160	100	15	0	15	77	77	160	160	0
Dissolved Chloride (Cl-)*	mg/L	300	-	15000	16000	16000	17000	18000	17000	16000	14000	15000	15000	15	0	15	14000	14000	18000	18000	0
Colour	TCU	5.0	-	5.5	<5	<5	<5	<5	<5	<5	<5	6.2	5.6	15	11	4	<5	5.5	14	14	0
Nitrate + Nitrite (N)	mg/L	0.050	-	ND	<0.05	<0.05	<0.05	<0.05	0.068	<0.05	<0.05	<0.05	<0.05	15	12	2	<0.05	0.068	0.51	0.51	0
Nitrite (N)	mg/L	0.010	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	15	13	2	<0.01	0.01	0.011	0.011	0
Nitrogen (Ammonia Nitrogen)*	mg/L	0.050	-	<0.14	<0.14	<0.14	<0.14	0.17	<0.14	<0.14	<0.14	0.44	<0.14	16	11	5	<0.05	0.052	0.44	0.44	0
Total Organic Carbon (C)	mg/L	0.5	-	<5	1.6	1.6	3	1	1	1.7	1.6	<0.5	2	16	7	9	<5	1	3	3	0
Orthophosphate (P)	mg/L	0.010	-	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	0.015	0.64	0.01	15	6	9	<0.01	0.01	0.64	0.64	0
pH	pH	-	7.0 - 8.7 [a]	7.66	7.67	7.78	7.82	7.98	7.95	7.87	7.97	7.18	7.9	15	0	15	7.18	7.18	8.27	8.27	0
Reactive Silica (SiO_2)	mg/L	0.50	-	<0.5	0.51	0.55	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	15	11	4	<0.5	0.5	0.55	0.55	0
Dissolved Sulphate (SO_4)	mg/L	100	-	2300	2200	2200	2400	2400	2500	2200	2400	2400	2100	15	0	15	2100	2100	2500	2500	0
Turbidity	NTU	0.10	-	5	0.26	0.28	0.89	0.72	0.64	2.8	0.46	21	0.23	15	1	14	<0.1	0.21	21	21	0
Conductivity	µS/cm	1	-	45000	46000	45000	47000	47000	47000	44000	46000	46000	46000	15	0	15	42000	42000	47000	47000	0
Cyanide (total)	µg/L	0.005	1 [b]	-	-	-	-	-	-	-	-	-	-	5	5	0	<0.005	-	<0.005	-	0

Notes

RDL = reportable detection limit.

Value exceeds guideline

RDL exceeds guideline

Elevated RDL due to matrix interference.

Elevated RDL due to sample turbidity.

* RDL for 2020 samples differed from 2023 samples as follows: dissolved chloride (Cl-) RDL = 250 mg/L; nitrogen (ammonia nitrogen) RDL = 0.05 mg/L; total alkalinity (as $CaCO_3$) RDL = 5.0 mg/L.

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine surface water. Individual guideline references are provided in footnotes.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Water Quality Guidelines for the Protection of Aquatic Life (Marine). Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[b] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2023). Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.

Table F2. Surface water metal and metalloid chemistry data from the WSP site compared to applicable surface water quality guidelines.

			Area	Area A - OFF SHORE						Area B - NEAR SHORE			Area C - ISLAND AND CENTRAL				Area D - CHANNEL				Area E - WHARF			
			Sample ID	SW-A-18	SW-A-17	SW-A-16	SW-A-15	SW-A-14	SW-A-9	SW-B-12	SW-B-10	SW-B-3	SW-C-13	SW-C-11	SW-C-8	SW-C-7	SW-D-6	SW-D-5	SW-D-4	SW-D-2	SW-E-4	SW-E-3	SW-E-2	SW-E-1
			Date	7/24/2023	7/24/2023	7/25/2023	7/24/2023	7/24/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	7/24/2023	7/25/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023
Parameters	Units	RDL	Surface Water Guideline																					
Aluminum	µg/L	50	1500 [a]	<50	<50	73	<50	<50	<50	<50	120	<50	<50	<50	<50	<50	<50	150	<50	<50	540	<50	54	<50
Antimony	µg/L	10	250 [b]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Arsenic	µg/L	10	12.5 [c]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Barium	µg/L	10	500 [b]	<10	<10	11	<10	<10	<10	10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Beryllium*	µg/L	1.0	100 [d]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bismuth	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Boron	µg/L	500	1200 [b]	3900	4000	3400	4100	4100	4200	3900	3800	3900	4000	3900	3800	3900	3800	3900	4100	4200	4100	3900	3800	3800
Cadmium	µg/L	0.10	0.12 [c]	<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
Calcium	µg/L	1000	-	330000	330000	280000	340000	340000	350000	320000	320000	330000	340000	330000	330000	320000	320000	320000	340000	350000	340000	330000	320000	330000
Chromium	µg/L	10	1.5 [c,e]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cobalt	µg/L	4.0	4 [b]	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Copper	µg/L	5.0	2 [f]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	µg/L	500	300 [a]	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	1200	<500	<500	<500
Lead	µg/L	5.0	2 [f,g]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Magnesium	µg/L	1000	-	1000000	1000000	890000	1100000	1100000	1100000	1000000	970000	1100000	1100000	1100000	1000000	1000000	1000000	1100000	1100000	1100000	1100000	1000000	1000000	1100000
Manganese	µg/L	20	100 [a]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Mercury (total)	µg/L	0.013	0.016 [c]	<0.013	<0.013	<0.013	0.013	<0.013	0.013	<0.013	0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	0.013	<0.013	<0.013	0.017	<0.013	<0.013	<0.013
Molybdenum	µg/L	20	1000 [b]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Nickel	µg/L	20	8.3 [d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	55	<20	<20	<20	<20	<20	<20	<20	<20	<20
Phosphorus	µg/L	1000	100 [a]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Potassium	µg/L	1000	-	320000	320000	260000	320000	330000	330000	310000	300000	320000	320000	320000	320000	310000	300000	320000	330000	320000	320000	310000	310000	320000
Selenium	µg/L	5.0	2 [f]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver	µg/L	1.0	1.5 [f]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sodium	µg/L	1000	-	8900000	9000000	7500000	9000000	9000000	9100000	8600000	8300000	8800000	8900000	8900000	8800000	8700000	8600000	8800000	9100000	9100000	8900000	8700000	8600000	8800000
Strontium	µg/L	20	-	6300	6400	5100	6600	6800	6800	6300	6100	6500	6500	6400	6400	6300	6200	6300	6600	6400	6700	6400	6200	6300
Thallium	µg/L	1.0	0.3 [b]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tin	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Titanium	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	23	<20	<20	<20
Uranium	µg/L	1.0	8.5 [b]	2.7	2.8	2.2	2.6	2.7	2.8	2.4	2.5	2.6	2.8	2.5	2.8	2.6	2.5	2.7	2.6	2.8	2.9	2.5	2.4	2.6
Vanadium	µg/L	20	50 [d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Zinc	µg/L	50	10 [f]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50

Notes

RDL = reportable detection limit.

Value exceeds guideline

RDL exceeds guideline

Elevated RDL due to matrix interference.

Elevated RDL due to sample turbidity.

* Beryllium RDL for 2020 samples = 10 µg/L.

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine surface water. Individual guideline references are provided in footnotes.

[a] United States Environmental Protection Agency (US EPA). (2018). Ecological Risk Assessment Supplemental Guidance: Surface Water Screening Values for Hazardous Waste Sites (saltwater screening value; chronic). Accessed online May 2024 from: https://www.epa.gov/sites/default/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf.

[b] BC Contaminated Sites Regulation Schedule 3.2 (Current to May 21, 2024; last amended March 1, 2023) Generic Numerical Water Standards for Aquatic Life (Marine). BC CSR notes that the aquatic life standards assume a minimum of 1:10 dilution is available prior to discharge to the aquatic environment. As such, BC CSR guideline values are divided by 10 for application to marine surface water.

[c] Canadian Council of Ministers of the Environment (CCME). Canadian Water Quality Guidelines for the Protection of Aquatic Life (Marine). Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[d] B.C. Ministry of Environment and Climate Change Strategy. (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[e] Guideline for hexavalent chromium (Cr(VI)) was selected to be conservative; however, it is unlikely that the greatest proportion of chromium in marine waters will be present in the hexavalent form rather than the trivalent form (Cr(III)) in marine waters.

[f] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2023). Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.

[g] Guideline is for average calculated from at least 45 weekly samples within 30 days; maximum value is 140 µg/L.

Table F2. Surface water metal and metalloid chemistry data from the WSP site compared to applicable surface water quality guidelines.

			Area	2020, 2021, 2022 Sampling Data										Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
			Sample ID	Barachois Wharf	Channel	Single Line	Channel	SP12	SP10	Winter 2020 Line	Summer 2021 Line	Winter 2021 Line	Summer 2022 Line								
			Date	6/2/2020	7/24/2020	7/24/2020	10/5/2020	10/5/2020	10/5/2020	4/15/2021	7/16/2021	10/26/2021	6/16/2022								
Parameters	Units	RDL	Surface Water Guideline																		
Aluminum	µg/L	50	1500 [a]	180	<50	<50	<50	<50	<50	91	<50	<50	<50	31	24	7	<50	54	540	540	0
Antimony	µg/L	10	250 [b]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	31	31	0	<10	-	<10	-	0
Arsenic	µg/L	10	12.5 [c]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	31	31	0	<10	-	<10	-	0
Barium	µg/L	10	500 [b]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	31	28	3	<10	10	11	11	0
Beryllium*	µg/L	1.0	100 [d]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	31	31	0	<1	-	<1	-	0
Bismuth	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	31	0	<20	-	<20	-	0
Boron	µg/L	500	1200 [b]	3900	<500	<500	3900	4200	3900	3700	3800	4200	3900	31	2	29	<500	3400	4200	4200	29
Cadmium	µg/L	0.10	0.12 [c]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.13	<0.1	31	30	1	<0.1	0.13	0.13	0.13	1
Calcium	µg/L	1000	-	320000	330000	330000	350000	360000	340000	350000	340000	360000	340000	31	0	31	280000	280000	360000	360000	0
Chromium	µg/L	10	1.5 [c,e]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	31	31	0	<10	-	<10	-	0
Cobalt	µg/L	4.0	4 [b]	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	31	31	0	<4	-	<4	-	0
Copper	µg/L	5.0	2 [f]	16	<5	<5	<5	<5	<5	19	<5	<5	<5	31	29	2	<5	16	19	19	2
Iron	µg/L	500	300 [a]	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	31	30	1	<500	1200	1200	1200	1
Lead	µg/L	5.0	2 [f,g]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	31	31	0	<5	-	<5	-	0
Magnesium	µg/L	1000	-	1100000	990000	980000	1100000	1100000	1100000	1100000	1100000	1100000	1000000	31	0	31	890000	890000	1100000	1100000	0
Manganese	µg/L	20	100 [a]	20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	30	1	<20	20	20	20	0
Mercury (total)	µg/L	0.013	0.016 [c]	-	-	-	-	-	-	-	-	-	-	21	16	5	<0.013	0.013	0.017	0.017	1
Molybdenum	µg/L	20	1000 [b]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	31	0	<20	-	<20	-	0
Nickel	µg/L	20	8.3 [d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	30	1	<20	55	55	55	1
Phosphorus	µg/L	1000	100 [a]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	31	31	0	<1000	-	<1000	-	0
Potassium	µg/L	1000	-	310000	290000	290000	320000	340000	310000	320000	330000	340000	310000	31	0	31	260000	260000	340000	340000	0
Selenium	µg/L	5.0	2 [f]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	31	31	0	<5	-	<5	-	0
Silver	µg/L	1.0	1.5 [f]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	31	31	0	<1	-	<1	-	0
Sodium	µg/L	1000	-	8700000	7700000	7700000	8900000	9400000	8600000	8500000	8700000	9600000	8600000	31	0	31	7500000	7500000	9600000	9600000	0
Strontium	µg/L	20	-	6000	5900	5900	6400	6700	6200	6300	6200	6800	6300	31	0	31	5100	5100	6800	6800	0
Thallium	µg/L	1.0	0.3 [b]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	31	31	0	<1	-	<1	-	0
Tin	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	31	0	<20	-	<20	-	0
Titanium	µg/L	20	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	30	1	<20	23	23	23	0
Uranium	µg/L	1.0	8.5 [b]	2.5	<1	<1	2.7	2.9	2.7	2.8	2.6	2.6	2.5	31	2	29	<1	2.2	2.9	2.9	0
Vanadium	µg/L	20	50 [d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	31	31	0	<20	-	<20	-	0
Zinc	µg/L	50	10 [f]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	31	31	0	<50	-	<50	-	0

Notes

RDL = reportable detection limit.

Value exceeds guideline

RDL exceeds guideline

Elevated RDL due to matrix interference.

Elevated RDL due to sample turbidity.

* Beryllium RDL for 2020 samples = 10 µg/L.

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine surface water. Individual guideline references are provided in footnotes.

[a] United States Environmental Protection Agency (US EPA). (2018). Ecological Risk Assessment Supplemental Guidance: Surface Water Screening Values for Hazardous Waste Sites (saltwater screening value; chronic). Accessed online May 2024 from: https://www.epa.gov/sites/default/files/2018-03/documents/era_regional_supplemental_guidance_report-march-2018_update.pdf.

[b] BC Contaminated Sites Regulation Schedule 3.2 (Current to May 21, 2024; last amended March 1, 2023) Generic Numerical Water Standards for Aquatic Life (Marine). BC CSR notes that the aquatic life standards assume a minimum of 1:10 dilution is available prior to discharge to the aquatic environment. As such, BC CSR guideline values are divided by 10 for application to marine surface water.

[c] Canadian Council of Ministers of the Environment (CCME). Canadian Water Quality Guidelines for the Protection of Aquatic Life (Marine). Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[d] B.C. Ministry of Environment and Climate Change Strategy. (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C.

[e] Guideline for hexavalent chromium (Cr(VI)) was selected to be conservative; however, it is unlikely that the greatest proportion of chromium in marine waters will be present in the hexavalent form rather than the trivalent form (Cr(III)) in marine waters.

[f] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2023). Approved Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.

[g] Guideline is for average calculated from at least 45 weekly samples within 30 days; maximum value is 140 µg/L.

Table F3. Sediment metal, metalloid, and cyanide chemistry data from the WSP site compared to applicable sediment quality guidelines.

			Area	Area A - OFF SHORE								Area B - NEAR SHORE					Area C - ISLAND AND CENTRAL				
			Sample ID	SED-A-18-S1	SED-A-18-S2	SED-A-17-S1	SED-A-16-S1	SED-A-15-S1	SED-A-14-S1	SED-A-14-S2	SED-A-9-S1	SED-B-12-S1	FD3	SED-B-10-S1	SED-B-10-S1	SED-B-3-S1	SED-C-13-S1	SED-C-11-S1	FD5	SED-C-8-S1	SED-C-7-S1
			Date	7/24/2023	7/24/2023	7/24/2023	7/25/2023	7/24/2023	7/24/2023	7/24/2023	7/24/2023	7/25/2023		7/25/2023	12/14/2023	7/25/2023	7/24/2023	7/25/2023		7/24/2023	7/25/2023
Parameters	Units	RDL	Sediment Guideline																		
Aluminum	mg/kg	10	-	6000	5900	6600	6500	6700	5700	5100	5700	7700	7700	6700	-	6600	5600	4600	4500	5500	4800
Antimony	mg/kg	2.0	25 [a]	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<2	<2
Arsenic	mg/kg	2.0	41.6 [b]	6.8	8.1	22	11	13	15	9.9	4.2	14	14	630	49	120	9.2	26	9.6	4.8	5.8
Barium	mg/kg	5.0	130 [c]	21	20	17	6.7	19	10	8.3	7	13	14	7.6	-	9	6.2	5.3	5.8	6	5.6
Beryllium	mg/kg	1.0	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1
Bismuth	mg/kg	2.0	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<2	<2
Boron (total)	mg/kg	50	-	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	-	<50	<50	<50	<50	<50	<50
Cadmium	mg/kg	0.30	4.2 [b]	<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	<0.3	<0.3	<0.3
Chromium (total)	mg/kg	2.0	160 [b]	12	11	12	11	12	9.9	8.8	9.4	13	13	11	-	11	8.9	7.4	7.4	8.6	8.1
Cobalt	mg/kg	1.0	-	4.5	4.4	4.8	5.1	4.8	4.4	3.9	4.2	6.7	6.7	5.2	-	5	4.1	3.4	3.3	4.2	3.6
Copper	mg/kg	2.0	108 [b]	6.5	6.5	7.5	4.6	7.8	5.3	4.8	3.4	8	8.6	5.4	-	5.7	3.4	2.4	2.5	3.4	3.1
Iron	mg/kg	50	-	12000	12000	14000	14000	13000	13000	11000	14000	21000	22000	15000	-	18000	13000	11000	10000	13000	11000
Lead	mg/kg	0.50	112 [b]	5.6	5.2	6.9	3.1	6.6	4.9	3.5	3.1	5.4	7	5	-	6	2.9	2.4	2.3	2.8	2.5
Lithium	mg/kg	2.0	-	16	16	17	16	16	15	13	16	23	23	22	-	19	18	12	13	14	14
Manganese	mg/kg	2.00	-	300	290	320	260	310	320	310	330	620	620	260	-	240	220	250	220	350	280
Mercury (total)	mg/kg	0.10	0.7 [b]	<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
Molybdenum	mg/kg	2.0	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<2	<2
Nickel	mg/kg	2.0	50 [d]	14	12	15	19	13	12	10	12	15	15	13	-	14	11	8.9	8.7	11	11
Rubidium	mg/kg	2.0	-	7.8	7.2	6.7	4	6.8	4.7	4	3.5	4.8	4.9	4.5	-	5	3.7	3	3	3.5	3.7
Selenium	mg/kg	0.50	2 [e]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1
Silver	mg/kg	0.50	2.2 [d]	<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
Strontium	mg/kg	5.0	-	37	34	29	55	37	18	13	20	20	20	13	-	19	13	6.8	7.3	13	16
Thallium	mg/kg	0.10	-	0.1	0.1	0.1	<5	0.11	<5	<5	<5	<5	<5	<5	-	<5	<5	<5	<5	<5	<5
Tin	mg/kg	1.0	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.3	<1	-	<1	<1	<1	<1	<1	<1
Uranium	mg/kg	0.10	-	0.66	0.67	0.64	0.35	0.8	0.74	0.48	0.33	0.54	0.6	1.2	-	0.49	0.33	0.27	0.26	0.29	0.36
Vanadium	mg/kg	2.0	-	15	14	16	11	16	13	11	12	18	18	12	-	13	11	9.4	8.9	12	9.1
Zinc	mg/kg	5.0	271 [b]	190	210	32	83	130	100	83	25	32	33	30	-	29	25	290	20	23	150
Cyanide (total)	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	-	-	-	-

Notes

RDL = reportable detection limit.

Value exceeds guideline

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine sediments. Individual guideline references are provided in footnotes.

[a] Simpson, S.L.; Batley, G.B.; and Chariton, A.A. (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[c] Buchman, M.F. (2008). NOAA Screening Quick Reference Table, NOAA OR&R Report 08-1, Seattle, WA. Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp.

[d] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf.

[e] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2014). Companion Document to: Ambient Water Quality Guidelines for Selenium Update. Accessed online May 2024 from: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg_companion_document.pdf.
The chronic sediment quality alert concentration for the protection of aquatic life; calculated as the mean concentration of at least 5 samples collected in a representative area (i.e., site).

Table F3. Sediment metal, metalloid, and cyanide chemistry data from the WSP site compared to applicable sediment quality guidelines.

			Area	Area D - CHANNEL					Area E - WHARF					Area G - ADDITIONAL SAMPLES FOR DELINEATION						2020 Sampling
			Sample ID	SED-D-6-S1	SED-D-6-S2	SED-D-5-S1	SED-D-4-S1	SED-D-2-S1	SED-E-4-S1	SED-E-4-S2	SED-E-3-S1	SED-E-2-S1	SED-E-1-S1	SED-G-6-S1	SED-G-5-S1	SED-G-4-S1	SED-G-3-S1	SED-G-2-S1	SED-G-1-S1	Channel Sediment
			Date	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/24/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	5-Oct-2020
Parameters	Units	RDL	Sediment Guideline																	
Aluminum	mg/kg	10	-	4700	4700	5100	5600	6200	7500	5600	5300	5200	7600	-	-	-	-	-	-	6400
Antimony	mg/kg	2.0	25 [a]	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-	-	-	-	<2
Arsenic	mg/kg	2.0	41.6 [b]	11	12	130	840	24	20	5.9	4.3	15	61	7.6	70	35	1200	170	260	58
Barium	mg/kg	5.0	130 [c]	5.9	5.4	6.7	7	8.1	14	8.8	5.6	8.8	17	-	-	-	-	-	-	15
Beryllium	mg/kg	1.0	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-	-	<1
Bismuth	mg/kg	2.0	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-	-	-	-	<2
Boron (total)	mg/kg	50	-	<50	<50	<50	<50	<50	<50	<50	<50	<50	52	-	-	-	-	-	-	<50
Cadmium	mg/kg	0.30	4.2 [b]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	-	-	-	-	-	<0.3
Chromium (total)	mg/kg	2.0	160 [b]	7.8	7.6	8.8	10	9.8	13	9.7	8.6	9.2	13	-	-	-	-	-	-	11
Cobalt	mg/kg	1.0	-	3.6	3.7	3.9	4.2	4.2	5.1	3.9	3.8	3.9	5.4	-	-	-	-	-	-	5.4
Copper	mg/kg	2.0	108 [b]	3.3	3	3.7	3.9	5.3	9	4.5	3.1	4.5	9.3	-	-	-	-	-	-	7.2
Iron	mg/kg	50	-	10000	11000	11000	17000	13000	16000	11000	11000	11000	16000	-	-	-	-	-	-	14000
Lead	mg/kg	0.50	112 [b]	2.7	2.4	3.2	3.5	4.4	5.8	2.9	3.2	4.7	8.8	-	-	-	-	-	-	5.7
Lithium	mg/kg	2.0	-	13	13	15	16	18	18	15	15	15	21	-	-	-	-	-	-	18
Manganese	mg/kg	2.00	-	270	260	210	280	190	250	200	200	190	250	-	-	-	-	-	-	290
Mercury (total)	mg/kg	0.10	0.7 [b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.13	-	-	-	-	-	-	<0.1
Molybdenum	mg/kg	2.0	-	<2	<2	<2	<2	<2	5.5	3.2	<2	<2	3.2	-	-	-	-	-	-	<2
Nickel	mg/kg	2.0	50 [d]	9.7	9.2	11	12	12	15	13	11	12	15	-	-	-	-	-	-	12
Rubidium	mg/kg	2.0	-	3.5	3.2	4.1	3.4	4.5	7.7	5.1	4.1	4.6	7.5	-	-	-	-	-	-	6.5
Selenium	mg/kg	0.50	2 [e]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-	-	<1
Silver	mg/kg	0.50	2.2 [d]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	<0.5
Strontium	mg/kg	5.0	-	11	6.5	8.8	11	13	22	11	13	10	31	-	-	-	-	-	-	24
Thallium	mg/kg	0.10	-	<5	<5	<5	<5	<5	0.13	0.1	<5	<5	0.15	-	-	-	-	-	-	<0.1
Tin	mg/kg	1.0	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-	-	<1
Uranium	mg/kg	0.10	-	0.34	0.34	0.52	0.37	0.59	1.6	1	0.47	0.68	0.93	-	-	-	-	-	-	0.72
Vanadium	mg/kg	2.0	-	9.2	8.9	9.9	14	10	18	11	9.1	11	18	-	-	-	-	-	-	15
Zinc	mg/kg	5.0	271 [b]	410	230	130	25	78	210	110	140	74	38	-	-	-	-	-	-	30
Cyanide (total)	mg/kg	0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-

Notes

RDL = reportable detection limit.

Value exceeds guideline

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine sediments. Individual guideline references are provided in footnotes.

[a] Simpson, S.L.; Batley, G.B.; and Chariton, A.A. (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[c] Buchman, M.F. (2008). NOAA Screening Quick Reference Table, NOAA OR&R Report 08-1, Seattle, WA. Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp.

[d] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf.

[e] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2014). Companion Document to: Ambient Water Quality Guidelines for Selenium Update. Accessed online May 2024 from: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg_companion_document.pdf.
The chronic sediment quality alert concentration for the protection of aquatic life; calculated as the mean concentration of at least 5 samples collected in a representative area (i.e., site).

Table F3. Sediment metal, metalloid, and cyanide chemistry data from the WSP site compared to applicable sediment quality guidelines.

			Area Sample ID Date	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Parameters	Units	RDL	Sediment Guideline								
Aluminum	mg/kg	10	-	28	0	28	4500	4500	7700	7700	0
Antimony	mg/kg	2.0	25 [a]	28	28	0	<2	-	<2	-	0
Arsenic	mg/kg	2.0	41.6 [b]	35	0	35	4.2	4.2	1200	1200	11
Barium	mg/kg	5.0	130 [c]	28	0	28	5.3	5.3	21	21	0
Beryllium	mg/kg	1.0	-	28	28	0	<1	-	<1	-	0
Bismuth	mg/kg	2.0	-	28	28	0	<2	-	<2	-	0
Boron (total)	mg/kg	50	-	28	27	1	<50	52	52	52	0
Cadmium	mg/kg	0.30	4.2 [b]	28	28	0	<0.3	-	<0.3	-	0
Chromium (total)	mg/kg	2.0	160 [b]	28	0	28	7.4	7.4	13	13	0
Cobalt	mg/kg	1.0	-	28	0	28	3.3	3.3	6.7	6.7	0
Copper	mg/kg	2.0	108 [b]	28	0	28	2.4	2.4	9.3	9.3	0
Iron	mg/kg	50	-	28	0	28	10000	10000	22000	22000	0
Lead	mg/kg	0.50	112 [b]	28	0	28	2.3	2.3	8.8	8.8	0
Lithium	mg/kg	2.0	-	28	0	28	12	12	23	23	0
Manganese	mg/kg	2.00	-	28	0	28	190	190	620	620	0
Mercury (total)	mg/kg	0.10	0.7 [b]	28	27	1	<0.1	0.13	0.13	0.13	0
Molybdenum	mg/kg	2.0	-	28	25	3	<2	3.2	5.5	5.5	0
Nickel	mg/kg	2.0	50 [d]	28	0	28	8.7	8.7	19	19	0
Rubidium	mg/kg	2.0	-	28	0	28	3	3	7.8	7.8	0
Selenium	mg/kg	0.50	2 [e]	28	28	0	<1	-	<1	-	0
Silver	mg/kg	0.50	2.2 [d]	28	28	0	<0.5	-	<0.5	-	0
Strontium	mg/kg	5.0	-	28	0	28	6.5	6.5	55	55	0
Thallium	mg/kg	0.10	-	28	21	7	<5	0.1	0.15	0.15	0
Tin	mg/kg	1.0	-	28	27	1	<1	1.3	1.3	1.3	0
Uranium	mg/kg	0.10	-	28	0	28	0.26	0.26	1.6	1.6	0
Vanadium	mg/kg	2.0	-	28	0	28	8.9	8.9	18	18	0
Zinc	mg/kg	5.0	271 [b]	28	0	28	20	20	410	410	2
Cyanide (total)	mg/kg	0.5	-	7	7	0	<0.5	-	<0.5	-	0

Notes

RDL = reportable detection limit.

Value exceeds guideline

Guidelines

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[a] Simpson, S.L.; Batley, G.B.; and Chariton, A.A. (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Accessed online May 2024 from: https://ccme.ca/en/resources/protocols-and-reference#.

[c] Buchman, M.F. (2008). NOAA Screening Quick Reference Table, NOAA OR&R Report 08-1, Seattle, WA. Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp.

[d] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2021). Working Water Quality Guidelines: Aquatic Life, Wildlife, & Agriculture. Water Quality Guideline Series, WQG-08. Prov. B.C., Victoria B.C. Accessed online May 2024 from https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf.

[e] B.C. Ministry of Environment and Climate Change Strategy (BC MOECC; formerly BC MOE). (2014). Companion Document to: Ambient Water Quality Guidelines for Selenium Update. Accessed online May 2024 from: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg_companion_document.pdf.
The chronic sediment quality alert concentration for the protection of aquatic life; calculated as the mean concentration of at least 5 samples collected in a representative area (i.e., site).

Table F4. Sediment BTEX/PHC chemistry data from the WSP site compared to applicable sediment quality guidelines.

			Area	Area D - CHANNEL	Area E - WHARF	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentratio	Maximum Concentration	Maximum Detected Concentrati	Number of Exceedances
			Sample ID	SED-D-2-S1	SED-E-1-S1								
			Date	7/25/2023	7/25/2023								
Parameters	Units	RDL	Sediment Guideline										
Benzene	mg/kg	0.005	1.2 [f]	<0.005	<0.005	2	2	0	<0.005	-	<0.005	-	0
Toluene	mg/kg	0.05	1.4 [f]	<0.05	<0.05	2	2	0	<0.05	-	<0.05	-	0
Ethylbenzene	mg/kg	0.01	1.2 [f]	<0.01	<0.01	2	2	0	<0.01	-	<0.01	-	0
Xylenes	mg/kg	0.05	1.3 [f]	<0.05	<0.05	2	2	0	<0.05	-	<0.05	-	0
F1 (C6-C10)	mg/kg	2.5	-	<2.5	<2.5	2	2	0	<2.5	-	<2.5	-	0
F2 (C10-C16)	mg/kg	10	-	<10	<10	2	2	0	<10	-	<10	-	0
F3 (C16-C21)	mg/kg	10	-	<10	<10	2	2	0	<10	-	<10	-	0
F3 (C21-C32)	mg/kg	15	-	<15	<15	2	2	0	<15	-	<15	-	0
Modified TPH	mg/kg	15	15 (gas) [f] 25 (fuel) 43 (lube)	<15	<15	2	2	0	<15	-	<15	-	0

Notes

RDL = reportable detection limit.

Value exceeds guideline.

Guidelines

Guidelines are the Nova Scotia Tier II Pathway Specific Standards (PSS) for marine sediments. Individual guideline references are provided in footnotes.

[a] Atlantic Risk Based Corrective Action (RBCA). (2023). Ecological Tier II Pathway Specific Standards for Marine Sediment. Accessed May 2024 from: https://atlanticrbca.com/wp-content/uploads/2023/06/Ecological_Tier_II_Pathway-Specific_Standards_PSS_for_Sediment_-_Freshwater_and_Marine_June2023.pdf.

Appendix G

ERA Exposure and Risk Modelling

Attachments

American Black Duck - Herbivorous Bird Food Chain Modelling

Whale Sanctuary ERA

Site Media Exposure Point Concentrations

COPC	COPC Concentrations: Sediment (Csed) (mg/kg dw) [1]	Marine Plants (Cp) (mg/kg ww) [2]		Marine Invertebrate (Cinv) (mg/kg ww) [3]	
Arsenic	318	Cp = 0.2*Csed	63.6	Max Concentration	4.66
Water Content of Food Items [4]		0.87		0.78	

Notes

1. UCLM 95 calculated from measured sediment concentration (Dillon, 2024)
2. Marine plant concentration calculated using site-specific BCAF. BCAF calculated from average ratio of sediment:root and sediment:leaf for eelgrass (n=6) on site.
3. Invertebrate concentration determined by calculating max concentration from sampled invertebrate data (rock crab, blue mussels and soft shell clam).
4. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	1.18	Cornell Lab of Ornithology. 2019. Weight given as a range: 0.720 - 1.64 kg. Used average of body weight range.
Average Water Content in Food Items	%	82.95	Sample and Suter, 1994
Food Ingestion Rate (IR_{Food})	kg/day ww	0.35	FCSAP, 2012b (value for mallard duck as a surrogate). Calculated from the published value of 0.05 kg dry food/kg BW/day, adjusted for average water content.
Marine Plant Diet Proportion (P_{Plant})	unitless factor	0.55	FCSAP, 2012b (value for mallard duck as a surrogate). Plant diet assumes all vegetation consumed is eelgrass.
Marine Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.45	FCSAP, 2012b (value for mallard duck as a surrogate). Invertebrate diet assumes all invertebrates consumed are marine invertebrates.
Marine Fish Diet Proportion (P_{Fish})	unitless factor	0	FCSAP (2012b) includes fish as potential food source alongside ground/flying insects at 5% of diet, assumed 0% for this model.
Sediment Ingestion Rate (IR_{Sed})	kg/day dw	1.95E-03	Beyer (2008) 4% of dry food ingestion rate for black duck. Calculated using a food ingestion rate of 0.05 kg dry food/kg BW/day for mallard duck (FCSAP, 2012b).
Foraging Range	ha	9.2	FCSAP, 2012b (value for Mallard Duck as a surrogate)
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	40	Assumed
Residency Factor (R)	unitless factor	1.00E+00	=(Asite / Foraging Range) x 10. *Multipled by 10 to be more conservative.

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Marine Plant Ingestion	Marine Invertebrate Ingestion	Sediment Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_{Inv} \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Sed} = \frac{C_{Sed} \cdot IR_{Sed}}{BW}$	$E_{TOTAL} = (E_{Plant} + E_{Inv} + E_{Sed}) \cdot TUF \cdot R$
Arsenic	10.4	0.622	0.525	11.5

Ecological Hazard Quotients (EHQs)

COPC	TRV (mg/kg body weight/day)	TRV Reference	Total COPC Exposure	EHQ (Total COPC Expousre/TRV)
Arsenic	4.4	FCSAP, 2021; CEAEQ, 2012	11.5	**2.60E+00**

List of Acronyms

C_{Sed} - Concentration in sediment
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_F - Concentration in fish
E_{Sed} - Exposure from sediment ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
COPC - Contaminant of Potential Concern
EHQ - Ecological Hazard Quotient
BSAF - Biota-sediment accumulation factor

Greater Scaup - Invertivorous Bird Food Chain Modelling

Whale Sanctuary ERA

Site Media Exposure Point Concentrations

COPC	COPC Concentrations				
	Sediment (Csed) (mg/kg dw) [1]	Marine Plants (Cp) (mg/kg ww) [2]		Marine Invertebrate (Cinv) (mg/kg ww) [3]	
Arsenic	318	Cp = 0.2*Csed	63.6	Max Concentration	4.66
Water Content of Food Items [4]		0.87		0.78	

Notes

1. UCLM 95 calculated from measured sediment concentration (Dillon, 2024)
2. Marine plant concentration calculated using site-specific BCAF. BCAF calculated from average ratio of sediment:root and sediment:leaf for eelgrass (n=6) on site.
3. Invertebrate concentration determined by calculating max concentration from sampled invertebrate data (rock crab, blue mussels and soft shell clam).
4. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	1.043	Cornell Lab of Ornithology. 2019. Weight given as a range: 0.726 - 1.36 kg. Used average of body weight range.
Average Water Content in Food Items	%	78.9	Sample and Suter, 1994
Food Ingestion Rate (IR_{Food})	kg/day ww	0.35	FCSAP, 2012b (value for lesser scaup as a surrogate). Calculate from the published value of 0.07 kg dry food/kg BW/day, adjusted for average water content.
Marine Plant Diet Proportion (P_{Plant})	unitless factor	0.1	FCSAP, 2012b (value for lesser scaup as a surrogate).Plant diet assumes all vegetation consumed is eelgrass.
Marine Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.9	FCSAP, 2012b (value for lesser scaup as a surrogate). Invertebrate diet assumes all invertebrates consumed are marine invertebrates.
Marine Fish Diet Proportion (P_{Fish})	unitless factor	0	FCSAP, 2012b (value for lesser scaup as a surrogate)
Sediment Ingestion Rate (IR_{Sed})	kg/day dw	2.77E-03	Beyer, 2008. 3.8% of dry food ingestion rate for greater scaup. Calculated using food ingestion rate of 0.07 kg dry food/kg BW/day for lesser scaup (FCSAP, 2012b).
Foraging Range	ha	10	FCSAP, 2012b (value for Lesser Scaup as a surrogate)
Temporal Use Factor (TUF)	unitless factor	0.583333333	Assumed
Site Area (A_{site})	ha	40	Assumed
Residency Factor (R)	unitless factor	1.00E+00	=(Asite / Foraging Range) x 10. *Multipled by 10 to be more conservative.

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Marine Plant Ingestion	Marine Invertebrate Ingestion	Sediment Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_{Inv} \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Sed} = \frac{C_{Sed} \cdot IR_{Sed}}{BW}$	$E_{TOTAL} = (E_{Plant} + E_{Inv} + E_{Sed}) \cdot TUF \cdot R$
Arsenic	2.13	1.41	0.846	2.56

Ecological Hazard Quotients (EHQs)

COPC	TRV (mg/kg body weight/day)	TRV Reference	Total COPC Exposure	EHQ (Total COPC Expousre/TRV)
Arsenic	4.4	FCSAP, 2021; CEAEQ, 2012	2.56	**5.80E-01**

List of Acronyms

C_{Sed} - Concentration in sediment

C_P - Concentration in plants

C_{Inv} - Concentration in invertebrates

C_F - Concentration in fish

E_{Sed} - Exposure from sediment ingestion

E_{Plant} - Exposure from plant ingestion

E_{Inv} - Exposure from invertebrate ingestion

E_{Total} - Total exposure from all assessed pathways

TRV - Toxicological Reference Value

COPC - Contaminant of Potential Concern

EHQ - Ecological Hazard Quotient

BSAF - Biota-sediment accumulation factor

Northern River Otter - Invertivorous Mammal Food Chain Modelling

Whale Sanctuary ERA

Site Media Exposure Point Concentrations

COPC	COPC Concentrations: Sediment (Csed) (mg/kg dw) [1]	Marine Plants (Cp) (mg/kg ww) [2]		Marine Invertebrate (Cinv) (mg/kg ww) [3]	
Arsenic	318	Cp = 0.2*Csed	63.6	Max Concentration	4.66
Water Content of Food Items [4]		0.87		0.78	

Notes

1. UCLM 95 calculated from measured sediment concentration (Dillon, 2024)
2. Marine plant concentration calculated using site-specific BCAF. BCAF calculated from average ratio of sediment:root and sediment:leaf for eelgrass (n=6) on site.
3. Invertebrate concentration determined by calculating max concentration from sampled invertebrate data (rock crab, blue mussels and soft shell clam).
4. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	7.5	FCSAP, 2012b
Average Water Content in Food Items	%	78	Sample and Suter, 1994. Assuming a diet consisting only of marine invertebrates.
Food Ingestion Rate (IR_{Food})	kg/day ww	1	FCSAP, 2012b. Calculated from the published value of 0.03 kg dry food/kg body weight/day, adjusted for average water content.
Marine Plant Diet Proportion (P_{Plant})	unitless factor	0	FCSAP, 2012b
Marine Invertebrate Diet Proportion (P_{Inv})	unitless factor	1	Assumed given the lack of available fish tissue data. The River Otter for the WSP only ingests invertebrates in this model.
Marine Fish Diet Proportion (P_{Fish})	unitless factor	0	Assumed given the lack of available fish tissue data. The River Otter for the WSP only ingests invertebrates in this model.
Sediment Ingestion Rate (IR_{Sed})	kg/day dw	4.50E-03	FCSAP, 2012b. No sediment ingestion rate provided, a default value was used instead. 2% of dry food ingestion rate. Ingestion rate is 0.03 kg dry food/kg BW/day.
Foraging Range	ha	900	FCSAP, 2012b
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	40	Assumed
Residency Factor (R)	unitless factor	4.44E-01	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Marine Plant Ingestion	Marine Invertebrate Ingestion	Sediment Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_{Inv} \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Sed} = \frac{C_{Sed} \cdot IR_{Sed}}{BW}$	$E_{TOTAL} = (E_{Plant} + E_{Inv} + E_{Sed}) \cdot TUF \cdot R$
Arsenic	0	0.621	0.191	0.361

Ecological Hazard Quotients (EHQs)

COPC	TRV (mg/kg body weight/day)	TRV Reference	Total COPC Exposure	EHQ (Total COPC Expousre/TRV)
Arsenic	1.04	Dillon, 2013	0.361	**3.50E-01**

List of Acronyms

C_{Sed} - Concentration in sediment
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_F - Concentration in fish
E_{Sed} - Exposure from sediment ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
COPC - Contaminant of Potential Concern
EHQ - Ecological Hazard Quotient
BSAF - Biota-sediment accumulation factor

*All concentrations of sediment reported in mg/kg.

SEDIMENT

Highlighted samples are excluded from UCL calculations

	Area A - OFF SHORE								Area B - NEAR SHORE					Area C - ISLAND AND CENTRAL				
	SED-A-18-S1	SED-A-18-S2	SED-A-17-S1	SED-A-16-S1	SED-A-15-S1	SED-A-14-S1	SED-A-14-S2	SED-A-9-S1	SED-B-12-S1	FD3	SED-B-10-S1	SED-B-10-S1	SED-B-3-S1	SED-C-13-S1	SED-C-11-S1	FD5	SED-C-8-S1	SED-C-7-S1
	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED
	WQA294	WQA295	WQA296	WOO439	WQA297	WQA298	WQA299	WOO440	WOO441	WOO455	WOO442	XXC928	WOO443	WOO444	WQA300	WOO445	WOO446	WQA301
	7/24/2023	7/24/2023	7/24/2023	7/25/2023	7/24/2023	7/24/2023	7/24/2023	7/24/2023	7/25/2023		7/25/2023	12/14/2023	7/25/2023	7/24/2023	7/25/2023		7/24/2023	7/25/2023
Arsenic	6.8	8.1	22	11	13	15	9.9	4.2	14	14	630	49	120	9.2	26	9.6	4.8	5.8

	Area D - CHANNEL					Area E - WHARF					Area G - ADDITIONAL SAMPLES FOR DELINEATION						2020 Sampling
	SED-D-6-S1	SED-D-6-S2	SED-D-5-S1	SED-D-4-S1	SED-D-2-S1	SED-E-4-S1	SED-E-4-S2	SED-E-3-S1	SED-E-2-S1	SED-E-1-S1	SED-G-6-S1	SED-G-5-S1	SED-G-4-S1	SED-G-3-S1	SED-G-2-S1	SED-G-1-S1	Channel Sediment
	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED
	WQA302	WQA303	WQA304	WOO447	WQA305	WQA306	WQA307	WQA308	WQA309	WOO448	XXC927	XXC926	XXC925	XXC924	XXC923	XXC922	
	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/24/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	5-Oct-2020
Arsenic	11	12	130	840	24	20	5.9	4.3	15	61	7.6	70	35	1200	170	260	58

Arsenic
6.8
8.1
22
11
13
15
9.9
4.2
14
630
49
120
9.2
26
4.8
5.8
11
12
130
840
24
20
5.9
4.3
15
61
7.6
70
35
1200
170
260
58

General Statistics on Uncensored Full Data

Date/Time of Computation ProUCL 5.2 6/6/2024 10:11:00 AM
User Selected Options
From File WorkSheet.xls
Full Precision ON

From File: WorkSheet.xls

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness
Arsenic	33	0	4.2	1200	117.3515	27.57266	264.2958	46.007991	13.63973	3.167551

Percentiles for Uncensored Data Sets

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile
Arsenic	33	0	5.82	7.8	9.2	15	61	100	242	714

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options
Date/Time of Computation ProUCL 5.2 6/6/2024 10:11:22 AM
From File WorkSheet.xls
Full Precision ON
Confidence Coefficient 0.95

Arsenic

Raw Statistics

Number of Valid Observations	33
Number of Distinct Observations	31
Minimum	4.2
Maximum	1200
Mean of Raw Data	117.3515
Standard Deviation of Raw Data	264.2958
Khat	0.446426
Theta hat	262.8689
Kstar	0.426044
Theta star	275.4447
Mean of Log Transformed Data	3.316825
Standard Deviation of Log Transformed Data	1.557311

Normal GOF Test Results

Correlation Coefficient R	0.679171
Shapiro Wilk Test Statistic	0.481203
Shapiro Wilk Critical (0.0500000) Value	0.931
Approximate Shapiro Wilk P Value	5.48E-12
Lilliefors Test Statistic	0.358973
Lilliefors Critical (0.0500000) Value	0.1518

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.949653
A-D Test Statistic	3.048171
A-D Critical (0.0500000) Value	0.822894
K-S Test Statistic	0.246346
K-S Critical(0.0500000) Value	0.163104

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.952787
Shapiro Wilk Test Statistic	0.895843
Shapiro Wilk Critical (0.0500000) Value	0.931
Approximate Shapiro Wilk P Value	0.004084
Lilliefors Test Statistic	0.167221
Lilliefors Critical (0.0500000) Value	0.1518

Data not Lognormal at (0.0500000) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.0500000) Level of Significance

Arsenic

General Statistics

Total Number of Observations	33	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	4.2	Mean	117.3515
Maximum	1200	Median	15
SD	264.2958	Std. Error of Mean	46.00799
Coefficient of Variation	2.252172	Skewness	3.167551

Normal GOF Test

Shapiro Wilk Test Statistic	0.481203	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.906	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.358973	Lilliefors GOF Test
1% Lilliefors Critical Value	0.177	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	195.2839	95% Adjusted-CLT UCL (Chen-1995)	220.1349
		95% Modified-t UCL (Johnson-1978)	199.5121

Gamma GOF Test

A-D Test Statistic	3.048171	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.822894	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246346	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.163104	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.446426	k star (bias corrected MLE)	0.426044
Theta hat (MLE)	262.8689	Theta star (bias corrected MLE)	275.4447
nu hat (MLE)	29.46412	nu star (bias corrected)	28.11889
MLE Mean (bias corrected)	117.3515	MLE Sd (bias corrected)	179.7884
		Approximate Chi Square Value (0.05)	17.02062
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	16.5753

Assuming Gamma Distribution

95% Approximate Gamma UCL	193.8704	95% Adjusted Gamma UCL	199.079

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.895843	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.167221	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.1392	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.435085	Mean of logged Data	3.316825
Maximum of Logged Data	7.090077	SD of logged Data	1.557311

Assuming Lognormal Distribution

95% H-UCL	222.8923	90% Chebyshev (MVUE) UCL	176.2505
95% Chebyshev (MVUE) UCL	217.0979	97.5% Chebyshev (MVUE) UCL	273.7924
99% Chebyshev (MVUE) UCL	385.1578		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	193.0279	95% BCA Bootstrap UCL	221.0242	
95% Standard Bootstrap UCL	192.6487	95% Bootstrap-t UCL	284.7461	
95% Hall's Bootstrap UCL	218.8597	95% Percentile Bootstrap UCL	196.8273	
90% Chebyshev(Mean, Sd) UCL	255.3755	95% Chebyshev(Mean, Sd) UCL	317.8957	Selected as the highest of non-parametric UCLM5 values.
97.5% Chebyshev(Mean, Sd) UCL	404.6713	99% Chebyshev(Mean, Sd) UCL	575.1252	

Suggested UCL to Use

95% Student's-t UCL	195.2839	Rejected as data is not normally distributed

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury Tissue Residue Guideline (TRG) Calculations

Parameters for Mallard Duck

Parameter	Value	Units	Note
TDI_{Avian}	31	ug/kg BW	Value from CCME for TDI for avian receptors for MeHg
BW	1.2	kg	FCSAP, 2012b
IR_{Food}	0.06	kg dw/day	FCSAP, 2012b
W%	82.95	%	Sample and Suter, 1994
IR_{Food}	0.351906	kg ww/day	Adjusted for water content =IR_{Food}/(W%/100)
RC	105.71	ug ww/kg	See equation below.

$$RC = \frac{TDI_{Avian} * BW}{IR_{Food}}$$

Acronyms

TDI_{Avian}	Tolerable Daily Intake (for birds)
BW	Body Weight
IR_{Food}	Ingestion Rate (of food)
W%	Percentage water content of food
RC	Reference Concentration

Appendix H

PEL-Q and Mean PEL-Q Calculations for Site *Sediment Samples*

$$PEL-Q = \sum_{i}^{n} \frac{\left(\frac{C_i}{PEL_i}\right)}{n}$$

		Area A - OFF SHORE								Area B - NEAR SHORE					Area C - ISLAND AND CENTRAL				
Sample ID		SED-A-18-S1	SED-A-18-S2	SED-A-17-S1	SED-A-16-S1	SED-A-15-S1	SED-A-14-S1	SED-A-14-S2	SED-A-9-S1	SED-B-12-S1	FD3	SED-B-10-S1	SED-B-10-S1	SED-B-3-S1	SED-C-13-S1	SED-C-11-S1	FD5	SED-C-8-S1	SED-C-7-S1
Media		SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED
Lab ID		WQA294	WQA295	WQA296	WOO439	WQA297	WQA298	WQA299	WOO440	WOO441	WOO455	WOO442	XXC928	WOO443	WOO444	WQA300	WOO445	WOO446	WQA301
Date		7/24/2023	7/24/2023	7/24/2023	7/25/2023	7/24/2023	7/24/2023	7/24/2023	7/24/2023	7/25/2023		7/25/2023	12/14/2023	7/25/2023	7/24/2023	7/25/2023		7/24/2023	7/25/2023
	SedQB																		
Reported Values																			
Antimony	25	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2	<2	<2	<2
Arsenic	41.6	6.8	8.1	22	11	13	15	9.9	4.2	14	14	630	49	120	9.2	26	9.6	4.8	5.8
Barium	130	21	20	17	6.7	19	10	8.3	7	13	14	7.6	-	9	6.2	5.3	5.8	6	5.6
Cadmium	4.2	<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	<0.3	<0.3	<0.3
Chromium (total)	160	12	11	12	11	12	9.9	8.8	9.4	13	13	11	-	11	8.9	7.4	7.4	8.6	8.1
Copper	108	6.5	6.5	7.5	4.6	7.8	5.3	4.8	3.4	8	8.6	5.4	-	5.7	3.4	2.4	2.5	3.4	3.1
Lead	112	5.6	5.2	6.9	3.1	6.6	4.9	3.5	3.1	5.4	7	5	-	6	2.9	2.4	2.3	2.8	2.5
Mercury (total)	0.7	<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
Nickel	50	14	12	15	19	13	12	10	12	15	15	13	-	14	11	8.9	8.7	11	11
Selenium	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1
Silver	2.2	<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
Zinc	271	190	210	32	83	130	100	83	25	32	33	30	-	29	25	290	20	23	150
PEL-Qs																			
Antimony		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080		0.080	0.080	0.080	0.080	0.080	0.080
Arsenic		0.163	0.195	0.529	0.264	0.313	0.361	0.238	0.101	0.337	0.337	15.144	1.178	2.885	0.221	0.625	0.231	0.115	0.139
Barium		0.162	0.154	0.131	0.052	0.146	0.077	0.064	0.054	0.100	0.108	0.058		0.069	0.048	0.041	0.045	0.046	0.043
Cadmium		0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071		0.071	0.071	0.071	0.071	0.071	0.071
Chromium (total)		0.075	0.069	0.075	0.069	0.075	0.062	0.055	0.059	0.081	0.081	0.069		0.069	0.056	0.046	0.046	0.054	0.051
Copper		0.060	0.060	0.069	0.043	0.072	0.049	0.044	0.031	0.074	0.080	0.050		0.053	0.031	0.022	0.023	0.031	0.029
Lead		0.050	0.046	0.062	0.028	0.059	0.044	0.031	0.028	0.048	0.063	0.045		0.054	0.026	0.021	0.021	0.025	0.022
Mercury (total)		0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143		0.143	0.143	0.143	0.143	0.143	0.143
Nickel		0.280	0.240	0.300	0.380	0.260	0.240	0.200	0.240	0.300	0.300	0.260		0.280	0.220	0.178	0.174	0.220	0.220
Selenium		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
Silver		0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227		0.227	0.227	0.227	0.227	0.227	0.227
Zinc		0.701	0.775	0.118	0.306	0.480	0.369	0.306	0.092	0.118	0.122	0.111		0.107	0.092	1.070	0.074	0.085	0.554
Mean PEL-Q		0.21	0.21	0.19	0.18	0.2	0.19	0.16	0.14	0.17	0.18	1.4	1.2	0.38	0.14	0.25	0.14	0.13	0.17
Average Site-wide Mean PEL-Q (all samples)		1.5																	

$$PEL-Q = \sum_{i}^{n} \frac{\left(\frac{C_i}{PEL_i}\right)}{n}$$

Area		Area D - CHANNEL					Area E - WHARF					Area G - ADDITIONAL SAMPLES FOR DELINEATION						2020 Sampling
Sample ID		SED-D-6-S1	SED-D-6-S2	SED-D-5-S1	SED-D-4-S1	SED-D-2-S1	SED-E-4-S1	SED-E-4-S2	SED-E-3-S1	SED-E-2-S1	SED-E-1-S1	SED-G-6-S1	SED-G-5-S1	SED-G-4-S1	SED-G-3-S1	SED-G-2-S1	SED-G-1-S1	Channel Sediment
Media		SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED	SED
Lab ID		WQA302	WQA303	WQA304	WOO447	WQA305	WQA306	WQA307	WQA308	WQA309	WOO448	XXC927	XXC926	XXC925	XXC924	XXC923	XXC922	
Date		7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/25/2023	7/24/2023	7/24/2023	7/25/2023	7/25/2023	7/25/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	12/14/2023	5-Oct-2020
	SedQB																	
Reported Values																		
Antimony	25	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-	-	-	-	-	<2
Arsenic	41.6	11	12	130	840	24	20	5.9	4.3	15	61	7.6	70	35	1200	170	260	58
Barium	130	5.9	5.4	6.7	7	8.1	14	8.8	5.6	8.8	17	-	-	-	-	-	-	15
Cadmium	4.2	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	-	-	-	-	-	<0.3
Chromium (total)	160	7.8	7.6	8.8	10	9.8	13	9.7	8.6	9.2	13	-	-	-	-	-	-	11
Copper	108	3.3	3	3.7	3.9	5.3	9	4.5	3.1	4.5	9.3	-	-	-	-	-	-	7.2
Lead	112	2.7	2.4	3.2	3.5	4.4	5.8	2.9	3.2	4.7	8.8	-	-	-	-	-	-	5.7
Mercury (total)	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.13	-	-	-	-	-	-	<0.1
Nickel	50	9.7	9.2	11	12	12	15	13	11	12	15	-	-	-	-	-	-	12
Selenium	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	-	-	-	<1
Silver	2.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	<0.5
Zinc	271	410	230	130	25	78	210	110	140	74	38	-	-	-	-	-	-	30
PEL-Qs																		
Antimony		0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080							0.080
Arsenic		0.264	0.288	3.125	20.192	0.577	0.481	0.142	0.103	0.361	1.466	0.183	1.683	0.841	28.846	4.087	6.250	1.394
Barium		0.045	0.042	0.052	0.054	0.062	0.108	0.068	0.043	0.068	0.131							0.115
Cadmium		0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071							0.071
Chromium (total)		0.049	0.048	0.055	0.063	0.061	0.081	0.061	0.054	0.058	0.081							0.069
Copper		0.031	0.028	0.034	0.036	0.049	0.083	0.042	0.029	0.042	0.086							0.067
Lead		0.024	0.021	0.029	0.031	0.039	0.052	0.026	0.029	0.042	0.079							0.051
Mercury (total)		0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.186							0.143
Nickel		0.194	0.184	0.220	0.240	0.240	0.300	0.260	0.220	0.240	0.300							0.240
Selenium		0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500							0.500
Silver		0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227							0.227
Zinc		1.513	0.849	0.480	0.092	0.288	0.775	0.406	0.517	0.273	0.140							0.111
Mean PEL-Q		0.26	0.21	0.42	1.8	0.19	0.24	0.17	0.17	0.18	0.28	0.18	1.7	0.84	29	4.1	6.3	0.26
Average Site-wide Mean PEL-Q (all samples)																		

Appendix I

Summary of Arsenic Speciation in Marine *Ecosystems*

Appendix I: Overview of Arsenic Speciation in Marine Ecosystems

This appendix provides an overview of the state of scientific knowledge regarding the speciation of arsenic in marine ecosystems. As the speciation of arsenic in site marine media and biota is important towards understanding potential exposures and risks to marine ecological receptors, including future sanctuary cetacean residents, literature searches that were focused on arsenic speciation in marine media and biota were conducted. The searches primarily utilized the following scientific literature databases: Google Scholar, Pubmed (which includes Toxline and Medline), and Dalhousie University Novanet (which accesses numerous academic literature databases under a single search platform).

In sea water, the forms or species of arsenic that predominate are inorganic arsenic species. Most arsenic in sea water occurs as arsenate (As V). Arsenite (As III), which is well known to be the most toxic arsenic species (ASTDR, 2007), rarely occurs in seawater unless very low oxygen (reducing) conditions are present (Francesconi and Edmonds, 1997; Francesconi and Kuehnelt, 2002).

In marine sediments, arsenate is also the predominant arsenic species, but minor or trace amounts of other arsenic species, such as arsenite, dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA) can also occur (Francesconi and Kuehnelt, 2002). Sediment arsenic speciation conducted at the sanctuary site indicates that arsenate is the primary form of arsenic present, but trace amounts of arsenite, DMA and MMA were also detected in some site sediment samples (See Section 2.1.7 of main report).

Marine organisms at the base of the marine food web, such as phytoplankton, bacteria, algae and microalgae, accumulate inorganic arsenic from sea water and sediments, whereupon it is rapidly reduced to arsenite, which then quickly undergoes methylation reactions, which then lead to the synthesis of various organoarsenicals (Francesconi and Kuehlert, 2002). The organoarsenicals formed at the base of the marine food web are taken up by higher trophic levels, and converted/metabolized to more complex organoarsenicals. As marine organisms die and decay and excrete wastes, organoarsenicals are released to the surrounding sea water and/or sediments. However, it appears they are rapidly degraded in sea water and sediments as measurable concentrations of organoarsenicals are rarely detected in sea water or sediments, though some organoarsenicals released to water or sediments may be expected to be taken up by biota. This may explain why some of the more complex or more metabolized organoarsenicals can be occasionally detected in lower trophic level marine biota. It is generally believed that the more complex organoarsenicals are only formed in higher trophic level organisms, such as mollusks, crustaceans, fish, birds and mammals, rather than in primary producers; however, primary producer organisms may be able to absorb the more complex organoarsenicals directly from sea water or sediments (Francesconi and Kuehnelt, 2002). Duncan et al., (2015) suggest that because arsenobetaine (AB) – a common complex organoarsenical in marine biota, is not found to occur in unicellular algae, this observation supports the hypothesis that AB is formed in higher tropic level marine biota, including consumers of algae, via the ingestion and further metabolism of arsenosugars.

Biotransformation of inorganic arsenic to organoarsenicals, and biotransformation of organoarsenicals to other organoarsenicals, appears to occur in virtually all marine biota, and at all trophic levels (from primary producers to apex predator marine fish, birds and mammals).

There is general consensus in the scientific literature that the lower marine trophic levels (such as algae, microalgae, phytoplankton, filter feeding bivalves) likely accumulate arsenic mainly as arsenate (As V) – though also as As (III), DMA and MMA, and possibly as more complex organoarsenicals too, but then rapidly transform/metabolize these compounds to various arsenosugars, DMA, and MMA (Francesoni and Kuehlert, 2002; Morita and Edmonds, 1992; Velez and Montoro, 1998; Luvonga et al., 2020; Tibon et al., 2023). The most common arsenosugars appear to be 5-dimethylarsinoyl derivatives of 5-deoxyribosides (Morita and Edmonds, 1992; Velez and Montoro, 1998). A wide variety of arsenosugars have been identified, and many more are believed likely to be formed in marine primary producers. Arsenosugars have been found to include numerous phosphate, hydroxide, thio, sulfite and sulfate complexes (Luvonga et al., 2020). Arsenosugars are the major organoarsenical compounds in marine algae and other marine primary producers, and can also occur at relatively high levels in organisms that predate mainly upon marine primary producers (e.g., many filter-feeding bivalves that consume algae and phytoplankton)(Francesconi and Kuehnelt, 2002). These types of organisms tend to have no or low amounts of the more complex organoarsenicals such as arsenobetaine (AB), and arsenocholine (AC) (Francesoni and Kuehnelt, 2002).

The arsenosugars formed in primary producers are believed to be precursors to the most common and predominant organoarsenicals - arsenobetaine (AB) and arsenocholine (AC) (Francesconi and Edmonds, 1997; Francesoni and Kuehnelt, 2002; Ritchie et al., 2004). Thus, when primary producer organisms are ingested by higher trophic level organisms, the arsenosugars are transformed/metabolized to AC, AB, and other organoarsenical compounds (likely as intermediates in AB formation, or as products of AB and other organoarsenical metabolism).

By far, the most frequently reported organoarsenical in marine biota is AB. In virtually all marine organisms, with the exception of primary producers, AB is nearly always the dominant organoarsenical and frequently accounts for all or almost all of the total arsenic burden present in marine organisms (Morita and Edmonds, 1992; Francesconi and Kuehnelt, 2002). However, many other organoarsenicals are also commonly detected at variable concentrations in a wide variety of marine organisms (e.g., arsenocholine (AC), tetramethylarsonium ion (TMA), dimethylarsinic acid (DMA), monomethylarsonic acid (MMA), and trimethylarsine oxide (TMAO) – which is believed to be a metabolite of AB, DMA, and MMA). These particular arsenic species are all water-soluble compounds. There are also a large and growing number of lipid-soluble organoarsenicals (arsenolipids) that have been identified in marine organisms, most commonly in fatty fish, oysters and in some seaweeds/kelps) (Morita and Edmonds, 1992; Velez and Montoro, 1998; EFSA, 2021; Francesconi and Kuehlert, 2002). To date, over 200 arsenolipids have been identified from various marine organisms, and the number of identified compounds increases with the improvement of analytical methods (Siregar, 2022; Liu et al., 2022). In addition to arsenolipids and the major water soluble organoarsenicals, various other arsenic-containing organic compounds have also been identified in recent years, including arseno- alcohols, hydrocarbons, and fatty acids (Siregar, 2022). It is likely that there are hundreds if not thousands of organoarsenicals that may occur in marine organisms and marine ecosystems.

Given the ubiquitous nature of AB in marine organisms from various trophic levels, many researchers and regulatory agencies consider that AB may on average represent 80% to 100% of the total arsenic present in marine biota (e.g., Hanoaka et al., 1999). However, many studies have shown that AB and other organoarsenical content can vary widely across marine taxa and is clearly influenced by the physiology and biochemistry of certain taxa, their diets, the arsenic species they were directly exposed to, the time since exposure occurred (arsenic metabolism is rapid but does not occur instantly), and numerous other environmental and biological factors. AC is the second most commonly reported organoarsenical detected in marine organisms, which may reflect the fact that AC is suspected to be a precursor of AB in most marine taxa (i.e., AC is metabolized to AB) (Hanoaka et al., 1999).

Generally, very little of the total arsenic content of marine organisms is comprised of inorganic arsenic species. While lower trophic level marine organisms, such as algae, phytoplankton, and consumers of algae/phytoplankton (such as some bivalve species) will tend to have higher proportions of inorganic arsenic than higher trophic levels do, a substantial amount of the total arsenic burden in these organisms will have been biotransformed from inorganic arsenic species to arsenosugars, DMA and MMA (Francesconi and Kuehnelt, 2002). Brown algae appears to be an exception though in that inorganic arsenic (mostly arsenate) tends to be a dominant arsenic species in this type of algae, relative to other algal species where only small amounts of arsenate are typically detected (Francesconi and Kuehnelt, 2002).

While marine algae are fairly well studied in terms of arsenic speciation, less appears to be known about arsenic speciation in marine vascular plants. However, limited information suggests that the main forms of arsenic in marine vascular plants are arsenosugars (Francesconi and Kuehnelt, 2002).

It has been well established for decades that arsenic (total arsenic) is known to bioaccumulate (though it does not biomagnify) in marine food webs. However, the substantial literature on arsenic speciation in marine ecosystems suggests that much of the accumulated arsenic is not the more toxic and bioavailable inorganic arsenic species (with the possible exception of primary producers), but rather, consists of a variety of organoarsenicals. For many marine organisms at higher trophic levels, organoarsenicals are both bioaccumulated (from food/prey ingestion and other marine exposure pathways such as respiration, water and sediment contact) and formed in the organisms via the biotransformation (metabolism) of absorbed organoarsenicals or inorganic arsenic (Francesconi and

Kuehnelt, 2002; Molin et al., 2007; 2012). For example, many marine fish species have been shown to accumulate AB from food and also form it within their bodies (Zhang et al., 2016). Once accumulated, organoarsenical compounds appear to be preferentially retained in marine organisms' bodies relative to inorganic arsenic (Francesoni and Kuehlert, 2002). This suggests that arsenic, in the form of organoarsenicals, may have some essential physiological and biochemical roles within marine organisms.

The most likely arsenic species that predatory marine birds and mammals would be exposed to is AB. However, they may also form AB in their own tissues and organs. There is some evidence from human studies that suggest higher trophic level mammals, and potentially birds as well, can transform inorganic arsenic and various organoarsenicals into AB *in vivo.* This is based on observations that human subjects fed blue mussels or cod excreted far more AB than they had ingested, and overall AB excretion was higher than would be expected from the estimated absorption of AB (Molin et al., 2007; 2012).

Arsenic speciation in marine ecosystems has important implications for any marine ERA. All organoarsenicals, from the simplest methylated species (such as DMA or MMA) to the more complex organoarsenicals (such as AB and AC) are known or believed to be of much lower bioavailability and toxicity than inorganic arsenite (As III) or arsenate (As V), and are also known to be efficiently metabolized and eliminated in marine organisms (and virtually all other known organisms) (ATSDR, 2007; Luvonga et al., 2020, Rainbow and Luoma, 2011). In ERAs however, there are presently no regulatory toxicity reference values (TRVs) available for organoarsenicals. Rather, ecological TRVs only exist for inorganic arsenic at this time. Furthermore, all current marine environmental quality guidelines for water and sediment are also based entirely on inorganic arsenic and do not reflect arsenic speciation within marine organisms. As such, any marine ERA of arsenic is likely to considerably overestimate the potential for risk if there is not some attempt to qualitatively account for or at least consider the wealth of evidence which indicates that most arsenic present in marine biota is comprised of organoarsenicals rather than inorganic arsenic.

Table I-1 provides a summary of selected literature that was identified on arsenic speciation in marine ecosystems. The information compiled in Table I-1 is only for biological species other than cetaceans as arsenic speciation in cetaceans is summarized in Section 7.3.4 of the main ERA report. The compiled data in Table I-1 does not represent an exhaustive review of the literature, but rather, seeks to provide some context on the species of arsenic that resident marine biota at the site are most likely to be exposed to. Many more studies than those addressed in Table I-1 have been reported in the scientific literature. For some of the studies summarized in Table I-1, proportions of arsenic species are provided, but such information is not always reported consistently, and some of the studies noted in this table may lack specific arsenic species proportion information, as a result. It is noted however, that specific proportions reported in a given study are less relevant than information which shows specific organoarsenicals being consistently dominant in various marine organisms. The arsenic species proportions will change constantly depending on exposure and diet conditions, life history stages of the organisms, and numerous environmental factors.

Table I- 1: Summary of Arsenic Speciation in Marine Biota

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Loggerhead turtle; black-footed albatross; black-tailed gull	Liver	AB	-mean % AB of total As as high as 97.1% and 87.5% in albatross and gull, respectively	Kubota et al., 2009
Harp and ringed seals; dugong; green and loggerhead sea turtles	Liver	AB	-AB was major As species in all types of organisms except dugong -DMA, MMA, AC, TMA, arsenite, and unidentified As compounds were also detected in all organisms as minor As species at widely varying relative proportions	Kubota et al., 2002
Various seabirds, marine mammals, and marine reptiles including: northern fur seal, ringed seal, black-footed albatross, black-tailed gull, hawksbill turtle, and green turtle	Liver	AB	-proportions of AB from 68 to 90% in seal liver -DMA, AC, TMA, MMA also detected in seal liver -in seabirds, mean proportion of AB >90% of total As (%AB in liver of black— footed albatross and black—tailed gull were 98% and 88%, respectively) -DMA, AC, TMA also detected as minor species -As speciation varied considerably across organisms likely due to differences in metabolism and/or different types of As compounds in their prey	Kubota et al., 2001;2003

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
			-turtles contained AB as main As species; AC, DMA, TMA and trace inorganic As also detected in turtles -%AB of total As in turtle livers ranged from 37% (in leatherback turtle) to 74% (in green turtle)	
Ringed seal; bearded seal	Liver	AB	-AB was dominant form -seal livers also had minor concentrations of AC, TMA, DMA, MMA though most MMA was <RDLs -inorganic As <RDLs in all samples -an unidentified As compound was present at low concentrations in all liver samples	Goessler et al., 1998
Harbour seals	Urine, plasma, and gastric juice	AB	-AB was dominant species in all tested fluids -plasma also contained minor amounts of DMA; gastric juice contained minor amounts of AC and TMA; several arsenic compounds identified in urine - dominant As species were DMA and thioDMA -high variability across samples in relative proportions of As species	Kuenstl et al., 2009
Cephalopods (Octopus)	Arms (muscle/meat)	AB	-nearly all As present as AB	Seixas et al., 2005

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Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Oysters	Whole body	AB	-AB comprised >90% of total As -trace amounts of MMA and As (V) also detected as were some unidentifiable organoarsenicals; As(III) was not detected	Nam et al., 2015
Oysters	Whole body	AB	-AB comprised 87% of total As -also detected a probable arsenosugar (4.9% of total As), and DMA (4.7% of total As)	Vilano and Rubio, 2001
Yellowfin tuna; marlin	Muscle (meat)	AB	-total As was 95% AB	Koesmawati and Arifin, 2015
Spirulina (algal-based powder for human nutritional supplement); geoduck clams; wild and aquaculture shrimp; aquacultured salmon	Whole organism (powdered); whole clams	AB and arsenosugars	-in spirulina, arsenosugars were main organoarsenical but 56% inorganic As content in spirulina -AB accounted for 13 % of total As in geoduck clam, 92 % in wild-caught shrimp, 79% in aquacultured salmon -arsensosugars were main As species in geoduck clams -DMA and unidentified organoarsenicals also detected in all organisms -As (V) was <RDLs in fish and shrimp but present in small amounts in geoduck clams	Luvonga et al., 2020
Various kelp species	Leafy parts	Arsenosugars	-99% of total As present as arsenosugars; <1% inorganic As	Ronan et al., 2017

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Blue crab	Shell, meat, hepatopancreas	DMA	-As species proportions of total As were: 88.3% DMA, 6.7% As (V), 4.7% As (III), and 0.2% MMA	Webb, 2015
Butter clam, Horse clam, Soft-shelled clam, Native littleneck clam and Manila clam	Whole organism	AB	-in all species, AB and TMA dominated in varying proportions -minor amounts of TMAO in butter clams and some unidentified organoarsenicals in most species	Cullen and Dodd, 1989
Macroalgae	Whole specimen or leafy parts	Arsenosugars	-arsenosugars dominated; mainly ribofuranosides -red and green algae contain mainly glycerophospho derivative while brown algae contain sulfate or sulfonate derivatives together with a glycerophospho derivative -brown algae may contain significant amounts of inorganic As (as arsenate)	Morita and Shibata, 1990

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Phytoplankton and zooplankton	Multiple organisms sampled and analyzed together	AB and arsenosugars	-in predatory zooplankton, AB was the dominant arsenic species -in herbivorous zooplankton, AB also present but arsenosugars were dominant As species -phytoplankton contained mostly arsenosugars	Shibata et al., 1996
Oysters	Whole organism	AB	-AB was dominant As species -arsenite, arsenate, DMA, MMA also detected in trace amounts; 1.3% of total As was present as inorganic arsenite and arsenate	Liu et al., 2008
Red algae	Extracts of cultures	Arsenosugars	-two arseno ribofuranosides accounted for almost all of total As -inorganic arsenic and DMA were also detected at trace levels; MMA not detected	Shibata et al., 1990
Jellyfish	Body tissue samples	AB	-almost all As present as AB regardless of feeding guild (planktivorous, omnivorous, piscivorous) -TMA and AC also detected at low concentrations	Hanoaka et al., 1999

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Algae, bivalves and crustaceans	Mostly whole organism or extracts from homogenized whole organisms	AB and arsenosugars	-in algae, arsenosugars were dominant As species -in crabs and shrimp, AB was dominant species -in bivalves, As speciation dominated by both AB and arsenosugars	Le et al., 1994
Mitten crabs	Meat (muscle)	AB	-<5% of total As present as inorganic As -detected organoarsenicals were: AC, AB, MMA, DMA, as well as unidentified organoarsenicals; AB was most dominant As species	Zihao et al., 2022
Red crab	Meat (muscle)	AB	-total As was >90% AB	Matsuto et al., 1986
Dungeness crab	Haemolymph	AB	-total As dominated by AB -two arsenosugars, DMA, and several unidentified arsenic species were also detected	Norum et al., 2005
Brown algae, red algae, fish, crab, shrimp, mussels, oysters, and clams	Analyzed edible portions (for human consumption)	Arsenosugars in algae and AB in other organisms	-arsenosugars were dominant As species in all algal samples; no inorganic As detected in algae -AB was dominant arsenic species in all fish and shellfish samples; inorganic As in fish and shellfish samples was <2% of total As	Li et al. 2003

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
19 marine species including: crabs, shrimps, benthic fish and pelagic fish	Edible portions consumed by humans	AB	-AB was 87 to 99.8% of total As in all tested organisms	Zhang et al., 2018
Various mollusks and crustaceans	Mostly soft tissues – edible portions – whole organisms in many cases	AB	-AB comprised 81 to 99% of total As -DMA comprised 0.47-3.4% of total As; MMA and As(V) were only detected in whelk and one crab species at trace amounts; As(III) was not detected in any sampled specimens; unidentified As species also detected	Zhang et al., 2013
Mussels	Digestive gland (hepatopancreas) and remaining soft tissues	AB and arsenosugars	-AB comprised majority of total As -arsenosugars also present at lower concentrations than AB; trace amounts of inorganic As were detected	Argese et al., 2005
Rays	Liver, muscle	AB	-most As was present as AB (especially in muscle); DMA and arsenolipids also detected	Slejkovek et al., 2014
Mussels	Digestive gland and soft tissues	AB	-AB was dominant As species in both tissue types	Whaley-Martin et al., 2012
Mussels	Whole organism composites	AB	-AB proportion of total As ranged from 17 to 82%; DMA, MMA and arsenosugars were also detected in varying amounts	Gomez-Delgado et al., 2023
Mussels	Whole organism composites	AB	-AB was the main As species; other organoarsenical compounds, including arsenosugars, DMA, MMA, and AC also detected at low concentrations; As(V) detected in trace amounts	Dagnac et al., 1999

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Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Clams, pearl oyster, cuttlefish, shrimp, and several finfish species	Edible (for humans) portions	AB	-in bivalves, AB was 58% of total As; inorganic As comprised <0.8% of total As -in the other species, AB comprised 81% of total As, and inorganic As comprised 0.03% of total As -in all organisms tested, other organoarsenicals comprised remainder of total As in varying proportions	Krishnakumar et al., 2016
Shrimp, crab, fish, fish liver, shellfish and lobster digestive gland (hepatopancreas)	Tissue extracts	AB, DMA	-AB comprised 19 to 98% of total As across tested organisms -low amounts of AC, TMAO detected (up to 0.6% of total As); low amounts of TMA detected (up to 2.2%) -unidentified As species were also detected and accounted for 0.2 to 18% of total As in shellfish and lobster digestive gland -inorganic As comprised trace amount of total As (up to 1.4%) -DMA proportion of total As ranged from 8.2 to 29% across organisms -MMA only detected in oyster at 0.3% of total As	Larsen et al., 1993

Marine Organism/Species	Tissue / Organ / Biological Fluid Type	Primary Arsenic Species Detected	Comment	Reference
Various fish and shellfish from Samoa	Edible portions	AB	-main detected As species was AB; smaller amounts of DMA, MMA, AC, TMA, TMAO, arsenosugars and unidentified As species were also detected -inorganic As proportion of total As ranged from 0.5% to 5%, with higher values detected in molluscs only	Peshut et al., 2008

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Appendix J

WSP Evaluation of Sanctuary Resident Potential for Exposure to Arsenic and Assessment of Potential Site Rock Crab Consumption by Sanctuary Residents

Sanctuary residents will be provided a satiating and nutritionally supportive well-rounded diet, a diet which will be similar to the diet which they have been accustomed to eating at land based captive facilities. Any consumption of live marine creatures within the sanctuary will most likely be limited to novel experimentation (as captive whales have no experience with live crustaceans or other live potential prey), making chronic long-term exposure unlikely. However individual behavior of animals can vary greatly and given the potential for unknowns, we want to assess risk of long-term exposure to elevated inorganic arsenic levels in food.

We have consulted with nine experts in the veterinary and toxicology fields. None of them have expressed significant concerns about the findings. Chris Harvey Clarke, DVM, at Dalhousie University called our attention to a study in which it was found that 90% of the arsenic in rock crabs is arsenobetaine, a much less toxic organic form found ubiquitously. He also noted that satiated whales are not likely to ingest crabs on a regular basis if at all.

The other experts are:

Dr. Tanya Brown, marine ecotoxicologist, Simon Fraser University

Dr. Peter Ross, Senior Scientist and Healthy Waters Program Director, Raincoast Conservation Foundation

Dr. Frances Gulland, veterinarian, Chair of Marine Mammal Commission

Dr. Melissa McKinney, natural resources scientist, McGill University

Dr. Juan Jose Alava, ocean pollution research unit, The University of British Columbia

Dr. Stephen Raverty, veterinary pathologist, marine mammal research unit, The University of British Columbia

Dr. Todd O'Hara, veterinary toxicology, Texas A&M University

Dr. John Harley, ecotoxicology, University of Alaska

Description of Marine Invertebrate Tissue Sampling

Marine invertebrate tissue samples were collected on July 24 and 25, 2023, from the marine area adjacent to the site (i.e., Indian Harbour).

A total of 59 invertebrate specimens, which included Atlantic rock crab (*Cancer irroratus*) (n = 15), blue mussel (*Mytilus edulis*), and Atlantic soft-shell clam (*Mya arenaria*), were collected from the marine area. Upon collection, specimens were brought to shore where a Strum field technician and WSP staff dissected and logged the invertebrate specimens and collected tissue samples.

Samples were kept in cool storage and transported back to the Strum office in Halifax, NS, for further processing. Tissue samples were then combined into composite samples based on sampling location IDs (i.e., sampling locations A, B, C, D, and E) and by species type [rock crab (RC), mussel (M), clam (C)] to get six total composite invertebrate tissue samples.

Of the marine invertebrate tissue samples that were collected, all four rock crab tissue samples reported elevated metals (arsenic) concentrations exceeding applicable Health Canada food safety guidelines, and two of the rock crab tissue samples reported elevated methylmercury concentrations exceeding applicable CCME tissue residue guidelines.

Please drag to enlarge the tables below.

Arsenic, selenium and total mercury:

				Sample ID						
				Area A	Area B	Area C	Area D	Area E		
Parameter	Units	RDL	Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)	INV-A-RC-0000101	INV-B-RC-0000102	INV-C-RC-0000103	INV-D-RC-0000104	INV-E-M-0000105	INV-E-M-0000105 Lab-Dup	INV-E-C-0000105
Arsenic	mg/kg	0.5	3.5	6.8	5.1	4.9	3.6	2.9	2.9	-
Selenium	mg/kg	0.5	-	1.4	0.66	0.63	0.7	0.65	0.65	-
Mercury (total)	mg/kg	0.01	0.05	0.048	0.043	0.019	0.05	0.036	0.05	nd

Methylmercury:

					Sample ID						
					Area A	Area B	Area C	Area D		Area E	
Parameter	Units	RDL	CCME Tissue Residue Quality Guidelines for the Protection of Wildlife Consumer of Aquatic Biota	Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)	INV-A-RC-0000101	INV-B-RC-0000102	INV-C-RC-0000103	INV-D-RC-0000104	INV-E-RC-0000104 (Lab-Dup)	INV-E-M-0000105	INV-E-M-0000105 (Lab-Dup)
Methylmercury (organic)	mg/kg	0.4	0.033 (mg/kg)	0.5 (mg/kg)	0.0243	0.0381	0.0095	0.0334	0.035	0.0158	0.016

Notes: Shading/bold indicates exceedance of: Health Canada Maximum Levels for Chemical Contaminants in Food (July 2020)

m = metres below bottom of water body
nd = non-detect
nd( ) = non-detect at elevated detection limit
\- = no established value or not analyzed
RDL = Reportable Detection Limit
mg/kg = milligrams per kilogram
RBCA = Risk Based Corrective Action
EQS = Environmental Quality Standards
PSS = Pathway Specific Standards
Lab analysis by Bureau Veritas, Bedford, NS
Samples collected on the dates indicated (yy/mm/dd)
RC = rock crab tissue sample
M = mussel tissue sample
C = clam tissue sample

Utilizing the EPA NOAEL (no observed adverse effect level) for chronic exposure of inorganic arsenic, 0.0008 mg/kg/day, we analyzed how many rock crabs could be eaten every day (perpetually for the life of the animal). This analysis is based on the assumption that metabolic pathways and excretion rates, as well as clinical implications of tissue concentration are similar in cetaceans and humans and toxicity can be extrapolated based on weight. There is no direct data available on inorganic As tissue toxicity in cetaceans.

This analysis was conducted for average adult male and female belugas, and average adult male and female orcas. The average size of these captive animals was taken from SeaWorld's reporting.

			Female Beluga Weight (kg)	Male Beluga Weight (kg)	Female Orca Weight (kg)	Male Orca Weight (kg) (average of 2 largest)
	Arsenic Threshold	Units	*1360*	*1500*	*2442*	*4860*
EPA (NOAEL)	0.0008	mg/kg of body weight/day	1.088	1.2	1.9536	3.888

Figure 1. Kg for average sized male and female captive beluga and orca according to SeaWorld, and their associated daily mg of As intake allowed at the EPA NOAEL level.

Estimates of the potential arsenic level for a single rock crab, was based on an estimate of average adult Atlantic rock crab sized (6oz or 0.17kg) and the percentage of body weight distributed as shell according to DFO. The total arsenic value of 6.8 ppm was the highest detected in the invertebrate sampling and analysis conducted at the sanctuary site, therefore that was the value selected for calculating the total arsenic estimation for an adult Atlantic rock crab. It should be noted that the WSP sampling assessed total arsenic in viscera of rock crabs and shell material was not analyzed, so the total As value for the rock crab with shell is an extrapolation based on weight.

	Rock Crab with Shell (kg)	Rock Crab without Shell (kg)	Highest Arsenic Measured (ppm or mg/kg of crab weight)
	0.17	0.0357	6.8
Total Arsenic consumed in 1 WSP Rock Crab (mg)	1.156	0.24276	

Figure 2. Atlantic rock crab average adult weight with and without shell included according to DFO, and how many mg of As would be present in that sized crab according to the highest total As levels detected in the invertebrate testing conducted by WSP.

To be conservative, we have assumed that sanctuary residents could potentially consume a whole crab including shell material. Using the above calculations, we then determined the number of Atlantic rock crab that the beluga and orca could theoretically consume daily before hitting the inorganic arsenic NOAEL threshold.

How Many Crabs Can Be Eaten Before Limit Hit (with shell)				
	Female Beluga	Male Beluga	Female Orca	Male Orca
EPA (NOAEL)	0.94117647	1.038062284	1.689965398	3.363321799

Figure 3. Limit to how many Atlantic rock crabs can be eaten every day (perpetually) before the NOAEL threshold is reached for males and females of each species.

There are a few limitations with the data used in this analysis that should be noted:

- The first is the fact that the total As level in crabs with their shell included is based on an assumption that the concentration measured in the viscera is consistent throughout other tissues. Based on research published on other crab species, it appears likely that the shell material, which in this analysis accounts for 79% of the total body weight, is significantly less concentrated in As. Therefore, the estimate we generated of the total As in a whole crab with its shell, is likely to be an overestimate.
- The second point to consider is that the As ppm in the Atlantic rock crabs was a measure of total As, including organic and inorganic As species. Therefore, this value is likely to include non-toxic organic arsenic species such as arsenobetaine (AsB). In the literature, AsB appears to be found in relatively high concentration in crustaceans, thus indicating that AsB is likely to represent at least some portion of the total As levels measured in the WSP sampling. This would also lead us to suspect that our estimate of inorganic arsenic consumed in a single rock crab is an overestimate.

Selenium Findings

Although direct data regarding the relationship between selenium and arsenic in cetaceans does not appear to exist, in humans selenium appears to have some protective action against arsenic toxicity (Couture, Raoul-Marie, et. al., 2012). The protective action of low dose selenium may be due to increased production of Se-dependent endogenous antioxidants, which in turn may increase arsenic methylation efficiency (Zwolak, 2020). As the rock crabs sampled were found to have low level selenium, we have highlighted the selenium results for your review of their relevance.

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Methylmercury Findings

The methylmercury concentrations in half of the rock crab samples slightly exceeded the CCME tissue residue guidelines, with reported methylmercury concentrations of 0.0381 mg/kg in Area B and 0.0334 in Area D, as compared to the guideline of 0.033 mg/kg. The methylmercury concentrations in rock crab in Area A and Area C were lower than the guideline, with reported concentrations of 0.0243 mg/kg and 0.0094 mg/kg, respectively. The methylmercury concentration in the mussel sample from Area E was also lower than the guideline, with a reported concentration of 0.0158 mg/kg.

III. Assessment of Potential Arsenic Impacts

by Dr. Ken Reimer

Whale Sanctuary Project:

Assessment of Potential Arsenic Impacts

Summary

Staff from the Whale Sanctury Project (WSP) contacted Dr. Ken Reimer (KJR) for advice regarding the potential health effects, if any, of arsenic contamination from historic gold mining that impacts a small portion of the nearshore sediments in the proposed sanctuary. The concern was that some of this arsenic could impact the marine food web and potentially affect the health of future whale inhabitants. After discussions with WSP personnel, a review of the Phase III Environmental Assessment Report, the ecological inventory, and available literature, it was concluded that arsenic might be taken up by organisms at the bottom of the food web but that it was unlikely that this would pose any risk to the whales. This report documents the evaluation process and the rationale for this conclusion.

Background

The Whale Sanctuary Project states that (https://whalesanctuaryproject.org):

'We work to transform the way people relate to whales and dolphins by bringing an end to their exploitation and by creating seaside sanctuaries, assisting with international marine mammal rescues, and advancing whale and dolphin science.

Right now, with your help, we are creating a gold-standard coastal sanctuary in Port Hilford Bay, Nova Scotia, where cetaceans (whales and dolphins) can live in an environment that maximizes well-being and autonomy and is as close as possible to their natural habitat. It is being designed to serve as a model for many more that can then be built all over the world in the coming years'.

The concept for the WSP began in 2015 and in April 2016 the Whale Sanctuary Project was incorporated as a tax-exempt non-profit organization. During the following years 120 potential sites were evaluated and, in February 2020, after consultation with the local First Nation, the WSP announced the choice of Port Hilford Bay, Nova Scotia as the future location. The lease area covers over 200 acres. This includes 100 acres of enclosed water space with up to 18 m in depth for the whales, a buffer area around the outside of the enclosure, Barachois Island and 30 acres of land. Future plans are still being developed but it is envisaged that, in addition to the enclosure, there will also be building(s) incorporating administration, veterinary and maintenance services and a parking lot.

Environmental Studies

Environmental Studies were initiated which included, amongst others, the following (https://whalesanctuaryproject.org):

- *Acoustic studies of the marine environment;*
- *Water quality and water temperature analyses throughout all seasons;*
- *Impacts assessments during two hurricanes;*
- *Seasonal wave, tides and current measurements;*
- *Hydrodynamic modeling of the sanctuary waters, including with LIDAR, a remote sensing method used to examine the surface of the Earth;*
- *Migratory bird analyses;*
- *Flora and fauna review;*
- *Eel grass productivity and location analyses;*
- *Sediment sampling and analyses on land and in the marine environment.*

Other investigations were conducted to satisfy regulatory responsibilities. In February, 2024 a detailed (Phase III) Environmental Site Assessment (ESA) report (Strum Consulting, 2024) was produced. A Phase III ESA is performed according to a standard set of guidelines and included previous ESA results as well as the collection of samples from both the land and marine environments. These involved sampling of: groundwater, freshwater (on-site pond/wetlands) and marine surface water and sediment from the proposed enclosure area. Marine invertebrates (rock crabs and mussels) were also obtained. These samples were mainly subjected to analyses for: metals, arsenic (a metalloid incorrectly described in the ESA report as a metal) but some were also screened for cyanide and petroleum hydrocarbons as well as methylmercury (invertebrate tissues).

The choice of substances for chemical analysis is based on information regarding the historical use of the site. In this case, it was known that Nova Scotia has a legacy of small gold mining operations that took place throughout the province during the late 1800s and early 1900s (Little, *et.al*., 2015). As noted: (https://whalesancturaryproject.org): '*Research completed by WSP identified a former gold stamp mill location, up to 20 former mine shafts, and a tailings pond on the site, as well as mine shafts that extended off the site onto the property to the west'.*

Gold is rarely found in a free form such as nuggets but is most often incorporated into rocks that commonly contain arsenic minerals such as arsenopyrite. To extract the gold, the crushed rock can be heated to drive off the arsenic and the gold separated from the residue by the use of cyanide and/or mercury. Alternatively, mercury amalgamation can be used to directly extract the gold. Mercury spilled during such activities can, under certain conditions, produce methylmercury. Tailings ponds will contain significant quantities of arsenic and this waste is often eroded into the ocean where the arsenic becomes incorporated into the sediments (the mud underlying the water). Hence the requirement to analyze for arsenic, a range of metals as well as hydrocarbons from possible past fuel spills.

The ESA identified (Strum Consulting, 2024): *'metal impacts attributed to former gold mining/processing activities on the southern half of the site, in surface water/sediment within the Barachois Pond and the wetland areas north and south of the pond, and in marine sediment on the southwest side of the proposed marine enclosure area. Elevated arsenic concentrations were identified as the primary indicator of former gold mining/processing impacts, with very high arsenic concentrations present in the area of the former gold stamp mill on the south/southeast side of Barachois Pond, and in the marine sediment located just offshore of that area'.*

Land based contamination can be dealt with during the development of the WSP facilities. Contaminated soils can, for example, be safely sequestered beneath building structures or the pavement of a parking lot. WSP staff were, however, concerned about the potential impact of the arsenic waste in the ocean where the enclosure is to be located.

The WSP Marine Environment

A total of 21 marine water samples were collected from the intertidal area as well as offshore. In addition, 33 sediment samples were obtained; 16 of these were surface sediments and the remainder were depth samples collected using a coring device (intended to reveal differences with the depth of the sediments). Collectively, these samples provide good coverage of the proposed enclosure area.

Marine invertebrate tissue samples (59) were also collected from the marine area. Targeted were Atlantic rock crab (*Cancer irroratus*), blue mussel (*Mytilus edulis*), and Atlantic soft-shell clam (*Mya arenaria*) but no clams were found in the proposed enclosure area. Samples were composited (to provide sufficient sample size for chemical analysis) and grouped according to different sampling locations.

Analysis of the water samples indicated that all samples, except one, had concentrations lower than federal guidelines. The single exception was only marginally greater than the guideline for mercury and was not due to any historical contamination. It was therefore concluded that water will not pose any risk to the cetaceans.

The only significant exceedances of sediment quality guidelines were for arsenic. A background (i.e. naturally occurring) arsenic concentration was not established but as the distance from land increases values fall to concentrations in the 'teen's (e.g. 14 mg/kg or 14 parts per million, 14 ppm) and eventually to single digits (e.g. 4 ppm). A value of 41.6 ppm (the most relevant federal criteria) was therefore used to screen the results for elevated arsenic concentrations. These elevated values define an area (plume) just offshore from the former stamp mill and former tailings pond locations. In this area, arsenic concentrations are typically in the 70 – 260 ppm range but three are significantly greater: 630, 840 and 1200 ppm (all in the near-shore). A preliminary visual inspection of the plume suggests that it occupies less than 20% of the total sanctuary area.

No invertebrate samples were collected from background areas – i.e. nearby areas where there is no impact due to the historic gold mine – so the results could only be compared to guideline values. Health Canada publishes a list of maximum concentrations of contaminants in food for human consumption, which in the case for arsenic is 3.5 ppm in fish protein (Health Canada, 2022). Note this value is the arsenic measured in the sample after it has been dried – referred to as dry weight, dw (Food and Drug Regulations, 2024). The ESA report does not specify but correspondence with the consultant indicates that the invertebrate results are presented as wet weight, ww. Mussels from a single area were found to have an arsenic content of 2.9 ppm ww, which corresponds to approximately 13 ppm dw (these conversions are estimates as the moisture content of the samples was not provided). The rock crab results ranged from 3.6 to 6.8 ppm ww (possibly around 25 ppm dw). This suggests that that all of the invertebrate results exceed the guideline of 3.5 ppm dw. This is, however, not necessarily a cause for concern.

The highest concentration of arsenic in rock crabs was not found adjacent to the shoreline impacted by the historic gold mine, but further away at the outer boundary of the proposed enclosure. Rock crabs are mobile and it is not known if the results are due to natural conditions and/or historical contaminant inputs. More importantly, the concentration of arsenic by itself does not indicate a health risk as the chemical from of arsenic is critical, as described in the next section.

<u>Arsenic in the Marine Environment</u>

Arsenic is generally associated by most people with poison. Arsenic is an element and, by itself, is not particularly toxic. When we refer to arsenic concentrations in the preceding sections of this report, we are describing the total amount of arsenic present in the various samples, not the chemical form it is in. Arsenic is found naturally in the environment and there is some in everything we eat and drink – whether it causes harm or not depends on how much arsenic there is ***and*** its chemical form (Cullen and Reimer, 2017). In 2017, the author of this report, Dr. Ken Reimer, co-authored a book entitled ‘Arsenic is Everywhere: Cause for Concern?’ The question mark at the end of this title is important: arsenic is everywhere but it is not always a problem.

Arsenic combines with other elements to form a wide variety of arsenic compounds. Indeed, arsenic associated with oxygen in a form called arsenic trioxide was used throughout history to kill rats and, sometimes, people. It is this compound that was called the King of Poisons due to its toxicity and to its ready availability. Arsenic trioxide is one of many compounds of arsenic that are collectively referred to as inorganic arsenic. When arsenic is bonded with carbon a group of compounds called organic arsenic results. In general, inorganic arsenic compounds are more toxic than the organic arsenic ones and there is one organic arsenic compound called arsenobetaine that is completely non-toxic.

A wide variety of arsenic compounds are found on land and in the ocean everywhere in the world but for finfish and shellfish living in the ocean, arsenobetaine is the most dominant form

Taylor *et.al*, 2017). Thus, moderate consumption of these types of seafood does not pose a risk as the main arsenic component is not toxic.

As noted earlier, arsenic compounds such as arsenopyrite are often found in association with gold. Depending on the geology, there can also be significant amounts of arsenopyrite in the absence of gold. Erosion of rocks rich in arsenopyrite will cause naturally elevated arsenic concentrations in soil and water in the area. Processing of gold rich ores with arsenopyrite can cause a dramatic increase in the local arsenic concentrations. The chemical form of the arsenic changes during processing and under different environmental conditions. If all of this arsenic was converted in organisms to arsenobetaine there would be no cause for concern. If the rock crabs collected from the proposed sanctuary contain only arsenobetaine it would not matter if the concentrations exceed the Health Canada guideline (which is for total arsenic), we could eat as many rock crabs as we wished without worry. Although complete arsenic speciation would be a way to gain further information, we can also gain insights by looking at other sites that are similar to the WSP location

Arsenic in Contaminated Marine Environments

As noted earlier, small gold mines were operated throughout Nova Scotia. My team, the Environmental Sciences Group (ESG) located at the Royal Military College of Canada studied one that has also impacted the marine environment; it is located in Seal Harbour, NS (Whaley-Martin *et.al.*, 2012).

Seal Harbour, Guysborough County, Nova Scotia is a marine harbour characterized by high arsenic concentrations in the sediment due to gold mining activities that took place from the 1860s to 1942 (Bates, 1987) approximately 2 km upstream of the harbour. Sediment and water samples were collected at 4 locations over a distance of 300m along the shoreline as well as at an uncontaminated location, Coddles Harbour, located 3 km to the northeast. Blue mussels (*Mytilus edulis*), periwinkles (*Littorina littorea*) and clams (*Mya arenaria*) were also obtained. These were subjected to analyses for total arsenic as well as speciation to determine what types of arsenic were present.

Arsenic water concentrations in Coddles Harbour were 30 µg/L (parts per billion, ppb) and 200 ppb at Seal Harbour. There was a wide concentration gradient of sediment arsenic concentrations ranging from 3 ppm at Coddles Harbour and up to 600 ppm dw at Seal Harbour. Mussels from the Coddles Harbour reference area contained 34 ppm dw compared to 16 ppm dw in some grocery store mussels. In contrast, mussels taken from the contaminated sediments in Seal Harbour had considerably more arsenic ranging from 60 to 109 ppm dw.

Speciation analysis revealed that the arsenic in the grocery store and Coddles Harbour mussels was predominately the non-toxic arsenobetaine. This was not the case for the ones from Seal Harbour; these all contained some arsenobetaine but also significant quantities of the more toxic inorganic arsenic. *'A strong positive correlation was observed between the concentration of inorganic arsenic species (arsenic with no As-C bonds) and total arsenic'* (Whaley-Martin *et.al.*, 2012), whereas organic arsenic concentrations, dominated by arsenobetaine, remained relatively constant regardless of the increasing arsenic concentration in the mussels. It appears that pathways that convert the inorganic arsenic found in the contaminated sediments to arsenobetaine become blocked or the total amount of arsenobetaine that can be retained is reached and then inorganic arsenic is accumulated by the mussels.

Arsenic concentrations in water from the proposed WSP sanctuary are lower (less than 1 ppb) than that found at Seal Harbour and the sediment concentrations are similar to those in Seal Harbour with one exception (1200 ppm). Mussels found at the WSP site with arsenic concentrationsof approximately 13 ppm dw (2.9 ppm ww) are very similar to the grocery store mussels described above and almost certainly dominated by arsenobetaine. The fact that they are lower than Seal Harbour is probably because the mussels were collected just outside of the edge of the arsenic impacted area. Mussels are not abundant at the WSP site, but periwinkles are.

WSP staff conducted an ecological inventory to document what is living on the bottom of the proposed sanctuary and have indicated that periwinkles (sea snails) are widely distributed throughout the WSP sediments. None of these periwinkles were subjected to arsenic analysis but we can gain some insight by examining the results from Coddles and Seal Harbours (Whaley-Martin, *et.al.*, 2013). Like the mussels, organic arsenic is dominant in the Coddles Harbour periwinkles but at Seal Harbour the inorganic arsenic concentrations were approximately six times those found in the mussels and reached 600 ppm dw (out of 840 ppm dw total arsenic) - amongst the highest concentration observed for any marine organism. Such high concentrations *could* pose a risk to higher trophic level consumers. It is therefore worthwhile to consider if a similar risk could be present in periwinkles in the proposed sanctuary.

<u>Can the Whales be Exposed to Arsenic in the Proposed Sanctuary?</u>

There can only be a risk if the whales consume sufficient quantities of the contaminated invertebrates. As noted on the WSP website:

'The orcas will be provided a satiating and nutritionally supportive well-rounded diet, similar to the diet which they have been accustomed to eating at land-based captive facilities. Any consumption of live marine creatures within the sanctuary will most likely be limited to novel experimentation (as captive whales have no experience with live crustaceans or other live potential prey), making chronic long-term exposure unlikely'.

Even though it is unlikely that there will be a significant consumption of periwinkles, we can still assess potential risks by considering how many periwinkles would have to be eaten before health effects might occur - there is a standardized way to do this called ecological risk assessment (ERA). This approach determines how much of a contaminant, in this case inorganic arsenic, a receptor (e.g. a whale) might be exposed to and compares this to a toxic reference value (TRV). *'TRVs are often used during the risk characterization phase of an ERA to derive hazard quotients (HQs). The HQ is the ratio between the estimated exposure level and the TRV.*

An HQ of 1 is generally used as the benchmark in ERA for interpreting whether risk could be unacceptable (i.e., HQ above 1) or acceptable (i.e., HQ below 1)' (FCSAP, 2021).

The arsenic TRV for mammals is 1.04 mg/kg body mass/day. This suggests that a mammal could consume 1.04 mg of inorganic arsenic for each kilogram of its body mass each day and have a hazard quotient of 1 – i.e. negligible risk. For a whale with a body mass of 1500 kg this would correspond to 1560 mg inorganic arsenic per day. Periwinkles in Seal Harbour had a wet body mass of 1- 5 g and had a maximum total arsenic concentration of 840 mg/kg (dw, ppm) after the sample was dried; this corresponds to 190 mg/kg ww of arsenic in the periwinkle as it would be eaten. Therefore, it would take 8.2 kg of periwinkles to reach a consumption that exceeds the TRV. This corresponds to somewhere between 1640 and 8200 periwinkles each day depending on how big the periwinkles are.

This calculation assumes that all of the arsenic is inorganic but only about 70% was inorganic in the periwinkles from Seal Harbour. Even if the small area with higher sediment concentrations at the WSP site had periwinkles with double the amount of arsenic and/or smaller whales were present, it is clear that several hundreds of periwinkles would have to be consumed each day to pose a risk. WSP staff are confident that this would not be possible for an animal that is being fed and such an intake could cause gastrointestinal problems from the shells alone.

Conclusion

Arsenic has been introduced into the sediments of the WSP proposed sanctuary site but, given the protective assumptions noted above, it should not pose any risk to future whale inhabitants.

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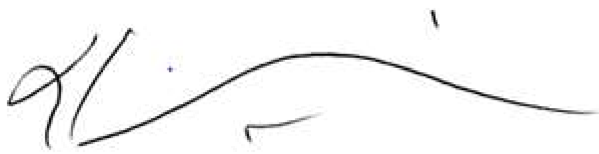
Dr. K.J. Reimer Biography

Dr. Ken Reimer is an Emeritus Professor at the Royal Military College of Canada. Prior to his retirement, Dr. Reimer was a Professor in the Chemistry and Chemical Engineering Department, was cross-appointed to the Biology and Chemistry Departments at Queen's University and held Adjunct Positions at the University of British Columbia and Memorial University. He was also the Founder and Director of the Environmental Sciences Group (ESG) at RMC. ESG was a multidisciplinary team consisting of chemists, engineers, biologists, geologists and geographers. ESG conducted basic research – often dealing with arsenic – as well as applied projects mainly involving contaminated sites. At a contaminated site, the group would determine the nature of chemical contaminants present, assess the ecological and human health risks and evaluate remediation solutions. Dr. Reimer was the Scientific Authority for one of Canada's largest environmental remediation projects – the Distant Early Warning Line Cleanup in the Arctic and led numerous other contaminated site investigations. He is particularly interested in involving stakeholders and has participated in hundreds of community consultations. Since his retirement, he continues to be involved in projects – for example he was Chair of the Independent Expert Advisory Committee (IEAC) to address concerns regarding methylmercury that might arise from the Muskrat Falls hydroelectric project. As well, he was the lead evaluator in a review (Arktis, 2021) of the effectiveness of the Giant Mine Oversight Board which oversees the $1B cleanup of the arsenic contaminated former gold mine. He has provided expert advice on arsenic for the development of a public health advisory for the Chief Public Health Officer of the Northwest Territories. Dr. Reimer has numerous publications, many dealing with arsenic. These include: 12 book chapters; 166 papers in refereed journals; 29 in refereed conference proceedings; >500 technical reports. In 2017 he co-authored, with Canada's preeminent arsenic expert Dr. W.R. Cullen, the book 'Arsenic is Everywhere: Cause for Concern?



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