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BUILD NOVA SCOTIA

Human Health and Ecological Risk Assessment: Former Country Harbour Mine, Nova Scotia (Revised Final)

Former Country Harbour Mine Site, Guysborough County, Nova Scotia
PID Nos. 35091354 and a Portion of 35094366



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Human Health and Ecological Risk Assessment: Former Country Harbour Mine, Guysborough County, Nova Scotia – Revised Final Report
Parcel Identification Designation Numbers (PID Nos.): 35091354 and 35094366

Dillon Consulting Limited (Dillon) is pleased to provide Build Nova Scotia, on behalf of the Department of Natural Resources and Renewables, the revised final report for the Human Health and Ecological Risk Assessment (HHERA) for the Former Country Harbour Mine property located in Guysborough, Nova Scotia, and identified by Parcel Identification Designation (PID) Nos. 35091354 and a portion of 35094366.

Should you have any questions, please do not hesitate to contact us.

Sincerely,

DILLON CONSULTING LIMITED

Nadine Wambolt, B.Tech, CET
Project Manager

Our file: 23-6465

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Acronyms

AC CDC	Atlantic Canada Conservation Data Centre	MW	Monitoring Well
AEC	Area of Environmental Concern	NA	Not Applicable
AEP	Alberta Environment and Parks	NAPL	Non-Aqueous Phase Liquids
ALARA	As Low as Reasonably Achievable	NDA	No Data Available
ANZECC / ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality	NGA	No Guideline Available
AO	Aesthetic Objective	NOAA	National Oceanic and Atmospheric Administration
APEC	Area of Potential Environmental Concern	NOAEL	No Observed Adverse Effect Level
ARD	Acid Rock Drainage	NRC	National Research Council
ASTM	American Society for Testing and Materials	NS	Nova Scotia
ATSDR	Agency For Toxic Substances and Disease Registry	NSDNRR	Nova Scotia Department of Natural Resources and Renewables
AUF	Area Use Factor	NSECC	Nova Scotia Department of Environment and Climate Change
B(a)P TPE	Benzo(a)pyrene Toxic Potency Equivalents	OEHHA	Office Of Health Hazard Assessment
BC CSR	British Columbia Contaminated Sites Regulation	PAH	Polycyclic Aromatic Hydrocarbons
BH	Borehole	PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
BNS	Build Nova Scotia	PEL	Probable Effect Level
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes	PHC	Petroleum Hydrocarbons
BW	Body Weight	PID	Parcel Identification Designation
CALEPA	California Environmental Protection Agency	PIRI	Partners in Risk Based Corrective Action Implementation

CCME	Canadian Council of Ministers of the Environment	PQRA	Preliminary Quantitative Risk Assessment
CEQG	Canadian Environmental Quality Guideline	PSS	Pathway Specific Standards
COC	Contaminant of Concern	PWQO	Provincial Water Quality Objective
COPC	Contaminant of Potential Concern	QA/QC	Quality Assurance and Quality Control
COSEWIC	Committee on the Status of Endangered Wildlife In Canada	RAF	Relative Absorption Factor
CSM	Conceptual Site Model	RBA	Relative Bioavailability
CWQG	Canadian Water Quality Guideline	RBCA	Risk Based Corrective Action
CWS	Canadian Wildlife Service	RDL	Reportable Detection Limit
$DQRA_{CHEM}$	Detailed Quantitative Risk Assessment for Chemicals	RFQ	Request For Quotation
ECCC	Environment and Climate Change Canada	ROC	Receptor of Concern
EHQ	Ecological Hazard Quotient	RPD	Relative Percent Difference
EPC	Exposure Point Concentration	RSL	Regional Screening Level
EPH	Extractable Petroleum Hydrocarbons	SAR	Species At Risk
EQS	Environmental Quality Standard	SARA	Species At Risk Act
ERA	Ecological Risk Assessment	SF	Slope Factor
ESA	Environmental Site Assessment	SQG	Soil Quality Guideline
FCSAP	Federal Contaminated Sites Action Plan	SQGE	Soil Quality Guideline for the Protection of Environmental Health
FD	Field Duplicate	SQG_{HH}	Soil Quality Guideline for the Protection of Human Health
FEQG	Federal Environmental Quality Guideline	SSTL	Site-Specific Target Level
GW	Groundwater	SW	Surface Water
HC	Health Canada	TCRL	Target Cancer Risk Level
HHERA	Human Health and Ecological Risk Assessment	TDI	Tolerable Daily Intake
HHRA	Human Health Risk Assessment	THQ	Target Hazard Quotient
HQ	Hazard Quotient	TOC	Total Organic Carbon
ICMM	International Council on Mining And Metals	TPH	Total Petroleum Hydrocarbons

ILCR	Incremental Lifetime Cancer Risk
ISQG	Interim Sediment Quality Guideline
IVBA	*In Vitro* Bioaccessibility
LOAEL	Lowest Observed Adverse Effect Level
LOE	Line of Evidence
LOEC	Lowest Observed Effect Concentration
MAC	Maximum Allowable Concentration
MDEP	Massachusetts Department of Environmental Protection
BC MOECCS	British Columbia Ministry of The Environment and Climate Change Strategy
MECP	Ministry Of Environment Conservation and Parks
TRV	Toxicity Reference Value
UCLM95	95th Percentile Upper Confidence Limit of The Mean
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
VPH	Volatile Petroleum Hydrocarbons
WOE	Weight Of Evidence
WQG	Water Quality Guideline

Executive Summary

Dillon Consulting Limited (Dillon) was retained by Build Nova Scotia (BNS), on behalf of the Department of Natural Resources and Renewables (DNRR), to complete a Human Health and Ecological Risk Assessment (HHERA) at the former Country Harbour Mine (herein referred to as the "subject property" or the "site"), which is located in Country Harbour Mines, Guysborough County, Nova Scotia (Figure 1, Appendix A).

The property is owned by DNRR and identified by Parcel Identification Designation Numbers (PID Nos.) 35091354 and a portion of 35094366. The former mine consists of an area of approximately 69 hectares (ha) with 46 known abandoned mine openings and one reported historical tailings area. The area of the site impacted by historical site activities identified in previous reports, comprises a smaller, localized portion of these properties consisting of four Areas of Environmental Concern (AECs). Based on sampling completed to date, the most heavily contaminated area is generally limited to within approximately 300 m east and 150 meters (m) west of the John Fenton Loop Road on PID No. 35091354, and within approximately 100 m east and west of Johnston Brook on PID No. 35094366. The assessment boundaries for the HHERA (hereafter referred to as the "study area" or the "study boundaries") includes this portion of the properties and is shown in Figure 2, Appendix A.

The HHERA considered potential risks to outdoor site visitors; outdoor site workers; vegetation and terrestrial invertebrates; herbivorous, insectivorous, and carnivorous small mammals; herbivorous and insectivorous birds; freshwater aquatic life; amphibians; and reptiles, via relevant exposure pathways to the identified contaminants of potential concern (COPCs). A summary of conclusions and recommendations for HHERA are provided below. These conclusions and recommendations based on the available data and assumptions used in the exposure and risk calculations. If site conditions and/or exposure assumptions change, the risk estimates should be re-evaluated to confirm the conclusions and risk management measures for this assessment still apply.

The overall conclusions from the Human Health Risk Assessment (HHRA) include:

- With the exception of arsenic, the identified COPCs were not considered to pose a potential risk to human health in the Outdoor Site Visitor Scenario or the Outdoor Site Worker Scenario;
- The hazard quotients (HQs) for cobalt, mercury and lead were below the target hazard quotient (THQ) for all receptors. The incremental lifetime cancer risk (ILCR) for cobalt was below the target cancer risk level (TCRL);
- The HHRA results suggest that soil risk management is required for arsenic for the toddler and adult receptors in the Outdoor Site Visitor Scenario and for the adult in the Outdoor Site Worker Scenario;
- The ILCR for arsenic was greater than the TCRL (target cancer risk level) for the toddler and adult receptors in the Outdoor Site Visitor Scenario and the adult in the Outdoor Site Worker scenario; and
- While there are potential risks to site visitors (toddler and adult, ILCR = 2.4 x 10-5 and 2.8 x 10-5 respectively) and site workers (adult, ILCR = 1.4 x 10-5), the estimated risk is considered an overestimate. This is largely because receptors interacting with the site are unlikely to interact with

the site for any significant duration. The HHRA assumed visitors would be present for six months of the year and did not account for factors such as inclement weather (e.g., cold rain during early spring) which would reduce time on site for potential visitors. The site is not easily accessible to the public, the site is heavily covered in vegetation/dense forest and likely to dissuade visitors from accessing more heavily impacted site soils (i.e., the waste rock piles where high levels of arsenic, mercury and other contaminants were observed are not adjacent to the road). It is also unlikely that the site would be used for recreational purposes (particularly for young children) which would further dissuade regular use of the site. For the workers, 48 weeks of site exposure per year and 10 hours per day were assumed in the HHRA. This is likely an overestimation of risk as winter conditions (e.g., frozen ground) may prevent outdoor work from being conducted and would greatly reduce potential exposures to site soil COPCs.

The overall conclusions of the Ecological Risk Assessment (ERA) include:

- The potential for adverse effects to vegetation and soil invertebrate communities as a result of COCs is within the study boundary is considered to be negligible to low based on the available data, within most areas of the site. In areas where waste rock and tailings have been placed, the likelihood of potential risks is medium. The presence of waste rock and tailing and the lack of nutrients in the "soils" in these areas, have most likely impacted vegetation in these areas and its ability to grow back/repopulate;
- There is a potential for individual level risks in individual herbivorous, insectivorous/ invertivorous small mammals, and herbivorous and insectivorous/invertivorous birds. However, based on the size of the study boundary and areas within it having elevated soil concentrations, available habitat and food resources, and consideration of population densities of avian receptors of concern (ROC), there is a low likelihood for population level effects in avian and mammalian ROC;
- Considering the available lines of evidence and using a weight of evidence (WOE) approach, the potential for adverse effects in pelagic freshwater aquatic life communities as a result of contamination on the site is low for species that may inhabit/forage in Johnston Brook, and medium for benthic freshwater aquatic life based on available data;
- Based on the available site and toxicity data related to surface water as well as sediments in Johnston Brook, the likelihood of potential risk to amphibian communities is considered to be low to medium; and
- While the potential for exposures of reptiles to site COCs is limited, there is uncertainty in the dietary exposures, particularly from the terrestrial environment from these species. As such, there is uncertainty in the potential risks for these receptors. Based on these considerations, the potential for risk to reptile communities is considered to be low to medium.

Risk Management

Proposed risk management recommendations, including additional sampling needs, for the site and HHERA study boundary are as follows:

- Soil risk management is required for arsenic. Iteration within the HHRA model produced the following initial human health soil Site Specific Target Level (SSTLs) for arsenic:
  - Outdoor Site Visitor – 530 mg/kg; and
  - Outdoor Site Worker – 1150 mg/kg.

Other considerations may be necessary to refine these initial soil SSTLs for arsenic, which may occur under separate cover as part of a site soil risk management plan. Given then extent of arsenic within the study area soils identified to date as being elevated above the SSTL, it is recommended that the SSTL be further examined/refined as part of a soil risk management plan. Any fresh exposed waste rock/tailings as a result remedial activities should be evaluated for sulfide baring materials for acid rock drainage potential as warranted.

SSTLs are not provided for ROC evaluated in the ERA. The planned risk management/remediation for the study boundary based on the HHRA outcomes will also reduce arsenic concentrations in soil that ecological receptors would be exposed to, and hence would also reduce potential risks.

Some other risk management recommendations for the site and HHERA study boundary are as follows:

- Develop site-specific health and safety plan for site workers, as required;
- A mercury hotspot exists in site soil and while localized, this area should be risk managed to mitigate potential risk. This occurred at BH15 where mercury was reported at 2920 mg/kg in soil at a depth of 0-0.15 meters below ground surface (mbgs);
- If there are areas of fine tailings on-site that are an open source of arsenic or other metals, which could disperse and mobilize, resulting in increased concentrations within the study area boundary or off-site, these tailings areas should be addressed in the remedial plan;
- If site conditions change, such that Johnston Brook dries up or its path significantly changes, resulting in the potential for exposure of soils as sediments, this should be addressed in the soil risk management plan;
- Some domestic waste was noted in APEC 4 (Figure 2). The waste includes partially buried materials including metal barrels. While not a chemical exposure issue, this debris could pose a physical hazard to someone walking or wildlife in the area. It would be prudent to remove the visible debris;
- There are currently 46 known abandoned mine openings, which consist of flooded pits, shafts, trenches and sunken spots. These openings could pose a physical hazard to someone visiting the site or wildlife in the area (i.e., falling into a shaft opening). While some of the abandoned mine openings were observed to be fenced, have berms and/or have posted signage, for the safety of potential visitors to the site and wildlife, consideration should be given to permanently safeguarding openings to remove this hazard;

- Given the limited number of groundwater samples collected, it is recommended to collect additional groundwater data to identify groundwater trends to more definitively determine whether monitoring well 24MW-01 can be considered as an upgradient background well;
- The approaches and assumptions used to calculate EHQs for the mammalian and avian ROCs are considered to be conservative and are likely substantially overestimates of actual risk. Furthermore, while no IVBA testing for arsenic has been validated in Canada for use with ecological receptors, given the low relative bioavailability of arsenic in soils (i.e., 42% based on human IVBA testing results), it is likely that arsenic exposures to avian and mammalian wildlife are lower than what was calculated in the quantitative exposure modelling. Uncertainty in the amount of arsenic and lead exposure most likely incurred by avian and mammalian receptors due to consumption of site soil invertebrates and vegetation can be reduced by the collection of site vegetation and soil invertebrates tissue samples, and analyze such samples for metals;
- Climate change impacts that could potentially increase concentrations of arsenic within the study boundary or off-site (e.g., tailings become exposed, Johnston Brook dries up resulting in the potential for exposure to sediments as soils for humans or terrestrial wildlife). Potential climate change impacts should be addressed as needed in the soil risk management plan;
- Site soils should be further delineated to provide further detail on the extent of soil impacts (particularly to the north of the site); and
- Surface water and sediment exceedances of freshwater aquatic life guidelines were present in Johnston Brook adjacent to the site boundary to the southern portion of the site. These exceedances likely extend beyond the site boundary, and as such, there could potentially be exposures to off-site aquatic species at elevated concentrations, particularly for arsenic. It was outside the scope of this assessment to evaluate potential off-site impacts.

1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by Build Nova Scotia (BNS), on behalf of the Department of Natural Resources and Renewables (DNRR), to complete a Human Health and Ecological Risk Assessment (HHERA) at the former Country Harbour Mine (herein referred to as the "subject property" or the "site"), which is located in Country Harbour Mines, Guysborough County, Nova Scotia (Figure 1, Appendix A). The property is owned by DNRR and identified by Parcel Identification Designation Numbers (PID Nos.) 35091354 and a portion of 35094366. The former mine consists of an area of approximately 69 hectares (ha) with 46 known abandoned mine openings and one reported tailings area.

The area of the site impacted by historical site activities identified in previous reports, comprises a smaller, localized portion of these properties consisting of four Areas of Environmental Concern (AECs). Based on sampling completed to date, the most heavily contaminated area is generally limited to within approximately 300 meters (m) east and 150 m west of the John Fenton Loop Road on PID No. 35091354, and within approximately 100 m east and west of Johnston Brook on PID No. 35094366. The assessment boundaries for the HHERA (hereafter referred to as the "study area" or the "study boundaries") includes this portion of the properties and is shown in Figure 2, Appendix A. Photos of the site are provided in Appendix B, with photo locations shown in Figure B-1.

The findings presented in this report are based on information and analytical data obtained from the Environmental Screening Report (Dillon, 2023), Phase I and II Environmental Site Assessments (ESAs) (Dillon, 2024a,b), ancillary studies conducted to support the completion of the HHERA (Dillon, 2025a,b), other reports and site records, information obtained during site visits, and discussions with the province and Build Nova Scotia.

1.1 Structure of the Report

The current section of this report (Section 1.0) details the objectives and scope of the HHERA. Section 2.0 provides information related to the site background and characterization, including physical descriptions of the site, summaries of previous investigations, and site data available for the assessment. Human Health Risk Assessment (HHRA) framework and outcomes are detailed in Section 3.0, and the Ecological Risk Assessment (ERA) framework and outcomes are detailed in Section 4.0. Section 5.0 briefly describes climate change considerations relevant to the HHERA, and overall conclusions and recommendations from the HHERA are presented in Section 6.0. Risk management discussions relevant to the site are provided in Section 7.0. Limitations and closure conditions are described in Section 8.0 and references are provided in Section 9.0. Site figures can be found in Appendix A, while site photos are provided in Appendix B. Additional information to support the HHERA is provided in Appendices C to J.

1.2 Objectives and Scope

The overall objective of the HHERA was to evaluate whether there is potential for unacceptable human and/or ecological health risks as a result of contamination at the site and provide recommendations for addressing potential risks, as required. The assessment was conducted in accordance with the Nova Scotia Contaminated Sites Regulations (NS CSRs) and associated Ministerial Protocols, where applicable.

The scope of the HHERA included the following tasks:

- Identification of contaminants of potential concern (COPCs), receptors of concern, and exposure pathways/routes/scenarios, in addition to the development of a conceptual site model (CSM) to provide a simplified representation of potential exposure pathways and routes that link the identified COPCs in site media to human and ecological receptors of interest (i.e., problem formulation);
- Where possible and if necessary, estimate exposures (as part of the exposure assessment step) using standard receptor parameters and appropriate statistical values to provide a realistic assessment of the potential risks;
- As part of the toxicity assessment (also called the hazard or effects assessment), identify exposure limits or toxicological reference values (TRVs) (i.e., concentration of a chemical not anticipated to be associated with adverse health effects or associated with an acceptable risk level) for each COC (contaminant of concern); and
- Calculate, as part of the risk characterization step, the potential for adverse health risks associated with the estimated exposures and toxicity for each COC for each receptor and provide risk management recommendations based on the results of the HHERA.

The overall study boundaries for the HHERA are provided in Figure 2, Appendix A. As shown on the figure, the study area generally includes the following areas of environmental concern (AECs) identified in previous reports:

- AEC 1 – Former Tailings Area: One former waste tailings area with potentially sulphide bearing materials;
- AEC 2 – Former Stamp Milling Area: Three former stamp milling areas where potentially sulphide bearing materials may have been processed;
- AEC 3 – Waste Rock Piles: Two waste rock areas with potentially sulphide bearing slates, one of which is in Johnston Brook; and
- AEC 4 – Domestic Waste Dumping Areas: Three locations where domestic waste and discarded fuel drums were identified during the Phase I ESA site visit.

These AECs were previously identified as areas of potential environmental concern (i.e., APECs) anticipated to be impacted by historical site activities in the Phase II ESA and earlier reports. The results of the Phase II ESA and subsequent sampling have confirmed contamination in these areas, and as such, they are referred to as AECs herein. This HHERA focused on analytical data for site soil, sediment, surface water, and groundwater collected within and adjacent to the AECs, as well as local background

data from areas of the site not expected to have been impacted by site activities (see Section 2.4). The evaluation of areas outside the study boundary, as shown on Appendix A; Figure 2, were outside the scope of this assessment.

The HHERA evaluates current and reasonably foreseeable future exposures associated with the site, assuming the anticipated future land use, existing engineering controls and site conditions remain consistent with current land use, as is anticipated.

2.0 Background and Site Characterization

2.1 Site History

The former mine site consists of an area of approximately 69 hectares (ha) with 46 known abandoned mine openings and one reported tailings area. Known mining operations for gold ore are reported to have occurred at the site between 1862 and 1951, and the site is no longer in operation. Mine workings were underground and included drifts and stopes, shafts access, and ramp accesses. Ore processing was reportedly completed by way of mercury amalgam. Approximately 26,301 tons of ore was processed on-site, producing approximately 9,960 ounces of gold, and resulting in an estimated 14,225 tons of tailings remaining on-site (BNS Request for Proposal RFQ BNS-2324-0201, 2023). Several stamp mills operated at the site, including the Old Antigonish Mill, the Stuart Mill, and the Robertson Mill. In addition to gold stamp mills, buildings and infrastructure were constructed to support mining operations at the site. These buildings and infrastructure have been removed from the site, although portions of some foundations remain. Fencing, barricades, berms, and warning signs have been installed at the site due to the number of abandoned mine openings. Currently, the site is used for commercial forest harvesting as a primary land use and is also being considered for wind energy development.

2.2 Property Description

The former mine consists of an area of approximately 69 ha (Figure 1, Appendix A). The area of the site anticipated to be most impacted by historical site activities comprises a smaller portion of the site and includes the four AECs identified in Section 1.2. Based on sampling completed to date, the most heavily contaminated area is generally limited to within approximately 300 m east and 150 m west of the John Fenton Loop Road on PID No. 35091354, and within approximately 100 m east and west of Johnston Brook on PID No. 35094366. The study boundary for the HHERA includes this portion of the properties and is shown in Figure 2, Appendix A. Photos of the site are provided in Appendix B, with photo locations provided in Figure B-1.

The subject properties of the former mine site are primarily forested and located on Crown land. Some smaller cleared areas exist where forest roads and old mining infrastructure are located. According to the provincial landscape map, the area is categorized as Tolerant Mixedwood Hills under the Ecological Land Classification system. Dominant tree species include balsam fir (*Abies balsamea*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*) and white spruce (*Picea glauca*) (NS DNRR, 2021).

These tree species are evident in photos from the site visits along with various species in the shrub and herbaceous layer such as common ferns, grasses and sedges (Appendix B).

The study area contains notable features including an intermittent watercourse, Johnston Brook, which flows through the subject properties from northwest to southeast, with a portion of the brook flowing underground (see Figure 2, Appendix A). Based on information obtained during previous investigations (Dillon, 2023), this watercourse has a steep grade and predominantly large substrate. A short waterfall exists at the furthest downstream extent of the watercourse on the site near the southern property line. Another waterfall is also noted from site photos approximately 500 metres (m) upstream of the southern property boundary line. Given these characteristics (i.e., an elevation drop at the entry to the properties, generally steep grade and intermittent nature), the section of Johnston Brook within the subject properties may not provide suitable habitat for aquatic species (i.e., Atlantic Salmon, Eastern Pearshell) to complete their life cycles (Dillon, 2023).

There are two mapped wetlands located on the subject properties: one surrounding a small lake approximately 1.2 km northeast of the former tailings area, and another approximately 800 m northeast of the tailings area along a site road. These two wetlands are together approximately 4 hectares in area, hydraulically up-gradient from and outside of the former mine footprint and do not occur within the study area. The provincial map viewer classifies these wetlands as low shrub swamp land (NS DNRR, 2021).

It is noted that several waste rock piles were identified as being on-site; however, much of these areas have been naturally revegetated to some extent. Based on the age of the historical mining operations at the site (1862 to 1951), the potential for acid rock drainage (ARD) (from waste rock piles) to be present at the site is considered to be low, as associated potential leaching has likely already occurred. Further, no visual evidence of leaching related to ARD was observed during the site visits; however, it is noted that the site is heavily vegetated.

2.3 Physical Setting

2.3.1 Water Supply/Groundwater Usage

Groundwater was encountered during the January 2024 sampling event at depths ranging from 0.62 meters below top of casing (mbtoc) (i.e., in 24MW-05) to 2.78 mbtoc (i.e., in 24MW-04). Based on the measured groundwater elevations, the generalized groundwater flow direction in the assessment area is interpreted to be to the south towards Country Harbour River. Non-aqueous phase liquids (NAPL) were not measured or observed in on-site monitoring wells during the groundwater monitoring events.

The site is not serviced by municipal water or sewer. There are currently no potable groundwater wells on site; however, the surrounding properties are serviced by individual potable wells with the nearest residential building located approximately 50 m south and downgradient of the southern site boundary. A water pipe was present on-site in Johnsons Brook (near 24MW-03) that reportedly may have been

accessed by a local property owner, possibly for drinking water. As of 2024, the pipe was removed by BNS, DNRR and is no longer on site.

2.3.2 Regional Geology and Topography

The topography of the site is steep, converging on Johnston's Brook from the east and the west, and also sloping to the south towards Highway 316. To describe the regional physiography and expected hydrogeological conditions beneath the subject property, the following documents were reviewed as part of the Phase II ESA (Dillon, 2024b):

- Stea, R.R., Conley, H., and Brown, Y. (compilers) 1992: Surficial Geology of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Map 92-3, Scale 1:500,000;
- Keppie, J.D. (compiler) 2000: Geological Map of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Minerals and Energy Branch, Map ME 2000-1, Scale 1:500,000; and
- S.M. Barr, C.E. White (compilers) 2017: Bedrock Geology Map of the Grand Narrows Area, NTS 11F/15, Cape Breton, Inverness, Richmond and Victoria Counties, Nova Scotia; Nova Scotia Department of Natural Resources, Map ME 2017-014, Scale 1:50,000.

The surficial geology of the subject area is mapped as of Stony Till Plain and drumlins. Till is stony, sandy and consists of material derived from local bedrock sources, ranging in thickness from 2 meters (m) to 20 m. Drumlin facies are siltier due to erosion and incorporation of older till units by glaciers. Soil observed during the Phase II ESA generally consisted of an organic/peat layer at surface, underlain by silty sand or sand and gravel.

The regional bedrock geology of the subject area is primarily mapped as the Goldenville Formation of the Cambrian period, consisting of sandstone, turbidites and slate. Continental rise prism is present in areas metamorphosed to schist and gneiss. Of note, the northern portion of PID 35094366 is mapped as Middle to Late Devonian muscovite biotite monzogranite (from the area of Johnsons Lake northward). Bedrock was encountered during the Phase II ESA drilling program between 0.53 meters below ground surface (mbgs) (24MW-05) and 4.27 mbgs (24MW-01). On-site bedrock was a mixture of granite and slate, with quartz and pyrite seams periodically observed.

2.3.3 Stratigraphy

There is significant variability in soil stratigraphy depending on the area of the site. Additionally, the grade of the site is even more variable depending on the specific area within the study boundary. Details pertaining to the reported stratigraphy in each AEC have been provided in the Phase II ESA (Dillon, 2024b) and are summarized in the following subsections.

2.3.3.1 Former Tailings Area: AEC #1

Soil stratigraphy in this area generally consisted of a layer of organics with peat, underlain by silty sand or sand with varying amounts of gravel. Granite bedrock was encountered at approximately 2.13 mbgs (24MW-02). A representative soil sample was collected from AEC 1 and was submitted for grain size analysis. Based on the grain-size analysis, the sample was classified as fine-grained.

2.3.3.2 Former Stamp Milling Areas: AEC #2

Soil stratigraphy in these areas generally consisted of a layer of organics/peat, underlain by sand and gravel, with slate bedrock encountered at between 0.53 mbgs (24MW-05) and 1.37 mbgs (24MW-03). Granite bedrock was encountered at 0.88 mbgs at one location (24MW-04). A representative soil sample was collected from APEC 2 (Stuart Mill Area) and was submitted for grain size analysis. Based on the grain-size analysis, the sample was classified as coarse-grained.

2.3.3.3 Waste Rock Piles: AEC #3

Soil stratigraphy in these areas generally consisted of a thin layer of rootmat and organics underlain by waste rock or silty sand with varying amounts of gravel. Intermittent coal fragments and iron oxides were observed.

2.3.3.4 Domestic Waste Dumping Area: AEC #4

Soil stratigraphy in this area generally consisted of a thin layer of rootmat and organics underlain by silty sand with varying amounts of gravel. Intermittent waste rock was also observed.

2.3.3.5 Background Area

The background area selected for the site soils is located approximately 1.5 kilometers (km) north of Highway 316, outside of expected areas of impact resulting from historic site activities. Soil stratigraphy in this area generally consists of a thin layer of organics/peat underlain with silty sand and gravel with varying amounts of sand atop fractured/weathered slate bedrock and then competent granite bedrock. Minor slate bedrock (approximately 1 m) was encountered in the background area at a depth of approximately 3.2 mbgs, followed by granite bedrock at 4.27 mbgs (24MW-01). Background surface water and sediment samples were collected upgradient of the site.

2.3.4 Climate

Current climate conditions at the site can be characterized by examining the historical data. Climate data were obtained from ClimateAtlas.ca using the historical period 1976-2005. All data are for the Guysborough County area which includes the Country Harbour site (ClimateAtlas.ca, 2024):

- Average annual temperature: 5.9 °C;
- Coldest month: February: -5.8 °C;

- Hottest month: August: 17.8 °C;
- Annual average precipitation: 1388 mm;
- Number of frost days (days with coldest temperature below 0°C): 158.6 days;
- Number of summer days (days above 25°C): 16.5 days; and
- Dry days (number of days without rain or snow): 199.0 days.

The site is situated within the Atlantic Highlands ecoregion (USEPA, 2024) which is characterized by a humid continental climate influenced by its higher altitudes and ocean proximity.

2.4 Land Use Considerations

The site is accessed by John Fenton Loop Road via Highway 316. The site is zoned for commercial land use, and surrounding land uses are primarily resource, with some residential properties located south of the site. The site is currently vacant with no buildings present; however, remnants of infrastructure foundations are present in some areas (e.g., Stuart stamp mill). To date, metals impacts in soil are laterally delineated to the north and south. Lateral delineation of impacts to the east and west have been partially delineated on the southern portion of the site; however, are not delineated to the east and west on the northern portion of the site. Vertically soil impacts are delineated by the presence of bedrock, which ranged from 0.53 mbgs (APEC #1) to 1.37 mbgs (APEC #2) (Appendix I).

2.5 Previous Investigations

- Dillon Consulting Limited (Dillon). (2023). Former Country Harbour Mine Site: Environmental Screening Report. September 2023;
- Dillon Consulting Limited (Dillon). (2024a). Phase I Environmental Site Assessment: Former Country Harbour Mine Site, Guysborough County, Nova Scotia, Property Identification Designation Numbers: 35091354 and a Portion of 35094366. March 2024;
- Dillon Consulting Limited (Dillon). (2024b). Phase II Environmental Site Assessment (Final): Former Country Harbour Mine Site, Guysborough County, Nova Scotia, Property Identification Designation Numbers: 35091354 and a Portion of 35094366. March 2024;
- Dillon Consulting Limited (Dillon). (2025a). Supplemental ESA: Former Country Harbour Mine Site, Guysborough County, Nova Scotia, Property Identification Designation Numbers: 35091354 and a Portion of 35094366. January 2025 (Appendix I); and
- Dillon Consulting Limited (Dillon). (2025b). Former Country Harbour Mine Site: Aquatic Habitat Assessment Report. January 2025 (Appendix E).

2.5.1 Environmental Screening Report (Dillon, **2023**)

Dillon was commissioned by BNS to complete an environmental screening report in anticipation of a planned Phase II ESA field program at the Former Country Harbour Mine Site. The purpose of the report was to present a technical assessment of potential environmental constraints that may affect project

activities. Watercourses, wetlands, species at risk (SAR) and species of conservation concern (SoCC) that had the potential to be impacted by project activities were identified. The interaction between those features and proposed project components (e.g., tree clearing, drilling) were assessed, and recommended mitigation measures to limit potential impacts were provided.

The report identified 26 different SAR and SoCC within 5 km of the former mine site based on historical observations reported to the Atlantic Canada Conservation Data Centre (AC CDC), including one fish, 14 birds, one freshwater mussel, two vascular plants, and eight lichens. However, it was noted that the AC CDC report showed no historical observations within the former mine footprint. The nearest SAR and SoCC records were approximately 1 km away from the approximate centre of the former mine site.

The report assessed potential fish and fish habitat, vegetation, wildlife and wildlife habitat at the site which have been previously discussed in Section 2.2 and recommended mitigation measures to limit impacts. Further details can be found in the Environmental Screening report (Dillon, 2023).

2.5.2 Phase I Environmental Site Assessment (Dillon, 2024a)

Dillon was commissioned by BNS to complete a Phase I ESA of the Former Country Harbour Mine, located at PID No. 35091354 and a portion of PID No. 35094366, with the objective of assessing whether the site is or may be subject to actual or potential contamination. The report identified four APECs and associated contaminants of potential concern (COPCs) as documented in Table 2-1 below.

Table 2-1: Summary of APECs COPCs (adopted from Dillon, 2024a)

APEC No.	APEC	COPCs	Media of Concern	Comments
1	Tailings Area	Metals, General Chemistry*, Sulphur	Soil, GW, Sed, SW	One waste tailings area with potentially sulphide bearing materials. Surface water discharge location in Johnston Brook, downstream of the cross-culverts along John Fenton Loop Road.
2	Stamp Milling Areas	Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW, Sed, SW	Three stamp milling areas where potentially sulphide bearing materials may have been processed. Processing of materials, heavy equipment storage, and petroleum storage. Surface water is directed to Johnston Brook.
3	Waste Rock Piles	Metals, General Chemistry*, Sulphur	Soil, GW, Sed, SW	Two waste rock areas with potentially sulphide bearing slates, one of which is located in Johnston Brook.
4	Domestic Waste Dumping Areas	Metals, PHCs, PAHs	Soil	Three locations where domestic waste and discarded fuel drums were identified during the Phase I ESA site visit.

APEC No.	APEC	COPCs	Media of Concern	Comments
Assessment of Naturally Occurring Background Conditions				
Background Location		Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW	Based on available topographic data and inferred groundwater flow direction, background conditions will be assessed at an upgradient location within the assessment boundary that is safely accessible.
Upstream Background Location		Metals, General Chemistry*, Sulphur, sPHCs, PAHs	Sed, SW	Surface water and sediment conditions will be assessed at an upstream location within the assessment boundary that is safely accessible.

*General chemistry analysis only to be completed on water.
Acronyms: GW = groundwater, Sed = sediment, SW = surface water, PHC = petroleum hydrocarbons (i.e., benzene, toluene, ethylbenzene, and xylenes (BTEX), and modified TPH), PAH = polycyclic aromatic hydrocarbons.

Historical documents for the site identified the construction of a large storage magazine and a day magazine, as well as costing for explosives intended to be used at the site. The locations of these former magazines were identified as unknown, although it was assumed that they would have been constructed some distance from other buildings and infrastructure previously on-site. The Phase I ESA recommended up to five soil samples be collected across the site in areas that are safely distanced from previous site building locations and analyzed for energetics (i.e., residual products of explosives including nitrotoluenes, glycerines, perchlorates, and bromate).

2.5.3 Phase II Environmental Site Assessment (Dillon, **2024**b)

Following completion of the Phase I ESA, Dillon was commissioned by BNS to complete a Phase II ESA of the Former Country Harbour Mine to further investigate site conditions. The Phase II ESA included the advancement of five boreholes, each completed as monitoring wells, and soil, groundwater, surface water and sediment sampling. For comparison to the Nova Scotia Contaminated Sites Regulations (NS CSRs) Tier I Environmental Quality Standards (EQS), the site was considered to be commercial, potable with both fine and coarse-grained soil conditions. Findings of the Phase II ESA as they pertain to the HHERA were as follows (further detail can be found in Dillon, 2024b):

- Concentrations of metals and pH in surface water that did not meet the applicable guidelines;
- Concentrations of metals in sediments that did not meet the applicable guidelines;
- Concentrations of metals and ethylbenzene in soils that did not meet the applicable guidelines; and
- Concentrations of metals in groundwater that did not meet the applicable guidelines.

Following completion of the Phase II ESA, Dillon completed a qualitative risk review of the site to identify relevant contaminants of concern (COCs), media, pathways, receptors, and potential risk. Supplemental sampling and a risk assessment was recommended.

2.5.4 Supplemental Environmental Site Assessment (Dillon, 2025a)

Dillon was retained by BNS on behalf of DNRR to complete a Supplemental ESA at the former Country Harbour Mine. Four AECs and various COCs were identified from the previous 2023 Phase I ESA at the site in soil, sediment, surface water and groundwater. The Supplemental ESA work included the advancement of 65 shallow borehole, and sampling of surface water, sediment, soil and groundwater.

Results from the Supplemental ESA sampling are noted below, while additional details can be found in Appendix I:

- Surface water samples collected from Johnston Brook had metal concentrations (i.e., aluminum, arsenic, iron, lead and/or zinc) that exceed the Nova Scotia Tier I EQS for surface water at each sample location;
- Metals concentrations in sediment were generally either below laboratory detection limits, or within the applicable Nova Scotia Tier I EQS, with the exception of arsenic, iron, lead, manganese and/or mercury exceedances observed at each sediment sampling location. Iron and manganese concentrations were generally of similar magnitude in each of the sediment samples;
- Dissolved metals concentrations in groundwater were generally either below laboratory detection limits or within the applicable Nova Scotia Tier I EQS, with some exceptions (i.e., arsenic, cobalt, iron, lead, and manganese). Delineation of metals impacts in groundwater has not been achieved;
- Metals concentrations in soil samples were noted above the Nova Scotia Tier I EQS across the site, with notable widespread exceedances for aluminum, arsenic, beryllium, iron, lead, manganese, selenium, vanadium and zinc. Although not widespread, mercury exceedances were noted above the Tier I EQS in ten locations in the central portion of the study area. Lateral delineation in soils for metals was achieved to the north and south with partial delineation to the east and west on the northern portion of the assessment area. Vertically soil impacts are delineated by bedrock across the site which ranged from 0.53 mbgs to 1.37 mbgs;
- Ethylbenzene in soil exceeded the Tier I EQS at BH17 (0-0.15 m), which was advanced in an area of refuse underlain by waste rock. Four step out samples and a deeper sample were collected in the location of BH17. Benzene, toluene, ethylbenzene, xylene and/or Modified TPH exceedances of the Tier I EQS were found in the deeper sample and in 3 of the 4 step out samples. Based on these findings, lateral delineation of petroleum hydrocarbon impacts was not achieved to the north, south or west. Vertical delineation was not achieved; and
- While there is no Tier I EQS for sulphur, a comparison value of 4000 mg/kg was taken from the Sulphide Bearing Material Disposal Regulations. Three soil samples, BH30 0-0.15, BH111 0-0.15 m and its field duplicate, with concentrations ranging from 4,500 mg/kg to 8,700 mg/kg, exceeded the 4000 mg/kg comparison value.

2.5.5 Aquatic Habitat Assessment (Dillon, 2025b)

Dillon was commissioned by BNS to conduct an aquatic habitat assessment for the portion of Johnston Brook that intersects the Former Country Harbour Mine Site. The purpose of the assessment was to map

the portion of the Johnston Brook watercourse that intersects the assessment area, and to collect information to confirm the absence or presence of suitable habitat for fish and other aquatic receptors.

A Dillon biologist conducted a field assessment in May 2024 and collected samples for analysis of environmental DNA (eDNA). The brook assessment was broken up into five reaches that were determined during the assessment, either by similar habitat characteristics or based on observed barriers to fish passage. In addition, an assessment of a background location upstream from the site was completed. A fish presence or absence visual survey was also conducted, and the biophysical characteristics of the watercourse were evaluated for fish habitat potential based on requirements for known species in the region. The eDNA testing consisted of targeted analyses for northern leopard frog, American eel, wood turtle, and dreissenid mussels, as well as a general fish assay.

The watercourse overall has a steep grade and predominantly large substrate, with a short waterfall at the furthest downstream extent and another waterfall approximately 500 m upstream of the southernmost property boundary. Although fish were not observed during the site visits, it was determined that most reaches of the brook likely provide suitable fish habitat at some times for common small-bodied fish species that can tolerate acidic water and are capable of maneuvering through some debris and waterfalls. An underground section of flow (between Reaches 3 and 4) represents an effective fish barrier and it was determined to be unlikely that fish would be capable of crossing it. The eDNA results corroborate these observations, showing very low confidence that fish species are present in the upstream locations, especially when compared to downstream sample locations where all replicates identified the presence of fish eDNA. Mussels, wood turtle, and northern leopard frog eDNA were not detected in any samples, and American eel eDNA was only detected at the downstream location (and at a very low detection rate). Further details pertaining to the Aquatic Habitat Assessment can be found in the report (Appendix E).

2.6 Data Availability and QA/QC

2.6.1 Background Data

Background samples of each media type with the exception of groundwater were collected within the subject property boundaries but outside of the assessment area, to represent local background conditions. One monitoring well was installed with the intention of representing background groundwater conditions (i.e., 24-MW01); however, upon review of the laboratory data, it was determined that concentrations of contaminants in this location were potentially influenced by historic site activities due to elevated soil PAH concentrations in that area. Therefore, this sample was removed from the background dataset.

Laboratory certificates of analysis can be found in the Environmental Site Assessment Report (Dillon, 2025a) which is included herein as Appendix I. Background soil, sediment and surface water analytical data considered in the HHERA can be found in Appendix C. Background data are further discussed in the following subsections.

2.6.1.1 Soil

The normal abundance of a contaminant (e.g., arsenic) occurring in uncontaminated soil is defined as the 'geochemical background' and is normally provided as a range, not a single value (Parsons and Little, 2015). Federal soil quality guidelines for human health do not take into account the variation in soil chemistry for specific sites (e.g., the CCME soil quality guideline for arsenic of 12 mg/kg is based on agricultural soils from Ontario and the Canadian prairies (i.e., the soil conditions of Nova Scotia were not considered)) and so these guideline values may not necessarily be appropriate for a former mining site positioned in an area containing arsenopyrite (a mineral containing iron, arsenic and sulphur). In much of the province, arsenic is naturally enriched in environmental media. For example, arsenic in well water in the Country Harbour area is considered to be high risk based on natural conditions (NS DNR, 2017) even in areas outside of known mining activity. Urban background concentrations of arsenic in the Halifax Regional Municipality ranged up to 45 mg/kg (Kennedy et al., 2018). The highest concentrations of arsenic Nova Scotia are found within 64 gold mining districts (including Country Harbour) which have been mined since the mid-1800s and arsenopyrite occurs naturally in these gold deposits (Parsons and Little, 2015). Background arsenic soil concentrations in the vicinity of the former Montague mine and Goldenville mine have been reported to range up to 273 mg/kg and 140 mg/kg, respectively (Parsons and Little, 2015). In consideration of this information, it was important for this HHERA to consider the differences between elevated arsenic concentrations which are present due to the site geology, and elevated arsenic concentrations from historical mining activities.

The background soil data selected for HHERA screening purposes were compiled from the sampling program in the Phase II ESA (Dillon, 2024b) and the Supplemental ESA (Dillon, 2025a). Samples were collected from within the subject property boundaries but outside the areas considered to be potentially contaminated (i.e., the assessment area). Samples collected to the north of the identified AECs (on PID 35094366) (Figure 3, Appendix A) were initially intended to represent background conditions. Upon reviewing the analytical chemistry data, many of these 'background' soil samples had elevated concentrations of arsenic (e.g., BH2 had a reported surface soil (0 to 0.15 m) arsenic concentration of 1,490 mg/kg; no analytical results for arsenic were available at this location at deeper depths) and are unlikely to be associated with naturally occurring sources of arsenic.

Sample BH69 (at 0 to 0.15 m) had an arsenic concentration of 400 mg/kg, while the deeper sample (0.15 to 0.34 m) at this same location had an arsenic concentration of 1050 mg/kg. Given the distance of sample BH69 from the site (approximately 450 m north of the most northern APEC which contained waste rock and refuse), and given the surface sample had a lower concentration than the sub-surface concentration, this sample was retained as a background sample. The majority of the background soil samples had lower arsenic concentrations in the surface soil sample (0 to 0.15 m) and higher arsenic concentrations in the deeper samples. Sample BH69 is also upgradient of the site (the elevation rises as one moves towards the north of the site).

After review, the following samples were removed from the background dataset and were considered to represent site conditions in this HHRA:

- BH1 - PHCs were reported at this location above the reported detection limit. PHCs are not known to be naturally occurring and so their presence suggests that this location could potentially be impacted by historical site activities;
- BH2 - Similar to BH1, PHCs were reported at this location above the reported detection limit. PHCs are not known to be naturally occurring and so their presence suggests that this location could potentially be impacted by historical site activities. Arsenic, which is associated with gold mining activity at the former Country Harbour mine was also reported at very high concentrations at BH2 (1,490 mg/kg) which implies this location could be impacted by historical activities; and
- 24MW-01 - Given the proximity of 24MW-01 in relation to BH1 and BH2 (i.e., 24MW-01 lies between BH1 and BH2, see Figure 3, Appendix A) 24MW-01 is conservatively assessed alongside site data and not background.

In total, 22 background soil samples (including two field duplicates) collected from within the property but outside the areas considered potentially impacted, were analyzed for metals. Local background soil samples were collected at various depths and distances from the site AECs, ranging from approximately 160 m to 650 m from the nearest AEC (Figure 3, Appendix A).

From this background soil chemistry data set, a representative background concentration statistic for arsenic was determined. It is helpful to estimate typical local background concentrations for arsenic in the vicinity of gold mining and milling operations as arsenic tends to be naturally elevated in areas of gold deposits, due to the close association of pyritic minerals with gold-bearing minerals. One of the key arsenic-containing pyritic minerals that is common to areas of gold deposits in Nova Scotia is arsenopyrite. A 90th percentile arsenic concentration in background soil samples was used as the arsenic background concentration statistic herein (i.e., 286 mg/kg). The 90th percentile is commonly used and widely accepted as a reasonable upper bound background concentration for chemicals in soil in a large number of North American jurisdictions.

In addition to local background soil data, two background surface water and two background sediment samples were collected from Johnston Brook (upgradient of the AECs and analyzed for metals, BTEX/PHCs, and general chemistry (sediment and surface water) as well as PAHs (surface water only) (Figure 4, Appendix A).

2.6.2 Site Data

The site data include soil, sediment, surface water and groundwater samples collected between November 2023 and May 2024. Samples selected for the HHERA were compiled from the Phase II ESA field program (Dillon, 2023) and the Supplemental ESA work conducted in 2024 for the HHERA (Dillon, 2025a, Appendix I).

Laboratory certificates of analysis can be found in Appendix I, and site soil, sediment and surface water analytical data considered in the HHERA can be found in Appendix C. Site data are further discussed in the following subsections.

Soil

A total of 122 soil samples (including nine duplicates) collected from various depths within the study boundary were analyzed for metals. In addition, a subset of 24 samples (including one duplicate) were analyzed for PAHs, 30 samples were analyzed for BTEX and PHCs (including three duplicates), five samples were analyzed for energetics and 12 samples were analyzed for general chemistry. In addition, 22 (including two duplicates) soil samples were collected to the north of the study area as background samples and were analyzed for metals.

Groundwater

A total of 12 groundwater samples (including one duplicate sample) were collected from five on-site monitoring wells during 2024. Each sample was analyzed for general chemistry and metals, with a sub-set of six of the samples being analyzed for PAHs, BTEX and PHCs. In addition, two groundwater samples (including one duplicate) were collected from 24MW-01 north of the study area and analyzed for general chemistry, metals, PAHs, BTEX and PHCs.

Surface Water

A total of 16 surface water samples (including one duplicate sample) were collected from various locations along Johnson's Brook within the study boundary. All samples were analyzed for general chemistry and metals. In addition, 10 of these samples were filtered and analyzed for metals. A sub-set of three samples (including one duplicate sample) were analyzed for PAHs, BTEX and PHCs. In addition, two surface water samples were collected from Johnson's Brook upstream from the study boundary and analyzed for metals and general chemistry and considered as background samples.

Sediment

A total of 16 sediment samples (including two duplicates) were collected from various locations along Johnson's Brook within the study boundary. All samples were analyzed for metals, and a sub-set of five samples (including one duplicate) were analyzed for BTEX and PHCs, and general chemistry. In addition, two sediment samples were collected from Johnson's Brook upstream from the study boundary and analyzed for metals and general chemistry and considered as background samples.

2.6.3 Bioaccessibility Data

To aid in calculating site-specific oral RBA (relative bioavailability), five soil samples were submitted for *in vitro* bioaccessibility (IVBA) testing for arsenic. The IVBA data were used in the exposure assessment step of the HHRA to aid in estimating the oral bioavailability of arsenic in soils. Additional details are provided in Section 3.4.2. Results of the IVBA testing can be found in Appendix D.

2.6.4 Data Quality Assurance and Control

A program to ensure data quality assurance and control (QA/QC) was implemented throughout the Phase I and II ESAs (Dillon, 2024a,b) and the Supplemental ESA (Dillon, 2025a). The QA/QC program consisted of the following elements:

- Collection of samples using protocols consistent with Dillon Standard Environmental Field Procedures and/or industry standards;
- Use of dedicated sampling equipment and/or adherence to established equipment cleaning protocols, where applicable;
- Use of laboratory supplied containers;
- Collection of blind field duplicates; and
- Implementation of laboratory QA/QC procedures including analysis of reference standards, laboratory blanks and replicates.

Validation criteria were established that required the analytical data to have an acceptable and documented level of precision, accuracy, representativeness, comparability and completeness (the PARCC criteria). The precision of the data for the samples collected was evaluated by calculating the Relative Percent Difference (RPD) between the original samples and its duplicate when the samples had concentrations greater than five times the laboratory Reportable Detection Limit (RDL).

Laboratory certificates of analysis were reviewed for internal quality assurance/quality control (QA/QC) metrics (i.e., method blanks, certified reference materials, spiked blanks, and matrix spikes). Overall, no significant data quality issues were identified that would affect the use of the site data in the HHERA. Laboratory certificates of analysis for data used in the HHERA can be found in Appendix I.

3.0 Human Health Risk Assessment

3.1 Human Health Risk Assessment Framework, Purpose and Scope

Risk assessment is a systematic quantitative or qualitative process for interpreting the potential adverse effects associated with an activity, situation, or an exposure. The framework and methods used for the HHRA for the Country Harbour site are described in this section and its associated subsections.



The fundamental purpose of any HHRA is to estimate or determine whether people working, living at, or visiting a given location are being exposed, or are likely to be exposed, to concentrations of chemicals that have the potential to result in adverse human health effects (i.e., toxicity). In order for a potential risk to exist, three things must be present: a contaminant of potential concern (or hazard), a receptor, and an exposure pathway that links the chemical constituent to the receptor, as presented in the graphic to the right. If one of these elements is missing, potential risk does not exist. If all three elements are present, then the degree of risk may be estimated and compared to target risk levels to identify whether or not unacceptable levels of risk are present and remedial action or risk management is required.

The HHRA for the Country Harbour Former Mine site was conducted in accordance with the following Canadian regulatory guidance documents, where applicable:

- Federal Contaminated Site Risk Assessment in Canada. Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Version 4.0. March 2024. Health Canada Contaminated Sites Division, Safe Environments Directorate (Health Canada, 2024);
- Federal Contaminated Site Risk Assessment in Canada. Toxicological Reference Values (TRVs). Version 3.0. March 2021. Health Canada Contaminated Sites Division, Safe Environments Directorate (Health Canada, 2021a);
- Federal Contaminated Site Risk Assessment in Canada. Overview of Health Canada Guidance Documents Related to Human Health Risk Assessment of Federal Contaminated Sites. March 2021. Health Canada Contaminated Sites Division, Safe Environments Directorate (Health Canada, 2021b);

- Federal Contaminated Site Risk Assessment in Canada. Part V. Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRACHEM). September 2012. Prepared by: Health Canada Contaminated Sites Division, Safe Environments Directorate (Health Canada, 2010);
- Canada Wide Standard for Petroleum Hydrocarbons in Soil: Scientific Rationale. Supporting Technical Document. PN 1399. ISBN 978-1-896997-77-3 PDF (Canadian Council of Ministers of the Environment [CCME], 2008); and
- CCME Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME, 2006).

The HHRA also utilized relevant guidelines and approaches provided in the Nova Scotia Contaminated Sites ministerial protocols (Atlantic PIRI, 2022; NSECC, 2022). NSECC has adopted environmental quality benchmarks derived by the CCME, and other regulatory authorities in Canadian or international jurisdictions. Where appropriate or necessary, the Human Health Risk Assessment (HHRA) also considered human health risk assessment guidance and procedures developed and endorsed by other regulatory agencies such as the US EPA (Environmental Protection Agency). In this HHRA, the US EPA Regional Screening Levels (RSL) (US EPA, 2024) were used as a guideline source for COPC screening, consistent with Health Canada (2024) PQRA guidance, in the absence of federal or provincial benchmarks.

An HHRA typically consists of five main steps or phases, as outlined below and in Figure 3-1.

Problem Formulation: The data gathered and evaluated in this step provides information regarding the history and layout of the subject site, possible exposure scenarios and pathways, identification of receptors of potential concern, identification of contaminants of concern, other specific issues of concern to be addressed, and the development of a conceptual site model.

Exposure Assessment: The exposure assessment of an HHRA involves estimation of exposure of hypothetical human receptors to each of the COPCs.

Toxicity (Hazard) Assessment: This step determines an exposure limit or toxicological reference value (i.e., concentration of a chemical not expected to be associated with adverse health effects or a concentration associated with an acceptable risk level) for each of the COPCs.

Risk Characterization: Integrates the exposure and toxicity (hazard) assessments to estimate the likelihood of potential human health risk for the receptors, COPCs, exposure pathways and exposure scenarios that were evaluated. Potential risk is characterized through a comparison of the estimated or predicted COPC exposures to the selected human receptors from all exposure pathways and routes (from the exposure assessment) with the identified TRVs from the toxicity (hazard) assessment.

Risk Management Recommendations: determination of the need for corrective action, and development of site-specific risk management objectives and/or criteria (such as site-specific target levels, or SSTLs), if required.

The specific methods used to conduct each step of the HHRA, as well as the results or outcomes of these steps, are described and discussed in Sections 3.2 through 3.5.

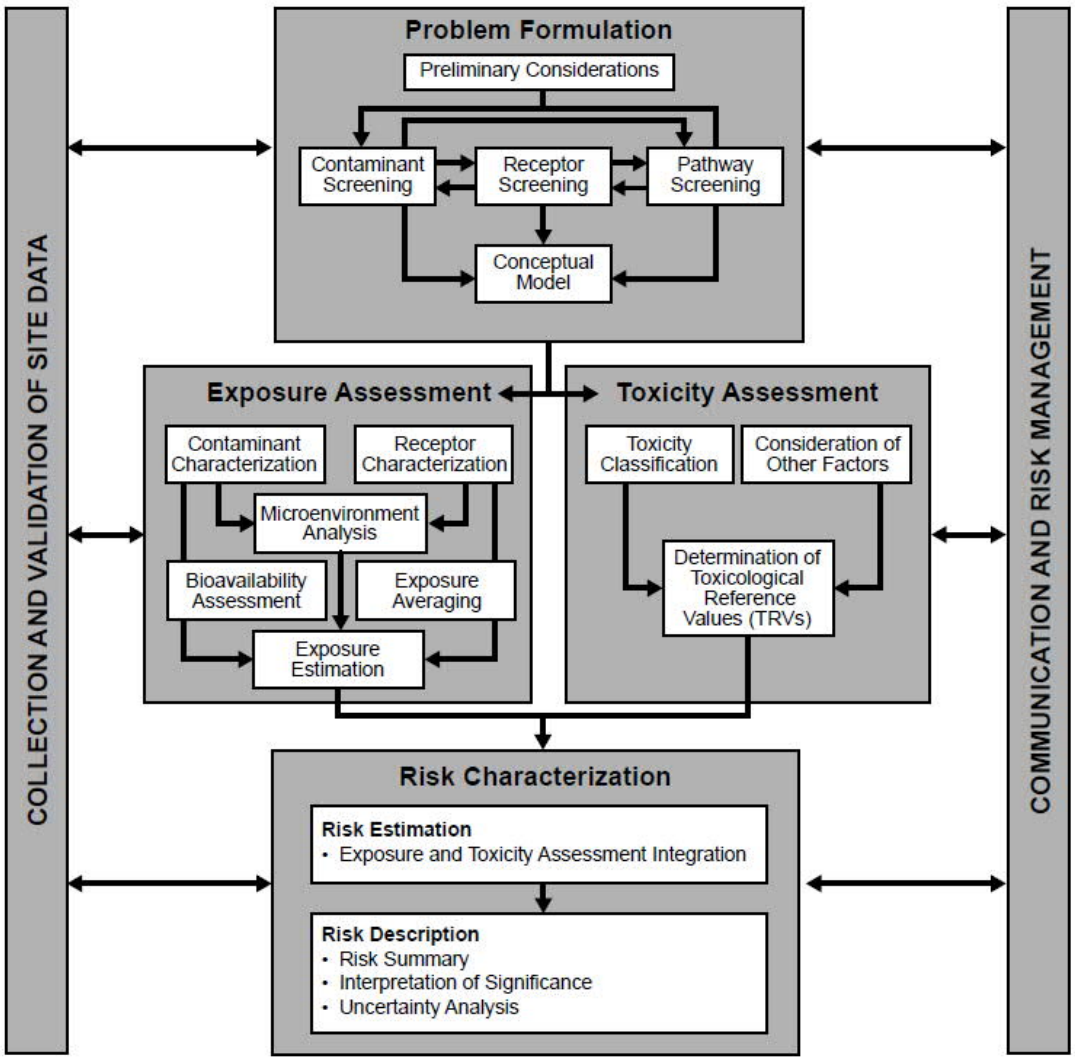


Figure 3-1: Human Health Risk Assessment Framework (from Health Canada, 2010)

3.2 Problem Formulation

The problem formulation step of an HHRA is an information gathering step that helps to plan and focus the risk assessment. The data gathered and evaluated in this step provides information regarding the history and layout of the subject site, possible exposure scenarios and pathways, identification of receptors of potential concern, identification of contaminants of concern, and other specific issues of concern to be addressed.

Key tasks requiring evaluation within the problem formulation step include the following:

- Site characterization;

- Selection of receptors;
- Selection of exposure pathways and scenarios;
- Identification of COPCs; and
- Development of a conceptual site model (CSM).

Outcomes of the problem formulation are provided in the following sections.

3.2.1 Site Characterization

The site characterization step provides a description of the site including information regarding the history and layout of the site and site characteristics that are pertinent to understanding and assessing potential exposures on the site.

Site characterization for the study boundary was previously provided in Section 2.0. Site photos are provided in Appendix B and within the Aquatic Habitat Assessment (Appendix E).

3.2.2 Selection and Characterization of Receptors

A human receptor is a hypothetical person (e.g., infant, toddler, child, adolescent, or adult) who resides, visits, or works in the area being investigated and is, or could potentially be, exposed to the chemicals identified as being of potential concern. General physical/physiological and behavioural characteristics specific to the receptor type (e.g., body weight, breathing rate, amount of soil, and food consumed) are used to determine the amount of chemical exposure received by each receptor. Due to differences in these characteristics between children and adults and between males and females, the exposures received by a female child, a male child, a female adult, or a male adult will be different. Consequently, the potential risks posed by the chemicals being evaluated will also differ depending on the receptor chosen for evaluation. While HHRA guidance in some jurisdictions continues to differentiate receptors based on gender, Health Canada HHRA guidance has moved away from distinguishing between genders for the selection of human receptors.

Since people have varying physical/physiological features, lifestyles and habits, it is not possible to evaluate all types of individuals. However, a HHRA must be sufficiently comprehensive to ensure that those receptors with the greatest potential for exposure to COPCs or those that have the greatest sensitivity, or potential for developing adverse effects from such exposures, are included in the evaluation. If potential health risks are not determined for relevant receptors that are considered to be either the most sensitive, or to receive the greatest exposures from the site, then it can be assumed that those receptors who are either less sensitive, or who receive lower exposures, would also not be at risk.

For chemicals that are considered to be carcinogens, or that have TRVs available that are based on a chemical's carcinogenic effects, it is necessary that HHRAs evaluate such substances over an appropriate period of time, as the development of cancer is a long-term process that may take many years to manifest (i.e., latency). For this reason, a special type of hypothetical receptor called a "lifetime" or "composite" receptor is evaluated when potential carcinogenic risks require consideration in a HHRA.

Based on the current and reasonably anticipated future land use identified for the site, the following potential human receptors (i.e., people who may be exposed to COPCs from the site) were selected:

- Outdoor Site Visitor (toddler, child, teen and adult age classes) – the most likely human receptor for the site are site visitors (all ages except infants) using the land for recreational purposes (walking, hiking, etc.). Infants are excluded from assessment as it is unlikely that infants would be present with their caregivers on the site. Furthermore, HHRAs do not typically assess infant receptors in relation to contaminated sites, unless the sites are residential or high use recreational, which isn't the case for the subject site; and
- Outdoor Site Worker (adult and teen age classes) - there are currently no buildings on site and no immediate construction work is planned for the site; however, the site is being considered for wind energy development. On this basis outdoor site workers could be exposed to contaminated media at the site including surface and subsurface soils.

Currently, within some areas within the two PIDs that encompass the site, commercial forest harvesting occurs to a limited extent. The worker exposure scenario assumes current chemical concentrations represent future concentrations and would apply to such workers on-site. It is anticipated that the site or portions of the site may be developed into a wind farm in the future. The assumptions made herein for the worker exposure scenario are considered to reflect both potential forestry workers and workers that may develop the site into a wind farm. Any worker scenarios beyond these are not considered herein and would be best addressed with site-specific health and safety plans and programs and adherence to provincial occupational health and safety regulations and legislation.

Key parameters and assumptions for the receptors evaluated in the HHRA are described in Table 3-1, below:

Table 3-1: Summary of Parameters and Assumptions for Human Receptors

Parameter	Value	Reference
Age (years)	Toddler: 6 months to <5 years Child: 5 years to <12 years Teen: 12 years to <20 years Adult: ≥20 years	Health Canada, 2024
Body Weight (kg)	Toddler: 16.5 Child: 32.9 Teen: 59.7 Adult: 70.7	Health Canada, 2024
Inhalation Rate (m^3/day)	Toddler: 8.3 Child: 14.5 Teen: 15.6 Adult: 16.6	Health Canada, 2024
Water Ingestion Rate (L/day)	Toddler: 0.6 Child: 0.8 Teen: 1.0 Adult: 1.5	Health Canada, 2024

Parameter	Value	Reference
Soil Ingestion Rate (mg/day)	Toddler: 80 Child: 20 Teen: 20 Adult: 20	Health Canada, 2024
Hand Surface Area (m^2)	Toddler: 0.043 Child: 0.059 Teen: 0.08 Adult: 0.089	Health Canada, 2024
Skin Surface Area (upper and lower arms and legs) (m^2)	Toddler: 0.258 Child: 0.455 Teen: 0.720 Adult: 0.822	Health Canada, 2024
Hand Soil Adherence Factor (kg/cm^2-event)	Toddler: 1×10^{-7} Child: 1×10^{-7} Teen: 1×10^{-7} Adult: 1×10^{-7}	Health Canada, 2024
Skin Soil Adherence Factor (kg/cm^2 – event)	Toddler: 1×10^{-8} Child: 1×10^{-8} Teen: 1×10^{-8} Adult: 1×10^{-8}	Health Canada, 2024
Outdoor Dust Level from Soil (g/m^3) [1]	7.6×10^{-6}	Health Canada, 2024
Fraction of airborne dust generated from site soil	1.0	Assumed [b]
Life Expectancy (yrs)	80	Health Canada, 2024
Time Spent On Site[2]	*Outdoor site visitor*: 2 hours/day, 1 day/week, for 6 months/year (26 weeks; assumed May to October). *Outdoor site worker*: 10 hours/day, 5 days/week, for 48 weeks/year for 2 consecutive years working on site out of a 40 year working lifespan.	Assumed

Notes:

1. The site is heavily forested with difficult terrain. There is an unpaved access road. Local residents would be able to access the site for recreational use (ATVs). As such the outdoor dust level assumes vehicular traffic on unpaved roads.
2. For oral and dermal soil contact exposure pathways (described in Section 3.2.3), exposures are considered event driven, and as such, the hours/day term does not apply in the exposure and risk modelling. Inhalation exposures are considered time driven where the hours/day is included. For developmental toxicants such as lead, the weeks per year time term is also omitted (as per Health Canada, 2024 guidance) leaving only days per week as the exposure frequency and duration terms.
3. For the worker, non-threshold risk was also amortized by conservatively assuming two years of the 40 year working life would be spent on-site.

3.2.3 Selection of Exposure Pathways and Scenarios

People can come into contact with chemicals in a variety of ways, depending on their daily activities and their land use patterns. The means by which a person comes into contact with a chemical in an environmental medium are referred to as exposure pathways. The means by which a chemical enters

the body from the environmental medium are referred to as exposure routes. There are three major exposure routes through which chemicals can enter the body: inhalation, ingestion, and dermal absorption through the skin. For each of these major exposure routes, there are a number of potential exposure pathways. For example:

- **Inhalation** of gases, vapours, and dusts/particulate material through the lungs;
- **Ingestion** of soils, dusts, drinking water, garden produce, local food items (e.g., fish, shellfish, game meats, wild berries/plants), grocery store-bought food items, and accidental/incidental ingestion of surface water, groundwater, and/or sediments; and
- **Dermal absorption** (uptake through the skin) from direct skin contact with gases/vapours, soils/dusts/sediments, water, and other materials.

The potential for adverse health effects to occur as a result of exposure to chemicals, in any medium, is directly related to the exposure pathways. If there is no possible pathway of exposure to a chemical, regardless of its toxic potency or concentration within a given medium, there is no potential for the development of adverse health effects from that chemical.

Exposure scenarios are based on the outcomes of exposure pathway, receptor, and COPC identification/selection at a site, and describe how human exposure to site contaminants may take place. Exposure scenarios were selected based on the information previously presented in relation to site characterization, COPC identification, receptor selection, exposure pathway selection, and land use.

Based on the information previously presented in relation to site characterization, COPC identification and exposure pathway selection, and assuming that a commercial land use will be applicable in the future, the selected exposure scenario was as follows:

- Outdoor Site Visitor Scenario: This scenario assumes that receptors (all age classes except infants) would periodically visit the site. It was assumed that outdoor site visitors would be present on the site for a maximum of 2 hours per day, 1 day per week for 26 weeks per year; and
- Outdoor Site Worker: This scenario assumes that receptors (adult and teen site workers) would be working on site. The outdoor site worker would potentially be exposed to impacted soil at all depths and it was assumed that any outdoor site worker would be on site for a maximum of 10 hours per day, 5 days per week, 48 weeks per year.

The most likely and relevant human exposure pathways/routes for site-related exposures were considered to be as follows:

Outdoor Site Visitor (all ages with the exception of infants)

- Inhalation of outdoor soils/dusts;
- Ingestion and dermal contact of outdoor soils/dusts; and
- Ingestion of groundwater (as potable drinking water).

Outdoor Site Worker (teen, adult)

- Inhalation of outdoor soils/dusts;

- Ingestion and dermal contact of outdoor soils/dusts; and
- Ingestion of groundwater (as potable drinking water).

These exposure pathways were evaluated in the HHRA.

A number of other potential exposure pathways for human receptors were considered, but were ultimately excluded, as briefly summarized in Table 3-2, below. HHRAs commonly exclude pathways that are not relevant to the site under investigation or that lack sufficient data to enable their evaluation with a reasonable degree of confidence and/or accuracy.

Table 3-2: Summary of Selected and Excluded Exposure Pathways for the Country Harbour Former Mine Site

Pathway	Selected or Excluded?	Rationale
Inhalation of outdoor soils/dusts	Selected	COPCs have been identified in site soils. People may be exposed to COPC in surface soils while on site.
Dermal Contact with outdoor soils/dusts	Selected	
Ingestion of outdoor soils/dusts	Selected	
Groundwater ingestion (as drinking water)	Selected	While there are currently no potable groundwater wells on site, there are potable wells immediately offsite to the south (the closest well is approximately 50 m south from the southern boundary). In addition, a subsurface worker could potentially be exposed to groundwater through incidental ingestion.
Ingestion and dermal contact of surface water/sediments	Excluded	While there is surface water and sediment present on the site within Johnson's Brook, this water is not anticipated to be used for drinking. Further, the brook is not anticipated to be used for swimming due to the brook's shallow depth and narrow width. If someone were to accidentally fall into the brook, exposure to COPCs in surface water and sediment would be considered transient (i.e., of very short duration and insignificant). The HHRA assumes current conditions are representative of future conditions including that water is consistently present in the on-site watercourse. Should the brook dry out (i.e., due to climate change) and existing sediment dries out and becomes exposed as soil, contaminants currently present in sediment will need to be examined further.

Pathway	Selected or Excluded?	Rationale
Dermal contact with groundwater	Excluded	The depth of groundwater throughout the site, based on site monitoring wells, is generally shallow (e.g., 24MW-05 had a reported depth to groundwater of 0.214 mbgs). The site is currently used for commercial forest harvesting and is also being considered for wind energy development. While site workers undertaking these activities could potentially experience dermal contact with the groundwater during potential excavations or in trenches, this would be expected to occur infrequently and of short-duration. As such, exposures via this pathway would be expected to be negligible. As such, dermal contact with groundwater was excluded.
Inhalation of vapours in indoor air	Excluded	There are no habitable or occupied buildings on the site. The construction of buildings on site is not anticipated to occur in the future.
Indoor dust ingestion, dermal contact and ingestion	Excluded	
Ingestion of country foods	Excluded	There is no indication that the site is used for country food harvesting (including plants, berries, and local fish and game species). In addition, the terrain on the site is challenging (e.g., steep areas, dense forest), which would make the site difficult to use for country food harvesting, relative to numerous other sites in the vicinity of the subject site. If hunting / harvesting is occurring on the site now or will be in the future, this pathway should be investigated further.
Ingestion of agricultural foods (crops, livestock)	Excluded	The site has never been and is unlikely to ever be used for agricultural purposes. Soil and terrain conditions would make any attempt to use the site for agricultural purposes extremely challenging.
Outdoor air inhalation	Excluded	Even though trace amounts of site contaminants could potentially volatilize from soils and groundwater to outdoor air, these vapours would be readily disbursed in the outdoor air. Exposures via this pathway are expected to be negligible and as such, this pathway was excluded from assessment.

Pathway	Selected or Excluded?	Rationale
Market basket (grocery) food ingestion	Excluded	Chemicals could occur in common grocery store food items; however, they would not be site-related and as such this pathway was excluded.

3.2.4 Identification of COPCs

It is common practice in HHRAs to limit the number of chemicals evaluated to those that represent the greatest potential concern to people that may be present in the area under consideration. This is done because it is often impractical in terms of time and cost to conduct a risk assessment for every chemical that has been found at measurable concentrations in a particular area. In addition, the concentrations of many chemicals associated with a particular site may be similar to chemical concentrations found naturally in the area rather than the result of predicted, current or former anthropogenic activities at the site. It is also preferable to comprehensively evaluate a smaller number of chemicals which represent the greatest potential concern, than it is to conduct a less detailed risk assessment on a larger number of chemicals that are of lesser potential concern.

This step of the HHRA identifies chemicals that have the potential to pose a risk to human health. As per Health Canada (2021a) guidance, COPCs are defined as follows:

- Chemicals for which the maximum on-site concentration exceeds appropriate human health-based environmental quality criteria (e.g., human health-based guidelines or criteria); AND
- Chemicals for which the maximum on-site concentration exceeds local or regional background concentrations; OR
- Chemicals for which no human health-based criteria or background data exist.

Health Canada (2024) also noted that a chemical is to be retained as a COPC for further evaluation if no human health-based criteria are available, and the measured concentrations exceed the local or regional background. In addition, chemicals which are not detected in site samples, but for which the detection limit is greater than the screening criterion, are to be retained as a COPC (Health Canada, 2024).

The identification of COPCs involved a sequential step-wise process, as follows:

1. Comparison of site chemistry data maxima to regulatory human health-based quality benchmarks (guidelines) and background data, where available, for soil, sediment, surface water and groundwater;
2. Chemicals with a maximum concentration that exceeded the applicable human health-based benchmark and were above background concentrations, were identified as initial COPCs. Chemicals for which no health-based benchmark was available were also identified as initial COPCs;
3. These initial COPCs were further evaluated by considering the frequency of detection, and the frequency and degree of exceedance of site soil chemistry data over human health-based soil quality benchmarks; and

4. Further considerations (where/if deemed necessary and relevant), such as: essential nutrient status of certain inorganic elements, ubiquity of certain elements in soils, statistical relationships, local geology, spatial distribution patterns of soil chemical concentrations, as well as environmental fate and behaviour properties (including the potential for a substance to bioaccumulate and biomagnify), and the likely speciation (chemical forms) in site media.

The COPC identification process excluded data for general chemistry and physical properties of environmental media (e.g., chloride, electrical conductivity, sodium absorption ratio, etc.). While such parameters can inform on soil and water quality (where applicable), and may influence or modify the bioavailability, mobility and toxicity of certain COPCs, they are not typically considered directly in the COPC identification step of a HHRA. Also, many of these parameters lack toxicity or human health-based benchmarks that media concentrations can be compared against. As such, these types of parameters were not considered further in the HHRA.

If site media concentrations are less than the applicable guidelines, then the likelihood of potential human health effects related to that chemical can be considered negligible. However, if site media concentrations exceed these guidelines, it does not necessarily mean that unacceptable risk exists; it is simply an indicator that further assessment is required. Guidelines are intentionally derived by regulatory agencies to be conservative and protective.

The goal of COPC selection is to identify those chemicals measured in site media that may pose a potential risk to human health. Based on the site characterization information, the anticipated future land use of the site, and consideration of the physical-chemical and environmental fate and behaviour properties of the chemicals present in site media, the human exposure media of concern are soil, sediment, surface water, and groundwater.

The site data and benchmarks (guidelines) used in the COPC screening process are described and discussed in the following sections. All analytical data used in the COPC screening, along with applicable benchmarks and background data are provided in Appendix C. The COPC screening results are discussed in the following sections.

3.2.4.1 COPCs in Site Soil

Determining Usability of Soil Data

For HHRAs, surface soils can be represented by soil depths ranging from 0.05 m bgs to 1.5 m bgs; however, the soil depth that is considered to contribute the greatest to incidental soil exposures via direct contact is typically the top 5 cm to 15 cm (provided the soils are not tilled, excavated, subjected to gardening) (Health Canada, 2021a).

For the screening of COPCs for human health in soil, all relevant soil data collected from within the study boundary and local background areas were considered in the surface soil COPC screening. The majority of soil samples were surface soil samples (i.e., 0-0.15 mbgs) with only a few sampling locations only having data greater than 0.15 mbgs (24MW-01 and BH3).

For the risk assessment of human health receptors (see Section 3.2) only surface soils were considered for the outdoor site visitor while soil samples at all depths were considered for the outdoor construction worker (excavation/trench work could involve a worker being exposed to soil at deeper depths).

As discussed in Section 2.6.1, maximum background concentrations of soil contaminants were considered in the soil COPC identification process. In addition, for arsenic, the 90th percentile concentration in background soil samples was also considered in the soil COPC identification process.

Comparison of Site Soil Data to Regulatory Human Health-Based Benchmarks

Part of the COPC identification process involved comparing site soil data to available benchmarks that are protective of human health. Maximum measured soil chemical concentrations were compared to applicable regulatory benchmarks that were derived specifically for the protection of human health as per Health Canada (2024) guidance.

The specific human health-based soil quality benchmarks that were considered in the COPC identification process are presented below. As the study area is located on Nova Scotia land, NS CSR guidelines apply and the NS PSS for commercial soils were preferentially used.

It is important to recognize that all human health-based benchmarks are derived by their respective regulatory agencies to be intentionally conservative and protective. Thus, exceedance of these benchmarks does not imply there is a risk of adverse health effects; rather, it suggests that further evaluation of those chemicals is warranted.

Given the available soil chemistry information for the site and considering the operable exposure pathways that were selected for the HHRA, soil quality benchmarks that were developed to be protective of direct soil contact exposure pathways (ingestion, dermal contact and soil/dust inhalation), were considered to be the most relevant and applicable for use. Where applicable, the applied soil quality benchmarks were for potable groundwater use and coarse-textured soil condition (particle size analysis showed the majority of soil samples are classified as coarse-grained). Potable groundwater conditions were selected as the site is designated as potable, although no known drinking wells exist on site. While for some chemicals, there is a guideline/check value that considers the protection of groundwater for potable uses (i.e., soil leaching); however, given actual groundwater data are available for the site, these data were used to determine COPCs in the groundwater as opposed to soil data to determine potential groundwater impacts would be highly uncertain compared to using actual groundwater data.

The study area has a current commercial land use designation, which was assumed not to change in the future. As such, commercial land use soil quality guidelines were used in the screening.

Nova Scotia assumes an acceptable target cancer risk level of 1 in 100,000 ($1E^{-5}$), similar to most federal departments and several other provinces. Thus, all soil quality benchmarks (guidelines) used for carcinogens were set to correspond to the $1E^{-5}$ target cancer risk level. The specific guideline sources used in the COPC screening are briefly described in the following sections.

Nova Scotia Pathway Specific Standards (NS PSS)

The Nova Scotia Tier II PSS for Soil (2022) - commercial land use; protective of direct soil contact/ingestion; were selected for the COPC screening, where available. The PSS are benchmarks (guidelines) developed by source agencies and departments outside of Nova Scotia such as the CCME soil quality guidelines (SoQGs) developed for the protection of human health ($SoQG_{HH}$); Alberta Environment and Parks (AEP) guidelines for human health; Ontario Ministry of the Environment, Conservation and Parks [MECP] soil component values; Atlantic Risk-Based Corrective Action (RBCA), human health-based tier II pathway-specific standards for soil; US EPA Regional Screening Levels [RSLs]). The primary guidelines adopted by NSECC, and thus applied herein, are provided below. The original guideline sources were reviewed to ensure the NS PSS guideline referenced the most recent applicable guideline from the original source. The specific source of the guidelines used in the COPC screening are identified in the human health screening tables (Tables C1 to C5, Appendix C).

Canadian Council of Ministers of the Environment (CCME)

CCME $SoQG_{HH}$ for a commercial land use (lower of coarse or fine-grained soils, where applicable) were then preferentially applied. The direct soil contact guidelines were selected. Where the CCME soil guidelines defer to the older CCME (1991) soil remediation criteria (which are not identified as being either human or ecological health-based), the benchmarks from the next preferred jurisdiction were selected rather than using the outdated CCME (1991) value(s), where possible. If no other guideline was available from another jurisdiction, the CCME (1991) value was used. The most up to date CCME guidelines were selected from on the online CCME summary tables and associated fact sheets (http://st-ts.ccme.ca/en/index.html; searched July 2024).

Atlantic Risk-Based Corrective Action (RBCA, 2023)

The Atlantic RBCA (2023) human health-based tier II pathway specific standards for soil for petroleum hydrocarbons for commercial sites were used for PHCs where applicable.

CCME Canada Wide Standards for PHCs in Soils (CCME, 2008)

The Canada Wide Standards (CWS) for PHCs for commercial land use and lower of fine and coarse-grained soils applicable for human health were selected for comparison purposes for PHC F1 to F4 (CCME, 2008). Tier 1 levels protective of direct soil contact were selected. Details on the basis and derivation of the CWS human health SoQGs are provided in CCME (2008).

Alberta Environment and Parks (AEP, 2024)

The direct soil contact, human health-based soil guidelines for commercial land use, and coarse-grained soils, were applied. These AEP guidelines are developed in a very similar manner to, and are protective of, the same human receptor types as the CCME $SoQG_{HH}$. Details on soil guideline basis and derivation are provided in AEP (2024).

Ontario Ministry of the Environment, Conservation, and Parks (MECP, 2011)

The MECP human health-based soil component values for soil contact (i.e., soil component values for Soil Contact, S1 Risk) were applied. The specific soil component values that were used are from Table 2 - Full Depth, Potable Water Scenario in MECP (2011). Residential land use soil components were initially used as the commercial land use components do not consider children. The derivation of these values is described in MECP (2011).

US Environmental Protection Agency (US EPA, 2024) Regional Screening Levels (RSL)

The US EPA RSLs for residential soil (summary table; May 2024) were applied where no federal or provincial guideline was available. The RSL value as published by US-EPA was divided by five to align with Health Canada and CCME guidance (which assumes a target HQ of 0.2). In the case of RSLs for carcinogenic compounds, risk levels were converted from 1 in 1,000,000 to 1 in 100,000 to align with the federal acceptable cancer risk levels. Details on the basis and derivation of these benchmarks is provided at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table 3-3: Human Health Screening for COPCs in Study Area Full Depth Soils, Direct Contact Pathway

Chemical	Maximum Measured Concentration (mg/kg)	Background Maximum Concentration (mg/kg)	Human Health - Soil Direct Contact ($SoQG_{HH}$) (mg/kg)		Carry forward as an initial COPC?
Metals					
Aluminium	36,500	26,200	15,400	a,b	Y
Antimony	48.1	0.30	7.5	c	Y
Arsenic	20,600	1,050	31	d,e	Y
Barium	198	62.8	10,000	d	N
Beryllium	7.49	1	110	d	N
Boron	<5.0	<5.0	4,300	c	N
Cadmium	2.63	0.197	49	d	N
Chromium (Total, III+VI)	61.3	69.6	630	d	N
Cobalt	162	5.09	22	c	Y
Copper	99.6	10.4	4,000	d	N
Iron	112,000	30,000	11,000	a,b	Y
Lead	1,360	88.1	260	d	Y
Manganese	7,510	218	360	a,b	Y
Mercury	2,920	0.2300	24	d	Y
Molybdenum	29.5	1.36	110	c	N
Nickel	48.5	33	310	d	N
Selenium	11.1	1.44	125	d	N

Chemical	Maximum Measured Concentration (mg/kg)	Background Maximum Concentration (mg/kg)	Human Health - Soil Direct Contact ($SoQG_{HH}$) (mg/kg)		Carry forward as an initial COPC?
Silver	1.27	0.16	77	c	N
Strontium	73.4	5.41	9,400	a,b	N
Sulphur as S	8,700	500	280,000	a,b,n	N
Thallium	1.47	0.185	1	d,f	Y
Tin	60.7	<2.0	9,400	a,b	N
Uranium	76.6	2.30	33	d	Y
Vanadium	72.6	38.6	78	o	N
Zinc	531	44.2	16,000	d	N
Polycyclic Aromatic Hydrocarbons					
1 & 2 Methylnaphthalene	0.784	N/A	72	a,b	N
Acenaphthene	0.0958	N/A	8,300	c	N
Acenaphthylene	0.392	N/A	78	a,d	N
Acridine	0.068	N/A	NGA		Y
Anthracene	0.661	N/A	41,000	c	N
Benz(a)anthracene	2.47	N/A	See B(a)P TPE	e	N
Benzo(a)pyrene	2.37	N/A	See B(a)P TPE	e	N
Benzo(b+j)fluoranthene	4.3	N/A	See B(a)P TPE	e	N
Benzo(b+j+k)fluoranthene	5.89	N/A	See B(a)P TPE	e	N
Benzo(g,h,i)perylene	1.31	N/A	See B(a)P TPE	e	N
Benzo(k)fluoranthene	1.59	N/A	See B(a)P TPE	e	N
Chrysene	2.9	N/A	See B(a)P TPE	e	N
Dibenz(a,h)anthracene	0.43	N/A	See B(a)P TPE	e	N
Fluorene	0.061	N/A	4,300	c	N
Fluoranthene	5.92	N/A	5,600	c	N
Indeno(1,2,3-c,d)pyrene	1.81	N/A	See B(a)P TPE	e	N
Naphthalene	0.267	N/A	3,000	c	N
Perylene	0.561	N/A	NGA		Y
Phenanthrene	1.39	N/A	NGA		Y

Chemical	Maximum Measured Concentration (mg/kg)	Background Maximum Concentration (mg/kg)	Human Health - Soil Direct Contact ($SoQG_{HH}$) (mg/kg)		Carry forward as an initial COPC?
Pyrene	4.43	N/A	3,300	c	N
B(a)P TPE	4.4481	N/A	5.3	e	N
BTEX and Petroleum Hydrocarbons (PHCs)					
Benzene	0.152	N/A	980	k	N
Toluene	1.02	N/A	1,400	k	N
Ethylbenzene	0.634	N/A	3,100	k	N
Xylenes (total)	2.02	N/A	1,800	k	N
VPH (C6-C10 - BTEX)	22.7	N/A	240	l	N
EPH >C10-C16	105	N/A	320	l	N
EPH >C16-C21	614	N/A	NGA	l,m	N
EPH >C21-C32	2180	N/A	NGA	l,m	N
EPH >C16-C32*	2228.5	N/A	1,700	l,m	Y
Modified TPH (Tier 1)	2228.5	N/A	1,700	l,m	N
EPH >C34-C50	12,100	N/A	3300	l	Y
Reached Baseline at C32	-	NA	NGA		NA
Hydrocarbon Resemblance	-	NA	NGA		NA

Notes

N = 118 for all metals, N = 24 for PAHs, N = 30 for BTEX and N = 29 for PHCs except VPH (C6-C10-BTEX) where N = 32.
NGA = no guideline available; NA = not applicable; Y = yes; N = no.

Bold values indicate exceedances over the guideline and background or is >RDL and no guideline/background is available.

* Calculated by adding together the PHC fractions >C16-C21 and >C21-C32.

a. United States Environmental Protection Agency (US EPA). (2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.
b. Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.
c. Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Soil Components for Soil Contact (S1), Ful Depth, Potable Water Use, Residential Land Use. Standards Development Branch, Ontario Ministry of the Environment.
d. Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from parameter-specific fact sheets.
e. Value has been adjusted from its original jurisdictional value to reflect a 1 x 10-5 target cancer risk level.
f. Provisional SQG_{HH}.
g. British Columbia Contaminated Sites Regulation Schedule 3.1 (BC CSR Schedule 3.1). (2023). Groundwater used for drinking water.
h. Value is pH-dependent. Given the reported pH of soils at the site (i.e., < 5), the most conservative guideline from the BC CSR has been applied.
i. Detection limit raised. Dilution required due to high concentration of test analyte(s)).
j. Alberta Environment and Parks (AEP). (2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.
k. Atlantic Risk-Based Corrective Action (RBCA). (2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.
l. Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.
m. Guideline applies to EPH >C16-C34
n. Guideline for sulphate (sulfuric acid).
o. The MECP (2011) S1 soil component for vanadium is essentially equal to the site background vanadium concentration. For vanadium the more recent US-EPA health-based Regional Screening Level (RSL) – Residential Soil Table (HQ=1), May, 2024 was used. RSL divided by 5 to account for 20% allowable exposure via one pathway (per Health Canada, 2024)

Soil Direct Contact

All contaminants in Table 3-3 were below the human health-based quality guideline for direct soil contact and the local background maximum with the exception of: metals (aluminium, antimony, arsenic, cobalt, iron, lead, manganese, mercury, thallium, uranium and vanadium) and the PHC fraction >C34-C50. In addition, the PAHs acridine, perylene and phenanthrene were above the detection limit and have no applicable guideline.

Substances with a maximum concentration which exceeded the applicable guidelines are shown in Figure 5a and 5b, Appendix A. Considering the number of samples collected and the local background data, the following chemicals were selected as initial COPCs (# of guideline exceedances provided in brackets) for the applicable pathways.

Initial COPCs – Direct Soil Contact

- Aluminium (47 of 120);
- Antimony (9 of 120);
- Arsenic (109 of 120);
- Cobalt (9 of 120);
- Iron (93 of 120);
- Lead (11 of 120);
- Manganese (55 of 120);
- Mercury (7 of 120);
- Thallium (3 of 120);
- Uranium (2 of 120);
- PHC (C16-C32) (2 of 29);
- PHC (>C34-C50) (1 of 29);
- Acridine (no guideline);
- Perylene (no guideline); and
- Phenanthrene (no guideline).

Further Examination of Initial COPCs

Aluminium exceeds the guideline for soil direct contact in 47 of 118 (40%) samples by up to 2.4 fold; however, only 9 of 118 samples exceed the maximum reported background concentration by 1.4 fold. Therefore, the elevated concentrations of aluminium in soil are anticipated to be associated with regional background conditions and aluminium is not carried forward for further consideration.

Arsenic exceeds the soil direct contact guideline in 110 of 120 (92%) samples by up to 665 fold and the background concentration of 286 mg/kg in 81 of 120 (66%) samples by 72 fold. Arsenic is also associated with the gold mining activity that historically occurred on site with the extraction of gold from arsenic/gold containing minerals. Due to the magnitude and the frequency of exceedance, arsenic is carried forward for further consideration for the soil direct contact pathway for both the site visitor and the site worker.

Antimony was reported at concentrations above the laboratory RDLs in 91 of the 120 analyzed samples (76%) and exceeded the human health guideline protective of the direct contact exposure pathway in 9 of 120 samples (7.5% including field duplicates and 6% excluding field duplicates [7/116])[1] by up to 6.4-fold. The reported antimony concentration exceedances were from samples collected at six sampling locations near the former tailings area (BH16, BH21 (and FD: BH DUPD) and BH24) and waste rock piles (BH7 (0 to 0.15 mbgs and 0.5 mbgs) BH111 [and FD: BH DUP J] and BH132) out of 100 locations across the site. The identified antimony impacts in soil have been delineated to the former tailings and waste rock pile areas (see Figure 5a, Appendix A), which suggests that the identified antimony impacts are localized and not widespread throughout the site. The potential for receptors to be within the study area, particularly site visitors that are toddlers or children, is low considering the dense forests and topography. The potential impacts of antimony in soil are anticipated to be limited due to the limited extent of soil quality guideline exceedances across the site. On this basis, as well as the low exceedance frequency, antimony was not carried forward for further consideration. The screening was conducted using the MECP residential/parkland S1 soil component value as the commercial/industrial S2 soil component value does not consider toddlers. If the S2 soil component value (63 mg/kg) was applied instead, antimony concentrations in site soils would not exceed this guideline value.

Cobalt exceeded the soil direct contact guideline in 9 of 120 samples (7.5%). In addition, the maximum reported background concentration of cobalt was only 5.34 mg/kg. The maximum reported concentration from the site exceeds this value by 30-fold. Due to the magnitude of exceedance, cobalt was carried forward for the soil direct contact pathway. The screening was conducted using the MECP residential/parkland S1 soil component value as the commercial/industrial S2 soil component value does not consider toddlers. If the S2 soil component value (250 mg/kg) was applied instead, cobalt measured in site soils would not have exceeded this guideline. Therefore, cobalt was carried forward for the site visitor scenario but was not carried forward for the site worker scenario.

Iron and manganese exceed the human health guideline for soil direct contact in 96 of 120 (7.8%) samples and in 55 of 120 (46%) samples respectively. Iron and manganese both exceeded the applicable guideline and the background in 41 and 44 of 120 samples respectively. The geology of the site is defined as Goldenville Formation of the Cambrian period which is a bedrock rich in both iron and manganese. These substances are ubiquitous to the bedrock of the area and high concentrations of iron and manganese in site soil/sediment are to be expected. As a result, iron and manganese were not carried forward for further consideration.

[1] While there is no consistent regulatory guidance on a cut-off value to use when considering the frequency of detection, or frequency of exceedance over benchmarks or reference concentration statistics , a value of 5% is often used in practice as it is consistent with the significance level used in typical statistical comparison testing. Also, within the Superfund program, the U.S. EPA has used a 5% cut-off value to eliminate chemicals from further consideration since the early 1990s. U.S. Navy (2008) HHRA guidance also supports the use of a 5% cut-off value when considering detection and benchmark exceedance frequency, but cautions that one must consider the sample size when choosing a cut-off value (as 5% is not appropriate if one has a sample size of <20; in these cases, professional judgement is used to determine if frequency considerations are appropriate and what an alternate cut-off value could be). The U.S. Navy also cautions that one must consider the spatial distribution of the chemicals of interest, when deciding whether or not to eliminate chemicals (or exposure pathways) from consideration on the basis of detection or benchmark exceedance frequency.

Lead exceeded the human health guideline for soil direct contact in 11 of 120 (9.2%) samples by 5-fold. In addition, lead exceeds the maximum reported background concentration in soils of 88.1 mg/kg by 15-fold. Lead exceedances over the guideline are not observed in any of the background samples but are observed across the site in every APEC. Due to the frequency and magnitude of exceedance, lead is carried forward for the soil direct contact pathway.

Mercury exceeds the guideline for soil direct contact in 7 of 120 (5.8%) samples by 120-fold. Mercury is associated with historical mining activity (mercury amalgamation to extract gold from crushed rock). The maximum reported concentration was 2,920 mg/kg in BH15 (near APEC 3, waste rock pile) in surface soils (0-0.15 m), a deeper sample at 0.5 m was taken at this location with a reported concentration of 30.9 mg/kg (1.3 fold over the guideline). Given the magnitude of exceedance, and that mercury is associated with the historical mining activity, mercury is carried forward for further consideration in the soil direct contact pathway.

Thallium and uranium exceed the soil direct contact pathway in only 3 of 120 (2.5%) and 2 of 120 (1.7%) samples respectively. This represents <3% of total samples, in addition, uranium and thallium are not associated with historical activities. Due to the infrequency of exceedance, thallium and uranium are excluded from further consideration for the soil direct contact pathway.

PHC F4 (>C34-C50) exceeded the guideline in 1 of 29 samples (3.4%) by 3.6 fold. The sample exceeding the guideline (BH128) is delineated immediately to the east, west, north and south, indicating a small, localized area of exceedance; however, only surface soil data are available for this sample location, so it was not delineated vertically. Soil at BH128 also slightly exceeds the guideline for PHC F3 (C16-C32) by 1.3-fold. One additional soil sample (BH13) slightly exceeds the guideline for PHC F3 (1,748 mg/kg compared to the guideline of 1,700 mg/kg) and this sample is below the guideline for PHC F4. As such, PHC F3 and PHC F4 are not carried forward for further assessment.

No guideline was available for acridine (detected in 1 of 24 samples); however, the anthracene guideline can be used as a surrogate for acridine. Both anthracene and acridine are three-ringed, low molecular weight PAHs. The maximum acridine concentration of 0.068 mg/kg is well below the anthracene guideline of 41,000 mg/kg. Therefore, acridine was not carried forward for further assessment.

No guideline was available for perylene (detected in 14 of 24 samples) with a maximum reported concentration of 0.561 mg/kg. Perylene is a five-ringed high molecular weight PAH and given the majority of other five-ringed, high molecular weight PAHs (e.g., benzo(a)pyrene) were reported at low concentrations similar to or greater than perylene, it is unlikely that perylene would pose a concern to human health. On this basis, perylene was not carried forward for further consideration.

No guideline was available for phenanthrene (detected in 19 of 24 samples); however, the anthracene guideline can be used as a surrogate for phenanthrene. Both anthracene and phenanthrene are three-ringed, low molecular weight PAHs. The maximum phenanthrene concentration of 1.39 mg/kg is well below the anthracene guideline of 41,000 mg/kg. Therefore, phenanthrene was not carried forward for further assessment.

Based on the available study area soil data, and the COPC identification steps and considerations described above, the following COPCs were carried forward as final COPCs for the Outdoor Site Visitor and Outdoor Site Worker exposure scenario:

Final COPCs – Direct Soil Contact (Site Visitor)

- Arsenic;
- Cobalt;
- Mercury; and
- Lead.

Final COPCs – Direct Soil Contact (Site Worker)

- Arsenic;
- Mercury; and
- Lead.

3.2.4.2 COPCs in Site Groundwater

Groundwater samples from within the study boundary were analyzed for metals, BTEX and PHCs, PAHs, and general chemistry. Analytical results were compared to drinking water guidelines or potable groundwater benchmarks (guidelines) protective of human health. The benchmarks used to screen the site groundwater data are described below. While groundwater samples were analysed for both total (unfiltered) and dissolved (filtered) metals, the screening was conducted using only the total concentrations, as the vast majority of regulatory potable groundwater and drinking water quality guidelines are derived based on measured total (unfiltered) concentrations, and consumption of any potable water does not involve use of a 0.45 micrometer filter (which is how dissolved or filtered concentrations of chemicals in water are determined). Both sets of groundwater data are presented in Table C6, Appendix C.

Nova Scotia Pathway Specific Standards (NS PSS)

The Nova Scotia Tier II PSS for Groundwater – commercial land use for potable drinking water; for the lower of fine or coarse soils (as both coarse and fine soils were identified within the study boundary) were selected for the COPC screening, where available. The PSS for groundwater is benchmarks developed by source agencies and departments outside of Nova Scotia such as the Health Canada (2024) drinking water quality guidelines, Ontario Ministry of the Environment, Conservation and Parks [MECP] groundwater component values; US EPA Regional Screening Levels [RSLs]); Alberta Environment and Parks [AEP] groundwater remediation guidelines. The primary guidelines adopted by NSECC, and thus applied herein, are provided below. The specific source of the guidelines used in the COPC screening are identified in the human health screening tables (Tables C6 to C9, Appendix C). The NS PSS guidelines were checked with the noted guideline sources to ensure the selected guidelines were up to date.

Health Canada Drinking Water Quality Guidelines

The primary source for drinking water guidelines were the Health Canada Guidelines for Canadian Drinking Water Quality (July 2024). Risk-based Maximum Acceptable Concentrations (MACs) were used where available. If risk-based values did not exist for a given substance, then the next preferred jurisdiction was reviewed. If no risk-based values were available, values referenced as ALARA (as low as reasonably achievable) or AO (aesthetic objective) were selected. Guidelines can be found at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html (searched July, 2024).

Ontario Ministry of the Environment, Conservation, and Parks (April, 2011)

The MECP human health-based groundwater component values for potable water (i.e., GW1 values) were applied. The specific groundwater component values that were used are for conditions of potable water, commercial land use, and coarse-textured soils (Table 2). The derivation of these values is described in MECP (2011).

Alberta Environment and Parks (July, 2024)

The AEP Tier I soil and groundwater remediation guidelines were applied. The specific groundwater guidelines applied were for commercial/industrial land use, potable water and coarse grained soil conditions. The derivation of these values is described in AEP (2024).

British Columbia Contaminated Sites Regulation Schedule 3.1 (BC CSR, 2024)

The BC CSR guidelines for human health protection groundwater used for drinking water on commercial land were applied. In certain instances, the BC CSR value is pH dependent, where this was applicable the lowest value from Schedule 3.1 was used.

US Environmental Protection Agency Regional Screening Levels (RSL) (2024)

The US EPA RSLs for tap water (summary table; May 2024) where no federal or provincial guideline was available. The RSL value as published by US-EPA was divided by five to align with Health Canada and CCME guidance (which assumes a target HQ of 0.2). In the case of RSLs for carcinogenic compounds, risk levels were converted from 1 in 1,000,000 to 1 in 100,000 to align with the federal acceptable cancer risk levels. Details on the basis and derivation of these benchmarks are provided at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

3.2.4.3 Results of the Human Health Based COPC Screening of Site Groundwater

The results of the screening of groundwater data collected within the study boundary for human health are provided in Table 3-4 below, and in Table C6 to C9, Appendix C. Figure 3, Appendix A shows the groundwater sampling locations.

The following substances were below their laboratory RDLs (i.e., non-detectable) in all groundwater samples that were analyzed for these parameters and were not considered further (Table C6 to C9, Appendix C): boron, tellurium, zirconium, all BTEX, PHCs and all PAHs except 1 and 2 methylnaphthalene, fluoranthene, naphthalene, and phenanthrene. RDL values were checked to see if they are above the applicable guidelines, and, if so these contaminants were carried forward. None of the contaminants analyzed had an RDL above the guideline so no COPC was carried forward based on this consideration.

The COPC identification process excluded data for the general chemistry of groundwater (e.g., pH, colour, hardness, etc.). While such parameters can inform on water quality (where applicable), and may influence or modify the bioavailability, mobility and toxicity of certain COPCs, they are not typically considered directly in the COPC identification step of a HHRA. Also, many of these parameters lack toxicity or human health-based benchmarks that media concentrations can be compared against. These parameters are not directly considered in the HHRA, but are indirectly considered in the interpretation of the HHRA results where applicable.

A drinking water guideline was not available for potassium; however, potassium is an essential nutrient and its absorption, metabolism, distribution and elimination are physiologically or biochemically regulated such that adverse effects would not be expected to occur except in conditions of extremely high exposure. Further, potassium is not associated with any known former or current site activities or structures. As such, potassium was not carried forward for further assessment. In addition, silica and silicon are natural components of soil/sediment and were not carried forward for screening.

Table 3-4: Human Health Screening for COPCs in Site Groundwater (Ingestion)

Chemical	Maximum Measured Concentration (mg/L)	Background Maximum Concentration (mg/L) [e]	Human Health Screening Level (mg/L)	Carry forward as an initial COPC?
Metals				
Aluminium	1.38	N/A	2.9 [a (MAC)]	N
Antimony	0.0006	N/A	0.006 [a]	N
Arsenic	0.195	N/A	0.01 [a (ALARA)]	Y
Barium	0.0201	N/A	2 [a (MAC)]	N
Beryllium	0.000231	N/A	0.004 [b]	N
Bismuth	0.000155	N/A	NGA	-
Cadmium	0.000321	N/A	0.007 [a (MAC)]	N
Chromium (Total, III+VI)	0.00095	N/A	0.05 [a (MAC)]	N
Cobalt	0.00963	N/A	0.003 [b]	Y
Copper	0.0673	N/A	2 [a (MAC)]	N
Iron	4.16	N/A	2.8 [c]	Y
Lead	0.0207	N/A	0.005 [a (ALARA)]	Y

Chemical	Maximum Measured Concentration (mg/L)	Background Maximum Concentration (mg/L) [e]	Human Health Screening Level (mg/L)	Carry forward as an initial COPC?
Manganese	0.34	N/A	0.12 [a (MAC)]	Y
Mercury	0.0000699	N/A	0.001 [a (MAC)]	N
Molybdenum	0.000728	N/A	0.07 [b]	N
Nickel	0.00617	N/A	0.1 [b]	N
Selenium	0.000188	N/A	0.05 [a (MAC)]	N
Cesium	0.000854	N/A	NGA	-
Rubidium	0.00867	N/A	NGA	-
Thorium	0.00041	N/A	NGA	-
Tungsten	0.0644	N/A	0.0032 [c]	Y
Lithium	0.0051	N/A	0.008 [c]	N
Silver	0.000952	N/A	0.0188 [c]	N
Sodium	5.37	N/A	200 [a,f (AO)]	N
Strontium	0.0337	N/A	7 [a (MAC)]	N
Sulphur as S	0.89	N/A	500 [a,f (AO)]	N
Titanium	0.0459	N/A	NGA	-
Thallium	0.000036	N/A	0.002 [b]	N
Tin	0.00029	N/A	2.4 [c]	N
Uranium	0.0144	N/A	0.02 [a (MAC)]	N
Vanadium	0.0014	N/A	0.0062 [b]	N
Zinc	0.0662	N/A	1.2 [c]	N
Polycyclic Aromatic Hydrocarbons (PAHs)				
1 & 2 Methylnaphthalene	0.000033	N/A	0.012 [b]	N
Fluoranthene	0.000014	N/A	0.15 [g]	N
Naphthalene	0.000015	N/A	0.47 [d]	N
Phenanthrene	0.000019	N/A	NGA	N

Notes:
N = 9
NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; ALARA = as low as reasonably achievable; MAC = maximum acceptable concentration; AO = aesthetic objective; Y=Yes; N=No.
Bold values indicate exceedances over the guideline and background.
Italicized values indicate exceedances over the guideline, but not background.

a Health Canada. (2024). Guidelines for Canadian Drinking Water Quality - Summary Tables. August, 2024. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

b Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Groundwater Components for Potable Water Scenario, Coarse Textured Soil (GW1). Standards Development Branch, Ontario Ministry of the Environment.

Chemical	Maximum Measured Concentration (mg/L)	Background Maximum Concentration (mg/L) [e]	Human Health Screening Level (mg/L)	Carry forward as an initial COPC?

c United States Environmental Protection Agency (US EPA). (2024). Regional Screening Level (RSL) Summary Table. Resident Tap Water (TR=1E-06, HQ=1), May 2024. Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

d Alberta Environment and Parks (AEP). (2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Groundwater Remediation Guideline Values for Commercial/Industrial - All Water Uses (Potable; Table B-4). June, 2024. Lands Policy and Programs Branch, Government of Alberta.

e All monitoring wells were considered part of the site data, as such, no background data are available for groundwater.

f No health based guideline was identified for the contaminant, therefore the aesthetic objective was used instead.

g BC CSR (Contaminated Sites Regulation). Schedule 3.2. Generic Numerical Water Standards. Drinking Water (applies to unfiltered samples at point of consumption). Last amended March 1, 2023 and consolidation current to September 24, 2024.

Based on the groundwater data presented in Table 3-4 above, and in Table C6 to C9, Appendix C, all other substances present in groundwater samples collected within the study boundary were below the human health-based groundwater quality guidelines with the exception of: arsenic, cobalt, iron, lead, manganese and tungsten. In addition, a number of contaminants do not have a guideline available and were reported at concentrations above the detection limit, and include: bismuth, cesium, rubidium, thorium, and titanium. Substances with a maximum concentration which exceeded the applicable guidelines are shown in Figure 6, Appendix A. The initial COPCs in groundwater are listed below (# of guideline exceedances provided in brackets) for the applicable pathways.

Initial COPCs – Groundwater Ingestion

- Arsenic (5 of 6);
- Cobalt (2 of 6);
- Iron (1 of 6);
- Lead (1 of 6);
- Bismuth (no guideline);
- Cesium (no guideline);
- Rubidium (no guideline);
- Thorium (no guideline);
- Tungsten (4 of 6);
- Titanium (no guideline); and
- Manganese (3 of 6).

Further Examination of Initial COPCs

Arsenic (5 of 6) samples and cobalt (2 of 6 samples) exceeded the applicable guidelines in 83% and 33% of samples, respectively. Arsenic is also related to historical mining activities. Given this and the high frequency of exceedance, arsenic and cobalt are carried forward for further investigation.

Iron (1 of 6) and manganese (3 of 6) were both reported at concentrations above their respective guidelines in groundwater. Iron and manganese are well-known essential elements for humans and its absorption, metabolism and elimination are physiologically and biochemically regulated. The presence of iron and manganese in groundwater is not surprising as they represent common metals that are ubiquitous in environmental media and their presence would be expected even in environmental media not from a mining site. For these reasons iron and manganese are not carried forward for further consideration.

The maximum total concentration of lead exceeded the applicable guideline by approximately 4-fold in 1 of 6 samples, with other samples of total lead being below the guideline. While only one of 6 samples

exceeded the lead guideline, lead is considered to be a non-threshold, non-carcinogen. Given this, and given the noted exceedances of lead in soil, lead in groundwater was carried forward for further assessment in groundwater.

Tungsten exceeds the human health guideline in 4 of 6 samples by up to 5.8 fold. Tungsten is not associated with the mining activity historically conducted at the site and is most likely present in groundwater due to weathering of minerals present in rocks, soils and sediments. In addition, the TRV used to derive the U.S. EPA RSL is believed to be quite conservative (i.e., a value of 0.0008 mg/kg/BW/d based on a somewhat subtle gastrointestinal effect in rats and a high cumulative uncertainty factor of 3000; See: https://cfpub.epa.gov/ncea/pprtv/chemicalLanding.cfm?pprtv_sub_id=1958). Uncertainty in this TRV is high, but oral toxicity data that are appropriate for human TRV development are quite limited at this time for tungsten. Tungsten exceedances over the guideline were reported in every monitoring well location except 24MW-02 and 24MW-04. Samples from 24MW-01 only show exceedances of tungsten in the January sampling period, and not in May. Similarly, an exceedance of the guideline for tungsten was reported in May for 24MW-03 but not in January (i.e., tungsten is not consistently reported at concentrations over the guideline). For these reasons, tungsten is nor carried forward for further consideration.

Cesium, rubidium, thorium and bismuth do not have any available human health guidelines for groundwater. These contaminants are not associated with historical mining activities and are expected to be present in trace amounts in environmental media. As such, these contaminants are not carried forward for further consideration.

Titanium also has no human health guideline available for groundwater. Titanium is not associated with historical mining activities at the site and is expected to be present in environmental media in trace amounts. In addition, titanium presents a low concern for human health and is not carried forward for further consideration.

Based on the available groundwater data, and the COPC identification steps and considerations described above, the following COPCs were carried forward as final COPCs for the Outdoor Site Visitor and the Outdoor Site Worker exposure scenario:

Final COPCs – Groundwater Ingestion (Site Visitor and Site Worker)

- Arsenic;
- Cobalt; and
- Lead.

3.2.4.4 Final COPCs in the HHRA

Outdoor Site Visitor

Soil - Direct Contact

- Arsenic;
- Cobalt;
- Lead; and
- Mercury.

Groundwater - Ingestion

- Arsenic;
- Cobalt; and
- Lead.

Outdoor Site Worker

Soil - Direct Contact

- Arsenic;
- Lead; and
- Mercury.

Groundwater - Direct Contact

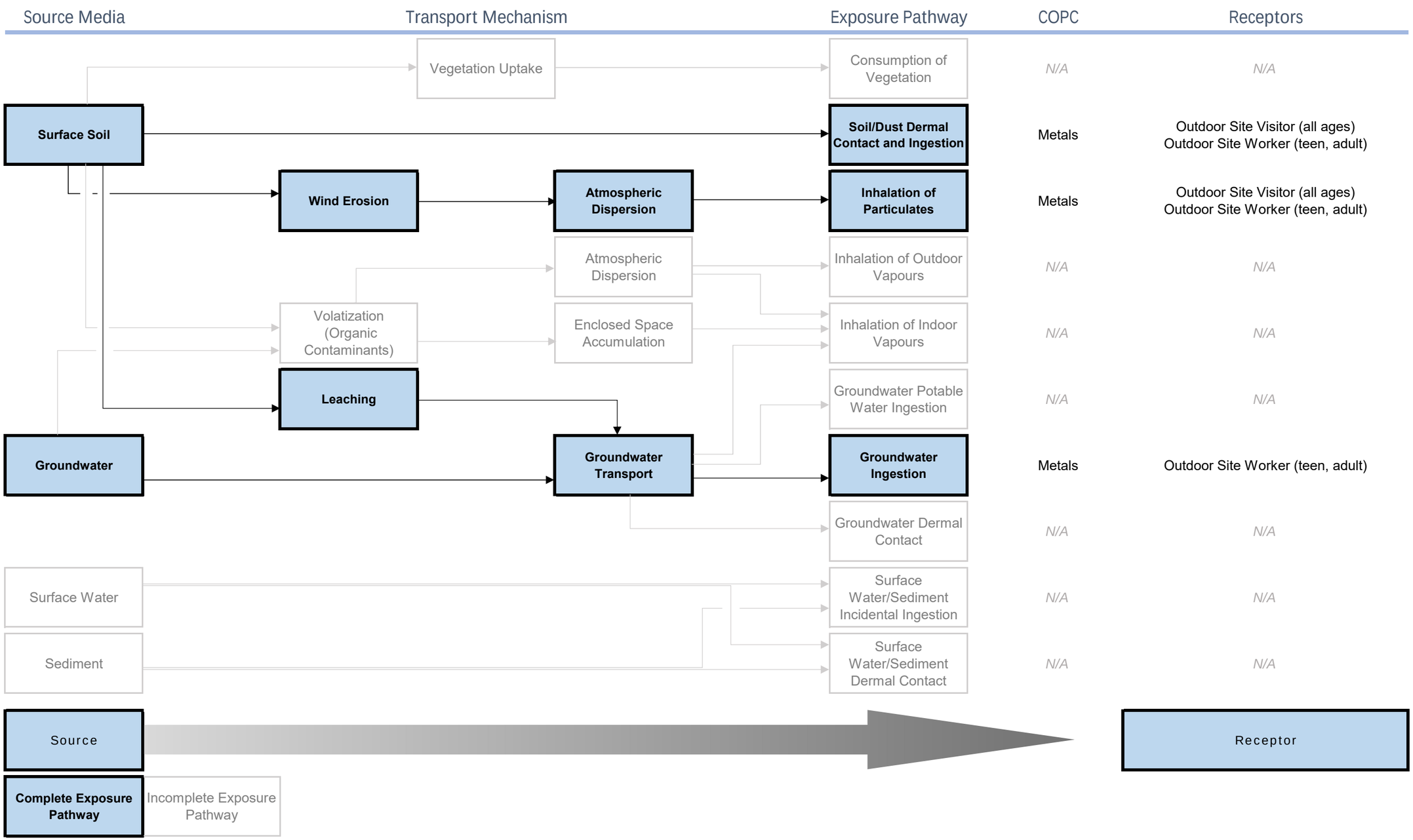
- Arsenic;
- Cobalt; and
- Lead.

It is noted that if a COPC was identified in one site medium, it was also assessed in all other relevant site media during the HHRA.

3.2.5 Conceptual Site Model

A CSM provides a description of relevant exposure pathways for the COPCs that have the potential to contribute to human exposures and potential health risks for the selected receptors. The HHRA CSM is presented in Figure 3-2. The CSM provides a simplified representation of relevant exposure pathways and routes that link the identified COPCs in site environmental media to the selected human receptors.

Figure 3-2: Conceptual Site Model for Soils for Human Receptors for the Former Country Harbour Mine, Nova Scotia



3.3 Exposure Assessment

The exposure assessment of an HHRA involves estimation of exposure of hypothetical human receptors to each of the COPCs. Exposure assessment involves the estimation of the amount of chemical received by individuals per unit time (i.e., the quantity of chemical and the rate at which that quantity is received). The exposure assessment evaluates and integrates available data for the chemicals, human receptors, and exposure pathways that were selected during the problem formulation step of the HHRA. The rate of exposure to chemicals, from the various environmental media being evaluated at a given site, is usually expressed as a dose, or the amount of chemical taken in per body weight per unit time (e.g., µg chemical/kg body weight/day).

The degree of human exposure to chemicals at a given site depends on the interactions of a number of parameters, including:

- The concentrations of chemicals in various site environmental media (e.g., air, water, soil, or foods) as determined by the quantities of chemicals entering the site's environmental media from various sources, their fate and persistence in these media, and the normal ambient, or background concentrations that may exist independent of a specific source;
- The various exposure pathways and routes for the transfer of the chemicals from the different environmental media to humans (e.g., inhalation of indoor and outdoor air, soil particles, and dusts; ingestion of food items, water, soils/dusts; skin penetration of various chemicals from water or soil/dust contact);
- The physiological, behavioural and lifestyle characteristics of human receptors that determine the actual exposures received through interactions with the various exposure pathways (e.g., respiration rate, water intake rate, food intake rate, soils/dusts intake rate, time spent at various activities and in different locations); and
- The various physical, chemical, and biological factors that determine the ability of people to take chemicals into their bodies from the exposure pathways and media (e.g., bioavailability of the chemicals within soil/dust, foods, water, and air).

For the current HHRA, deterministic (or point estimate) exposure analysis was conducted. This is the typical approach to exposure analysis that is taken in most HHRAs and is almost always the approach taken for initial HHRA studies of a given site or study area. Deterministic exposure analysis involves calculating reasonable upper bound point estimate exposures for the receptor-exposure pathway-COPC combinations, under each of the exposure scenarios evaluated. This is a conservative approach that tends to overestimate exposures and risks, but also helps to identify areas where more detailed or advanced approaches (such as further data collection, more detailed statistical analyses, use of probabilistic modelling techniques) could/should be used to refine the various exposure-related assumptions and enable a more site-specific and realistic exposure assessment. However, in situations where the upper bound point estimate approaches show no potential risks to receptors, or risk

management decisions based on such approaches are considered reasonable, it is often unnecessary to apply more detailed/sophisticated site-specific exposure and risk assessment approaches.

3.3.1 Characterization of Site Data for the Exposure Assessment

The exposure assessment step of the current HHRA utilized the available soil and groundwater chemical characterization data from within the study boundary compiled from the Phase II ESA field program and the additional site investigation work conducted in 2024 for the HHERA (Dillon, 2025a).

3.3.2 Soil

To evaluate the level of soil exposure for receptors to each potential COPC, it is necessary to first estimate the representative concentration of each COPC in soil. Where data are sufficient in terms of sample size, Health Canada (2024) recommends use of the 95% upper confidence limit of the arithmetic mean (UCLM95) to assess exposure (i.e., the UCLM95 is applied as the exposure point concentration (EPC)). The UCLM95 is the most common statistic used to represent EPCs in HHRAs. Most regulatory agencies recognize that the best approximation of the exposure point concentration (EPC), often referred to as the "true mean", or "the concentration most likely to be contacted over time", is the 95% upper confidence limit (UCL) of the arithmetic mean. Accurate and statistically robust estimates of the UCLM95 are important in an HHRA. To derive the UCLM95 values, the U.S. EPA computer program, ProUCL™ Version 5.2 was used. The U.S. EPA recommends the use of ProUCL when calculating EPCs for use in HHRAs of contaminated sites. ProUCL determines the most appropriate UCLM95 value for a dataset, given its distribution and characteristics. A number of statistically valid methods to calculate a UCLM95 can be run simultaneously, with the program recommending the most appropriate or statistically robust value(s) to select. However, according to its user guidance, ProUCL can only determine robust and reliable UCLM95 values if the sample size is at least ten. As the sample size for COPCs within the study boundary soil chemistry dataset is larger than this (i.e., N=>99 for soil samples), it was possible to calculate adequately robust UCLM95 soil concentrations for each COPC.

In calculating the UCLM95 soil concentrations for the various COPCs (if/as necessary), the following tasks/conditions were conducted/applied, all of which tend to bias the UCLM95-based EPCs high:

- For soil samples within the study boundary with corresponding laboratory or field duplicates, the higher concentrations out of the original and duplicate samples were retained;
- For soil samples collected from the same locations, but at different depths, the sample depth most relevant for human exposures was retained (i.e., the top 15 cm for the outdoor site visitor, and at full depth for the construction worker);
- For any study boundary soil samples with analytical results for the various COPCs 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 HHRA. Thus, the study boundary soil chemistry data were considered to be of adequate quality for use in an HHRA and appropriate for the purposes of EPC calculation;

- As the measured COPC concentrations in study boundary soil samples represent potential concentrations that human 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 soil or chemistry datasets. Thus, the UCLM95-based EPC calculations for the COPCs included the presence of potential extreme values. In the case of mercury in soil, where the data set was highly skewed by a single sample (i.e., BH15 at 2920 mg/kg), a 95th percentile was used for the EPC rather than a UCLM95-derived EPC; and
- 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 soil data distribution type), some degree of professional judgement is typically necessary in selecting the most appropriate UCLM95 value for use as the EPC in a HHRA. 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. ProUCL UCLM95 outputs are provided in Appendix F.

3.3.3 Groundwater/Surface Water

In calculating an EPC in groundwater, there are not enough monitoring well locations available (i.e., <10) to calculate a UCLM95. Although the site is classified as potable groundwater, no potable wells are present on site. The nearest potable well is located off-site, approximately 50 m away from the southern boundary of the study area. However, the distance from the nearest potable well is much further away from the nearest groundwater well, being approximately 390 m away from 24MW-03. In the absence of groundwater data closer to the potable well, the reported concentrations from the closest monitoring well (23MW-03) were used as EPCs for drinking water.

3.3.4 Selected Exposure Point Concentrations (EPCs) for Exposure Modelling and Exposure Estimation

The selected EPCs for arsenic, cobalt, lead and mercury are provided in Table 3-5, along with a brief description for the selected EPC values. The ProUCL outputs for soil EPC calculation are provided in Appendix F.

Table 3-5: Exposure Point Concentrations for COPCs Evaluated in the HHRA

COPC	EPC Value	Source/Description
Surface Soil - (0-0.15 mbgs)		
Arsenic	1.52 x 10^{3} µg/g	95% Approximate Gamma UCL
Cobalt	1.23 x 10^{1} µg/g	95% H-UCL
Lead	1.61 x 10^{2} µg/g	95% H-UCL
Mercury	3.80 x 10^{1} µg/g	95th Percentile
Soil - Full Depth		
Arsenic	1.60 x 10^{3} µg/g	95% Approximate Gamma UCL
Cobalt	1.21 x 10^{1} µg/g	95% H-UCL
Lead	1.54 x 10^{2} µg/g	95% H-UCL
Mercury	3.67 x 10^{1} µg/g	95th Percentile
Groundwater		
Arsenic	3.91 x 10^{-2} µg/L	As no potable wells are located on-site, groundwater concentrations closest to the nearest off site potable well (24MW-03) were selected as an EPC.
Cobalt	4.70 x 10^{-3} µg/L	
Lead	1.44 x 10^{-3} µg/L	
Mercury	5.00 x 10^{-6} µg/L	

Exposure Equations:

Exposure equations based on those provided within Health Canada (2024) were used to estimate exposures to COPCs within the HHRA. Appendix H provides a worked example of these calculations. provides the equations, factors, parameters and assumptions used in the exposure and risk calculations.

3.4 Toxicity (Hazard) Assessment

Toxicity is the potential for a chemical agent to produce any type of damage, permanent or temporary, to the structure or function of any part of an organism. The toxicity of a chemical depends on the amount that is taken into the organism (referred to as the “dose”) and the duration of exposure (i.e., the length of time the person or other organism is exposed to the chemical). For every chemical, there is a specific dose and duration of exposure necessary to produce a toxic effect in an organism (this is referred to as the “dose-response relationship” of a chemical). In the toxicity assessment step of a HHRA, information relating to the dose-response relationship of each COPC is evaluated (usually from laboratory animal studies and epidemiological studies of human exposure in the workplace) to determine the maximum dose to which humans can be continuously exposed that would be associated with no or a very low probability of adverse health effects. These toxicity estimates are called toxicity or toxicological reference values (TRVs) (also referred to as exposure limits, the terms are analogous) and indicate an exposure that will not likely result in adverse human health effects.

3.4.1 Toxicity Reference Values

TRVs are typically derived by regulatory agencies based on detailed reviews of toxicological, epidemiological, and other scientific information, professional judgment, and technical oversight by a number of experienced scientists with expertise in the toxicological sciences. They are often derived to be protective of the most sensitive endpoints in individuals (e.g., organ damage, neurological effects, cancer, or reproductive effects), and large safety or uncertainty factors (i.e., 100-fold or greater) are commonly used in their estimation. These factors are often applied to exposure levels from studies where no adverse effects were observed (i.e., the no observed adverse effect level [NOAEL]). Thus, exceedance of a TRV does not necessarily mean that adverse effects will occur; rather, it means that the safety factor beyond the no-effect exposure is somewhat reduced. Usually, exposure rates that are less than TRVs are not likely to be associated with adverse health effects; therefore, they are less likely to be of concern. As the frequency or magnitude of exposures exceeding a TRV increase, the probability of adverse health effects occurring in a human individual or population also increases. However, it should not be categorically concluded that all exposures below the TRV will be "acceptable" (unlikely to result in adverse health effects), and that all exposures above the TRV are "unacceptable" (likely to result in adverse health effects).

There are two main types of dose-response relationships that have been established for chemical agents:

- Threshold Response Chemicals: For these substances, there is a dose-response threshold below which no adverse effects would be expected to occur. This relationship is generally true for all chemicals that do not cause cancer. TRVs derived for threshold chemicals that are not believed to be potential carcinogens are typically expressed as dose (e.g., µg/kg body weight/day); and
- Non-Threshold Response Chemicals: For these types of chemicals, it is assumed there is no dose-response threshold. This means that any exposure greater than zero is assumed to cause some type of response, or damage. This relationship is typically used/assumed for carcinogens (although, some carcinogenic substances do have a well-defined threshold below which cancer does not appear to be a response to exposure). In theory, any exposure to a non-threshold substance has the potential to cause damage. As such, it is necessary to define an "acceptable" degree of risk associated with these types of exposures. This "acceptable" degree of risk is usually defined as a target cancer risk level of one-in-one hundred thousand to one-in-one million. Essentially, these numbers correspond to the dose rate that may cause an increased cancer risk in one person out of one hundred thousand people, or one person out of one million people. The acceptable or target level of carcinogenic risk is a policy rather than a scientific decision, and is set by regulatory agencies, as opposed to risk assessors. TRVs derived for non-threshold chemicals that are believed to be potential carcinogens are typically expressed as cancer slope factors or cancer potency factors [e.g., (µg/kg body weight/day)$^{-1}$)], or unit risk values for environmental media [e.g., (µg/m^3)$^{-1}$]. However, TRVs for carcinogens may also be expressed as risk-specific media concentrations or doses that are associated with a particular level of acceptable cancer risk.

Lead, one of the COPCs in the current HHRA, is a unique substance in that it is not believed to have a threshold below which adverse effects do not occur, but the toxicological endpoints for lead are not related to carcinogenicity. No known regulatory agency has developed guidance to assess lead given its unique non-threshold, non-carcinogen status, but in practice, most risk assessment professionals have opted to assess lead as if it were a threshold substance, and then account for its non-threshold status during risk characterization and when developing risk management recommendations. That was the approach taken herein.

Health Canada (2021a) states that for the assessment of risks posed by chemicals found at federal contaminated sites in Canada, Health Canada TRVs should be employed, when available, for the characterization of potential health risks. While the Country Harbour property is provincially owned, Nova Scotia follows the federal guidance for human health risk assessment, and Health Canada TRVs were preferentially used where available.

TRVs for the identified COPCs are summarized in Table 3-6. Health Canada TRVs were selected where available. TRVs are generally developed to be protective of all members of a human population including sensitive life stages (such as the elderly and/or pregnant women) and individuals of compromised health, where data allow.

Where Health Canada TRVs were unavailable for the COPCs (i.e., cobalt) other scientific sources were reviewed to obtain a human health based TRV. These sources included state and federal organizations from the United States (e.g., US EPA, CDC and California Environmental Protection Agency (CalEPA)).

Table 3-6: Summary of Toxicity Reference Values (TRVs) Used in the Human Health Risk Assessment

COPC	Exposure Route	Toxicity Reference Value (TRV)	Health Endpoint(s)	Regulatory Agency
Arsenic	Oral	SF = 1.8 $mg/kg_{BW}/day$	Cancer of the bladder, lung, liver; (based on Morales et al.,2000; Chen et al., 1985; Wu et al., 1989).	Health Canada, 2021a
	Inhalation	IUR = 6.4 mg/m^3	Lung cancer; (based on Higgins et al., 1986).	Health Canada, 2021a
Cobalt	Oral	TDI = 0.003 $mg/kg_{BW}/day$ (provisional)	Thyroid toxicity (provisional toxicity reference dose based on severe non-reversible thyroid effects).	US EPA PPTRV, 2008
	Inhalation	TC = 0.1 $\mu g/m^3$ (provisional)	Reduced lung function; (based Nemery et al., 1992).	ATSDR MRL, 2023

COPC	Exposure Route	Toxicity Reference Value (TRV)	Health Endpoint(s)	Regulatory Agency
	Inhalation	IUR = 7.7 x 10^{-3} µg/m^3	Cancer of the lungs, adrenal gland, pancreas or kidney; (based on a study of rat exposure to aerosolized cobalt, NTP, 2014).	CALEPA OEHHA, 2023
Lead	All (oral; inhalation)	RsD = 0.5 µg/kg_{BW}/day (provisional)	Neuro-developmental toxicity; cognitive function; (from European Food Safety Authority, 2013, based on Lanphear et al., 2005).	Health Canada, 2021a
Mercury	Oral	TDI = 3.0 x 10^{-4} mg/kg_{BW}/day	Immunotoxicity, autoimmune glomerulonephritis; (based on Druet et al., 1978; Bernaudin et al., 1981; Andres, 1984).	Health Canada, 2021a

Notes:
TRV=toxicity reference value; BW= bodyweight; TDI = Tolerable Daily Intake; RsD = Risk-Specific Dose; IUR = Inhalation Unit Risk; TC = Toxicity Concentration.

3.4.2 Bioavailability, Bioaccessibility and Route Extrapolation Considerations

3.4.2.1 Bioavailability

The response of the body to chemical exposure depends on the quantity of the chemicals that actually enter the target organs, tissues and cells. In many cases, only a fraction of the chemicals that are ingested, inhaled, or come into contact with the skin are actually absorbed into the body's systemic circulation. Bioavailability refers to the extent and rate to which a chemical can be absorbed into the systemic circulation of an organism and potentially produce an adverse effect (Hrudey et al., 1996; Kelly et al., 2002). Relative bioavailability is the most important type in the context of HHRA. It is defined as a measure of the differences in extent of absorption between two or more forms of the same chemical (e.g., organic arsenic versus inorganic arsenic), different exposure vehicles (e.g., food, soil, and/or water), or different doses (Schoof, 2003; Kelly et al., 2002).

3.4.2.2 Selection of Oral, Inhalation and Dermal RAFs for the HHRA

Oral toxicity of a soil-borne chemical depends on the fraction absorbed from the gastrointestinal tract into the systemic circulation and that reaches target organs and tissues. In an HHRA, the bioavailability of a chemical describes the absorption and uptake of that chemical into the human circulatory system. In the exposure assessment of an HHRA, external doses of a chemicals are mostly used to estimate the amount of the chemical absorbed into systemic circulation. The portion of chemical absorbed following soil ingestion is assumed to equal the absorption in the toxicity studies used to determine human health benchmarks. This generally overestimates the bioavailability since the toxicity studies commonly use

forms of chemicals that are easily absorbed. There can be large differences in metals bioavailability due to a variety of factors including, for example, the form of the metal, chemical interactions, soil weathering and properties of the soil (e.g., pH and organic carbon; Health Canada, 2017).

The fraction (or percent) of a dose that is absorbed is called absolute bioavailability (ABA). Relative bioavailability (RBA) describes the comparative difference in bioavailability between different forms of a substance or different environmental matrices (e.g., food vs. water). Health Canada has published default RBA values for some contaminants including arsenic; however, using a site-specific RBA value can provide a more realistic estimate of potential exposures and risks. RBA values can be derived using validated *in vitro* bioaccessibility (IVBA) testing. Validated tests for human IVBA analysis are available for arsenic and lead.

As arsenic is the main COPC related to former mining conducted on the site, to aid in calculating site-specific oral RBA for arsenic, ten soil samples (plus two duplicate samples) were submitted to the Environmental Sciences Group at Royal Military College (RMC) of Canada for IVBA testing. The IVBA test methods used have been validated and approved by Health Canada. IVBA results for arsenic are provided in Appendix D.

The %BA results from the site ranged from 4.1% to 59%, with the highest bioaccessibility (BH-122) occurring in the samples from the tailings disposal area (APEC 1). To better relate the IVBA data to an oral RAF, the Health Canada equation for determining relative bioavailability (RBA) for arsenic provided below (HC, 2017):

$$RBA_{arsenic} = 0.79(IVBA) + 0.03 \text{ (R2 = 0.87)}$$

Where IVBA, was assumed to be the 95th percentile of the reported IVBA data. When determining the 95th percentile the highest of the parent and duplicate arsenic %BA concentrations was used. Using the above equation with the 95th percentile of IVBA data for arsenic, the RBA of arsenic was determined to be 0.42. The calculated RBA is a suitable approximation of an oral RAF and was used for the human health risk estimates in this HHRA.

In the absence of IVBA data for cobalt, lead and mercury, published default oral RAF values were used instead. Health Canada documentation was preferentially used in the selection of RAF values; however, no oral RAF was available for cobalt or mercury. Provincial guidelines were next consulted, and the Ontario MECP Rationale for the Development of Soil and Groundwater Guidelines (2011) contains oral RAF values for cobalt (oral RAF = 1) and mercury (oral RAF = 0.5) but not lead. In the absence of IVBA data, Health Canada recommends the use of a US EPA default oral RAF of 0.6 (HC, 2017).

The HHRA assumed that soil/dust inhalation exposures to the COPCs were 100% bioavailable. This is consistent with Health Canada (2024) guidance.

Dermal RAFs used in the HHRA are described below in the context of oral to dermal route extrapolation.

3.4.2.3 Exposure Route Extrapolation

It is necessary to consider exposure route extrapolation when a TRV is not available for the exposure route of interest and no other data (such as toxicokinetics) are available. For example, it is common in HHRAs to assess the potential risks posed by dermal exposure based on TRVs that are established for the oral exposure route. In doing so, the systemic dose that is absorbed dermally is scaled to the 'equivalent' oral dose by adjusting for the bioavailability of the dermally applied chemical relative to an orally-administered dose (i.e., relative bioavailability adjustment).

Other situations where adjustments for bioavailability may be made in an HHRA are as follows, where sufficient data exist:

- When the effects of the chemical of interest are systemic in nature (i.e., following entry into and distribution by the bloodstream, as opposed to effects occurring only at the site of entry [e.g., lungs, skin, gut]);
- When the medium of administration or medium of exposure results in different relative bioavailabilities (e.g., ingestion in drinking water versus ingestion in soil); and
- If the bioavailability of the chemical based on the particular study animal/receptor is different from that of the assessment receptor (e.g., the published TRV is based on a study using rats, the receptor of interest is a human, and there are reported different bioavailabilities for the chemical between species).

When oral-to-dermal route extrapolation is necessary, the relative absorption or bioavailability difference between the oral and dermal routes of exposure can be expressed as a relative absorption factor (i.e., RAF_{dermal}). This RAF, calculated as follows, is applied to dermal exposure estimates to adjust these exposures prior to their comparison with oral TRVs.

$$RAF_{dermal} = \frac{AF_{dermal}}{AF_{oral}}$$

Where:

RAF_{dermal}	=	the dermal relative absorption factor.
AF_{dermal}	=	the fraction of the applied chemical absorbed through the skin.
AF_{oral}	=	the fraction of the ingested chemical absorbed via the gastrointestinal tract.

For the COPCs evaluated in this HHRA, dermal RAFs have been determined by regulatory agencies as follows (Table 3-7). This table also summarizes the oral and inhalation RAFs that were assumed for the HHRA.

Table 3-7: Summary of RAFs Used in the HHRA

COPC	Relative Absorption Factor (RAF)		
	Dermal	Oral	Inhalation
Arsenic	0.03 [a]	0.42 [e] (soil only) 1 (all other oral pathways, assumed)	1 [d]
Cobalt	0.01 [b]	1 [b]	1 [d]
Lead	0.006 [a]	0.6 [c]	1 [d]
Mercury	1 [a]	0.5 [b]	1 [d]

Notes:
[a] Health Canada, 2021
[b] MECP, 2011.
[c] Health Canada, 2017
[d] Conservatively assumed that RAF=1.0. The HHRA assumed that inhalation exposures to the COPCs were 100%.
[e] Oral RAF for arsenic calculated from the Health Canada recommended equation for estimating relative bioavailability (RBA) using the 95th percentile of site-specific IVBA data (Health Canada, 2017).

3.5 Risk Characterization

Risk characterization is the final step in a HHRA. It integrates the exposure and hazard (toxicity) assessments to estimate the likelihood of potential human health risk for the receptors, COPCs, exposure pathways and exposure scenarios that were evaluated. Potential risk is characterized through a comparison of the estimated COPC exposures to the selected human receptors from all exposure pathways and routes (from the Exposure Assessment) with the identified TRVs from the Hazard (Toxicity) Assessment.

Risk characterization differs depending upon whether the chemical is a threshold substance (i.e., there is a level of chemical exposure below which effects are not expected to occur); or a non-threshold substance (i.e., there is the potential for human health risk at any level of exposure). Further details are provided in the following subsections.

3.5.1 Threshold Chemicals

For chemicals with TRVs based on threshold effects (typically non-carcinogenic effects), risk characterization takes the form of a ratio calculation, and is referred to as the hazard quotient (also sometimes referred to as an exposure ratio (ER) or risk quotient (RQ)). The HQ is calculated by dividing the estimated level of total exposure by the TRV, as follows.

$$HQ = \frac{\text{Estimated Exposure (}\mu\text{g/kg body weight/day)}}{\text{TRV (}\mu\text{g/kg body weight/day)}}$$

3.5.1.1 Interpretation of HQs

Once HQ values have been determined, they are then compared to a target HQ (THQ) that is essentially an indicator of "safety". In general, if the total chemical exposure from all relevant exposure pathways is equal to or less than the TRV, then the THQ would be 1.0 or less, and no adverse health effects would be expected.

However, in HHRAs where a number of potential human exposure pathways are excluded from evaluation (due to limited data, uncharacterized exposure sources, etc.), which is very common for contaminated site HHRAs, the THQ cannot be 1.0 as a number of pathways would not be considered. Rather, a lower THQ would be selected. The reason for this is that non-carcinogenic (threshold chemical) TRVs represent the level of total exposure that would not result in adverse health effects, regardless of the sources or pathways of exposure. If a HHRA evaluates only single sources of contamination and/or a limited number of exposure pathways, the selection of a THQ of 1.0 may not be appropriate or adequately protective.

In many HHRAs conducted across Canada, a default THQ of 0.2 is typically used when the assessment is only investigating exposure from relatively few selected pathways, sources, and routes. This implies that a maximum of 20% of the total exposure has been apportioned to any one source or pathway and is based on simple subdivision of the five main categories of human chemical exposure (i.e., intake from air, water, soil/sediments, diet, and consumer products). The default THQ of 0.2 has been endorsed and/or recommended by various regulatory agencies in Canada for many years when limited exposure pathways, sources, and routes are under investigation. This does not mean, however, that a higher THQ value cannot be used for certain substances in a given contaminated site HHRA, so long as the rationale for a higher THQ value can be justified in a technically defensible manner. For example, if all key site and at least some key non-site (background) sources and/or pathways of exposure can be accounted for in a HHRA, or if there is information to demonstrate that certain site-related or non-site-related exposure pathways for a COPC are negligible, then there would be less justification for a THQ of 0.2 and a higher THQ could be applied.

In the current HHRA, a limited amount of site sources and exposure pathways are considered (i.e., soil contact pathways and groundwater ingestion; other potential site-related exposure pathways are negligible with respect to COPC exposure), and no non-site (background) sources and pathways of exposure for the COPCs were considered. As such, a THQ of 0.2 (rather than 1.0), was applied in the HHRA to account for the fact that not all categories of human exposure were not considered.

In general, if non-cancer risk estimates (i.e., HQ values) are less than the THQ in a HHRA, no adverse health effects would be expected to occur given the COPCs, receptors, exposure pathways and scenarios evaluated. As HHRAs typically utilize a number of conservative factors and assumptions, there is usually a high degree of confidence that such HQ values do not pose a potential human health risk. If HQ values are greater than the THQ, there may be a potential for adverse effects in sensitive individuals or in one or more of the exposure scenarios considered. However, given the conservatism typically employed in HHRAs, calculated HQ values greater than the THQ value do not necessarily indicate that adverse health

effects are likely to occur. Generally, in cases where HQ values are greater than the THQ in an HHRA, assumptions, parameters and data used within the HHRA are closely re-examined prior to concluding whether or not a human health risk exists.

3.5.2 Non-Threshold Chemicals

For chemicals with TRVs based on non-threshold dose response relationships (such as carcinogens), risk characterization typically involves determining an ILCR level that would be expected given the predicted exposures. The ILCR is calculated by multiplying the predicted exposure by the slope factor (or unit risk value) for the COPC in question[2]. The ILCR is defined as the predicted risk of an individual in a population of a given size developing cancer over a lifetime, and is expressed as the prediction that one extra person per "n" people, exposed at the assessed rate daily over a lifetime, would develop cancer, where the magnitude of "n" reflects the risks to that population – the larger "n" is, the smaller the risk (e.g., if the ILCR is 1 person per 10, the predicted risks of any individual developing cancer would be higher than if the ILCR is 1 per 1,000). Calculated ILCRs are then compared to target cancer risk levels (TCRLs) to evaluate the significance of the ILCR. For contaminated sites in Nova Scotia, the TCRL is one-in-one hundred thousand (i.e., 1×10^{-5}, or one additional cancer case per hundred thousand people) which is the same TCRL that is used for federal sites.

The following equation provides the method by which the ILCR is calculated:

*ILCR = Estimated Exposure (**µ**g/kg body weight/day) x CSF ([**µ**g/kg body weight/day]$^{-1}$)*

Where:

ILCR	=	Incremental Lifetime Cancer Risk
CSF	=	Cancer Slope Factor

The resulting estimated cancer risk (i.e., the ILCR) can then be compared to the TCRL (i.e., 1 in 100,000) to determine if estimated COPC exposures pose a potentially unacceptable human health risk.

The risk characterization of carcinogens is based on 100% of the TCRL of 1 in 100,000 (i.e., there is no apportioning of cancer risks), as ILCR values are considered to be independent of background exposure sources; Health Canada, 2021a).

3.5.2.1 Interpretation of ILCRs

Similar to the interpretation of HQ values, ILCR values less than 1 in 100,000 suggest that adverse health effects would not be expected to occur in relation to the exposure scenarios that were evaluated. However, ILCR values greater than 1 in 100,000 do not necessarily indicate a potential cancer risk exists under these scenarios. Rather, when ILCRs exceed the target cancer risk level, assumptions, parameters

[2] Alternatively, the risk characterization of carcinogens can be conducted in the same manner as the risk characterization of non-carcinogens if the cancer-based slope factors or unit risks are converted to risk-specific doses or concentrations that correspond to the acceptable target cancer risk level.

and data used in the HHRA are typically re-examined prior to making final conclusions regarding the likelihood of adverse health effects occurring.

In HHRA, it is also common to assess COPCs that have available TRVs which are based on both cancer and non-cancer endpoints, as both a carcinogen and a non-carcinogen, and to determine human health risk estimates for both types of endpoints.

It is important to recognize that HQ and ILCR values are not absolute measures of risk, nor are they measures of actual risk. Rather, they are most appropriately considered as indicators of potential human health risks which enable the following:

- Comparisons of potential adverse health effects between COPCs and between different exposure scenarios (e.g., different site-specific conditions, different site use options);
- Estimation of potential adverse health effects from exposures to mixtures of COPCs that may elicit similar effects in organs, tissues or cells (e.g., all chemicals that cause liver toxicity, or kidney toxicity, or respiratory tract cancers, or respiratory irritation effects); and
- Simplification of HHRA results to provide clear understanding of the results, and an appreciation of their significance.

Another key aspect of risk characterization is to identify and consider uncertainty within the HHRA. A discussion of key areas of uncertainty in the HHRA is provided in Section 3.7.

3.5.3 Other Risk Characterization Considerations

For COPCs that have different effects, target organs and/or mechanisms of action by the oral and inhalation routes, it is standard HHRA practice that exposures for all oral and dermal pathways be summed separately from all inhalation pathways and then compared separately to the pathway-specific TRVs, with the resulting risk estimates compared separately to the THQ or TCRL value. For such COPCs, there may be different TRVs for the oral and inhalation routes that reflect differences in target tissues, endpoints, effects, and mechanisms of action. This is not conducted for COPCs where the same or similar effects are reported to occur *via* both the oral and inhalation routes, or for COPCs where only an oral TRV exists. Rather, in these situations, oral, dermal and inhalation exposures and/or risks can be summed together. This was the case for lead in the HHRA, the TRV for lead is based on an internal dose (i.e., blood lead concentrations) where the key endpoints are the same for all potential pathways and routes of exposure.

With respect to potential chemical mixture effects and the potential for toxicological interactions between the COPCs assessed in the HHRA, and between the COPCs and other substances, the following standard HHRA approach was taken. That is, the HHRA evaluates the COPCs individually, and then determines whether or not the exposures or risks for the individual COPCs could reasonably be considered additive, based on the health effects associated with each substance. Other potential types of toxicological interactions are typically not considered in HHRAs as the data to assess such interactions is generally not available or is insufficient to quantify the type, extent and direction of the potential interaction.

Other considerations that can be important when interpreting HQ and ILCR values include considering other potential sources of COPC exposure, and the impact of uncertainty, variability, data gaps, and the assumptions made in the Problem Formulation, Exposure Assessment and Hazard (Toxicity) Assessment steps, on the magnitude of the human health risk estimates.

3.5.3.1 Site Specific Target Levels

When risk characterization results of HHRAs indicate potentially unacceptable risks for human receptors, site-specific target levels (SSTL) for site media are typically generated. SSTLs are typically iterated from the HHRA exposure and risk model and provide the maximum allowable concentration of a COPC in site media, based on the assessed exposure scenarios, which will not pose a risk to human receptors. SSTLs are often used to guide remediation or risk management activities, if/as warranted.

SSTLs for site media are typically only developed if a COPC in a given site medium is considered to pose a potential human health risk, via the assessed exposure pathway(s) that involve that medium. SSTLs are often addressed under separate cover from HHRAs, and are presented in risk management or remedial options reports, as considerations beyond simply iterating SSTL values from a HHRA model are often important when both establishing and implementing final SSTLs for site media (e.g., technical feasibility, potential management or remedial options to prevent/reduce exposure, site media COPC data distributions).

With respect to the latter, and using soil as an example, it is common that a site can have a number of soil sample locations exceed a calculated soil SSTL and not pose a potential human health risk. This is because HHRAs focus on upper estimates of central tendency for EPCs of COPCs. What matters most is whether or not the EPCs for site soil COPC data will be below a SSTL following risk management or remedial measures. Often, reductive iteration approaches are applied to site soil data (i.e., systematic and sequential removal of sample locations above the SSTL, with EPC recalculation following sample location removal) to determine which site soil sample locations require risk management or remediation, and which do not.

3.5.4 HHRA Results

Results of the HHRA for the Outdoor Site Visitor scenario and the Outdoor Site Worker scenario are summarized in Table 3-8. For the Outdoor Site Visitor, only surface soils (i.e., soils at a depth of 0-0.15 mbgs) were considered in the generation of exposure and risk estimates, as in this scenario it is unlikely that a person would be exposed to soils at deeper depths while visiting the site. For the Outdoor Site Worker, soil data at full depth was considered in the generation of risk estimates to account for potential digging/excavation/earthwork activities which could bring contaminated soils at deeper depths to the surface where a worker could be exposed. Appendix F provides the equations, factors, parameters and assumptions used in the exposure and risk calculations.

Table 3-8: Summary of Human Health Risk Estimates

COPC	Receptor	HQ (oral + dermal)	HQ (inhalation)	ILCR (oral + dermal)	ILCR (inhalation)	Benchmarks of Safety (THQ and TCRL)
Outdoor Site Visitor						
Arsenic	Toddler	-	-	2.4×10^{-5}	2.5×10^{-8}	THQ = 0.2 TCRL = 1×10^{-5}
	Child	-	-	6.0×10^{-6}	3.8×10^{-8}	
	Teen	-	-	4.2×10^{-6}	4.4×10^{-8}	
	Adult	-	-	2.8×10^{-5}	3.3×10^{-7}	
Cobalt	Toddler	1.4×10^{-3}	9.3×10^{-8}	-	2.4×10^{-10}	
	Child	1.9×10^{-4}	8.1×10^{-8}	-	3.7×10^{-10}	
	Teen	1.1×10^{-4}	4.8×10^{-8}	-	4.3×10^{-10}	
	Adult	9.2×10^{-5}	4.3×10^{-8}	-	3.2×10^{-9}	
Lead	Toddler	1.3×10^{-1}		-	-	
	Child	1.8×10^{-2}		-	-	
	Teen	9.9×10^{-3}		-	-	
	Adult	8.5×10^{-3}		-	-	
Mercury	Toddler	6.0×10^{-2}	2.9×10^{-6}	-	-	
	Child	3.2×10^{-2}	2.5×10^{-6}	-	-	
	Teen	2.5×10^{-2}	1.5×10^{-6}	-	-	
	Adult	2.3×10^{-2}	1.3×10^{-6}	-	-	
Outdoor Site Worker						
Arsenic	Teen	-	-	2.1×10^{-6}	1.1×10^{-7}	THQ = 0.2 TCRL = 1 x 10-5
	Adult	-	-	1.4×10^{-5}	8.0×10^{-7}	
Cobalt	Teen	9.8×10^{-4}	2.2×10^{-6}	-		
	Adult	8.4×10^{-4}	2.0×10^{-6}	-		
Lead	Teen	4.8×10^{-2}		-	-	
	Adult	4.1×10^{-2}		-	-	
Mercury	Teen	2.2×10^{-1}	6.7×10^{-5}	-	-	
	Adult	2.1×10^{-1}	6.0×10^{-5}	-	-	

Notes:
Risk estimates incorporate UCLM95 (95th percentile for mercury) site soil concentrations of COPCs and maximum site groundwater concentrations. The risk estimates are rounded to two significant figures.
BOLD values indicate exceedance of THQ or TCRL.A

As presented in Table 3-8, no COPC exceeded the THQ of 0.2 for the Outdoor Site Visitor and the Outdoor Site Worker scenarios. The TCRL for arsenic was slightly exceeded in the Outdoor Site Visitor scenario for the toddler and adult receptors, for the oral and dermal exposure routes. The TCRL for arsenic was also slightly exceeded in the Outdoor Site Worker scenario for the adult receptor, for the oral and dermal exposure routes.

For both exposure scenarios (Outdoor Site Visitor, Outdoor Site Worker), for all receptors, the oral and dermal risk estimates are driven by the soil direct contact pathways, with the ingestion of groundwater contributing a minimal amount to oral exposures (Appendix G).

The reported soil arsenic concentrations in various APECs are orders of magnitude above both the generic CCME soil quality guideline for human health protection and the local background soil concentration, in a large number of site soil samples. Given the human health risk estimates and these additional considerations, soil risk management for arsenic is necessary at the site.

Soil risk management considerations for arsenic are provided in Section 3.6.

3.6 Risk Management Recommendations

When risk characterization results of HHRAs indicate potentially unacceptable risks for human receptors, site-specific target levels (SSTL) for site media can be generated as part of the risk management plan. SSTLs are typically iterated from the HHRA exposure and risk model and provide the maximum allowable concentration of a COPC in site media, based on the assessed exposure scenario, which will not pose a risk to human receptors. SSTLs are often used to guide remediation or risk management activities, if/as warranted.

As only site soil is significantly impacted by COPCs (and only by arsenic), such that a potential risk was identified for human receptors, only a soil SSTL was determined for arsenic. Cobalt, lead and mercury did not pose a risk to any human receptor under the assessed exposure scenarios. Thus, these COPCs do not require soil SSTLs.

As noted in the preceding section, the TCRL for arsenic was slightly exceeded in the Outdoor Site Visitor scenario for the toddler and adult receptors, for the oral and dermal exposure routes. The TCRL for arsenic was also slightly exceeded in the Outdoor Site Worker scenario for the adult receptor, for the oral and dermal exposure routes. Since only the adult receptor displayed ILCRs for arsenic that exceeded the TCRL in the Outdoor Site Worker scenario, and the adult receptor in the Outdoor Site Visitor scenario had a higher ILCR than the toddler receptor, arsenic soil SSTL development focused only on the adult receptor as SSTLs for this receptor would be protective of all other human receptors given that the other human receptor types displayed lower ILCRs for arsenic relative to the adult receptor.

Iteration within the HHRA model produced the following initial human health soil SSTLs for arsenic:

- Outdoor Site Visitor – 530 mg/kg.
- Outdoor Site Worker – 1150 mg/kg.

Other considerations may be necessary to refine these initial soil SSTLs for arsenic, which may occur under separate cover as part of a site soil risk management plan. Given then extent of arsenic within the study area soils identified to date as being elevated above the SSTL, it is recommended that the SSTL be further examined/refined as part of a soil risk management plan.

Any freshy exposed waste rock/tailings as a result remedial activities should be evaluated for sulfide bearing materials for acid rock drainage potential as warranted.

Some other risk management recommendations for the site and HHRA study boundary are as follows:

- Develop site-specific health and safety plan for site workers, as required;
- As noted in **Section 3.2.4.4**, a mercury hotspot exists in site soil and while localized, this area should be risk managed to mitigate potential risk. This occurred at BH15 where mercury was reported at 2920 mg/kg in soil at a depth of 0-0.15 mbgs;
- If there are areas of fine tailings on-site that are an open source of arsenic or other metals which could disperse and mobilize, resulting in increased concentrations within the study area boundary or off-site, these tailings areas should be addressed in the remedial plan;
- If site conditions change, such that Johnston Brook dries up or its path significantly changes, resulting in the potential for exposure of soils as sediments, this should be addressed in the soil risk management plan;
- Some domestic waste was noted in APEC 4 (Figure 2). The waste includes partially buried materials including metal barrels. While not a chemical exposure issue, this debris could pose a physical hazard to someone walking in the area. It would be prudent to remove the visible debris;
- There are currently 46 known abandoned mine openings which consist of flooded pits, shafts, trenches and sunken spots. These openings could pose a physical hazard to someone visiting the site or wildlife in the area (i.e., falling into a shaft opening). While some of the abandoned mine openings were observed to be fenced, have berms and/or have posted signage, for the safety of potential visitors to the site and wildlife, consideration should be given to permanently safeguarding openings to remove this hazard; and
- Given the limited number of groundwater samples collected, it is recommended to collect additional groundwater data to identify groundwater trends to more definitively determine whether 24MW-01 can be considered as an upgradient background well.

3.7 HHRA Uncertainty Analysis 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. Reasonable efforts are made to ensure the assumptions and data adequately represent conditions at a given site. However, data are often limited, resulting in uncertainty and/or reduced accuracy or confidence 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 HHRA are presented below. Overall, given the tendency for the conservative assumptions used in the HHRA to overestimate

COPC exposures, it is considered likely that the HHRA has substantially overestimated potential human health risks.

- The exposure scenarios evaluated in the HHRA are considered the most likely (and most conservative) scenarios given the current use and anticipated future use of the site. However, if anticipated future site use conditions change appreciably, then the need to evaluate other exposure scenarios in the HHRA may need to be considered. No HHRA evaluates all possible scenarios that could relate to a given site at some point in the future, and it is not uncommon for new or revised HHRAs to sometimes be necessary if future site use conditions end up deviating considerably from what was anticipated;
- While the site has been reasonably well characterized in terms of distribution of soil metal concentrations, there remains some sampling and spatial coverage uncertainty as background samples for certain contaminants (e.g., PAHs) were not available for the HHRA and so background conditions could not be adequately characterized;
- Lateral delineation in soils for metals has been achieved to the north and south with partial delineation to the east and west on the northern portion of the assessment area. Vertically soil impacts are delineated by bedrock across the site which range from 0.53 mbgs to 1.37 mbgs;
- Ethylbenzene in soil exceeded the Tier I EQS at BH17 (0-0.15 m), which was advanced in an area of refuse (e.g., household waste, plastic and metal (including a drum and lawnmower)) underlain by waste rock. As no other petroleum exceedances were identified on-site. Four (4) step out samples and a deeper sample were collected in the location of BH17. Findings indicated benzene, toluene, ethylbenzene, xylene and/or Modified TPH exceedances of the Tier I EQS in the deeper sample (i.e., BH127 (0.35 m)) and in three (3) of the four (4) step out samples (i.e., BH129 (0-0.15 m) and BH130 (0-0.15 m) (noting that there were no exceedances were found in the duplicate sample collected from BH130), and BH128 (0-0.15 m). Based on these findings, lateral delineation of petroleum hydrocarbon impacts has not been achieved to the north, south or west. Vertical delineation has not been achieved at BH127;
- While EPCs for metals in soils were calculated using a statistically derived method (e.g., UCLM95 calculations), insufficient data were available for groundwater to determine a reasonable EPC. In place of this, the reported concentrations from 24MW-03 was used instead. This monitoring well is the closest monitoring well to off site potable wells located 50 m to the south of the site boundary. While 24MW-03 is the closest monitoring well to this potable well, it is still 390 m away and the current HHRA assumes no attenuation of contaminants in groundwater between these two wells, nor is it known if the site and potable wells are hydraulically connected to each other;
- Given the natural enrichment of some metals in site soil, there is some uncertainty regarding the distinction “line” between impacted soils within the study boundary and local background areas. However, there is also reasonable confidence that background concentrations of metals in soil have been identified, and that study boundary assessment activities have discerned impacted soils within the study boundary from un-impacted soils influenced by natural geologic enrichment. A background arsenic concentration of 286 mg/kg was used in the HHRA. This value is similar to background concentrations observed in the vicinity of the former Montague mine and Goldenville

mine, where background arsenic has been reported to range up to 273 mg/kg and 140 mg/kg, respectively (Parsons and Little, 2015);

- While no potable groundwater wells are located within the study boundary, potable conditions were conservatively assumed for potential receptors, as well as to be protective of potential impacts to nearby offsite wells located near the site;
- The HHRA considered only soil direct contact and groundwater ingestion as exposure pathways for human receptors on site. Other exposure pathways (including ambient air exposure, dietary consumption and consumer products) are potential pathways for exposure to the identified COPCs and were not assessed. Not accounting for all exposure pathways introduces some uncertainty in to the HHRA;
- In contaminated site HHRAs, it is typical to consider soil ingestion and dermal contact as "event driven". In terms of exposure frequency and duration values that are used in the HHRA of these exposure pathways, the event-driven assumption amounts to not considering hours per day on a site, but only considering days per week and weeks per year. Although, for developmental toxicants (such as lead), the weeks/year term is also typically not considered, leaving only the days/week term to represent exposure frequency and duration. These are inherently highly conservative assumptions, as there is considerable uncertainty surrounding how soil contact exposure actually occurs, and whether or not it is truly event-driven, or more related to time spent on a site. In reality, it is probably a combination of both. For sites that have a land use that corresponds to a large amount of time spent on-site (e.g., residential), the event-driven assumption is logical and appropriate, as the probability of a contact event occurring is related to the amount of time spent on a site. However, this assumption is less reasonable/realistic for sites where the land use is recreational, or where site access by humans occurs in a manner that is transient, infrequent or intermittent (as is the case for the study boundary and the Outdoor Site Visitor scenario), as the probability of a contact event occurring is again related to the amount of time spent on a site. When exposure frequency and duration are amortized to reflect the event-driven assumption for direct soil contact exposure, the assumed time spent on-site for low access land use scenarios ends up being much greater than is realistic or plausible for the actual site access situation that is being assessed. Thus, for low access scenarios, the event-driven assumption results in substantial overestimates of exposure and risk via the soil ingestion and dermal contact pathways and can lead to inappropriately identifying a need for corrective action, when there is none. While there are HHRAs of sites with low/limited human access, where deviation from the event-driven assumption has been accepted through both peer and regulatory review processes, it is very rare for this to occur, and be accepted in HHRAs conducted within Canada at this time;
- While the HHRA utilized current Health Canada and CCME soil ingestion rates for human receptors, it should be recognized that these rates are no longer supported by the scientific literature and greatly overestimate COPC exposure via the soil ingestion pathway (e.g., Richardson, 2013). Health Canada is yet to update their recommended soil ingestion rates in light of recent literature that supports lower rates for human receptors;

- Treatment of data for the HHRA was conducted in a manner that is intentionally conservative (i.e., tending towards overestimation of exposure and risk). For example, for soil samples with field and/or laboratory duplicate samples, the higher concentrations of the identified COPC between the original and duplicate soil samples were retained for assessment. For locations where sample data was available at multiple depths, the highest concentration across depths was also used;
- The amortization of time on site for the worker conservatively assumed that a worker would spend a total of two years of their working life at the site. A two year time frame would cover a range of potential construction projects and was conservatively used as an estimate of total time on site a worker would be present;
- The HHRA assumed that the entire outdoor dust level would be completely inhaled (i.e., all dust is comprised of the respirable PM10 fraction). In reality, the outdoor dust level assumed in the HHRA applies to total suspended particulate (TSP). For airborne dusts of crustal origin, only a small proportion of TSP contains particles small enough to be in an inhalable or respirable range;
- The use of deterministic (or point estimate) exposure analysis techniques in the HHRA is an approach that 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 the soil (or other media) contaminant concentrations on a site. This was the case in the current HHRA, where UCLM95 soil concentrations (or 95th percentile for mercury) of the identified COPCs were evaluated as the EPCs. The use of these upper estimates of study boundary soil concentrations as EPCs represents a highly conservative assumption in the HHRA. In reality, elevated media concentrations of the contaminants are not distributed uniformly across the study boundary but rater, are localized to certain areas within the study boundary. No one accessing the site would ever be exposed to the upper bound estimates of soil COPC concentrations for the entire duration of their time spent on the property;
- The exposure modelling in the HHRA assumed that there is no attenuation, transformation, degradation or loss of COPCs in soils within the study boundary;
- No country food harvesting / hunting was assumed to occur on the site. If these activities do occur, they country food pathway should be investigated further;
- The John Fenton Loop Road is mainly a gravel and dirt road that runs through the site and may be used by all terrain vehicles. No analytical data was available for the road / adjacent to the road. Uncertainty in potential exposures from this area could be reduced by collecting soil samples from the area; and
- No alteration in human receptor exposure patterns due to inclement weather (e.g., rain, winds, very hot or very cold temperature) was assumed. It is likely that exposure to the COPCs in site soils would be limited during heavy rain or high wind events, as well as on days of high heat and humidity, and on very cold days with or without snow or ice cover. These meteorological factors would reduce the receptors' time outdoors on the subject property, thereby reducing potential exposures. Not accounting for such factors likely overestimates potential exposures and risks.

3.8 HHRA Conclusions

The overall conclusions from the HHRA are reiterated below.

- With the exception of arsenic, the identified COPCs were not considered to pose a potential risk to human health in the Outdoor Site Visitor Scenario or the Outdoor Site Worker Scenario;
- HQs for cobalt, mercury and lead were below the THQ for all receptors. The ILCR for cobalt was below the TCRL;
- The HHRA results suggest that soil risk management is required for arsenic for the toddler and adult receptors in the Outdoor Site Visitor Scenario and for the adult in the Outdoor Site Worker Scenario;
- The ILCR for arsenic was greater than the TCRL for the toddler and adult receptors in the Outdoor Site Visitor Scenario and the adult in the Outdoor Site Worker scenario;
- While there is potential risks to site visitors (toddler and adult, ILCR = 2.4×10^{-5} and 2.8×10^{-5} respectively) and site workers (adult, ILCR = 1.4×10^{-5}), the estimated risk is considered an overestimate. This is largely because receptors interacting with the site are unlikely to interact with the site for any significant duration. The HHRA assumed visitors would be present for six months of the year and did not account for factors such as inclement weather (e.g., cold rain during early spring) which would reduce time on site for potential visitors. The site is not easily accessible to the public, the site is heavily covered in vegetation/dense forest and likely to dissuade visitors from accessing more heavily impacted site soils (i.e., the waste rock piles where high levels of arsenic, mercury and other contaminants were observed are not adjacent to the road). It is also unlikely that the site would be used for recreational purposes (particularly for young children) which would further dissuade regular use of the site. For the workers, 48 weeks of site exposure per year and 10 hours per day were assumed in the HHRA. This is likely an overestimation of risk as winter conditions (e.g., frozen ground) may prevent outdoor work from being conducted and would greatly reduce potential exposures to site soil COPCs;
- **Section 3.6** discusses proposed risk management recommendations for the study boundary. This included the development of an initial soil SSTL for arsenic of 530 mg/kg for the site visitor and 1150 mg/kg for the site worker, which is protective of all other human receptors for each scenario; and
- **Section 3.7** describes various uncertainties and conservative assumptions applied in the HHRA that are collectively believed to result in substantial overestimates of exposure and risk for all human receptors assessed in the HHRA.

4.0 Ecological Risk Assessment

4.1 Ecological Risk Assessment Framework

An ERA evaluates potential effects on non-human (ecological) organisms, populations or communities in response to human-induced stressors. The framework and methods used for the ERA are described in this section and its associated subsections.

4.1.1 ERA Goals, Approach and Scope

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 environmental media at the former Country Harbour mine site warrant risk management for the protection of ecological receptors that may occur on or utilize the properties. 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 conditions at the site, and if so, determine what (if any) management or remedial action is needed to reduce environmental risks and liabilities.

The scope of this ERA is limited to the terrestrial and aquatic media at the site. The scope of the ERA is also limited by the chemistry data that are currently available for the on-site media. The ERA does not evaluate or consider potential exposures and risks to ecological receptors that may occur on adjacent properties other than the site, nor does it consider the adjacent freshwater water bodies that could potentially be influenced by the current and historical activities at the site. The framework and associated methodologies for each step of the ERA is provided below.

The ERA for the site was conducted in accordance with the NS CSRs and associated Ministerial Protocols, where relevant. In addition, the current ERA considered widely accepted ecological risk assessment frameworks, methodologies and guidance published and endorsed by Environment Canada (e.g., CCME, 2020; the FCSAP ERA Guidance Document [2012a] and associated modules, and the US EPA [i.e., US EPA, 1998]). Where necessary, consideration was also given to ERA guidance from other agencies and jurisdictions in Canada and internationally.

ERAs can involve various levels of detail, complexity and level of effort. The initial ERA framework developed by Environment Canada (CCME, 1996) reflected 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 federally contaminated sites (i.e., CCME, 2020; FCSAP, 2012a) does not categorize ERAs according to scope or level of detail/effort (e.g., screening-level versus detailed quantitative). Rather, this recent 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 specific steps used to conduct an ERA are based on CCME (2020) and FCSAP (2012a) guidance as illustrated on Figure 4-1, below.

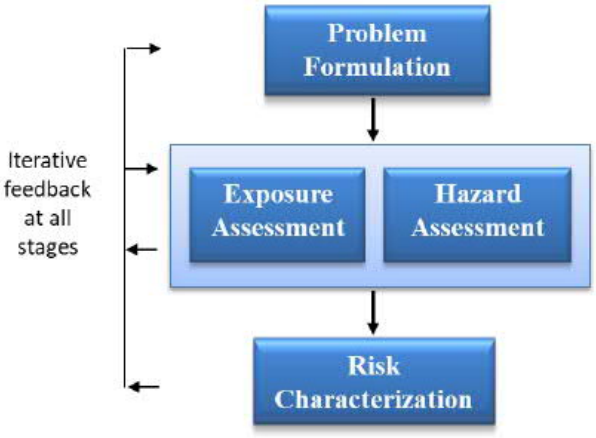


Figure 4-1: Ecological Risk Assessment Steps (from CCME, 2020; FCSAP, 2012a)

Each step of an ERA is briefly described in the following sections.

Problem Formulation: The problem formulation step of an ERA is analogous to that described above for the HHRA and acts as an information-gathering and interpretation stage, which serves to plan and focus the approach of the ERA on the most critical aspects of the site being evaluated.

There are several elements or tasks that typically comprise the problem formulation step in an ERA, including:

- Site characterization and review of existing site information;
- Review regulatory context;
- Establish the objectives, goals, and level of effort of the ERA;
- Selection of study boundary and reference areas;
- Identify receptors of concern (ROC);
- Identify assessment and measurement endpoints;
- Develop lines of evidence (LOE);
- Identify exposure pathways;

- Identify COPCs; and
- Develop a CSM 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, and/or lead to sampling and analytical plan development and determine whether there is a need to further evaluate certain areas of a site, receptor types, exposure pathways and site-related chemicals. The outcomes of the problem formulation step for the Country Harbour ERA are provided in Section 4.2.

Exposure Assessment: The exposure assessment step of an ERA involves estimating the amount of each COPC 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., soil concentrations are assumed to represent exposure concentrations for soil invertebrates). Outcomes of the exposure assessment are provided in Section 4.3.

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 COPC. Outcomes of the effects assessment step are provided in Section 4.4.

Risk Characterization and Uncertainty Assessment: Risk characterization typically involves the evaluation and interpretation of each line of evidence (LOE) considered in the preceding steps of the ERA. This is often done using a weight of evidence (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. This step also involves an uncertainty assessment which provides details of major uncertainties in ERA. Outcomes of the risk characterization and uncertainty assessment step are provided in Section 4.5 and 4.6.

4.2 Problem Formulation

As discussed in Section 4.1, the problem formulation step is an important information gathering and interpretation stage, which serves to plan and focus the approach of the ERA on the most critical aspects of the site being evaluated. The data gathered and evaluated in this step provides information regarding the history and layout of the site, possible exposure scenarios and pathways, identification of receptors of potential concern, identification of COPC, and any other specific areas or issues of concern to be addressed. The outcomes of the problem formulation step for the former Country Harbour mine are provided in the following sections.

4.2.1 Site Habitat Characterization

Site characterization information has been previously presented in Section 2.0 of this report. Additional site information specifically relevant for the ERA are provided below. Photos of the site and the surrounding ecological habitat can be found in Appendix B.

The former mine consists of an area of approximately 69 hectares (ha), with 46 known abandoned mine openings and one reported tailings area. Some small areas in the southern and central portions of the site are comprised mainly of rock cover; however, the vast majority of the study area is dense forest that is well vegetated and provides ample habitat for ecological receptors. The area of 69 ha outlined in Figure 2, Appendix A comprises the study area for the ERA. As described in the Phase II ESA (Dillon, 2024b), the study boundary generally consisted of an organic/peat layer at surface, underlain by silty sand or sand and gravel.

As noted previously there is a watercourse, Johnston Brook, within the study boundary. The watercourse overall has a steep grade and predominantly large substrate, with a short waterfall at the furthest downstream extent and another waterfall approximately 500 m upstream of the southernmost property boundary. During the time when the aquatic habitat assessment was conducted, surface water in Johnston Brook was dried up or flowed underground towards the southern end of the brook (see Appendix E). Although fish were not observed during the site visits, it was determined that most reaches of the brook likely provide suitable fish habitat at some times for common small-bodied fish species that can tolerate acidic water and are capable of maneuvering through some debris and waterfalls. The underground section of flow form Johnston Brook represents an effective fish barrier, and it is unlikely that fish could cross that barrier. Environmental DNA (eDNA) samples collected at the site help corroborate these observations. Additional information can be found in the aquatic habitat assessment report (Section 3.2, Appendix E).

Johnston Brook is identified as a habitat of potential ecological concern, as it intersects the site and eventually drains into Country Harbour via the Country Harbour River. Most of the brook is shaded and the main sources of cover from surrounding mature mixed wood forest, undercut banks and woody debris. Based on evidence of washed-out sediment and large debris, noted by Dillon during the aquatic habitat assessment, as well as the surrounding topography, the brook is assumed to be influenced by variable flow conditions and flash flood conditions at times. At the time of the aquatic habitat assessment, the depth of the brook ranged from 0.16 to 0.18 m with a wetted width of approximately 1.8 m to 2.6 m (Appendix E).

4.2.2 Regulatory Context

With respect to the regulatory context for the ERA, the site is located on land owned by the NSDNRR, and as such the NS PSS were preferentially applied. The PSS are benchmarks developed by source agencies and departments outside of NS such as the CCME, AEP and MECP. The original guideline sources were reviewed to ensure the NS PSS guideline referenced was the most recent applicable guideline from the original source, and if the guideline was outdated it was updated. Where NS PSS was

not identified, other provincial or federal regulatory benchmarks were used, where available. In the absence of Canadian guidelines, the US EPA Ecological Soil Screening Levels (EcoSSL) were considered.

For a number of regulatory jurisdictions, ecological soil quality benchmarks have been derived for specific receptor types such as terrestrial vegetation, soil invertebrates, mammals and birds. In these cases, the lowest benchmark provided was selected for COPC identification purposes.

The study boundary primarily contains areas with dense forests. Some clearing has taken place to accommodate environmental site assessment activities (Dillon, 2023) and limited areas of the site are comprised of rock cover; however, the majority of the site remains forested and provides ample habitat for ecological receptors. Based on this, the commercial zoning of the site, and the reasonably anticipated future site use, the most appropriate land use for selecting applicable guidelines for the ERA was determined to be commercial. As such, the COPC screening was conducted using commercial guidelines for ecological health.

Soil within the study boundary ranges from fine to coarse-grained. As such, guidelines for the lower of the guidelines for coarse or fine-grained soils were preferentially sourced from all jurisdictions, where applicable.

4.2.3 Selection of Site Boundaries and Reference Areas

The spatial boundary for the current ERA is the assessment area shown on Figure 2, Appendix A (i.e., approximately 69 ha). Available study area and background data used in the ERA have been previously discussed in Section 2.6. A summary of the site and background data are provided in Appendix E.

4.2.4 Species at Risk (SAR) Assessment

To identify a preliminary list of SAR and species of conservation concern (SoCC) that may use the site, relevant federal and provincial guidance was reviewed along with applicable regulations and legislation. The following definitions of SAR and SoCC applied to the assessment:

- Species at Risk (SAR): A species that is determined to be endangered, threatened, or vulnerable/special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Nova Scotia Endangered Species Act (NSESA), or the federal Species at Risk Act (SARA); and
- Species of Conservation Concern (SoCC): those species that are not SAR but are identified as regionally vulnerable or imperilled by the Atlantic Canada Conservation Data Centre (ACCDC) (i.e., those species with ACCDC S-ranks of S1: critically imperiled in the province; S2: imperiled in the province; and S3: vulnerable in the province).

Data was gathered from ACCDC, previous reports, and the species at risk registry, with special attention to applicable recovery strategies, action plans, and management plans. The ACCDC report included 41 historical records of rare and endangered flora and fauna within a 5 km radius of the site centre. Of these records there were 16 species considered to be SAR, as defined above, for this assessment.

Table 4-1: Suitable Habitat Descriptions for Potential SAR

Species	Suitable Habitat Description	Available Suitable Habitat within the Site	Species on site?
Atlantic Salmon - Nova Scotia Southern Upland population *Salmo salar*	Requires rivers or streams that are generally clear, cool and well-oxygenated (COSEWIC, 2010).	Given the elevation drop at the entry to the properties, generally steep grade of Johnston Brook and intermittent nature of the watercourse, the section of Johnston Brook within the subject properties is not likely to provide suitable habitat.	ACCDC records within 5 km
Bank Swallow *Riparia riparia*	Nests within steep embankments along eroding river/ocean shore, but also quarries and gravel pits. Breeding sites are often situated near open terrestrial habitat used for aerial foraging (e.g., grasslands, meadows, pastures, and agricultural cropland). Large wetlands are used as communal nocturnal roost sites during post-breeding, migration, and wintering periods (COSEWIC, 2013).	Suitable nesting habitat is not present within the site.	ACCDC records within 5 km
Canada Warbler *Cardellina canadensis*	Abundant in moist, mixed coniferous-deciduous forest with a well-developed understory. Nests are built on or near the ground, hidden in mossy hummocks, or beneath root masses, downed wood, base of large wet forest fern species and clumps of grass (COSEWIC, 2023).	Potential suitable habitat present within the forested areas.	ACCDC records within 5 km
Common Nighthawk *Chordeiles minor*	Require open ground or clearings for nesting. Breeds in a wide range of open habitats. Forage in open areas with flying insects during crepuscular periods, although they sometimes forage during the day. Roosting sites consist of tree limbs, ground, fence posts, rooftops (COSEWIC, 2023).	Habitat not likely within the AECs; however, may nest on access roads.	ACCDC records within 5 km
Olive-sided Flycatcher *Contopus cooperi*	Nests in open, forested areas, often with many conspicuous perches (i.e., tall trees or snags alongside open	Potential suitable habitat present within the forested areas.	ACCDC records

Species	Suitable Habitat Description	Available Suitable Habitat within the Site	Species on site?
	areas) (ECCC, 2016). Diet is comprised almost entirely of flying insects (NatureServe Explorer, 2024).		within 5 km
Evening Grosbeak *Coccothraustes vespertinus*	Breeding habitat generally includes open, mature mixed wood forests where fir species and/or white spruce are dominant and Spruce Budworm is abundant. Outside of the breeding season the species is dependent on seed crops from various trees such as firs and spruces. Nests are located in the canopy and the preference is to use conifers (COSEWIC, 2016).	Potential suitable habitat present within the forested areas.	ACCDC records within 5 km
Common Tern *Sterna hirundo*	Nest on rocky islands, barrier beaches, and saltmarshes. Forage over open waters (Cornell, 2019).	Suitable habitat not present within the site.	ACCDC records within 5 km
Canada Jay *Perisoreus canadensis*	Boreal forests where black or white spruce trees are common. Nests at low to moderate height, often in trees close to the south-facing edge of a forest patch to take advantage of the extra warmth from sunlight (Cornell, 2019).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Boreal Chickadee *Poecile hudsonicus*	Inhabit mostly mature coniferous forests, usually spruce and balsam fir, often near water. Nests are made inside cavities, usually in dead trees (Cornell, 2019).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Greater Yellowlegs *Tringa melanoleuca*	Use a wide variety of fresh and brackish wetlands, including mudflats, marshes, lake and pond edges, wet meadows, sewage ponds, and flooded agricultural fields during migration. Seek out boreal wetlands, wet meadows, and sedge lands for breeding habitat (Cornell, 2019).	Suitable habitat not present within the site.	ACCDC records within 5 km

Species	Suitable Habitat Description	Available Suitable Habitat within the Site	Species on site?
American Kestrel *Falco sparverius*	Favor open areas with short ground vegetation and sparse trees. Nest in cavities such as old woodpecker holes, natural tree hollows, rock crevices, and nooks in buildings and other human-built structures (Cornell, 2019)	Suitable habitat not present within the site.	ACCDC records within 5 km
Wilson's Snipe *Gallinago delicata*	Found in wet, marshy settings, including bogs, fens, alder and willow swamps, wet meadows, and along rivers and ponds. Nest on the ground close to or surrounded by water. The nest is often placed atop or on the edge of a hummock and well hidden by sedges, grass, or sphagnum moss. Willow, alder, or other brush may obscure the nest from above (Cornell, 2019).	Suitable habitat not present within the site.	ACCDC records within 5 km
Black-backed woodpecker *Picoides arcticus*	Inhabit coniferous forests. Highest densities in recently burned areas, occasionally including burned or insect-infested deciduous forest. Nest in usually relatively small, dead tree cavities in areas with a high density of relatively large trees (Cornell University, 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Bay-breasted Warbler *Setophaga castanea*	Breed mostly in mature spruce and fir forests, often near water. Nests are most often in dense spruce or balsam fir, usually on a branch in the lower third of the tree (Cornell University, 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Red-breasted Merganser *Mergus serrator*	Breed in fresh, brackish, and saltwater wetlands, typically close to the coast. Nest along forested riverbanks, marsh edges, lakeshores, coastal islands, and sandy shores with vegetation (Cornell University, 2023).	Suitable habitat not present within the site.	ACCDC records within 5 km

Species	Suitable Habitat Description	Available Suitable Habitat within the Site	Species on site?
Eastern Pearlshell *Margaritifera margaritifera*	Generally live buried in clean, mixed stable substrate in fast-flowing unpolluted streams and rivers. Not found in lakes, ponds, or warmwater streams (WARM, 2024).	Suitable habitat not present within the site.	ACCDC records within 5 km
American Beech *Fagus grandifolia*	Needs moist, well-drained, rich soils. Shade tolerant species (OMNRF, 2023)	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Woodland Strawberry *Fragaria vesca*	Abandoned fields, along roads and in open woodlands (NatureWatch, 2023).	Potential suitable habitat present along access roads at the site.	ACCDC records within 5 km
Boreal Felt Lichen - Atlantic pop. *Erioderma pedicellatum*	Cool, humid, forests containing Balsam Fir (*Abies balsamea*) (ECCC, 2020b).	Potential suitable habitat present along access roads at the site.	ACCDC records within 5 km
Blue Felt Lichen *Pectenia plumbea*	Hardwood trees with mature bark and high humidity in woodlands (ECCC, 2022c).	Potential suitable habitat present along access roads at the site.	ACCDC records within 5 km
Frosted Glass-whiskers - Atlantic pop. *Sclerophora peronella*	Grows on old deciduous trees, usually on the exposed heartwood of living trunks and more rarely on bark, in humid and shaded situations. Often associated with old-growth forests in coastal regions, but it is also found in open forests, in clearings, and on the margins of old deciduous forests (COSEWIC, 2014).	Potential suitable habitat present along access roads at the site.	ACCDC records within 5 km
Peppered Moon Lichen *Sticta fuliginosa*	Found on conifer and hardwood trees in mature, moist forests and bogs (MNDNR, 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km

Species	Suitable Habitat Description	Available Suitable Habitat within the Site	Species on site?
Acadian Jellyskin Lichen *Leptogium acadiense*	According to the AC CDC report, the individual recorded near the former mine site was found on the bark of two mature red maples in an upland forest near a swamp (AC CDC 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Salted Shell Lichen *Coccocarpia palmicola*	According to the AC CDC report, the individual recorded near the former mine site was found on the bark of a mature balsam fir in a forested swamp (AC CDC 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Shaggy Fringed Lichen *Anaptychia palmulata*	According to the AC CDC report, the individual recorded near the former mine site was found on the bark of a mature yellow birch in an intermediate upland forest (AC CDC 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km
Fringe Lichen *Heterodermia neglecta*	According to the AC CDC report, the individuals recorded near the former mine site were found on the bark of a mature red maple in a small ravine and on an immature yellow birch in a mixed upland forest (AC CDC 2023).	Potential suitable habitat present within the forested areas at the site.	ACCDC records within 5 km

Notes:
Bold denotes SAR with potential suitable habitat on the site.
Shaded cell denotes SAR with potential suitable habitat near the site and that may incidentally be present on the site.

Though present on and/or within 5 km from the subject properties, the AC CDC report showed no historical observations of SAR or SoCC within the former mine footprint. The nearest SAR and SoCC records are approximately 1 km away from the approximate center of the former mine site. Overall, the assessment indicated the potential presence of several SAR on the site, as follows:

- Black-backed Woodpecker (*Picoides arcticus*);
- Bay-breasted Warbler (*Setophaga castanea*);
- Canada Warbler (*Cardellina canadensis*);
- Olive-sided Flycatcher (*Contopis cooperi*);
- Evening Grosbeak (*Coccothraustes vespertinus*);
- Canada Jay (*Perisoreus canadensis*);
- Boreal Chickadee (*Poecile hudsonicus*);
- American Beech (*Fagus grandifolia*);
- Woodland Strawberry (*Fragaria vesca*);

- Boreal Felt Lichen - Atlantic pop. (*Poecile hudsonicus*);
- Blue Felt Lichen (*Pectenia plumbea*);
- Frosted Glass-whiskers (Atlantic pop.) (*Sclerophora peronella*);
- Peppered Moon Lichen (*Sticta fuliginosa*);
- Acadian Jellyskin Lichen (*Leptogium acadiense*);
- Salted Shell Lichen (*Coccocarpia palmicola*);
- Shaggy Fringed Lichen (*Anaptychia palmulata*); and
- Fringe Lichen (*Heterodermia neglecta*).

These SAR were further examined by considering their potential for exposures to site-related COPCs which is influenced by several factors, including the size of the study boundary, availability of food resources within the study boundary, the surrounding habitats and food resources, the home range of the species, and species diet. Table 4-2 summarizes the potential for site exposures for the SAR evaluated herein. Based on these considerations, it was concluded that it is unlikely that the SAR would use the site as breeding habitat. Further SAR surveys are not recommended.

Table 4-2: Discussion of the Exposure Potential of COPCs for Species at Risk within the Study Boundary

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
Black-backed Woodpecker (*Picoides arcticus*)	The black-backed woodpecker is a non-migratory bird that typically nests in burned forests, favoring areas with abundant dead trees for foraging and nesting (AllAboutBirds, 2024). Its diet primarily consists of wood-boring beetles and their larvae, which it forages for by pecking into dead and dying trees (AllAboutBirds, 2024). The black-backed woodpecker prefers to breed in post-fire habitats or recently disturbed areas with a high density of snags, providing ample food and suitable nesting sites (AllAboutBirds, 2024).	Potential suitable habitat in forested areas.	Limited potential for exposure given diet of insects from within tree trunks and foraging above ground, preferred foraging habits, and home range size (> 5km). As such, potential for risk to the Black-backed Woodpecker was considered to be low and they were not carried forward for further assessment.

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
Bay-breasted Warbler (*Setophaga castanea*)	The bay-breasted warbler is a migratory bird that breeds in the boreal forests of Canada and the northeastern United States, typically nesting in coniferous trees at higher elevations (AllAboutBirds, 2024). Its diet mainly consists of insects and small spiders, with the most important part of their diet being the spruce budworm. They typically feed in middle levels of the tree canopy (AllAboutBirds, 2024). The bay-breasted warbler breeds in dense coniferous or mixed forests, particularly favoring areas with abundant spruce and fir trees for nesting and foraging.	Potential suitable habitat in forested areas.	Limited potential for exposure given diet of insects from understory vegetation and foraging above ground, preferred foraging habitats, and home range size (>5 km). As such, potential for risk to the Bay-breasted Warbler was considered to be low and they were not carried forward for further assessment.
Canada Warbler (*Cardellina canadensis*)	Canada Warblers are migratory birds. Their nests are on or near the ground, among roots of fallen trees, in cavities in banks, or on ledges, sides of rocks, hummocks, stumps, or fallen logs, or on the ground under shrubbery (NatureServe, 2024). Canada Warblers eat many types of insects and spiders. They quickly hop between branches picking insects from understory vegetation in a flurry of activity. They also grab flying insects in the air, a foraging strategy called flycatching or hawking (Cornell, 2019). Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall	Potential suitable habitat present within the forested areas.	Limited potential for exposure given diet of insects from understory vegetation and foraging above ground, preferred foraging habitats, and home range size (>5 km). As such, potential for risk to the Canada Warbler was considered to be low and they were not carried forward for further assessment.

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
	shrubbery along streams or near swamps, and deciduous second growth (NatureServe, 2024). As such, breeding would not likely occur in the more contaminated areas of the study boundary.		
Olive-sided flycatcher *(Contopus cooperi)*	Olive-sided flycatchers are migratory birds. They nest above ground (generally more than 5 feet above ground; Cornell, 2019) in open, forested areas, often with many conspicuous perches (i.e., tall trees or snags alongside open areas) (ECCC, 2016). Diet consists almost entirely of flying insects and often forage for insects near or above the canopy level of surrounding forests (ECCC, 2016). The olive-sided flycatcher is highly territorial with large home ranges between 10 and 20 ha (ECCC, 2016). Breeding occurs primarily in forests (ECCC, 2016). As such, breeding would not likely occur in the more contaminated areas of the study boundary.	Potential suitable habitat in forested areas.	Limited potential for exposure given diet of flyng insects, foraging many meters above ground, preferred breeding and foraging habitats, and home range size. As such, potential for risk to the olive-sided flycatcher was considered to be low and they were not carried forward for further assessment.
Evening Grosbeak (*Coccothraustes vespertinus*)	Coniferous (primarily spruce and fir) and mixed coniferous- deciduous woodland, second growth, and occasionally parks; in migration and winter in a variety of forest and woodland habitats, and around human habitation (NatureServe, 2024).	Potential suitable habitat in forested areas.	Limited potential for exposure given diet of non-soil dwelling invertebrates as well as a wide variety of fruits and seeds, preferred breeding and foraging habitats, and home range size. As such, potential for risk to the Evening Grosbeak was considered

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
	In summer, Evening Grosbeaks eat mostly invertebrates such as spruce budworm larvae, caterpillars, and aphids. They also eat a wide variety of seeds and small fruits, such as ash fruits, cherries, crabapples, snowberries, hawthorn fruits, Russian olive fruits, and juniper berries. Evening Grosbeaks typically feed at the tops of trees and shrubs, but you may see them come to the ground for fallen fruits and seeds or capture aerial insects in flight (Cornell, 2019). Evening Grosbeaks nest high in trees or large shrubs (Cornell, 2019).		to be low and they were not carried forward for further assessment.
Canada Jay (*Perisoreus canadensis*)	The Canada Jay makes its home in boreal and subalpine forests across northern North America, usually where black or white spruce trees are common (Cornell, 2019). Usually nests in a conifer, 1-9 m (usually 2-3 m) above ground (NatureServe, 2024). Omnivorous: Feeds on insects, berries, lichen, mice, carrion, scraps from campsites (NatureServe, 2024). Gray Jays have home ranges of about 65-130 hectares in Ontario (NatureServe, 2024).	Potential suitable habitat in forested areas.	Limited potential for exposure given the wide variety of dietary items, preferred breeding and foraging habitats, and home range size. As such, potential for risk to the Canada Jay was considered to be low and they were not carried forward for further assessment.

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
Boreal Chickadee (*Poecile hudsonicus*)	Boreal Chickadee habitat includes boreal coniferous and mixed forests, muskeg bogs, vicinity of white cedar and hemlock swamps, birches and streamside willows. Nests in natural cavities or abandoned woodpecker holes, or in cavities dug in rotten tree stub, usually within 1 m of ground (but up to 3.7 m) (NatureServe, 2024). Boreal chickadees forage in trees, eating conifer and birch seeds, and the eggs, immature stages, and on tree-inhabiting spiders, insects, pupae and eggs (NatureServe, 2024). Most of the foraging takes place in the middle and upper forest canopy. However, in the presence of Black-capped Chickadees they may shift their foraging sites further up the trees.	Potential suitable habitat in forested areas.	Limited potential for exposure given diet of tree-inhabiting invertebrates as well as a variety of seeds and occasionally fruits, preferred breeding and foraging habitats. As such, potential for risk to the Boreal Chickadee was considered to be low and they were not carried forward for further assessment.
American Beech (*Fagus grandifolia*)	The American beech is a large native tree known for its wide, low-growing branches and silver-gray bark. This deciduous tree, which can reach heights of 50 to 70 feet and prefers moist, well-drained, acidic soils, is valuable for wildlife, attracting various birds and small mammals (The Morton Arboretum, 2024).	Potential suitable habitat in forested areas.	Limited potential for exposure due to the large size of the species relative to the anticipated uptake of chemicals in soil by the roots. Potential risk to the American Beech tree would be covered by the terrestrial vegetation assessment.
Woodland Strawberry (*Fragaria vesca*)	The woodland strawberry thrives in a variety of habitats, including hardwood forests, swamps, and rocky woodlands, typically blooming early in the growing season between April and June. It prefers moister and	Potential suitable habitat along access roads.	Limited potential for exposure as the species was not observed to be on site and AC CDC records did not report observations of the species within the former mine footprint.

Species	Life History Comments	Available Suitable Habitat within the Site	Potential for Exposure of Site COPCs
	shadier environments compared to its more common counterpart, the wild strawberry (USDA, 2024).		
Boreal Felt Lichen - Atlantic pop. (*Poecile hudsonicus*)	Lichen SAR identified in the ACCDC report typically grow on tree trunks and branches.	Potential suitable habitat in forested areas.	Limited potential for exposure given their presence on tree branches and trunks (i.e., not in direct contact with soil, surface water, sediment, or groundwater). Although exposure could occur as a result of root uptake by the host trees, exposure of site-related chemicals to lichens through this process would likely be negligible. As such, potential exposures to lichen SAR are considered to be low and they were not carried forward for further assessment.
Blue Felt Lichen (*Pectenia plumbea*)			
Frosted Glass-whiskers (Atlantic pop.) (*Sclerophora peronella*)			
Peppered Moon Lichen (*Sticta fuliginosa*)			
Acadian Jellyskin Lichen (*Leptogium acadiense*)			
Salted Shell Lichen (*Coccocarpia palmicola*)			
Shaggy Fringed Lichen (*Anaptychia palmulata*)			
Fringe Lichen (*Heterodermia neglecta*)			

4.2.5 Identification of Receptors of Concern

In an ERA, 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 site-specific and must reflect an understanding of the specific ecological attributes of the site being investigated. For example, sites that offer limited or no habitat or food resources for ecological receptors likely do not merit an ERA study. Identification of ROCs is not limited to those that only occur on the site of interest, but also considers receptors that may utilize the site for foraging, breeding, nesting, resting and other aspects of their life history.

For the purposes of an ERA, it is neither practical nor necessary to assess each and every species that may potentially occupy or utilize a site. 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:

- General study area characteristics (e.g., surface coverings, habitat types present, observed species) as determined from environmental site investigations;
- Representation from the various trophic levels, habitats, and feeding guilds that are appropriate for the study area;
- 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, or body weights);
- Habitat quality, suitability, and preferences for receptors that may occur on or utilize a site (e.g., does the site meet habitat requirements or preferences for receptors of interest?);
- Likely percentage of time spent within potentially impacted areas of a site and fraction of diet obtained from within these areas;
- Whether species of interest are resident biota or migratory (and other seasonal factors, such as species that may hibernate);
- The availability of biological data describing receptor characteristics, life history and behaviour for the study area;
- The physical-chemical, environmental fate/behaviour, and toxicological properties of COPCs (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 the ROC;
- Availability of regional and 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 (e.g., commercial importance of a species, level of value to humans; recognized as a pest or vermin);
- Availability of information from local experts and residents of the area or surrounding properties;

- Potential presence of domestic animals (e.g., livestock, cats, dogs); domestic animals may have different protection goals or biological endpoints of interest than wildlife, and the presence of domestic animals may serve as key ecological stressors for wildlife species that may occur on a given site;
- A site visit to visually confirm habitat types, exposure pathways, and the potential for certain wildlife species to occur on or utilize the site; and
- Professional judgement.

The key outcome of the ROC identification step is the consideration of 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 the study boundary (or would be expected to utilize the site on a regular basis), have a high exposure potential to COPCs in site media, and/or have a known sensitivity to one or more COPCs. 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 vegetation and soil and sediment 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[3] of biological organization. The individual organism level of biological organization is typically evaluated in an ERA only if the ROCs are rare, threatened, or endangered species (FCSAP, 2012a; Suter et al., 2000).

Thus, for most ROCs that are assessed at contaminated sites, the relevant level of biological organization is either community or population. The ecological protection goals for ROCs are the same in that the 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 the *Species at Risk Act* [SARA]). As such, in most contaminated site ERAs, the focus is not on protecting individual organisms or even groups of individuals (such as breeding pairs) that may occur on or utilize a site. Rather, the ecological protection goal is focused on maintenance of local populations of the ROC (or its surrogate), or maintenance of community ecological structure and function.

[3] 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.

The selection of ROC considers receptor diet, receptor characteristics, site characteristics (e.g., available habitat), in addition to the size of the site. The assessment area is approximately 69 ha, and the majority of the site has ample habitat for ecological receptors. The study boundary is shown on Figure 2, Appendix A. To date, metals impacts in soil are laterally delineated to the north and south. Lateral delineation of impacts to the east and west have been partially delineated on the southern portion of the site; however, impacts are not delineated to the east and west on the northern portion of the site. Vertically, soil impacts are delineated by the presence of bedrock, which ranged from 0.53 mbgs (APEC #1) to 1.37 mbgs (APEC #2). Given that soil contamination on the site has not been fully delineated, there is some uncertainty in how far the contamination extends into off-site areas that may have suitable habitat for ecological receptors. The evaluation of off-site soil contamination was not within the scope of this assessment.

To identify ROCs for the site, a number of information sources were reviewed and considered including:

- Previous environmental reports (e.g., Dillon 2023, 2024a,b as well as historical reports);
- FCSAP (2012b) Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. This document suggests a number of candidate receptors for Canadian federally owned sites;
- Specific guidance related to spatial and habitat quality considerations for ERA (i.e., ASTM, 2016; 2023); and
- Information gathered during fieldwork on the site and obtained through on-line searches regarding wildlife species that would be expected to be within the study boundary.

The ecological receptors and receptor groups that were considered for selection as receptors for the ERA, along with rationale for their inclusion/exclusion are provided in Table 4-3. Among the rationale for inclusion or exclusion of ecological receptors is the presence or absence of operable exposure pathways by which receptors could come into contact with COPCs in soil. While the selection of exposure pathways is typically its own item within the problem formulation step of ERA, it is only conducted for ROCs that have been deemed to merit inclusion in the ERA. Furthermore, receptor and exposure pathway selection are linked processes that influence each other, and it is commonplace for exposure pathway considerations to be a factor in deciding whether or not certain ecological receptors should be selected for evaluation in an ERA.

Surrogate receptor species are also provided in Table 4-3, where relevant. As noted in FCSAP (2012a), 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 4-3: Ecological Receptors Selected for or Excluded from Evaluation in the ERA

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Terrestrial Vegetation	Include	Not applicable; assessed at the community level	The site is heavily forested with terrestrial vegetation (see Appendix B). Some cleared areas exist where drilling took place as part of the site investigations, and there are minimal areas of the site comprised of exposed rock. Balsam fir (*Abies balsamea*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*) and white spruce (*Picea glauca*) as well as various species in the shrub and herbaceous layer such as common ferns, grasses and sedges are presented throughout the site. COPCs in soil may enter vegetation via root uptake and potentially via the pathway of volatilization from soil and subsequent foliar uptake of vapour phase COPCs. Terrestrial vegetation on the site may be consumed by herbivorous wildlife. Terrestrial vegetation is not mobile, and most species have limited strategies to avoid root contact with contaminated soil. Thus, these organisms have a high exposure potential to COPCs in soil and were selected as ROC.
Soil Invertebrates	Include	Not applicable; assessed at the community level	Soil invertebrates would be expected to inhabit the site based on physical characteristics. Soil invertebrates (such as earthworms and arthropods) have a key role in soil development and nutrient cycling and are a major food item for many wildlife species. Soil invertebrates are in constant direct contact with soil, are largely immobile, and some species directly consume soil. Thus, these organisms have a high exposure potential to COPCs in soil.

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Herbivorous Small Mammals	Include	Meadow vole (*Microtus pennsylvanicus*) Snowshoe hare (*Lepus americanus*)	Small herbivorous mammals such as the deer mouse, snowshoe hare and woodchucks are some of the herbivorous mammals that are found in Nova Scotia and could possibly be found on the site (Government of Nova Scotia, 2021). Herbivorous small mammals have a high potential to be exposed to COPCs in soil due to burrowing behaviour, ground-foraging of vegetation and seeds, and generally small home ranges. The site is large relative to the home and foraging range sizes of small mammal herbivores (e.g., meadow vole - 0.0069 ha to 0.348 ha; snowshoe hare - 1.6 ha; FCSAP, 2012b). Small herbivorous mammals could be exposed to COPCs via the consumption of vegetation and incidental soil ingestion. As such, this receptor group was selected as a ROC. The meadow vole and the snowshoe hare were selected as surrogate species for this receptor group as they occur in Nova Scotia and would likely have relatively high exposures due to their small home ranges.
Insectivorous or Invertevorous Small Mammals	Include	Masked shrew (*Sorex cinereus*)	Insectivorous/invertevorous small mammals such as the masked shrew, star-nosed mole and deer mouse are some of the insectivorous/invertevorous mammals that are found in Nova Scotia and could possibly be in the area (Government of Nova Scotia, 2021; NatureServe, 2024). Insectivorous/invertevorous small mammals have a high potential to be exposed to COCs in soil due to their burrowing behaviour, consumption of soil dwelling organisms (soil invertebrates) and generally small home ranges. The site is large relative to the home

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
			and foraging range sizes of small mammal insectivores/invertevores. This receptor group was included as a ROC and the masked shrew was selected as a surrogate for this receptor group.
Herbivorous Birds	Include	Ruffed Grouse (*Bonasa umbellus*)	Herbivorous birds such as the ruffed grouse and spruce grouse have been reported to occur in Nova Scotia (Nova Scotia Bird Society, 2023). While herbivorous birds tend to have moderately large home/foraging ranges, some areas of the site likely contain habitat and food resources for herbivorous birds. Thus, it is possible that herbivorous birds occur/forage on the site where they would be exposed to COPCs via the consumption of vegetation and incidental soil ingestion. The ruffed grouse was selected as a surrogate for this receptor group given that it occurs in Nova Scotia (NatureServe, 2024).
Insectivorous/ Invertevorous Birds	Include	Dark-eyed Junco *(Junco hyemalis)*	Insectivorous/invertevorous birds have a high potential to be exposed to COPCs in contaminated soils due to their typical ground foraging behaviour in relation to the consumption of soil dwelling organisms (soil invertebrates) and generally small home/foraging ranges. The site is large relative to the home and foraging range sizes of most small bird insectivores/invertevores. The dark-eyed junco was selected as a surrogate for this receptor group to assess COPC exposures to insectivorous bird species. The junco has been reported to be a year-round resident of Nova Scotia and is physically smaller in size (Cornell, 2019). The junco is a commonly assessed avian receptor in ERAs due to its year-round residency, foraging behaviours which tend to increase potential

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
			exposure to COPCs in soil and food items, its small body weight, and relatively small home/foraging range.
Carnivorous Small Mammals	Include	Ermine (*Mustela erminea*)	Carnivorous small mammals, such as the red fox and the ermine (or short-tailed weasel), could potentially occur on site and be exposed to COCs via the ingestion of prey items that occur or forage on the site, and via incidental soil ingestion from the site. Prey items on the site would consist primarily of herbivorous small mammals and birds. The study boundary area is larger than some home ranges of carnivorous species (e.g., the ermine home range in NS is reported to be approximately 12 ha to 16 ha Natural Resources and Renewables, 2023). As such, carnivorous small mammals were assumed to occur/forage on the site, where they could be exposed to COPCs via the consumption of small mammals and soil (incidentally) and were selected as receptors. The ermine was selected as a surrogate species for this receptor group as it has been reported to occur in Nova Scotia (Natural Resources and Renewables, 2024).
Freshwater Pelagic and Benthic Aquatic Life	Include	Not applicable; assessed at the community level	Johnston Brook flows through the site from northwest to southeast, generally adjacent to the access road. A short waterfall exists at the furthest downstream extent of the watercourse on the site near the southern property line. Another waterfall was noted from site photos approximately 500 m upstream of the southern property boundary line. Given these characteristics (i.e., an elevation drop at the entry to the site, generally steep grade and intermittent nature), the section of Johnston Brook within the site may not provide suitable habitat for many aquatic species; however, due to the findings of the aquatic habitat assessment (Appendix E)

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
			which indicates that some sections may potentially provide habitat for some smaller-bodied fish, these ROC were retained for assessment.
Amphibians	Include	Not applicable; assessed at the community level	Amphibians are commonly regarded as being among the more highly exposed and sensitive receptors to contaminants in environmental media due to various aspects of their life history, dietary preferences, and physiology. Although DNA from the northern leopard frog was not detected during the eDNA analysis, some sections of Johnston Brook could potentially offer habitat to other amphibian species. Amphibians were therefore carried forward as a receptor.
Reptiles	Include	Not applicable; qualitatively discussed	Terrestrial reptile species could potentially inhabit the site. Reptiles are commonly regarded as being among the more highly exposed and sensitive receptors to contaminants in environmental media due to various aspects of their life history, dietary preferences, and physiology. However, the availability of reliable or relevant toxicity data for these receptors is essentially non-existent at this time for most substances. This paucity of suitable toxicity data precludes the assessment of reptiles in most ERA studies; however, these receptors were carried forward for qualitative discussion in the ERA.
Soil Microorganisms	Exclude		While soil microorganisms play key roles in nutrient cycling within soils (as they are primary consumers of organic matter and convert soil nutrients into forms that are available for uptake by plants and higher trophic level organisms), their inclusion as ROCs in an ERA is problematic, even though there are some soil quality benchmarks that utilize nutrient cycling parameters as the biological endpoints.

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
			There is high spatial and temporal variability in soils with respect to microbial community composition and tolerance to most contaminants. Reliable toxicity data are extremely limited and exposure-response relationships are unclear for most contaminants, especially those that can be utilized by certain microbial species as energy sources, or terminal electron receptors in respiration. There are limited tools and approaches that reliably determine microbial exposure and responses to chemical stressors. The ecological relevance of microbial responses to contaminants is questionable, given the often high rates of functional redundancy in soil microbial communities. Basic understanding of microbial community structure and function in soils is limited. Given these considerations, soil microorganisms were excluded as ROCs.
Herbivorous Large Mammals	Exclude		Herbivorous large mammals such as deer and moose could occur on site (e.g., one fawn was noted within the AECs during field work conducted by Dillon in May 2024); however, given the large home range of large herbivorous mammals (e.g., white-tailed deer have a home range of 30 ha and moose have a home range of 460 ha; FCSAP, 2012b), their diets, as well as their increased body weights relative to other herbivores, the exposure potential to COPCs for these receptors is likely limited. Further, the contaminated areas of the site do not offer better or more suitable habitat and food resources than areas outside of the site boundaries (i.e., habitat and resources within the site are similar to those outside of the site); therefore, it is unlikely that these receptors would choose to forage within

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
			the former mine site over other similar areas adjacent to the site. While exposure routes for this receptor group were not selected for evaluation (i.e., direct soil contact/soil ingestion and vegetation ingestion), the evaluation of these pathways for small mammal herbivores adequately captures potential worst case COPC exposures for large mammals. Small mammals have much smaller body weights and home/foraging range sizes than large mammals and would therefore incur much higher exposures and potential risks to site COPCs.
Carnivorous Large Mammals	Exclude		While large carnivorous mammals occur in Nova Scotia, they generally have large home ranges. For example, the coyote home range is reported to be approximately 2,000 ha and the bobcat home range is reported to be 100 ha to 10,000 ha (NatureServe, 2024). While these species could potentially be exposed to COPCs via the ingestion of prey from the site, given the limited food resources within the most highly contaminated areas of the study boundary, the large home ranges and body weights of carnivorous large mammals, their exposure potential to COPCs in media and biota at the site are likely limited. As such, carnivorous large mammals were excluded as ROCs. The evaluation of small mammal carnivores adequately represents or captures potential worst case COC exposures for large mammals, as small mammals have much smaller body weights and home/foraging range sizes than large mammals and would therefore incur much higher exposures to COPCs.

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Carnivorous Birds	Exclude		Carnivorous birds may be exposed to COPCs via the ingestion of prey items that occur or forage on the site, and incidental soil ingestion. The prey items on the site would consist primarily of herbivorous and/or insectivorous/invertevorous small mammals (and birds). The potential for exposure of carnivorous birds to site related COCs would be expected to be limited due their large home ranges, and the limited available habitat/food resources with the most highly contaminated areas of the study boundary for these birds, compared to other nearby areas. As such, carnivorous birds were excluded as ROCs.
Marine Pelagic and Benthic Aquatic Life	Exclude		Marine surface water and aquatic receptors are not located on or near the site; thus, this receptor group was excluded as ROC.
Waterfowl and Piscivorous Wildlife (bird and mammal piscivores)	Exclude		No waterfowl or piscivores were observed on the site during the Phase II ESA or subsequent site visits. While piscivorous wildlife could occur within the study boundary, their exposures to COPCs from site media and food items in these areas is likely limited given that the only on-site water body, Johnston Brook, is not anticipated to provide habitat for fish other than potentially small-bodied fish in limited portions of the brook. In addition, the brook has a steep grade and intermittent nature of the watercourse. Therefore, given their relatively large home and foraging range sizes, the limited number of waterbodies on the site, and varied diets for some species (e.g., fish, benthic invertebrates, aquatic vegetation), waterfowl and piscivorous wildlife were excluded as ROC.

Receptor Groups	Include/ Exclude	Surrogate Species for Receptor Group (if included)	Rationale for Inclusion/Exclusion
Species at Risk	Excluded; For any SAR that that can be reasonably expected to occur on the Site, surrogate species for the above receptor types and groups were selected to be representative and protective of potential SAR that are members of such receptor types and groups.		The SAR assessment was conducted in conjunction with the Environmental Screening completed for the site and identified 17 SAR as having potential to occur in the vicinity of the site. However, it was considered unlikely that the identified SAR species would be exposed to COPCs in soil given their variety of dietary items, preferred breeding and foraging habitats, and home range sizes of the various SAR. Further discussion provided in Section 4.2.4.

4.2.5.1 Size of Site and Potential Habitat

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 (US EPA, 1997; 1998; 1994; ASTM, 2023; MCP, 1996). Ideally, spatial scale issues are discussed at the onset of the ERA process. This can allow small sized sites that 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 (2023) states that the space or size of a contaminated site is directly related to the potential for ecological receptors to be exposed. 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.

ASTM (2023) suggests that for terrestrial environments (or sites), ecological habitat areas of less than two acres (equivalent to approximately 0.81 ha) are commonly considered too small to require an ERA, so long as there are no site-specific issues of special concern. While it is noted that sites of < 2 acres may contain foraging or breeding areas for individual small mammals, birds, and herpetofauna (amphibians and reptiles), this spatial scale does not usually support local populations of such wildlife species, and these sites would not require an ERA in most cases. Vegetation and soil invertebrates are typically excluded from this criterion, as there can be populations or communities of these receptors on sites < 2 acres in size, as long as the habitat and soil conditions are suitable. ASTM (2023) also notes that site coverings and surface features (such as foundations, pavement, gravel, concrete, fences, walls) are important to account for, as they limit the size of the habitat and foraging areas for various receptors.

The subject site is approximately 69 ha, which is above the ASTM (2023) spatial criterion of 0.81 ha, indicating the site may be large enough to support local populations of mammalian and avian receptors. This, however, does not consider the available habitat and food resources on the site. The site is heavily

forested, with some areas being on a steep hill, and Johnston Brook runs through the site, so some areas may not be suitable habitat for some species.

4.2.5.2 Consideration of Habitat Quality and Habitat Preferences

ASTM (2016) provides guidance on using habitat quality and preference information as a means of determining if an ERA of a site is warranted. This guidance defines "habitat" as the combination of physical (landscape) and biological features preferred by a particular species. ASTM (2016) states that consideration of landscape features to characterize habitat quality can enhance the ecological relevance of an ERA and avoid conducting ERAs on sites or in areas where wildlife species would be absent (or limited) because of a lack of suitable habitat. ASTM (2016) further notes that even if the habitat is determined to be suitable for certain ecological receptors, other factors such as limited food resources, predation, or human disturbances may override the apparent habitat quality for a given receptor, such that its exposure to contaminants in site media and biota would be minimal. Because the foraging behaviour/time and occurrence of receptors on a site is directly related to habitat suitability, the exposure potential to contaminants in site media is also directly related to the suitability of the site's habitat for a given receptor. ERAs should only be conducted for sites where ecological receptors occur or would likely occur. If receptors are not present or are unlikely to be present because of poor habitat quality or suitability, then an ERA of those receptors is not warranted.

Other habitat-related considerations suggested by ASTM (2016) include the following:

- Consider the size of the site relative to receptor home/foraging/breeding range requirements; and
- Consider the site habitat quality relative to habitat quality on adjacent or surrounding sites. If a 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 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 site.

To further explore these concepts in relation to the site, information was sourced on habitat preferences, and home, foraging, and breeding range size for the selected ROCs. Review of habitat preferences for these ROCs shows that the site has some conditions and ecological features that are consistent with their preferred habitat types for some species (e.g., heavily forested area, riparian areas). As such, it is possible that local populations of some of these receptors could utilize the site for foraging, nesting, breeding, and other activities. This conclusion is generally supported by conducting N_s calculations for these receptors (where N_s is the number of individuals of a given receptor species that are likely to inhabit any habitat subdivision on a site), as presented in ASTM (2016). The N_s calculation is similar to the common Area Use Factor (AUF) calculation that is sometimes used in ERAs. One form of this calculation is as follows (some alternate means of determining N_s are also provided in ASTM, 2016).

Equation 1

Where:

N_S = the number of individuals likely to inhabit the habitat subdivision on a site and incur potential exposures to COPCs from site media.

A_S = the area of the habitat subdivision (or portions of the site with potential habitat or foraging areas). In this case, the habitat subdivision of interest includes area within the study boundary of approximately 69 ha.

HR_S = the approximate home/foraging range size of the receptor (ha); based on literature regarding lowest reported home range sizes.

To examine whether the site could support populations of the mammalian ROC being examined, N_s values were calculated for the ROC in addition to other typical avian and mammalian species evaluated in ERA. N_s calculations for the receptors selected as ROC are presented below (Table 4-4). For all receptor species, the smallest identified HR_s value was taken from the FCSAP ERA guidance documentation (i.e., FCSAP, 2012b) or other resources if no FCSAP value was available. The A_S value used was approximately 69 ha which is the entire area within the study boundary.

Table 4-4: Estimated N_s Values for Selected Ecological Receptors at the former Country Mine Site, NS

Receptor	As	HRs	Ns
Meadow vole	69	0.348 ha	198
Masked shrew		0.6 ha	115
Dark-eyed junco 1		0.833 ha	82
Ruffed grouse		1 ha	69
Ermine		1 ha	69
Snowshoe hare		1.6 ha	43
White-tailed deer		30 ha	2
Black bear		300 ha	<1

Notes:
Home ranges from FCSAP, 2012b unless otherwise noted. The smallest home ranges provided were used for the N_s calculation except for the meadow vole. The lowest home range for the meadow vole provided by FCSAP (2012b) was 0.0069 ha; however, their home range was reported to easily range up to 0.348 ha. As such, a home range of 0.348 ha was applied for the meadow vole.
[1]Home range is female home range during nestling period (Reichard and Ketterson, 2012).
N_s values rounded down to the nearest whole number.
Receptors include terrestrial receptors selected as ROC in this ERA in addition to other typical avian and mammalian species evaluated in ERAs.

While there is no set N_s value that represents the presence of a population for each receptor, the N_s values in Table 4-4 suggest that populations of receptors with smaller home ranges may potentially occur on site. The N_s scores were calculated based on the total area of the site within the study boundary which is approximately 69 ha. If the areas of limited habitat and food resources/unsuitable habitat for ROC within the study boundary are considered, the N_s scores for each receptor would be lower; thus, these estimations are considered to be conservative.

While the N_s calculation is not without uncertainty and does not account for literature reports of actual measured population density and territoriality considerations, it provides a reasonable and often conservative indication of the numbers of individual organisms that may be expected to use a habitat subdivision on a given site. For the Country Harbour site, these N_s values would be considered conservative given the types of habitat/food resources within some areas of the study boundary. As such, it would be unrealistic to assume that ROC presence and foraging occurs extensively within the study boundary, but not on the various adjacent areas that have equally suitable (or better) habitat conditions and food availability.

There is nothing to distinguish the site from other areas as offering unique or preferred habitat or food resources for any known ecological receptor population or community. In fact, areas outside of the study boundary would offer better habitat and food resources than the habitat within the study boundary for receptors that prefer more open areas and wetlands (as the study area is mainly forested).

The calculated N_s scores support that the use of the site by small mammalian receptors, and to a lesser extent avian receptors, could potentially include populations. However, the N_s scores were calculated based on the total site area and did not exclude areas within the study boundary where there is no available habitat and/or limited food resources (e.g., the watercourse). It is unlikely that populations of larger mammals or birds could be supported within the study boundary (particularly in the most contaminated areas). However, the site would likely support populations of mammals with smaller home ranges.

The N_s score for the junco indicates a potential local population of this receptor (i.e., $N_s = 82$). However, the home range used to estimate this N_s score was a home range of a female for breeding and nesting (Reichard and Ketterson, 2012). Non-breeding winter home range has been reported to be approximately 4 ha to 5 ha (10 to 12 acres; Sullivan, 1999; US DOA, 1991). When these home ranges are considered, the N_s scores are 17 and 14, respectively, which would not likely support a population. Additional support for the site not being able to support a population of junco comes from a study in Minnesota, where the overall mean densities of the junco in national forest lands, ranged from 0.08 to 0.11 pairs per 40 ha (Minnesota Breeding Bird Atlas, 2023). Given the size of the study boundary is 69 ha, it is unlikely that there would be more than a couple of nesting pairs of junco present within the contaminated areas of the site.

Similarly, population densities of the ruffed grouse in North America are low and have been reported to average approximately 10 to 15 birds per square km (100 ha) (Collicutt, 2023). Given the size of the study boundary is approximately 69 ha, about 70 % of that amount would be estimated. Based on these overall considerations, it is unlikely that populations of dark-eyed junco or ruffed grouse or other similar species would be supported within the contaminated areas of the site.

The Ns score for the ermine indicates a potential local population of this receptor (i.e., Ns = 69) based on the home range size of 1 ha reported in FCSAP (2012b). However, the home range of ermine specifically in Nova Scotia is reported to be approximately 12 to 16 ha (Government of Nova Scotia, n.d.). When these home ranges are considered, the N_s scores are 5 and 4, respectively, which would not likely

support a population. However, to be conservative, these ROC have been retained for further assessment.

4.2.5.3 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

ROC	Surrogate	Comment
Terrestrial vegetation	NA	Assessed at the community level
Soil invertebrates	NA	Assessed at the community level
Herbivorous small mammals	Meadow Vole Snowshoe Hare	Assessed at the population level
Insectivorous/invertevorous small mammals	Masked Shrew	Assessed at the population level
Herbivorous birds	Ruffed Grouse	Assessed at the population level
Insectivorous/invertevorous birds	Dark-eyed Junco	Assessed at the population level
Carnivorous small mammals	Ermine	Assessed at the population level
Amphibians	NA	Assessed at the community level
Reptiles	NA	Qualitatively discussed
Freshwater aquatic life	NA	Assessed at the community level

Notes:
NA = not applicable

4.2.6 Selection of Assessment and Measurement Endpoints and Lines of Evidence

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 overall 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 LOEs 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.

Specific assessment and measurement endpoints and LOE were identified for the ROC 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 (ROC)	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
Terrestrial vegetation	Survival, growth, and reproduction of vegetation communities	Concentrations of chemicals in site soil and reference areas. Vegetation health-based soil quality benchmarks. Qualitative site survey of vegetation types and apparent health and similarity to surrounding sites.	Outcomes of the comparison of site soil chemical concentrations to vegetation health-based soil quality benchmarks and reference areas. Comparison of vegetation on site to vegetation present in the surrounding area.
Soil invertebrates	Survival and reproduction of soil invertebrate communities	Concentrations of chemicals in site soil and reference areas. Soil invertebrate health-based soil quality benchmarks.	Outcomes of the comparison of site soil chemical concentrations to soil invertebrate health-based soil quality benchmarks and reference areas.
Herbivorous small mammals (surrogates: meadow vole and snowshoe hare)	Survival, growth, reproduction, and abundance of populations	Concentrations of chemicals in site soils and reference areas. Mammalian health-based soil quality benchmarks. Modeled exposure and risk estimates for COCs in food items and soil. Applicable mammalian TRVs. Spatial size and habitat quality/preference considerations for the site. N_s (the number of individuals of a given receptor species that are likely to inhabit any habitat subdivision on a site) values estimated for the site.	Outcomes of the comparison of site soil chemical concentrations to mammalian health-based soil quality benchmarks. Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Comparison of site spatial size to ASTM spatial criteria for ERA; comparison of receptor habitat preferences to site habitat conditions and habitat quality. Interpretation of N_s values with respect to likelihood for populations or individuals to utilize or occur on the site.

Receptor of Concern (ROC)	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
Insectivorous or invertevorous small mammals (surrogate: masked shrew)	Survival, growth, reproduction, and abundance of populations	Concentrations of chemicals in site soils and reference areas. Mammalian health-based soil quality benchmarks. Modeled exposure and risk estimates for COCs in food items and soil. Applicable mammalian TRVs. Spatial size and habitat quality/preference considerations for the site. N_s (the number of individuals of a given receptor species that are likely to inhabit any habitat subdivision on a site) values estimated for the site.	Outcomes of the comparison of site soil chemical concentrations to mammalian health-based soil quality benchmarks. Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Comparison of site spatial size to ASTM spatial criteria for ERA; comparison of receptor habitat preferences to site habitat conditions and habitat quality. Interpretation of N_s values with respect to likelihood for populations or individuals to utilize or occur on the site.
Herbivorous birds (surrogate: Ruffed Grouse)	Survival, growth, reproduction, and abundance of populations	Concentrations of chemicals in site soils and reference areas. Avian health-based soil quality benchmarks. Modeled exposure and risk estimates for COCs in food items and soil. Applicable avian TRVs. Spatial size and habitat quality/preference considerations for the site. N_s (the number of individuals of a given receptor species that are likely to inhabit any habitat	Outcomes of the comparison of site soil chemical concentrations to avian health-based soil quality benchmarks. Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Comparison of site spatial size to ASTM spatial criteria for ERA; comparison of receptor habitat preferences to site habitat conditions and habitat quality. Interpretation of N_s values with respect to likelihood for

Receptor of Concern (ROC)	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
		subdivision on a site) values estimated for the site.	populations or individuals to utilize or occur on the site.
Insectivorous or invertevorous birds (surrogate: Dark-eyed Junco)	Survival, growth, reproduction, and abundance of populations	Concentrations of chemicals in site soils and reference areas. Avian health-based soil quality benchmarks. Modeled exposure and risk estimates for COCs in food items and soil. Applicable avian TRVs. Spatial size and habitat quality/preference considerations for the site. N_s (the number of individuals of a given receptor species that are likely to inhabit any habitat subdivision on a site) values estimated for the site.	Outcomes of the comparison of site soil chemical concentrations to avian health-based soil quality benchmarks. Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Comparison of site spatial size to ASTM spatial criteria for ERA; comparison of receptor habitat preferences to site habitat conditions and habitat quality. Interpretation of N_s values with respect to likelihood for populations or individuals to utilize or occur on the site.
Carnivorous small mammals (surrogate: ermine)	Survival, growth, reproduction, and abundance of populations	Concentrations of chemicals in site soils and reference areas. Mammalian health-based soil quality benchmarks. Modeled exposure and risk estimates for COCs in food items and soil. Applicable mammalian TRVs. Spatial size and habitat quality/preference considerations for the site.	Outcomes of the comparison of site soil chemical concentrations to mammalian health-based soil quality benchmarks. Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients). Comparison of site spatial size to ASTM spatial criteria for ERA; comparison of receptor habitat preferences to site habitat conditions and habitat quality.

Receptor of Concern (ROC)	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
		N_s (the number of individuals of a given receptor species that are likely to inhabit any habitat subdivision on a site) values estimated for the site.	Interpretation of N_s values with respect to likelihood for populations or individuals to utilize or occur on the site.
Freshwater Aquatic Life	Survival, growth, reproduction, and abundance of communities.	Concentrations of chemicals in site sediment, surface water and groundwater. Freshwater aquatic life health-based groundwater quality benchmarks. Consideration of the aquatic habitat assessment.	Outcomes of the comparison of site sediment and surface water to freshwater aquatic life health-based sediment, surface water and groundwater benchmarks. Outcomes of the aquatic habitat assessment.
Amphibians	Survival, growth, reproduction, and abundance of communities.	Concentrations of chemicals in site surface water and sediments. Amphibian toxicity data. Spatial size and habitat quality/preference considerations for the subject property. Consideration of the aquatic habitat assessment.	Comparison of freshwater aquatic life guidelines and amphibian toxicity data to site concentrations. Comparison spatial size and habitat quality to surrounding areas, comparison of receptor habitat preferences to subject property habitat conditions and habitat quality. Outcomes of the aquatic habitat assessment.

Receptor of Concern (ROC)	Assessment Endpoint	Measurement Endpoints	Lines of Evidence (LOE)
Reptiles	Survival, growth, reproduction, and abundance of communities.	Potential exposure routes Spatial size and habitat quality/preference considerations for the subject property. Consideration of the habitat assessment.	Qualitative outcomes of the exposure potential via the relevant exposure routes Comparison spatial size and habitat quality to surrounding areas, comparison of receptor habitat preferences to subject property habitat conditions and habitat quality. Outcomes of the habitat assessment.

Notes:
In the ERA context, the definition of a "population" can vary, and as such, very few ERA guidance documents define this term. FCSAP (2012a) states the following "From a pure biology perspective, an ecological population is defined as a group of organisms of a single species that interbreed and share a common habitat." From a risk assessment perspective, however, this definition is too broad. 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.

The abundance of a species could be affected directly (i.e., as a result of direct toxicity of COCs on survival, growth or reproduction), or indirectly (e.g., as a result of decreased habitat suitability or reduced prey/food abundance) as a result of toxicity to food or prey items and other site activities that may affect habitat and presence of food resources. This ERA focuses on potential health effects as a result of direct chemical exposures.

4.2.7 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 COPCs 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. Exposure pathways selected for the receptor groups in the ERA are provided below.

4.2.7.1 Terrestrial Vegetation and Soil Invertebrates

- Exposure of terrestrial plants to chemicals in soil is controlled by the root distribution in the soil profile, physicochemical characteristics of the soil (which determines the forms of the chemicals and their phytoavailability) and by interactions of the chemicals of interest with other chemicals present in soil (Suter II, 2007);
- Exposure of soil invertebrates to chemicals in soil is determined by depth of burrowing, the rate, and quantity of soil material ingested, activity patterns, soil physical-chemical characteristics, and interactions of the chemicals of interest with other chemicals in soil (Suter II, 2007); and
- The main exposure pathways and routes evaluated for terrestrial vegetation and soil invertebrates included the direct soil contact pathways, which include direct contact with the dermal coverings or integument of invertebrates, direct soil ingestion by invertebrates, and root uptake by plants.

4.2.7.2 Birds and Mammals

- For avian and mammalian 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, drinking water ingestion, incidental soil, and 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, Science Advisory Board of Contaminated Sites in British Columbia [SABCS], 2008; US EPA, 2003). This is considered to be the case in the current ERA as well, given that the ROCs have fur that would limit dermal contact of the COPC with skin, and given that the potential for significant soil/dust resuspension in local ambient air is low at the site for much of the year due to snow cover or frozen ground in the winter;
- For the current ERA, it was assumed that herbivorous small mammalian ROCs are exposed to COCs in site soil via direct soil contact (soil ingestion) as well as the ingestion of vegetation;
- For many small mammals, and many birds, it is common not to consume water from surface water bodies, but rather, to obtain the majority of their water requirements from puddles or droplets on vegetation surfaces, as well as from the consumption of food. Many small mammals and many bird species obtain their water requirements from consumed food items, wherein their physiological water needs are met via the metabolism of ingested food. For the small mammals and birds expected to be on the site, surface water ingestion would not be expected to be a pathway of concern;
- The main exposure pathways and routes evaluated for herbivorous small mammals and birds were soil ingestion and ingestion of vegetation;
- The main exposure pathways and routes evaluated for insectivorous/invertivorous small mammals and birds were soil ingestion and ingestion of soil invertebrates; and
- The main exposure pathways and routes evaluated for carnivorous small mammals were soil ingestion and ingestion of prey.

4.2.7.3 Freshwater Aquatic Life

The main routes and pathways by which these receptors may be potentially exposed to COPCs would include: direct contact of gills and other respiratory surfaces with water and sediments, sediment and 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.

4.2.7.4 Amphibians

Amphibians have a complex life history and can live in either aquatic or terrestrial habitats depending on life stage. As such, the evaluation of exposure pathways for amphibians is complicated. Generally, during embryo and larval life stages, amphibian exposures are primarily aquatic, while during juvenile and adult stages, exposures are primarily terrestrial. The main exposure pathways associated with life stages in the terrestrial areas of the site would include soil ingestion and direct contact and ingestion of terrestrial foods, while exposures in aquatic areas would include direct contact with sediment and surface water, incidental ingestion of soil/sediments and ingestion of aquatic foods.

4.2.7.5 Reptiles

The main exposure pathway for reptiles would be dietary exposures and dermal exposures. Depending on the reptile species, foods could be from terrestrial or aquatic habitats. Dermal exposures via soils and surface water (depending on the species and chemicals present on site) may also be important.

4.2.7.6 Exposure Pathway Summary

With respect to the assessment and measurement endpoints and LOEs noted in Table 4-7 and the exposure pathways and routes selected for the ROC, there were some inherent conservative assumptions within the ERA that must be acknowledged. It is assumed that the ROC forage entirely in areas of the site that contain impacted soils and that their diet consists entirely of food from within the study boundary. While these are typical assumptions for an ERA of a contaminated site, they are considered conservative, particularly given the limited habitat and food resources on some areas of the site compared to the surrounding area. For the receptor groups selected for evaluation in the current ERA, the following information on exposure pathways applies. Exposure pathways and routes for each receptor group are summarized in Table 4-7.

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

Receptor Group	Exposure Pathway Selected for Evaluation
Terrestrial vegetation	• Direct contact with soils • Root uptake
Soil invertebrates	• Direct soil ingestion • Direct contact with dermal coverings or integument
Herbivorous small mammals	• Incidental soil ingestion • Vegetation ingestion
Insectivorous or invertevorous small mammals	• Incidental soil ingestion • Ingestion of soil invertebrates
Herbivorous birds	• Incidental soil ingestion • Vegetation ingestion
Insectivorous or invertevorous birds	• Incidental soil ingestion • Ingestion of soil invertebrates
Carnivorous small mammals	• Incidental soil ingestion • Ingestion of prey
Freshwater Aquatic Life	• Direct contact with sediment • Direct contact with surface water
Amphibians	• Soil and sediment ingestion • Direct contact with soil, sediments and surface water • Ingestion of aquatic and terrestrial foods
Reptiles	• Soil and sediment ingestion • Direct contact with soil, sediments and surface water • Ingestion of aquatic and terrestrial foods

4.2.8 Identification of COPCs

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

Similar to the COC identification process for the HHRA, the identification of COCs for the ERA also involved a sequential process, as follows:

1. Comparison of the maximum measured concentrations of contaminants in site media to applicable regulatory ecological health-based benchmarks and available local background data;
2. Chemicals with a maximum concentration that exceeded the applicable ecological health-based benchmark and were above background concentrations, were identified as initial COPCs;
3. These initial COPCs were further evaluated by determining the frequency, magnitude, and spatial extent of relevant media exceedances from the site above the applicable receptor-specific ecological

health-based benchmarks, where available. For mobile receptors (e.g., mammals and birds), the initial COPCs were further screened against a 90th percentile soil concentrations as per FCSAP (2012a);

4. Further considerations (where/if deemed necessary and relevant), such as:
   - 4.1. Essential nutrient status of certain inorganic elements;
   - 4.2. Ubiquity of elements in soil, water or sediments;
   - 4.3. Statistical relationships;
   - 4.4. Local geology;
   - 4.5. Spatial distribution of soil chemical concentrations;
   - 4.6. Fate and behaviour properties (including potential to bioaccumulation and biomagnification);
   - 4.7. Speciation of chemicals in site media; and
5. Final COCs are selected considering all other above, where relevant.

COC identification in site media was 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;
- All site data were considered, including field duplicate samples;
- Soil concentrations of analytes were assumed to be accessible for ecological receptor exposure regardless of location and considered soils up to 1.5 m deep;
- The more conservative of coarse or fine-grained soil benchmarks were used based on the particle size analysis;
- With respect to sediment 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 or interim sediment quality guidelines). 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, 2006a,b). 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 (e.g., FCSAP Aquatic Sites Classification System);

- Chemicals having a maximum concentration which exceeded the applicable ecological benchmark value and available local background data were retained for further assessment as COPCs. 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; and
- Chemicals without environmental health-based benchmarks were carried forward for further discussion.

The COC identification processes used are consistent with site and risk assessment procedures and help to distinguish natural occurring concentrations from those that have been influenced by anthropogenic activities.

With respect to the regulatory context for the ERA, the site is located on land owned by the NSDNRR, and as such the NS CSR guidelines apply and were preferentially used in the COPC screening. As part of the NS Contaminated Sites protocol, Tier I EQS and Tier II PSS for soil, groundwater, surface water and sediment have been selected for use in NS. Links to these EQS and PSS are provided on the NS CSR website (https://novascotia.ca/nse/contaminatedsites/protocols.asp). While the ecological health-based PSS for commercial soils were not found on the NS CSR website, these values have been provided by Atlantic RBCA and have been adopted by the province. Except for petroleum hydrocarbons and select chlorinated volatile organic compounds (CVOCs), the Atlantic RBCA EQS/PSS values are adopted values that have been derived by CCME and other regulatory authorities in Canadian or international jurisdictions. For contaminants other than PHCs and CVOCs, the general hierarchy used to select EQS/PSS is outlined in the Environmental Quality Standards Rationale and Guidance Document (2021). The PSS were developed by source agencies and departments outside of Nova Scotia such as the CCME, AEP and MECP. The original guideline sources were reviewed to ensure the NS PSS guideline referenced 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. In the absence of Canadian guidelines, the US EPA EcoSSL (ecological soil screening levels) were applied. As previously noted, since the site is zoned as commercial, commercial land use guidelines were selected for screening purposes for the ERA.

For terrestrial vegetation and soil invertebrates, freshwater aquatic life, amphibians and reptiles, the focus of the ERA is on community level effects, and for birds and mammals, the focus is on population level effects (with the exception of SAR). As such, an exceedance of a maximum concentration over a guideline is not indicative of potential risks. Assuming that exposures occur only to the maximum soil, surface water or sediment concentration is highly conservative and unrealistic. For mobile receptors, FCSAP (2013a) guidance states that if maximum concentrations are exceeded, then consideration should be given to summary statistics (e.g., compare the 95th upper confidence limit on the mean [UCLM] or the 90th percentile of the concentrations to the guideline) for screening when data sizes are reasonable (e.g.,

10 or more samples in the area used by a receptor), as these metrics are more realistic for determining true COPCs. Therefore, in addition to the maximum media concentrations, the 90th percentile concentrations have also been considered in some cases. In addition, the frequency, magnitude, and spatial extent of exceedance of Study Area soil, surface water or sediment data over applicable ecological health-based benchmarks was also considered before final selection of a chemical as a COPC.

An initial list of COPCs was identified by comparing maximum measured concentrations within site media concentrations (i.e., soil, surface water, sediments and groundwater) to ecological health-based guidelines and local background data where available. These initial COPCs were then considered further to select the final COCs for the ERA. Appendix C provides results of the COPC screening. Laboratory certificates for these data are provided in Appendix I.

Results of the soil screening were used to identify COCs for terrestrial vegetation, soil invertebrates and small mammals (herbivorous, insectivorous and carnivorous). Results of the sediment and surface water screening were used to identify COCs for freshwater aquatic life.

There are no surface water, sediment, or soil health-based benchmarks specifically derived for amphibians. While freshwater and sediment guidelines were not necessarily derived to be protective of amphibians, some amphibian toxicity data are available for metals, and some of the more recent guidelines do incorporate amphibian data into their derivation (e.g., CCME freshwater quality guideline for cadmium). FCSAP (2019) examined water quality guidelines for several metals (i.e., lead, mercury, cadmium, and zinc) from various jurisdictions and noted that most water quality guidelines appear to provide adequate protection of amphibians for the metals evaluated. As such, the COCs selected for freshwater aquatic life were also selected as COCs for amphibians.

No reptilian health-based guidelines are available for screening and there is a paucity of reptile toxicity data. As such, no COC screening was conducted for this receptor group and potential risks are qualitatively discussed in Section 4.6.5.

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 terrestrial biota. When interpreting screening level exceedances, it is also important to consider the body of literature regarding acclimation and adaptation of terrestrial organisms to metals and other substances in soil 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 terrestrial and 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. Acclimation and adaptation to metals is described further in Kapustka et al., (2004), ICMM (2007), Chapman (2008), and Newman and Clements (2008).

4.2.8.1 COPCs in Site Soil

FCSAP (2012a) states that all data in the top 1.5 m of soil should be considered relevant for screening COPCs for an ERA. As such, all soil samples collected within the top 1.5 m were screened against direct contact soil guidelines. Sample locations are presented on Figure 3, Appendix A. Site photographs are presented in Appendix B. All soil data used in the current assessment are presented in Appendix C.

For a number of regulatory jurisdictions, ecological soil quality benchmarks have been derived for specific receptor types such as terrestrial vegetation, soil invertebrates, mammals and birds. In these cases, the lowest benchmark provided was selected for COC identification purposes.

The specific regulatory ecological health-based soil quality benchmarks that were used to identify COPCs in site soil are briefly described below. Based on soil grain size data, the site was considered to have coarse and fine-grained soils and as such, soil data were compared to the lower of coarse- and fine-grained soil guidelines, where applicable.

The specific source of the guideline used in the COPC screening of soils are identified in the ecological health screening tables (Tables C17-C21, Appendix C).

Canadian Council of Ministers of the Environment (CCME)

The CCME Canadian soil quality guidelines developed for the protection of ecological health ($SoQG_E$), commercial land use (lower of coarse- and fine-grained soils), were preferentially applied. The lowest of the ecological soil contact or soil and food ingestion guidelines were used. Where the CCME soil guidelines defer to the older CCME (1991) soil remediation criteria (which are not identified as being either human or ecological health-based), the benchmarks from the next preferred jurisdiction were selected rather than using the outdated CCME (1991) value(s), where possible. If no other guideline was available from another jurisdiction, the CCME (1991) value was used. The most up to date CCME guidelines are available from on the online CCME summary tables and associated fact sheets (http://st-ts.ccme.ca/en/index.html; searched August 2024).

CCME Canada Wide Standards for PHCs in Soils (CCME, 2008)

The Canada Wide Standards (CWS) for PHCs for commercial land use and lower of fine and coarse-grained soils applicable for ecological health (ecological soil contact) were selected for comparison purposes for PHC F1 to F4 (CCME, 2008). Details on the basis and derivation of the CWS ecological health $SoQG_E$ are provided in CCME (2008).

Alberta Environment and Parks (AEP, 2024)

The lower of the direct soil contact, livestock soil and food ingestion, and wildlife soil and food ingestion ecological health-based soil guidelines for commercial land use and (lower of coarse- and fine-grained soils) were applied. These AEP guidelines are developed in a very similar manner to, and are protective of, the same ecological receptor types as the CCME $SoQG_E$. Details on soil guideline basis and derivation are provided in AEP (2024).

Ontario Ministry of the Environment, Conservation, and Parks (MECP, 2011)

The lowest of the relevant MECP ecological health-based soil component values (i.e., soil component values for plants and soil organisms, soil component values for mammals and birds) were applied. The specific soil component values that were used are from Table 3 in MECP (2011), for conditions of non-potable water, institutional land use, and lower of coarse- and fine-grained soils. The derivation of these values is described in MECP (2011).

Atlantic Risk-Based Corrective Action (RBCA)

The Atlantic RBCA (2022) soil quality guidelines for petroleum hydrocarbons for commercial sites were used for PHCs where applicable.

United States Environmental Protection Agency Ecological Soil Screening Levels (US EPA)

Where a Canadian value was not available, the lowest relevant United States Environmental Protection Agency Ecological Regional Screening Level (US EPA EcoSSL) was used in the screening. The lower of plant, soil invertebrate, avian, and mammalian EcoSSLs were applied. The EcoSSL background and derivation documents can be found at https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documentsat.

Oregon Department of Environmental Quality Risk-Based Concentrations (2020)

The Oregon Department of Environmental Quality Risk-Based Concentrations for Plants, Invertebrates, and Wildlife Exposed to Soil were applied where other guidelines were not available. These values were obtained from the Los Alamos National Library (LANL) ECORISK Database (LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico; LANL 2017, 602538). The lower of the herbivore, omnivore, or mixed diet exposure scenarios was applied. Background and derivation documents can be found at https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf.

Results of Ecological Health-Based Soil Screening

Site soil screening results are provided in Table 4-8 and discussed in the following sections. Details of the ecological screening for site soil are provided in Tables C17-C21, Appendix C and Figures 7a to 8b (Appendix A) show the locations of guideline exceedances for COCs in soil. Results of the soil screening were used to identify COCs for terrestrial vegetation, soil invertebrates, and mammalian and avian ROC.

Soil data were available for metals, PAHs, BTEX/PHCs, and energetics. Chemicals that were not detected in any of the analyzed soil samples and were not associated with current and historical activities at the site were excluded from further assessment. For completeness, the RDL for parameters with concentrations < the RDL were cross-referenced with the appropriate ecological-health based guideline, and RDLs were below the applicable guideline; therefore, none of the non-detected parameters were carried forward in the ERA. Chemicals that were not detected in any of the analyzed soil samples and had an RDL below the applicable guideline, where one was available, and were excluded from further assessment included boron, quinoline, and all energetics parameters which were analyzed.

Table 4-8: Ecological Screening (Soil COPC Identification) for the Country Harbour Former Mine Site

Chemical	Ecological Soil Quality Benchmark ($SoQG_E$) (mg/kg)	Maximum Background Concentration (mg/kg)	Maximum Measured Concentration (mg/kg)	Carried Forward as Initial COPC? (Y/N)
Metals				
Aluminum	*NGA*	*26,200*	*36,500*	*Y*
Antimony	40 [a]	0.3	48.1	Y
Arsenic	26 [b]	1,050	20,600	Y
Barium	670 [c]	62.8	198	N
Beryllium	8 [a]	0.76	7.49	N
Cadmium	1.9 [c]	0.197	2.63	Y
Chromium (Total, III+VI)	87 [b]	69.6	61.3	N
Cobalt	180 [c]	5.1	162	N
Copper	91 [b]	10.4	99.6	Y
Iron	*NGA*	*30,000*	*112,000*	*Y*
Lead	32 [c]	88	1,360	Y
Manganese	220 [d]	218	7,510	Y
Mercury	20 [c]	0.2	2,920	Y
Molybdenum	40 [a]	1.4	29.5	N
Nickel	89 [b]	33.0	48.5	N
Selenium	2.9 [b]	1.4	11.1	Y
Silver	40 [a]	0.2	1.27	N
Strontium	950 [e,f]	5.4	73.4	N
Sulphur as S	500 [a]	500	8,700	Y
Thallium	3.6 [b]	0.2	1.47	N
Tin	300 [a]	<2.0	60.7	N

Chemical	Ecological Soil Quality Benchmark ($SoQG_E$) (mg/kg)	Maximum Background Concentration (mg/kg)	Maximum Measured Concentration (mg/kg)	Carried Forward as Initial COPC? (Y/N)
Uranium	33 [c]	2.3	76.6	Y
Vanadium	18 [c]	38.6	72.6	Y
Zinc	340 [c]	44.2	531	Y
PAHs				
1-Methylnaphthalene	NGA	NA	0.373	Y
2-Methylnaphthalene	NGA	NA	0.411	Y
1 & 2 Methylnaphthalene	NGA	NA	0.784	Y
Acenaphthene	46,000 [c]	NA	0.0958	N
Acenaphthylene	NGA	NA	0.392	Y
Acridine	NGA	NA	0.068	Y
Anthracene	32 [b]	NA	0.661	N
Benz(a)anthracene	1 [c]	NA	2.47	Y
Benzo(a)pyrene	72 [b]	NA	2.37	N
Benzo(b+j+k)fluoranthene	15 [c]	NA	5.89	N
Benzo(g,h,i)perylene	13 [c]	NA	1.31	N
Chrysene	14 [c]	NA	2.9	N
Dibenz(a,h)anthracene	10 [b,]	NA	0.43	N
Fluorene	NGA	NA	0.061	Y
Fluoranthene	180 [b]	NA	5.92	N
Indeno(1,2,3-c,d)pyrene	0.76 [c]	NA	1.81	Y
Naphthalene	22 [c]	NA	0.267	N
Perylene	NGA	NA	0.561	Y
Phenanthrene	12 [c]	NA	1.39	N
Pyrene	99,000 [c]	NA	4.43	N
BTEX/PHCs				
Benzene	180 [b]	NA	0.152	N
Toluene	250 [b]	NA	1.02	N
Ethylbenzene	300 [b]	NA	0.634	N
Xylene (o)	NGA	NA	0.678	N
Xylene (m & p)	NGA	NA	1.34	N
Xylene Total	350 [b]	NA	2.02	N
VPH (C6-C10 - BTEX)	320 [g]	NA	22.7	N
EPH >C10-C16	260 [g]	NA	105	N

Chemical	Ecological Soil Quality Benchmark ($SoQG_E$) (mg/kg)	Maximum Background Concentration (mg/kg)	Maximum Measured Concentration (mg/kg)	Carried Forward as Initial COPC? (Y/N)
EPH >C16-C32[c]	1700 [g,h]	NA	2180	Y
EPH >C34-C50	3300 [g]	NA	12100	Y

Notes:
N = 119 for metals; N = 27 for PAHs; N = 34 for BTEX; N = 33 for PHCs with the exception of PHC F1 (C6-C10) where N = 36.
PAH = polycyclic aromatic hydrocarbons; BTEX = benzene, toluene, ethylbenzene, and xylenes; PHC = petroleum hydrocarbons; $SoQG_E$ = soil quality guideline for the protection of ecological health; COPC = contaminant of potential concern; VPH = volatile petroleum hydrocarbons; EPH = extractable petroleum hydrocarbons; NGA = no guideline available; NA = not applicable; RDL = reportable detection limit; Y = yes; N = no; "<" indicates that the value was less than the laboratory RDL.

BOLDED values indicate concentrations above applicable guidelines and background.
Italicized values indicate that the maximum site concentration was above the maximum background concentration, but no guideline was available for comparison.
Underlined values indicate that no guideline or background data were available for comparison.
Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.
[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. $SoQG_E$ for commercial land use.
[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.
[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA). (2007a). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf
[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf
[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.
[g] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.
[h] Available guideline is for PHC F2 fraction (C16-C34).
[i] Interim guideline from CCME (1991) applied in the absence of a guideline from another jurisdiction.

As shown in Table 4-8, guidelines were not available for aluminum and iron, and maximum site concentrations of each of these parameters were above local background concentrations. Therefore, they were carried forward as initial COPCs for further assessment.

Metals reported in site samples at concentrations exceeding their applicable guideline and the local background maximum included antimony, arsenic, cadmium, copper, lead, manganese, mercury, selenium, sulphur, uranium, vanadium, and zinc; therefore, these parameters were carried forward as initial COPCs for further assessment.

Several PAHs including 1- and 2-methylnaphthalene, acenaphthylene, acridine, fluorene, and perylene did not have available guidelines or background data for comparison; therefore, these parameters were carried forward as initial COPCs.

Several PAHs and PHCs including benzo(a)anthracene, indeno(1,2,3-c,d)pyrene, PHC F3 (>C16-34), and PHC F4 (>C34-50) were reported in site samples at concentrations exceeding their applicable guideline, and background data were not available; therefore, these parameters were carried forward as initial COPCs for further assessment.

Based on the comparisons presented in Table 4-8 and Tables C17-C21, Appendix C, the following chemicals were carried forward for further evaluation as initial COPCs (on the basis of maximum site soil concentrations exceeding applicable ecological soil quality benchmarks and/or local background concentrations, or due to lack of available guidelines; number of samples that exceed provided in parentheses):

Initial COPCs - Soil

- Aluminum (NGA);
- Antimony (1 of 119);
- Arsenic (110 of 119);
- Cadmium (5 of 119);
- Copper (1 of 119);
- Iron (NGA);
- Lead (87 of 119);
- Manganese (75 of 119);
- Mercury (11 of 119);
- Selenium (10 of 119);
- Sulphur (19 of 119);
- Uranium (2 of 119);
- Vanadium (94 of 119);
- Zinc (2 of 119);
- 1 & 2-methylnaphthalene (NGA);
- Acenaphthylene (NGA);
- Acridine (NGA);
- Benz(a)anthracene (2 of 27);
- Fluorene (NGA);
- Indeno(1,2,3-c,d)pyrene (2 of 27);
- Perylene (NGA);
- PHC F3 (>C16-34) (2 of 33); and
- PHC F4 (>C34-50) (1 of 33).

Further Examination of Initial COPCs

Initial COPCs that had applicable guidelines were carried forward for a secondary screening using receptor-specific guidelines (Table 4-9), while initial COPCs without guidelines are discussed further below.

Metals:

Aluminum does not have an applicable guideline available for comparison, and only 12 of 119 samples (10%) exceed the maximum reported local background concentration of 26,200 mg/kg by a maximum of 1.4 fold. Aluminum is the most abundant metal on the earth's crust (Royal Society of Chemistry, 2024). Background aluminum concentrations in Halifax urban soils were reported to range up to 44,800 mg/kg (Kennedy et al., 2018). The measured site concentrations of aluminum would not be expected to be related to site activities. Aluminum in site soils is anticipated to be associated with regional background conditions and aluminum was not carried forward for further consideration.

Iron does not have an applicable guideline available for comparison, and 41 of 119 samples (34%) exceed the maximum reported local background concentration of 30,000 mg/kg by a maximum of 3.7-fold. However, the geology of the site reflects the Goldenville Formation of the Cambrian period, which is a bedrock rich in iron. This substance is ubiquitous to the bedrock of the area, and high concentrations of iron in site soil are to be expected. Given these considerations, iron was not carried forward for further consideration.

Sulphur was detected in 20 of 119 site samples (17%) and was reported at concentrations above the guideline of 500 mg/kg in 19 of the 20 samples by a maximum of 17-fold. One background sample was reported at a concentration equal to the detection limit and guideline (i.e., 500 mg/kg). Detection limits for sulphur varied across samples due to matrix interference and ranged from 500 to 10,000 mg/kg. The weathering of bedrock containing sulfide minerals, which is characteristic of the Goldenville Formation, releases sulfur into the environment, so soil concentrations similar to the measured concentrations of sulphur at the site, would be expected in regional soils. Given these considerations, sulphur was not carried forward for further evaluation.

Polycyclic Aromatic Hydrocarbons (PAHs):

Neither guidelines nor background data were available for several PAHs, inclusive of 1- and 2-methylnaphthalene (individually or collectively), acenaphthylene, acridine, dibenz(a,h)anthracene, fluorene, or perylene. Of these, low molecular weight PAHs (LMWPAHs) include 1- and 2-methylnaphthalene, acenaphthylene, and fluorene. 1- and 2-methylnaphthalene were reported as individual compounds as well as the sum of both parameters, the latter of which will be discussed hereafter for simplicity. These compounds were detected in 8 of 27 site samples (30%) with a maximum concentration of 0.784 mg/kg. Acenaphthylene was detected in 15 of 27 site samples (56%) with a maximum concentration of 0.392 mg/kg. Fluorene was detected in 4 of 27 site samples (15%) with a maximum concentration of 0.061 mg/kg. Given that the majority of PAHs were detected at relatively low concentrations, and detectable concentrations of LMWPAHs were reported in only a maximum of 15 samples, it is unlikely that these parameters would be of concern to ecological receptors at the site. Additionally, the US EPA (2007c) EcoSSL for LMWPAHs of 29 mg/kg for soil invertebrates and 100 mg/kg for mammals are at least an order of magnitude higher than the sum of observed concentrations for LMWPAHs in site samples (i.e., 3.65 mg/kg). On this basis, these COPCs were not carried forward.

Acridine was detected in 1 of 27 site samples (4%) and has no guideline available; however, the anthracene guideline can be used as a surrogate for this parameter. Both anthracene and acridine are three-ringed, low molecular weight PAHs. The maximum site acridine concentration of 0.068 mg/kg is well below the anthracene guideline of 32 mg/kg. Therefore, acridine was not carried forward for further assessment.

Perylene was detected in 14 of 27 site samples (52%) with a maximum concentration of 0.561 mg/kg and no applicable guideline or background data were available. Given that the majority of PAHs were detected at relatively low concentrations, and detectable concentrations of other five-ringed, high molecular weight PAHs were reported at concentrations similar to or greater than the maximum reported perylene concentration, it is unlikely that perylene would be of concern to ecological receptors at the site. In addition, the maximum perylene concentration is below the guidelines for all other HMWPAHs that are similar to perylene in structure. On this basis, perylene was not carried forward.

Secondary Screening of Initial COPCs

As previously mentioned, the ecological health-based benchmarks selected in the initial soil screening were the lowest available benchmark for any receptor. Where exceedances occurred, the chemicals identified as initial COPCs were then carried forward for a receptor-specific secondary screening (i.e., separate screening conducted for soil invertebrates and vegetation, and mammals and avian ROC) (Table 4-9). The soil quality guidelines specific to vegetation and soil invertebrates for direct soil contact exposure pathways were compared to the maximum site soil chemical concentrations as these receptors are immobile. The soil quality guidelines specific to mammalian and avian receptors for soil and food ingestion exposure pathways were compared to the 90th percentile site soil chemical concentrations. This is in keeping with FCSAP (2012a) guidance, which indicates that a 90th percentile soil concentration can be used for screening mobile receptors if the sample size is > 10 and a site is adequately characterized. Data for this site included > 10 samples and the site has been adequately characterized; as such, the 90th percentile soil concentrations were used in the secondary screening. Soil concentrations were also compared to the background soil concentration range (Table 4-9).

Table 4-9 compares maximum site soil chemical concentrations for the initial COPCs that were selected for further evaluation to vegetation and soil invertebrate-specific ecological health-based soil guidelines, and compares 90th percentile soil chemical concentrations to mammalian and avian-specific ecological health-based soil guidelines. The maximum and 90th percentile concentrations were also compared to background soil concentrations where available. Table 4-9 also provides the frequency of soil guideline exceedance.

Table 4-9: Comparison of Former Country Harbour Mine Soil Chemistry Data for Initial COPCs to Receptor-Specific Ecological Health-Based Soil Quality Benchmarks and Local Background

Chemical	Number of Samples*	# Detectable Samples	Max Concentration (mg/kg)	90th Percentile (mg/kg)[d]	Background Range (mg/kg)[c]	Ecological Health-Based Soil Quality Benchmarks by Receptor Group (mg/kg)		Number of Samples Exceeding Ecological Soil Quality Benchmarks and Background		Frequency of Exceedance Over Ecological Soil Quality Benchmarks and Background (%)	
						Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]	Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]	Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]
Antimony	119	93	48.1	4.4	<0.10 – 0.30	40[j]	1500	1	0	0.8	0
Arsenic	119	119	20,600	2,680	1.77 - 1,050	26	330	40	40	34	34
Cadmium	119	99	2.63	0.55	0.024 - 0.197	22	1.9	0	5	0	4.2
Copper	119	110	99.6	40	1.03 – 10.4	91	3100	1	0	0.8	0
Lead	119	119	1,360	232	3.99 – 88	600	32	4	48	3	40
Manganese	119	119	7,510	1040	30 – 218	220[i]	4000[k]	75	1	63	0.8
Mercury	119	115	2,920	15	0.01 - 0.230	50	20	5	11	4	9
Selenium	119	86	11.1	4.0	0.36 - 1.4	2.9	5.5	10	2	8	2
Uranium	119	110	76.6	5.95	0.78 – 2.3	2000	33	0	2	0	2
Vanadium	119	119	72.6	48.4	3.24 – 38.6	130	18	0	31	0	26
Zinc	119	113	531	155	2.7 – 44	450	960 [e]	1	0	0.8	0
Benz(a)anthracene	27	7	2.47	0.51	NDA	1 [f]	6.2 [g]	2	0	7	0
Indeno(1,2,3-cd)pyrene	27	7	1.81	0.34	NDA	0.76 [f]	NGA	2	NA	7	NA

Chemical	Number of Samples*	# Detectable Samples	Max Concentration (mg/kg)	90th Percentile (mg/kg)[d]	Background Range (mg/kg)[c]	Ecological Health-Based Soil Quality Benchmarks by Receptor Group (mg/kg)		Number of Samples Exceeding Ecological Soil Quality Benchmarks and Background		Frequency of Exceedance Over Ecological Soil Quality Benchmarks and Background (%)	
						Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]	Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]	Terrestrial Vegetation/ Soil Organisms[a]	Birds/ Mammals[b]
PHC F3	33	28	2180	1267	NDA	**1700** [h]	NGA	2	NA	6	NA
PHC F4	33	28	12,100	684	NDA	**3300** [h]	NGA	1	NA	3	NA

Notes:

BOLDED values indicate the maximum (terrestrial vegetation and soil organisms) or 90th percentile (birds and mammals) concentration exceeded the applicable guideline and background maximum.

* Note that for metals, 120 samples were analyzed but one sample was excluded from the calculations (24 MW-01-SS5 (2.4-3.0 m)) as it was collected from a depth greater than 1.5 m bgs and was therefore not considered relevant for ecological receptors.

NGA = no guideline available; NA = not applicable; NDA = no data available.

[a] CCME $SoQG_E$ soil contact guidelines; commercial land use; lower of coarse or fine-grained soil.

[b] MECP (2011) Table 3 Soil Components - Full Depth, Potable Water - Industrial/Commercial land use; Coarse soils; Mammals & Birds Soil Components.

[c] Range of soil samples collected by Dillon within the property that are not considered to be impacted and assumed to represent local background.

[d] For 90th percentile calculations, non-detectable concentrations were assumed to equal the detection limit and the higher of a sample and its corresponding field duplicate were used in the calculation. Similarly, the highest sample result for a given location was used to calculate the 90th percentile. Values rounded to 2 significant figures.

[e] The CCME (2018) developed updated zinc guidelines which included a commercial soil contact guideline of 450 mg/kg and an agricultural soil and food ingestion guideline of 960 mg/kg. The CCME (2018) agricultural soil and food ingestion guideline was selected for the evaluation of birds and mammals.

[f] MECP (2011) Table 3 Soil Components - Full Depth, Non-Potable Water - Industrial/Commercial land use; Coarse soils; Plants & Soil Organisms Soil Components.

[g] CCME $SoQG_E$ for soil and food ingestion. No value was available for commercial land use, so the value for a residential/parkland land use was selected.

[h] CCME Canada Wide Standards for PHCs in Soils (CCME, 2008); commercial land use and lower of fine and coarse-grained soils applicable for ecological soil contact.

[i] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007a). Lower of plant and soil invertebrate EcoSSLs.

[j] Alberta Environment and Parks (AEP, 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4).

[k] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007a). Lower of mammalian (vole, shrew, weasel) EcoSSLs.

For the initial COPCs identified in Table 4-8, a significance level of 5% was applied for both frequency of detection and frequency of exceedance. While there is no consistent regulatory guidance on a significance level or cut-off value to use when considering the frequency of detection, and/or exceedance over benchmarks in a COPC identification process, a value of 5% has some regulatory precedent within the U.S. Superfund program and as per the U.S. Navy HHRA Guidance document (US Navy, 2008). The US EPA Superfund Program has used a 5% cut-off value for detection frequency to eliminate chemicals from further consideration since the early 1990s, and the U.S. Navy (2008) HHRA guidance also supports the use of a 5% cut-off value when considering detection and benchmark exceedance frequency. Thus, the initial COPCs in Table 4-9 carried forward for the receptor-specific benchmark comparison that displayed a frequency of detection and/or a frequency of exceedance over the applicable soil benchmark of less than 5% were excluded from further consideration in the ERA. If the frequency of detection was equal to or greater than 5% for the carried forward substances, they were then evaluated on the basis of their frequency of exceedance over the applicable soil quality benchmark. In addition, the degree of benchmark exceedance was also considered. If the frequency of exceedance over the soil benchmark was equal to or greater than 5%, then the substance was carried forward into the next step of the COPC identification process. Also, a 5% significance level is consistent with the default alpha value used in most statistical calculations with environmental data sets. This approach in COPC identification procedures has been applied for at least 20 years in the numerous ERAs and HHRAs conducted by Dillon, and the approach has been accepted by the applicable federal and provincial regulatory authorities.

For terrestrial vegetation and soil invertebrate ROC, the maximum soil concentrations for antimony, arsenic, copper, lead, manganese, mercury, selenium, zinc, benz(a)anthracene, indeno(1,2,3-c,d)pyrene, PHC F3 and PHC F4 exceeded the applicable soil quality guideline and the background maximum, where available. Of these initial COPCs, only arsenic, manganese, selenium, benz(a)anthracene, indeno(1,2,3-c,d)pyrene, and PHC F3 had a frequency of guideline exceedance of 5% or greater.

Manganese exceeded the applicable guideline of 220 mg/kg in 75 of 119 samples (63%) by a maximum of 34-fold (maximum measured concentration was 7,510 mg/kg). Manganese occurs naturally in soil, primarily from the weathering of rocks (Kennedy, 2021). While manganese concentrations in the local background samples ranged up to 218 mg/kg, the geology of the site reflects the Goldenville Formation which is a bedrock rich in manganese (Kennedy, 2021), and higher natural concentrations of manganese in site soils would not be unexpected. Given these considerations, the elevated manganese concentrations are considered not to be related to historical site activities, and manganese was not carried forward for further assessment.

Arsenic, selenium, benz(a)anthracene, indeno(1,2,3-c,d)pyrene, and PHC F3 were carried forward as COCs for further assessment for terrestrial vegetation and soil invertebrates. The exceedances of individual soil samples over the applicable guidelines are provided in Tables C17-C21, Appendix C. The locations of the exceedances of the vegetation and soil invertebrate health-based guidelines are provided in Figures 7a and 7b, Appendix A.

For mammalian and avian ROC, the 90th percentile concentration exceeded the applicable guideline and background maximum for arsenic, lead, and vanadium. Exceedances of the applicable guidelines and background data occurred in 34% (40 of 119) arsenic samples, 40% (48 of 119) lead samples, and 26% (31 of 119) vanadium samples (Table 4-9). The 90th percentile soil concentrations of arsenic, lead, and vanadium exceeded their applicable guidelines by 8.6-fold, 7.8-fold, and 3-fold, respectively. Based on these considerations, arsenic, lead, and vanadium were carried forward for further assessment for mammalian and avian ROC. The exceedances of individual soil samples over the applicable guidelines are provided in Tables C17-C21, Appendix C. The locations of the exceedances of the mammalian and avian health-based guidelines are provided in Figures 8a and 8b, Appendix A.

No avian and/or mammalian specific guideline or background data were available for indeno(1,2,3-c,d)pyrene, PHC F3 and PHC F4. PHCs are readily metabolized by vertebrates and do not accumulate in tissues (CCME, 2008). In addition, PHCs are not readily absorbed into and accumulated into plants (CCME, 2008). As such, the measured concentrations of PHC F3 and PHC F4 in site soils were not considered to be of concern to birds and mammals, and these initial COPCs were not carried forward for further assessment. Similarly, indeno(1,2,3-c,d)pyrene is a 6-ringed PAH. The CCME (2010) reported that while high molecular weight PAHs (5 or more rings, such as indeno(1,2,3-c,d)pyrene) may sorb to plant roots, they are unlikely to translocate or accumulate within the plant. In addition, PAHs have been reported to be extensively metabolised in higher-trophic level consumers (ATSDR, 1995). Given these considerations, indeno(1,2,3-c,d)pyrene was not carried forward for further assessment for birds and mammals.

Based on the COPC identification steps and considerations described above, a number of COCs in soil were carried forward for assessment as listed below:

COCs for Terrestrial Vegetation and Soil Invertebrates:

- Arsenic;
- Selenium;
- Benz(a)anthracene;
- Indeno(1,2,3-c,d)pyrene; and
- PHC F3.

COCs for Small Mammals and Birds:

- Arsenic;
- Lead; and
- Vanadium.

4.2.8.2 COPCs in Site Surface Water

Surface water samples from portions of Johnston Brook within the study boundary, as well as within the subject property but outside of areas anticipated to be impacted by historical site activities (i.e., background areas) were compared to freshwater aquatic life guidelines. The source of the guidelines initially used in the COPC screening were the Nova Scotia Tier II Pathway-Specific Standards for Surface Water and are identified in the ecological health screening tables (Tables C29-C32, Appendix C), while the original guideline sources are provided below. Some CWQG can be modified by site-specific water quality parameters (e.g., hardness and pH); however, hardness and/or pH were reported at concentrations in each of the site samples outside the range where guidelines for individual samples couple be adjusted. Therefore, the most conservative guidelines were applied for these parameters.

While some general chemical analytical data were collected from site surface water and groundwater, these measured parameters that are not generally considered in the selection of COPCs for an ERA (e.g., various common or major ions in water, including: calcium, magnesium, sodium, potassium, phosphorus, sulphur, “nitrate+nitrite” (in water), hardness (as CaCO3); in situ field measured data such as temperature, field conductivity, dissolved oxygen, redox conditions). While such parameters can inform surface water and sediment quality, and groundwater mobility (where applicable), and may influence or modify the bioavailability, mobility and toxicity of certain COPCs, they are not typically considered directly in the COPC identification step of an ERA. Also, some of these parameters are essential nutrients known to support aquatic life (NRC, 2005; US EPA Region 4, 2018) or lack toxicity or risk-based ecological benchmarks that media concentrations can be compared against. In addition, silica and silicon are natural components of soil/sediment and were not carried forward for screening.

It should be noted that based on the upstream and downstream samples, the site surface waters are somewhat acidic (pH range of 6.29 to 7.15) and of low hardness (as CaCO3; range of 3.65 mg/L to 13.7 mg/L), but this appears to be natural and not site related (upstream background pH ranged from 6.21 to 6.4, while hardness ranged from 2.03 mg/L to 3.58 mg/L; see Table C32, Appendix C).

Canadian Council of Ministers of the Environment (CCME)

The Canadian Water Quality Guidelines (CWQG) for the Protection of Freshwater 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. Details regarding surface water guideline bases and derivation are provided in their respective fact sheets available from CCME (https://ccme.ca/en/summary-table).

Federal Environmental Quality Guidelines (FEQG)
Federal Environmental Quality Guidelines (FEQGs) have been developed by Environment and Climate Change Canada (ECCC) under the federal Chemicals Management Plan to support federal environmental quality monitoring, risk assessment, and risk management activities on substances for which CCME guidelines do not yet exist or are not reasonably expected to be updated in the near future (Government of Canada, 2023). Details on surface water guideline bases and derivation are provided on

the Government of Canada's website (https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html).

BC MOECCS Approved and Working Water Quality Guidelines (2024)

The British Columbia Ministry of Environment and Climate Change Strategy (BC MOECC) Approved and Working Water Quality Guidelines (WQG) are ambient water quality guidelines developed for a variety of receptors including aquatic life. These guidelines were preferentially used for screening following the federal guidelines described above. The "approved" guidelines were the first preference, followed by the "working" guidelines. The BC MOECC (2017c) reported that the BC Approved and Working Water guidelines are concentrations that are considered to be protective of aquatic life in receiving environments. Where available, long term (chronic) guidelines were used in the screening. Details can be found 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.

BC Contaminated Site Regulation (BC CSR) (2024)

The BC CSR Schedule 3.2 – Generic Numerical Water Standards for Aquatic Life (Searched August 2024) are for the protection of groundwater and surface water that may discharge into aquatic receiving environments. These standards are generally 10-times the respective WQG as it assumed a 10-fold dilution will occur prior to discharge to surface water (BC MOECC, 2017c). As such, where the BC CSR Schedule 3.2 standards were used, they were divided by 10 to remove the adjustment for dilution. Details can be found at http://www.bclaws.ca/civix/document/id/complete/statreg/375_96_08.

Ontario Ministry of the Environment Conservation and Parks (MECP, 1994)

The Ontario MECP Provincial Water Quality Objectives (PWQO) are numerical and narrative criteria which serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e., lakes and rivers) and, where it discharges to the surface, the groundwater of the province. The PWQO are set at a level of water quality which is protective of all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure to the water.

Michigan Department of Environment, Great Lakes and Energy

Aquatic life, final chronic values (reported as MDEQ in NS PSS (2021)). Searched August 2024. https://www.michigan.gov/egle/about/organization/water-resources/assessment-michigan-waters/rule-57-water-quality-values.

Results of Ecological Health-Based Surface Water Screening

Surface water screening results are provided in Table 4-10 and discussed in the following sections. Details of the ecological screening for surface water are provided in Tables C29 to C32, Appendix C. Figures 9a and 9b (Appendix A) show the locations of guideline exceedances for COCs in surface water. Results of the surface water screening were used to identify COCs for freshwater aquatic life and amphibians.

Surface water data were available for metals, PAHs, and BTEX/PHCs. Chemicals that were not detected in any of the analyzed surface water samples and were not associated with current and historical activities at the site were excluded from further assessment, regardless of whether a guideline was available (i.e., antimony, bismuth, boron, tellurium, thorium, tin, tungsten, lithium, silver, zirconium, all PAHs, BTEX and PHCs). For completeness, the RDL for parameters with concentrations < the RDL were cross-referenced with the appropriate ecological-health based guideline, and RDLs were below the applicable guideline; therefore, none of the non-detected parameters were carried forward in the ERA.

Table 4-10: Ecological Screening of Surface Water for the Former Country Harbour Mine

Chemical	Ecological Surface Water Quality Benchmark (mg/L)	Maximum Background Concentration (mg/L)	Maximum Measured Concentration (mg/L)	Carried Forward As Initial COPC? (Y/N)
Metals				
Aluminum	0.005 [a,g]	0.233	0.325	Y
Arsenic	0.005 [a]	0.0013	0.0633	Y
Barium	0.1 [b,d]	0.00286	0.00484	N
Beryllium	0.00013 [b]	0.000022	0.000067	N
Cadmium	0.00004 [a,e]	0.0000155	0.0000341	N
Chromium (Total, III+VI)	0.0089 [a]	0.0005	0.00159	N
Cobalt	0.004 [b]	0.0001	0.00132	N
Copper	0.002 [a,h]	<0.00050	0.00086	N
Iron	0.3 [a]	0.399	0.621	Y
Lead	0.001 [a,i]	0.000879	0.00208	Y
Manganese	0.21 [a,j]	0.0141	0.105	N
Mercury	0.000026 [a]	<0.0000050	0.000023	N
Molybdenum	0.073 [a]	<0.000050	0.000052	N
Nickel	0.025 [a,k]	<0.00050	0.00115	N
Selenium	0.001 [a]	0.000127	0.000118	N
Cesium	NGA	0.000142	0.000131	N
Rubidium	*NGA*	*0.00172*	*0.00177*	*Y*
Strontium	2.5 [c]	0.00451	0.00586	N
Titanium	*NGA*	*0.0112*	*0.0115*	*Y*
Thallium	0.0008 [a]	<0.000010	0.000012	N
Uranium	0.015 [a]	0.000033	0.000261	N

Chemical	Ecological Surface Water Quality Benchmark (mg/L)	Maximum Background Concentration (mg/L)	Maximum Measured Concentration (mg/L)	Carried Forward As Initial COPC? (Y/N)
Vanadium	0.12 [c]	<0.00050	0.0005	N
Zinc	0.007 [a]	<0.0030	0.0088	Y

Notes:
N = 16 for metals.

COPC = contaminant of potential concern; NGA = no guideline available; NA = not applicable; RDL = reportable detection limit; Y = yes; N = no; "<" indicates that the value was less than the laboratory RDL.

BOLDED values indicate concentrations above applicable guidelines and background.

Italicized values indicate that the maximum site concentration was above the maximum background concentration, but no guideline was available for comparison.

Underlined values indicate that no guideline or background data were available for comparison.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] B.C. Ministry of Water, Land and Resource Stewardship 2024. Approved and Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guideline Series, WQG-08-01. Prov. B.C., Victoria B.C.

[c] Environment Canada. (2021). Federal Environmental Quality Guidelines.

[d] Guideline is based on a 30-day average.

[e] Guideline is hardness-dependent. As all site samples had a reported hardness of < 17 mg/L, the most conservative guideline was applied.

[f] Guideline is hardness-dependent. As all site samples had a reported hardness of < 52 mg/L, the most conservative guideline was applied.

[g] Guideline is pH-dependent. Given that the majority of site samples had a reported pH < 6.5, the most conservative guideline was applied.

[h] Guideline is hardness-dependent. As all site samples had a reported hardness of < 82 mg/L, the most conservative guideline was applied.

[i] Guideline is hardness-dependent. As all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

[j] Guideline is pH and hardness-dependent. The most conservative guideline based on pH and hardness data across site samples was applied.

[k] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

Parameters reported in site samples at concentrations exceeding their applicable guideline and the local background maximum included aluminum, arsenic, iron, lead, and zinc; therefore, these parameters were carried forward for further assessment.

All other parameters were either reported at concentrations below the laboratory RDL or below their applicable guideline and were therefore excluded from further assessment.

Based on the comparisons presented in Table 4-10 and Tables C29-C32, Appendix C, the following chemicals were carried forward for further evaluation as initial COPCs (on the basis of maximum site surface water concentrations exceeding applicable ecological surface water quality benchmarks and/or local background concentrations, or due to lack of available guidelines; number of samples that exceed provided in parentheses):

Initial COPCs - Surface Water

- Aluminum (16 of 16);
- Arsenic (16 of 16);
- Iron (7 of 16);
- Lead (4 of 16);
- Rubidium (NGA);
- Titanium (NGA); and
- Zinc (3 of 16).

Further Examination of Initial COPCs

Aluminum was reported at concentrations exceeding the guideline of 0.005 mg/L in 16 of 16 site samples (100%) by up to 65-fold with a maximum value of 0.325 mg/L. All but one site sample (i.e., 94%) fell within the range of background values (i.e., 0.138 - 0.233 mg/L) indicating that aluminum in surface water is likely attributable to naturally elevated background conditions and not representative of contamination resulting from site activities. Given the low frequency and degree of exceedance of background data, aluminum was not carried forward for further consideration.

Arsenic was reported at concentrations exceeding the guideline of 0.005 mg/L in 16 of 16 site samples (100%) by up to 13-fold with a maximum value of 0.0633 mg/L. All site samples were also reported at concentrations above the background maximum of 0.0013 mg/L. Given the frequency and degree of exceedance, and that arsenic can be attributed to former site operations, arsenic was carried forward for further consideration.

Iron was reported at concentrations exceeding the guideline of 0.3 mg/L in 7 of 16 site samples (44%) by up to 2-fold with a maximum value of 0.621 mg/L. Of these, 3 of 16 site samples (19%) also exceeded the maximum background concentration of 0.399 mg/kg, which also exceeded the guideline. The geology of the site reflects the Goldenville Formation of the Cambrian period, which is a bedrock rich in iron. This substance is ubiquitous to the bedrock of the area, and high concentrations of iron in site media are to be expected. As a result, iron was not carried forward for further consideration.

Lead was reported at concentrations exceeding the guideline of 0.001 mg/L in 4 of 16 site samples (25%) by up to 2-fold with a maximum value of 0.00208 mg/L. Each of the samples that exceeded the guideline also exceeded the background maximum of 0.000879 mg/L. Given the frequency and degree of exceedance, lead was carried forward for further consideration.

Rubidium and titanium were reported at concentrations marginally above the background maximum in 2 of 16 (13%) and 1 of 16 (6%) samples, respectively. Both rubidium and titanium are common natural trace elements in most environmental media and biota. In addition, neither rubidium nor titanium are likely to be associated with site activities. Given these considerations, rubidium and titanium were not carried forward for further evaluation.

Zinc was reported at concentrations exceeding the guideline of 0.007 mg/L in 3 of 16 site samples (19%) by up to 1.3-fold with a maximum value of 0.0088 mg/L. Each of the samples that exceeded the guideline also exceeded the background maximum of < 0.003 mg/L (i.e., < RDL). Given the frequency and degree of exceedance, zinc was carried forward for further evaluation.

Based on the screening of the initial COPCs, the following chemicals were carried forward as COCs in surface water for freshwater aquatic life and amphibians.

Final COCs - Surface Water (Freshwater Aquatic Life and Amphibians)

- Arsenic;
- Lead; and
- Zinc.

4.2.8.3 COPCs in Site Groundwater

Groundwater samples from within the study boundary were compared to groundwater quality guidelines. While surface water data are more relevant for ecological receptors, groundwater were also screened to identify whether groundwater from the site flowing into surface waters may be of concern.

The specific source of the guidelines used in the COPC screening are identified in the ecological health screening tables (Tables C22-C25, Appendix C), while the original guideline sources are provided below. The preferential source of the guidelines was the NS Tier II PSS for groundwater >10 m from a surface water body, for freshwater aquatic life, which were based on using a value of 10-times the surface water guideline. The results of the groundwater screening are provided below.

Results of Ecological Health-Based Groundwater Screening

Groundwater screening results are provided in Table 4-11 and discussed in the following sections. Details of the ecological screening for groundwater are provided in Tables C22-C25, Appendix C. Results of the groundwater screening were used to identify COCs for freshwater aquatic life.

Groundwater data were available for metals, PAHs, and BTEX/PHCs in site samples only (i.e., no background data were available for comparison). Chemicals that were not detected in any of the analyzed groundwater samples and were not associated with current and historical activities at the site were excluded from further assessment, regardless of whether a guideline was available. For groundwater, these included boron, tellurium, zirconium, the majority of PAHs (with the exception of those included in Table X below), BTEX, and PHCs. For completeness, the RDL for parameters with concentrations < the RDL were cross-referenced with the appropriate ecological-health based guideline, and RDLs were below the applicable guideline; therefore, none of the non-detected parameters were carried forward in the ERA.

Table 4-11: Ecological Screening of Groundwater for the Former Country Harbour Mines

Chemical	Ecological Groundwater Quality Benchmark (mg/L)	Maximum Background Concentration (mg/L)	Maximum Measured Concentration (mg/L)	Carried Forward as Initial COPC? (Y/N)
Metals				
Aluminum	0.05 a,h,*	NA	1.38	Y
Antimony	0.09 a	NA	0.0006	N
Arsenic	0.05 a	NA	0.195	Y
Barium	10 a	NA	0.0201	N
Beryllium	0.0015 a	NA	0.000231	N
Bismuth	NGA	NA	0.000155	Y
Boron	15 a	NA	<0.010	N
Cadmium	0.0009 a,f	NA	0.000321	N
Chromium (Total, III+VI)	0.089 a	NA	0.00095	N
Cobalt	0.010 b	NA	0.00963	N
Copper	0.02 a	NA	0.0673	Y
Iron	3 a	NA	4.16	Y
Lead	0.01 a	NA	0.0207	Y
Manganese	4.3 a	NA	0.34	N
Mercury	0.00026 a	NA	0.0000699	N
Molybdenum	0.73 a	NA	0.000728	N
Nickel	0.25 a	NA	0.00617	N
Selenium	0.01 a	NA	0.000188	N
Cesium	NGA	NA	0.000854	Y
Rubidium	NGA	NA	0.00867	Y
Thorium	NGA	NA	0.00041	Y
Tungsten	NGA	NA	0.0644	Y
Lithium	NGA	NA	0.0051	Y
Silver	0.0025 a	NA	0.000952	N
Strontium	210 d	NA	0.0337	N
Titanium	NGA	NA	0.0459	Y
Thallium	0.008 a	NA	0.000036	N
Tin	NGA	NA	0.00029	Y
Uranium	0.15 a	NA	0.0144	N
Vanadium	1.2 c	NA	0.0014	N
Zinc	0.07 a	NA	0.0662	N

Chemical	Ecological Groundwater Quality Benchmark (mg/L)	Maximum Background Concentration (mg/L)	Maximum Measured Concentration (mg/L)	Carried Forward as Initial COPC? (Y/N)
PAHs				
1-Methylnaphthalene	NGA	NA	0.000013	N
2-Methylnaphthalene	NGA	NA	0.00002	N
1 & 2 Methylnaphthalene	0.002 [c,d]	NA	0.000033	N
Fluoranthene	0.00004 [a]	NA	0.000014	N
Naphthalene	0.0011 [a]	NA	0.000015	N
Phenanthrene	0.0004 [a]	NA	0.000019	N

Notes:

N = 6 for metals, PAHs, BTEX and PHCs.

PAH = polycyclic aromatic hydrocarbons; BTEX = benzene, toluene, ethylbenzene, and xylenes; PHC = petroleum hydrocarbons; TPH = total petroleum hydrocarbons; COPC = contaminant of potential concern; VPH = volatile petroleum hydrocarbons; EPH = extractable petroleum hydrocarbons; NGA = no guideline available; NA = not applicable; RDL = reportable detection limit; Y = yes; N = no; "<" indicates that the value was less than the laboratory RDL

BOLDED values indicate concentrations above applicable guidelines and background.

Italicized values indicate that the maximum site concentration was above the maximum background concentration, but no guideline was available for comparison.

Underlined values indicate that no guideline or background data were available for comparison.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater >10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Environment Canada. (2017). Federal Environmental Quality Guidelines: Cobalt.

[d] Michigan Department of Environmental Quality (MDEQ). (2008). Rule 57 Water Quality Values - Surface Water Quality Assessment Section.

As shown in Table 4-11, guidelines were not available for bismuth, cesium, rubidium, thorium, tungsten, lithium, titanium, and tin, but they were detected in at least one site sample and background data were not available for comparison. Therefore, they were carried forward as initial COPCs for further assessment.

Parameters reported in site samples at concentrations exceeding their applicable guideline included aluminum, arsenic, copper, iron, and lead; therefore, these parameters were carried forward for further assessment.

All other parameters were either reported at concentrations below the laboratory RDL or below their applicable guideline and were therefore excluded from further assessment.

Based on the comparisons presented in Tables C22-C25, Appendix C, the following chemicals were carried forward for further evaluation as initial COPCs (on the basis of maximum site groundwater concentrations exceeding applicable ecological surface water quality benchmarks, or due to lack of available guidelines; number of samples that exceed provided in parentheses):

Initial COPCs - Groundwater

- Aluminum (5 of 16);
- Arsenic (5 of 16);
- Bismuth (NGA);
- Copper (5 of 16);
- Iron (6 of 16);
- Lead (4 of 16);
- Cesium (NGA);
- Rubidium (NGA);
- Thorium (NGA);
- Tungsten (NGA);
- Lithium (NGA);
- Titanium (NGA); and
- Tin (NGA).

Further Examination of Initial COPCs

Aluminum was reported at concentrations exceeding the guideline in 5 of 16 site samples (31%) by up to 2.8-fold with a maximum value of 1.38 mg/L. Although background data were not available for groundwater, aluminum is the most abundant metal on the earth's crust (Royal Society of Chemistry, 2024) so it is not unexpected that it would be found in groundwater. The measured site concentrations of aluminum would not be expected to be related to site activities. As such, aluminum was not carried forward for further assessment.

Arsenic was reported at concentrations exceeding the guideline of 0.05 mg/L in 1 of 6 site samples (17%) by up to 3.9-fold with a maximum value of 0.195 mg/L. Arsenic was elevated above the guideline in the duplicate of sample for 24MW-02, but not in the parent sample. Given arsenic can be attributed to former site operations, arsenic was carried forward for further consideration.

Bismuth, cesium, rubidium, thorium, tungsten, lithium, titanium, and tin were reported at concentrations above the detection limit in several site samples; however, guidelines were not available for comparison. These parameters are common natural trace elements in most environmental media and biota. In addition, they are not likely to be associated with site activities. Given these considerations, these COPCs were not carried forward for further evaluation.

Copper was reported at concentrations exceeding the guideline of 0.02 mg/L in 2 of 6 site samples (33%) by up to 3.4-fold with a maximum value of 0.0673 mg/L. Given the frequency and degree of exceedance, copper was carried forward for further consideration.

Iron exceeded the guideline of 3 mg/L in 1 of 6 (17%) of samples. Iron was elevated above the guideline in the duplicate of sample for 24MW-02, but not in the parent sample. As previously noted, the geology of the site reflects the Goldenville Formation of the Cambrian period, which is a bedrock rich in iron. This substance is ubiquitous to the bedrock of the area, and as such, it is not unexpected to find high concentrations of iron in sediments. Iron is not expected to be site-related. For these reasons, iron was not carried forward for further consideration.

Lead was reported at concentrations exceeding the guideline of 0.01 mg/L in 1 of 6 site samples (17%) by up to 2.1-fold with a maximum value of 0.0207 mg/L. Given the frequency and degree of exceedance, lead was carried forward for further consideration.

The following chemicals were carried forward as COCs in groundwater for further evaluation.

Final COCs – Groundwater (Freshwater Aquatic Life)

- Arsenic;
- Copper; and
- Lead.

4.2.8.4 COPCs in Site Sediment

Sediment samples from portions of Johnston Brook within the study boundary, as well as within the subject property but outside of areas anticipated to be impacted by historical site activities (i.e., upgradient, background areas) were compared to sediment quality guidelines. Sediment screening results are provided in Table 4-12 and discussed in the following sections. Details of the ecological screening for site sediments are provided in Tables C26-C28, Appendix C, while the specific guideline sources are provided below.

Canadian Council of Ministers of the Environment (CCME)

The applicable guidelines for freshwater sediments are the CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (http://ceqg-rcqe.ccme.ca/en/index.html). CCME has two types of sediment guidelines: Interim Sediment Quality Guidelines (ISQGs) and Probable Effects Levels (PELs). The ISQGs are essentially threshold effect levels (TELs), which represent the concentration of a contaminant below which adverse effects are not anticipated (CCME, 1995). A PEL is defined by CCME (1995) as the concentration of a contaminant above which adverse biological effects are usually or always observed. As previously noted, the PEL guidelines were preferentially applied for the COPC screening.

British Columbia Ministry of Environment and Climate Change Strategy Approved and Working Sediment Quality Guidelines

The BC MOECCS (2021; 2023) Working and Approved Sediment Quality Guidelines (freshwater). These guidelines represent safe levels of substances that protect different water uses including freshwater aquatic life. The BC MOECCS (2023) notes that exceeding the guideline does not imply that unacceptable risks exist, but rather that the potential for adverse effects may be increased and additional investigation may be required.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ; Simpson et al., 2013)

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ) provide comprehensive guidance on assessing and managing the quality of freshwater and marine environments in Australia and New Zealand. These guidelines offer a framework for water quality monitoring and management, covering aspects such as water quality objectives, environmental indicators, and assessment methodologies to protect and sustainably manage aquatic ecosystems and water resources in the region. They are an essential reference for policymakers, researchers, and environmental practitioners involved in water quality management in Australia and New Zealand. The derivation of these values can be found at https://publications.csiro.au/rpr/pub?pid=legacy:965.

Results of Ecological Health-Based Sediment Screening

Sediment screening results are provided in Table 4-12 and discussed in the following sections. Details of the ecological screening for site sediment are provided in Tables C26-C28, Appendix C. Figures 10a and 10b (Appendix A) shows the locations of guideline exceedances for COCs in sediment. Results of the sediment screening were used to identify COCs for freshwater aquatic life, amphibians, and reptiles.

Sediment data were available for metals (site and background) and BTEX/PHCs (site only). Chemicals that were not detected in any of the analyzed sediment samples and were not associated with current and historical activities at the site were excluded from further assessment, regardless of whether a guideline was available (i.e., boron, tungsten, zirconium, BTEX, PHCs). For completeness, the RDL for parameters with concentrations < the RDL were cross-referenced with the appropriate ecological-health based guideline, and all RDLs were below the applicable guideline; therefore, none of the non-detected parameters were carried forward in the ERA.

As noted previously for other media, essential nutrients including calcium, magnesium, potassium, sodium and sulphur were excluded from the selection of COPCs for the ERA.

Table 4-12: Ecological Screening of Sediment for the Former Country Harbour Mine

Chemical	Ecological Sediment Quality Benchmark (SQG_E) (mg/kg)	Maximum Background Concentration (mg/kg)	Maximum Measured Concentration (mg/kg)	Carried Forward as Initial COPC? (Y/N)
Metals				
Aluminum	*NGA*	*4,000*	*22600*	*Y*
Antimony	25 [d,e]	<0.10	4.68	N
Arsenic	17 [a,f]	49.5	8770	Y
Barium	*NGA*	*35.7*	*443*	*Y*
Beryllium	*NGA*	*0.34*	*1.39*	*Y*
Bismuth	*NGA*	*<0.20*	*0.32*	*Y*
Cadmium	3.5 [a,f]	0.227	0.218	N
Chromium (Total, III+VI)	90 [a,f]	6.26	38.7	N
Cobalt	*NGA*	*1.86*	*120*	*Y*
Copper	197 [a,f]	4.71	26.5	N
Iron	43,766 [c,g]	10,600	58000	Y
Lead	91.3 [a,f]	23.4	124	Y
Lithium	*NGA*	*6.9*	*48.2*	*Y*
Manganese	1100 [c,g]	155	6910	Y
Mercury	0.486 [a,f]	0.156	3.21	Y
Molybdenum	23,000 [c,g]	0.65	5.87	N
Nickel	75 [c,g]	3.04	19.6	N
Selenium	2 [b]	1.41	1.07	N
Silver	0.5 [c,h]	0.1	0.2	N
Strontium	NGA	18.8	11.6	N
Titanium	*NGA*	*321*	*1200*	*Y*
Thallium	*NGA*	*0.076*	*0.593*	*Y*
Tin	*NGA*	*<2.0*	*6.7*	*Y*
Uranium	*NGA*	*0.859*	*1.67*	*Y*
Vanadium	*NGA*	*10.3*	*53.2*	*Y*

Chemical	Ecological Sediment Quality Benchmark (SQG_E) (mg/kg)	Maximum Background Concentration (mg/kg)	Maximum Measured Concentration (mg/kg)	Carried Forward as Initial COPC? (Y/N)
Zinc	315 [a,f]	12.9	109	N

Notes:

N = 16 for metals; N = 6 for BTEX and PHCs.

COPC = contaminant of potential concern; NGA = no guideline available; NA = not applicable; RDL = reportable detection limit; Y = yes; N = no; "<" indicates that the value was less than the laboratory RDL.

BOLDED values indicate concentrations above applicable guidelines and background.

Italicized values indicate that the maximum site concentration was above the maximum background concentration, but no guideline was available for comparison.

Underlined values indicate that no guideline or background data were available for comparison.

Where applicable, guidelines taken from Atlantic RBCA Tier II Pathway-Specific Standards for Sediment - Freshwater. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater).

[b] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2014). Ambient Water Quality Guidelines for Selenium. Technical Report. Update. April, 2014. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, British Columbia Ministry of Environment. Alert Concentration.

[c] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2017; updated 2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Working Sediment Quality Guidelines.

[d] 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.

[e] Recommended SQG (high value).

[f] Probable Effect Level (PEL).

[g] Upper Working Sediment Quality Guideline.

[h] Lower Working Sediment Quality Guideline (upper guideline not available).

As shown in Table 4-12, guidelines were not available for aluminum, barium, beryllium, bismuth, cobalt, lithium, titanium, thallium, tin, uranium, and vanadium, and maximum site concentrations of each of these parameters were above local background concentrations (Table 4-12). Therefore, they were carried forward as initial COPCs for further assessment.

Parameters reported in site samples at concentrations exceeding their applicable guideline and local background maximum included arsenic, iron, lead, manganese, and mercury; therefore, these parameters were carried forward for further assessment.

All other parameters were either reported at concentrations below the laboratory RDL or below their applicable guideline and were therefore excluded from further assessment.

Based on the comparisons presented in Tables C26-C28, Appendix C, the following chemicals were carried forward for further evaluation as initial COPCs (on the basis of maximum site sediment concentrations exceeding applicable ecological sediment quality benchmarks and/or local background concentrations, or due to lack of available guidelines; number of samples that exceed provided in parentheses):

Initial COPCs - Sediment

- Aluminum (NGA);
- Arsenic (16 of 16);
- Barium (NGA);
- Beryllium (NGA);
- Bismuth (NGA);
- Cobalt (NGA);
- Iron (2 of 16);
- Lead (3 of 16);
- Lithium (NGA);
- Manganese (12 of 16);
- Mercury (6 of 16);
- Titanium (NGA);
- Thallium (NGA);
- Tin (NGA);
- Uranium (NGA); and
- Vanadium (NGA).

Further Examination of Initial COPCs

No sediment quality guidelines were available for aluminum, barium, beryllium, bismuth, cobalt, lithium, thallium, titanium, tin, uranium, and vanadium (Table 4-12). All of these metals are well established as being common elements that occur naturally in all freshwater sediments. The presence of these metals in freshwater sediments is rarely related to former or current activities at a given site. While subject site sediment concentrations of most of these metals are higher than the concentrations in sediment samples collected upstream of the site, it is believed that their occurrence in site sediments is natural, and not a result of former site activities. Furthermore, there are virtually no freshwater sediment toxicity data available for these metals, which greatly limits the ability to interpret the implications of measured site sediment concentrations. Given the above considerations, these metals were not carried forward for further assessment in the ERA.

Arsenic was reported at concentrations exceeding the guideline of 17 mg/kg in 16 of 16 site samples (100%) by up to 516-fold with a maximum value of 8,770 mg/kg. All site samples were also reported at concentrations above the background maximum of 49.5 mg/kg. Given the frequency and degree of exceedance, and that arsenic can be attributed to former site operations, arsenic was carried forward for further consideration.

Iron was reported at concentrations exceeding the guideline of 43,766 mg/kg in 2 of 16 site samples (13%) by up to 1.3-fold with a maximum value of 58,000 mg/kg. All site samples were also reported at concentrations above the background maximum of 10,600 mg/kg. The geology of the site reflects the Goldenville Formation of the Cambrian period, which is a bedrock rich in iron. This substance is ubiquitous to the bedrock of the area, and high concentrations of iron in site media are to be expected.

On this basis, as well as the low frequency and degree of exceedance, iron was not carried forward for further consideration.

Lead was reported at concentrations exceeding the guideline of 91.3 mg/kg in 3 of 16 site samples (19%) by up to 1.4-fold with a maximum value of 124 mg/kg. All site samples were also reported at concentrations above the background maximum of 23.4 mg/kg. Given the frequency and degree of exceedance, lead was carried forward for further consideration.

Manganese exceeded the applicable guideline of 1,100 mg/kg in 12 of 16 site samples (75%) by up to 6.3-fold with a maximum value of 6,901 mg/kg. All site samples were also reported at concentrations above the maximum background of 155 mg/kg. However, the geology of the site reflects the Goldenville Formation of the Cambrian period, which similarly to iron is a bedrock rich in manganese. These substances are ubiquitous to the bedrock of the area, and high concentrations of both iron and manganese in site media are to be expected. As a result, manganese was not carried forward for further consideration.

Mercury was reported at concentrations exceeding the guideline of 0.486 mg/kg in 6 of 16 site samples (38%) by up to 6.6-fold with a maximum value of 3.21 mg/kg. Each of the site samples that exceeded the guideline were also reported at concentrations above the background maximum of 0.156 mg/kg. Given the frequency and degree of exceedance, and that mercury is associated with historical mining activity at the site, mercury was carried forward for further consideration.

The following chemicals were carried forward as COCs in surface water for freshwater aquatic life and amphibians.

Final COCs - Sediment (Freshwater Aquatic Life and Amphibians)

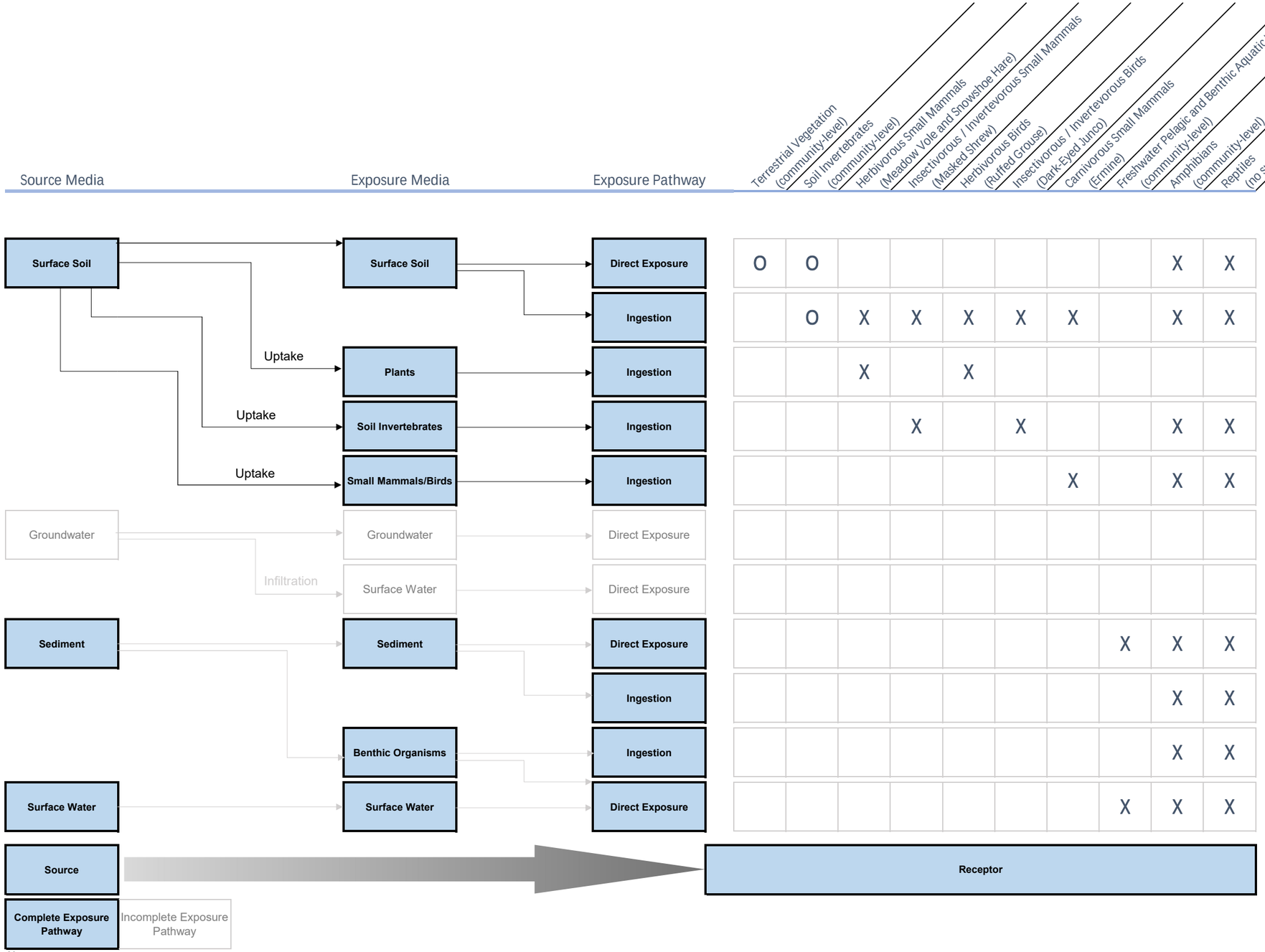
- Arsenic;
- Lead; and
- Mercury.

4.2.9 Conceptual Site Model for Ecological Receptors

A CSM provides a description of relevant exposure pathways for the COCs that have the potential to contribute to ecological exposures and potential health risks for the selected receptors. The ERA CSM is presented in Figure 4-2.

Based on the COPC screening, COCs were carried forward for terrestrial vegetation and soil invertebrates, small mammals and birds, freshwater aquatic life and amphibians. No COCs were selected for reptiles; however, the potential risks to this receptor group are discussed in Section 4.6.5.

Figure 4-2: Conceptual Site Model for Soils for Ecological Receptors at the Former Country Harbour Mine



Notes
X - indicates a potentially complete exposure pathway for quantitative analysis.
O - Indicates an interaction that will be evaluated qualitatively.

4.3 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., water, soil, 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., inhalation of soil particles and dusts; ingestion of food items, water, soils/dusts);
- 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, soils/dusts intake, energy utilization); and
- 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 soil/dust particles, foods, water and air).

For the terrestrial vegetation, soil invertebrates, and freshwater aquatic life, potential exposures were assessed qualitatively, and exposures were assumed to equal the measured COC concentrations in the applicable site media (i.e., soil, sediment, surface water).

Exposures to amphibians were also assessed qualitatively and were assumed to be equal to site surface water and sediment concentrations for their aquatic life stages/exposure pathways. There is a paucity of toxicity data for land-based exposures for these receptors and as such, the focus was on aquatic-based exposures. Similarly, potential exposures to reptiles were considered qualitatively.

For the remaining ROCs (i.e., vole, shrew, hare, ermine, junco, grouse), COC exposures were assessed quantitatively using various site-specific assumptions, as well as standard food chain modeling equations, uptake factors (or regression 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.

Within the current ERA, the assumed exposure scenario is current site conditions within the study boundary. At this time, it is also assumed that current conditions represent future conditions, as the site is not anticipated to change in the future. The temporal boundaries for the ERA are also current conditions. Spatial boundaries for the ERA exposure scenario are the current areal extent of the study boundary. Other properties or other off-site areas are not considered in the ERA.

4.3.1 Equations, Factors, Parameters and Assumptions used in the Quantitative Exposure Modelling

Table 4-13 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., vole, shrew, hare, ermine, junco, and grouse). Equations illustrating how exposures were estimated for the mammalian and avian ROCs in the ERA, via the selected exposure pathways and routes are provided in Appendix G along with the ERA modelling results.

Equations used to estimate how trace metals transfer into plants and soil invertebrates vary by COC. These uptake equations were sourced from the U.S. EPA Ecological Soil Screening Level (EcoSSL) documents and are presented in Appendix G for each COC and medium. The uptake equations for the COCs from U.S. EPA (2007b) yield concentrations that are expressed as dry weight. The dry weight values were converted to their equivalent wet weight concentrations using literature-based data for water content of the plant, invertebrate and small mammal prey food items that are consumed by the selected ROCs. Total exposures were estimated for the ROCs, via the selected exposure pathways and routes using the following equations:

Exposure via Terrestrial Vegetation Ingestion

$$EXP_{TV} = \left(\frac{C_P \times FI \times D_F}{BW}\right)$$

Where:

EXP_{TV}	=	Exposure from terrestrial vegetation ingestion (mg/kg body weight/day)
C_P	=	Calculated terrestrial plant tissue concentration (mg/kg ww)
FI	=	Receptor specific food ingestion rate (kg ww/day)
BW	=	Receptor specific body weight (kg)
D_F	=	Proportion of diet that is terrestrial vegetation (receptor-specific) (%)

Table 4-13: Receptor Parameters and Assumptions for Mammalian and Avian ROCs

Parameter/ Assumption	Meadow Vole	Common (Masked) Shrew	Snowshoe Hare	Ermine	Ruffed Grouse	Dark-eyed Junco
Body Weight (kg)	0.0349 (FCSAP, 2012b)	0.0041 (FCSAP, 2012b)	1.3 (FCSAP, 2012b)	0.089 (FCSAP, 2012b)	0.552 (FCSAP, 2012b)	0.0188 (Dunning, 1993)
Diet Assumptions	100% terrestrial vegetation (i.e., berries, grains, mushrooms) (FCSAP, 2012b)	95% soil invertebrates (e.g., insect larvae, slugs, snails, earthworms) and 5% other (assumed terrestrial vegetation) (FCSAP, 2012b)	100% terrestrial vegetation (e.g., grasses, sedges) (FCSAP, 2012b)	95% small mammals (e.g., rabbits, birds and other small mammals) and 5% invertebrates (e.g., amphibians, insects, and bird eggs)	85% terrestrial vegetation (leaves, berries) and 15% soil invertebrates (e.g., insects and invertebrates) (FCSAP, 2012b)	60% soil invertebrates and 40% terrestrial vegetation (Martin et al., 1951)
Average Water Content in Food Items (%)	85% (Sample and Suter, 1994)	85% (terrestrial plants) 84% (terrestrial invertebrates) (Sample and Suter, 1994)	85% (Sample and Suter, 1994)	84% (terrestrial invertebrates) 68% (small mammals) (Sample and Suter, 1994)	85% (terrestrial plants) 84% (terrestrial invertebrates) (Sample and Suter, 1994)	85% (terrestrial plants) 84% (terrestrial invertebrates) (Sample and Suter, 1994)
Food Ingestion Rate	0.33 kg wet food/kg wet BW/day (FCSAP, 2012b)	(0.621 x (BW (g))$^{0.564}$)/1000 (FCSAP, 2012)	0.06 kg dry food/kg wet BW/day (FCSAP, 2012b)	0.11 kg dry food/kg wet BW/day (FCSAP, 2012b)	0.06 kg dry food/kg wet BW/day (FCSAP, 2012b)	(0.398 x (BW (g))$^{0.850}$)/1000 (U.S. EPA, 1993)
Soil Ingestion Rate (% of food consumption rate)	2.4% of dry food ingestion rate (FCSAP, 2012b)	2% of dry food ingestion rate (FCSAP, 2012b)	6.3% of dry food ingestion rate (FCSAP, 2012b)	4% based on US EA, 2005b using the long-tailed weasel as a surrogate species	2% of dry food ingestion rate (FCSAP, 2012b)	9.3; based on values reported in Beyer et al. (1994) using the wild turkey as a surrogate species
Home Range (ha)	0.348 (FCSAP, 2012b)	0.6 (FCSAP, 2012b)	1.6 (FCSAP, 2012b)	1.0 (FCSAP, 2012b)	1.0 (FCSAP, 2012b)	0.833 (Reichard and Ketterson, 2012).
Temporal Use Factor (TUF)	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)
Residency Factor – R	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)	1 (assumed)

Exposure via Soil Invertebrate Ingestion

$$EXP_{SI} = \left(\frac{C_I \times FI \times D_F}{BW}\right)$$

Where:

- EXP_{SI} = Exposure from soil invertebrate ingestion (mg/kg body weight/day)
- C_I = Calculated soil invertebrate tissue concentration (mg/kg ww)
- FI = Receptor specific food ingestion rate (kg ww/day)
- BW = Receptor specific body weight (kg)
- D_F = Proportion of diet that is soil invertebrates (receptor-specific) (%)

Exposure via Small Mammal Ingestion

$$EXP_M = \left(\frac{C_M \times FI \times D_F}{BW}\right)$$

Where:

- EXP_M = Exposure from small mammal ingestion (mg/kg body weight/day)
- C_M = Calculated insectivorous small mammal prey tissue concentration (mg/kg ww)
- FI = Food ingestion rate (kg ww/day)
- BW = Receptor specific body weight (kg)
- D_F = Receptor specific diet proportions (%)

Exposure from Incidental Ingestion of Soil

$$EXP_S = \left(\frac{C_S \times SI}{BW}\right)$$

Where:

- EXP_S = Exposure from ingestion of soil (mg/kg body weight/day)
- C_S = Soil exposure point concentration (maximum measured) (mg/kg dw)
- SI = Receptor specific soil ingestion rate (kg/day)
- BW = Receptor specific body weight (kg)

Total Exposure (from soil, terrestrial plant, small mammal and soil invertebrate ingestion)

$$EXP_{Total} = (EXP_{TV} + EXP_{SI} + EXP_M + EXP_S) \times TUF \times R$$

Where:

- EXP_{Total} = Total exposure (mg/kg body weight/day)
- EXP_{TV} = Exposure from terrestrial vegetation ingestion (mg/kg body weight/day)
- EXP_{SI} = Exposure from soil invertebrate ingestion (mg/kg body weight/day)
- EXP_M = Exposure from small mammal prey ingestion (mg/kg body weight/day)
- EXP_S = Exposure from ingestion of soil (mg/kg body weight/day)
- TUF = Temporal use factor (unitless) (1, assumed)
- R = Residency factor (unitless) (calculated, receptor specific: area of site/home range)

4.3.2 Exposure Point Concentrations

The mammalian and avian ROC quantitatively modelled in the ERA are not sedentary and would be expected to move around the site in search of food and suitable habitat. The focus of the ERA for these receptors is at the population level. Assuming these ecological receptors will spend their entire time and get all their food from locations within the study boundary with the highest concentrations, while highly conservative, is unrealistic. As such, the COC exposure point concentrations (EPCs) for soils utilized in the modelling equations presented in Appendix G were the 95% upper confidence level on the mean (UCML95) soil concentrations calculated with U.S. EPA ProUCL Version 5.2. The same considerations and decision rules previously described in the HHRA applied to the calculation of UCLM95 soil EPCs for ERA purposes. The soil EPCs for each COC are summarized in Table 4-14.

Table 4-14: UCLM95-based EPCs for COCs in Study Boundary Surface Soil

COC	Maximum Reported Concentration in Surface Soil (mg/kg)	UCLM95-based EPC (mg/kg)	Comment
Arsenic	20,600	1,596	UCLM 95 95% Approximate Gamma UCL
Lead	1,360	154	UCLM 95 95% H-UCL
Vanadium	72.6	32.5	UCLM 95 95% Student's-t UCL

Notes:
UCLM95 derived using U.S. EPA ProUCL Version 5.2

4.4 Effects Assessments

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 freshwater 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 4.5 and 4.6).

For receptors that were not quantitatively modelled (i.e., terrestrial vegetation, soil invertebrates, freshwater aquatic life), the selected TRVs were the applicable benchmarks used in the COC screening. For amphibians, existing toxicity data and other scientific and government sources were consulted to obtain relevant toxicity information. The available toxicity data for amphibians is provided in Section 4.6.4.

For receptors that were quantitatively modelled (i.e., masked shrew, meadow vole, snowshoe hare, ermine, junco, grouse), published regulatory TRVs were preferentially used where available (i.e., FCSAP, 2021). The FCSAP (2021) TRVs for arsenic, lead, and vanadium are based on no effect concentrations (for reproduction, growth and survival), and were derived to set conservative soil screening values by the US EPA (2005a,b,c). These NOAEL-based TRVs were selected for initial use in the ERA modelling. As these TRVs are based on no effect concentrations (generally the lowest no effect concentration of all identified), an exceedance does not indicate a potential risk. Rather it indicates that further examination/discussion is warranted. The selected TRVs and their basis are provided in Table 4-15.

Table 4-15: Initial No-Effect Based Toxicity Reference Values (TRVs) for COCs for Mammalian and Avian ROCs

COC	Avian TRV (Reference) [1] (mg/kg-BW/d)	Mammalian TRV (Reference) [1] (mg/kg-BW/d)
Arsenic	4.4 (CEAEQ, 2012)	1.04 (US EPA, 2005a)
Lead	1.63 (US EPA, 2005b)	4.7 (US EPA, 2005b)
Vanadium	0.344 (US EPA, 2005c)	4.16 (US EPA, 2005c)

Notes:

[1.] Federal TRVs selected from the FCSAP (2021) guidance document where available, unless otherwise noted. Original sources upon which the TRV was selected that were provided in FCSAP (2021) are included in the table above.

The TRVs in Table 4-16 are generally based on reported NOAELs for reproductive, growth and survival effects from toxicological studies conducted with numerous bird and mammal species. The approach that the U.S. EPA (2007b) takes for developing TRVs (i.e., for broad taxonomic classes, such as *Mammalia* and *Aves*) is considered to be a current preferred best practice when feasible, and when sufficient toxicological data exist that are of adequate quality. The approach attempts to address the frequent high variability in NOAEL and LOAEL values that often occur across different toxicological studies with different species, and even across studies conducted using the same species. For example, U.S. EPA (2007b) presents information which shows that PAH NOAELs and LOAELs (for reproduction, growth and survival effects), span three to four orders of magnitude across the numerous bird and mammal species that have been studied. Clearly, such high variability (which is not uncommon) creates difficulties in identifying representative TRVs for various taxonomic groupings of mammals and birds (i.e., individual species, genus, family or order). In many cases, such values cannot be developed for some or all of these taxonomic groups from the available toxicology data with a high degree of confidence. Conservative TRVs that apply to broad taxonomic classes allows for greater use of the available animal toxicology data for a given substance and reduces some of the uncertainty inherent in developing TRVs for more specific taxonomic groupings. These types of TRVs are often considered appropriate for initial quantitative ERA risk estimates.

Because the TRVs presented in Table 4-15 are initial conservative values (as they are based on no-effect values), calculated exposures that exceed these TRVs should not be considered a definitive indication of ecological risk. If ecological risks were predicted in the ERA using these initial TRVs, alternate (or secondary) LOAEL-based TRVs could be utilized, which was the case herein. The data compiled in U.S. EPA (2007b) provides available toxicity data which were used to further refine TRVs for specific ROCs, if/as necessary. The US EPA documentation provides tables of all NOAELs and LOAELs that were considered, organized by species. Where warranted, these data were used to develop TRVs for more specific taxonomic groupings, assuming sufficient toxicological data exist. This step was only considered if use of the initial (NOAEL-based) TRVs resulted in elevate EHQs for the bird and mammal ROCs evaluated in the ERA. Table 4-16 provides a summary of the alternate (or secondary) TRVs that were applied in the modelling. The TRVs were calculated based on either the geometric mean of LOAELs for reproduction, growth, and survival, if available in the U.S. EPA EcoSSL supporting documents, or by the application of the dose considered to be a chronic LOAEL (Sample et al. 1996).

Table 4-16: COC Secondary Toxicity Reference Values for Mammalian and Avian ROCs

COC	Avian TRV (mg/kg-BW/d)	Mammalian TRV (mg/kg-BW/d)
Arsenic	7.3 (geometric mean of behavioral, pathology, and growth effects (n=5), US EPA, 2005a)	9.7 (geometric mean of bounded LOAELs for growth, reproduction and survival from US EPA, 2005a)
Lead	9.9 (EC20 for chicken in US EPA, 2005b)	35 (geometric means of reproductive LOAELS from US EPA, 2005b, with 3-fold uncertainty factor)

COC	Avian TRV (mg/kg-BW/d)	Mammalian TRV (mg/kg-BW/d)
Vanadium	1.9 (geometric mean of bounded reproductive and growth LOAELs from US EPA, 2005c)	6.7 (geometric mean of bounded reproductive and growth LOAELs from US EPA, 2005c)

4.5 Risk Characterization

In an ERA, the risk characterization step is the process by which the probability of adverse ecological effects (based on the information obtained from the exposure and effects assessments for each LOE), is integrated and interpreted in the context of the overall potential for ecological risk (FCSAP, 2012a).

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 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." This definition encompasses 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 approach is conducted, key principles are transparency, clarity, consistency, and reasonableness (FCSAP, 2012a).

ROCs selected in the problem formulation included terrestrial vegetation and soil invertebrate communities, freshwater aquatic life communities, amphibian communities, herbivorous small mammal populations (represented by the meadow vole and snowshoe hare), carnivorous small mammals (represented by the ermine); herbivorous birds (represented by the ruffed grouse); insectivorous birds (represented by the dark-eyed junco). Reptile communities were also selected as ROC; however, limited toxicity data are available to evaluate these receptors, and as such, the potential for exposures to these receptors was qualitatively discussed. A discussion of potential risks to these ROC based on site chemical concentrations is provided below.

4.5.1 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:

$$Ecological\ Hazard\ Quotient\ (EHQ) = \frac{EXP_{Total}\ (mg/kg\ BW/day)}{TRV\ (mg/kg\ BW/day)}$$

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 LOE, 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, 2012b). 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.

4.6 ERA Results

Risk characterization results for each of the receptor groups evaluated in the ERA are presented in Sections 4.6.1 to 4.6.5. A summary of the ERA results is provided in Section 4.6.6.

4.6.1 Terrestrial Vegetation and Soil Invertebrates

Arsenic, selenium, benz(a)anthracene, indeno(1,2,3-c,d)pyrene, and PHC F3 were carried forward as COCs for terrestrial vegetation and soil invertebrates based on comparison of soil data to soil contact guidelines protective of vegetation and soil invertebrate health and to background concentrations and

considering the degree and frequency of exceedance (Table 4-9). Figures 7a and 7b show sampling locations where vegetation/soil invertebrate health-based guidelines were exceeded.

Background data were available for arsenic and selenium, and maximum site concentrations of each of these parameters were greater than maximum reported background concentrations. Background data were not available for PAHs or PHCs; however, PHCs are known to not readily be absorbed into and accumulated into plants (CCME, 2008).

Based on the results of the comparison to vegetation and soil invertebrate health-based guidelines, it is possible there could be effects to some of these receptors if receptors were within areas of the highest concentrations. However, the exceedance of a guideline does not necessarily indicate there will be a risk or an adverse effect. The guidelines have been derived to be conservative and apply to all vegetation types. In addition, contamination within the study boundary has been present for many years, and some vegetation and soil invertebrate species present may have adapted/acclimated to site conditions over time.

To provide another line of evidence regarding whether effects on vegetation are occurring, observations and photos of the vegetation at the site and in the surrounding area were reviewed to determine whether vegetation appeared stressed in contaminated areas of the site relative to areas not anticipated to be contaminated (Appendix B). The vegetation on the site consists of forested areas dominated by balsam fir (*Abies balsamea*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*) and white spruce (*Picea glauca*), along with various species in the shrub and herbaceous layer such as common ferns, grasses and sedges. Areas within the study boundary but outside the AECs do resemble the surrounding areas outside the study boundary in that vegetation is not stunted or unhealthy in appearance. Limited vegetation was observed in some areas where the ground was mostly covered in rock (including waste rock and tailings); however, this is likely more due to the lack of available nutrients/suitable soil substrate for vegetation to grow in these areas than an effect brought about by elevated chemical concentrations. Exceedances over vegetation and soil invertebrate health-based direct contact guidelines are not only noted in areas with limited vegetation, but also in areas where vegetation is more plentiful (see photos in Appendix B).

A formal survey of invertebrates in soil was not conducted at the site. However, it is generally recognized that if vegetation can occur on a given site, some degree of soil invertebrate communities will also be present. Terrestrial vegetation and soil invertebrate health are often closely linked (e.g., Gillison et al., 2003), and soil ecological function is often dependent on both healthy vegetation and soil invertebrate communities. Thus, if one of these receptor groups is adversely affected by soil contamination, the other group typically is as well; therefore, as vegetation at the site appears largely healthy and typical for its setting, there is no reason to suspect the occurrence of adverse effects on soil invertebrate communities.

Considering the available lines of evidence and using a WOE approach, the potential for adverse effects to vegetation and soil invertebrate communities as a result of COCs is within the study boundary is considered negligible to low based on the available data within most areas of the site. In areas where

waste rock and tailings have been placed and the area has not been overgrown with vegetation, the likelihood of potential risks is considered medium. The presence of waste rock and tailing and the lack of nutrients in the "soils" in these areas, have most likely impacted vegetation in these areas and its ability to grow back/repopulate. Areas with waste rock/tailings that have not been naturally revegetated occur on a relatively small portion of the site (approximately 10 to 15% of the study area; see photos in Appendix B).

4.6.2 Birds and Mammals

Arsenic, lead, and vanadium were carried forward for quantitative modelling small mammals and birds based on comparison of the 90th percentile soil concentrations to soil guidelines protective of avian and mammalian health and to background concentrations and consideration of the degree and frequency of exceedance over these guidelines (Table 4-9). Soil sampling locations that exceeded the applicable avian and mammalian health-based soil quality guidelines and background soil concentrations are provided in Figures 8a and 8b. As shown in Figure 8a, the extent contamination in excess mammalian and avian soil quality guidelines and background soi concentrations is not well defined in some areas to the north of the site.

Table 4-17 presents EHQs for the mammalian and avian ROCs that were evaluated in the ERA based on the initial TRVs, while Table 4-18 provides relevant EHQs for ROC evaluated with final TRVs. EHQs were calculated using UCLM 95 site soil concentrations. Appendix G provides further information on the exposure and risk estimates for these ROCs.

Table 4-17: Calculated EHQs for Mammalian and Avian ROCs Based Upon Initial TRVs

COPC	EHQ					
	Meadow Vole	Masked Shrew	Snowshoe Hare	Ermine	Ruffed Grouse	Dark-eyed Junco
Target EHQ	< 1.0	< 1.0	<1.0	<1.0	<1.0	< 1.0
Arsenic	22	91	29	8.5	5.7	28
Lead	0.37	19	0.5	1	2.8	34
Vanadium	0.022	0.69	0.045	0.072	0.51	6.7

Notes:
Bold indicates that the total calculated EHQ exceeds the target EHQ.
EHQ values rounded to 2 significant figures

Table 4-17 shows that there were elevated EHQs for arsenic for all ROC, for lead for all ROC except the snowshoe hare and the meadow vole, and for vanadium for the dark-eyed junco only. As previously noted, these EHQs were conservatively calculated using NOAEL-based TRVs. The secondary LOAEL-based TRVs were therefore used for the receptors having elevated EHQs to refine estimates of potential ecological risk as presented in Table 4-18.

As previously noted, while less conservative than the initial TRVs, the alternate (secondary) TRVs (which include geometric means of LOAELs for growth and reproductive effects) remain adequately conservative and protective of the mammalian and avian ROCs evaluated in the ERA.

Table 4-18: Calculated EHQS FOR Mammalian and Avian ROCs Based Upon Secondary TRVs

COPC	EHQ					
	Meadow Vole	Masked Shrew	Snowshoe Hare	Ermine	Ruffed Grouse	Dark-eyed Junco
Target EHQ	< 1.0	< 1.0	<1.0	<1.0	<1.0	< 1.0
Arsenic	2.3	9.8	3.1	0.92	3.4	17
Lead	-	2.6	-	0.14	0.45	5.5
Vanadium	-	-	-	-	-	1.2

Notes:
Bold indicates that the total calculated EHQ exceeds the target EHQ.
EHQ values rounded to 2 significant figures.
Shading and "-" indicate that an EHQ was not calculated as the primary EHQ did not exceed the target EHQ of 1.

When EHQs are calculated based on the secondary TRVs, arsenic represented elevated EHQs for all receptor types except the ermine, lead demonstrated elevated EHQs for the masked shrew and dark-eyed junco, and vanadium demonstrated an elevated EHQ for the dark-eyed junco only.

Based on the EHQs in Table 4-18, there is the potential for effects in individual mammalian and avian receptors evaluated related to site soil arsenic and lead concentrations. For the snowshoe hare, meadow vole and ruffed grouse, EHQs were elevated for arsenic only and were relatively low ranging from 2.3 to 3.4. While the magnitude of the EHQ cannot be directly correlated with potential effects, given the low EHQs that were determined, as well as the various conservative assumption applied in the ERA (e.g., assuming receptors fed on site and in the contaminated areas of the site for 100% of their time), and the diet of these species and/or their home ranges relative to the areas of the site with elevated soil lead and arsenic concentrations (Figures 8a and 8b), potential for effects in populations of these receptors is considered to be low, and the EHQs are likely substantial overestimates of actual risk. Furthermore, while no IVBA testing for arsenic has been validated in Canada for use with ecological receptors, given the low relative bioavailability of arsenic in soils (i.e., 42% based on human IVBA testing results), it is likely that arsenic exposures to avian and mammalian wildlife are lower than what was calculated in the quantitative exposure modelling.

The elevated masked shrew and dark-eyed junco EHQs are likely due in part to the conservative default models and uptake factors/equations used to estimate exposures in soil invertebrates. While the size of the study boundary is 69 ha, it is unlikely that there would be more than a couple of nesting pairs of junco present with the most contaminated areas of the site (see Section 4.2.5.1 and Figure 8a). In addition, heavily contaminated tailings and waste rock would offer limited suitable habitat for such receptors' preferred prey items.

Similar to the masked shrew and junco, the elevated EHQs in the meadow vole are also likely due to conservative default models and uptake factors/equations used to estimate vegetation tissue concentrations. Arsenic has been reported to be generally of low solubility in acidic soils and is consequently taken up by plants less in readily acidic soils (Dadrach et al., 2020). Site soil pH was quite acidic in all soil samples and ranged from 3.22 to 4.42).

Uncertainty in the amount of arsenic and lead exposure most likely incurred by avian and mammalian receptors due to consumption of site soil invertebrates and vegetation can be reduced by the collection of site vegetation and soil invertebrates tissue samples, and analyze such samples for arsenic and lead.

As previously noted, EHQs can provide a conservative indication of whether or not the assessed exposure conditions pose a potential for ecological risks; however, they are not necessarily definitive or even accurate representations of true ecological risk. In addition, they 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 and reliable enough to merit further study or corrective action.

Outcomes for the other LOE considered in the ERA of the mammalian and avian ROCs are summarized in the following bullets:

- The study boundary has a total area of roughly 69 ha which exceeds the ASTM spatial criterion of 0.81 ha. The area encompassing the study boundary is considered large enough to potentially support local populations of small mammalian receptors with small home ranges based on the ASTM spatial criterion and Ns calculations. However, only select areas within the study boundary contain elevated soil concentrations (Figures 8a and 8b; Appendix A). The study boundary would not be anticipated to support most avian populations based on available habitat and food resources and population densities for the avian ROC;
- Review of habitat preferences for the mammalian and avian ROCs shows that the study boundary conditions are somewhat consistent with the preferred habitat types for some of these ROCs (and other small mammals and birds); thus, it can be concluded that the study boundary offers suitable habitat conditions and food resources for the ROCs and other common small mammal and avian receptors. As such, it is considered likely that individual birds or mammals or limited populations of small mammals (represented by the ROCs) may occur on or utilize the land within the study boundary for foraging, nesting and/or breeding;
- Estimated Ns values (Table 4-4), suggest that the land within the study boundary could support populations of meadow vole and masked shrew, while populations of dark-eyed junco, ruffed grouse, snowshoe hare, and ermine are less likely, particularly within areas of the site where the most highly contaminated soils occur. While the Ns calculation is not without uncertainty and does not account for literature reports of actual measured population density and territoriality considerations, it provides a reasonable and often conservative indication of the numbers of individual organisms that may be expected to use a habitat subdivision on a given site. As such, it would be unrealistic to assume that ROC presence and foraging occurs extensively within the study boundary, but not on the various adjacent areas that have equally suitable (or better) habitat conditions and food availability. There is nothing to distinguish the site from other areas as offering unique or preferred habitat or food resources for any known ecological receptor population or community. This further supports that use of lands within the study boundary by avian receptors would likely be limited to individuals, while it could support population of some small mammals with small home ranges; and

- While the lands within the study boundary likely provide habitat conditions that can support populations of small mammalian ROCs, it is probably unrealistic to assume that ROC presence and foraging occurs extensively within the study boundary, but not on the various adjacent properties that have equally suitable habitat conditions and food availability. There is nothing to distinguish the lands within the study boundary from these other areas as offering unique or preferred habitat for any ecological receptor population or community. ASTM (2011) states that if a subject property'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.

Collectively, consideration of all available LOE and using a WOE approach suggests that small mammal and avian ROCs may occur within or near the study boundary, and some individuals may be expected to spend sufficient time at this location (foraging, nesting, breeding or resting) to incur elevated exposures to COCs in soils within the study boundary.

Conservative estimates of ROC exposure to the identified COCs via the selected exposure pathways and routes and the use effects-based TRVs and available data resulted in EHQ values that exceeded 1.0 for all ROCs except the ermine. As such, there is a potential for individual level risks in individual herbivorous, insectivorous/invertivorous small mammals, and herbivorous and insectivorous/invertivorous birds. However, based on the size of the study boundary and areas within it having elevated soil concentrations, available habitat and food resources, and consideration of population densities of avian ROC, there is a low likelihood for population level effects in avian and mammalian ROC.

Some domestic waste was noted in APEC 4 (Figure 2). The waste includes partially buried materials including metal barrels. While not a chemical exposure issue, this debris could potentially pose a physical hazard to some wildlife in the area. It would be prudent to remove the visible debris.

There are currently 46 known abandoned mine openings which consist of flooded pits, shafts, trenches and sunken spots. These openings could pose a physical hazard to someone visiting the site or wildlife in the area (i.e., falling into a shaft opening). While some of the abandoned mine openings were observed to be fenced, have berms and/or have posted signage, for the safety of potential visitors to the site and wildlife, consideration should be given to permanently safeguarding openings to remove this hazard.

The approaches and assumptions used to calculate EHQs for the mammalian and avian ROCs are considered to be conservative and likely substantially overestimate the potential for ecological risk. In addition, the arsenic in site soils is likely not bioavailable to a high degree; however, there are currently no validated arsenic bioaccessibility methods available for use in ERA. Uncertainties in the ERA could be reduced through the collection of vegetation and soil invertebrate tissue for analysis. The major areas of conservatism in the ERA are described and discussed in Section 4.8.

The planned risk management/remediation for the study boundary based on the HHRA outcomes (Section 3.6) will also reduce arsenic concentrations in soil that ecological receptors would be exposures to, and hence would also reduce potential risks.

4.6.3 Freshwater Aquatic Life

The assessment of potential risks to freshwater aquatic life ROCs followed a simple qualitative weight of evidence (WOE) approach using the available lines of evidence which included the outcomes of the comparison of surface water and sediment to freshwater aquatic life guidelines and outcomes of the aquatic habitat assessment. While surface water data are more relevant for examining potential exposures to freshwater aquatic life receptors, groundwater were also screened to identify whether groundwater from the site flowing into surface waters may be of concern.

4.6.3.1 Surface Water

Several chemicals were selected for further evaluation for freshwater aquatic life based on concentrations in surface water exceeding their respective freshwater aquatic life-based guideline. These included arsenic in 100% of samples (16 of 16) by a maximum of 13-fold, lead in 25% of samples (4 of 16 samples) by a maximum of 2-fold, and zinc in 19% of samples (3 of 16 samples) by a maximum of 1.3-fold (Tables C29-C32; Appendix C). Sample locations with surface water exceedances are provided in Figures 9a and 9b.

An assessment of freshwater aquatic life and aquatic habitat assessment was conducted for Johnston Brook (Appendix E). As discussed in Section 4.2.5, the watercourse overall has a steep grade and predominantly large substrate, with a short waterfall at the furthest downstream extent and another waterfall approximately 500 m upstream of the southernmost property boundary. An underground section of flow was identified as an effective fish barrier, and it is unlikely that fish would be capable of crossing it. Fish were not observed during the site visits; however, most reaches of the brook likely provide suitable fish habitat at some times for common small-bodied fish species that can tolerate acidic water and are capable of maneuvering through some debris and waterfalls. Based on evidence of washed-out sediment and large debris, the brook is assumed to be influenced by variable flow conditions and flash flood conditions at times (Appendix E).

Based on the freshwater aquatic life guideline exceedances, there is the potential for individual-level effects on some freshwater aquatic species. Considering the available habitat and food resources, the potential for site surface water COC concentrations to result in community-level effects is considered low. This is because fish that do inhabit the brook would be limited to small-bodied forage fish. Physical barriers (i.e., underground passages and steep waterfalls), rather than the presence of COCs are likely to limit the use this waterway to larger fish species.

Based on the findings of the aquatic habitat assessment for Johnson Brook, fish are not likely to represent a significant food source for other ecological receptors at higher trophic levels, and further, arsenic (which is widespread in site surface water) is not known to bioaccumulate in fish as it does in other species (i.e., marine algae and shellfish), nor is it known to biomagnify in food webs (ATSDR, 2007).

4.6.3.2 Groundwater

Several chemicals were selected for further evaluation for freshwater aquatic life based on concentrations in groundwater exceeding their respective groundwater quality guideline. These included arsenic in 17% of samples (1 of 6), copper in 33% of samples (2 of 6), and lead in 17% of samples (1 of 6).

While groundwater data shows that copper from the site may be of concern to freshwater aquatic life, surface water samples had low copper concentrations relative to the surface water guidelines. Aside from copper, COCs that were identified in groundwater were also identified in surface water (i.e., arsenic and lead). Given that surface water concentrations are more relevant for freshwater aquatic life than groundwater concentrations, potential risks to these COCs are discussed above relative to the surface water concentrations.

Limited groundwater data metals were available (one round of sampling in January, 2024 for dissolved metals, and one round of sampling in May of 2024 for total and dissolved metals).

4.6.3.3 Sediment

Arsenic and mercury were selected as COCs for freshwater aquatic life based on concentrations in sediment exceeding their respective freshwater aquatic life-based guideline. Arsenic exceeded the guideline in 100% (16 of 16) samples by a maximum of 516-fold, and mercury exceeded the guideline in 38% (6 of 16) samples by a maximum of 6.6-fold (Tables C26-C28, Appendix C). Sediment guideline exceedances for freshwater aquatic life are provided on Figures 10a and 10b.

Although there were many guideline exceedances observed in site sediments, the exceedance of a guideline does not necessarily indicate that an adverse effect will occur as the guidelines are conservative in nature. Published regulatory benchmarks are generic values, with no consideration given to site-specific populations/communities or media conditions that influence bioavailability. Exceedance of these values does not necessarily imply there is a risk of adverse effects; rather, it suggests that further evaluation is warranted. As previously noted, this is especially true for metals, many of which have essential nutritional and physiological roles in terrestrial biota. The acclimation and adaptation to metals is well known to occur (e.g., Kapustka et al., (2004), ICMM (2007), Chapman (2008), and Newman and Clements (2008)) and should be considered. Given the contamination has been present for decades, it would be likely that some acclimation or adaptation of freshwater life has occurred.

The aquatic habitat assessment (Appendix E) identified that Johnston Brook has large substrate which is primarily gravel and cobble throughout the water course. The benthic species that are likely present in Johnston Brook within the study area, are more likely to be attached to the rocks and cobble and not in direct contact with the sediments. While sediment concentrations of the COCs (i.e., arsenic, lead and mercury) exceeded the applicable sediment quality guidelines in some samples (e.g., for arsenic by over 500-fold), most sections of Johnston Brook within the assessed area are unlikely to provide significant suitable habitat for sediment dwelling invertebrates. In addition, the dynamic nature of the brook (which is influenced by variable flow conditions and flash flooding at times) (Appendix E), reduces the

potential for benthic communities to establish. If species were to be in constant direct contact with contaminated sediments, there would be a medium potential for community level effects.

4.6.3.4 WOE Conclusion for Freshwater Aquatic Life

Considering the available lines of evidence and using a WOE approach, the potential for adverse effects in pelagic freshwater aquatic life communities as a result of contamination on the site is low for species that may inhabit/forage in the Johnston Brook, and medium for benthic freshwater aquatic life.

Surface water and sediment exceedances of freshwater aquatic life guidelines were present in Johnston Brook adjacent to the site boundary to the southern portion of the site. These exceedances likely extend beyond the site boundary, and as such, there could potentially be exposures to off-site aquatic species at elevated concentrations, particularly for arsenic. It was outside the scope of this assessment to evaluate potential off-site impacts.

4.6.4 Amphibians

The assessment of potential risks to amphibians followed a simple qualitative weight of evidence (WOE) approach using the available lines of evidence, which included: the outcomes of the comparison of surface water and sediment to freshwater aquatic life guidelines and amphibian toxicity data; comparison of the spatial size and habitat quality to surrounding areas; receptor habitat preferences; and the outcomes of the aquatic habitat assessment.

4.6.4.1 Surface Water

Several chemicals were selected for further evaluation for freshwater aquatic life based on concentrations in surface water exceeding their respective freshwater aquatic life-based guideline. These included arsenic in 100% of samples (16 of 16) by a maximum of 13-fold, lead in 25% of samples (4 of 16 samples) by a maximum of 2-fold, and zinc in 19% of samples (3 of 16 samples) by a maximum of 1.3-fold.

To examine potential risks to amphibians, a search was conducted for surface water and sediment toxicity values using the U.S. EPA ECOTOX database (the world's largest aquatic toxicity literature knowledgebase) for the identified COCs (i.e., arsenic, lead, and zinc). In addition, available scientific literature was reviewed for each of the COCs to identify, available toxicity data for amphibians. Outcomes of this search effort and a discussion of the identified toxicity information in comparison to site surface water and sediment COC concentrations are discussed in the following sections.

The maximum site surface water concentration of arsenic (i.e., 0.0633 mg/L) is significantly lower than the lowest observed effect concentration (LOEC) for amphibians reported in Gornati et al., 2002, which was documented as 16 mg/L and based on endpoints related to growth (i.e., length). Another EC50 value retrieved from the literature search was 4.5 mg/L, which is also significantly higher than the maximum reported site concentration (NRCC, 1978; US Fish and Wildlife Service, 1988), Therefore, it is

not anticipated that maximum observed site concentrations of arsenic would result in adverse effects to populations of amphibians accessing the site, based on the limited available toxicity data.

Surface water toxicity data for amphibians has been compiled in FCSAP (2019) for several metals, including lead and zinc. For lead, studies demonstrated effects on 10% or less of the population at concentrations an order of magnitude higher than the site maximum at Country Harbour (i.e., 0.00208 mg/L), with the majority of studies that tested concentrations within the range of the site maximum reporting no effects (FCSAP, 2019). One study demonstrated sublethal effects (inability to escape and/or avoid predation) on approximately 20% of the population at concentrations more than two orders of magnitude higher than the site maximum. Overall, the available amphibian surface water toxicity data (FCSAP, 2019) demonstrate that observed adverse effects on amphibians are typically associated with considerably higher lead concentrations than the maximum concentration observed within Johnston Brook. Generally, significant adverse effects on amphibians were not observed at lead concentrations as high as 0.01 mg/L, with effect levels remaining below 20% in most studies up to a concentration of 0.1 mg/L.

For zinc, adverse effects on amphibians exposed to zinc are typically associated with considerably higher zinc concentrations than the maximum concentration observed at the site (i.e., 0.0088 mg/L). The majority of studies compiled in FCSAP (2019) did not report significant adverse effect levels on amphibians at zinc concentrations in the same order of magnitude as the maximum concentration in Johnston Brook; in fact, effect levels of greater than 20% were reported in the majority of studies at concentrations of at least 1 mg/L.

The potential impact on amphibians in surface waters within the study boundary appears to be relatively low compared to the concentrations at which adverse effects were observed in amphibians in the broader body of toxicity studies documented in FCSAP (2019) and other sources.

There are eight species of frogs in Nova Scotia most of which are found across the province (NS Museum, 2024). The eDNA samples from Johnston Brook did not indicate the presence of the northern leopard frog, one of the amphibian species that occurs in the province. While there is no eDNA test for all amphibians, the eDNA general fish assay has been demonstrated to also detect the presence of some amphibian species. The results of the eDNA test indicated fish in the downstream samples but only in one of eight replicates in the site samples (these results may apply to some amphibians too) indicating a barrier to fish (and aquatic amphibian) passage. Outcomes of the aquatic habitat assessment eDNA analysis did not indicate the presence of the northern leopard frog, a common amphibian species in the region. Their presence would indicate suitable habitat for amphibians within the study boundary, though their absence does not necessarily indicate that suitable habitat for other amphibian species is not present (Appendix E). There are also other lakes outside of the study boundary that would offer habitat that is of similar or better quality as habitat within the study boundary.

In summary, the likelihood the concentrations of COCs in measured surface water pose a risk to area amphibian communities is low based on the available data.

4.6.4.2 Sediment

Sediment data in Johnston Brook were compared to sediment guidelines for the protection of freshwater life to identify COCs (i.e., arsenic and mercury). However, there is a paucity of relevant amphibian toxicity data to which to compare the site sediment concentrations.

One study was noted in the available amphibian sediment toxicity data compiled by FCSAP (2019) for mercury in sediments. In this study, the eastern narrow-mouthed toad (*Gastrophryne carolinensis*) was exposed to spiked sediments with mercury at concentrations of 0.1 mg/kg up to 100 mg/kg; however, effect levels were similar were similar in both of these exposure groups (mercury in site sediments ranged from 0.0233 mg/kg to 3.21 mg/kg). The authors suggested this similarity in effects across exposures, could be related to the species used, which is not present in Nova Scotia.

While toxicity data are limited, as noted previously, Johnston Brook has large substrate which is primarily gravel and cobble through the watercourse. Potential exposures to aquatic life stages of amphibians would be anticipated to be low; however, amphibian life stages such as larvae could be exposed to high arsenic and mercury concentrations where sediment are found. There were no wetlands noted within the study area, although no specific wetland survey was conducted. Potential risk to amphibian communities as a result of exposures to site sediments is considered medium.

4.6.4.3 WOE Conclusion for Amphibians

In summary, based on the available site and toxicity data related to surface water as well as sediments in Johnston Brook, the likelihood of potential risk to amphibian communities is considered to be low to medium.

4.6.5 Reptiles

Even though reptiles appear to be declining globally, and significant data deficiencies are acknowledged (Weir et al., 2014), there is still a paucity of toxicity data for reptiles. Environmental contaminants are considered to be one of the factors contributing to this decline and threatening reptile populations (Ortiz-Santaliestra et al., 2018; Weir et al., 2014; Weir et al., 2010). Because of this, more emphasis is being placed on including reptiles in ecological risk assessment; however, there are limited standard testing, methodologies and toxicity data to conduct such assessments.

Toxicity data from avian studies have often been used as surrogate data for land based exposures to reptiles in ERAs. However, recent research has suggested that reptiles may have significantly different exposures profiles, and their sensitivity to contaminants may be significantly different than avian species, resulting in an underestimation of potential risks (Ortiz-Santaliestra et al., 2018; Weir et al., 2014; Weir et al., 2010). A recent review of pesticide toxicity data found that warm-blooded vertebrates (i.e., birds and mammals) are generally not good surrogates for reptiles and terrestrial amphibian risk assessment (Ortiz-Santaliestra et al., 2018).

Ecological risk assessment typically focus on dietary exposures. However dermal exposures may be more important to reptiles than oral exposures, depending on the chemical, as the cold blooded physiology of reptiles' results in lower energetic demands and lower dietary exposure compared to birds and mammals (Weir et al., 2014). In addition, a high percentage of reptile body surface areas is potentially in contact with contaminated media.

Given the many uncertainties still remaining, the evaluation of reptiles in the current ERA focussed on the potential for these species to be exposed to COCs on the site.

While no reptile species were observed during the site visit, the site offers some habitat that could be suitable for some reptiles. The garter snake, one of five species of snakes in NS (NS Museum, 2024), is widespread across the province and can be found in a variety of habitats including forests and shorelines (NS Museum, 2024), which occur on the site. There are four species of turtles in NS that occur in freshwater environments, all of which are considered at risk. The eDNA samples collected from Johnston Brook did not indicate the presence of the wood turtle, one of the four freshwater species of turtles found in NS.

Given the size of Johnson Brook, the rocky substrate, and limited fish, there is limited aquatic food resources and habitat for freshwater turtles that would potentially occur on/obtain food from the site. This would limit their exposures to COCs. In addition, Johnston Brook does not provide suitable over-wintering habitat for turtles.

For snake species, dermal contact with historical tailings/soils high in COCs could be a potential exposure route; however, much of the site is covered over in vegetation which would limit direct contact exposures of these species. There is uncertainty in the dietary exposures from the terrestrial environment for these species.

While the potential for exposures of reptiles to site COCs is limited, there is uncertainty in the dietary exposures, particularly from the terrestrial environment from these species. As such, there is uncertainty in the potential risks for these receptors. Based on these considerations, the potential for risk to reptile communities is considered to be low to medium.

4.6.6 Summary of ERA Results

Considering the available lines of evidence and using a WOE approach, the potential for adverse effects to vegetation and soil invertebrate communities as a result of COCs within the study boundary is considered negligible to low based on the available data within most areas of the site. In areas where waste rock and tailings have been placed, the likelihood of potential risks is medium. The presence of waste rock and tailing and the lack of nutrients in the "soils" in these areas have most likely impacted vegetation in these areas and its ability to grow back/repopulate.

Collectively, consideration of all available LOE and using a WOE approach, suggests that small mammal and avian ROCs may occur within or near the study boundary, and some individuals may be expected to spend sufficient time at this location (foraging, nesting, breeding or resting) to incur significant exposures to COCs in soils within the study boundary. Conservative estimates of ROC exposure to the

identified COPCs via the selected exposure pathways and routes and the use effects-based TRVs and available data resulted in EHQ values that exceeded 1.0 for all ROCs. As such, there is a potential for individual level risks in individual herbivorous, insectivorous/invertivorous small mammals, and herbivorous and insectivorous/invertivorous birds. However, based on the size of the study boundary and areas within it having elevated soil concentrations, available habitat and food resources, and consideration of population densities of avian ROC, there is a low likelihood for population level effects in avian and mammalian ROC.

Considering the available lines of evidence and using a WOE approach, the potential for adverse effects in pelagic freshwater aquatic life communities as a result of contamination on the site is low for species that may inhabit/forage in Johnston Brook, and medium for benthic freshwater aquatic life based on available data.

In summary, based on the available site and toxicity data related to surface water as well as sediments in Johnston Brook, the likelihood of potential risk to amphibian communities is considered to be low to medium.

While the potential for exposures of reptiles to site COCs is limited, there is uncertainty in the dietary exposures, particularly from the terrestrial environment from these species. As such, there is uncertainty in the potential risks for these receptors. Based on these considerations, the potential for risk to reptile communities is considered to be low to medium.

Table 4-19 provides a summary of the conclusions for the ERA for the ROC based on the LOE and overall WOE.

Table 4-19: Overall Weight of Evidence (WOE) Evaluation for Each Assessed Line of Evidence (LOE) for the Receptors Evaluated in the ERA

Receptor of Concern (ROC)	Line of Evidence (LOE)	Degree to which the LOE suggests a Potential for Effects or Impairment	Confidence in the LOE [2]	Potential for Adverse Health Effects [1]
Terrestrial Vegetation Communities	Outcomes of the comparison of site soil chemical concentrations to vegetation health-based soil quality benchmarks and reference areas.	Medium	Low	Negligible to low in most areas; medium in areas covered with mine wastes and tailings (due physical impacts)
	Comparison of vegetation on site to vegetation present in the surrounding area	Negligible to low	High	
Soil Invertebrate Communities	Outcomes of the comparison of site soil chemical concentrations to soil invertebrate health-based soil quality benchmarks and reference areas.	Medium	Low	Negligible to Low in most areas; medium in areas covered with mine wastes and tailings (due physical impacts)
Herbivorous, Insectivorous/ Invertevorous, and Carnivorous Small Mammal Populations	Outcomes of the comparison of site soil chemical concentrations to avian and mammalian health-based soil quality benchmarks.	Medium	Low	Low
	Comparisons between estimated COC exposures and TRVs (i.e., ecological hazard quotients).	Low to Medium	Medium	
Herbivorous and Insectivorous/ Invertevorous Bird Populations	Outcomes of the consideration of terrestrial habitat assessment; spatial size of available habitat within and adjacent to the study boundary, and receptor home ranges and consideration of Ns for likelihood of population level effects.	Low	Medium	

Receptor of Concern (ROC)	Line of Evidence (LOE)	Degree to which the LOE suggests a Potential for Effects or Impairment	Confidence in the LOE [2]	Potential for Adverse Health Effects [1]
Freshwater Pelagic and Benthic Aquatic Life Communities	Outcomes of the comparison of site surface water and groundwater to freshwater aquatic life health-based benchmarks for surface water and groundwater.	Medium	Low	Low for pelagic aquatic life and medium for benthic aquatic life where relevant habitat occurs.
	Outcomes of the comparison of site sediment concentrations to freshwater aquatic life health-based sediment benchmarks.	Medium to High	Low	
	Outcomes of the aquatic habitat assessment.	Low	Medium	
Amphibian Communities	Comparison of freshwater aquatic life toxicity data and amphibian toxicity data to site concentrations.	Low	Low	Low to medium
	Comparison of spatial size and habitat quality to surrounding areas, comparison of receptor habitat preferences to subject property habitat conditions and habitat quality.	Low	Low	
	Outcomes of the aquatic habitat assessment.	Low	Medium	

Receptor of Concern (ROC)	Line of Evidence (LOE)	Degree to which the LOE suggests a Potential for Effects or Impairment	Confidence in the LOE [2]	Potential for Adverse Health Effects [1]
Reptile Communities	Qualitative outcomes of the exposure potential via the relevant exposure routes.	Medium	Low	Low to medium
	Comparison of spatial size and habitat quality to surrounding areas, comparison of receptor habitat preferences to subject property habitat conditions and habitat quality.	Low	Low	
	Outcomes of the aquatic habitat assessment.	Low	Medium	

Notes:
1. Weights are High, Medium, Low or Negligible
2. Weights are High, Medium or Low

4.7 Risk Management

SSTLs are not provided for ROC evaluated in the ERA. The planned risk management/remediation for the study boundary based on the HHRA outcomes (Section 3.6), will also reduce arsenic concentrations in soil that ecological receptors would be exposures to, and hence would also reduce potential risks.

- Some domestic waste noted in APEC 4. The waste included partially buried materials including metal barrels. While not a chemical exposure issue, the debris could pose a physical risk to wildlife in the area. It would be prudent to remove the visible debris;
- There are currently 46 known abandoned mine openings, which consist of flooded pits, shafts, trenches and sunken spots. These openings could pose a physical hazard to someone visiting the site or wildlife in the area (i.e., falling into a shaft opening). While some of the abandoned mine openings were observed to be fenced, have berms and/or have posted signage, for the safety of potential visitors to the site and wildlife, consideration should be given to permanently safeguarding openings to remove this hazard;
- The approaches and assumptions used to calculate EHQs for the mammalian and avian ROCs are considered to be conservative and are likely substantially overestimates of actual risk. Furthermore, while no IVBA testing for arsenic has been validated in Canada for use with ecological receptors, given the low relative bioavailability of arsenic in soils (i.e., 42% based on human IVBA testing results), it is likely that arsenic exposures to avian and mammalian wildlife are lower than what was calculated in the quantitative exposure modelling. Uncertainty in the amount of arsenic and lead exposure most likely incurred by avian and mammalian receptors due to consumption of site soil invertebrates and vegetation can be reduced by the collection of site vegetation and soil invertebrates tissue samples, and analyze such samples for metals;
- If there are areas of fine tailings on-site that are an open source of arsenic or other COCs, which could disperse and mobilize, resulting in increased concentrations within the study area boundary or off-site, these tailings areas should be addressed in the remedial plan;
- Site soils should be further delineated to provide further detail on the extent of soil impacts (particularly to the north of the site);
- Surface water and sediment exceedances of freshwater aquatic life guidelines were present in Johnston Brook adjacent to the site boundary to the southern portion of the site. These exceedances likely extend beyond the site boundary, and as such, there could potentially be exposures to off-site aquatic species at elevated concentrations, particularly for arsenic. It was outside the scope of this assessment to evaluate potential off-site impacts; and
- Climate change impacts that could potentially increase concentrations of arsenic within the study boundary or off-site (e.g., tailings become exposed, Johnston's Brook dries up resulting in the potential for exposure to sediments as soils for terrestrial wildlife) should be addressed in the soil risk management plan.

4.8 ERA Uncertainty Analysis and Conservative Assumptions

As a result of the scientific investigations, literature reviews, and risk assessment guidance followed in the preparation of this ERA, it is believed that the risk assessment results present a reasonable yet conservative evaluation of the risk to ecological receptors present within the study boundary.

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 qualitatively discussed below.

Receptor Selection. Receptors selected for assessment were either known to be present or can reasonably be expected to be present within the study boundary. These receptors are also known to be reasonably or conservatively representative of other species that may be present within the study 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 Organisms. The use of receptors as surrogates typically reflects the availability of receptor parameters that can reliably enable ERA of a given receptor species. The receptors selected are considered to be sensitive, and potentially present within the study boundary, and exposed to the COCs present within study boundary 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. A number of Species at risk (SAR) have been reported as having the potential to occur within the vicinity of the site; however, it was considered unlikely that the identified SAR would be exposed to COCs in site soils to any large degree given their dietary preferences, breeding and foraging habits, and home range sides of the various SAR. For any SAR that that can be reasonably expected to occur on the site, surrogate species for the receptor types and groups evaluated in the ERA would be representative and protective of potential SAR that are members of such receptor types and groups.

Receptor-Specific Toxicity Data. For most COCs and receptors, toxicity data are available in some form. However, it is important to note that toxicity data are not necessarily available for the particular receptor species under consideration. 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 uncertainty associated with the extrapolations that may be used to translate toxicity data from one species into a TRV for a second species.

The TRVs selected to derive the EHQs were generally based on the US EPA EcoSSLs. The US EPA (2005d) states that the EcoSSLs are, "intentionally conservative in order to provide confidence that contaminants which could present an unacceptable risk are not screened out early in the ERA process". The selected TRVs were based on no-effect concentrations (e.g., geomean of NOAELs; highest NOAEL value lower than the lowest bounded LOAEL value for effects on reproduction, growth or survival) for the initial TRVs and effects-based concentrations for the secondary TRVs.

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 the soil (or other media) contaminant concentrations. This was the case in the current ERA (i.e., UCLM95 soil concentrations of the COCs were evaluated as the exposure point concentrations (EPCs) for the exposure pathways of soil ingestion). The UCLM95 soil concentration was also used to estimate COC uptake into vegetation and soil invertebrates and small mammal prey.

Data Limitations. Surface soil, sediment and surface water are considered the most likely media to be impacted from current and historical mine activities. The study boundary is considered to be adequately characterized for soil, surface water and sediments in the most contaminated areas of the site.

Other Stressors. The current ERA only assesses chemical stressors present in the study boundary soil, sediments, surface water and groundwater. While other common ecological stressors such as predation, disease, habitat loss/fragmentation, competition, limited food resources etc. are likely having some influence on the resident biota within the study boundary, these stressors were not evaluated in either a quantitative or qualitative manner, with the exception of the evaluation of terrestrial vegetation and soil invertebrates (where physical impacts to soil from tailings and waste rock piles were considered to some degree). 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 a number of inorganic contaminants (such as metals) depends to a large extent upon their chemical form. Oral TRVs, however, are typically based on chemical forms in toxicity studies that have high bioavailability. In the ERA, it was assumed that 100% of each ingested COC is absorbed from ingested food. While no IVBA testing for arsenic has been validated in Canada for use with ecological receptors, given the low bioavailability of arsenic in soils based on huma IVBA data of 42%, it is likely that arsenic exposures to wildlife are lower than as calculated in the quantitative exposure modelling.

Chemical Exposures. Chemical exposures for terrestrial vegetation, soil invertebrates, and freshwater aquatic life were assumed to equal measured soil, surface water and sediment concentrations (as applicable). This is considered to be a conservative assumption as there are limits to the amount of any substance that can be taken up into these receptors from soil, water and sediments, which are a function of the solubility or extractability of the substances in these media, which in turn, affects bioavailability. This assumption overestimates the actual exposure potential, as it ignores natural

barriers to chemical uptake (i.e., bioavailability considerations), and biochemical transformation processes that may occur within the rhizosphere (root zone) for plants, as well as within cells, tissues and organs, which may reduce the actual amount of a substance that reaches a target site within an organism. Thus, measured environmental media concentrations likely overestimate the amount of a chemical that may actually be taken up by ecological receptors.

Foraging Behaviour. The ERA was conducted in a manner that assumed that the ROCs forage entirely within the impacted areas of the study boundary and that their respective diets consisted entirely of food items (i.e., terrestrial vegetation, soil invertebrates, prey) from the study boundary. While these are typical assumptions for an ERA, they are considered to be unrealistic and 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 study boundary, 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 soil/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' soil 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, where receptors were assumed to feed primarily on their majority dietary components. The focus on the majority dietary components is an acceptable method used to estimate exposures based on FCSAP (2013b) guidance.

4.9 ERA Conclusions

The conclusions of the ERA are summarized below, with details for each ROC being provided in Sections 4.6.1 to 4.6.5. Risk management measures and recommendations to reduce uncertainties in the ERA have been provided in Section 4.7.

The overall conclusions from the ERA include:

- The potential for adverse effects to vegetation and soil invertebrate communities as a result of COCs is within the study boundary is considered to be negligible to low based on the available data, within most areas of the site. In areas where waste rock and tailings have been placed, the likelihood of potential risks is medium. The presence of waste rock and tailing and the lack of nutrients in the "soils" in these areas, have most likely impacted vegetation in these areas and its ability to grow back/repopulate;
- There is a potential for individual level risks in individual herbivorous, insectivorous/ invertivorous small mammals, and herbivorous and insectivorous/invertivorous birds. However, based on the size of the study boundary and areas within it having elevated soil concentrations, available habitat and food resources, and consideration of population densities of avian ROC, there is a low likelihood for population level effects in avian and mammalian ROC;
- Considering the available lines of evidence and using a WOE approach, the potential for adverse effects in pelagic freshwater aquatic life communities as a result of contamination on the site is low for species that may inhabit/forage in Johnston Brook, and medium for benthic freshwater aquatic life based on available data;
- Based on the available site and toxicity data related to surface water as well as sediments in Johnston Brook, the likelihood of potential risk to amphibian communities is considered to be low to medium; and
- While the potential for exposures of reptiles to site COCs is limited, there is uncertainty in the dietary exposures, particularly from the terrestrial environment from these species. As such, there is uncertainty in the potential risks for these receptors. Based on these considerations, the potential for risk to reptile communities is considered to be low to medium.

5.0 Climate Change Considerations

As discussed in Section 2.3.4, the site is situated within the Atlantic Highlands ecoregions (USEPA, 2024) humid continental climate influenced by its higher altitudes and ocean proximity; however, impacts from climate change may occur throughout Atlantic Canada further into the future. Warmer temperatures brought about by climate change may incur additional impacts to Atlantic Canada in the form of extreme weather events and changing weather patterns. Annual precipitation under a high emissions scenario is projected to increase by 13% (ClimateData.ca, 2024) by the end of the century, but the overall pattern of precipitation may change to drier summers and wetter spring/fall leading to more intense rainfall patterns in these parts of the year.

Extreme weather events (heat waves, flooding, drought, storm events) are typically the drivers of change and are likely to increase in frequency and severity due to climate change (Bush and Lemmen, 2019). Extreme weather events may damage on-site risk mitigation infrastructure (i.e., storms may damage a containment cap). Changes to climate may cause a change in habitat within the site and could affect the types and quantities of vegetation and/or ecological receptors encountered within the site.

Changes to climate may also change how human receptors interact with the site (i.e., heat waves may deter people from accessing an outdoor site, while shorter/more mild winters may encourage use of the site for longer parts of the year).

Climate change impacts that could potentially increase arsenic impacts within the study boundary or off-site (e.g., drier summers may lead to increased wind erosion dispersing contaminated soil; drier summers may lead to sediments in Johnston Brook being exposed if the brook dries up, resulting in a potential pathway for humans to be exposed to these sediments as "soils") should be addressed in the soil risk management plan.

6.0 Summary of HHERA Conclusions

The HHERA considered potential risks to site visitors; site workers, vegetation and terrestrial invertebrates; herbivorous, insectivorous and carnivorous small mammals; herbivorous and insectivorous birds; freshwater aquatic life; amphibians and reptiles relevant exposure pathways to the identified contaminants of potential concern (COPCs). A summary of conclusions and recommendations for HHERA are provided below. These conclusions and recommendations based on the available data and assumptions used in the exposure and risk calculations. If site conditions and/or exposure assumptions change, the risk estimates should be re-evaluated to confirm the conclusions and risk management measures for this assessment still apply.

The overall conclusions from the HHRA include:

- With the exception of arsenic, the identified COPCs were not considered to pose a potential risk to human health in the Outdoor Site Visitor Scenario or the Outdoor Site Worker Scenario;
- The hazard quotients (HQs) for cobalt, mercury and lead were below the target hazard quotient (THQ) for all receptors. The incremental lifetime cancer risk (ILCR) for cobalt was below the target cancer risk level (TCRL);
- The HHRA results suggest that soil risk management is required for arsenic for the toddler and adult receptors in the Outdoor Site Visitor Scenario and for the adult in the Outdoor Site Worker Scenario;
- The ILCR for arsenic was greater than the TCRL (target cancer risk level) for the toddler and adult receptors in the Outdoor Site Visitor Scenario and the adult in the Outdoor Site Worker scenario;
- While there is potential risks to site visitors (toddler and adult, ILCR = 2.4×10^{-5} and 2.8×10^{-5} respectively) and site workers (adult, ILCR = 1.4×10^{-5}), the estimated risk is considered an overestimate. This is largely because receptors interacting with the site are unlikely to interact with the site for any significant duration. The HHRA assumed visitors would be present for six months of the year and did not account for factors such as inclement weather (e.g., cold rain during early spring) which would reduce time on site for potential visitors. The site is not easily accessible to the public, the site is heavily covered in vegetation/dense forest and likely to dissuade visitors from accessing more heavily impacted site soils (i.e., the waste rock piles where high levels of arsenic, mercury and other contaminants were observed are not adjacent to the road). It is also unlikely that the site would be used for recreational purposes (particularly for young children) which would

further dissuade regular use of the site. For the workers, 48 weeks of site exposure per year and 10 hours per day were assumed in the HHRA. This is likely an overestimation of risk as winter conditions (e.g., frozen ground) may prevent outdoor work from being conducted and would greatly reduce potential exposures to site soil COPCs; and

- **Section 7.0** discusses proposed risk management recommendations for the study boundary. This included the development of an initial soil SSTL for arsenic of 530 mg/kg for the site visitor and 1150 mg/kg for the site worker, which is protective of all other human receptors for each scenario.

The overall conclusions of the ERA include:

- The potential for adverse effects to vegetation and soil invertebrate communities as a result of COCs is within the study boundary is considered to be negligible to low based on the available data, within most areas of the site. In areas where waste rock and tailings have been placed, the likelihood of potential risks is medium. The presence of waste rock and tailing and the lack of nutrients in the "soils" in these areas, have most likely impacted vegetation in these areas and its ability to grow back/repopulate;
- There is a potential for individual level risks in individual herbivorous, insectivorous/ invertivorous small mammals, and herbivorous and insectivorous/invertivorous birds. However, based on the size of the study boundary and areas within it having elevated soil concentrations, available habitat and food resources, and consideration of population densities of avian ROC, there is a low likelihood for population level effects in avian and mammalian ROC;
- Considering the available lines of evidence and using a WOE approach, the potential for adverse effects in pelagic freshwater aquatic life communities as a result of contamination on the site is low for species that may inhabit/forage in Johnston Brook, and medium for benthic freshwater aquatic life based on available data;
- Based on the available site and toxicity data related to surface water as well as sediments in Johnston Brook, the likelihood of potential risk to amphibian communities is considered to be low to medium; and
- While the potential for exposures of reptiles to site COCs is limited, there is uncertainty in the dietary exposures, particularly from the terrestrial environment from these species. As such, there is uncertainty in the potential risks for these receptors. Based on these considerations, the potential for risk to reptile communities is considered to be low to medium.

7.0 Risk Management

Proposed risk management recommendations, including additional sampling needs, for the site and HHERA study boundary are as follows:

Soil risk management is required for arsenic. Iteration within the HHRA model produced the following initial human health soil SSTLs for arsenic:

- Outdoor Site Visitor – 530 mg/kg; and
- Outdoor Site Worker – 1150 mg/kg.

Other considerations may be necessary to refine these initial soil SSTLs for arsenic, which may occur under separate cover as part of a site soil risk management plan. Given then extent of arsenic within the study area soils identified to date as being elevated above the SSTL, it is recommended that the SSTL be further examined/refined as part of a soil risk management plan. Any freshy exposed waste rock/tailings as a result remedial activities should be evaluated for sulfide baring materials for acid rock drainage potential as warranted.

SSTLs are not provided for ROC evaluated in the ERA. The planned risk management/remediation for the study boundary based on the HHRA outcomes, will also reduce arsenic concentrations in soil that ecological receptors would be exposures to, and hence would also reduce potential risks.

Some other risk management recommendations for the site and HHERA study boundary are as follows:

- Develop site-specific health and safety plan for site workers, as required;
- As noted in **Section 3.2.4.4**, a mercury hotspot exists in site soil and while localized, this area should be risk managed to mitigate potential risk. This occurred at BH15 where mercury was reported at 2920 mg/kg in soil at a depth of 0-0.15 mbgs;
- If there are areas of fine tailings on-site that are an open source of arsenic or other metals which could disperse and mobilize, resulting in increased concentrations within the study area boundary, these tailings areas should be addressed in the remedial plan (possible off-site movement of contamination was outside the scope of this contract and is not discussed herein);
- If site conditions change, such that Johnston Brook dries up or its path significantly changes, resulting in the potential for exposure of soils as sediments, this should be addressed in the soil risk management plan;
- Some domestic waste was noted in APEC 4. The waste includes partially buried materials including metal barrels. While not a chemical exposure issue, this debris could pose a physical hazard to someone walking or wildlife in the area. It would be prudent to remove the visible debris;
- There are currently 46 known abandoned mine openings which consist of flooded pits, shafts, trenches and sunken spots. These openings could pose a physical hazard to someone visiting the site or wildlife in the area (i.e., falling into a shaft opening). While some of the abandoned mine openings were observed to be fenced, have berms and/or have posted signage, for the safety of potential

visitors to the site and wildlife, consideration should be given to permanently safeguarding openings to remove this hazard;

- Given the limited number of groundwater samples collected, it is recommended to collect additional groundwater data to identify groundwater trends to more definitively determine whether monitoring well 24MW-01 can be considered as an upgradient background well;
- The approaches and assumptions used to calculate EHQs for the mammalian and avian ROCs are considered to be conservative and are likely substantially overestimates of actual risk. Furthermore, while no IVBA testing for arsenic has been validated in Canada for use with ecological receptors, given the low relative bioavailability of arsenic in soils (i.e., 42% based on human IVBA testing results), it is likely that arsenic exposures to avian and mammalian wildlife are lower than what was calculated in the quantitative exposure modelling. Uncertainty in the amount of arsenic and lead exposure most likely incurred by avian and mammalian receptors due to consumption of site soil invertebrates and vegetation can be reduced by the collection of site vegetation and soil invertebrates tissue samples, and analyze such samples for metals;
- Climate change impacts that could potentially increase concentrations of arsenic and other metals within the study boundary or off-site (e.g., tailings become exposed, Johnston's Brook dries up resulting in the potential for exposure to sediments as soils for humans or terrestrial wildlife). Potential climate change impacts should be addressed as needed in the soil risk management plan;
- Site soils should be further delineated to provide further detail on the extent of soil impacts (particularly to the north of the site); and
- Surface water and sediment exceedances of freshwater aquatic life guidelines were present in Johnston Brook adjacent to the site boundary to the southern portion of the site. These exceedances likely extend beyond the site boundary, and as such, there could potentially be exposures to off-site aquatic species at elevated concentrations, particularly for arsenic. It was outside the scope of this assessment to evaluate potential off-site impacts.

8.0 Limitations and 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 site investigation. Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of any contaminants from the site. Rather, 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 sole benefit of Build Nova Scotia. The material in the report reflects Dillon's best judgment in light of the information available to Dillon at the time of preparation. Any use which a third party (e.g., a party other than Build Nova Scotia) 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.

Respectfully submitted,

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Appendix A

Figures



BUILD NOVA SCOTIA

Former Country Harbour Mine Site Human Health and Ecological Risk Assessment

Subject Parcels

PROJECT LOCATION

FIGURE 1

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY: GeoNova, ESRI, Build NS

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

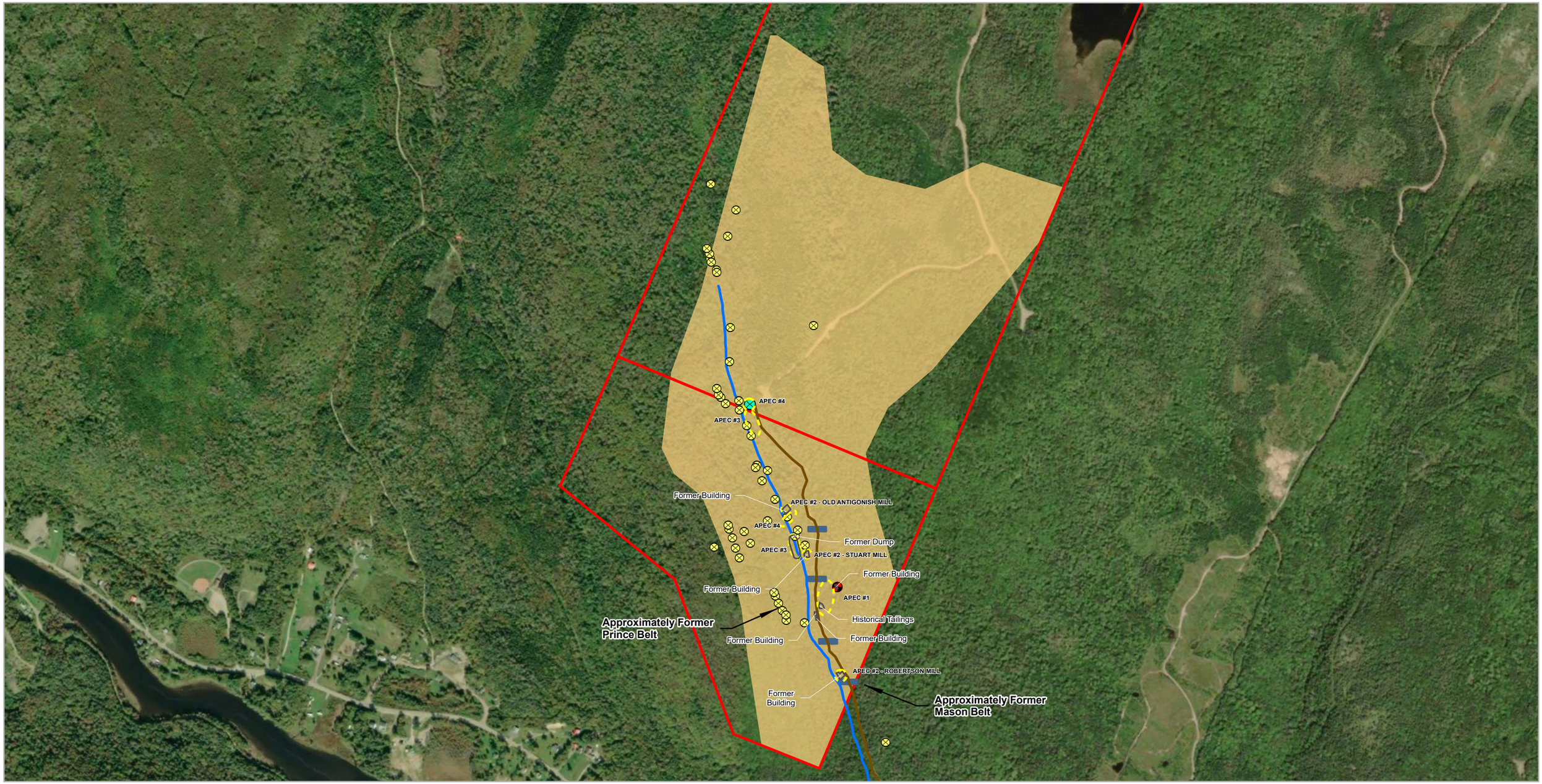
N W E S

SCALE 1:30,000

0 200 400 800 m

PROJECT: 236465
STATUS: FINAL
DATE: 2024-10-07

FILE LOCATION: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx



BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR
MINE SITE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

IDENTIFIED AECS AND HHERA ASSESSMENT AREA

FIGURE 2

- AEC
- John Fenton Loop Road
- Known Abandoned Mine Opening (NSDNRR)
- Johnston Brook
- Drum
- Cross Culvert
- Open Pit/Trench or Mine Opening (Field Identified)
- Subject Parcel
- HHERA Assessment Area
- Historical Feature

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:8,500

N W E S

PROJECT: 23-6465 STATUS: FINAL Date: 2024-10-07

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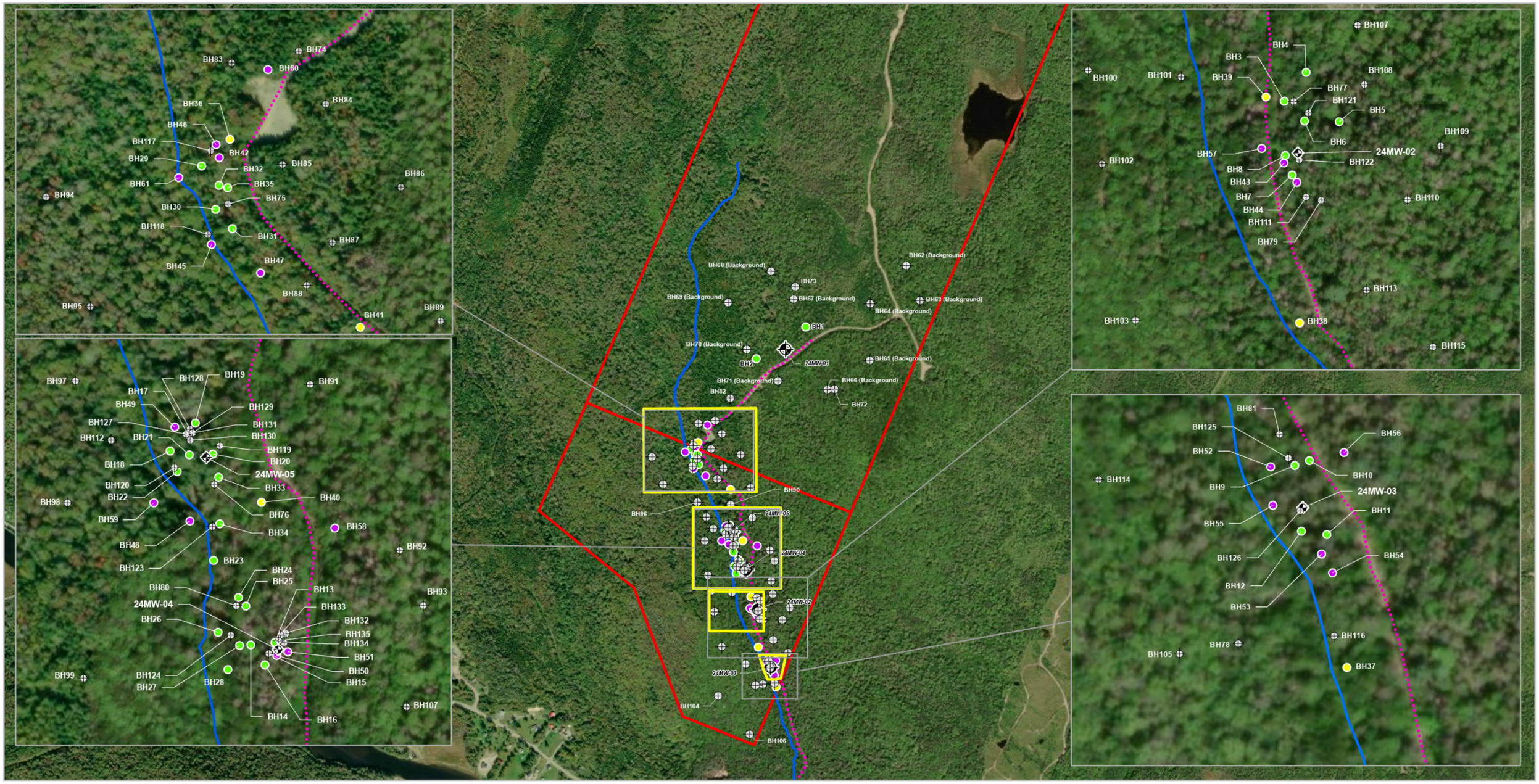

BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SAMPLE LOCATIONS FOR SOIL
AND GROUNDWATER
FIGURE 3

Shallow Test Hole Sample

- Shallow Test Hole Sample Dillon 2023-2024
- Step Out Sample Dillon 2023-2024
- Energetics Sample Dillon 2023-2024
- Monitoring Well (Dillon, 2024)
- Delineation Borehole Location (May 2024)
- Inferred Aerial Extent of Metals Impacts in Soil (147,380 m^2)*
- Subject Parcel
- Site Access Road
- Watercourse

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:10,210

PROJECT:23-6465 STATUS: FINAL Date: 2024-10-15

* Boundary not yet confirmed

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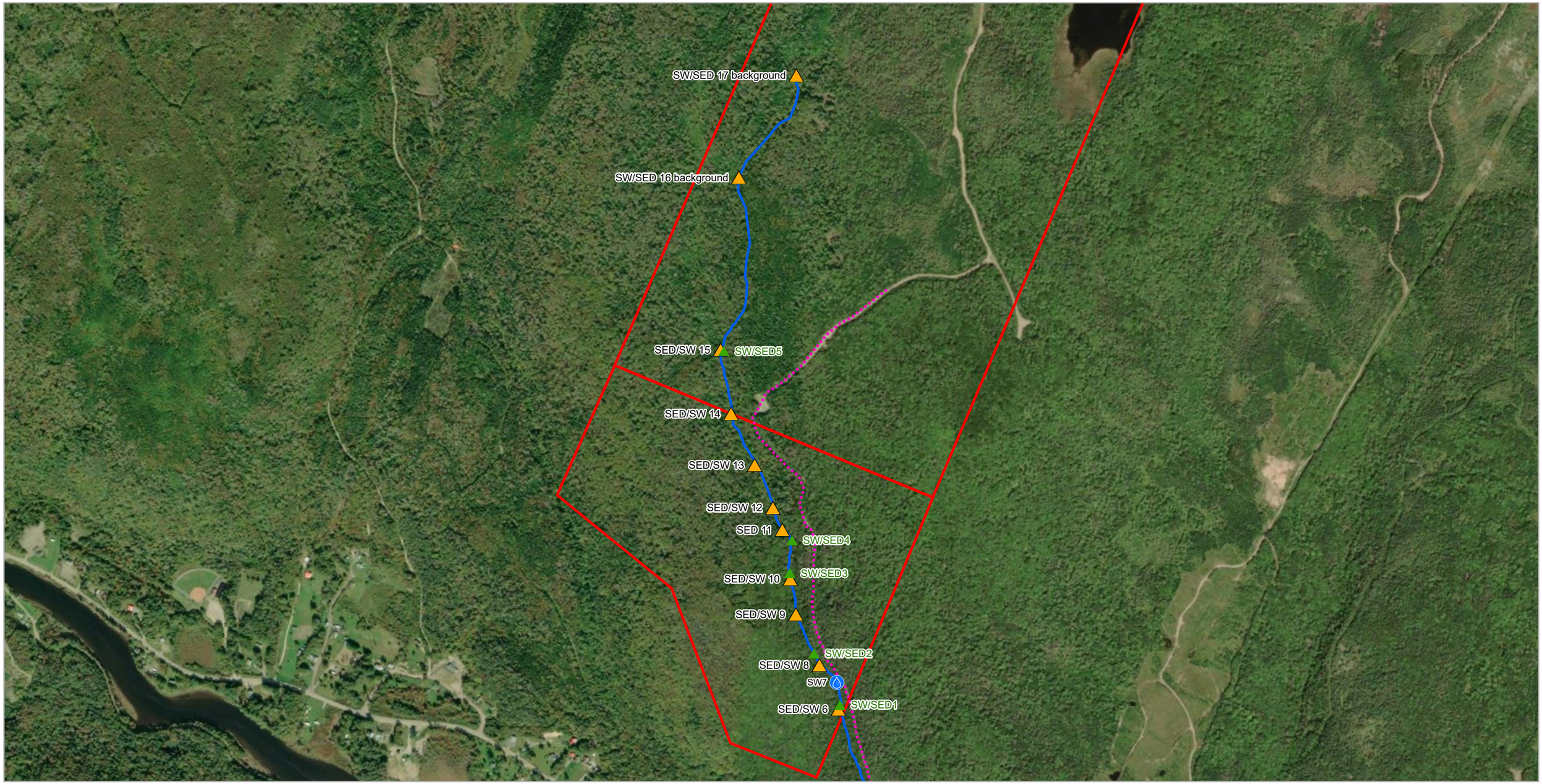

BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SAMPLE LOCATIONS FOR SEDIMENT AND SURFACE WATER

FIGURE 4

Build NOVA SCOTIA

- Sediment/Surface Water Sample Location (Supplemental ESA, 2024)
- Surface Water Sample Location
- Surface Water and Sediment Sample Location (Phase II ESA, 2024)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:8,500

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SOIL EXCEEDANCES OF METALS
ABOVE HUMAN HEALTH-BASED
GUIDELINES AND LOCAL BACKGROUND
FIGURE 5A

Soil Exceedances of Metals Above
Human Health-Based Guidelines
and Local Background

- No Exceedance (BH)
- Exceedance (BH)
- No Exceedance (MW)
- Exceedance (MW)
- Watercourse
- Site Access Road
- Subject Parcel

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:7,000

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

Document Path: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx

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24MW-03
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BH37

BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SOIL EXCEEDANCES OF PAHS,
BTEX AND PHCS
ABOVE HUMAN HEALTH-
BASED GUIDELINES
FIGURE 5B

Build NOVA SCOTIA

Soil Exceedances of PAHs, BTEX and PHCs Above Human Health-Based Guidelines

- No Exceedance (BH)
- Exceedances (BH)
- No Exceedance (MW)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:6,250

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PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

GROUNDWATER EXCEEDANCES
ABOVE HUMAN HEALTH-BASED
GUIDELINES

FIGURE 6

Groundwater Exceedances Above
Human Health-Based Guidelines

Exceedances

Watercourse

Site Access Road

Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:7,500

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PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BH60 BH85 BH68 BH62
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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SOIL EXCEEDANCES OF METALS
ABOVE ECOLOGICAL HEALTH-BASED
GUIDELINES AND LOCAL BACKGROUND
FOR TERRESTRIAL PLANTS AND INVERTEBRATES
FIGURE 7A

Build NOVA SCOTIA

Metals in Soil Ecological Health-Based Guidelines and Local Background for Terrestrial Plants and Invertebrates

- Exceedance (BH)
- Exceedance (MW)
- No Exceedance (BH)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:7,450

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

EXCEEDANCES OF PAHS, BTEX
AND PHCS ABOVE ECOLOGICAL
HEALTH-BASED GUIDELINES FOR
TERRESTRIAL PLANTS AND INVERTEBRATES
FIGURE 7B

Build NOVA SCOTIA

Exceedances of PAHs, BTEX and PHCs Above Ecological Health-Based Guidelines for Mammals and Birds

- Exceedance (BH)
- No Exceedance (MW)
- No Exceedance (BH)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:5,250

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SOIL EXCEEDANCES OF METALS
ABOVE ECOLOGICAL HEALTH-BASED
GUIDELINES AND LOCAL BACKGROUND
FOR MAMMALS AND BIRDS
FIGURE 8A

Build NOVA SCOTIA

Metals in Soil Ecological Health-Based Guidelines and Local Background for Mammals and Birds

- No Exceedance (BH)
- Exceedance (BH)
- No Exceedance (MW)
- Exceedance (MW)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:7,000

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

Document Path: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx

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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SOIL EXCEEDANCES OF PAHS,
BTEX AND PHCS ABOVE
ECOLOGICAL HEALTH-BASED
GUIDELINES FOR MAMMALS AND BIRDS
FIGURE 8B

Build NOVA SCOTIA

Exceedances of PAHs, BTEX and PHCs Above Ecological Health-Based Guidelines for Mammals and Birds

- No Exceedance (BH)
- No Exceedance (MW)
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:6,159

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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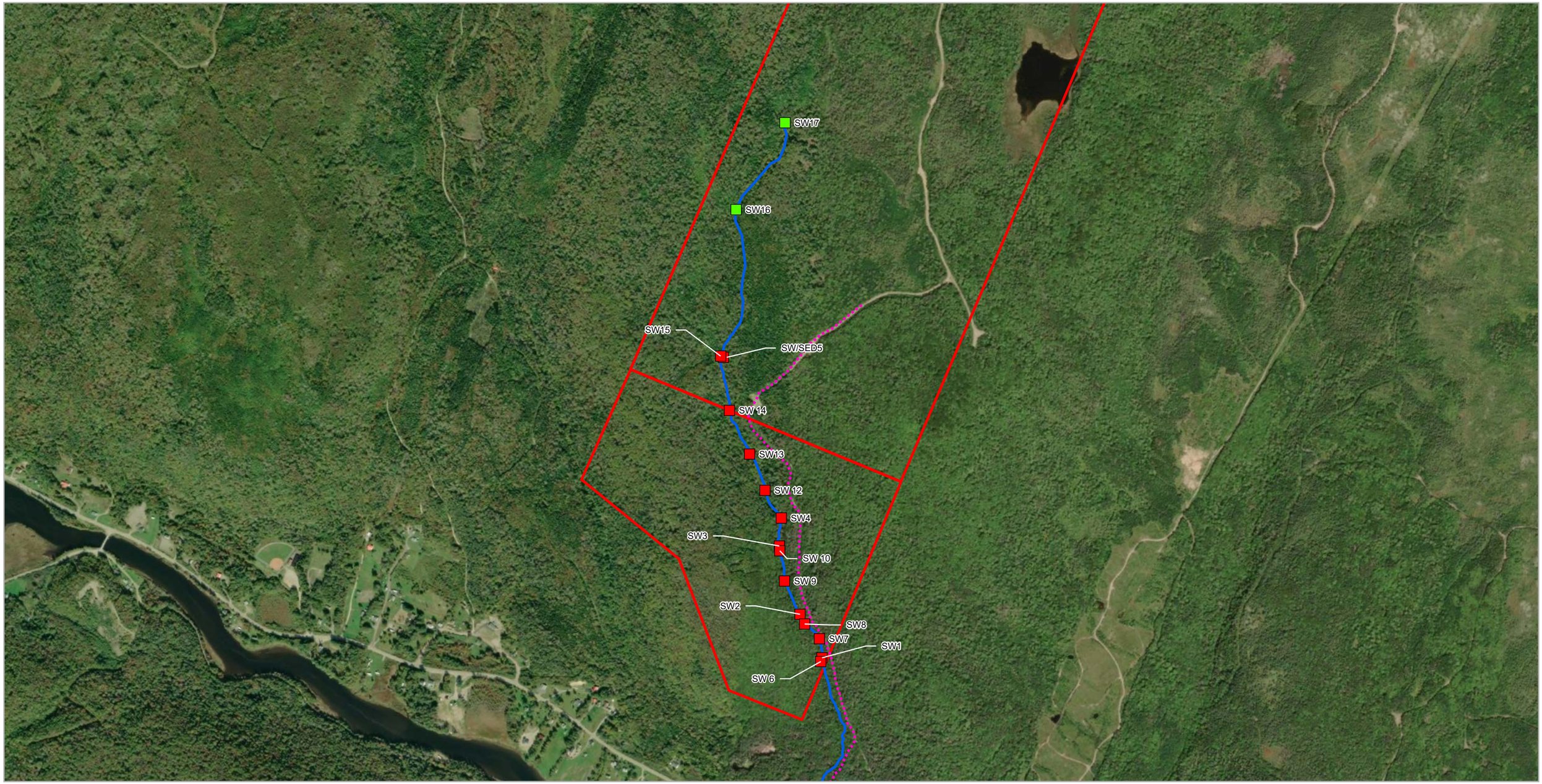

BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SURFACE WATER EXCEEDANCES
OF METALS ABOVE ECOLOGICAL
HEALTH-BASED GUIDELINES
AND LOCAL BACKGROUND
FIGURE 9A

Surface Water Exceedances of Metals Above Ecological Health-Based Guidelines and Local Background

- No Excedance
- Exceedance
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:10,000

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W E
S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

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BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SURFACE WATER EXCEEDANCES
OF PAHS, BTEX AND PHCS
ABOVE ECOLOGICAL HEALTH-BASED
GUIDELINES
FIGURE 9B

Surface Water Exceedances of PAHs, BTEX and PHCs Above Ecological Health-Based Guidelines

- No Exceedances
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

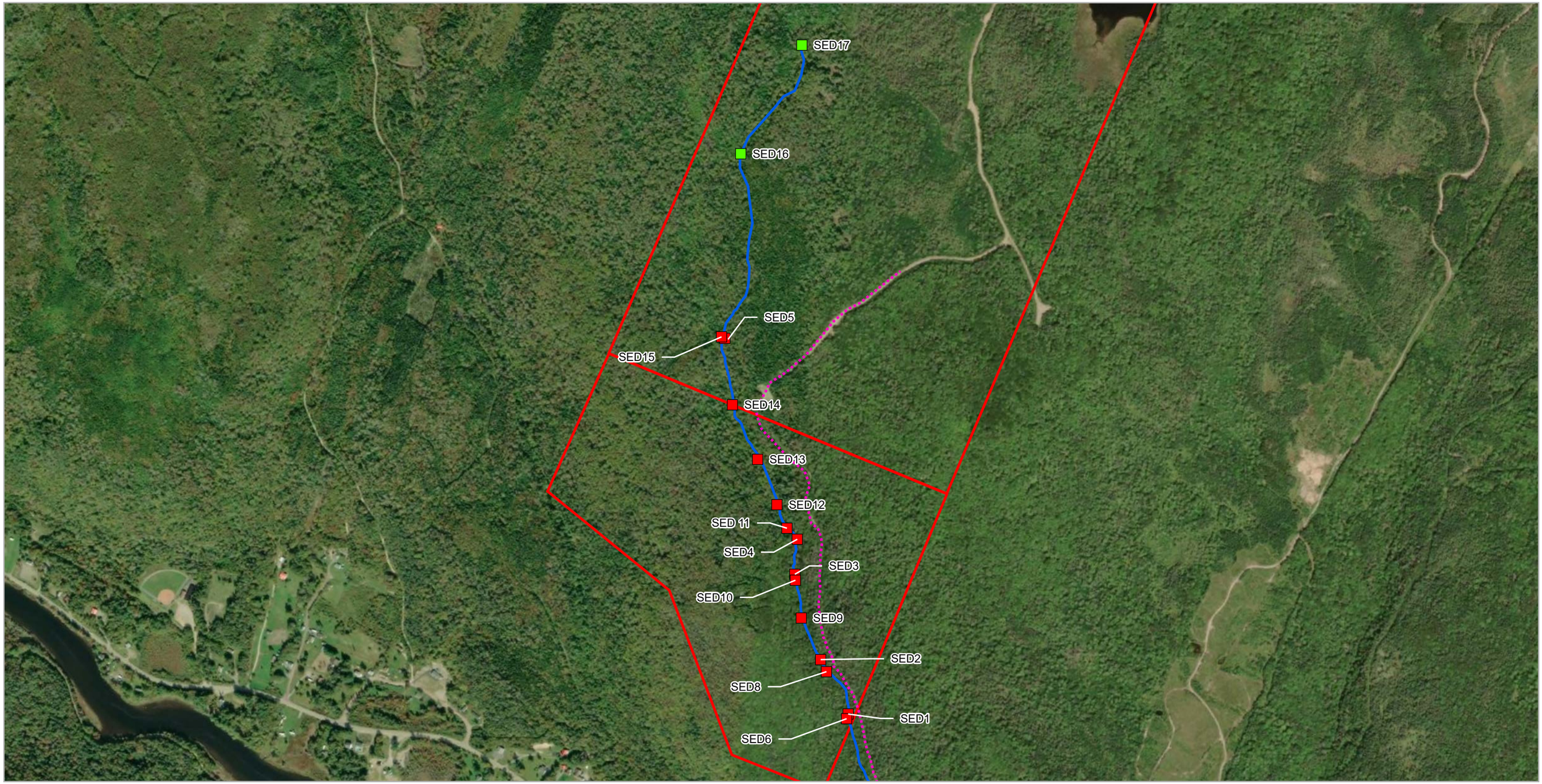
MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:7,000

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

Document Path: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx



BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SEDIMENT EXCEEDANCES
OF METALS ABOVE ECOLOGICAL
HEALTH-BASED GUIDELINES
AND LOCAL BACKGROUND
FIGURE 10A

Build NOVA SCOTIA

Sediment Exceedances of Metals Above Ecological Health-Based Guidelines and Local Background

- No Exceedances
- Exceedances

- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

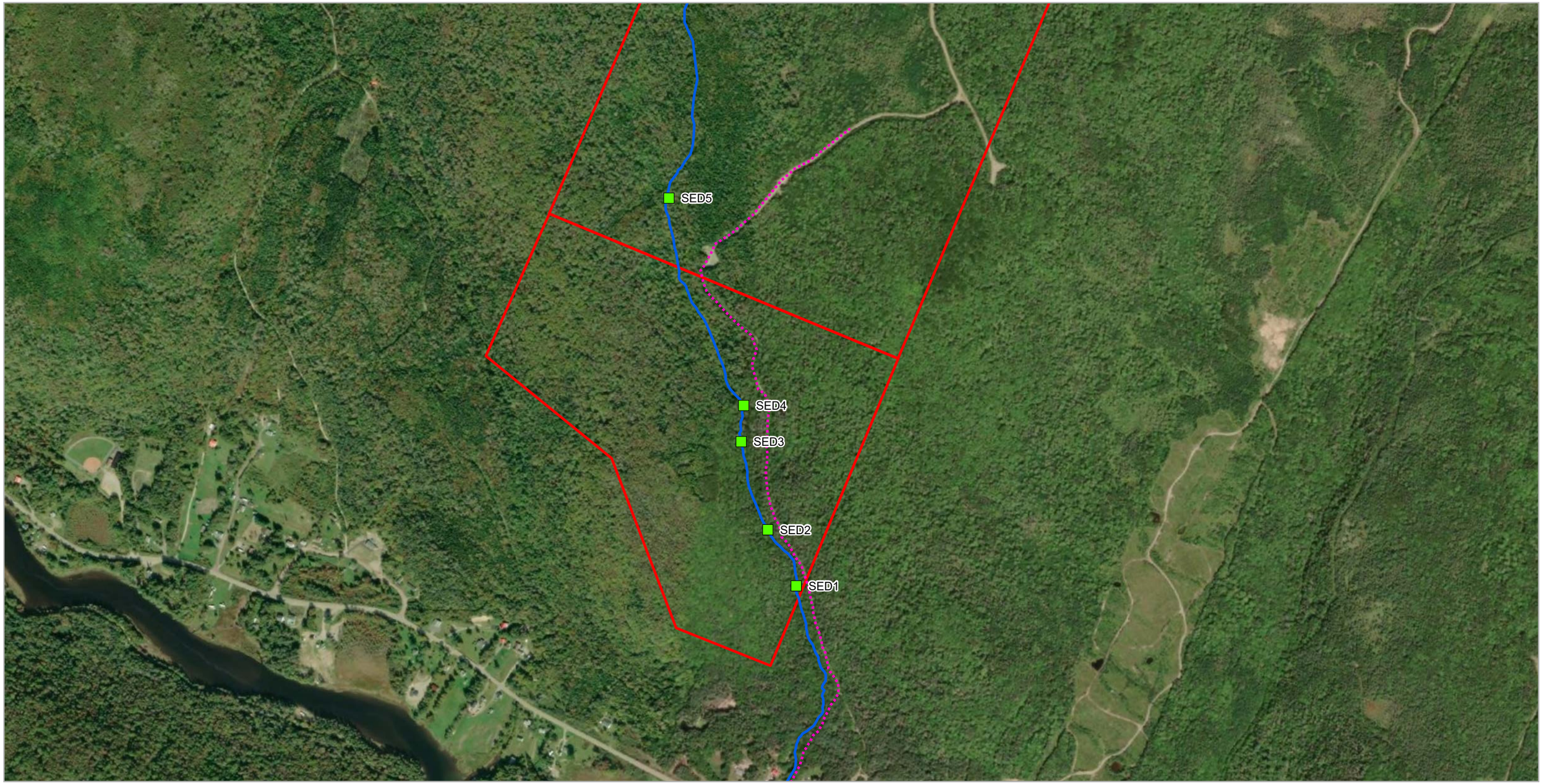
MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:8,000

N W E S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

Document Path: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx



BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT

SEDIMENT EXCEEDANCES
OF BTEX AND PHCS
ABOVE ECOLOGICAL
HEALTH-BASED GUIDELINES
FIGURE 10B

Build NOVA SCOTIA

Sediment Exceedances of BTEX and PHCs
Above Ecological Health-Based Guidelines

- No Exceedances
- Watercourse
- Site Access Road
- Subject Parcel

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: RJE
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:7,750

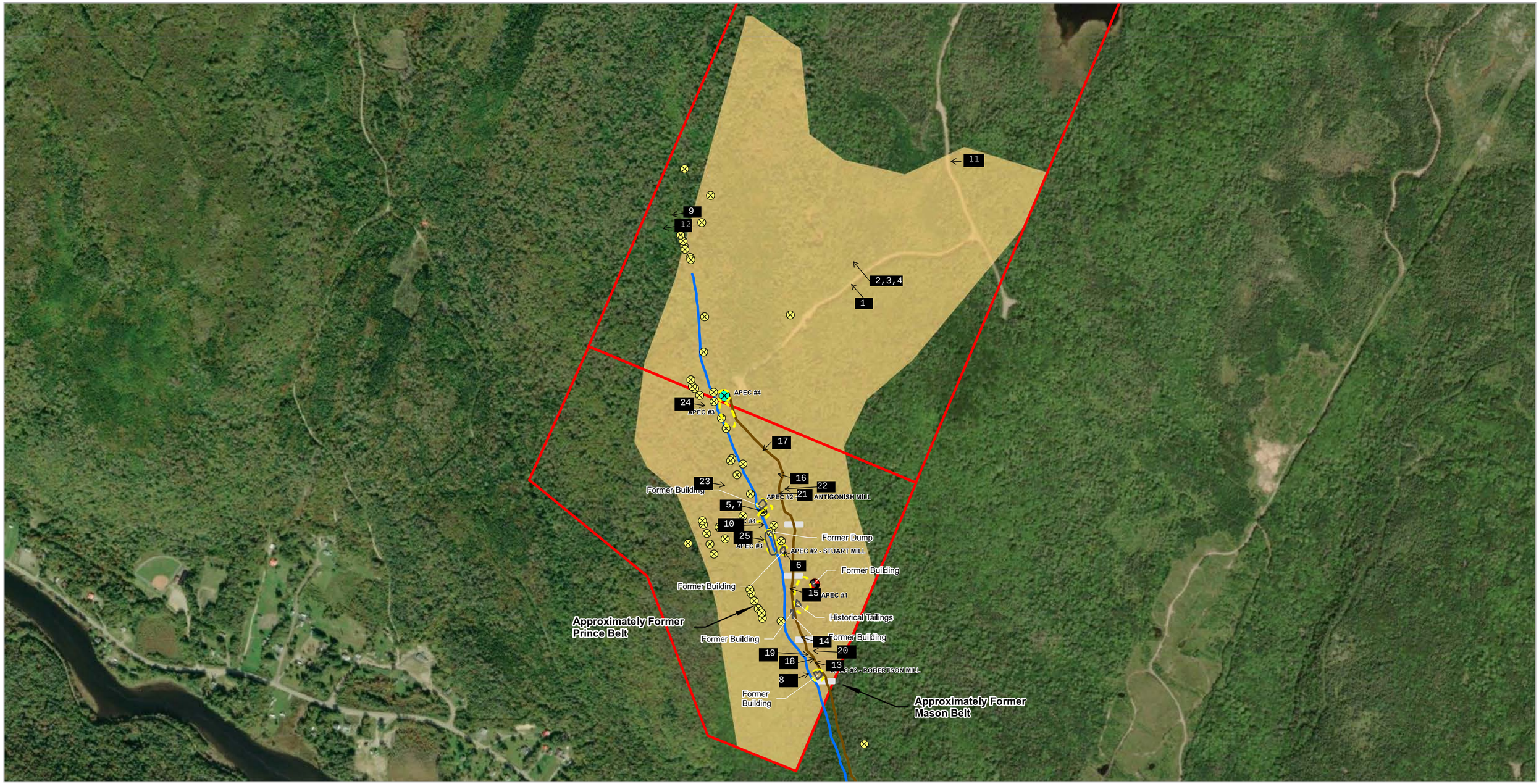
N
W E
S

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-16

Document Path: K:\2023\236465\product\Client\HHERA\Country Harbour Mines HHERA\Country Harbour Mines HHERA.aprx

Appendix B

Site Photographs



BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR MINE
ENVIRONMENTAL SITE ASSESSMENT

PHOTOGRAPH LOCATIONS

FIGURE B-1

- APEC (Phase1 ESA, Dillon 2023)
- John Fenton Loop Road
- Known Abandoned Mine Opening (NSDNRR)
- Johnston Brook
- Drum
- Cross Culvert
- Open Pit/Trench or Mine Opening (Field Identified)
- Subject Parcel
- Assessment Area
- Historical Feature
- 1 Photograph

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: BT
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:8,250

N W E S

PROJECT: 23-6465 STATUS: FINAL Date: 2025-01-09

Document Path: \\dillon.ca\DILLON_DFS_projects\GIS\2023\236465\product\Client\Supplemental Environmental Site Assessment\September 2024 Report Figures\F2_ Phase I ESA Identified APECs.mxd



View looking north on the access road. January, 2024. **Photo 1**



View of soil sampling equipment from monitoring wells. January, 2024. **Photo 2**



Soil sample from 24MW-01. January, 2024. **Photo 3**



Soil sample from 24MW-02. January, 2024. **Photo 4**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
	Former Country Harbour Mine	PHOTO NO.
October, 2024	**HHERA - October, 2024**	1, 2, 3, 4



View of soil sampling from 24MW-03, looking NNW. January, 2024. **Photo 5**



Soil sample from 24MW-04. January, 2024. **Photo 6**

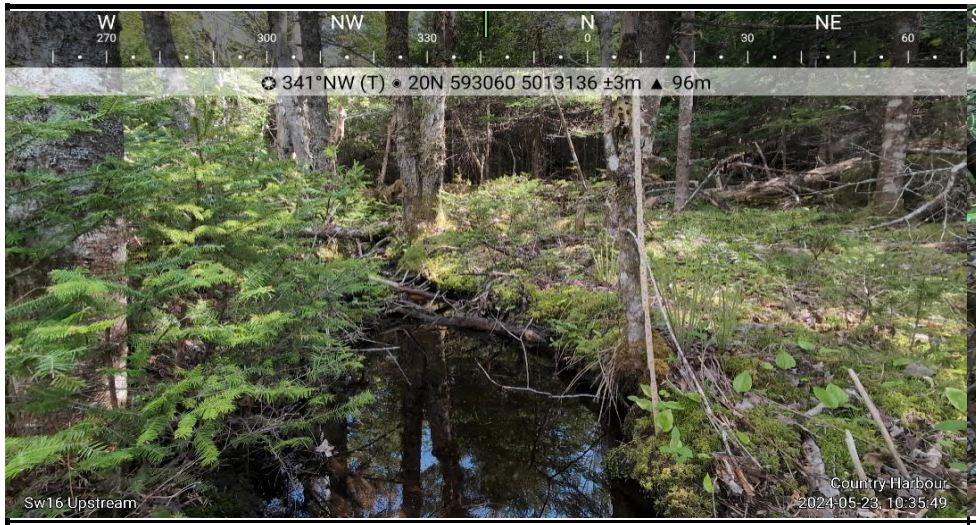


Soil sample from 24MW-05. January, 2024. **Photo 7**



Surface water sample SW07, looking west. May, 2024. **Photo 8**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 5, 6, 7, 8



Surface water sample SW16, looking north. May, 2024. **Photo 9**



Surface water sample SW11, looking southwest. Waterbody was dry. May, 2024. **Photo 10**

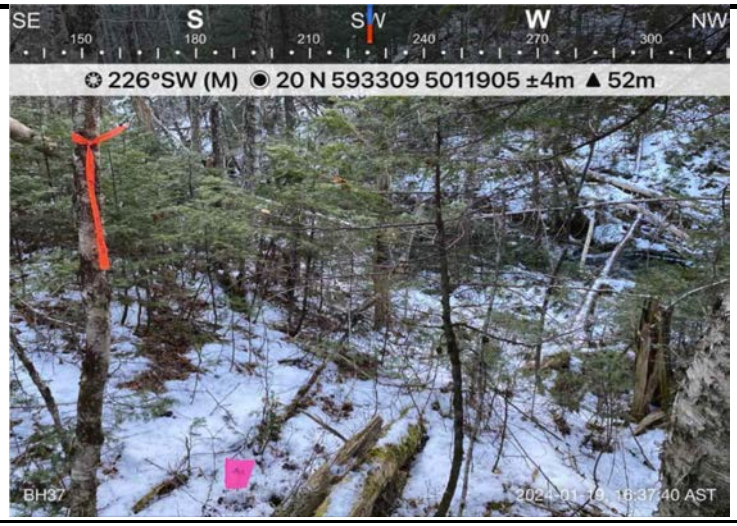


Forest composition north of the site. Looking west. May, 2024. **Photo 11**



Forest composition at the site. Looking north. May, 2024. **Photo 12**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 9, 10, 11, 12



Soil sampling location BH37. Looking southwest. January, 2024. **Photo 13**



Soil sampling location BH38. Looking north. January, 2024. **Photo 14**



Soil sampling location BH39. Looking north. January, 2024. **Photo 15**



Soil sampling location BH40. Looking northwest. January, 2024. **Photo 16**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 13, 14, 15, 16



Soil sampling location BH41. Looking southwest. January, 2024. **Photo 17**



Soil sampling location BH54. Looking northwest. January, 2024. **Photo 18**



Soil sampling location BH55. Looking north. January, 2024. **Photo 19**



Soil sampling location BH56. Looking west. January, 2024. **Photo 20**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 17, 18, 19, 20



Soil sampling location BH57. Looking southwest. January, 2024. **Photo 21**



Soil sampling location BH58. Looking north. January, 2024. **Photo 22**



Soil sampling location BH59. Looking northeast. January, 2024. **Photo 23**



Soil sampling location BH61. Looking north. January, 2024. **Photo 24**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 21, 22, 23, 24



View of a rock pile near one of the waste rock areas (AEC 3). May, 2024. **Photo 25**

DILLON CONSULTING	SITE PHOTOGRAPHS	PROJECT NO. 23-6465
October, 2024	**Former Country Harbour Mine** **HHERA - October, 2024**	PHOTO NO. 25

Appendix C

Analytical Tables

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH62		BH63		BH64		BH65		BH66		
Sample ID				BH62 0-0.15M	BH62 0.15-0.50M	BH63 0-0.15M	BH63 0.15-0.50M	BH64 0-0.15M	BH64 0.15-0.50M	BH65 0-0.15M	BH65 0.15-0.50M	BH66 0-0.15M	BH DUP F (FD: BH66 0-0.15M)	BH66 0.15-0.50M
Depth (m bgs)				0-0.15	0.15-0.50	0-0.15	0.15-0.50	0-0.15	0.15-0.50	0-0.15	0.15-0.50	0-0.15	0-0.15	0.15-0.50
Date				21 May 2024		21 May 2024		21 May 2024		21 May 2024		21 May 2024		
Sample Area				Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})											
Metals														
Aluminium	mg/kg	50	15400 [a,b]	9,590	8,720	5,270	26,100	1,920	17,300	3,660	5,240	18,000	18,600	11,900
Antimony	mg/kg	0.1	7.5 [c]	0.12	0.16	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	mg/kg	0.1	31 [d,e]	8.65	14	4.16	5.74	1.77	4.25	5.33	6.25	71.2	76.1	55.7
Barium	mg/kg	0.5	10000 [d]	11.8	12.9	11.3	21.3	6.41	15	11.8	13.3	25.6	25.1	24.1
Beryllium	mg/kg	0.1	110 [d]	0.2	0.22	0.12	0.76	<0.10	0.52	<0.10	0.12	0.45	0.46	0.31
Boron	mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02	49 [d]	0.043	0.031	0.046	0.039	0.03	0.044	<0.020	<0.020	0.05	0.048	0.034
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	19	35.6	15.2	27.2	12.5	27.6	16.8	16.9	40.1	25.5	22.6
Cobalt	mg/kg	0.1	22 [c]	1.29	1.7	0.89	3.75	0.33	1.69	0.7	1.03	3.18	2.72	2.22
Copper	mg/kg	0.5	4000 [d]	5.38	5.86	3.7	5.95	1.03	2.78	1.74	1.8	6.36	6.03	3.8
Iron	mg/kg	50	11000 [a,b]	28,300	30,000	14,900	22,800	2,450	18,900	7,260	10,700	21,900	22,400	16,900
Lead	mg/kg	0.5	260 [d]	14.1	16.2	15.2	17.3	5.12	13.4	10.4	10	20.8	21.5	15
Manganese	mg/kg	1	360 [a,b]	153	151	81.2	211	29.5	95.7	84	164	167	163	146
Mercury	mg/kg	0.005	24 [d]	0.0594	0.23	0.0585	0.0525	0.0264	0.0589	0.0267	0.0473	0.0586	0.089	0.058
Molybdenum	mg/kg	0.1	110 [c]	1.04	1.29	0.5	0.78	0.2	0.93	0.4	0.44	0.65	0.62	0.48
Nickel	mg/kg	0.5	310 [d]	6.3	14.3	6.45	12	5.79	10.9	6.82	6.6	17.3	10.3	9.05
Selenium	mg/kg	0.2	125 [d]	1.37	1.35	0.85	1.19	<0.20	1.06	0.38	0.48	1.09	1.28	0.79
Silver	mg/kg	0.1	77 [c]	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.12	<0.10
Strontium	mg/kg	0.5	9400 [a,b]	1.78	1.54	1.6	1.55	1.38	1.37	1.85	1.46	2.2	2.4	2.2
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	1 [d,f]	0.082	0.082	0.094	0.128	0.055	0.121	0.095	0.082	0.131	0.132	0.122
Tin	mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [d]	1.18	1.31	1.16	1.09	1.68	1.48	1.2	1.22	1.14	1.24	1.21
Vanadium	mg/kg	0.2	78 [a,b]	31	38.6	26	22.9	3.24	19.4	18	19.2	29.2	27.9	24.9
Zinc	mg/kg	2	16000 [d]	13.5	17.2	9.8	37.8	3.7	18.2	5.7	6.6	30.4	29.8	20.8

Notes

Shaded cells denote an exceedance above the direct contact guideline.

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH67			BH68		BH69		BH70		BH71					
Sample ID				BH67 0-0.15M	BH DUP G (FD: BH67 0-0.15M)	BH67 0.15-0.45M	BH68 0-0.15M	BH68 0.15-0.50M	BH69 0-0.15M	BH69 0.15-0.34M	BH70 0-0.15M	BH70 0.15-0.50M	BH71 0-0.15M	BH71 0.15-0.50M			Local Background Min.	Local Background Max.
Depth (m bgs)				0-0.15	0-0.15	0.15-0.45	0-0.15	0.15-0.50	0-0.15	0.15-0.34	0-0.15	0.15-0.50	0-0.15	0.15-0.50				
Date				21 May 2024			21 May 2024		21 May 2024		21 May 2024		21 May 2024					
Sample Area				Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background				
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})															
Metals																		
Aluminium	mg/kg	50	15400 [a,b]	1,280	1,280	26,200	1,560	24,300	4,290	16,500	8,300	4,410	5,680	16,200			1,280	26,200
Antimony	mg/kg	0.1	7.5 [c]	<0.10	<0.10	<0.10	<0.10	<0.10	0.19	0.3	<0.10	<0.10	<0.10	0.1			0.10	0.30
Arsenic	mg/kg	0.1	31 [d,e]	7.4	9.23	59.1	12.7	71.6	*400*	*1,050*	33.9	11.3	9.79	114			2	*1,050*
Barium	mg/kg	0.5	10000 [d]	6.44	6.47	47.4	7.22	44.9	30.1	62.8	11.6	18.5	28	22.6			6.4	62.8
Beryllium	mg/kg	0.1	110 [d]	<0.10	<0.10	0.5	<0.10	0.59	0.11	0.35	0.28	0.27	0.39	0.37			0	1
Boron	mg/kg	5	4300 [c]	<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
Cadmium	mg/kg	0.02	49 [d]	<0.020	0.024	0.075	0.025	0.04	0.043	0.054	0.038	0.114	0.197	0.029			0.024	0.197
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	4.75	2.25	37	6.06	69.6	19.5	49.5	9.25	21.9	60.2	13.2			2.25	69.6
Cobalt	mg/kg	0.1	22 [c]	0.24	0.21	4.51	0.23	5.09	1	3.04	0.58	0.88	1.94	1.97			0.21	5.09
Copper	mg/kg	0.5	4000 [d]	1.1	1.44	6.5	1.8	10.4	4.01	7.66	1.2	2.23	4.77	2.73			1.03	10.4
Iron	mg/kg	50	11000 [a,b]	2,840	3,080	26,700	3,090	29,000	9,740	28,200	4,090	4,210	4,810	14,000			2,450	30,000
Lead	mg/kg	0.5	260 [d]	4.33	5.58	25.3	3.99	28.5	54.6	88.1	14.4	10.3	12.2	22.4			3.99	88.1
Manganese	mg/kg	1	360 [a,b]	37.3	38	211	41.6	212	79.8	218	32.8	62	88	107			29.5	218
Mercury	mg/kg	0.005	24 [d]	0.017	0.0263	0.0945	0.0146	0.0689	0.029	0.0716	0.0671	0.0859	0.0387	0.0966			0.0146	0.2300
Molybdenum	mg/kg	0.1	110 [c]	0.19	0.22	0.75	0.29	1.36	0.52	1.04	0.33	0.58	0.81	0.51			0.19	1.36
Nickel	mg/kg	0.5	310 [d]	1.73	0.66	15.9	2.33	33	8.32	20	3.52	9.04	27	5.14			0.66	33
Selenium	mg/kg	0.2	125 [d]	<0.20	<0.20	1.43	<0.20	1.13	0.36	1.3	1.44	1.08	0.93	0.78			0.36	1.44
Silver	mg/kg	0.1	77 [c]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	<0.10	<0.10	<0.10			0.11	0.16
Strontium	mg/kg	0.5	9400 [a,b]	1.36	1.77	2.32	1.43	3.42	3.01	5.41	1.36	2.42	2.62	1.69			1.36	5.41
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	<500	<500	<500	<500	<500	500	<500			500	500
Thallium	mg/kg	0.05	1 [d,f]	<0.050	<0.050	0.185	<0.050	0.16	0.077	0.149	0.085	0.061	0.08	0.122			0.055	0.185
Tin	mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0			<2.0	<2.0
Uranium	mg/kg	0.05	33 [d]	0.889	0.775	1.14	0.986	1.24	1.37	1.35	1.38	1.43	2.3	1.14			0.775	2.30
Vanadium	mg/kg	0.2	78 [a,b]	7.54	8.88	32.6	11	30.5	16.1	34.6	8	6.6	8.69	20			3.24	38.6
Zinc	mg/kg	2	16000 [d]	2.9	4	38	2.7	44.2	10	28.2	5.7	10	26.2	22.4			2.70	44.2

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Location			BH 1	24 MW-01	BH 2	BH 3	BH 3	BH 4	BH 5	BH 6		BH 7		BH 8	BH 9	
	Sample ID			BH1 0-0.15m	24 MW-01-SS5 (2.4-3.0 m)	BH2 0-0.15m	BH3 0-0.15m	BH 3 0.60m	BH4 0-0.15m	BH5 0-0.15m	BH6 0-0.15m	BH DUPA 0-0.15m (FD: BH6 0-0.15m)	BH7 0-0.15m	BH 7 0.50m	BH8 0-0.15m	BH9 0-0.15m	BH 9 0.85m
	Depth (m bgs)			0-0.15	2.4-3.0	0-0.15	0-0.15	0.6	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0.5	0-0.15	0-0.15	0.85
	Date			07 Nov 2023	17 Jan 2024	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023		07 Nov 2023		07 Nov 2023	07 Nov 2023	
	Sample Area			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})													
Metals																	
Aluminium		mg/kg	50	15400 [a,b]	4,630	9,420	8,180	15,600	8,340	9,710	9,370	6,610	6,940	14,700	14,300	12,800	18,100	14,400
Antimony		mg/kg	0.1	7.5 [c]	0.14	0.1	0.3	2.53	0.51	0.22	0.17	0.32	0.35	*12.2*	*8.49*	1.25	3.14	<2.00
Arsenic		mg/kg	0.1	31 [d,e]	22	79.2	*1.490*	*4.300*	*315*	78.9	152	51.9	52.9	*7.170*	*4.870*	*1.270*	*3.170*	*647*
Barium		mg/kg	0.5	10000 [d]	10.7	46.6	25.8	98.3	31.6	70.2	18.2	175	177	51.9	60	41	145	63.2
Beryllium		mg/kg	0.1	110 [d]	<0.10	0.36	0.18	0.65	0.38	3.5	0.58	4.16	3.38	0.55	<2.00	0.97	1.45	<2.00
Boron		mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<5.0	<100
Cadmium		mg/kg	0.02	49 [d]	0.058	0.037	0.089	0.073	0.046	2.21	0.112	2.63	1.75	0.5	0.533	0.065	0.481	<0.400
Chromium (Total, III+VI)		mg/kg	0.5	630 [d]	8.13	29.7	12.4	32.4	13.2	6.28	8.4	3.08	3.23	20.5	20.4	21.3	36	22.1
Cobalt		mg/kg	0.1	22 [c]	0.66	5.34	0.58	1.04	2.32	1.83	2.15	2.01	1.96	4.36	4.96	1.92	16.7	10.6
Copper		mg/kg	0.5	4000 [d]	3.19	13.1	4.86	4.02	8.46	19.7	9.18	12.3	13.1	31.5	25.2	5.15	32	73.3
Iron		mg/kg	50	11000 [a,b]	22,400	17,100	29,000	*30,100*	13,200	3,590	11,000	3,700	3,240	21,800	27,200	17,500	*73,800*	*40,100*
Lead		mg/kg	0.5	260 [d]	13.3	18.3	44.5	118	55.6	98.1	39.6	99.1	118	127	87.5	54.8	164	96.9
Manganese		mg/kg	1	360 [a,b]	60.4	342	65.4	*472*	154	102	173	313	257	157	168	309	*1,010*	*446*
Mercury		mg/kg	0.005	24 [d]	0.0877	0.006	0.0842	4.19	0.684	0.404	0.108	0.204	0.317	4.03	3.9	1.96	11.9	1.12
Molybdenum		mg/kg	0.1	110 [c]	0.52	3.87	0.67	0.23	0.39	1.05	0.52	1.07	0.81	1.18	<2.00	0.41	7.43	4.08
Nickel		mg/kg	0.5	310 [d]	2.52	12.1	2.36	5.12	6.64	4.11	4.3	5.27	4.79	9.67	10.5	6.29	21.2	20.5
Selenium		mg/kg	0.2	125 [d]	1	<0.20	1.07	0.31	<0.20	4.61	0.58	3.97	3.4	1.48	<4.00	0.75	2.2	<4.00
Silver		mg/kg	0.1	77 [c]	0.1	<0.10	0.41	0.2	<0.10	0.52	0.11	0.22	0.26	0.25	<2.00	0.14	0.8	<2.00
Strontium		mg/kg	0.5	9400 [a,b]	2.55	2.15	1.99	3.15	2.37	25.2	2.54	73.4	69.6	5.22	<10.0	2.41	16.3	<10.0
Sulphur as S		mg/kg	1,000	NGA	<500	<500	<500	<500	<500	3600	<500	3900	3500	3300	<10000	<500	1900	<10000
Thallium		mg/kg	0.05	1 [d,f]	0.075	0.158	0.092	0.294	0.133	0.179	0.124	<0.050	<0.050	0.192	<1.00	0.165	0.439	<1.00
Tin		mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.4	<40.0	<2.0	3.3	<40.0
Uranium		mg/kg	0.05	33 [d]	0.949	1.56	1.14	1.13	1.74	24.4	4.46	27.7	20.6	5.31	4.61	2.71	2.62	5.95
Vanadium		mg/kg	0.2	78 [a,b]	24.9	16.2	52.6	36.2	14.1	7.6	9.97	3.45	3.94	27.1	25.6	23.4	48.4	27.2
Zinc		mg/kg	2	16000 [d]	10.3	39	11.2	52.8	85.7	74.6	67.8	109	108	126	201	49	104	115

Notes

Shaded cells denote an exceedance above the direct contact guideline.

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH10	BH11			BH12	BH13	BH14	BH15		BH16	BH17	BH18		BH19
Sample ID				BH10 0-0.15m	BH11 0-0.15m	BH DUPB 0-0.15m (FD: BH11 0-0.15m)	BH 11 0.90m	BH12 0-0.15m	BH13 0-0.015m	BH14 0-0.15m	BH15 0-0.15m	BH 15 0.50m	BH16 0-0.15m	BH17 0-0.15m	BH18 0-0.15m	BH 18 1.0m	BH19 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0.9	0-0.15	0-0.15	0-0.15	0-0.15	0.5	0-0.15	0-0.15	0-0.15	1	0-0.15
Date				07 Nov 2023	07 Nov 2023			07 Nov 2023	10 Nov 2023	09 Nov 2023	08 Nov 2023		08 Nov 2023	09 Nov 2023	08 Nov 2023		08 Nov 2023
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})														
Metals																	
Aluminium	mg/kg	50	15400 [a,b]	14,000	16,000	21,300	***29,200***	20,100	17,300	14,000	23,200	12,200	***27,500***	9,580	7,900	14,800	17,700
Antimony	mg/kg	0.1	7.5 [c]	0.5	1.5	1.92	1.1	4.38	1.48	1.11	2.72	0.37	***15.8***	2.86	1.46	<2.00	0.89
Arsenic	mg/kg	0.1	31 [d,e]	***383***	***808***	***1,270***	***459***	***1,110***	***998***	***340***	***1,240***	135	***463***	***694***	194	***2,690***	***620***
Barium	mg/kg	0.5	10000 [d]	44.4	49	72.7	108	78.2	73.4	53.7	52.3	35.9	31.6	161	52.1	142	51.4
Beryllium	mg/kg	0.1	110 [d]	0.62	0.92	1.22	1.14	1.3	0.6	0.58	1.24	0.65	0.86	0.54	1.18	<2.00	0.56
Boron	mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0
Cadmium	mg/kg	0.02	49 [d]	0.116	0.108	0.153	0.15	0.378	0.223	0.139	0.079	0.031	0.166	0.35	0.478	<0.400	0.283
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	21.7	22.7	29	28.8	24.6	22.1	16.2	22.3	13.6	18.2	58	15.3	37.9	21.5
Cobalt	mg/kg	0.1	22 [c]	4.87	6.69	8.7	5.66	12.2	4.36	2.73	6.45	4.8	2.05	8.07	13.2	4.44	3.87
Copper	mg/kg	0.5	4000 [d]	14.8	24	33.3	25.5	99.6	20.4	19.9	14.5	6.07	14.7	30	56.7	<10.0	13
Iron	mg/kg	50	11000 [a,b]	27,200	24,900	***31,800***	***30,900***	26,600	21,600	23,200	23,600	14,400	28,700	***39,500***	***112,000***	***30,600***	28,900
Lead	mg/kg	0.5	260 [d]	87.8	107	138	69.8	***791***	140	229	***1,360***	57.1	***428***	***349***	35.9	35.3	55.3
Manganese	mg/kg	1	360 [a,b]	***517***	***532***	***690***	348	***763***	***517***	292	***433***	335	170	***411***	***927***	***505***	278
Mercury	mg/kg	0.005	24 [d]	0.699	6.15	7.84	2.81	8.09	22.9	***28.1***	***2,920***	***30.9***	2.25	6.39	1.19	8.67	0.962
Molybdenum	mg/kg	0.1	110 [c]	0.79	1.11	1.43	1.02	1.2	0.39	0.83	0.45	0.4	0.61	5.22	29.5	<2.00	1.62
Nickel	mg/kg	0.5	310 [d]	8.68	11.8	15.5	15	19.1	9.99	6.86	15.2	9.52	6.57	14.7	30.9	<10.0	10.6
Selenium	mg/kg	0.2	125 [d]	0.77	0.68	0.79	0.96	0.55	0.71	1.76	0.57	<0.20	1.97	1.69	2.34	<4.00	1.52
Silver	mg/kg	0.1	77 [c]	0.26	0.19	0.39	0.1	0.19	0.48	0.2	0.41	<0.10	0.28	0.22	0.15	<2.00	0.26
Strontium	mg/kg	0.5	9400 [a,b]	2.72	4.22	4.36	2.91	5.34	10.6	6.72	3.3	1.3	7.64	21.5	36.3	<10.0	7.8
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	3200	1200	<10000	<500
Thallium	mg/kg	0.05	1 [d,f]	0.228	0.235	0.27	0.294	0.3	0.184	0.194	0.192	0.148	0.151	***1.21***	***1.14***	<1.00	0.225
Tin	mg/kg	2	9400 [a,b]	2.9	5	5.7	3.8	9	3.6	7.4	3.9	<2.0	27.2	3.1	<2.0	<40.0	<2.0
Uranium	mg/kg	0.05	33 [d]	1.87	2.45	3.14	3.89	6.21	1.06	1.43	1.43	1.2	1.48	0.807	1.02	<1.00	1.09
Vanadium	mg/kg	0.2	78 [a,b]	38.7	29.4	36.5	36.5	28.4	30.5	25.1	25.2	16.3	32.5	26.7	32.7	46.7	33
Zinc	mg/kg	2	16000 [d]	52.5	82.2	108	155	240	125	59.1	105	62.2	55.7	150	30.4	46.6	101

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	BH20	BH21		BH22	BH23			BH24	BH25	BH26	BH27		BH28
			Sample ID	BH20 0-0.15m	BH21 0-0.15m	BH DUPD 0-0.15m (FD: BH21 0-0.15m)	BH22 0-0.15m	BH23 0-0.15m	BH DUPC 0-0.15m (FD: BH23 0-0.15m)	BH23-0.95m	BH24 0-0.15m	BH25 0-0.15m	BH26 0-0.15m	BH27 0-0.15m	BH 27 0.45m	BH28 0-0.15m
			Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0.95	0-0.15	0-0.15	0-0.15	0-0.15	0.45	0-0.15
			Date	08 Nov 2023	08 Nov 2023		08 Nov 2023	08 Nov 2023			08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023		08 Nov 2023
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})													
Metals																
Aluminium	mg/kg	50	15400 [a,b]	15,000	12,600	12,000	15,200	11,200	13,600	***16,900***	***29,100***	13,300	***15,500***	***26,800***	***29,600***	17,700
Antimony	mg/kg	0.1	7.5 [c]	7.14	***23***	***48.1***	1.15	2.96	4.37	2.75	***10.9***	6.12	0.65	0.86	<2.00	1.73
Arsenic	mg/kg	0.1	31 [d,e]	***2,260***	***2,500***	***2,750***	***1,620***	***922***	***1,200***	***4,130***	***2,090***	***1,490***	***2,290***	***2,330***	***4,370***	***2,680***
Barium	mg/kg	0.5	10000 [d]	57.1	114	120	120	119	106	117	94.1	63	64.2	109	148	64.8
Beryllium	mg/kg	0.1	110 [d]	0.64	0.5	0.5	0.5	0.65	0.74	<2.00	1.91	0.85	1.07	1.86	<2.00	1.5
Boron	mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<5.0	<5.0	<5.0	<100	<5.0
Cadmium	mg/kg	0.02	49 [d]	0.114	0.25	0.293	0.094	1.91	0.964	0.54	0.127	0.133	0.338	0.086	<0.400	0.501
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	28.6	28.9	27.6	32.7	22.2	27.2	29.9	49.4	23.1	23	50.8	54.6	23.1
Cobalt	mg/kg	0.1	22 [c]	4.44	7.66	9.27	6.74	7.5	6.56	9.85	6.45	12.9	***58.1***	10.5	15.6	***162***
Copper	mg/kg	0.5	4000 [d]	31.3	35.3	39	18.4	33	28.7	38.5	25.2	11.5	19.5	40.3	28.5	34.1
Iron	mg/kg	50	11000 [a,b]	***39,400***	***40,000***	***39,400***	***28,800***	***33,000***	***35,100***	***39,000***	***50,700***	***35,800***	***41,200***	***51,800***	***53,500***	***41,800***
Lead	mg/kg	0.5	260 [d]	193	***505***	***591***	53.3	138	133	53.6	132	86.7	147	102	51.3	258
Manganese	mg/kg	1	360 [a,b]	***449***	***573***	***604***	***622***	***792***	***704***	***647***	***1,130***	***940***	***3,290***	***1,200***	***1,080***	***7,510***
Mercury	mg/kg	0.005	24 [d]	***46.4***	***77.8***	***83.6***	6.83	6.9	0.0989	1.38	0.334	13	2	0.321	0.0509	3.15
Molybdenum	mg/kg	0.1	110 [c]	1.6	2.45	2.52	1.47	2.95	2.43	<2.00	0.44	2.42	2.21	0.39	<2.00	1.99
Nickel	mg/kg	0.5	310 [d]	11.1	11.6	12.1	10.8	15.3	15	19.7	16.1	13.1	14.5	16.4	25.2	16.6
Selenium	mg/kg	0.2	125 [d]	1.54	1.04	1.17	0.49	0.97	0.86	<4.00	0.44	0.95	2.34	0.55	<4.00	2.47
Silver	mg/kg	0.1	77 [c]	0.33	0.75	0.61	0.12	0.14	0.14	<2.00	0.18	0.21	0.29	0.18	<2.00	0.47
Strontium	mg/kg	0.5	9400 [a,b]	3.17	5.08	5.68	3.72	23.2	17	15.9	3.81	5.2	11.4	6.3	<10.0	12.1
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	800	<500	800	<500	<500	800	600	<10000	800
Thallium	mg/kg	0.05	1 [d,f]	0.319	0.472	0.491	0.311	0.249	0.253	<1.00	0.354	0.178	0.254	0.446	<1.00	0.459
Tin	mg/kg	2	9400 [a,b]	11.3	31.4	60.7	<2.0	26.8	17.9	<40.0	28.5	6.3	<2.0	<2.0	<40.0	7.6
Uranium	mg/kg	0.05	33 [d]	0.99	0.73	0.812	0.733	0.574	0.731	<1.00	1.05	1.36	1.91	1.17	<1.00	2.77
Vanadium	mg/kg	0.2	78 [a,b]	37.6	35.5	33.6	39.5	32.2	36.8	40.5	56.8	34.8	40.9	61.7	63.8	37
Zinc	mg/kg	2	16000 [d]	52.7	82	84.7	53.4	531	310	213	81.4	60	71	89.1	97.3	76.4

Notes

Shaded cells denote an exceedance above the direct contact guideline.

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

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[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Location	BH29		BH30	BH31		BH32	BH33	BH34	BH35	BH36	BH44	BH45	BH47	BH54
	Sample ID	BH29 0-0.15m	BH 29 0.35m	BH30 0-0.15m	BH31 0-0.15m	BH 31 0.50m	BH32 0-0.15m	BH33 0-0.15m	BH34 0-0.15m	BH35 0-0.15m	BH36 0-0.15m	BH 44 0-0.15m	BH 45 0-0.15m	BH 47 0-0.15m	BH 54 0-0.15m
	Depth (m bgs)	0-0.15	0.35	0-0.15	0-0.15	0.5	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
	Date	09 Nov 2023		09 Nov 2023	09 Nov 2023		09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	07 Nov 2023	09 Nov 2023	10 Nov 2023	18 Jan 2024
	Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})													
Metals																
Aluminium	mg/kg	50	15400 [a,b]	***30,200***	***36,300***	***31,300***	***34,100***	***29,600***	10,400	11,600	15,300	17,900	16,900	13,900	17,300	9,170	19,500
Antimony	mg/kg	0.1	7.5 [c]	1.77	<2.00	0.75	1.36	<2.00	0.84	0.98	0.47	0.31	0.99	0.54	<2.00	0.11	2.31
Arsenic	mg/kg	0.1	31 [d,e]	***4.210***	***4.950***	88.9	***2.230***	***2.480***	***296***	***399***	***1.010***	46.3	***844***	48	***989***	70.3	***1.010***
Barium	mg/kg	0.5	10000 [d]	158	198	48.4	163	174	79.8	80.8	76.3	31.8	64.7	79.5	55.2	37.8	65
Beryllium	mg/kg	0.1	110 [d]	2.44	2.2	1.79	2.83	<2.00	1.36	0.31	0.67	1.03	0.63	3.09	<2.00	0.39	<2.00
Boron	mg/kg	5	4300 [c]	<5.0	<100	<5.0	<5.0	<100	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<100
Cadmium	mg/kg	0.02	49 [d]	0.124	<0.400	1.47	0.456	<0.400	0.779	0.04	0.229	0.192	0.18	1.79	<0.400	0.278	<0.400
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	52	61.3	11	57.8	52.6	16.6	26.5	28.6	12.1	24.9	15.8	29.3	14.8	25.2
Cobalt	mg/kg	0.1	22 [c]	18	19.7	2.75	***32.7***	***33.5***	***54.9***	2.57	7.29	2.44	3.8	1.36	11.5	1.38	10.8
Copper	mg/kg	0.5	4000 [d]	35.8	40	63	61.6	46.5	51.4	7.8	19.3	17	48.4	42	16.4	5.97	39.4
Iron	mg/kg	50	11000 [a,b]	***55,100***	***67,700***	2,640	***60,500***	***53,600***	15,000	21,000	28,300	5,580	***31,200***	7,210	***35,100***	8,700	***32,500***
Lead	mg/kg	0.5	260 [d]	***391***	238	232	***715***	***475***	130	24.9	52.3	104	120	142	142	81.1	140
Manganese	mg/kg	1	360 [a,b]	***1,340***	***1,290***	85	***1,520***	***1,210***	***1,390***	313	***376***	89	277	149	***587***	131	***830***
Mercury	mg/kg	0.005	24 [d]	0.178	0.116	0.778	0.148	0.0751	0.52	14.1	3.8	0.232	0.809	1.2	2.34	0.14	***104***
Molybdenum	mg/kg	0.1	110 [c]	0.44	<2.00	0.53	0.42	<2.00	0.29	0.43	1.01	0.38	0.65	2.02	<2.00	0.29	<2.00
Nickel	mg/kg	0.5	310 [d]	21.1	29.3	33.4	43.9	48.5	31.7	8.08	17.9	6.09	11.5	5.96	11.9	4.61	15.2
Selenium	mg/kg	0.2	125 [d]	0.29	<4.00	8.28	0.33	<4.00	0.67	0.36	1.02	3.38	0.97	5.15	<4.00	0.95	<4.00
Silver	mg/kg	0.1	77 [c]	0.24	<2.00	1.27	0.27	<2.00	0.16	0.1	0.13	0.23	0.21	0.37	<2.00	<0.10	<2.00
Strontium	mg/kg	0.5	9400 [a,b]	3.9	<10.0	13.7	3.8	<10.0	6.47	2.3	11	2.39	6.21	16.6	<10.0	2.2	<10.0
Sulphur as S	mg/kg	1,000	NGA	<500	<10000	4500	<500	<10000	<500	<500	500	1000	<500	3000	<10000	<500	<10000
Thallium	mg/kg	0.05	1 [d,f]	0.526	<1.00	0.104	0.479	<1.00	0.291	0.225	0.293	0.126	0.166	0.124	<1.00	0.13	<1.00
Tin	mg/kg	2	9400 [a,b]	<2.0	<40.0	<2.0	2.1	<40.0	<2.0	<2.0	<2.0	<2.0	4.1	3.8	<40.0	<2.0	<40.0
Uranium	mg/kg	0.05	33 [d]	1.59	1.06	4.06	2.86	1.85	1.61	0.77	0.977	2.67	1.19	***55.6***	1.97	1.78	5.52
Vanadium	mg/kg	0.2	78 [a,b]	62.9	72.6	7.35	68.3	61.6	21.5	34.6	35.6	15.3	39.7	14.8	45.6	15.8	31.4
Zinc	mg/kg	2	16000 [d]	152	129	257	367	316	226	39.1	70	35.9	99.5	87.6	83.7	43.9	106

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Location			BH55	BH56	BH57	BH58	BH59	BH60	BH61		24 MW-02	24MW-03	24MW-04	24 MW-05	BH82	BH83
	Sample ID			BH 55 0-0.15m	BH 56 0-0.15m	BH 57 0-0.15m	BH 58 0-0.15m	BH 59 0-0.15m	BH 60 0-0.15m	BH 61 0-0.15m	BH DUP E 0-0.15m (FD: BH 61 0-0.15m)	24 MW-02-SS3 (1.2-1.6m)	24MW-03 SS1-SS2 (0-1.2m)	24MW-04 SS2 (0-0.64m)	24 MW-05-SS1 (0-0.58m)	BH82 0-0.15m	BH83 0-0.15m
	Depth (m bgs)			0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	1.2-1.6	0-1.2	0-0.64	0-0.58	0-0.15	0-0.15
	Date			19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	20 Jan 2024		16 Jan 2024	18 Jan 2024	18 Jan 2024	16 Jan 2024	22 May 2024	22 May 2024
	Sample Area			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})													
Metals																	
Aluminium		mg/kg	50	15400 [a,b]	14,800	***36,500***	12,600	12,600	6,610	21,800	25,600	26,200	10,800	23,700	14,300	20,100	2,930	10,500
Antimony		mg/kg	0.1	7.5 [c]	3.06	<2.00	<2.00	<0.10	<2.00	0.15	0.68	0.56	<0.10	0.54	0.2	1.12	<0.10	0.29
Arsenic		mg/kg	0.1	31 [d,e]	***1.590***	***480***	***810***	105	***496***	148	***1.250***	***1.020***	75.7	***441***	250	***593***	97.6	104
Barium		mg/kg	0.5	10000 [d]	114	34	29.9	18	28.5	21.5	172	171	50.6	59.6	61.1	167	17.7	40.3
Beryllium		mg/kg	0.1	110 [d]	<2.00	<2.00	<2.00	0.49	<2.00	0.4	1.67	1.83	0.38	0.96	0.8	0.79	<0.10	0.24
Boron		mg/kg	5	4300 [c]	<100	<100	<100	<5.0	<100	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium		mg/kg	0.02	49 [d]	1.77	0.545	<0.400	0.092	<0.400	0.086	0.122	0.127	0.043	0.282	0.058	0.093	0.049	0.153
Chromium (Total, III+VI)		mg/kg	0.5	630 [d]	21	26.3	12.8	10.7	11.4	18.3	48.9	49.2	19.7	23	12.9	46.1	4.05	22.8
Cobalt		mg/kg	0.1	22 [c]	8.92	3.77	2.79	1.45	4.93	2.4	6.53	7.16	6.09	7.06	8.3	14.2	0.44	2.17
Copper		mg/kg	0.5	4000 [d]	40.6	11.3	<10.0	4.79	<10.0	6.18	9.3	8.58	10.6	31.7	7.06	36.4	1.78	11
Iron		mg/kg	50	11000 [a,b]	***41,300***	27,500	17,900	17,200	13,600	23,100	***42,400***	***43,000***	17,900	22,300	19,900	***30,900***	4,900	23,200
Lead		mg/kg	0.5	260 [d]	124	39.2	38.3	26.6	21.7	18.3	96.8	87.5	20.4	104	21.8	60.4	8.1	41.7
Manganese		mg/kg	1	360 [a,b]	***801***	139	240	70.1	345	131	***989***	***1,040***	***471***	***436***	***699***	***743***	67.7	147
Mercury		mg/kg	0.005	24 [d]	14.9	0.359	0.605	0.143	0.228	0.193	0.642	0.492	0.0086	1.05	1.14	2.52	0.052	0.103
Molybdenum		mg/kg	0.1	110 [c]	5.34	<2.00	<2.00	0.38	<2.00	0.55	0.24	0.24	1.29	0.89	0.75	2.28	0.28	1.32
Nickel		mg/kg	0.5	310 [d]	21.7	10.4	<10.0	3.43	<10.0	6.89	16.3	16.4	12.6	17.2	9.15	26.2	1.41	8.12
Selenium		mg/kg	0.2	125 [d]	<4.00	<4.00	<4.00	1.04	<4.00	1.42	<0.20	<0.20	<0.20	0.53	<0.20	0.24	0.28	1.24
Silver		mg/kg	0.1	77 [c]	<2.00	<2.00	<2.00	0.15	<2.00	0.13	0.24	0.2	<0.10	<0.10	<0.10	<0.10	0.12	0.13
Strontium		mg/kg	0.5	9400 [a,b]	16.2	<10.0	<10.0	1.59	<10.0	2.5	4.3	4.14	2.06	4.22	1.74	5.23	2.91	7.77
Sulphur as S		mg/kg	1,000	NGA	<10000	<10000	<10000	<500	<10000	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium		mg/kg	0.05	1 [d,f]	***1.47***	<1.00	<1.00	0.086	<1.00	0.099	0.336	0.334	0.166	0.26	0.496	0.342	<0.050	0.093
Tin		mg/kg	2	9400 [a,b]	<40.0	<40.0	<40.0	<2.0	<40.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.3	<2.0	<2.0	<2.0
Uranium		mg/kg	0.05	33 [d]	2.17	1.28	1.28	1.63	<1.00	0.877	1.22	1.41	1.58	3.02	1.74	2	0.68	0.938
Vanadium		mg/kg	0.2	78 [a,b]	29.2	28.5	19.2	19.1	13.4	22.5	60.9	61.4	19.2	23.8	24.5	47.8	12.6	43.7
Zinc		mg/kg	2	16000 [d]	268	65.6	<40.0	25.9	<40.0	28.4	95	95.8	40.1	152	98	114	5.5	40.8

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH84	BH85	BH86	BH87	BH88		BH89	BH90	BH91	BH92	BH93	BH94	BH95	BH96
Sample ID				BH84 0-0.15m	BH85 0-0.15m	BH86 0-0.15m	BH87 0-0.15m	BH88 0-0.15m	BH DUP i 0-0.15m (FD: BH88 0-0.15m)	BH89 0-0.15m	BH90 0-0.15m	BH91 0-0.15m	BH92 0-0.15m	BH93 0-0.15m	BH94 0-0.15m	BH95 0-0.15m	BH96 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Date				22 May 2024	22 May 2024	23 May 2024	23 May 2024	23 May 2024		23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	24 May 2024	24 May 2024	24 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})														
Metals																	
Aluminium	mg/kg	50	15400 [a,b]	20,700	25,200	1,430	7,030	7,280	7,470	11,900	13,100	7,670	14,400	21,400	12,900	9,120	10,600
Antimony	mg/kg	0.1	7.5 [c]	0.44	0.13	<0.10	<0.10	0.17	0.15	0.14	0.39	0.11	0.23	0.46	0.15	<0.10	0.18
Arsenic	mg/kg	0.1	31 [d,e]	*1,390*	98.8	2.39	40.3	129	146	67.1	*638*	26.2	37.3	13.9	10.2	10.6	*371*
Barium	mg/kg	0.5	10000 [d]	29	31.6	4.93	26.1	23.1	24.7	30.2	26.7	15.4	99.5	57.1	27.4	29	22.2
Beryllium	mg/kg	0.1	110 [d]	0.8	0.43	<0.10	0.19	0.25	0.28	0.42	0.34	0.19	7.49	3.63	1.3	0.72	0.26
Boron	mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.5 [i]	<7.5 [i]	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02	49 [d]	0.065	0.063	<0.020	0.056	0.156	0.157	0.112	0.095	0.049	2.3	0.633	0.177	0.058	0.05
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	21.9	35.1	0.99	10.7	7.13	7.85	16	17.2	13.2	5.11	2.48	9.25	10.5	12.4
Cobalt	mg/kg	0.1	22 [c]	2.85	2.7	0.15	1.56	0.97	1.09	1.9	2.03	1.23	0.77	0.76	3.09	1.9	1.24
Copper	mg/kg	0.5	4000 [d]	8.72	6.19	<0.50	2.77	4.2	3.86	4.08	4.51	2	30.2	7.67	6.26	4.66	2.86
Iron	mg/kg	50	11000 [a,b]	24,000	*34,000*	960	5,770	9,340	9,770	26,900	21,500	23,800	1,780	2,030	14,800	7,290	16,000
Lead	mg/kg	0.5	260 [d]	49.6	51.9	3.56	22.5	25.5	24	50.5	31.2	23.9	49.5	44.1	22.5	27.3	26.2
Manganese	mg/kg	1	360 [a,b]	144	155	20.4	83.6	85.9	92.4	147	153	86	59.7	29.8	193	94.2	129
Mercury	mg/kg	0.005	24 [d]	0.0969	0.183	0.066	0.0726	0.0632	0.0552	0.116	0.278	0.16	0.166 [i]	0.304 [i]	0.12	0.0734	0.0867
Molybdenum	mg/kg	0.1	110 [c]	1.66	0.53	0.11	0.59	0.5	0.45	0.44	0.7	0.3	0.71	0.4	0.87	0.92	0.52
Nickel	mg/kg	0.5	310 [d]	7.66	7.6	<0.50	4.6	3.17	3.42	5.67	6.01	3.78	6.49	3.96	4.25	4.24	3.27
Selenium	mg/kg	0.2	125 [d]	1.05	1.93	<0.20	0.38	0.57	0.58	1.02	1.12	0.51	11.1	5.27	1.72	1.58	0.9
Silver	mg/kg	0.1	77 [c]	0.16	0.18	<0.10	<0.10	0.21	0.2	0.12	0.11	0.26	0.31	0.74	0.19	0.13	<0.10
Strontium	mg/kg	0.5	9400 [a,b]	2.2	2.16	0.86	1.48	2.18	2.08	3.79	2.17	1.4	46.8	20.2	3.62	2.75	2.36
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	<500	<500	<500	<500	<500	3700	<1000	<500	<500	<500
Thallium	mg/kg	0.05	1 [d,f]	0.138	0.108	0.056	0.084	0.082	0.088	0.106	0.106	0.085	<0.075 [i]	<0.075 [i]	0.145	0.167	0.11
Tin	mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<3.0 [i]	<3.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [d]	6.44	1.03	0.767	1.85	1.1	1.05	1.33	0.98	0.919	*76.6*	7.45 [i]	1.12	1.55	0.861
Vanadium	mg/kg	0.2	78 [a,b]	33.4	40.7	1.99	15.4	18.9	19.4	64.6	28.3	47.9	4.92	2.94	22.1	18.3	21.9
Zinc	mg/kg	2	16000 [d]	44.5	50.8	3.1	18.2	16.9	19.2	34.1	32.3	31.1	56.2	18.8	15.6	20.5	16.6

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

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[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH97	BH98	BH99	BH100	BH101	BH102	BH103	BH104	BH105	BH106	BH107	BH108	BH109	BH110
Sample ID				BH97 0-0.15m	BH98 0-0.15m	BH99 0-0.15m	BH100 0-0.15m	BH101 0-0.15m	BH102 0-0.15m	BH103 0-0.15m	BH104 0-0.15m	BH105 0-0.15m	BH106 0-0.15m	BH107 0-0.15m	BH108 0-0.15m	BH109 0-0.15m	BH110 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Date				24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})														
Metals																	
Aluminium	mg/kg	50	15400 [a,b]	4,370	18,000	17,800	15,500	10,800	17,600	15,100	740	7,730	14,000	8,510	12,600	5,640	14,600
Antimony	mg/kg	0.1	7.5 [c]	0.19	0.43	0.52	0.19	0.29	0.31	0.22	<0.10	0.19	0.21	<0.10	0.2	0.16	0.18
Arsenic	mg/kg	0.1	31 [d,e]	*404*	*918*	*1,010*	*465*	*800*	*700*	*450*	8.82	*317*	*408*	16.1	137	190	*311*
Barium	mg/kg	0.5	10000 [d]	17	54.7	60.1	56.4	64.8	51.9	31.4	4.89	16.4	21.8	9.49	17.9	20.6	12.6
Beryllium	mg/kg	0.1	110 [d]	<0.10	1.35	0.56	0.64	0.38	0.56	0.53	<0.10	0.46	0.41	0.52	0.36	0.12	0.38
Boron	mg/kg	5	4300 [c]	<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
Cadmium	mg/kg	0.02	49 [d]	0.05	0.12	0.07	0.097	0.075	0.057	0.089	<0.020	0.119	0.106	0.129	0.098	0.041	0.075
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	7.11	18.6	23.3	21.3	16.5	22.2	21	1.45	5.51	12.3	2.13	8.96	9.19	12.1
Cobalt	mg/kg	0.1	22 [c]	0.57	*66.2*	3.58	6.26	3.28	4.08	2.78	0.16	0.84	1.93	0.17	1.16	1.08	1.01
Copper	mg/kg	0.5	4000 [d]	3.7	8.06	9.45	12.6	7.65	9.42	4.71	1.29	3.27	4.58	2.41	5.64	3.37	2.98
Iron	mg/kg	50	11000 [a,b]	10,200	28,300	24,200	21,800	20,200	25,500	26,500	1,720	12,200	16,700	2,640	13,000	12,700	17,700
Lead	mg/kg	0.5	260 [d]	12.2	91.4	22.6	24.2	29.5	26.8	17.6	3.98	32.6	26.8	15.5	36.5	22.8	19.9
Manganese	mg/kg	1	360 [a,b]	90.8	*2,130*	313	*490*	*376*	329	247	24	190	191	13	81.1	77.4	80.9
Mercury	mg/kg	0.005	24 [d]	0.0686	0.135	0.0621	0.0535	0.102	0.0711	0.0747	0.0127	0.0684	0.121	0.108	0.48	0.0568	0.0974
Molybdenum	mg/kg	0.1	110 [c]	0.6	2.83	0.56	0.69	0.57	0.71	0.73	0.3	0.46	0.47	0.24	0.32	0.45	0.37
Nickel	mg/kg	0.5	310 [d]	1.77	9.89	8.77	11.9	7.09	9.8	6.38	<0.50	1.89	4.31	1.06	3.31	3.45	2.67
Selenium	mg/kg	0.2	125 [d]	0.33	3.05	0.83	0.56	0.7	0.94	1.24	<0.20	1.03	1.18	1.06	0.86	0.43	1.28
Silver	mg/kg	0.1	77 [c]	<0.10	0.2	<0.10	<0.10	<0.10	<0.10	0.18	<0.10	0.37	0.2	0.9	0.18	0.11	0.14
Strontium	mg/kg	0.5	9400 [a,b]	1.86	4.6	3.06	3.93	4.93	2.75	1.66	0.64	1.49	1.63	2.46	1.57	2.27	1.22
Sulphur as S	mg/kg	1,000	NGA	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	1 [d,f]	0.068	0.867	0.202	0.202	0.164	0.183	0.146	<0.050	0.109	0.133	<0.050	0.088	0.075	0.085
Tin	mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [d]	0.87	1.92	0.968	0.992	1.02	1.13	1.01	1.16	1.62	1.57	1.2	1.03	0.886	0.885
Vanadium	mg/kg	0.2	78 [a,b]	24.8	29.4	30.1	26.6	28	31.4	36.5	2.86	13.5	19.6	2.96	16.6	24	24.8
Zinc	mg/kg	2	16000 [d]	9.9	90.2	40.7	42.5	30.8	36.5	37.2	2.3	12.8	23.4	5.2	31.9	12.1	16.3

Notes

Shaded cells denote an exceedance above the direct contact guideline.

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH111		BH112	BH113		BH114	BH115	BH116	BH117	BH118	BH119	BH120	BH121	BH122
Sample ID				BH111 0-0.15m	BH DUP J 0-0.15m (FD: BH111 0-0.15m)	BH112 0-0.15m	BH113 0-0.15m	BH DUP K 0-0.15m (FD: BH113 0-0.15m)	BH114 0-0.15m	BH115 0-0.15m	BH116 0-0.15m	BH117 0-0.15m	BH118 0-0.15m	BH119 0-0.15m	BH120 0-0.15m	BH121 0-0.15m	BH122 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Date				24 May 2024		25 May 2024	25 May 2024		25 May 2024	25 May 2024	25 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})														
Metals																	
Aluminium	mg/kg	50	15400 [a,b]	14,800	11,400	12,500	850	992	2,820	11,600	10,200	16,200	25,000	13,600	12,900	7,350	20,200
Antimony	mg/kg	0.1	7.5 [c]	***22***	***22.3***	0.5	<0.10	<0.10	<0.10	<0.10	0.29	1	0.24	<2.00 [I]	<2.00 [I]	0.31	0.23
Arsenic	mg/kg	0.1	31 [d,e]	***18,700***	***20,600***	***1,440***	22.8	21.2	203	39.7	***348***	***1,150***	***730***	***965***	***1,640***	33.2	70.1
Barium	mg/kg	0.5	10000 [d]	104	87.4	35	5.32	6.03	12.8	9.46	48.7	80	66.4	45.5	108	130	128
Beryllium	mg/kg	0.1	110 [d]	0.67	0.54	0.37	<0.10	<0.10	0.16	0.78	0.6	0.63	0.78	<2.00 [I]	<2.00 [I]	2.53	0.74
Boron	mg/kg	5	4300 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100 [I]	<100 [I]	<5.0	<5.0
Cadmium	mg/kg	0.02	49 [d]	0.322	0.16	0.14	0.024	0.038	0.068	0.033	0.207	0.146	0.195	<0.400 [I]	<0.400 [I]	1.98	0.058
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	30.3	24.6	15.1	1.1	1.25	2.53	3.72	16.3	25.4	33.8	19.6	30.3	5.93	39.2
Cobalt	mg/kg	0.1	22 [c]	20.2	***23.5***	4.04	0.17	0.16	0.31	0.39	4.09	10.9	***52.6***	2.7	8.18	1.78	2.26
Copper	mg/kg	0.5	4000 [d]	32.5	19.9	11	1.03	1	1.73	3.38	9.8	22.4	13.7	11.1	14.7	14.7	5.76
Iron	mg/kg	50	11000 [a,b]	***32,600***	***31,000***	20,400	2,780	2,410	6,830	3,660	18,400	27,700	***35,200***	26,000	26,000	2,670	26,200
Lead	mg/kg	0.5	260 [d]	***445***	245	31.6	3.32	3.97	34.5	20.9	98.4	105	173	58.2	42.1	62.4	33.5
Manganese	mg/kg	1	360 [a,b]	***428***	289	340	65.2	69.5	37.2	26.9	274	***923***	***1,140***	177	***586***	***367***	***535***
Mercury	mg/kg	0.005	24 [d]	19.2 [3]	12.5 [3]	0.209	0.0256	0.0295	0.0286	0.0565	0.404	0.605	0.206	3.10 [I]	7.56 [I]	0.48	3.99
Molybdenum	mg/kg	0.1	110 [c]	0.54	0.53	0.75	0.24	0.22	0.33	0.46	1.1	0.52	1.78	<2.00 [I]	<2.00 [I]	1.19	0.26
Nickel	mg/kg	0.5	310 [d]	36.3	35.2	6.15	<0.50	<0.50	1.02	1.27	6.36	15.6	8.73	<10.0 [I]	<10.0 [I]	5.6	8.56
Selenium	mg/kg	0.2	125 [d]	1.11	0.9	0.82	<0.20	<0.20	0.34	0.89	1.21	0.41	2.13	<4.00 [I]	<4.00 [I]	3.89	0.2
Silver	mg/kg	0.1	77 [c]	0.6	0.44	0.13	<0.10	<0.10	0.13	0.1	0.18	0.12	0.34	<2.00 [I]	<2.00 [I]	0.31	0.16
Strontium	mg/kg	0.5	9400 [a,b]	4.65	2.37	2.15	0.96	1.18	1.43	0.92	3.05	2.63	2.79	<10.0 [I]	<10.0 [I]	42.4	2.54
Sulphur as S	mg/kg	1,000	NGA	8700	8700	<500	<500	<500	<500	<500	<500	<500	<500	<10000	<10000	3000	<500
Thallium	mg/kg	0.05	1 [d,f]	0.347	0.274	0.165	<0.050	<0.050	0.069	0.084	0.184	0.218	0.313	<1.00 [I]	<1.00 [I]	0.053	0.325
Tin	mg/kg	2	9400 [a,b]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.3	2.2	<2.0	<2.0	<40.0 [I]	<40.0 [I]	<2.0	2.3
Uranium	mg/kg	0.05	33 [d]	2.9	1.69	0.995	0.8	0.836	1.64	6.06	3.9	1.12	2.44	1.23	<1.00 [I]	18.5	3.25
Vanadium	mg/kg	0.2	78 [a,b]	35.3	27.2	22.5	5.63	5.16	7.47	5.94	29.6	35.4	53.3	43.5	38.1	5.83	44.3
Zinc	mg/kg	2	16000 [d]	110	63.8	28.5	2.7	2.7	5.6	26	58.6	110	114	<40.0 [I]	41.8	87.8	85.6

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

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[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[I] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})	BH123 0-0.15m	BH124 0-0.15m	BH125 0-0.15m	BH DUP L 0-0.15m (FD: BH125 0-0.15m)	BH126 0-0.15m	BH132 0-0.15m	BH133 0-0.15m	BH134 0-0.15m	BH135 0-0.15m
Location				BH123	BH124	BH125		BH126	BH132	BH133	BH134	BH135
Sample ID				BH123 0-0.15m	BH124 0-0.15m	BH125 0-0.15m	BH DUP L 0-0.15m (FD: BH125 0-0.15m)	BH126 0-0.15m	BH132 0-0.15m	BH133 0-0.15m	BH134 0-0.15m	BH135 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Date				25 May 2024	25 May 2024	25 May 2024		25 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site
Metals												
Aluminium	mg/kg	50	15400 [a,b]	24,800	***32,400***	21,300	21,500	21,000	18,700	13,500	10,200	12,400
Antimony	mg/kg	0.1	7.5 [c]	<2.00 [i]	0.14	<2.00 [i]	<2.00 [i]	2.01	***34.8***	<2.00 [i]	3.41	4.64
Arsenic	mg/kg	0.1	31 [d,e]	***2,310***	***326***	***509***	***471***	***1,250***	***2,420***	***2,350***	***5,170***	***6,380***
Barium	mg/kg	0.5	10000 [d]	130	127	49.8	48.3	102	117	131	88.7	93.8
Beryllium	mg/kg	0.1	110 [d]	<2.00 [i]	2.46	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]
Boron	mg/kg	5	4300 [c]	<100 [i]	<5.0	<100 [i]	<100 [i]	<100 [i]	<100 [i]	<100 [i]	<100 [i]	<100 [i]
Cadmium	mg/kg	0.02	49 [d]	<0.400 [i]	0.274	<0.400 [i]	<0.400 [i]	<0.400 [i]	0.51	<0.400 [i]	<0.400 [i]	<0.400 [i]
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	48.9	56.2	28.5	27.9	32.1	22.6	32.8	23.7	30.1
Cobalt	mg/kg	0.1	22 [c]	15.1	***28.7***	3.48	3.74	16	7.46	2.38	<2.00 [i]	<2.00 [i]
Copper	mg/kg	0.5	4000 [d]	22.5	17.1	<10.0 [i]	<10.0 [i]	71.7	36.5	<10.0 [i]	<10.0 [i]	<10.0 [i]
Iron	mg/kg	50	11000 [a,b]	***48,900***	***51,500***	***33,100***	***31,100***	***36,500***	***34,400***	25,300	22,300	26,100
Lead	mg/kg	0.5	260 [d]	58.6	126	52.2	49.7	137	***1,140***	68.6	86.4	89
Manganese	mg/kg	1	360 [a,b]	***1,030***	***1,770***	307	305	***966***	***377***	***404***	266	***379***
Mercury	mg/kg	0.005	24 [d]	0.578	0.818	0.412	0.452	3.08 [i]	108 [i]	5.84 [i]	26.2 [i]	37.1 [i]
Molybdenum	mg/kg	0.1	110 [c]	<2.00 [i]	0.29	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]
Nickel	mg/kg	0.5	310 [d]	24.8	34.2	<10.0 [i]	<10.0 [i]	19.5	21.3	<10.0 [i]	<10.0 [i]	<10.0 [i]
Selenium	mg/kg	0.2	125 [d]	<4.00 [i]	0.27	<4.00 [i]	<4.00 [i]	<4.00 [i]	<4.00 [i]	<4.00 [i]	<4.00 [i]	<4.00 [i]
Silver	mg/kg	0.1	77 [c]	<2.00 [i]	0.16	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]	<2.00 [i]
Strontium	mg/kg	0.5	9400 [a,b]	<10.0 [i]	7.86	<10.0 [i]	<10.0 [i]	<10.0 [i]	<10.0 [i]	<10.0 [i]	<10.0 [i]	<10.0 [i]
Sulphur as S	mg/kg	1,000	NGA	<10000	<500	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Thallium	mg/kg	0.05	1 [d,f]	<1.00 [i]	0.317	<1.00 [i]	<1.00 [i]	<1.00 [i]	<1.00	<1.00 [i]	<1.00 [i]	<1.00 [i]
Tin	mg/kg	2	9400 [a,b]	<40.0 [i]	<2.0	<40.0 [i]	<40.0 [i]	<40.0 [i]	53.5	<40.0 [i]	<40.0 [i]	<40.0 [i]
Uranium	mg/kg	0.05	33 [d]	1	1.06	1.07	1.13	5.96	1.21	<1.00 [i]	<1.00 [i]	<1.00 [i]
Vanadium	mg/kg	0.2	78 [a,b]	57.2	67.3	46.1	44	38.1	34.3	38.7	29.7	32.6
Zinc	mg/kg	2	16000 [d]	80	165	50.6	51	224	176	<40.0 [i]	<40.0 [i]	<40.0 [i]

Notes

Shaded cells denote an exceedance above the direct contact guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

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[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

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[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-1: Analytical data for metals in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				Data Summary								
Sample ID Depth (m bgs) Date Sample Area				Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances	Number of Exceedances over Guideline and Background
	Unit	RDL	Based Soil Direct Contact Quality Guideline (SQG_{HH})									
Metals												
Aluminium	mg/kg	50	15400 [a,b]	120	0	120	740	740	36500	36500	47	*12*
Antimony	mg/kg	0.1	7.5 [c]	120	27	93	<2.00	0.1	48.1	48.1	9	*9*
Arsenic	mg/kg	0.1	31 [d,e]	120	0	120	2.39	2.39	20600	20600	110	*81*
Barium	mg/kg	0.5	10000 [d]	120	0	120	4.89	4.89	198	198	0	0
Beryllium	mg/kg	0.1	110 [d]	120	29	91	<0.10	0.12	7.49	7.49	0	0
Boron	mg/kg	5	4300 [c]	120	120	0	<5.0	-	<5.0	-	0	0
Cadmium	mg/kg	0.02	49 [d]	120	20	100	<0.400	0.024	2.63	2.63	0	0
Chromium (Total, III+VI)	mg/kg	0.5	630 [d]	120	0	120	0.99	0.99	61.3	61.3	0	0
Cobalt	mg/kg	0.1	22 [c]	120	2	118	<2.00 i	0.15	162	162	9	*9*
Copper	mg/kg	0.5	4000 [d]	120	9	111	<10.0	1	99.6	99.6	0	0
Iron	mg/kg	50	11000 [a,b]	120	0	120	960	960	112000	112000	96	*41*
Lead	mg/kg	0.5	260 [d]	120	0	120	3.32	3.32	1360	1360	11	*11*
Manganese	mg/kg	1	360 [a,b]	120	0	120	13	13	7510	7510	55	*55*
Mercury	mg/kg	0.005	24 [d]	120	0	109	0.006	0.006	2920	2920	7	*7*
Molybdenum	mg/kg	0.1	110 [c]	120	21	99	<2.00	0.11	29.5	29.5	0	0
Nickel	mg/kg	0.5	310 [d]	120	14	106	<10.0	1.02	48.5	48.5	0	0
Selenium	mg/kg	0.2	125 [d]	120	34	86	<0.20	0.2	11.1	11.1	0	0
Silver	mg/kg	0.1	77 [c]	120	42	78	<0.10	0.1	1.27	1.27	0	0
Strontium	mg/kg	0.5	9400 [a,b]	120	21	99	<10.0	0.64	73.4	73.4	0	0
Sulphur as S	mg/kg	1,000	NGA	120	100	20	<500	500	8700	8700	0	0
Thallium	mg/kg	0.05	1 [d,f]	120	31	89	<0.050	0.053	1.47	1.47	3	*3*
Tin	mg/kg	2	9400 [a,b]	120	92	28	<2.0	2.1	60.7	60.7	0	0
Uranium	mg/kg	0.05	33 [d]	120	8	111	<1.00	0.574	76.6	76.6	2	*2*
Vanadium	mg/kg	0.2	78 [a,b]	120	0	120	1.99	1.99	72.6	72.6	0	0
Zinc	mg/kg	2	16000 [d]	120	6	114	<40.0	2.3	531	531	0	0

Notes

Shaded cells denote an exceedance above the direct contact guideline.

Values in bold, italic and underline exceed both the guideline and the background.

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the site visitor as the S2 soil

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health. Available from

[e] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk le

[f] Provisional SQG_{HH}.

[i] Detection limit raised. Dilution required due to high concentration of test analyte(s)).

Table C-2: Analytical data for PAHs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH 1	BH 2	24 MW-01	BH 9	BH10	BH11		BH12	BH 13	BH14	BH15	BH16	BH17	BH18
Sample ID				BH1 0-0.15m	BH2 0-0.15m	24 MW-01-SS5 (2.4-3.1m)	BH9 0-0.15m	BH10 0-0.15m	BH11 0-0.15m	BH DUPB 0-0.15m	BH12 0-0.15m	BH13 0-0.15m	BH14 0-0.15m	BH15 0-0.15m	BH16 0-0.15m	BH17 0-0.15m	BH18 0-0.15m
Depth (m bgs)				0-0.15	0-0.15	2.4-3.1	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Date				07 Nov 2023	07 Nov 2023	17 Jan 2024	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	10 Nov 2023	09 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023	08 Nov 2023
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	FD (BH11 0-0.15m)	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH})														
Polycyclic Aromatic Hydrocarbons (PAHs)																	
1-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	<0.010	<0.010	<0.010	0.04	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.37	0.03
2-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	<0.010	<0.010	<0.010	0.04	0.02	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.41	0.03
1 & 2 Methylnaphthalene	mg/kg	0.015	72 [a,b]	<0.015	<0.015	<0.015	0.08	0.03	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.78	0.06
Acenaphthene	mg/kg	0.005	8,300 [c]	<0.0052	<0.0054	<0.0050	<0.0078	<0.0051	<0.0060	<0.0058	<0.0050	<0.0063	<0.0056	<0.0050	<0.0065	0.10	<0.0051
Acenaphthylene	mg/kg	0.005	78 [a,d]	<0.0052	<0.0054	<0.0050	0.02	<0.0051	<0.0060	0.01	0.01	0.03	0.08	0.01	0.04	0.10	<0.0051
Acridine	mg/kg	0.01	NGA	<0.051	<0.050	<0.010	<0.136	<0.047	<0.052	<0.054	<0.046	<0.014	<0.052	<0.031	<0.069	<0.081	<0.052
Anthracene	mg/kg	0.004	41,000 [c]	<0.0052	<0.0054	<0.0040	0.02	0.01	<0.0104	0.02	0.01	0.04	0.07	0.02	0.05	0.15	0.01
Benz(a)anthracene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.07	0.03	0.04	0.08	0.01	0.22	0.15	0.03	0.12	0.52	0.03
Benzo(a)pyrene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.06	0.03	0.04	0.07	0.01	0.21	0.13	0.03	0.10	0.34	0.02
Benzo(b+j)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.09	0.04	0.05	0.10	0.04	0.42	0.36	0.07	0.17	0.62	0.03
Benzo(b+j+k)fluoranthene	mg/kg	0.015	See B(a)P TPE [e]	<0.015	<0.015	<0.015	0.12	0.06	0.07	0.14	0.05	0.59	0.48	0.09	0.24	0.81	0.03
Benzo(g,h,i)perylene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.03	0.02	0.02	0.04	0.03	0.10	0.11	0.02	0.05	0.19	0.01
Benzo(k)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.03	0.01	0.02	0.04	0.01	0.17	0.12	0.03	0.07	0.20	<0.010
Chrysene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.07	0.03	0.03	0.07	<0.034	<0.619	0.22	0.04	0.12	0.56	0.02
Dibenz(a,h)anthracene	mg/kg	0.005	See B(a)P TPE [e]	<0.0052	<0.0054	<0.0050	<0.0100	<0.0051	<0.0065	0.01	0.01	0.04	0.03	0.01	0.02	0.06	<0.0051
Fluorene	mg/kg	0.01	4,300 [c]	<0.010	<0.010	<0.010	<0.022	<0.010	<0.017	<0.019	<0.010	0.01	<0.014	<0.010	<0.025	0.06	<0.010
Fluoranthene	mg/kg	0.01	5,600 [c]	<0.010	<0.010	<0.010	0.10	0.06	0.06	0.14	0.02	0.55	0.33	0.08	0.27	0.87	0.04
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	See B(a)P TPE [e]	<0.010	<0.010	<0.010	0.04	0.02	0.02	0.05	0.02	0.14	0.15	0.03	0.07	0.23	0.01
Naphthalene	mg/kg	0.01	3,000 [c]	<0.010	<0.010	<0.010	0.02	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.27	0.02
Perylene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.02	<0.010	0.01	0.02	<0.010	0.05	0.03	<0.010	0.03	0.08	<0.010
Phenanthrene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.07	0.04	0.02	0.03	<0.016	0.20	0.09	0.03	0.04	0.71	0.07
Pyrene	mg/kg	0.01	3,300 [c]	<0.010	<0.010	<0.010	0.10	0.06	0.06	0.13	0.02	0.41	0.25	0.07	0.20	0.85	0.05
Quinoline	mg/kg	0.01	NGA	<0.068	<0.075	<0.010	<0.090	<0.047	<0.052	<0.091	<0.046	<0.033	<0.055	<0.031	<0.090	<0.081	<0.052
Index of Additive Cancer Risk (IACR) [f]	-	0.15	NGA	0.15	0.16	0.15	1.94	0.91	1.15	2.27	0.71	8.97	7.15	1.38	3.86	13.30	0.53
B(a)P TPE [g]	mg/kg	0.02	5.3 [e]	0.02	0.02	0.02	0.10	0.05	0.06	0.13	0.03	0.41	0.30	0.06	0.19	0.65	0.03

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines and the value was changed accordingly as applicable. The original sources are indicated below.

[a] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the

[b] The guideline is applicable to both 1- and 2-methylnaphthalene isomers. If both isomers are detected, the sum of the two must not exceed the guideline.

[c] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[d] Value has been adjusted from its original jurisdictional value to reflect a 1 x 10^{-5} target cancer risk level.

[e] Canadian Council of Ministers of the Environment (CCME). (2010). Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Polycyclic Aromatic Hydrocarbons (Fact Sheet).

[f] Calculated by dividing the soil concentration (numerator) of each carcinogenic PAH by its soil quality guideline for protection of potable water component value (denominator) to calculate a hazard index for each PAH, and then summing the hazard indices for the entire PAH mixture, as in the following equation: [benzo(a)anthracene ÷ 0.33 mg/kg] + [benzo(b+j+k)fluoranthene ÷ 0.16 mg/kg] + [benzo(g+h+i)perylene ÷ 6.8 mg/kg] + [benzo(a)pyrene ÷ 0.37 mg/kg] + [chrysene ÷ 2.1 mg/kg] + [dibenz(a,h)anthracene ÷ 0.23 mg/kg] + [indeno(1,2,3-c,d)pyrene ÷ 2.7 mg/kg]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to 1/2 the RDL value.

[g] Calculated using CCME 2010 total potency equivalents factors (PEFs) and then summing the products as in the following equation: [benzo(a)pyrene*1 + benzo(a)anthracene*0.1 + benzo(b+j+k)fluoranthene*0.1 + benzo(g,h,i)perylene*0.01 + chrysene*0.01 + dibenz(a,h)anthracene*1 + indeno(1,2,3-c,d)pyrene*0.1]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to the RDL.

Table C-2: Analytical data for PAHs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

Location				BH19	BH20	BH21	BH22	BH23	BH33	BH34	BH35	BH36	24 MW-02	24MW-03		24MW-04
Sample ID				BH19 0-0.15m	BH20 0-0.15m	BH21 0-0.15m	BH22 0-0.15m	BH DUPC 0-0.15m	BH33 0-0.15m	BH34 0-0.15m	BH35 0-0.15m	BH36 0-0.15m	24 MW-02-SS3 (1.2-1.6m)	24MW-03 SS1-SS2 (0-1.2m)	24MW-DUP C	24MW-04 SS2 (0-0.64m)
Depth (m bgs)				0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	1.2-1.6	0-1.2	0-1.2	0-0.64
Date				08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	16 Jan 2024	18 Jan 2024	18 Jan 2024	18 Jan 2024
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	FD (24MW-03 SS1-SS2 (0-	Normal
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH})													
Polycyclic Aromatic Hydrocarbons (PAHs)																
1-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	0.08	<0.010	0.01	<0.010	0.09	<0.010	<0.010	<0.010	0.01	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	0.08	0.01	0.01	<0.010	0.12	<0.010	<0.010	<0.010	0.01	<0.010	<0.010	<0.010	<0.010
1 & 2 Methylnaphthalene	mg/kg	0.015	72 [a,b]	0.17	<0.015	0.03	<0.015	0.20	<0.015	<0.015	<0.015	0.02	<0.015	<0.015	<0.015	<0.015
Acenaphthene	mg/kg	0.005	8,300 [c]	0.02	0.01	<0.0052	0.01	<0.0057	<0.0050	<0.0069	<0.0086	0.01	<0.0050	<0.0081	<0.0050	<0.0068
Acenaphthylene	mg/kg	0.005	78 [a,d]	0.02	0.37	0.06	0.02	<0.0057	0.01	<0.0069	0.01	0.39	<0.0050	<0.0081	<0.0050	<0.0068
Acridine	mg/kg	0.01	NGA	<0.052	<0.053	<0.055	<0.010	<0.029	<0.053	<0.072	<0.010	0.07	<0.010	<0.010	<0.010	<0.010
Anthracene	mg/kg	0.004	41,000 [c]	0.05	0.20	0.06	0.05	0.01	0.01	0.02	0.01	0.66	<0.0040	<0.0081	<0.0045	<0.0068
Benz(a)anthracene	mg/kg	0.01	See B(a)P TPE [e]	0.17	1.20	0.50	0.19	0.03	0.04	0.05	0.03	2.47	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	mg/kg	0.01	See B(a)P TPE [e]	0.12	1.16	0.45	0.16	0.05	0.04	0.04	0.03	2.37	<0.010	<0.010	<0.010	<0.010
Benzo(b+j)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	0.24	2.07	1.03	0.25	0.14	0.06	0.07	0.06	4.30	<0.010	<0.010	<0.010	<0.010
Benzo(b+j+k)fluoranthene	mg/kg	0.015	See B(a)P TPE [e]	0.32	2.81	1.33	0.34	0.19	0.08	0.10	0.08	5.89	<0.015	<0.015	<0.015	<0.015
Benzo(g,h,i)perylene	mg/kg	0.01	See B(a)P TPE [e]	0.08	0.78	0.54	0.11	0.09	0.03	0.03	0.02	1.31	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	0.08	0.74	0.30	0.09	0.04	0.02	0.03	0.02	1.59	<0.010	<0.010	<0.010	<0.010
Chrysene	mg/kg	0.01	See B(a)P TPE [e]	0.18	1.26	<0.663	0.17	0.07	0.04	0.04	0.03	2.90	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	mg/kg	0.005	See B(a)P TPE [e]	0.03	0.21	0.20	0.03	0.02	0.01	0.01	<0.0086	0.43	<0.0050	<0.0081	<0.0050	<0.0068
Fluorene	mg/kg	0.01	4,300 [c]	0.01	<0.041	<0.014	<0.010	<0.010	<0.010	<0.022	<0.030	0.06	<0.010	<0.010	<0.010	<0.010
Fluoranthene	mg/kg	0.01	5,600 [c]	0.31	2.30	1.04	0.32	0.07	0.07	0.08	0.07	5.92	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	See B(a)P TPE [e]	0.10	1.02	0.51	0.14	0.09	0.03	0.04	0.03	1.81	<0.010	<0.010	<0.010	<0.010
Naphthalene	mg/kg	0.01	3,000 [c]	0.05	0.04	0.02	<0.010	0.07	<0.010	<0.010	<0.010	0.02	<0.010	<0.010	<0.010	<0.010
Perylene	mg/kg	0.01	NGA	0.03	0.35	0.13	0.05	0.01	0.01	<0.010	<0.010	0.56	<0.010	<0.010	<0.010	<0.010
Phenanthrene	mg/kg	0.01	NGA	0.14	0.31	0.13	0.13	0.09	0.02	0.05	0.03	1.39	<0.010	<0.010	<0.010	<0.010
Pyrene	mg/kg	0.01	3,300 [c]	0.27	1.97	0.93	0.28	0.06	0.06	0.07	0.05	4.43	<0.010	0.011	<0.010	<0.010
Quinoline	mg/kg	0.01	NGA	<0.052	<0.053	<0.055	<0.010	<0.061	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Index of Additive Cancer Risk (IACR) [f]	-	0.15	NGA	5.11	43.90	20.70	5.58	2.73	1.32	1.57	1.21	91.60	0.15	0.16	0.15	0.16
B(a)P TPE [g]	mg/kg	0.02	5.3 [e]	0.24	2.17	1.03	0.30	0.11	0.07	0.07	0.06	4.45	0.02	0.02	0.02	0.02

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines and the value was changed accordingly as applicable. The original sources are indicated below.

[a] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the

[b] The guideline is applicable to both 1- and 2-methylnaphthalene isomers. If both isomers are detected, the sum of the two must not exceed the guideline.

[c] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[d] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk level.

[e] Canadian Council of Ministers of the Environment (CCME). (2010). Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Polycyclic Aromatic Hydrocarbons (Fact Sheet).

[f] Calculated by dividing the soil concentration (numerator) of each carcinogenic PAH by its soil quality guideline for protection of potable water component value (denominator) to calculate a hazard index for each PAH, and then summing the hazard indices for the entire PAH mixture, as in the following equation: [benzo(a)anthracene ÷ 0.33 mg/kg] + [benzo(b+j+k)fluoranthene ÷ 0.16 mg/kg] + [benzo(g+h+i)perylene ÷ 6.8 mg/kg] + [benzo(a)pyrene ÷ 0.37 mg/kg] + [chrysene ÷ 2.1 mg/kg] + [dibenz(a,h)anthracene ÷ 0.23 mg/kg] + [indeno(1,2,3-c,d)pyrene ÷ 2.7 mg/kg]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to 1/2 the RDL value.

[g] Calculated using CCME 2010 total potency equivalents factors (PEFs) and then summing the products as in the following equation: [benzo(a)pyrene*1 + benzo(a)anthracene*0.1 + benzo(b+j+k)fluoranthene*0.1 + benzo(g,h,i)perylene*0.01 + chrysene*0.01 + dibenz(a,h)anthracene*1 + indeno(1,2,3-c,d)pyrene*0.1]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to the RDL.

Table C-2: Analytical data for PAHs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH})	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Polycyclic Aromatic Hydrocarbons (PAHs)											
1-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	27	19	8	<0.010	0.01	0.373	0.373	0
2-Methylnaphthalene	mg/kg	0.01	NGA [a,b]	27	18	9	<0.010	0.01	0.411	0.411	0
1 & 2 Methylnaphthalene	mg/kg	0.015	72 [a,b]	27	19	8	<0.015	0.022	0.784	0.784	0
Acenaphthene	mg/kg	0.005	8,300 [c]	27	22	5	<0.0052	0.0065	0.0958	0.0958	0
Acenaphthylene	mg/kg	0.005	78 [a,d]	27	12	15	<0.0052	0.0079	0.392	0.392	0
Acridine	mg/kg	0.01	NGA	27	26	1	<0.051	0.068	0.068	0.068	0
Anthracene	mg/kg	0.004	41,000 [c]	27	8	19	<0.0052	0.0069	0.661	0.661	0
Benz(a)anthracene	mg/kg	0.01	See B(a)P TPE [e]	27	7	20	<0.010	0.013	2.47	2.47	0
Benzo(a)pyrene	mg/kg	0.01	See B(a)P TPE [e]	27	7	20	<0.010	0.014	2.37	2.37	0
Benzo(b+j)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	27	7	20	<0.010	0.028	4.3	4.3	0
Benzo(b+j+k)fluoranthene	mg/kg	0.015	See B(a)P TPE [e]	27	7	20	<0.015	0.028	5.89	5.89	0
Benzo(g,h,i)perylene	mg/kg	0.01	See B(a)P TPE [e]	27	7	20	<0.010	0.011	1.31	1.31	0
Benzo(k)fluoranthene	mg/kg	0.01	See B(a)P TPE [e]	27	8	19	<0.010	0.012	1.59	1.59	0
Chrysene	mg/kg	0.01	See B(a)P TPE [e]	27	10	17	<0.010	0.023	2.9	2.9	0
Dibenz(a,h)anthracene	mg/kg	0.005	See B(a)P TPE [e]	27	12	15	<0.0052	0.0055	0.43	0.43	0
Fluorene	mg/kg	0.01	4,300 [c]	27	23	4	<0.010	0.012	0.061	0.061	0
Fluoranthene	mg/kg	0.01	5,600 [c]	27	7	20	<0.010	0.02	5.92	5.92	0
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	See B(a)P TPE [e]	27	7	20	<0.010	0.01	1.81	1.81	0
Naphthalene	mg/kg	0.01	3,000 [c]	27	18	9	<0.010	0.012	0.267	0.267	0
Perylene	mg/kg	0.01	NGA	27	13	14	<0.010	0.011	0.561	0.561	0
Phenanthrene	mg/kg	0.01	NGA	27	8	19	<0.010	0.02	1.39	1.39	0
Pyrene	mg/kg	0.01	3,300 [c]	27	6	21	<0.010	0.011	4.43	4.43	0
Quinoline	mg/kg	0.01	NGA	27	27	0	<0.068	-	<0.068	-	0
Index of Additive Cancer Risk (IACR) [f]	-	0.15	NGA	27	0	27	0.154	0.154	91.6	91.6	0
B(a)P TPE [g]	mg/kg	0.02	5.3 [e]	27	0	27	0.0207	0.0207	4.4481	4.4481	0

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines and the value was changed accordingly as applicable. The original sources are indicated below.

[a] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Table 2 Soil Component Values, Full Depth, Potable Water Scenario, Coarse grained soil. Residential/Parkland S1 component Value was used to screen for the

[b] The guideline is applicable to both 1- and 2-methylnaphthalene isomers. If both isomers are detected, the sum of the two must not exceed the guideline.

[c] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[d] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk level.

[e] Canadian Council of Ministers of the Environment (CCME). (2010). Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Polycyclic Aromatic Hydrocarbons (Fact Sheet).

[f] Calculated by dividing the soil concentration (numerator) of each carcinogenic PAH by its soil quality guideline for protection of potable water component value (denominator) to calculate a hazard index for each PAH, and then summing the hazard indices for the entire PAH mixture, as in the following equation: [benzo(a)anthracene ÷ 0.33 mg/kg] + [benzo(b+j+k)fluoranthene ÷ 0.16 mg/kg] + [benzo(g+h+i)perylene ÷ 6.8 mg/kg] + [benzo(a)pyrene ÷ 0.37 mg/kg] + [chrysene ÷ 2.1 mg/kg] + [dibenz(a,h)anthracene ÷ 0.23 mg/kg] + [indeno(1,2,3-c,d)pyrene ÷ 2.7 mg/kg]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to 1/2 the RDL value.

[g] Calculated using CCME 2010 total potency equivalents factors (PEFs) and then summing the products as in the following equation: [benzo(a)pyrene*1 + benzo(a)anthracene*0.1 + benzo(b+j+k)fluoranthene*0.1 + benzo(g,h,i)perylene*0.01 + chrysene*0.01 + dibenz(a,h)anthracene*1 + indeno(1,2,3-c,d)pyrene*0.1]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to the RDL.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

				Location	BH 1	BH 2	24 MW-01		BH 9	BH10	BH11	
				Sample ID	BH1 0-0.15m	BH2 0-0.15m	24 MW-01-SS5 (2.4-3.1m)	24 MW-Dup E	BH9 0-0.15m	BH10 0-0.15m	BH11 0-0.15m	BHDUPB 0-0.15m (FD: BH11 0-0.15m)
				Depth (m bgs)	0-0.15	0-0.15	2.4-3.1	2.4-3.1	0-0.15	0-0.15	0-0.15	0-0.15
				Date	07 Nov 2023	07 Nov 2023	17 Jan 2024	17 Jan 2024	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable								
BTEX												
	Benzene	mg/kg	0.005	980 [a]	<0.0057	<0.0050	<0.0050	<0.0050	<0.0072	<0.0050	<0.0056	<0.0050
	Toluene	mg/kg	0.05	1,400 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Ethylbenzene	mg/kg	0.015	3,100 [a]	<0.015	<0.015	<0.015	<0.015	<0.018	<0.015	<0.015	<0.015
	Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene Total	mg/kg	0.05	1,800 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)												
	VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.4	<5.0
	EPH >C10-C16	mg/kg	5	320 [b]	11	<5.0	<5.0	<5.0	11.8	<5.0	<5.0	<5.0
	EPH >C16-C21	mg/kg	5	NGA [b,c]	25	7.4	<5.0	<5.0	21.9	6.9	12.2	12.1
	EPH >C21-C32	mg/kg	5	NGA [b,c]	365	111	<5.0	<5.0	196	94.3	231	205
	>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	390	118.4	<5.0	<5.0	217.9	101.2	243.2	217.1
	EPH >C34-C50	mg/kg	20	3300 [b]	532	132	<20	<20	248	190	285	272
	Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	401	118	<10	<10	230	101	249	217
	Reached Baseline at C32	-	-	NGA	No	No	Yes	Yes	No	No	No	No
	Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	N/A	N/A	LOF	LOF	LOF	LOF

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

				Location	BH12	BH 13	BH14	BH15	BH16	BH17		BH18
				Sample ID	BH12 0-0.15m	BH13 0-0.015m	BH14 0-0.15m	BH15 0-0.15m	BH16 0-0.15m	BH17 0-0.15m		BH18 0-0.15m
				Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
				Date	07 Nov 2023	10 Nov 2023	09 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023		08 Nov 2023
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable								
BTEX												
	Benzene	mg/kg	0.005	980 [a]	<0.0050	<0.0054	<0.0050	<0.0050	<0.0053	0.0344	-	<0.0059
	Toluene	mg/kg	0.05	1,400 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	0.217	-	<0.050
	Ethylbenzene	mg/kg	0.015	3,100 [a]	<0.015	<0.015	<0.015	<0.015	<0.015	0.079	-	<0.015
	Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	0.107	-	<0.030
	Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	0.156	-	<0.030
	Xylene Total	mg/kg	0.05	1,800 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	0.263	-	<0.050
Petroleum Hydrocarbons (PHCs)												
	VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	<5.0	<5.0	<5.0	<5.0	to b	10.6	11.2	22.7
	EPH >C10-C16	mg/kg	5	320 [b]	29.4	8.8	12.4	5.7	<5.0	73.2	-	12
	EPH >C16-C21	mg/kg	5	NGA [b,c]	345	128	15.9	11.5	18.9	101	-	39.2
	EPH >C21-C32	mg/kg	5	NGA [b,c]	993	1,620	231	119	257	476	-	222
	>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	1338	1748	246.9	130.5	275.9	577	-	261.2
	EPH >C34-C50	mg/kg	20	3300 [b]	638	1,030	343	185	559	567	-	410
	Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	1370	1760	259	136	276	661	-	296
	Reached Baseline at C32	-	-	NGA	No	No	No	No	No	No	-	No
	Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	LOF	LOF	LOF	LOF	-	LOF

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	BH19		BH20	BH21	BH22	BH23	BH33	BH34
			Sample ID	BH19 0-0.15m		BH20 0-0.15m	BH21 0-0.15m	BH22 0-0.15m	H DUPC 0-0.15r	BH33 0-0.15m	BH34 0-0.15m
			Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
			Date	08 Nov 2023		08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023	09 Nov 2023
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable							
BTEX											
	Benzene	mg/kg	0.005	980 [a]	0.015	-	<0.0050	<0.0051	<0.0050	<0.0050	<0.0050	<0.0079
	Toluene	mg/kg	0.05	1,400 [a]	0.12	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Ethylbenzene	mg/kg	0.015	3,100 [a]	0.044 [1]	-	<0.015	<0.015	<0.015	<0.015	<0.015	<0.020
	Xylene (o)	mg/kg	0.03	NGA	0.061	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene (m & p)	mg/kg	0.03	NGA	0.098	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene Total	mg/kg	0.05	1,800 [a]	0.159	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)												
	VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	7.4	7.7	<5.0	6.3	<5.0	<5.0	<5.0	<5.0
	EPH >C10-C16	mg/kg	5	320 [b]	19.9	-	13.6	17.9	<5.0	8.2	<5.0	6.8
	EPH >C16-C21	mg/kg	5	NGA [b,c]	40.7	-	29	66.6	<5.0	21.6	8.7	27
	EPH >C21-C32	mg/kg	5	NGA [b,c]	297	-	249	1,530	16.4	174	132	311
	>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	337.7	-	278	1596.6	21.4	195.6	140.7	338
	EPH >C34-C50	mg/kg	20	3300 [b]	340	-	600	2,230	54	332	284	695
	Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	365	-	292	1620	16	204	141	345
	Reached Baseline at C32	-	-	NGA	No	-	No	No	No	No	No	No
	Hydrocarbon Resemblance	none	-	NGA	LOF	-	LOF	LOF	LOF	LOF	LOF	LOF

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

				Location	BH35	BH36	24 MW-02	24MW-03	24MW-04	24 MW-05	BH127	BH128
				Sample ID	BH35 0-0.15m	BH36 0-0.15m	24 MW-02-SS3 (1.2-1.6m)	24MW-03 SS3	24MW-04 SS1 (0-0.61m)	24 MW-05-SS1 (0-0.58m)	BH127 0.35M	BH128 0-0.15M
				Depth (m bgs)	0-0.15	0-0.15	1.2-1.6	0-1.2	0-0.61	0-0.58	0.35	0-0.15
				Date	09 Nov 2023	09 Nov 2023	16 Jan 2024	18 Jan 2024	18 Jan 2024	16 Jan 2024	22 May 2024	22 May 2024
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable								
BTEX												
	Benzene	mg/kg	0.005	980 [a]	<0.0075	<0.0057	<0.0050	<0.0050	<0.0050	<0.0050	0.0965	<0.0165
	Toluene	mg/kg	0.05	1,400 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.498	<0.064
	Ethylbenzene	mg/kg	0.015	3,100 [a]	<0.019	<0.015	<0.015	<0.015	<0.015	<0.015	0.093	<0.022
	Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.119	<0.030
	Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.212	<0.046
	Xylene Total	mg/kg	0.05	1,800 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.331	<0.055
Petroleum Hydrocarbons (PHCs)												
	VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	7.6	<5.0
	EPH >C10-C16	mg/kg	5	320 [b]	<5.0	9.6	<5.0	<5.0	<5.0	-	18.1	<48.5
	EPH >C16-C21	mg/kg	5	NGA [b,c]	12.8	51.4	<5.0	<5.0	<5.0	-	27.9	<48.5
	EPH >C21-C32	mg/kg	5	NGA [b,c]	152	378	<5.0	<5.0	<5.0	-	116	2,180
	>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	164.8	429.4	<5.0	<5.0	<5.0	-	143.9	2228.5
	EPH >C34-C50	mg/kg	20	3300 [b]	305	482	<20	<20	<20	-	164	12,100
	Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	165	439	<10	<10	<10	-	170	2180
	Reached Baseline at C32	-	-	NGA	No	No	Yes	Yes	Yes	-	No	No
	Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	N/A	N/A	N/A	-	LOF	LOF

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	BH129	BH130		BH131
			Sample ID	BH129 0-0.15M	BH130 0-0.15M	BH DUPH (FD: BH130 0-0.15M)	BH131 0-0.15M
			Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable				
BTEX							
Benzene	mg/kg	0.005	980 [a]	0.11	0.15	<0.0389	0.022
Toluene	mg/kg	0.05	1,400 [a]	1.02	1.00	0.178	<0.162
Ethylbenzene	mg/kg	0.015	3,100 [a]	0.63	0.30	<0.072	<0.039
Xylene (o)	mg/kg	0.03	NGA	0.68	0.45	0.092	0.065
Xylene (m & p)	mg/kg	0.03	NGA	1.34	0.76	<0.140	<0.108
Xylene Total	mg/kg	0.05	1,800 [a]	2.02	1.21	<0.156	<0.112
Petroleum Hydrocarbons (PHCs)							
VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	18	16.1	18.7	7.3
EPH >C10-C16	mg/kg	5	320 [b]	105	53	64.2	18.6
EPH >C16-C21	mg/kg	5	NGA [b,c]	614	71.8	92.5	33.7
EPH >C21-C32	mg/kg	5	NGA [b,c]	371	213	283	67.3
>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	985	284.8	375.5	101
EPH >C34-C50	mg/kg	20	3300 [b]	383	216	353	116
Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	1110	354	458	127
Reached Baseline at C32	-	-	NGA	No	No	No	No
Hydrocarbon Resemblance	none	-	NGA	LOF+FOF	LOF	LOF	LOF

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-3: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

				Data Summary							
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
BTEX											
Benzene	mg/kg	0.005	980 [a]	34	28	6	<0.0057	0.015	0.152	0.152	0
Toluene	mg/kg	0.05	1,400 [a]	34	28	6	<0.050	0.12	1.02	1.02	0
Ethylbenzene	mg/kg	0.015	3,100 [a]	34	29	4	<0.015	0.079	0.634	0.634	0
Xylene (o)	mg/kg	0.03	NGA	34	27	7	<0.030	0.061	0.678	0.678	0
Xylene (m & p)	mg/kg	0.03	NGA	34	29	5	<0.030	0.098	1.34	1.34	0
Xylene Total	mg/kg	0.05	1,800 [a]	34	29	5	<0.050	0.159	2.02	2.02	0
Petroleum Hydrocarbons (PHCs)											
VPH (C6-C10 - BTEX)	mg/kg	5	240 [b]	36	23	12	<5.0	5.4	22.7	22.7	0
EPH >C10-C16	mg/kg	5	320 [b]	33	14	19	<5.0	5.7	105	105	0
EPH >C16-C21	mg/kg	5	NGA [b,c]	33	7	26	<5.0	6.9	614	614	0
EPH >C21-C32	mg/kg	5	NGA [b,c]	33	5	28	<5.0	16.4	2180	2180	0
>C16-C21 + >C21-C32*	mg/kg	5	1,700 [b,c]	33	5	28	<5.0	21.4	2228.5	2228.5	2
EPH >C34-C50	mg/kg	20	3300 [b]	33	5	28	<20	54	12100	12100	1
Modified TPH (Tier 1)	mg/kg	10	13,000 [a]	33	5	28	<10	16	2180	2180	0
Reached Baseline at C32	-	-	NGA	33	0	0	0	-	-	-	0
Hydrocarbon Resemblance	none	-	NGA	33	0	0	0	-	-	-	0

Notes

Shaded cells denote an exceedance above the direct contact guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; LOF = lube oil fraction; FOF = fuel oil fraction.

Where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

* Calculated for guideline comparison.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2023). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Soil - Commercial Land Use.

[b] Canadian Council of Ministers of the Environment (CCME). (2008). Canada Wide Standards for Petroleum Hydrocarbons in Soil. Commercial Land Use, Coarse Soil, lowest of applicable pathways.

[c] Guideline applies to EPH >C16-C34.

Table C-4: Analytical data for energetics in soils for the former Country Harbour mine compared to human health-based soil quality guidelines.

										Data Summary							
			Location	BH 37	BH 38	BH 39	BH 40	BH 41									
			Sample ID	BH 37 0-0.15M	BH 38 0-0.15M	BH 39 0-0.15M	BH 40 0-0.15M	BH 41 0-0.15M									
			Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15									
			Date	19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	20 Jan 2024									
			Sample Area	Site	Site	Site	Site	Site									
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable						Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Energetics																	
1,3,5-Trinitrobenzene	mg/kg	0.05	1,800 [a]	<0.050	<0.050	<0.120	<0.750	<0.050	5	5	0	<0.050	-	<0.050	-	0
1,3-Dinitrobenzene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
2,4,6-Trinitrotoluene (TNT)	mg/kg	0.05	10 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
2,4-Dinitrotoluene	mg/kg	0.05	55 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
2,6-Dinitrotoluene	mg/kg	0.05	55 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
2-Amino-4,6-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
2-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
4-Amino-2,6-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
4-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
HMX	mg/kg	0.05	3,100 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
m-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
Nitrobenzene	mg/kg	0.05	76 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
Nitroglycerine	mg/kg	0.1	NGA	<0.10	<0.10	<0.10	<0.10	<0.10	5	5	0	<0.10	-	<0.10	-	0
PETN	mg/kg	0.1	430 [a]	<0.10	<0.10	<0.10	<0.10	<0.10	5	5	0	<0.10	-	<0.10	-	0
RDX	mg/kg	0.05	250 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
Tetryl	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0
3,5-Dinitroaniline	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	5	5	0	<0.050	-	<0.050	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

[a] Health Canada. (2020). Soil Screening Values - Fact Sheets. Commercial land use, toddler receptor, lowest of direct contact pathways, 10^{-5} threshold where applicable.

Table C-5: Analytical data for general chemistry in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	BH43	BH51	BH72	BH73	BH74	BH75
			Sample ID	BH 43 0-0.15m	BH 51 0-0.15m	BH72 0-0.15m	BH73 0-0.15m	BH74 0-0.15m	BH75 0-0.15m
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal
			Date	07 Nov 2023	10 Nov 2023	21 May 2024	21 May 2024	21 May 2024	23 May 2024
			Samplel Area	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable						
Physical Properties									
% >75um	%	1	NGA	36.6	56.4	57.7	40.2	61.4	54.3
Sieve Analysis - 75 µm (passing)	%	1	NGA	63.4	43.6	42.3	59.8	38.6	45.7
Texture	N/A		NGA	Fine	Coarse	Coarse	Fine	Coarse	Coarse
General Chemistry									
Fraction Organic Carbon (FOC)	g/g	0.001	NGA	-	-	0.019	0.0414	0.0483	0.0576
Total Organic Carbon (TOC)	mg/kg	1,000	NGA	-	-	19,000	41,400	48,300	57,600
pH (Lab)	pH Units	0.1	NGA	-	-	3.22	3.59	4.09	4.05

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Table C-5: Analytical data for general chemistry in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	BH76	BH77	BH78	BH79	BH80	BH81
			Sample ID	BH76 0-0.15m	BH77 0-0.15m	BH78 0-0.15m	BH79 0-0.15m	BH80 0-0.15m	BH81 0-0.15m
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024	24 May 2024	24 May 2024	23 May 2024	25 May 2024
			Samplel Area	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable						
Physical Properties									
% >75um	%	1	NGA	54.6	63.9	14.6	39.6	72.8	63.1
Sieve Analysis - 75 µm (passing)	%	1	NGA	45.4	36.1	85.4	60.4	27.2	36.9
Texture	N/A		NGA	Coarse	Coarse	Fine	Fine	Coarse	Coarse
General Chemistry									
Fraction Organic Carbon (FOC)	g/g	0.001	NGA	0.0161	0.0258	0.248	0.0742	0.0322	0.0464
Total Organic Carbon (TOC)	mg/kg	1,000	NGA	16,100	25,800	248,000	74,200	32,200	46,400
pH (Lab)	pH Units	0.1	NGA	3.5	4.43	3.84	3.36	3.82	4.09

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Table C-5: Analytical data for general chemistry in soil for the former Country Harbour mine compared to human health-based soil quality guidelines.

				Data Summary							
	Unit	RDL	Human Health-Based Soil Direct Contact Quality Guideline (SQG_{HH}) Commercial, Potable	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Physical Properties											
% >75um	%	1	NGA	12	0	12	14.6	14.6	72.8	72.8	0
Sieve Analysis - 75 µm (passing)	%	1	NGA	12	0	12	27.2	27.2	85.4	85.4	0
Texture	N/A		NGA	12	0	NA	NA	NA	NA	NA	0
General Chemistry											
Fraction Organic Carbon (FOC)	g/g	0.001	NGA	10	0	10	0.0161	0.0161	0.248	0.248	0
Total Organic Carbon (TOC)	mg/kg	1,000	NGA	10	0	10	16100	16100	248000	248000	0
pH (Lab)	pH Units	0.1	NGA	10	0	10	3.22	3.22	4.43	4.43	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Table C-6: Analytical data for metals in groundwater for the former Country Harbour mine compared to human health-based groundwater quality guidelines.

Location	Unit	RDL	Human Health-Based Groundwater Quality Guideline	24MW-01			24MW-02			24MW-03		24MW-04		24MW-05		Site Sample Summary							
Sample Type				Normal	24MW-DUPA (FD: 24MW-01)	Normal	Normal	Normal	24MW-DUPB (FD: 24MW-02)	Normal	Normal	Normal	Normal	Normal	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Date				19 Jan 2024	19 Jan 2024	22 May 2024	18 Jan 2024	22 May 2024	22 May 2024	20 Jan 2024	22 May 2024	20 Jan 2024	22 May 2024	19 Jan 2024	22 May 2024								
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site								
Metals																							
Aluminium	mg/L	0.001	2.9 [a] (MAC)	-	-	0.259	-	0.22	0.497	-	0.0556	-	1.38	-	0.122	6	0	6	0.0556	0.0556	1.38	1.38	0
Aluminium (filtered)	mg/L	0.001	2.9 [a] (MAC)	0.0564	0.0558	0.208	0.167	0.19	0.185	0.0458	0.0172	0.0826	0.0629	0.0312	0.07	12	0	12	0.0172	0.0172	0.208	0.208	0
Antimony	mg/L	0.0001	0.006 [a]	-	-	<0.00010	-	<0.00010	<0.00010	-	<0.00010	-	0.0006	-	0.00011	6	4	2	<0.00010	0.00011	0.0006	0.0006	0
Antimony (filtered)	mg/L	0.0001	0.006 [a]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0004	0.00053	<0.00010	0.0001	12	9	3	<0.00010	0.0001	0.00053	0.00053	0
Arsenic	mg/L	0.0001	0.01 [a] (ALARA)	-	-	0.00017	-	0.0395	0.195	-	0.0391	-	0.0273	-	0.0123	6	0	6	0.00017	0.00017	0.195	0.195	5
Arsenic (filtered)	mg/L	0.0001	0.01 [a] (ALARA)	0.00013	0.00014	<0.00010	0.0422	0.0368	0.0342	0.0296	0.0121	0.00173	0.00161	0.0272	0.0118	12	1	11	<0.00010	0.00013	0.0422	0.0422	7
Barium	mg/L	0.0001	2 [a] (MAC)	-	-	0.007	-	0.00612	0.00737	-	0.00579	-	0.0201	-	0.0105	6	0	6	0.00579	0.00579	0.0201	0.0201	0
Barium (filtered)	mg/L	0.0001	2 [a] (MAC)	0.00698	0.00714	0.00732	0.00023	0.00591	0.00604	0.01	0.00587	0.0144	0.0127	0.00367	0.0105	12	0	12	0.00023	0.00023	0.0144	0.0144	0
Beryllium	mg/L	0.00002	0.004 [b]	-	-	0.000052	-	0.000163	0.000231	-	0.000048	-	0.000204	-	0.000056	6	0	6	0.000048	0.000048	0.000231	0.000231	0
Beryllium (filtered)	mg/L	0.00002	0.004 [b]	0.000036	0.000035	0.000042	0.000038	0.000151	0.000165	0.000033	0.000041	0.000064	0.000058	0.000059	0.000058	12	0	12	0.000033	0.000033	0.000165	0.000165	0
Bismuth	mg/L	0.00005	NGA	-	-	<0.000050	-	<0.000050	0.000096	-	0.000155	-	0.000054	-	<0.000050	6	3	3	<0.000050	0.000054	0.000155	0.000155	0
Bismuth (filtered)	mg/L	0.00005	NGA	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00032	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	12	11	1	<0.000050	0.00032	0.00032	0.00032	0
Boron	mg/L	0.01000	5 [a] (MAC)	-	-	<0.010	-	<0.010	<0.010	-	<0.010	-	<0.010	-	<0.010	6	6	0	<0.010	-	<0.010	-	0
Boron (filtered)	mg/L	0.01	5 [a] (MAC)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	12	12	0	<0.010	-	<0.010	-	0
Cadmium	mg/L	0.000005	0.007 [a] (MAC)	-	-	0.0000331	-	0.0000958	0.00011	-	0.000321	-	0.000102	-	0.000109	6	0	6	0.0000331	0.0000331	0.000321	0.000321	0
Cadmium (filtered)	mg/L	0.000005	0.007 [a] (MAC)	0.0000317	0.0000334	0.0000298	<0.0000050	0.000095	0.0000922	0.000176	0.000301	0.0000941	0.0000869	0.0000559	0.000116	12	1	11	<0.0000050	0.0000298	0.000301	0.000301	0
Calcium	mg/L	0.050000	NR [a, d]	-	-	0.268	-	1.44	1.42	-	2.63	-	3.95	-	0.793	6	0	6	0.268	0.268	3.95	3.95	0
Calcium (filtered)	mg/L	0.05	NR [a, d]	0.725	0.702	0.254	<0.050	1.34	1.34	2.86	2.58	2.6	2.82	0.978	0.761	12	1	11	<0.050	0.254	2.86	2.86	0
Chromium (Total, III+VI)	mg/L	0.0005	0.05 [a] (MAC)	-	-	<0.00050	-	<0.00050	0.00084	-	<0.00050	-	0.00095	-	<0.00050	6	4	2	<0.00050	0.00084	0.00095	0.00095	0
Chromium (Total, III+VI) (filtered)	mg/L	0.0005	0.05 [a] (MAC)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	12	12	0	<0.00050	-	<0.00050	-	0
Cobalt	mg/L	0.0001	0.003 [b]	-	-	0.00175	-	0.00045	0.0005	-	0.0047	-	0.00245	-	0.00963	6	0	6	0.00045	0.00045	0.00963	0.00963	2
Cobalt (filtered)	mg/L	0.0001	0.003 [b]	0.00453	0.00449	0.00168	<0.00010	0.00041	0.00043	0.00336	0.00437	0.0009	0.00058	0.0065	0.00898	12	1	11	<0.00010	0.00041	0.00898	0.00898	6
Copper	mg/L	0.0002	2 [a] (MAC)	-	-	0.0673	-	0.00728	0.0101	-	0.012	-	0.0558	-	0.00178	6	0	6	0.00178	0.00178	0.0673	0.0673	0
Copper (filtered)	mg/L	0.0002	2 [a] (MAC)	0.0102	0.0104	0.0677	0.00428	0.00612	0.00593	0.00695	0.00931	0.00262	0.0082	0.00162	0.00066	12	0	12	0.00066	0.00066	0.0677	0.0677	0
Iron	mg/L	0.0100	2.8 [c]	-	-	1.3	-	0.537	4.16	-	0.379	-	1.34	-	0.832	6	0	6	0.379	0.379	4.16	4.16	1
Iron (filtered)	mg/L	0.01	2.8 [c]	3.79	3.84	0.846	0.063	0.46	0.433	0.245	0.08	0.08	0.01	0.509	0.735	12	0	12	0.01	0.01	3.84	3.84	2
Lead	mg/L	0.00005	0.005 [a] (ALARA)	-	-	0.00007	-	0.00472	0.0207	-	0.00144	-	0.00197	-	0.000621	6	0	6	0.00007	0.00007	0.0207	0.0207	1
Lead (filtered)	mg/L	0.00005	0.005 [a] (ALARA)	<0.000050	<0.000050	<0.000050	0.00222	0.0029	0.00268	0.000674	0.00012	0.000099	0.000064	0.000219	0.00042	12	3	9	<0.000050	0.000064	0.0029	0.0029	0
Magnesium	mg/L	0.00500	NR [a, d]	-	-	0.33	-	0.527	0.542	-	1.22	-	0.928	-	0.565	6	0	6	0.33	0.33	1.22	1.22	0
Magnesium (filtered)	mg/L	0.005	NR [a, d]	0.429	0.418	0.324	0.0171	0.507	0.512	1.01	1.22	0.682	0.529	0.294	0.55	12	0	12	0.0171	0.0171	1.22	1.22	0
Manganese	mg/L	0.0001	0.12 [a] (MAC)	-	-	0.144	-	0.0427	0.0451	-	0.34	-	0.0929	-	0.317	6	0	6	0.0427	0.0427	0.34	0.34	3
Manganese (filtered)	mg/L	0.0001	0.12 [a] (MAC)	0.556	0.543	0.138	0.00138	0.0406	0.0401	0.315	0.314	0.0452	0.0444	0.19	0.296	12	0	12	0.00138	0.00138	0.556	0.556	7
Mercury	mg/L	0.000005	0.001 [a] (MAC)	-	-	<0.0000050	-	<0.0000050	<0.0000050	-	<0.0000050	-	0.0000699	-	0.0000474	6	4	2	<0.0000050	0.0000474	0.0000699	0.0000699	0
Mercury (filtered)	mg/L	0.000005	0.001 [a] (MAC)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.000011	0.0000069	0.0000357	0.0000185	12	8	4	<0.0000050	0.0000069	0.0000357	0.0000357	0
Molybdenum	mg/L	0.00005	0.07 [b]	-	-	0.000059	-	0.000151	0.000257	-	0.000728	-	0.000091	-	0.000332	6	0	6	0.000059	0.000059	0.000728	0.000728	0
Molybdenum (filtered)	mg/L	0.00005	0.07 [b]	0.000294	0.00027	<0.000050	0.000382	0.000158	0.00014	0.00073	0.00066	0.000062	0.000072	0.000809	0.000281	12	1	11	<0.000050	0.000062	0.000809	0.000809	0
Nickel	mg/L	0.00050	0.1 [b]	-	-	0.00617	-	<0.00050	0.00058	-	0.00322	-	0.0045	-	0.00318	6	1	5	<0.00050	0.00058	0.00617	0.00617	0
Nickel (filtered)	mg/L	0.0005	0.1 [b]	0.00334	0.00332	0.00609	<0.00050	<0.00050	<0.00050	0.00322	0.00281	0.00258	0.00165	0.00405	0.003	12	3	9	<0.00050	0.00165	0.00609	0.00609	0
Silica (SiO_2) (filtered)	mg/L	0.21	NGA	3.74	3.7	3.29	7.68	6.87	7.29	4.38	9.84	3.72	8.08	5.07	4.86	12	0	12	3.29	3.29	9.84	9.84	0
Potassium	mg/L	0.05	NGA	-	-	0.231	-	0.316	0.338	-	0.62	-	1.74	-	0.658	6	0	6	0.231	0.231	1.74	1.74	0
Potassium (filtered)	mg/L	0.05	NGA	0.616	0.612	0.233	0.247	0.312	0.314	0.885	0.612	1.3	1.26	0.727	0.635	12	0	12	0.233	0.233	1.3	1.3	0
Selenium	mg/L	0.00005	0.05 [a] (MAC)	-	-	<0.000050	-	0.00011	0.000188	-	<0.000050	-	0.000074	-	<0.000050	6	3	3	<0.000050	0.000074	0.000188	0.000188	0
Selenium (filtered)	mg/L	0.00005	0.05 [a] (MAC)	0.000056	0.000053	0.000054	0.000163	0.000097	0.000113	<0.000050	<0.000050	0.000066	0.000074	0.00006	<0.000050	12	3	9	<0.000050	0.000053	0.000163	0.000163	0
Cesium	mg/L	0.00001	NGA	-	-	0.000019	-	0.000117	0.000172	-	0.000662	-	0.000854	-	0.000113	6	0	6	0.000019	0.000019	0.000854	0.000854	0
Cesium (filtered)	mg/L	0.00001	NGA	0.000023	0.000021	0.000015	0.000014	0.000115	0.000114	0.000177	0.000638	0.000176	0.000198	0.000035	0.000115	12	0	12	0.000014	0.000014	0.000638	0.000638	0
Rubidium	mg/L	0.00020	NGA	-	-	0.00119	-	0.00155	0.00183	-	0.00266	-	0.00867	-	0.00294	6	0	6	0.00119	0.00119	0.00867	0.00867	0
Rubidium (filtered)	mg/L	0.0002	NGA	0.00212	0.00208	0.00106	0.00058	0.00152	0.00155	0.00303	0.0026	0.00413	0.0041	0.00192	0.00288	12	0	12	0.00058	0.00058	0.00413	0.00413	0
Tellurium	mg/L	0.0002	NGA	-	-	<0.00020	-	<0.00020	<0.00020	-	<0.00020	-	<0.00020	-	<0.00020	6	6	0	<0.00020	-	<0.00020	-	0
Tellurium (filtered)	mg/L	0.0002	NGA	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	12	12	0	<0.00020	-	<0.00020	-	0
Thorium	mg/L	0.0001	NGA	-	-	<0.00010	-	0.00011	0.00041	-	<0.00010	-	0.00019	-	<0.00010	6	3	3	<0.00010	0.00011	0.00041	0.00041	0
Thorium (filtered)	mg/L	0.0001	NGA	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	12	11	1	<0.00010	0.00012	0.00012	0.00012	0
Tungsten	mg/L	0.0001	0.0032 [c]	-	-	0.00964	-	0.00117	0.00647	-	0.00547	-	0.0644	-	0.00056	6	0	6	0.00056	0.00056	0.0644	0.0644	4
Tungsten (filtered)	mg/L	0.0001	0.0032 [c]	0.0103	0.01	0.00168	0.00631	0.00104	0.00096	0.00619	0.00378	0.0186	0.00761	0.00418	0.00033	12	0	12	0.00033	0.00033	0.0186	0.0186	8
Lithium	mg/L	0.0010	0.008 [c]	-	-	<0.0010	-	0.002	0.0019	-	0.0049	-	0.0051	-	<0.0010	6	2	4	<0.0010	0.0019	0.0051	0.0051	0
Lithium (filtered)	mg/L	0.001	0.008 [c]	0.0014	0.0013	0.0013	0.003	0.0025	0.0026	0.0035	0.0055	0.0016	<0.0010	0.0017	0.0011	12	1	11	<0.0010	0.0011	0.0055	0.0055	0
Silver	mg/L	0.00001	0.0188 [c]	-	-	0.000521	-	0.000098	0.000156	-	0.00008	-	0.000952	-	<0.000010	6	1	5	<0.000010	0.00008	0.000952	0.000952	0
Silver (filtered)	mg/L	0.00001	0.0188 [c]	<0.000010	<0.000010	0.000417	0.000017	0.00005	0.000048	<0.000010	<0.000010	<0.000010	0.000014	<0.000010	<0.000010	12	7	5	<0.000010	0.000014	0.000417	0.000417	0
Silicon	mg/L	0.05	NGA	-	-	1.54	-	3.21	3.41	-	4.6	-	3.78	-	2.27	6	0	6	1.54	1.54	4.6	4.6	0
Silicon (filtered)	mg/L	0.05	NGA	1.75	1.73	1.5	3.59	3.22	3.28	2.05	4.56	1.74	2.08	2.37	2.28	12	0	12	1.5	1.5	4.56	4.56	0
Sodium	mg/L	0.05	200 [a] (AO)	-	-	3.16	-	4.4	4.38	-	5.37	-	3.25	-	3.95	6	0	6	3.16	3.16	5.37	5.37	0
Sodium (filtered)	mg/L	0.05	200 [a] (AO)	3.29	3.24	3.05	8.81	4.36	4.34	3.93	5.17	3.07	3.04	6.76	3.8	12	0	12	3.04	3.04	8.81	8.81	0
Strontium	mg/L	0.0002	7 [a] (MAC)	-	-	0.00296	-	0.0111	0.0115	-	0.0154	-	0.0337	-	0.0086	6	0	6	0.00296	0.00296	0.0337	0.0337	0
Strontium (filtered)	mg/L	0.0002	7 [a] (MAC)	0.00782	0.00745	0.00282	0.00036	0.0106	0.0104	0.0102	0.0152	0.0195	0.0232	0.00972	0.00813	12	0	12	0.00036	0.00036	0.0232	0.0232	0
Sulphur as S	mg/L	0.5000	500 [a] (AO)	-	-	<0.50	-	0.69	0.7	-	0.79	-	0.78	-	0.89	6	1	5	<0.50	0.69	0.89	0.89	0
Sulphur as S (filtered)	mg/L	0.5	500 [a] (AO)	0.6	0.6	<0.50	1	0.86	0.76	0.64	0.82	0.9	0.83	1.04	0.95	12	1	11	<0.50	0.6	1.04	1.04	0
Titanium	mg/L	0.0003	NGA	-	-	0.00037	-	0.00122	0.00422	-	<0.00090	-	0.0459	-	0.00045	6	1	5	<0.00090	0.00037	0.0459	0.0459	0
Titanium (filtered)	mg/L	0.0003	NGA	<0.00030	<0.00030	<0.00030	0.00115	0.00093	0.00087	0.00051	<0.00030	0.00057	<0.00030	<0.00030	<0.00030	12	7	5	<0.00030	0.00051	0.00115	0.00115	0
Thallium	mg/L	0.00001	0.002 [b]	-	-	0.00001	-	<0.000010	<0.000010	-	0.000012	-	<0.000050	-	0.000036	6	3	3	<0.000010	0.00001	0.000036	0.000036	0
Thallium (filtered)	mg/L	0.00001	0.002 [b]	0.000013	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	0.000012	0.000014	0.000013	0.000016	0.000031	12	4	8	<0.000010	0.000012	0.000031	0.000031	0
Tin	mg/L	0.0001	2.4 [c]	-	-	<0.00010	-	<0.00010	0.00018	-	<0.00010	-	0.00029	-	<0.00010	6	4	2	<0.00010	0.00018	0.00029	0.00029	0
Tin (filtered)	mg/L	0.0001	2.4 [c]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	12	12	0	<0.00010	-	<0.00010	-	0
Uranium	mg/L	0.0000	0.02 [a] (MAC)	-	-	0.000044	-	0.00753	0.0144	-	0.000486	-	0.000414	-	0.000119	6	0	6	0.000044	0.000044	0.0144	0.0144	0
Uranium (filtered)	mg/L	0.00001	0.02 [a] (MAC)	0.000082	0.000076	0.00003	0.00417	0.00616	0.00608	0.000214	0.000313	0.00015	0.000193	0.000176	0.000089	12	0	12	0.00003	0.00003	0.00616	0.00616	0
Vanadium	mg/L	0.0005	0.0062 [b]	-	-	<0.00050	-	<0.00050	0.0014	-	<0.00050	-	0.00127	-	<0.00050	6	4	2	<0.00050	0.00127	0.0014	0.0014	0
Vanadium (filtered)	mg/L	0.0005	0.0062 [b]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	12	12	0	<0.00050	-	<0.00050	-	0
Zinc	mg/L	0.001	1.2 [c]	-	-	0.0491	-	0.0223	0.0235	-	0.0662	-	0.0496	-	0.0154	6	0	6	0.0154	0.0154	0.0662	0.0662	0
Zinc (filtered)	mg/L	0.001	1.2 [c]	0.0237	0.0238	0.0513	0.0016	0.0222	0.0222	0.0255	0.0685	0.0125	0.0154	0.0099	0.0152	12	0	12	0.0016	0.0016	0.0685	0.0685	0
Zirconium	mg/L	0.0002	0.00032 [c]	-	-	<0.00020	-	<0.00020	<0.00020	-	<0.00020	-	<0.00020	-	<0.00020	6	6	0	<0.00020	-	<0.00020	-	0
Zirconium (filtered)	mg/L	0.0002	0.00032 [c]	<0.00020	<0.00020	<0.00030	<0.00020	<0.00030	<0.00030	<0.00020	<0.00030	<0.00020	<0.00030	<0.00020	<0.00030	12	12	0	<0.00020	-	<0.00020	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; OG = operational guidance value; ALARA = as low as reasonably achievable; MAC = maximum acceptable concentration; AO = aesthetic objective.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water (Table 6C). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines and values were updated accordingly, as required. The original sources are indicated below.

[a] Health Canada. (2024). Guidelines for Canadian Drinking Water Quality - Summary Tables August, 2024. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[b] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Groundwater Components for Potable Water Scenario, Coarse Textured Soil (GW1), within 30 m of a surface water body (Table 8). Standards Development Branch, Ontario Ministry of the Environment.

[c] United States Environmental Protection Agency (US EPA). (2024). Regional Screening Level (RSL) Resident Tapwater Table (TR=1E-06, HQ=1), May 2024.
Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2 for non-carcinogens. For carcinogens, values have been convereted from 1 in 1,000,000 to 1 in 100,000 risk level.

[d] Not required, no evidence of health effects in drinking water (Health Canada, 2024).

Table C-7: Analytical data for PAHs in groundwater for the former Country Harbour mine compared to human health-based groundwater quality guidelines.

			Location	24MW-01		24MW-02	24MW-03	24MW-04	24MW-05
			Sample Type	Normal	24MW-DUPA (FD: 24MW-01)	Normal	Normal	Normal	Normal
			Date	19 Jan 2024		18 Jan 2024	20 Jan 2024	20 Jan 2024	19 Jan 2024
			Sample Area	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Groundwater Quality Guideline						
Polycyclic Aromatic Hydrocarbons (PAHs)									
1-Methylnaphthalene	mg/L	0.00001	0.012 [a]	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010
2-Methylnaphthalene	mg/L	0.00001	0.012 [a]	<0.000010	<0.000010	0.00002	<0.000010	<0.000010	<0.000010
1 & 2 Methylnaphthalene	mg/L	0.000015	0.012 [a]	<0.000015	<0.000015	0.000033	<0.000015	<0.000015	<0.000015
Acenaphthene	mg/L	0.00001	1.4 [b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acenaphthylene	mg/L	0.00001	0.0045 [a,c]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acridine	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Anthracene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benz(a)anthracene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(a)pyrene	mg/L	0.000005	0.00004 [d (MAC)]	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000080	<0.0000050
Benzo(b+j)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	0.000015	NGA	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
Benzo(g,h,i)perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(k)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chrysene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dibenz(a,h)anthracene	mg/L	0.000005	NGA	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Fluorene	mg/L	0.00001	0.94 [b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Fluoranthene	mg/L	0.00001	0.15 [e]	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Naphthalene	mg/L	0.00001	0.47 [b]	<0.000010	<0.000010	0.000015	<0.000010	<0.000010	<0.000010
Perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Phenanthrene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	0.000019	<0.000010
Pyrene	mg/L	0.00001	0.71 [b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Quinoline	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
B(A)P TPE[f]	mg/L	0.00001	0.00004 [d,e]	0.0000157	0.0000157	0.0000157	0.0000157	0.0000187	0.0000157

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; MAC = maximum acceptable concentration.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water, within 30 m of a surface water body (Table 8). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Groundwater Components for Potable Water Scenario, Coarse Textured Soil (GW1). Standards Development Branch, Ontario Ministry of the Environment.

[b] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Groundwater Remediation Guideline Values for Commercial/Industrial - All Water Uses (Potable; Table B-4). Lands Policy and Programs Branch, Government of Alberta.

[c] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk level.

[d] Health Canada. (2019; updated 2024). Guidelines for Canadian Drinking Water Quality - Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[e] No Health Canada Drinking Water Quality Guideline was available for B(a)P TPE; however, since the guideline for benzo(a)pyrene is based on a carcinogenic endpoint (stomach tumours) and B(a)P TPE values are calculated from benzo(a)pyrene potency equivalent factors using a cancer endpoint (see note *f*), this guideline was applied to both parameters.

[f] Calculated using CCME 2010 total potency equivalents factors (PEFs) and then summing the products as in the following equation: [benzo(a)pyrene*1 + benzo(a)anthracene*0.1 + benzo(b+j+k)fluoranthene*0.1 + benzo(g,h,i)perylene*0.01 + chrysene*0.01 + dibenz(a,h)anthracene*1 + indeno(1,2,3-c,d)pyrene*0.1]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to the RDL (full RDL). In instances where all contributing parameters are < RDL, B(a)P TPE is reported as < RDL.

[g] BC CSR (Contaminated Sites Regulation). Schedule 3.2. Generic Numerical Water Standards. Drinking Water (applies to unfilteres samples at point of consumption). Last amended March 1, 2023 and consolidation current to September 24, 2024.

Table C-7: Analytical data for PAHs in groundwater for the former Country Harbour mine compared to human health-based groundwater quality guidelines.

	Unit	RDL	Human Health-Based Groundwater Quality Guideline	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Polycyclic Aromatic Hydrocarbons (PAHs)											
1-Methylnaphthalene	mg/L	0.00001	0.012 [a]	6	5	1	<0.000010	0.000013	0.000013	0.000013	0
2-Methylnaphthalene	mg/L	0.00001	0.012 [a]	6	5	1	<0.000010	0.00002	0.00002	0.00002	0
1 & 2 Methylnaphthalene	mg/L	0.000015	0.012 [a]	6	5	1	<0.000015	0.000033	0.000033	0.000033	0
Acenaphthene	mg/L	0.00001	1.4 [b]	6	6	0	<0.000010	-	<0.000010	-	0
Acenaphthylene	mg/L	0.00001	0.0045 [a,c]	6	6	0	<0.000010	-	<0.000010	-	0
Acridine	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Anthracene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benz(a)anthracene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(a)pyrene	mg/L	0.000005	0.00004 [d (MAC)]	6	6	0	<0.0000050	-	<0.0000050	-	0
Benzo(b+j)fluoranthene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(b+j+k)fluoranthene	mg/L	0.000015	NGA	6	6	0	<0.000015	-	<0.000015	-	0
Benzo(g,h,i)perylene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(k)fluoranthene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Chrysene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Dibenz(a,h)anthracene	mg/L	0.000005	NGA	6	6	0	<0.0000050	-	<0.0000050	-	0
Fluorene	mg/L	0.00001	0.94 [b]	6	6	0	<0.000010	-	<0.000010	-	0
Fluoranthene	mg/L	0.00001	0.15 [e]	6	5	1	<0.000010	0.000014	0.000014	0.000014	0
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Naphthalene	mg/L	0.00001	0.47 [b]	6	5	1	<0.000010	0.000015	0.000015	0.000015	0
Perylene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Phenanthrene	mg/L	0.00001	NGA	6	5	1	<0.000010	0.000019	0.000019	0.000019	0
Pyrene	mg/L	0.00001	0.71 [b]	6	6	0	<0.000010	-	<0.000010	-	0
Quinoline	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
B(A)P TPE[f]	mg/L	0.00001	0.00004 [d,e]	6	0	6	0.0000157	0.0000157	0.0000187	0.0000187	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; MAC = maximum acceptable concentration.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water, within 30 m of a surface water body (Table 8). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Groundwater Components for Potable Water Scenario, Coarse Textured Soil (GW1). Standards Development Branch, Ontario Ministry of the Environment.

[b] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Groundwater Remediation Guideline Values for Commercial/Industrial - All Water Uses (Potable; Table B-4). Lands Policy and Programs Branch, Government of Alberta.

[c] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer risk level.

[d] Health Canada. (2019; updated 2024). Guidelines for Canadian Drinking Water Quality - Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

[e] No Health Canada Drinking Water Quality Guideline was available for B(a)P TPE; however, since the guideline for benzo(a)pyrene is based on a carcinogenic endpoint (stomach tumours) and B(a)P TPE values are calculated from benzo(a)pyrene potency equivalent factors using a cancer endpoint (see note *f*), this guideline was applied to both parameters.

[f] Calculated using CCME 2010 total potency equivalents factors (PEFs) and then summing the products as in the following equation: [benzo(a)pyrene*1 + benzo(a)anthracene*0.1 + benzo(b+j+k)fluoranthene*0.1 + benzo(g,h,i)perylene*0.01 + chrysene*0.01 + dibenz(a,h)anthracene*1 + indeno(1,2,3-c,d)pyrene*0.1]. In instances where the reported concentration was below the RDL, it was assumed that the concentration was equal to the RDL (full RDL). In instances where all contributing parameters are < RDL, B(a)P TPE is reported as < RDL.

[g] BC CSR (Contaminated Sites Regulation). Schedule 3.2. Generic Numerical Water Standards. Drinking Water (applies to unfilteres samples at point of consumption). Last amended March 1, 2023 and consolidation current to September 24, 2024.

Table C-8: Analytical data for BTEX and PHCs in groundwater for the former Country Harbour mine compared to human health-based grondwater quality guidelines.

			Location	24MW-01		24MW-02	24MW-03	24MW-04	24MW-05	Data Summary							
			Sample Type	Normal	24MW-DUPA (FD: 24MW-01)	Normal	Normal	Normal	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
			Date	19 Jan 2024		18 Jan 2024	20 Jan 2024	20 Jan 2024	19 Jan 2024								
			Sample Area	Site	Site	Site	Site	Site	Site								
	Unit	RDL	Human Health-Based Groundwater Quality Guideline														
BTEX																	
Benzene	mg/L	0.0005	0.005 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	6	6	0	<0.00050	-	<0.00050	-	0
Toluene	mg/L	0.0005	0.024 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	6	6	0	<0.00050	-	<0.00050	-	0
Ethylbenzene	mg/L	0.0005	0.0016 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	6	6	0	<0.00050	-	<0.00050	-	0
Xylene (o)	mg/L	0.0003	NGA	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	6	6	0	<0.00030	-	<0.00030	-	0
Xylene (m & p)	mg/L	0.0004	NGA	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	6	6	0	<0.00040	-	<0.00040	-	0
Xylene Total	mg/L	0.0005	0.02 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	6	6	0	<0.00050	-	<0.00050	-	0
Petroleum Hydrocarbons (PHCs)																	
VPH (C6-C10 - BTEX)	mg/L	0.025	NGA	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	6	6	0	<0.025	-	<0.025	-	0
EPH >C10-C16	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	6	6	0	<0.050	-	<0.050	-	0
EPH >C16-C21	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	6	6	0	<0.050	-	<0.050	-	0
EPH >C21-C32	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	6	6	0	<0.050	-	<0.050	-	0
EPH >C34-C50	mg/L	0.10	NGA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	6	6	0	<0.10	-	<0.10	-	0
Modified TPH (Tier 1)	mg/L	0.09	3.2 [a,b]	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	6	6	0	<0.090	-	<0.090	-	0
Reached Baseline at C32	-		NGA	Yes	Yes	Yes	Yes	Yes	Yes	6	0	0	0	-	-	-	0
Hydrocarbon Resemblance	none		NGA	NA	NA	NA	NA	NA	NA	6	0	0	0	-	-	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; NA = not applicable.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water (Table 6C). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] Atlantic Risk-Based Corrective Action (RBCA). (2021, updated 2022). Human Health-Based Tier II Pathway-Specific Standards (PSS) for Groundwater - Commercial Land Use.

[b] Most conservative guideline applied (gasoline) given no reported resemblances.

Table C-9: Analytical data for general chemistry in groundwater for the former Country Harbour mine compared to human health-based groundwater quality guidelines.

				Location	24MW-01			24MW-02			24MW-03		24MW-04		24MW-05	
				Sample Type	Normal	24MW-DUPA (FD: 24MW-01)	Normal	Normal	Normal	24MW-DUPB (FD: 24MW-02)	Normal	Normal	Normal	Normal	Normal	Normal
				Date	19 Jan 2024		22 May 2024	18 Jan 2024	22 May 2024		20 Jan 2024	22 May 2024	20 Jan 2024	22 May 2024	19 Jan 2024	22 May 2024
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Groundwater Quality Guideline													
Calculated Parameters																
Anions Total (filtered)	meq/L	0.1	NGA		0.28	0.29	0.21	0.43	0.3	0.3	0.48	0.48	0.39	0.36	0.42	0.28
Cations Total (filtered)	meq/L	0.1	NGA		0.39	0.39	0.27	0.41	0.36	0.52	0.45	0.52	0.37	0.67	0.42	0.33
Ionic Balance (filtered)	%	0.01	NGA		139	134	128	95.3	120	173	93.8	108	94.9	186	100	118
Langelier Index (@ 20C)	N/A	0.01	NGA		-4.33	-4.43	-5.46	Incalculable	-3.57	-3.62	-2.78	-2.66	-2.78	-2.79	-3.99	-4.28
Langelier Index (@ 4C)	N/A	0.01	NGA		-4.58	-4.68	-5.7	Incalculable	-3.82	-3.87	-3.03	-2.91	-3.03	-3.04	-4.25	-4.53
Saturation pH (@ 4C)	N/A	0.01	NGA		11	11	11.9	Incalculable	10.6	10.6	10	10	10.2	9.97	10.5	11.1
Saturation pH (@ 20C)	N/A	0.01	NGA		10.7	10.7	11.7	Incalculable	10.4	10.4	9.76	9.75	9.93	9.72	10.3	10.8
General Chemistry																
Carbonate	mg/L	1	NGA		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (total)	mg/L	1	NGA		5	5.4	1.5	10.8	5.8	5.7	11.9	13.6	8.9	9.4	10.7	3.6
Bicarbonate	mg/L	1	NGA		6.1	6.6	1.8	13.2	7	6.9	14.5	16.6	10.9	11.5	13	4.4
Hardness as CaCO3 (Measured)	mg/L	0.5	NGA		3.58	3.47	2.03	<0.50	5.76	5.78	11.3	11.6	9.3	13.7	3.65	4.31
Ammonia as N	mg/L	0.005	NGA		0.0066	0.0054	<0.0050	0.0328	0.0053	0.0059	0.0113	<0.0050	0.0296	0.015	0.023	0.0092
Total Organic Carbon (TOC)	mg/L	0.5	NGA		2.14	1.82	1.15	4.65	2.92	2.94	2.27	0.83	2.55	2.5	2.04	1.56
Ortho Phosphate as P (filtered)	mg/L	0.001	NGA		<0.0010	<0.0010	<0.0010	0.0299	0.0053	0.0045	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	mg/L		NGA		-	-	<0.050	-	<0.050	0.057	-	<0.050	-	0.057	-	<0.050
Phosphorus (filtered)	mg/L	0.05	NGA		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride	mg/L	0.02	1.5 [a (MAC)]		<0.020	<0.020	<0.020	0.1	0.083	0.083	0.026	0.059	0.026	<0.020	0.024	<0.020
Chloride (filtered)	mg/L	0.5	250 [a (AO)]		5.26	5.24	5.1	5.12	4.82	4.83	7.11	5.41	5.46	4.09	5.34	5.27
Color	CU	2.0	15 [a (AO)]		112	117	16.5	258	35.9	36	30.8	15.9	13.9	117	302	30.1
Electrical Conductivity (Lab)	µS/cm	1	NGA		33.5	34.6	24.6	49.1	36.1	35.6	53.3	54	45.3	41.8	48.6	34.3
Hydroxide	mg/L	1	NGA		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrate (as N)	mg/L	0.02	10 [a (MAC)]		<0.020	<0.020	<0.020	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.01	1 [a (MAC)]		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrite + Nitrate as N	mg/L	0.0224	NGA		<0.0224	<0.0224	<0.0224	0.025	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224
pH (Lab)	pH Units	0.1	NGA		6.4	6.28	6.21	6.36	6.8	6.77	6.98	7.09	7.15	6.93	6.29	6.55
Sulphate (filtered)	mg/L	0.3	500 [a (AO)]		1.68	1.65	1.65	2.88	2.36	2.32	1.84	2.71	2.54	2.6	2.82	2.97
Total Dissolved Solids (TDS) - Measured	mg/L	10	500 [a (AO)]		26	27	20	85	32	33	31	39	31	29	44	25
Turbidity	NTU	0.1	NGA		6.38	6.33	3.55	109	1.38	1.41	3.62	2.62	2.25	24.2	35	2.2

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; AO = aesthetic objective.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water (Table 6C). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] Health Canada. (2019; updated 2024). Guidelines for Canadian Drinking Water Quality - Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Table C-9: Analytical data for general chemistry in groundwater for the former Country Harbour mine compared to human health-based groundwater quality guidelines.

	Unit	RDL	Human Health-Based Groundwater Quality Guideline	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Calculated Parameters											
Anions Total (filtered)	meq/L	0.1	NGA	12	0	12	0.21	0.21	0.48	0.48	0
Cations Total (filtered)	meq/L	0.1	NGA	12	0	12	0.27	0.27	0.67	0.67	0
Ionic Balance (filtered)	%	0.01	NGA	12	0	12	93.8	93.8	186	186	0
Langelier Index (@ 20C)	N/A	0.01	NGA	12	0	11	-5.46	-5.46	-2.66	-2.66	0
Langelier Index (@ 4C)	N/A	0.01	NGA	12	0	11	-5.7	-5.7	-2.91	-2.91	0
Saturation pH (@ 4C)	N/A	0.01	NGA	12	0	11	9.97	9.97	11.9	11.9	0
Saturation pH (@ 20C)	N/A	0.01	NGA	12	0	11	9.72	9.72	11.7	11.7	0
General Chemistry											
Carbonate	mg/L	1	NGA	12	12	0	<1.0	-	<1.0	-	0
Alkalinity (total)	mg/L	1	NGA	12	0	12	1.5	1.5	13.6	13.6	0
Bicarbonate	mg/L	1	NGA	12	0	12	1.8	1.8	16.6	16.6	0
Hardness as CaCO3 (Measured)	mg/L	0.5	NGA	12	1	11	<0.50	2.03	13.7	13.7	0
Ammonia as N	mg/L	0.005	NGA	12	2	10	<0.0050	0.0053	0.0328	0.0328	0
Total Organic Carbon (TOC)	mg/L	0.5	NGA	12	0	12	0.83	0.83	4.65	4.65	0
Ortho Phosphate as P (filtered)	mg/L	0.001	NGA	12	8	4	<0.0010	0.0015	0.0299	0.0299	0
Phosphorus	mg/L		NGA	6	4	2	<0.050	0.057	0.057	0.057	0
Phosphorus (filtered)	mg/L	0.05	NGA	12	12	0	<0.050	-	<0.050	-	0
Fluoride	mg/L	0.02	1.5 [a (MAC)]	12	5	7	<0.020	0.024	0.1	0.1	0
Chloride (filtered)	mg/L	0.5	250 [a (AO)]	12	0	12	4.09	4.09	7.11	7.11	0
Color	CU	2.0	15 [a (AO)]	12	0	12	13.9	13.9	302	302	11
Electrical Conductivity (Lab)	µS/cm	1	NGA	12	0	12	24.6	24.6	54	54	0
Hydroxide	mg/L	1	NGA	12	12	0	<1.0	-	<1.0	-	0
Nitrate (as N)	mg/L	0.02	10 [a (MAC)]	12	11	1	<0.020	0.025	0.025	0.025	0
Nitrite (as N)	mg/L	0.01	1 [a (MAC)]	12	12	0	<0.010	-	<0.010	-	0
Nitrite + Nitrate as N	mg/L	0.0224	NGA	12	11	1	<0.0224	0.025	0.025	0.025	0
pH (Lab)	pH Units	0.1	NGA	12	0	12	6.21	6.21	7.15	7.15	0
Sulphate (filtered)	mg/L	0.3	500 [a (AO)]	12	0	12	1.65	1.65	2.97	2.97	0
Total Dissolved Solids (TDS) - Measured	mg/L	10	500 [a (AO)]	12	0	12	20	20	85	85	0
Turbidity	NTU	0.1	NGA	12	0	12	1.38	1.38	109	109	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate; AO = aesthetic objective.

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards for Groundwater - Commercial Land Use, Potable Groundwater Drinking Water (Table 6C). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] Health Canada. (2019; updated 2024). Guidelines for Canadian Drinking Water Quality - Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Table C-10: Analytical data for metals in sediment for the former Country Harbour mine compared to human health-based soil quality guidelines.

	Location		SED16	SED17	*Local Background Minimum*	*Local Background Maximum*	SED1	SED2	SED3		SED4	SED5	SED6
	Sample ID		SED16	SED17			SED1	SED2	SED3	SED-DUPA (FD: SED3)	SED4	SED5	SED6
	Date		23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023		06 Nov 2023	06 Nov 2023	22 May 2024
	Sample Area		Background	Background			Site	Site	Site	Site	Site	Site	Site
	Unit	RDL											
Metals													
Aluminium	mg/kg	50	3410	4000	3410	4000	11400	9720	19300	18900	22600	12400	12300
Antimony	mg/kg	0.1	<0.10	<0.10	<0.10	<0.10	1.8	4.68	0.44	1.6	1.18	0.33	4.46
Arsenic	mg/kg	2	49.5	8.21	8.21	49.5	2050	5640	1440	5120	4410	1490	8770
Barium	mg/kg	0.5	21.3	35.7	21.3	35.7	63.3	82	113	254	285	85.8	70.8
Beryllium	mg/kg	0.1	0.17	0.34	0.17	0.34	0.71	0.5	1.1	1.11	1.39	0.49	<2.00
Bismuth	mg/kg	0.2	<0.20	<0.20	<0.20	<0.20	-	-	-	-	-	-	<4.00
Boron	mg/kg	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100
Cadmium	mg/kg	0.02	0.022	0.227	0.022	0.227	0.088	0.064	0.098	0.186	0.218	0.054	<0.400
Calcium	mg/kg	50.00	163	1380	163	1380	-	-	-	-	-	-	<1,000
Chromium (Total, III+VI)	mg/kg	0.5	6.26	2.27	2.27	6.26	19.6	20.9	38.7	34.1	38.3	26.7	22.8
Cobalt	mg/kg	0.1	1.86	1.06	1.06	1.86	15.3	5.76	67.3	120	93.5	53.5	20.8
Copper	mg/kg	0.5	1.16	4.71	1.16	4.71	7.51	4.61	10.3	11.8	26.5	5.19	<10.0
Iron	mg/kg	50	10600	3080	3080	10600	28200	25100	37800	42700	58000	35900	30400
Lead	mg/kg	0.5	12	23.4	12	23.4	57.3	60.4	74.4	124	110	78.8	52.4
Lithium	mg/kg	2.0	6.9	<2.0	6.9	6.9	-	-	-	-	-	-	<40.0
Magnesium	mg/kg	20.0	1190	455	455	1190	-	-	-	-	-	-	6660
Manganese	mg/kg	1	155	54.5	54.5	155	1210	403	3950	6270	4550	2410	1040
Mercury	mg/kg	0.005	0.0195	0.156	0.0195	0.156	2.38	3.21	0.314	0.616	0.24	0.0233	0.738
Molybdenum	mg/kg	0.1	0.65	0.56	0.56	0.65	0.69	0.45	0.91	1.41	5.87	1.33	<2.00
Nickel	mg/kg	0.5	3.04	2.37	2.37	3.04	10.6	8.88	17.1	16.3	18	10.7	19.6
Potassium	mg/kg	100.0	1000	210	210	1000	-	-	-	-	-	-	4410
Selenium	mg/kg	0.2	0.27	1.41	0.27	1.41	0.2	0.28	0.28	0.41	1.07	0.38	*<4.00* [#1]
Tungsten	mg/kg	0.5	<0.50	<0.50	<0.50	<0.50	-	-	-	-	-	-	<10.0
Silver	mg/kg	0.1	<0.10	0.1	0.1	0.1	<0.10	0.2	<0.10	0.12	0.2	<0.10	*<2.00* [#1]
Sodium	mg/kg	50.0	<50	160	160	160	-	-	-	-	-	-	<1,000
Strontium	mg/kg	0.5	2.43	18.8	2.43	18.8	1.88	2.84	2.65	3.91	11.6	2.44	<10.0
Sulphur as S	mg/kg	1,000	<500	3000	3000	3000	<500	1600	<500	<500	<500	<500	<10000
Titanium	mg/kg	1	321	34.1	34.1	321	-	-	-	-	-	-	878
Thallium	mg/kg	0.05	0.076	<0.050	0.076	0.076	0.213	0.174	0.377	0.593	0.548	0.232	<1.00
Tin	mg/kg	2	<2.0	<2.0	<2.0	<2.0	<2.0	3	<2.0	6.7	<2.0	<2.0	<40.0
Uranium	mg/kg	0.05	0.624	0.859	0.624	0.859	0.901	0.958	1.23	1.26	1.49	0.791	<1.00
Vanadium	mg/kg	0.2	10.3	3.1	3.1	10.3	26.3	23.3	49.9	47.6	53.2	37	28.4
Zinc	mg/kg	2	12.9	12.2	12.2	12.9	53.9	45.7	88.7	89.6	109	62.4	44.1
Zirconium	mg/kg	1	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<20.0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

[#1] Detection limit raised due to high concentration of test analytes.

Given that there are no human health-based sediment criteria or guidelines established by a Canadian jurisdiction, where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Soil Components for within 30 m of a Water Body, Potable Water Scenario. Standards

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer

[f] Provisional SQG_{HH}.

Table C-10: Analytical data for metals in sediment for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	SED8	SED9	SED10	SED11	SED12	SED13		SED14	SED15
			Sample ID	SED8	SED9	SED10	SED11	SED12	SED13	SED - Dup CHQAOC04	SED14	SED15
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024		22 May 2024	22 May 2024
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL										
Metals												
Aluminium	mg/kg	50		17100	11400	15500	17100	14500	12400	14900	16500	16500
Antimony	mg/kg	0.1		<2.00	<2.00	<2.00	<2.00	<2.00	0.19	0.18	0.18	0.11
Arsenic	mg/kg	2		1200	1050	1660	2400	4400	418	373	561	651
Barium	mg/kg	0.5		443	87.4	105	162	120	62.7	71.7	96.6	93.9
Beryllium	mg/kg	0.1		<2.00	<2.00	<2.00	<2.00	<2.00	0.59	0.68	0.75	0.59
Bismuth	mg/kg	0.2		<4.00	<4.00	<4.00	<4.00	<4.00	0.29	0.26	0.32	<0.20
Boron	mg/kg	5		<100	<100	<100	<100	<100	<5.0	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02		<0.400	<0.400	<0.400	<0.400	<0.400	0.162	0.086	0.112	0.046
Calcium	mg/kg	50.00		<1,000	<1,000	<1,000	<1,000	<1,000	715	603	591	609
Chromium (Total, III+VI)	mg/kg	0.5		26.6	19.6	29.9	30	22.8	20.3	24.4	27.8	29.5
Cobalt	mg/kg	0.1		56.4	93.3	29.8	71.7	93.1	21.9	8.12	21	8.61
Copper	mg/kg	0.5		12.5	<10.0	<10.0	22.4	15.1	7.7	7.51	9.35	6.58
Iron	mg/kg	50		28900	25500	31300	44400	38800	21300	22600	28000	28700
Lead	mg/kg	0.5		75.2	78.4	50.1	85.4	107	63.2	58.9	63.1	29.4
Lithium	mg/kg	2.0		48.2	<40.0	<40.0	<40.0	<40.0	26.1	30.3	36.5	37.1
Magnesium	mg/kg	20.0		8100	5300	8310	8540	6470	5370	6580	6950	8490
Manganese	mg/kg	1		4340	6910	1870	4420	5840	1290	572	1160	463
Mercury	mg/kg	0.005		0.352	0.489	0.925	0.226	0.202	0.145	0.173	0.056	0.0335
Molybdenum	mg/kg	0.1		<2.00	<2.00	<2.00	2.09	<2.00	1.07	0.83	0.96	0.38
Nickel	mg/kg	0.5		13.6	12.5	12.8	13.8	11	9.17	10.4	17.1	18.7
Potassium	mg/kg	100.0		4990	3480	5170	5610	4440	3380	4190	4140	6530
Selenium	mg/kg	0.2		*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	1.06	1.06	0.87	0.2
Tungsten	mg/kg	0.5		<10.0	<10.0	<10.0	<10.0	<10.0	<0.50	<0.50	<0.50	<0.50
Silver	mg/kg	0.1		*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	0.14	0.16	0.12	<0.10
Sodium	mg/kg	50.0		<1,000	<1,000	<1,000	<1,000	<1,000	107	102	100	112
Strontium	mg/kg	0.5		<10.0	<10.0	<10.0	<10.0	<10.0	6.52	4.57	4.51	2.51
Sulphur as S	mg/kg	1,000		<10000	<10000	<10000	<10000	<10000	600	<500	<500	<500
Titanium	mg/kg	1		943	835	1200	1130	759	687	853	1170	1150
Thallium	mg/kg	0.05		<1.00	<1.00	<1.00	<1.00	<1.00	0.204	0.209	0.261	0.231
Tin	mg/kg	2		<40.0	<40.0	<40.0	<40.0	<40.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05		1.67	1.27	<1.00	1.04	1.12	1.06	1.16	1.21	0.758
Vanadium	mg/kg	0.2		31.9	26.2	37.3	41.6	38.2	25.7	28.2	39.9	34.9
Zinc	mg/kg	2		65	59.6	57.6	72.4	62.8	60.8	61.9	84.1	59.9
Zirconium	mg/kg	1		<20.0	<20.0	<20.0	<20.0	<20.0	<1.0	<1.0	<1.0	<1.0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

[#1] Detection limit raised due to high concentration of test analytes.

Given that there are no human health-based sediment criteria or guidelines established by a Canadian jurisdiction, where applicable, guidelines were applied from the Nova Scotia Tier II Pathway-Specific Standards for Soil - Commercial Land Use, Table 3C (Soil Contact/Ingestion). Where the original source has been updated more recently than the NS PSS, the original source was consulted to confirm up to date guidelines. The original sources are indicated below.

[a] United States Environmental Protection Agency (US EPA). (2019; updated 2024). Regional Screening Level (RSL) Resident Soil Table (TR=1E-06, HQ=1), lowest of ingestion, dermal, and inhalation pathways, May 2024.

[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

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[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer

[f] Provisional SQG_{HH}.

Table C-10: Analytical data for metals in sediment for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Data Summary						
			Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
	Unit	RDL							
Metals									
Aluminium	mg/kg	50	16	0	16	9720	9720	22600	22600
Antimony	mg/kg	0.1	16	5	11	<2.00	0.11	4.68	4.68
Arsenic	mg/kg	2	16	0	16	373	373	8770	8770
Barium	mg/kg	0.5	16	0	16	62.7	62.7	443	443
Beryllium	mg/kg	0.1	16	6	10	<2.00	0.49	1.39	1.39
Bismuth	mg/kg	0.2	10	7	3	<4.00	0.26	0.32	0.32
Boron	mg/kg	5	16	16	0	<5.0	-	<5.0	-
Cadmium	mg/kg	0.02	16	6	10	<0.400	0.046	0.218	0.218
Calcium	mg/kg	50.00	10	6	4	<1,000	591	715	715
Chromium (Total, III+VI)	mg/kg	0.5	16	0	16	19.6	19.6	38.7	38.7
Cobalt	mg/kg	0.1	16	0	16	5.76	5.76	120	120
Copper	mg/kg	0.5	16	3	13	<10.0	4.61	26.5	26.5
Iron	mg/kg	50	16	0	16	21300	21300	58000	58000
Lead	mg/kg	0.5	16	0	16	29.4	29.4	124	124
Lithium	mg/kg	2.0	10	5	5	<40.0	26.1	48.2	48.2
Magnesium	mg/kg	20.0	10	0	10	5300	5300	8540	8540
Manganese	mg/kg	1	16	0	16	403	403	6910	6910
Mercury	mg/kg	0.005	16	0	16	0.0233	0.0233	3.21	3.21
Molybdenum	mg/kg	0.1	16	5	11	<2.00	0.38	5.87	5.87
Nickel	mg/kg	0.5	16	0	16	8.88	8.88	19.6	19.6
Potassium	mg/kg	100.0	10	0	10	3380	3380	6530	6530
Selenium	mg/kg	0.2	16	6	10	<4.00 #1	0.2	1.07	1.07
Tungsten	mg/kg	0.5	10	10	0	<10.0	-	<10.0	-
Silver	mg/kg	0.1	16	10	6	<0.10	0.12	0.2	0.2
Sodium	mg/kg	50.0	10	6	4	<1,000	100	112	112
Strontium	mg/kg	0.5	16	6	10	<10.0	1.88	11.6	11.6
Sulphur as S	mg/kg	1,000	16	14	2	<500	600	1600	1600
Titanium	mg/kg	1	10	0	10	687	687	1200	1200
Thallium	mg/kg	0.05	16	6	10	<1.00	0.174	0.593	0.593
Tin	mg/kg	2	16	14	2	<2.0	3	6.7	6.7
Uranium	mg/kg	0.05	16	2	14	<1.00	0.758	1.67	1.67
Vanadium	mg/kg	0.2	16	0	16	23.3	23.3	53.2	53.2
Zinc	mg/kg	2	16	0	16	44.1	44.1	109	109
Zirconium	mg/kg	1	10	10	0	<20.0	-	<20.0	-

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_{HH} = soil quality guideline for the protection of human health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

[#1] Detection limit raised due to high concentration of test analytes.

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[b] Original US EPA value has been divided by 5 to adjust from a target hazard quotient of 1.0 to a target hazard quotient of 0.2.

[c] Ontario Ministry of the Enviroment and Climate Change (MOECC). (2011). Rationale for the Development of Soil and Groundwater Standards for Use at Contaminated Sites in Ontario: Soil Components for within 30 m of a Water Body, Potable Water Scenario. Standards

[d] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Human Health

[e] Value has been adjusted from its original jurisdictional value to reflect a 1×10^{-5} target cancer

[f] Provisional SQG_{HH}.

Table C-11: Analytical data for BTEX and PHCs in sediment for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Location	SED1	SED2	SED3		SED4	SED5
			Sample ID	SED1	SED2	SED3	SED-DUPA (FD: SED3)	SED4	SED5
			Date	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023
			Sample Area	Site	Site	Site	Site	Site	Site
		Unit	RDL						
BTEX									
	Benzene	mg/kg	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Toluene	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Ethylbenzene	mg/kg	0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
	Xylene (o)	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene (m & p)	mg/kg	0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene Total	mg/kg	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)									
	VPH (C6-C10 - BTEX)	mg/kg	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Table C-11: Analytical data for BTEX and PHCs in sediment for the former Country Harbour mine compared to human health-based soil quality guidelines.

			Data Summary						
	Unit	RDL	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
BTEX									
Benzene	mg/kg	0.005	6	6	0	<0.0050	-	<0.0050	-
Toluene	mg/kg	0.05	6	6	0	<0.050	-	<0.050	-
Ethylbenzene	mg/kg	0.015	6	6	0	<0.015	-	<0.015	-
Xylene (o)	mg/kg	0.03	6	6	0	<0.030	-	<0.030	-
Xylene (m & p)	mg/kg	0.03	6	6	0	<0.030	-	<0.030	-
Xylene Total	mg/kg	0.05	6	6	0	<0.050	-	<0.050	-
Petroleum Hydrocarbons (PHCs)									
VPH (C6-C10 - BTEX)	mg/kg	5	6	6	0	<5.0	-	<5.0	-

Table C-12: Analytical data for general chemistry in sediment for the former Country Harbour mine.

	Location		SED16	SED17			SED6	SED8	SED9	SED10	SED11	SED12	SED13		SED14	SED15
	Sample ID		SED16	SED17	*Local Background Minimum*	*Local Background Maximum*	SED6	SED8	SED9	SED10	SED11	SED12	SED13	SED - Dup CHQAOC04	SED14	SED15
	Date		23 May 2024	23 May 2024			22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024		22 May 2024	22 May 2024
	Sample Area		Background	Background			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL														
General Chemistry																
Fraction Organic Carbon (f_{OC})	g/g	0.001	0.0212	0.334	0.0212	0.334	0.0119	0.0427	0.022	0.0107	0.0876	0.106	0.109	0.0845	0.0577	0.0257
Total Organic Carbon (TOC)	mg/kg	1,000	21,200	334,000	21200	334000	11,900	42,700	22,000	10,700	87,600	106,000	109,000	84,500	57,700	25,700
Phosphorus	mg/kg	50	332	647	332	647	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	560	576	518	414
Grain Size																
passing (0.002 mm)	%	1	-	-	-	-	1.2	-	-	-	-	-	-	-	-	1.3
passing (0.004 mm)	%	1	-	-	-	-	1.2	-	-	-	-	-	-	-	-	1.3
passing (0.005 mm)	%	1	-	-	-	-	1.2	-	-	-	-	-	-	-	-	1.3
passing (0.020 mm)	%	1	-	-	-	-	1.2	-	-	-	-	-	-	-	-	1.7
passing (0.0312 mm)	%	1	-	-	-	-	1.5	-	-	-	-	-	-	-	-	2.5
passing (0.05 mm)	%	1	-	-	-	-	1.7	-	-	-	-	-	-	-	-	3.4
passing (0.063 mm)	%	1	-	-	-	-	1.5	-	-	-	-	-	-	-	-	4.2
passing (0.075 mm)	%	1	-	-	-	-	1.3	-	-	-	-	-	-	-	-	5.1
passing (0.125 mm)	%	1	-	-	-	-	1.9	-	-	-	-	-	-	-	-	6.8
passing (0.149 mm)	%	1	-	-	-	-	2.2	-	-	-	-	-	-	-	-	7.6
passing (0.250 mm)	%	1	-	-	-	-	3.7	-	-	-	-	-	-	-	-	10.7
passing (0.420 mm)	%	1	-	-	-	-	7	-	-	-	-	-	-	-	-	17.1
passing (0.50 mm)	%	1	-	-	-	-	7.9	-	-	-	-	-	-	-	-	19.4
passing (0.841 mm)	%	1	-	-	-	-	11.6	-	-	-	-	-	-	-	-	28.7
passing (1.0 mm)	%	1	-	-	-	-	14.2	-	-	-	-	-	-	-	-	33.4
passing (19 mm)	%	1	-	-	-	-	100	-	-	-	-	-	-	-	-	100
passing (2.0 mm)	%	1	-	-	-	-	30.9	-	-	-	-	-	-	-	-	63.3
passing (25.4 mm)	%	1	-	-	-	-	100	-	-	-	-	-	-	-	-	100
passing (38.1 mm)	%	1	-	-	-	-	100	-	-	-	-	-	-	-	-	100
passing (4.75 mm)	%	1	-	-	-	-	64	-	-	-	-	-	-	-	-	84.6
passing (50.8 mm)	%	1	-	-	-	-	100	-	-	-	-	-	-	-	-	100
passing (76.2 mm)	%	1	-	-	-	-	100	-	-	-	-	-	-	-	-	100
passing (9.5 mm)	%	1	-	-	-	-	95	-	-	-	-	-	-	-	-	94.7

Table C-12: Analytical data for general chemistry in sediment for the former Country Harbour mine.

	Unit	RDL	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
General Chemistry									
Fraction Organic Carbon (f_{OC})	g/g	0.001	10	0	10	0.0107	0.0107	0.109	0.109
Total Organic Carbon (TOC)	mg/kg	1,000	10	0	10	10700	10700	109000	109000
Phosphorus	mg/kg	50	10	6	4	<1,000	414	576	576
Grain Size									
passing (0.002 mm)	%	1	2	0	2	1.2	1.2	1.3	1.3
passing (0.004 mm)	%	1	2	0	2	1.2	1.2	1.3	1.3
passing (0.005 mm)	%	1	2	0	2	1.2	1.2	1.3	1.3
passing (0.020 mm)	%	1	2	0	2	1.2	1.2	1.7	1.7
passing (0.0312 mm)	%	1	2	0	2	1.5	1.5	2.5	2.5
passing (0.05 mm)	%	1	2	0	2	1.7	1.7	3.4	3.4
passing (0.063 mm)	%	1	2	0	2	1.5	1.5	4.2	4.2
passing (0.075 mm)	%	1	2	0	2	1.3	1.3	5.1	5.1
passing (0.125 mm)	%	1	2	0	2	1.9	1.9	6.8	6.8
passing (0.149 mm)	%	1	2	0	2	2.2	2.2	7.6	7.6
passing (0.250 mm)	%	1	2	0	2	3.7	3.7	10.7	10.7
passing (0.420 mm)	%	1	2	0	2	7	7	17.1	17.1
passing (0.50 mm)	%	1	2	0	2	7.9	7.9	19.4	19.4
passing (0.841 mm)	%	1	2	0	2	11.6	11.6	28.7	28.7
passing (1.0 mm)	%	1	2	0	2	14.2	14.2	33.4	33.4
passing (19 mm)	%	1	2	0	2	100	100	100	100
passing (2.0 mm)	%	1	2	0	2	30.9	30.9	63.3	63.3
passing (25.4 mm)	%	1	2	0	2	100	100	100	100
passing (38.1 mm)	%	1	2	0	2	100	100	100	100
passing (4.75 mm)	%	1	2	0	2	64	64	84.6	84.6
passing (50.8 mm)	%	1	2	0	2	100	100	100	100
passing (76.2 mm)	%	1	2	0	2	100	100	100	100
passing (9.5 mm)	%	1	2	0	2	94.7	94.7	95	95

Table C-13: Analytical data for metals in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW16	SW17	*Local Background Minimum*	*Local Background Maximum*	SW1	SW2	SW3		SW4	SW5	CHQAQC03
			Sample Type	Normal	Normal			Normal	Normal	Normal	SW DUP A (FD: SW3)	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	22 May 2024
			Sample Area	Background	Background			Site	Site	Site	Site	Site	Site	Site
		Unit	RDL											
Metals														
	Aluminium	mg/L	0.003	0.233	0.138	0.138	0.233	0.194	0.325	0.227	0.228	0.226	0.218	0.132
	Aluminium (filtered)	mg/L	0.001	0.12	0.127	0.12	0.127	-	-	-	-	-	-	0.12
	Antimony	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Antimony (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-	-	<0.00010
	Arsenic	mg/L	0.0001	0.0013	0.00028	0.00028	0.0013	0.0355	0.0633	0.0467	0.0473	0.0505	0.0558	0.031
	Arsenic (filtered)	mg/L	0.0001	0.00088	0.00026	0.00026	0.00088	-	-	-	-	-	-	0.0301
	Barium	mg/L	0.0001	0.00286	0.002	0.002	0.00286	0.00392	0.00484	0.00419	0.00414	0.00359	0.00392	0.00244
	Barium (filtered)	mg/L	0.0001	0.0021	0.00201	0.00201	0.0021	-	-	-	-	-	-	0.00246
	Beryllium	mg/L	0.00002	0.000022	<0.000020	0.000022	0.000022	0.00004	0.000067	0.000037	0.000042	0.000034	0.000032	0.00002
	Beryllium (filtered)	mg/L	0.00002	0.00002	<0.000020	0.00002	0.00002	-	-	-	-	-	-	0.000023
	Bismuth	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Bismuth (filtered)	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	-	-	-	-	-	-	<0.000050
	Boron	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Boron (filtered)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-	-	<0.010
	Cadmium	mg/L	0.000005	0.0000155	0.0000142	0.0000142	0.0000155	0.0000289	0.0000341	0.000034	0.0000314	0.0000255	0.0000269	0.0000154
	Cadmium (filtered)	mg/L	0.000005	0.0000131	0.0000128	0.0000128	0.0000131	-	-	-	-	-	-	0.0000161
	Calcium	mg/L	0.1	0.376	0.364	0.364	0.376	0.586	0.368	0.58	0.584	0.43	0.503	0.382
	Calcium (filtered)	mg/L	0.05	0.357	0.337	0.337	0.357	-	-	-	-	-	-	0.472
	Chromium (Total, III+VI)	mg/L	0.0005	0.0005	<0.00050	0.0005	0.0005	<0.00050	0.00159	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Total, III+VI) (filtered)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-	-	<0.00050
	Cobalt	mg/L	0.0001	0.0001	<0.00010	0.0001	0.0001	0.00025	0.00034	0.00044	0.00047	0.00132 [1]	0.00092	0.00039
	Cobalt (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-	-	0.00033
	Copper	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.00059	<0.00050	0.00086	0.00084	<0.00050	0.00083	<0.00050
	Copper (filtered)	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-	-	-	-	0.00026
	Iron	mg/L	0.01	0.399	0.233	0.233	0.399	0.252	0.609	0.391	0.394	0.562	0.621	0.218
	Iron (filtered)	mg/L	0.01	0.188	0.213	0.188	0.213	-	-	-	-	-	-	0.182
	Lead	mg/L	0.00005	0.000879	0.00038	0.00038	0.000879	0.000539	0.00208	0.000722	0.000722	0.00132 [1]	0.00109 [1]	0.000412
	Lead (filtered)	mg/L	0.00005	0.000306	0.000335	0.000306	0.000335	-	-	-	-	-	-	0.000354
	Magnesium	mg/L	0.005	0.316	0.292	0.292	0.316	0.373	0.347	0.402	0.403	0.352	0.377	0.3
	Magnesium (filtered)	mg/L	0.005	0.288	0.282	0.282	0.288	-	-	-	-	-	-	0.285
	Manganese	mg/L	0.0001	0.0141	0.014	0.014	0.0141	0.0284	0.0447	0.0454	0.0462	0.105	0.0811	0.0315
	Manganese (filtered)	mg/L	0.0001	0.0134	0.0135	0.0134	0.0135	-	-	-	-	-	-	0.0291
	Mercury	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000141	0.000023	0.0000177	0.0000195	0.0000054	<0.0000050	<0.0000050
	Mercury (filtered)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	-	-	-	-	-	<0.0000050
	Molybdenum	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (filtered)	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	-	-	-	-	-	-	<0.000050
	Nickel	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	0.0009	<0.00050	0.00115	0.00114	<0.00050	0.00051	<0.00050
	Nickel (filtered)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-	-	<0.00050
	Silica (SiO2)	mg/L	0.21	6.42	6.2	6.2	6.42	5.3	5.86	5.26	5.3	5.58	5.73	3.72
	Potassium	mg/L	0.05	0.345	0.337	0.337	0.345	0.319	0.323	0.339	0.34	0.317	0.366	0.281
	Potassium (filtered)	mg/L	0.05	0.327	0.328	0.327	0.328	-	-	-	-	-	-	0.282
	Selenium	mg/L	0.00005	0.000127	0.000093	0.000093	0.000127	0.000086	0.000118	0.000092	0.000098	0.000091	0.000108	0.000092
	Selenium (filtered)	mg/L	0.00005	0.000103	0.000123	0.000103	0.000123	-	-	-	-	-	-	0.000059
	Cesium	mg/L	0.00001	0.000142	0.000047	0.000047	0.000142	0.000108	0.000131	0.000124	0.000121	0.000092	0.000083	0.000069
	Cesium (filtered)	mg/L	0.00001	0.000042	0.000047	0.000042	0.000047	-	-	-	-	-	-	0.000065
	Rubidium	mg/L	0.0002	0.00172	0.00152	0.00152	0.00172	0.00158	0.00175	0.0016	0.00166	0.00161	0.00177	0.00145
	Rubidium (filtered)	mg/L	0.0002	0.00146	0.00151	0.00146	0.00151	-	-	-	-	-	-	0.0014
	Tellurium	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tellurium (filtered)	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	-	-	-	-	-	-	<0.00020
	Thorium	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thorium (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-	-	<0.00010
	Tungsten	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tungsten (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-	-	<0.00010
	Lithium	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (filtered)	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-	-	<0.0010
	Silver	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Silver (filtered)	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-	-	-	<0.000010
	Silicon	mg/L	0.1	3	2.9	2.9	3	2.48	2.74	2.46	2.48	2.61	2.68	1.74
	Silicon (filtered)	mg/L	0.05	2.8	2.75	2.75	2.8	-	-	-	-	-	-	1.64
	Sodium	mg/L	0.05	3.35	3.4	3.35	3.4	3.26	3.35	3.21	3.33	3.2	3.33	3.3
	Sodium (filtered)	mg/L	0.05	3.18	3.17	3.17	3.18	-	-	-	-	-	-	3.29
	Strontium	mg/L	0.0002	0.00451	0.00386	0.00386	0.00451	0.0056	0.00462	0.00562	0.00568	0.00462	0.00535	0.00408
	Strontium (filtered)	mg/L	0.0002	0.00415	0.00379	0.00379	0.00415	-	-	-	-	-	-	0.00403
	Sulphur as S	mg/L	0.5	0.65	0.6	0.6	0.65	0.61	0.56	0.53	0.51	<0.50	0.5	0.7
	Sulphur as S (filtered)	mg/L	0.5	<0.50	0.51	0.51	0.51	-	-	-	-	-	-	0.63
	Titanium	mg/L	0.0003	0.0112	0.002	0.002	0.0112	0.00156	0.0115	0.00211	0.00187	0.00437	0.0035	0.00157
	Titanium (filtered)	mg/L	0.0003	0.0018	0.00171	0.00171	0.0018	-	-	-	-	-	-	0.0012
	Thallium	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	0.000012	0.000011	<0.000010	<0.000010
	Thallium (filtered)	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-	-	-	<0.000010
	Tin	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-	-	<0.00010
	Uranium	mg/L	0.00001	0.000033	0.000021	0.000021	0.000033	0.000123	0.000261	0.000043	0.000044	0.000038	0.000039	0.000024
	Uranium (filtered)	mg/L	0.00001	0.000018	0.000018	0.000018	0.000018	-	-	-	-	-	-	0.000022
	Vanadium	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Vanadium (filtered)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	-	-	-	-	-	-	<0.00050
	Zinc	mg/L	0.003	<0.0030	<0.0030	<0.0030	<0.0030	0.0063	0.005	0.0073	0.0075	0.0045	0.0088	0.0032
	Zinc (filtered)	mg/L	0.001	0.0027	0.0028	0.0027	0.0028	-	-	-	-	-	-	0.0046
	Zirconium	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Zirconium (filtered)	mg/L	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	-	-	-	-	-	-	<0.00030

Table C-13: Analytical data for metals in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW6	SW7	SW8	SW9	SW10	SW12	SW13	SW14	SW15
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	04 Jun 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL									
Metals												
	Aluminium	mg/L	0.003	0.119	0.12	0.126	0.138	0.142	0.182	0.186	0.131	0.131
	Aluminium (filtered)	mg/L	0.001	0.118	0.117	0.116	0.134	0.135	0.169	0.12	0.126	0.121
	Antimony	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Antimony (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic	mg/L	0.0001	0.0276	0.0295	0.0298	0.031	0.0328	0.0347	0.0394	0.0315	0.0263
	Arsenic (filtered)	mg/L	0.0001	0.0275	0.0293	0.0289	0.0306	0.0318	0.0346	0.0293	0.0313	0.0264
	Barium	mg/L	0.0001	0.00301	0.00304	0.00301	0.00331	0.00325	0.00295	0.00316	0.00243	0.00244
	Barium (filtered)	mg/L	0.0001	0.00309	0.00307	0.00303	0.00329	0.00321	0.00304	0.00281	0.00249	0.00239
	Beryllium	mg/L	0.00002	0.000029	0.00003	0.000024	0.000027	0.000028	0.00003	0.000024	0.000026	0.000021
	Beryllium (filtered)	mg/L	0.00002	0.000034	0.000033	0.000022	0.00002	0.000025	0.000026	<0.000020	<0.000020	<0.000020
	Bismuth	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Bismuth (filtered)	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Boron (filtered)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium	mg/L	0.000005	0.0000182	0.0000211	0.0000166	0.0000234	0.000022	0.0000202	0.0000195	0.0000144	0.0000138
	Cadmium (filtered)	mg/L	0.000005	0.000016	0.00002	0.0000155	0.0000234	0.0000234	0.0000199	0.0000156	0.0000168	0.0000149
	Calcium	mg/L	0.1	0.564	0.583	0.712	0.55	0.526	0.447	0.412	0.384	0.398
	Calcium (filtered)	mg/L	0.05	0.565	0.588	0.704	0.553	0.509	0.419	0.393	0.371	0.373
	Chromium (Total, III+VI)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	<0.00050	<0.00050
	Chromium (Total, III+VI) (filtered)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt	mg/L	0.0001	0.00012	0.00013	0.0002	0.00027	0.00032	0.00044	0.001	0.00038	0.00038
	Cobalt (filtered)	mg/L	0.0001	<0.00010	0.00011	0.00011	0.00022	0.00022	0.00023	0.00026	0.00035	0.00036
	Copper	mg/L	0.0005	<0.00050	<0.00050	0.00053	0.00056	0.00058	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (filtered)	mg/L	0.0002	0.00042	0.00041	0.00049	0.00061	0.00052	0.00027	0.00023	<0.00020	<0.00020
	Iron	mg/L	0.01	0.11	0.124	0.131	0.163	0.192	0.318	0.379	0.219	0.214
	Iron (filtered)	mg/L	0.01	0.093	0.102	0.1	0.134	0.152	0.259	0.152	0.187	0.183
	Lead	mg/L	0.00005	0.000352	0.000353	0.000404	0.000456	0.000506	0.000782	0.00144	0.000425	0.000435
	Lead (filtered)	mg/L	0.00005	0.000321	0.000314	0.000274	0.00037	0.000394	0.000513	0.000396	0.000368	0.000382
	Magnesium	mg/L	0.005	0.342	0.35	0.368	0.347	0.341	0.324	0.319	0.308	0.294
	Magnesium (filtered)	mg/L	0.005	0.339	0.344	0.359	0.339	0.33	0.324	0.293	0.295	0.285
	Manganese	mg/L	0.0001	0.01	0.012	0.0173	0.0252	0.0282	0.0368	0.07	0.0317	0.0292
	Manganese (filtered)	mg/L	0.0001	0.00892	0.01	0.0104	0.0221	0.0231	0.0255	0.0255	0.0296	0.0276
	Mercury	mg/L	0.000005	0.0000084	0.0000079	0.0000107	0.0000097	0.0000134	0.000005	<0.0000050	<0.0000050	<0.0000050
	Mercury (filtered)	mg/L	0.000005	0.0000066	0.0000083	0.0000098	0.0000118	0.0000112	0.0000068	<0.0000050	<0.0000050	<0.0000050
	Molybdenum	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050
	Molybdenum (filtered)	mg/L	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel	mg/L	0.0005	0.00055	0.00058	0.00082	0.00086	0.00088	<0.00050	<0.00050	<0.00050	<0.00050
	Nickel (filtered)	mg/L	0.0005	0.00054	0.00058	0.00078	0.00078	0.00082	<0.00050	<0.00050	<0.00050	<0.00050
	Silica (SiO2)	mg/L	0.21	3.64	3.74	3.42	3.66	3.89	-	3.98	3.81	3.79
	Potassium	mg/L	0.05	0.295	0.296	0.318	0.318	0.314	0.282	0.304	0.29	0.302
	Potassium (filtered)	mg/L	0.05	0.296	0.3	0.322	0.322	0.31	0.288	0.288	0.287	0.281
	Selenium	mg/L	0.00005	0.000078	0.000058	0.000065	0.000074	0.000071	0.000105	0.000073	0.000074	0.000078
	Selenium (filtered)	mg/L	0.00005	0.000072	<0.000050	0.000076	0.000067	0.000061	0.000108	0.000071	0.000064	0.000078
	Cesium	mg/L	0.00001	0.000101	0.000103	0.000125	0.000113	0.000123	0.000078	0.000112	0.000072	0.000067
	Cesium (filtered)	mg/L	0.00001	0.000101	0.000103	0.000117	0.000114	0.000113	0.000069	0.000073	0.000064	0.000062
	Rubidium	mg/L	0.0002	0.00154	0.0015	0.00155	0.00157	0.00158	0.00134	0.0015	0.00147	0.0015
	Rubidium (filtered)	mg/L	0.0002	0.00152	0.00144	0.00162	0.0017	0.00158	0.00124	0.00148	0.00148	0.00144
	Tellurium	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tellurium (filtered)	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thorium	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thorium (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tungsten	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tungsten (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Lithium	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (filtered)	mg/L	0.001	0.0011	0.001	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silver	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Silver (filtered)	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Silicon	mg/L	0.1	1.7	1.75	1.6	1.71	1.82	2.03	1.86	1.78	1.77
	Silicon (filtered)	mg/L	0.05	1.72	1.7	1.56	1.69	1.77	1.98	1.74	1.7	1.7
	Sodium	mg/L	0.05	3.44	3.43	3.33	3.26	3.18	3.31	3.33	3.31	3.37
	Sodium (filtered)	mg/L	0.05	3.26	3.28	3.16	3.18	3.02	3.29	3.2	3.15	3.13
	Strontium	mg/L	0.0002	0.00497	0.00505	0.00586	0.00506	0.00468	0.00452	0.00418	0.00411	0.00406
	Strontium (filtered)	mg/L	0.0002	0.00506	0.00524	0.00576	0.00507	0.0045	0.00438	0.00403	0.004	0.00406
	Sulphur as S	mg/L	0.5	0.76	0.77	0.83	0.7	0.75	0.55	0.69	0.67	0.73
	Sulphur as S (filtered)	mg/L	0.5	0.65	0.63	0.71	0.67	0.63	<0.50	0.64	0.58	0.52
	Titanium	mg/L	0.0003	0.00099	0.00109	0.00106	0.0012	0.0012	0.00267	0.00479	0.00162	0.00172
	Titanium (filtered)	mg/L	0.0003	0.00081	0.00082	0.00079	0.00092	<0.00090	0.00175	0.00103	0.00129	0.0012
	Thallium	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thallium (filtered)	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (filtered)	mg/L	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium	mg/L	0.00001	0.000097	0.000081	0.000045	0.000032	0.000027	0.000035	0.00003	0.000026	0.000024
	Uranium (filtered)	mg/L	0.00001	0.000094	0.000079	0.00004	0.000031	0.000026	0.00003	0.000021	0.000023	0.000021
	Vanadium	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Vanadium (filtered)	mg/L	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc	mg/L	0.003	0.0053	0.0049	0.0052	0.0053	0.0053	0.0048	0.004	0.0032	0.0032
	Zinc (filtered)	mg/L	0.001	0.0062	0.0054	0.0058	0.0073	0.0058	0.0048	0.0038	0.0035	0.0031
	Zirconium	mg/L	0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Zirconium (filtered)	mg/L	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

Table C-13: Analytical data for metals in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

	Unit	RDL	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
Metals									
Aluminium	mg/L	0.003	16	0	16	0.119	0.119	0.325	0.325
Aluminium (filtered)	mg/L	0.001	10	0	10	0.116	0.116	0.169	0.169
Antimony	mg/L	0.0001	16	16	0	<0.00010	-	<0.00010	-
Antimony (filtered)	mg/L	0.0001	10	10	0	<0.00010	-	<0.00010	-
Arsenic	mg/L	0.0001	16	0	16	0.0263	0.0263	0.0633	0.0633
Arsenic (filtered)	mg/L	0.0001	10	0	10	0.0264	0.0264	0.0346	0.0346
Barium	mg/L	0.0001	16	0	16	0.00243	0.00243	0.00484	0.00484
Barium (filtered)	mg/L	0.0001	10	0	10	0.00239	0.00239	0.00329	0.00329
Beryllium	mg/L	0.00002	16	0	16	0.00002	0.00002	0.000067	0.000067
Beryllium (filtered)	mg/L	0.00002	10	3	7	<0.000020	0.00002	0.000034	0.000034
Bismuth	mg/L	0.00005	16	16	0	<0.000050	-	<0.000050	-
Bismuth (filtered)	mg/L	0.00005	10	10	0	<0.000050	-	<0.000050	-
Boron	mg/L	0.01	16	16	0	<0.010	-	<0.010	-
Boron (filtered)	mg/L	0.01	10	10	0	<0.010	-	<0.010	-
Cadmium	mg/L	0.000005	16	0	16	0.0000138	0.0000138	0.0000341	0.0000341
Cadmium (filtered)	mg/L	0.000005	10	0	10	0.0000149	0.0000149	0.0000234	0.0000234
Calcium	mg/L	0.1	16	0	16	0.368	0.368	0.712	0.712
Calcium (filtered)	mg/L	0.05	10	0	10	0.371	0.371	0.704	0.704
Chromium (Total, III+VI)	mg/L	0.0005	16	14	2	<0.00050	0.00051	0.00159	0.00159
Chromium (Total, III+VI) (filtered)	mg/L	0.0005	10	10	0	<0.00050	-	<0.00050	-
Cobalt	mg/L	0.0001	16	0	15	0.00012	0.00012	0.001	0.001
Cobalt (filtered)	mg/L	0.0001	10	1	9	<0.00010	0.00011	0.00036	0.00036
Copper	mg/L	0.0005	16	9	7	<0.00050	0.00053	0.00086	0.00086
Copper (filtered)	mg/L	0.0002	10	2	8	<0.00020	0.00023	0.00061	0.00061
Iron	mg/L	0.01	16	0	16	0.11	0.11	0.621	0.621
Iron (filtered)	mg/L	0.01	10	0	10	0.093	0.093	0.259	0.259
Lead	mg/L	0.00005	16	0	14	0.000352	0.000352	0.00208	0.00208
Lead (filtered)	mg/L	0.00005	10	0	10	0.000274	0.000274	0.000513	0.000513
Magnesium	mg/L	0.005	16	0	16	0.294	0.294	0.403	0.403
Magnesium (filtered)	mg/L	0.005	10	0	10	0.285	0.285	0.359	0.359
Manganese	mg/L	0.0001	16	0	16	0.01	0.01	0.105	0.105
Manganese (filtered)	mg/L	0.0001	10	0	10	0.00892	0.00892	0.0296	0.0296
Mercury	mg/L	0.000005	16	5	11	<0.0000050	0.000005	0.000023	0.000023
Mercury (filtered)	mg/L	0.000005	10	4	6	<0.0000050	0.0000066	0.0000118	0.0000118
Molybdenum	mg/L	0.00005	16	15	1	<0.000050	0.000052	0.000052	0.000052
Molybdenum (filtered)	mg/L	0.00005	10	10	0	<0.000050	-	<0.000050	-
Nickel	mg/L	0.0005	16	7	9	<0.00050	0.00051	0.00115	0.00115
Nickel (filtered)	mg/L	0.0005	10	5	5	<0.00050	0.00054	0.00082	0.00082
Silica (SiO2)	mg/L	0.21	15	0	15	3.42	3.42	5.86	5.86
Potassium	mg/L	0.05	16	0	16	0.281	0.281	0.366	0.366
Potassium (filtered)	mg/L	0.05	10	0	10	0.281	0.281	0.322	0.322
Selenium	mg/L	0.00005	16	0	16	0.000058	0.000058	0.000118	0.000118
Selenium (filtered)	mg/L	0.00005	10	1	9	<0.000050	0.000059	0.000108	0.000108
Cesium	mg/L	0.00001	16	0	16	0.000067	0.000067	0.000131	0.000131
Cesium (filtered)	mg/L	0.00001	10	0	10	0.000062	0.000062	0.000117	0.000117
Rubidium	mg/L	0.0002	16	0	16	0.00134	0.00134	0.00177	0.00177
Rubidium (filtered)	mg/L	0.0002	10	0	10	0.00124	0.00124	0.0017	0.0017
Tellurium	mg/L	0.0002	16	16	0	<0.00020	-	<0.00020	-
Tellurium (filtered)	mg/L	0.0002	10	10	0	<0.00020	-	<0.00020	-
Thorium	mg/L	0.0001	16	16	0	<0.00010	-	<0.00010	-
Thorium (filtered)	mg/L	0.0001	10	10	0	<0.00010	-	<0.00010	-
Tungsten	mg/L	0.0001	16	16	0	<0.00010	-	<0.00010	-
Tungsten (filtered)	mg/L	0.0001	10	10	0	<0.00010	-	<0.00010	-
Lithium	mg/L	0.001	16	16	0	<0.0010	-	<0.0010	-
Lithium (filtered)	mg/L	0.001	10	7	3	<0.0010	0.001	0.0011	0.0011
Silver	mg/L	0.00001	16	16	0	<0.000010	-	<0.000010	-
Silver (filtered)	mg/L	0.00001	10	10	0	<0.000010	-	<0.000010	-
Silicon	mg/L	0.1	16	0	16	1.6	1.6	2.74	2.74
Silicon (filtered)	mg/L	0.05	10	0	10	1.56	1.56	1.98	1.98
Sodium	mg/L	0.05	16	0	16	3.18	3.18	3.44	3.44
Sodium (filtered)	mg/L	0.05	10	0	10	3.02	3.02	3.29	3.29
Strontium	mg/L	0.0002	16	0	16	0.00406	0.00406	0.00586	0.00586
Strontium (filtered)	mg/L	0.0002	10	0	10	0.004	0.004	0.00576	0.00576
Sulphur as S	mg/L	0.5	16	1	15	<0.50	0.5	0.83	0.83
Sulphur as S (filtered)	mg/L	0.5	10	1	9	<0.50	0.52	0.71	0.71
Titanium	mg/L	0.0003	16	0	16	0.00099	0.00099	0.0115	0.0115
Titanium (filtered)	mg/L	0.0003	10	1	9	<0.00090	0.00079	0.00175	0.00175
Thallium	mg/L	0.00001	16	13	3	<0.000010	0.000011	0.000012	0.000012
Thallium (filtered)	mg/L	0.00001	10	10	0	<0.000010	-	<0.000010	-
Tin	mg/L	0.0001	16	16	0	<0.00010	-	<0.00010	-
Tin (filtered)	mg/L	0.0001	10	10	0	<0.00010	-	<0.00010	-
Uranium	mg/L	0.00001	16	0	16	0.000024	0.000024	0.000261	0.000261
Uranium (filtered)	mg/L	0.00001	10	0	10	0.000021	0.000021	0.000094	0.000094
Vanadium	mg/L	0.0005	16	15	1	<0.00050	0.0005	0.0005	0.0005
Vanadium (filtered)	mg/L	0.0005	10	10	0	<0.00050	-	<0.00050	-
Zinc	mg/L	0.003	16	0	16	0.0032	0.0032	0.0088	0.0088
Zinc (filtered)	mg/L	0.001	10	0	10	0.0031	0.0031	0.0073	0.0073
Zirconium	mg/L	0.0002	16	16	0	<0.00020	-	<0.00020	-
Zirconium (filtered)	mg/L	0.0003	10	10	0	<0.00030	-	<0.00030	-

Table C-14: Analytical data for PAHs in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW4		SW5	Data Summary						
			Sample Type	Normal	SW DUP B (FD: SW4)	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
			Date	06 Nov 2023	06 Nov 2023	06 Nov 2023							
			Sample Area	Site	Site	Site							
		Unit	RDL										
Polycyclic Aromatic Hydrocarbons (PAHs)													
	1-Methylnaphthalene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	2-Methylnaphthalene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	1 & 2 Methylnaphthalene	mg/L	0.000015	<0.000015	<0.000015	<0.000015	3	3	0	<0.000015	-	<0.000015	-
	Acenaphthene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Acenaphthylene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Acridine	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Anthracene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Benz(a)anthracene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Benzo(a)pyrene	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	3	3	0	<0.0000050	-	<0.0000050	-
	Benzo(b+j)fluoranthene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Benzo(b+j+k)fluoranthene	mg/L	0.000015	<0.000015	<0.000015	<0.000015	3	3	0	<0.000015	-	<0.000015	-
	Benzo(g,h,i)perylene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Benzo(k)fluoranthene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Chrysene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Dibenz(a,h)anthracene	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	3	3	0	<0.0000050	-	<0.0000050	-
	Fluorene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Fluoranthene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Naphthalene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Perylene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Phenanthrene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Pyrene	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	Quinoline	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-
	B(A)P TPE[c]	mg/L	0.00001	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-

Table C-15: Analytical data for BTEX and PHCs in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW4		SW5	Data Summary						
			Sample Type	Normal	SW DUP B (FD: SW4)	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
			Date	06 Nov 2023	06 Nov 2023	06 Nov 2023							
			Sample Area	Site	Site	Site							
		Unit	RDL										
BTEX													
	Benzene	mg/L	0.0005	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-
	Toluene	mg/L	0.0005	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-
	Ethylbenzene	mg/L	0.0005	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-
	Xylene (o)	mg/L	0.0003	<0.00030	<0.00030	<0.00030	3	3	0	<0.00030	-	<0.00030	-
	Xylene (m & p)	mg/L	0.0004	<0.00040	<0.00040	<0.00040	3	3	0	<0.00040	-	<0.00040	-
	Xylene Total	mg/L	0.0005	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-
Petroleum Hydrocarbons (PHCs)													
	VPH (C6-C10 - BTEX)	mg/L	0.025	<0.025	<0.025	<0.025	3	3	0	<0.025	-	<0.025	-
	EPH >C10-C16	mg/L	0.05	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-
	EPH >C16-C21	mg/L	0.05	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-
	EPH >C21-C32	mg/L	0.05	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-
	Modified TPH (Tier 1)	mg/L	0.09	<0.090	<0.090	<0.090	3	3	0	<0.090	-	<0.090	-
	Reached Baseline at C32	-		Yes	Yes	Yes	3	NA	NA	NA	-	NA	-

Table C-16: Analytical data for gneral chemistry in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW16	SW17	*Local Background Minimum*	*Local Background Maximum*	SW1	SW2	SW3		SW4	SW5	CHQAQC03
			Sample Type	Normal	Normal			Normal	Normal	Normal	SW DUP A (FD: SW3)	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023		06 Nov 2023	06 Nov 2023	22 May 2024
			Sample Area	Background	Background			Site	Site	Site	Site	Site	Site	Site
		Unit	RDL											
Calculated Parameters														
	Anions Total	meq/L	0.1	0.16	0.16	0.16	0.16	0.2	0.17	0.16	0.17	0.16	0.16	0.17
	Cations Total	meq/L	0.1	0.24	0.23	0.23	0.24	0.24	0.26	0.26	0.26	0.25	0.27	0.22
	Ionic Balance	%	0.01	150	144	144	150	120	153	162	153	156	169	129
	Langelier Index (@ 20C)	N/A	0.01	Incalculable	-7.03	-7.03	-7.03	-5.61	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
	Langelier Index (@ 4C)	N/A	0.01	Incalculable	-7.28	-7.28	-7.28	-5.87	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
	Saturation @ 4c	-	0.01	Incalculable	12.2	12.2	12.2	11.6	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
	Saturation pH (@ 20C)	N/A	0.01	Incalculable	12	12	12	11.3	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
	Colour, Apparent	CU	2.00	82.3[b]	104	104	104	-	-	-	-	-	-	54.1
General Chemistry														
	Carbonate	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity (total)	mg/L	1	<1.0	<1.0	<1.0	<1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Bicarbonate	mg/L	1	<1.0	<1.0	<1.0	<1.0	1.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Hardness as CaCO3 (Measured)	mg/L	0.5	2.24	2.11	2.11	2.24	3	2.35	3.1	3.12	2.52	2.81	2.19
	Ammonia as N	mg/L	0.005	0.0064	0.0086	0.0064	0.0086	<0.0050	<0.0050	0.0084	0.005	0.0086	0.0126	<0.0050
	Total Organic Carbon (TOC)	mg/L	0.5	10.8	7.67	7.67	10.8	7.01	7.15	9.42	9.5	9.24	10.3	4.86
	Ortho Phosphate as P (filtered)	mg/L	0.001	0.0055	0.0058	0.0055	0.0058	0.0013	0.002	0.002	0.0035	0.0064	0.002	0.004
	Phosphorus	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Phosphorus (filtered)	mg/L		<0.050	<0.050	<0.050	<0.050	-	-	-	-	-	-	<0.050
	Fluoride	mg/L	0.02	<0.020	<0.020	<0.020	<0.020	0.02	0.022	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (filtered)	mg/L	0.5	4.42	4.38	4.38	4.42	4.58	4.64	4.59	4.64	4.58	4.62	4.52
	Electrical Conductivity (Lab)	µS/cm	1	25.8	27.4	25.8	27.4	27.1	26.5	28.1	28.2	27.8	28.4	25.1
	Hydroxide	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Nitrate (as N)	mg/L	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Nitrite + Nitrate as N	mg/L	0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224
	pH (Lab)	pH Units	0.1	5.3	4.96	4.96	5.3	5.73	5.51	5.36	5.38	5.3	5.18	5.51
	Sulphate (filtered)	mg/L	0.3	1.86	1.71	1.71	1.86	1.92	1.78	1.73	1.76	1.67	1.57	2.05
	Total Dissolved Solids (TDS) - Measured	mg/L	10	29	32	29	32	28	28	32	36	29	27	24
	Turbidity	NTU	0.1	2.84	1	1	2.84	0.18	1.38	0.17	0.19	0.47	1.25	0.34

Table C-16: Analytical data for gneral chemistry in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Location	SW6	SW7	SW8	SW9	SW10	SW12		SW13	SW14	SW15
			Sample Type	Normal	Normal	Normal	Normal	Normal	Normal		Normal	Normal	Normal
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	04 Jun 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL										
Calculated Parameters													
	Anions Total	meq/L	0.1	0.17	0.18	0.18	0.17	0.17	-	-	0.17	0.17	0.16
	Cations Total	meq/L	0.1	0.23	0.23	0.24	0.23	0.23	-	-	0.24	0.22	0.22
	Ionic Balance	%	0.01	135	128	133	135	135	-	-	141	129	138
	Langelier Index (@ 20C)	N/A	0.01	Incalculable	Incalculable	Incalculable	Incalculable	-	-	-	Incalculable	Incalculable	Incalculable
	Langelier Index (@ 4C)	N/A	0.01	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
	Saturation @ 4c	-	0.01	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
	Saturation pH (@ 20C)	N/A	0.01	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
	Colour, Apparent	CU	2.00	31.4	31.6	29.4	34.2	38.7	54.5[b]	-	45.3	54	53.8
General Chemistry													
	Carbonate	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
	Alkalinity (total)	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
	Bicarbonate	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
	Hardness as CaCO3 (Measured)	mg/L	0.5	2.82	2.9	3.29	2.8	2.72	-	-	2.34	2.23	2.2
	Ammonia as N	mg/L	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0103	-	<0.0050	<0.0050	<0.0050
	Total Organic Carbon (TOC)	mg/L	0.5	3.5	3.59	3.82	4.09	4.14	5.66	-	4.43	4.77	4.65
	Ortho Phosphate as P (filtered)	mg/L	0.001	0.0014	0.0015	0.0014	0.0014	0.0026	0.0026	-	0.0029	0.0027	0.0029
	Phosphorus	mg/L	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
	Phosphorus (filtered)	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
	Fluoride	mg/L	0.02	0.022	0.02	<0.020	<0.020	<0.020	<0.020	-	<0.020	<0.020	<0.020
	Chloride (filtered)	mg/L	0.5	4.56	4.54	4.47	4.4	4.35	4.48	-	4.47	4.47	4.44
	Electrical Conductivity (Lab)	µS/cm	1	25.4	25.4	26	25.3	25.5	25	-	24.9	25	25.4
	Hydroxide	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
	Nitrate (as N)	mg/L	0.02	<0.020	<0.020	<0.020	0.028	0.042	<0.020	-	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010
	Nitrite + Nitrate as N	mg/L	0.0224	<0.0224	<0.0224	<0.0224	0.028	0.042	<0.0224	-	<0.0224	<0.0224	<0.0224
	pH (Lab)	pH Units	0.1	5.82	5.89	5.98	5.64	5.45	5.37	-	5.37	5.57	5.38
	Sulphate (filtered)	mg/L	0.3	2.16	2.22	2.38	2.24	2.15	2.01	-	1.97	1.94	1.94
	Total Dissolved Solids (TDS) - Measured	mg/L	10	29	22	26	26	23	23	-	27	29	30
	Turbidity	NTU	0.1	0.16	0.18	0.18	0.19	0.26	1.67	-	0.37	0.37	0.47

Table C-16: Analytical data for gneral chemistry in surface water for the former Country Harbour mine compared to human health-based surface water quality guidelines.

			Data Summary						
	Unit	RDL	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration
Calculated Parameters									
Anions Total	meq/L	0.1	15	0	15	0.16	0.16	0.2	0.2
Cations Total	meq/L	0.1	15	0	15	0.22	0.22	0.27	0.27
Ionic Balance	%	0.01	15	0	15	120	120	169	169
Langelier Index (@ 20C)	N/A	0.01	14	0	1	-5.61	-5.61	-5.61	-5.61
Langelier Index (@ 4C)	N/A	0.01	15	0	1	-5.87	-5.87	-5.87	-5.87
Saturation @ 4c	-	0.01	15	0	1	11.6	11.6	11.6	11.6
Saturation pH (@ 20C)	N/A	0.01	15	0	1	11.3	11.3	11.3	11.3
Colour, Apparent	CU	2.00	10	0	9	29.4	29.4	54.1	54.1
General Chemistry									
Carbonate	mg/L	1	16	16	0	<1.0	-	<1.0	-
Alkalinity (total)	mg/L	1	16	15	1	<1.0	1.4	1.4	1.4
Bicarbonate	mg/L	1	16	15	1	<1.0	1.7	1.7	1.7
Hardness as CaCO3 (Measured)	mg/L	0.5	15	0	15	2.19	2.19	3.29	3.29
Ammonia as N	mg/L	0.005	16	11	5	<0.0050	0.005	0.0126	0.0126
Total Organic Carbon (TOC)	mg/L	0.5	16	0	16	3.5	3.5	10.3	10.3
Ortho Phosphate as P (filtered)	mg/L	0.001	16	0	16	0.0013	0.0013	0.0064	0.0064
Phosphorus	mg/L	0.05	16	16	0	<0.050	-	<0.050	-
Phosphorus (filtered)	mg/L		10	10	0	<0.050	-	<0.050	-
Fluoride	mg/L	0.02	16	12	4	<0.020	0.02	0.022	0.022
Chloride (filtered)	mg/L	0.5	16	0	16	4.35	4.35	4.64	4.64
Electrical Conductivity (Lab)	µS/cm	1	16	0	16	24.9	24.9	28.4	28.4
Hydroxide	mg/L	1	16	16	0	<1.0	-	<1.0	-
Nitrate (as N)	mg/L	0.02	16	14	2	<0.020	0.028	0.042	0.042
Nitrite (as N)	mg/L	0.01	16	16	0	<0.010	-	<0.010	-
Nitrite + Nitrate as N	mg/L	0.0224	16	14	2	<0.0224	0.028	0.042	0.042
pH (Lab)	pH Units	0.1	16	0	16	5.18	5.18	5.98	5.98
Sulphate (filtered)	mg/L	0.3	16	0	16	1.57	1.57	2.38	2.38
Total Dissolved Solids (TDS) - Measured	mg/L	10	16	0	16	22	22	36	36
Turbidity	NTU	0.1	16	0	16	0.16	0.16	1.67	1.67

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH62		BH63		BH64		BH65		BH66			BH67		
Sample ID				BH62 0-0.15M	BH62 0.15-0.50M	BH63 0-0.15M	BH63 0.15-0.50M	BH64 0-0.15M	BH64 0.15-0.50M	BH65 0-0.15M	BH65 0.15-0.50M	BH66 0-0.15M	BH DUP F	BH66 0.15-0.50M	BH67 0-0.15M	BH DUP G	BH67 0.15-0.45M
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal	Normal	Duplicate	Normal
Date				21 May 2024		21 May 2024		21 May 2024		21 May 2024		21 May 2024			21 May 2024		
Sample Area				Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background	Background
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	9,590	8,720	5,270	26,100	1,920	17,300	3,660	5,240	18,000	18,600	11,900	1,280	1,280	26,200
Antimony	mg/kg	0.1	40 [a]	0.12	0.16	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	mg/kg	0.1	26 [b]	8.65	14	4.16	5.74	1.77	4.25	5.33	6.25	71.2	76.1	55.7	7.4	9.23	59.1
Barium	mg/kg	0.5	670 [c]	11.8	12.9	11.3	21.3	6.41	15	11.8	13.3	25.6	25.1	24.1	6.44	6.47	47.4
Beryllium	mg/kg	0.1	8 [a]	0.2	0.22	0.12	0.76	<0.10	0.52	<0.10	0.12	0.45	0.46	0.31	<0.10	<0.10	0.5
Boron	mg/kg	5	120 [c]	<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
Cadmium	mg/kg	0.02	1.9 [c]	0.043	0.031	0.046	0.039	0.03	0.044	<0.020	<0.020	0.05	0.048	0.034	<0.020	0.024	0.075
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	19	35.6	15.2	27.2	12.5	27.6	16.8	16.9	40.1	25.5	22.6	4.75	2.25	37
Cobalt	mg/kg	0.1	180 [c]	1.29	1.7	0.89	3.75	0.33	1.69	0.7	1.03	3.18	2.72	2.22	0.24	0.21	4.51
Copper	mg/kg	0.5	91 [b]	5.38	5.86	3.7	5.95	1.03	2.78	1.74	1.8	6.36	6.03	3.8	1.1	1.44	6.5
Iron	mg/kg	50	NGA	28,300	30,000	14,900	22,800	2,450	18,900	7,260	10,700	21,900	22,400	16,900	2,840	3,080	26,700
Lead	mg/kg	0.5	32 [c]	14.1	16.2	15.2	17.3	5.12	13.4	10.4	10	20.8	21.5	15	4.33	5.58	25.3
Manganese	mg/kg	1	220 [d]	153	151	81.2	211	29.5	95.7	84	164	167	163	146	37.3	38	211
Mercury	mg/kg	0.005	20 [c]	0.0594	0.23	0.0585	0.0525	0.0264	0.0589	0.0267	0.0473	0.0586	0.089	0.058	0.017	0.0263	0.0945
Molybdenum	mg/kg	0.1	40 [a]	1.04	1.29	0.5	0.78	0.2	0.93	0.4	0.44	0.65	0.62	0.48	0.19	0.22	0.75
Nickel	mg/kg	0.5	89 [b]	6.3	14.3	6.45	12	5.79	10.9	6.82	6.6	17.3	10.3	9.05	1.73	0.66	15.9
Selenium	mg/kg	0.2	2.9 [b]	1.37	1.35	0.85	1.19	<0.20	1.06	0.38	0.48	1.09	1.28	0.79	<0.20	<0.20	1.43
Silver	mg/kg	0.1	40 [a]	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.12	<0.10	<0.10	<0.10	<0.10
Strontium	mg/kg	0.5	950 [e,f]	1.78	1.54	1.6	1.55	1.38	1.37	1.85	1.46	2.2	2.4	2.2	1.36	1.77	2.32
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	0.082	0.082	0.094	0.128	0.055	0.121	0.095	0.082	0.131	0.132	0.122	<0.050	<0.050	0.185
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [c]	1.18	1.31	1.16	1.09	1.68	1.48	1.2	1.22	1.14	1.24	1.21	0.889	0.775	1.14
Vanadium	mg/kg	0.2	18 [c]	31	38.6	26	22.9	3.24	19.4	18	19.2	29.2	27.9	24.9	7.54	8.88	32.6
Zinc	mg/kg	2	340 [c]	13.5	17.2	9.8	37.8	3.7	18.2	5.7	6.6	30.4	29.8	20.8	2.9	4	38

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH68		BH69		BH70		BH71		*Local Background Minimum*	*Local Background Maximum*	BH 1	BH 2	24 MW-01	BH 3
Sample ID				BH68 0-0.15M	BH68 0.15-0.50M	BH69 0-0.15M	BH69 0.15-0.34M	BH70 0-0.15M	BH70 0.15-0.50M	BH71 0-0.15M	BH71 0.15-0.50M			BH1 0-0.15m	BH2 0-0.15m	24 MW-01-SS5 (2.4-3.0 m)	BH3 0-0.15m
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal			Normal	Normal	Normal	Normal
Date				21 May 2024		21 May 2024		21 May 2024		21 May 2024				07 Nov 2023	07 Nov 2023	17 Jan 2024	07 Nov 2023
Sample Area				Background	Background	Background	Background	Background	Background	Background	Background	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	1,560	24,300	4,290	16,500	8,300	4,410	5,680	16,200	*1,280*	*26,200*	4,630	8,180	9,420	15,600
Antimony	mg/kg	0.1	40 [a]	<0.10	<0.10	0.19	0.3	<0.10	<0.10	<0.10	0.1	*0.10*	*0.30*	0.14	0.3	0.1	2.53
Arsenic	mg/kg	0.1	26 [b]	12.7	71.6	400	1,050	33.9	11.3	9.79	114	*1.77*	*1,050*	22	*1,490*	79.2	*4,300*
Barium	mg/kg	0.5	670 [c]	7.22	44.9	30.1	62.8	11.6	18.5	28	22.6	*6.41*	*62.8*	10.7	25.8	46.6	98.3
Beryllium	mg/kg	0.1	8 [a]	<0.10	0.59	0.11	0.35	0.28	0.27	0.39	0.37	*0.11*	*0.76*	<0.10	0.18	0.36	0.65
Boron	mg/kg	5	120 [c]	<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
Cadmium	mg/kg	0.02	1.9 [c]	0.025	0.04	0.043	0.054	0.038	0.114	0.197	0.029	*0.024*	*0.197*	0.058	0.089	0.037	0.073
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	6.06	69.6	19.5	49.5	9.25	21.9	60.2	13.2	*2.25*	*69.6*	8.13	12.4	29.7	32.4
Cobalt	mg/kg	0.1	180 [c]	0.23	5.09	1	3.04	0.58	0.88	1.94	1.97	*0.21*	*5.1*	0.66	0.58	5.34	1.04
Copper	mg/kg	0.5	91 [b]	1.8	10.4	4.01	7.66	1.2	2.23	4.77	2.73	*1.03*	*10.4*	3.19	4.86	13.1	4.02
Iron	mg/kg	50	NGA	3,090	29,000	9,740	28,200	4,090	4,210	4,810	14,000	*2,450*	*30,000*	22,400	29,000	17,100	30,100
Lead	mg/kg	0.5	32 [c]	3.99	28.5	54.6	88.1	14.4	10.3	12.2	22.4	*3.99*	*88*	13.3	44.5	18.3	*118*
Manganese	mg/kg	1	220 [d]	41.6	212	79.8	218	32.8	62	88	107	*30*	*218*	60.4	65.4	*342*	*472*
Mercury	mg/kg	0.005	20 [c]	0.0146	0.0689	0.029	0.0716	0.0671	0.0859	0.0387	0.0966	*0.01*	*0.230*	0.0877	0.0842	0.006	4.19
Molybdenum	mg/kg	0.1	40 [a]	0.29	1.36	0.52	1.04	0.33	0.58	0.81	0.51	*0.19*	*1.4*	0.52	0.67	3.87	0.23
Nickel	mg/kg	0.5	89 [b]	2.33	33	8.32	20	3.52	9.04	27	5.14	*0.66*	*33.0*	2.52	2.36	12.1	5.12
Selenium	mg/kg	0.2	2.9 [b]	<0.20	1.13	0.36	1.3	1.44	1.08	0.93	0.78	*0.36*	*1.4*	1	1.07	<0.20	0.31
Silver	mg/kg	0.1	40 [a]	<0.10	<0.10	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	*0.11*	*0.2*	0.1	0.41	<0.10	0.2
Strontium	mg/kg	0.5	950 [e,f]	1.43	3.42	3.01	5.41	1.36	2.42	2.62	1.69	*1.36*	*5.4*	2.55	1.99	2.15	3.15
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	500	<500	500	500	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	<0.050	0.16	0.077	0.149	0.085	0.061	0.08	0.122	*0.06*	*0.2*	0.075	0.092	0.158	0.294
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*<2.0*	*<2.0*	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [c]	0.986	1.24	1.37	1.35	1.38	1.43	2.3	1.14	*0.78*	*2.3*	0.949	1.14	1.56	1.13
Vanadium	mg/kg	0.2	18 [c]	11	30.5	16.1	34.6	8	6.6	8.69	20	*3.24*	*38.6*	24.9	*52.6*	16.2	36.2
Zinc	mg/kg	2	340 [c]	2.7	44.2	10	28.2	5.7	10	26.2	22.4	*2.70*	*44.2*	10.3	11.2	39	52.8

Notes

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SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

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[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

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[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH 3	BH 4	BH 5	BH 6		BH 7		BH 8	BH 9		BH10	BH11		
Sample ID				BH 3 0.60m	BH4 0-0.15m	BH5 0-0.15m	BH6 0-0.15m	BH DUPA 0-0.15m	BH7 0-0.15m	BH 7 0.50m	BH8 0-0.15m	BH9 0-0.15m	BH 9 0.85m	BH10 0-0.15m	BH11 0-0.15m	BH DUPB 0-0.15m	BH 11 0.90m
Sample Type				Normal	Normal	Normal	Normal	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal
Date				07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023		07 Nov 2023		07 Nov 2023	07 Nov 2023		07 Nov 2023	07 Nov 2023		
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	8,340	9,710	9,370	6,610	6,940	14,700	14,300	12,800	18,100	14,400	14,000	16,000	21,300	29,200
Antimony	mg/kg	0.1	40 [a]	0.51	0.22	0.17	0.32	0.35	12.2	8.49	1.25	3.14	<2.00	0.5	1.5	1.92	1.1
Arsenic	mg/kg	0.1	26 [b]	315	78.9	152	51.9	52.9	*7,170*	*4,870*	*1,270*	*3,170*	647	383	808	*1,270*	459
Barium	mg/kg	0.5	670 [c]	31.6	70.2	18.2	175	177	51.9	60	41	145	63.2	44.4	49	72.7	108
Beryllium	mg/kg	0.1	8 [a]	0.38	3.5	0.58	4.16	3.38	0.55	*<2.00*	0.97	1.45	*<2.00*	0.62	0.92	1.22	1.14
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<5.0	<100	<5.0	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02	1.9 [c]	0.046	*2.21*	0.112	*2.63*	1.75	0.5	0.533	0.065	0.481	<0.400	0.116	0.108	0.153	0.15
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	13.2	6.28	8.4	3.08	3.23	20.5	20.4	21.3	36	22.1	21.7	22.7	29	28.8
Cobalt	mg/kg	0.1	180 [c]	2.32	1.83	2.15	2.01	1.96	4.36	4.96	1.92	16.7	10.6	4.87	6.69	8.7	5.66
Copper	mg/kg	0.5	91 [b]	8.46	19.7	9.18	12.3	13.1	31.5	25.2	5.15	32	73.3	14.8	24	33.3	25.5
Iron	mg/kg	50	NGA	13,200	3,590	11,000	3,700	3,240	21,800	27,200	17,500	73,800	40,100	27,200	24,900	31,800	30,900
Lead	mg/kg	0.5	32 [c]	55.6	*98.1*	39.6	*99.1*	*118*	*127*	87.5	54.8	*164*	*96.9*	87.8	*107*	*138*	69.8
Manganese	mg/kg	1	220 [d]	154	102	173	*313*	*257*	157	168	*309*	*1,010*	*446*	*517*	*532*	*690*	*348*
Mercury	mg/kg	0.005	20 [c]	0.684	0.404	0.108	0.204	0.317	4.03	3.9	1.96	11.9	1.12	0.699	6.15	7.84	2.81
Molybdenum	mg/kg	0.1	40 [a]	0.39	1.05	0.52	1.07	0.81	1.18	<2.00	0.41	7.43	4.08	0.79	1.11	1.43	1.02
Nickel	mg/kg	0.5	89 [b]	6.64	4.11	4.3	5.27	4.79	9.67	10.5	6.29	21.2	20.5	8.68	11.8	15.5	15
Selenium	mg/kg	0.2	2.9 [b]	<0.20	*4.61*	0.58	*3.97*	*3.4*	1.48	*<4.00*	0.75	2.2	*<4.00*	0.77	0.68	0.79	0.96
Silver	mg/kg	0.1	40 [a]	<0.10	0.52	0.11	0.22	0.26	0.25	<2.00	0.14	0.8	<2.00	0.26	0.19	0.39	0.1
Strontium	mg/kg	0.5	950 [e,f]	2.37	25.2	2.54	73.4	69.6	5.22	<10.0	2.41	16.3	<10.0	2.72	4.22	4.36	2.91
Sulphur as S	mg/kg	1,000	500 [a]	<500	*3600*	<500	*3900*	*3500*	*3300*	<10000	<500	*1900*	<10000	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	0.133	0.179	0.124	<0.050	<0.050	0.192	<1.00	0.165	0.439	<1.00	0.228	0.235	0.27	0.294
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	4.4	<40.0	<2.0	3.3	<40.0	2.9	5	5.7	3.8
Uranium	mg/kg	0.05	33 [c]	1.74	24.4	4.46	27.7	20.6	5.31	4.61	2.71	2.62	5.95	1.87	2.45	3.14	3.89
Vanadium	mg/kg	0.2	18 [c]	14.1	7.6	9.97	3.45	3.94	27.1	25.6	23.4	*48.4*	27.2	*38.7*	29.4	36.5	36.5
Zinc	mg/kg	2	340 [c]	85.7	74.6	67.8	109	108	126	201	49	104	115	52.5	82.2	108	155

Notes

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[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH12	BH13	BH14	BH15		BH16	BH17	BH18		BH19	BH20	BH21		BH22
Sample ID				BH12 0-0.15m	BH13 0-0.015m	BH14 0-0.15m	BH15 0-0.15m	BH 15 0.50m	BH16 0-0.15m	BH17 0-0.15m	BH18 0-0.15m	BH 18 1.0m	BH19 0-0.15m	BH20 0-0.15m	BH21 0-0.15m	BH DUPD 0-0.15m	BH22 0-0.15m
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal
Date				07 Nov 2023	10 Nov 2023	09 Nov 2023	08 Nov 2023		08 Nov 2023	09 Nov 2023	08 Nov 2023		08 Nov 2023	08 Nov 2023	08 Nov 2023		08 Nov 2023
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	20,100	17,300	14,000	23,200	12,200	27,500	9,580	7,900	14,800	17,700	15,000	12,600	12,000	15,200
Antimony	mg/kg	0.1	40 [a]	4.38	1.48	1.11	2.72	0.37	15.8	2.86	1.46	<2.00	0.89	7.14	23	***48.1***	1.15
Arsenic	mg/kg	0.1	26 [b]	***1,110***	998	340	***1,240***	135	463	694	194	***2,690***	620	***2,260***	***2,500***	***2,750***	***1,620***
Barium	mg/kg	0.5	670 [c]	78.2	73.4	53.7	52.3	35.9	31.6	161	52.1	142	51.4	57.1	114	120	120
Beryllium	mg/kg	0.1	8 [a]	1.3	0.6	0.58	1.24	0.65	0.86	0.54	1.18	*<2.00*	0.56	0.64	0.5	0.5	0.5
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02	1.9 [c]	0.378	0.223	0.139	0.079	0.031	0.166	0.35	0.478	<0.400	0.283	0.114	0.25	0.293	0.094
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	24.6	22.1	16.2	22.3	13.6	18.2	58	15.3	37.9	21.5	28.6	28.9	27.6	32.7
Cobalt	mg/kg	0.1	180 [c]	12.2	4.36	2.73	6.45	4.8	2.05	8.07	13.2	4.44	3.87	4.44	7.66	9.27	6.74
Copper	mg/kg	0.5	91 [b]	***99.6***	20.4	19.9	14.5	6.07	14.7	30	56.7	<10.0	13	31.3	35.3	39	18.4
Iron	mg/kg	50	NGA	26,600	21,600	23,200	23,600	14,400	28,700	39,500	112,000	30,600	28,900	39,400	40,000	39,400	28,800
Lead	mg/kg	0.5	32 [c]	***791***	***140***	***229***	***1,360***	57.1	***428***	***349***	35.9	35.3	55.3	***193***	***505***	***591***	53.3
Manganese	mg/kg	1	220 [d]	***763***	***517***	***292***	***433***	***335***	170	***411***	***927***	***505***	***278***	***449***	***573***	***604***	***622***
Mercury	mg/kg	0.005	20 [c]	8.09	***22.9***	***28.1***	***2,920***	***30.9***	2.25	6.39	1.19	8.67	0.962	***46.4***	***77.8***	***83.6***	6.83
Molybdenum	mg/kg	0.1	40 [a]	1.2	0.39	0.83	0.45	0.4	0.61	5.22	29.5	<2.00	1.62	1.6	2.45	2.52	1.47
Nickel	mg/kg	0.5	89 [b]	19.1	9.99	6.86	15.2	9.52	6.57	14.7	30.9	<10.0	10.6	11.1	11.6	12.1	10.8
Selenium	mg/kg	0.2	2.9 [b]	0.55	0.71	1.76	0.57	<0.20	1.97	1.69	2.34	*<4.00*	1.52	1.54	1.04	1.17	0.49
Silver	mg/kg	0.1	40 [a]	0.19	0.48	0.2	0.41	<0.10	0.28	0.22	0.15	<2.00	0.26	0.33	0.75	0.61	0.12
Strontium	mg/kg	0.5	950 [e,f]	5.34	10.6	6.72	3.3	1.3	7.64	21.5	36.3	<10.0	7.8	3.17	5.08	5.68	3.72
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	***3200***	***1200***	<10000	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	0.3	0.184	0.194	0.192	0.148	0.151	1.21	1.14	<1.00	0.225	0.319	0.472	0.491	0.311
Tin	mg/kg	2	300 [a]	9	3.6	7.4	3.9	<2.0	27.2	3.1	<2.0	<40.0	<2.0	11.3	31.4	60.7	<2.0
Uranium	mg/kg	0.05	33 [c]	6.21	1.06	1.43	1.43	1.2	1.48	0.807	1.02	<1.00	1.09	0.99	0.73	0.812	0.733
Vanadium	mg/kg	0.2	18 [c]	28.4	30.5	25.1	25.2	16.3	32.5	26.7	32.7	***46.7***	33	37.6	35.5	33.6	***39.5***
Zinc	mg/kg	2	340 [c]	240	125	59.1	105	62.2	55.7	150	30.4	46.6	101	52.7	82	84.7	53.4

Notes

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[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH23			BH24	BH25	BH26	BH27		BH28	BH29		BH30	BH31	
Sample ID				BH23 0-0.15m	BH DUPC 0-0.15m	BH23-0.95m	BH24 0-0.15m	BH25 0-0.15m	BH26 0-0.15m	BH27 0-0.15m	BH 27 0.45m	BH28 0-0.15m	BH29 0-0.15m	BH 29 0.35m	BH30 0-0.15m	BH31 0-0.15m	BH 31 0.50m
Sample Type				Normal	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Date				08 Nov 2023			08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023		08 Nov 2023	09 Nov 2023		09 Nov 2023	09 Nov 2023	
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	11,200	13,600	16,900	29,100	13,300	15,500	26,800	29,600	17,700	30,200	36,300	31,300	34,100	29,600
Antimony	mg/kg	0.1	40 [a]	2.96	4.37	2.75	10.9	6.12	0.65	0.86	<2.00	1.73	1.77	<2.00	0.75	1.36	<2.00
Arsenic	mg/kg	0.1	26 [b]	922	*1,200*	*4,130*	*2,090*	*1,490*	*2,290*	*2,330*	*4,370*	*2,680*	*4,210*	*4,950*	88.9	*2,230*	*2,480*
Barium	mg/kg	0.5	670 [c]	119	106	117	94.1	63	64.2	109	148	64.8	158	198	48.4	163	174
Beryllium	mg/kg	0.1	8 [a]	0.65	0.74	*<2.00*	1.91	0.85	1.07	1.86	*<2.00*	1.5	2.44	2.2	1.79	2.83	*<2.00*
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<100	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<5.0	<100	<5.0	<5.0	<100
Cadmium	mg/kg	0.02	1.9 [c]	*1.91*	0.964	0.54	0.127	0.133	0.338	0.086	<0.400	0.501	0.124	<0.400	1.47	0.456	<0.400
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	22.2	27.2	29.9	49.4	23.1	23	50.8	54.6	23.1	52	61.3	11	57.8	52.6
Cobalt	mg/kg	0.1	180 [c]	7.5	6.56	9.85	6.45	12.9	58.1	10.5	15.6	162	18	19.7	2.75	32.7	33.5
Copper	mg/kg	0.5	91 [b]	33	28.7	38.5	25.2	11.5	19.5	40.3	28.5	34.1	35.8	40	63	61.6	46.5
Iron	mg/kg	50	NGA	33,000	35,100	39,000	50,700	35,800	41,200	51,800	53,500	41,800	55,100	67,700	2,640	60,500	53,600
Lead	mg/kg	0.5	32 [c]	*138*	*133*	53.6	*132*	86.7	*147*	*102*	51.3	*258*	*391*	*238*	*232*	*715*	*475*
Manganese	mg/kg	1	220 [d]	*792*	*704*	*647*	*1,130*	*940*	*3,290*	*1,200*	*1,080*	*7,510*	*1,340*	*1,290*	85	*1,520*	*1,210*
Mercury	mg/kg	0.005	20 [c]	6.9	0.0989	1.38	0.334	13	2	0.321	0.0509	3.15	0.178	0.116	0.778	0.148	0.0751
Molybdenum	mg/kg	0.1	40 [a]	2.95	2.43	<2.00	0.44	2.42	2.21	0.39	<2.00	1.99	0.44	<2.00	0.53	0.42	<2.00
Nickel	mg/kg	0.5	89 [b]	15.3	15	19.7	16.1	13.1	14.5	16.4	25.2	16.6	21.1	29.3	33.4	43.9	48.5
Selenium	mg/kg	0.2	2.9 [b]	0.97	0.86	*<4.00*	0.44	0.95	2.34	0.55	*<4.00*	2.47	0.29	*<4.00*	*8.28*	0.33	*<4.00*
Silver	mg/kg	0.1	40 [a]	0.14	0.14	<2.00	0.18	0.21	0.29	0.18	<2.00	0.47	0.24	<2.00	1.27	0.27	<2.00
Strontium	mg/kg	0.5	950 [e,f]	23.2	17	15.9	3.81	5.2	11.4	6.3	<10.0	12.1	3.9	<10.0	13.7	3.8	<10.0
Sulphur as S	mg/kg	1,000	500 [a]	*800*	<500	*800*	<500	<500	*800*	*600*	<10000	*800*	<500	<10000	*4500*	<500	<10000
Thallium	mg/kg	0.05	3.6 [b]	0.249	0.253	<1.00	0.354	0.178	0.254	0.446	<1.00	0.459	0.526	<1.00	0.104	0.479	<1.00
Tin	mg/kg	2	300 [a]	26.8	17.9	<40.0	28.5	6.3	<2.0	<2.0	<40.0	7.6	<2.0	<40.0	<2.0	2.1	<40.0
Uranium	mg/kg	0.05	33 [c]	0.574	0.731	<1.00	1.05	1.36	1.91	1.17	<1.00	2.77	1.59	1.06	4.06	2.86	1.85
Vanadium	mg/kg	0.2	18 [c]	32.2	36.8	*40.5*	*56.8*	34.8	*40.9*	*61.7*	*63.8*	37	*62.9*	*72.6*	7.35	*68.3*	*61.6*
Zinc	mg/kg	2	340 [c]	*531*	310	213	81.4	60	71	89.1	97.3	76.4	152	129	257	*367*	316

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH32	BH33	BH34	BH35	BH36	BH44	BH45	BH47	BH54	BH55	BH56	BH57	BH58	BH59
Sample ID				BH32 0-0.15m	BH33 0-0.15m	BH34 0-0.15m	BH35 0-0.15m	BH36 0-0.15m	BH 44 0-0.15m	BH 45 0-0.15m	BH 47 0-0.15m	BH 54 0-0.15m	BH 55 0-0.15m	BH 56 0-0.15m	BH 57 0-0.15m	BH 58 0-0.15m	BH 59 0-0.15m
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Date				09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	07 Nov 2023	09 Nov 2023	10 Nov 2023	18 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil														
Metals																	
Aluminium	mg/kg	50	NGA	10,400	11,600	15,300	17,900	16,900	13,900	17,300	9,170	19,500	14,800	36,500	12,600	12,600	6,610
Antimony	mg/kg	0.1	40 [a]	0.84	0.98	0.47	0.31	0.99	0.54	<2.00	0.11	2.31	3.06	<2.00	<2.00	<0.10	<2.00
Arsenic	mg/kg	0.1	26 [b]	296	399	1,010	46.3	844	48	989	70.3	1,010	***1,590***	480	810	105	496
Barium	mg/kg	0.5	670 [c]	79.8	80.8	76.3	31.8	64.7	79.5	55.2	37.8	65	114	34	29.9	18	28.5
Beryllium	mg/kg	0.1	8 [a]	1.36	0.31	0.67	1.03	0.63	3.09	*<2.00*	0.39	*<2.00*	*<2.00*	*<2.00*	*<2.00*	0.49	*<2.00*
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<5.0	<100	<100	<100	<100	<5.0	<100
Cadmium	mg/kg	0.02	1.9 [c]	0.779	0.04	0.229	0.192	0.18	1.79	<0.400	0.278	<0.400	1.77	0.545	<0.400	0.092	<0.400
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	16.6	26.5	28.6	12.1	24.9	15.8	29.3	14.8	25.2	21	26.3	12.8	10.7	11.4
Cobalt	mg/kg	0.1	180 [c]	54.9	2.57	7.29	2.44	3.8	1.36	11.5	1.38	10.8	8.92	3.77	2.79	1.45	4.93
Copper	mg/kg	0.5	91 [b]	51.4	7.8	19.3	17	48.4	42	16.4	5.97	39.4	40.6	11.3	<10.0	4.79	<10.0
Iron	mg/kg	50	NGA	15,000	21,000	28,300	5,580	31,200	7,210	35,100	8,700	32,500	41,300	27,500	17,900	17,200	13,600
Lead	mg/kg	0.5	32 [c]	***130***	24.9	52.3	***104***	***120***	***142***	***142***	81.1	***140***	***124***	39.2	38.3	26.6	21.7
Manganese	mg/kg	1	220 [d]	***1,390***	***313***	***376***	89	***277***	149	***587***	131	***830***	***801***	139	***240***	70.1	***345***
Mercury	mg/kg	0.005	20 [c]	0.52	14.1	3.8	0.232	0.809	1.2	2.34	0.14	***104***	14.9	0.359	0.605	0.143	0.228
Molybdenum	mg/kg	0.1	40 [a]	0.29	0.43	1.01	0.38	0.65	2.02	<2.00	0.29	<2.00	5.34	<2.00	<2.00	0.38	<2.00
Nickel	mg/kg	0.5	89 [b]	31.7	8.08	17.9	6.09	11.5	5.96	11.9	4.61	15.2	21.7	10.4	<10.0	3.43	<10.0
Selenium	mg/kg	0.2	2.9 [b]	0.67	0.36	1.02	***3.38***	0.97	***5.15***	*<4.00*	0.95	*<4.00*	*<4.00*	*<4.00*	*<4.00*	1.04	*<4.00*
Silver	mg/kg	0.1	40 [a]	0.16	0.1	0.13	0.23	0.21	0.37	<2.00	<0.10	<2.00	<2.00	<2.00	<2.00	0.15	<2.00
Strontium	mg/kg	0.5	950 [e,f]	6.47	2.3	11	2.39	6.21	16.6	<10.0	2.2	<10.0	16.2	<10.0	<10.0	1.59	<10.0
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	500	***1000***	<500	***3000***	<10000	<500	<10000	<10000	<10000	<10000	<500	<10000
Thallium	mg/kg	0.05	3.6 [b]	0.291	0.225	0.293	0.126	0.166	0.124	<1.00	0.13	<1.00	1.47	<1.00	<1.00	0.086	<1.00
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	4.1	3.8	<40.0	<2.0	<40.0	<40.0	<40.0	<40.0	<2.0	<40.0
Uranium	mg/kg	0.05	33 [c]	1.61	0.77	0.977	2.67	1.19	***55.6***	1.97	1.78	5.52	2.17	1.28	1.28	1.63	<1.00
Vanadium	mg/kg	0.2	18 [c]	21.5	34.6	35.6	15.3	***39.7***	14.8	***45.6***	15.8	31.4	29.2	28.5	19.2	19.1	13.4
Zinc	mg/kg	2	340 [c]	226	39.1	70	35.9	99.5	87.6	83.7	43.9	106	268	65.6	<40.0	25.9	<40.0

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

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[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location			BH60	BH61		24 MW-02	24MW-03	24MW-04	24 MW-05	BH82	BH83	BH84	BH85	BH86	BH87
Sample ID			BH 60 0-0.15m	BH 61 0-0.15m	BH DUP E 0-0.15m	24 MW-02-SS3 (1.2-1.6m)	24MW-03 SS1-SS2 (0-1.2m)	24MW-04 SS2 (0-0.64m)	24 MW-05-SS1 (0-0.58m)	BH82 0-0.15m	BH83 0-0.15m	BH84 0-0.15m	BH85 0-0.15m	BH86 0-0.15m	BH87 0-0.15m
Sample Type			Normal	Normal	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Date			19 Jan 2024	20 Jan 2024		16 Jan 2024	18 Jan 2024	18 Jan 2024	16 Jan 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	23 May 2024	23 May 2024
Sample Area			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil												
Metals															
Aluminium	mg/kg	50	NGA	21,800	25,600	26,200	10,800	23,700	14,300	20,100	2,930	10,500	20,700	25,200	1,430	7,030
Antimony	mg/kg	0.1	40 [a]	0.15	0.68	0.56	<0.10	0.54	0.2	1.12	<0.10	0.29	0.44	0.13	<0.10	<0.10
Arsenic	mg/kg	0.1	26 [b]	148	*1,250*	1,020	75.7	441	250	593	97.6	104	*1,390*	98.8	2.39	40.3
Barium	mg/kg	0.5	670 [c]	21.5	172	171	50.6	59.6	61.1	167	17.7	40.3	29	31.6	4.93	26.1
Beryllium	mg/kg	0.1	8 [a]	0.4	1.67	1.83	0.38	0.96	0.8	0.79	<0.10	0.24	0.8	0.43	<0.10	0.19
Boron	mg/kg	5	120 [c]	<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
Cadmium	mg/kg	0.02	1.9 [c]	0.086	0.122	0.127	0.043	0.282	0.058	0.093	0.049	0.153	0.065	0.063	<0.020	0.056
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	18.3	48.9	49.2	19.7	23	12.9	46.1	4.05	22.8	21.9	35.1	0.99	10.7
Cobalt	mg/kg	0.1	180 [c]	2.4	6.53	7.16	6.09	7.06	8.3	14.2	0.44	2.17	2.85	2.7	0.15	1.56
Copper	mg/kg	0.5	91 [b]	6.18	9.3	8.58	10.6	31.7	7.06	36.4	1.78	11	8.72	6.19	<0.50	2.77
Iron	mg/kg	50	NGA	23,100	42,400	43,000	17,900	22,300	19,900	30,900	4,900	23,200	24,000	34,000	960	5,770
Lead	mg/kg	0.5	32 [c]	18.3	*96.8*	87.5	20.4	*104*	21.8	60.4	8.1	41.7	49.6	51.9	3.56	22.5
Manganese	mg/kg	1	220 [d]	131	*989*	*1,040*	*471*	*436*	*699*	*743*	67.7	147	144	155	20.4	83.6
Mercury	mg/kg	0.005	20 [c]	0.193	0.642	0.492	0.0086	1.05	1.14	2.52	0.052	0.103	0.0969	0.183	0.066	0.0726
Molybdenum	mg/kg	0.1	40 [a]	0.55	0.24	0.24	1.29	0.89	0.75	2.28	0.28	1.32	1.66	0.53	0.11	0.59
Nickel	mg/kg	0.5	89 [b]	6.89	16.3	16.4	12.6	17.2	9.15	26.2	1.41	8.12	7.66	7.6	<0.50	4.6
Selenium	mg/kg	0.2	2.9 [b]	1.42	<0.20	<0.20	<0.20	0.53	<0.20	0.24	0.28	1.24	1.05	1.93	<0.20	0.38
Silver	mg/kg	0.1	40 [a]	0.13	0.24	0.2	<0.10	<0.10	<0.10	<0.10	0.12	0.13	0.16	0.18	<0.10	<0.10
Strontium	mg/kg	0.5	950 [e,f]	2.5	4.3	4.14	2.06	4.22	1.74	5.23	2.91	7.77	2.2	2.16	0.86	1.48
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	0.099	0.336	0.334	0.166	0.26	0.496	0.342	<0.050	0.093	0.138	0.108	0.056	0.084
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [c]	0.877	1.22	1.41	1.58	3.02	1.74	2	0.68	0.938	6.44	1.03	0.767	1.85
Vanadium	mg/kg	0.2	18 [c]	22.5	*60.9*	*61.4*	19.2	23.8	24.5	*47.8*	12.6	*43.7*	33.4	*40.7*	1.99	15.4
Zinc	mg/kg	2	340 [c]	28.4	95	95.8	40.1	152	98	114	5.5	40.8	44.5	50.8	3.1	18.2

Notes

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Values in bold, italic and underline exceed both the guideline and the background.

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[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location			BH88		BH89	BH90	BH91	BH92	BH93	BH94	BH95	BH96	BH97	BH98	BH99	BH100
Sample ID			BH88 0-0.15m	BH DUP i 0-0.15m	BH89 0-0.15m	BH90 0-0.15m	BH91 0-0.15m	BH92 0-0.15m	BH93 0-0.15m	BH94 0-0.15m	BH95 0-0.15m	BH96 0-0.15m	BH97 0-0.15m	BH98 0-0.15m	BH99 0-0.15m	BH100 0-0.15m
Sample Type			Normal	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Date			23 May 2024		23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024
Sample Area			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil													
Metals																
Aluminium	mg/kg	50	NGA	7,280	7,470	11,900	13,100	7,670	14,400	21,400	12,900	9,120	10,600	4,370	18,000	17,800	15,500
Antimony	mg/kg	0.1	40 [a]	0.17	0.15	0.14	0.39	0.11	0.23	0.46	0.15	<0.10	0.18	0.19	0.43	0.52	0.19
Arsenic	mg/kg	0.1	26 [b]	129	146	67.1	638	26.2	37.3	13.9	10.2	10.6	371	404	918	1,010	465
Barium	mg/kg	0.5	670 [c]	23.1	24.7	30.2	26.7	15.4	99.5	57.1	27.4	29	22.2	17	54.7	60.1	56.4
Beryllium	mg/kg	0.1	8 [a]	0.25	0.28	0.42	0.34	0.19	7.49	3.63	1.3	0.72	0.26	<0.10	1.35	0.56	0.64
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<7.5 [3]	<7.5 [3]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium	mg/kg	0.02	1.9 [c]	0.156	0.157	0.112	0.095	0.049	***2.3***	0.633	0.177	0.058	0.05	0.05	0.12	0.07	0.097
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	7.13	7.85	16	17.2	13.2	5.11	2.48	9.25	10.5	12.4	7.11	18.6	23.3	21.3
Cobalt	mg/kg	0.1	180 [c]	0.97	1.09	1.9	2.03	1.23	0.77	0.76	3.09	1.9	1.24	0.57	66.2	3.58	6.26
Copper	mg/kg	0.5	91 [b]	4.2	3.86	4.08	4.51	2	30.2	7.67	6.26	4.66	2.86	3.7	8.06	9.45	12.6
Iron	mg/kg	50	NGA	9,340	9,770	26,900	21,500	23,800	1,780	2,030	14,800	7,290	16,000	10,200	28,300	24,200	21,800
Lead	mg/kg	0.5	32 [c]	25.5	24	50.5	31.2	23.9	49.5	44.1	22.5	27.3	26.2	12.2	***91.4***	22.6	24.2
Manganese	mg/kg	1	220 [d]	85.9	92.4	147	153	86	59.7	29.8	193	94.2	129	90.8	***2,130***	***313***	***490***
Mercury	mg/kg	0.005	20 [c]	0.0632	0.0552	0.116	0.278	0.16	0.166 [3]	0.304 [3]	0.12	0.0734	0.0867	0.0686	0.135	0.0621	0.0535
Molybdenum	mg/kg	0.1	40 [a]	0.5	0.45	0.44	0.7	0.3	0.71	0.4	0.87	0.92	0.52	0.6	2.83	0.56	0.69
Nickel	mg/kg	0.5	89 [b]	3.17	3.42	5.67	6.01	3.78	6.49	3.96	4.25	4.24	3.27	1.77	9.89	8.77	11.9
Selenium	mg/kg	0.2	2.9 [b]	0.57	0.58	1.02	1.12	0.51	***11.1***	***5.27***	1.72	1.58	0.9	0.33	***3.05***	0.83	0.56
Silver	mg/kg	0.1	40 [a]	0.21	0.2	0.12	0.11	0.26	0.31	0.74	0.19	0.13	<0.10	<0.10	0.2	<0.10	<0.10
Strontium	mg/kg	0.5	950 [e,f]	2.18	2.08	3.79	2.17	1.4	46.8	20.2	3.62	2.75	2.36	1.86	4.6	3.06	3.93
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	***3700***	<1000	<500	<500	<500	<500	<500	<500	<500
Thallium	mg/kg	0.05	3.6 [b]	0.082	0.088	0.106	0.106	0.085	<0.075 [3]	<0.075 [3]	0.145	0.167	0.11	0.068	0.867	0.202	0.202
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	<3.0 [3]	<3.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [c]	1.1	1.05	1.33	0.98	0.919	***76.6***	7.45 [3]	1.12	1.55	0.861	0.87	1.92	0.968	0.992
Vanadium	mg/kg	0.2	18 [c]	18.9	19.4	***64.6***	28.3	***47.9***	4.92	2.94	22.1	18.3	21.9	24.8	29.4	30.1	26.6
Zinc	mg/kg	2	340 [c]	16.9	19.2	34.1	32.3	31.1	56.2	18.8	15.6	20.5	16.6	9.9	90.2	40.7	42.5

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH101	BH102	BH103	BH104	BH105	BH106	BH107	BH108	BH109	BH110	BH111		BH112
Sample ID				BH101 0-0.15m	BH102 0-0.15m	BH103 0-0.15m	BH104 0-0.15m	BH105 0-0.15m	BH106 0-0.15m	BH107 0-0.15m	BH108 0-0.15m	BH109 0-0.15m	BH110 0-0.15m	BH111 0-0.15m	BH DUP J 0-0.15m	BH112 0-0.15m
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal
Date				24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024		25 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil													
Metals																
Aluminium	mg/kg	50	NGA	10,800	17,600	15,100	740	7,730	14,000	8,510	12,600	5,640	14,600	14,800	11,400	12,500
Antimony	mg/kg	0.1	40 [a]	0.29	0.31	0.22	<0.10	0.19	0.21	<0.10	0.2	0.16	0.18	22	22.3	0.5
Arsenic	mg/kg	0.1	26 [b]	800	700	450	8.82	317	408	16.1	137	190	311	***18,700***	***20,600***	***1,440***
Barium	mg/kg	0.5	670 [c]	64.8	51.9	31.4	4.89	16.4	21.8	9.49	17.9	20.6	12.6	104	87.4	35
Beryllium	mg/kg	0.1	8 [a]	0.38	0.56	0.53	<0.10	0.46	0.41	0.52	0.36	0.12	0.38	0.67	0.54	0.37
Boron	mg/kg	5	120 [c]	<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
Cadmium	mg/kg	0.02	1.9 [c]	0.075	0.057	0.089	<0.020	0.119	0.106	0.129	0.098	0.041	0.075	0.322	0.16	0.14
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	16.5	22.2	21	1.45	5.51	12.3	2.13	8.96	9.19	12.1	30.3	24.6	15.1
Cobalt	mg/kg	0.1	180 [c]	3.28	4.08	2.78	0.16	0.84	1.93	0.17	1.16	1.08	1.01	20.2	23.5	4.04
Copper	mg/kg	0.5	91 [b]	7.65	9.42	4.71	1.29	3.27	4.58	2.41	5.64	3.37	2.98	32.5	19.9	11
Iron	mg/kg	50	NGA	20,200	25,500	26,500	1,720	12,200	16,700	2,640	13,000	12,700	17,700	32,600	31,000	20,400
Lead	mg/kg	0.5	32 [c]	29.5	26.8	17.6	3.98	32.6	26.8	15.5	36.5	22.8	19.9	***445***	***245***	31.6
Manganese	mg/kg	1	220 [d]	***376***	***329***	***247***	24	190	191	13	81.1	77.4	80.9	***428***	***289***	***340***
Mercury	mg/kg	0.005	20 [c]	0.102	0.0711	0.0747	0.0127	0.0684	0.121	0.108	0.48	0.0568	0.0974	19.2 [3]	12.5 [3]	0.209
Molybdenum	mg/kg	0.1	40 [a]	0.57	0.71	0.73	0.3	0.46	0.47	0.24	0.32	0.45	0.37	0.54	0.53	0.75
Nickel	mg/kg	0.5	89 [b]	7.09	9.8	6.38	<0.50	1.89	4.31	1.06	3.31	3.45	2.67	36.3	35.2	6.15
Selenium	mg/kg	0.2	2.9 [b]	0.7	0.94	1.24	<0.20	1.03	1.18	1.06	0.86	0.43	1.28	1.11	0.9	0.82
Silver	mg/kg	0.1	40 [a]	<0.10	<0.10	0.18	<0.10	0.37	0.2	0.9	0.18	0.11	0.14	0.6	0.44	0.13
Strontium	mg/kg	0.5	950 [e,f]	4.93	2.75	1.66	0.64	1.49	1.63	2.46	1.57	2.27	1.22	4.65	2.37	2.15
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	***8700***	***8700***	<500
Thallium	mg/kg	0.05	3.6 [b]	0.164	0.183	0.146	<0.050	0.109	0.133	<0.050	0.088	0.075	0.085	0.347	0.274	0.165
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	mg/kg	0.05	33 [c]	1.02	1.13	1.01	1.16	1.62	1.57	1.2	1.03	0.886	0.885	2.9	1.69	0.995
Vanadium	mg/kg	0.2	18 [c]	28	31.4	36.5	2.86	13.5	19.6	2.96	16.6	24	24.8	35.3	27.2	22.5
Zinc	mg/kg	2	340 [c]	30.8	36.5	37.2	2.3	12.8	23.4	5.2	31.9	12.1	16.3	110	63.8	28.5

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

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[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location			BH113		BH114	BH115	BH116	BH117	BH118	BH119	BH120	BH121	BH122	BH123	BH124
Sample ID			BH113 0-0.15m	BH DUP K 0-0.15m	BH114 0-0.15m	BH115 0-0.15m	BH116 0-0.15m	BH117 0-0.15m	BH118 0-0.15m	BH119 0-0.15m	BH120 0-0.15m	BH121 0-0.15m	BH122 0-0.15m	BH123 0-0.15m	BH124 0-0.15m
Sample Type			Normal	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Date			25 May 2024		25 May 2024	25 May 2024	25 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	23 May 2024	25 May 2024	25 May 2024
Sample Area			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil												
Metals															
Aluminium	mg/kg	50	NGA	850	992	2,820	11,600	10,200	16,200	25,000	13,600	12,900	7,350	20,200	24,800	32,400
Antimony	mg/kg	0.1	40 [a]	<0.10	<0.10	<0.10	<0.10	0.29	1	0.24	<2.00 [3]	<2.00 [3]	0.31	0.23	<2.00 [3]	0.14
Arsenic	mg/kg	0.1	26 [b]	22.8	21.2	203	39.7	348	*1,150*	730	965	*1,640*	33.2	70.1	*2,310*	326
Barium	mg/kg	0.5	670 [c]	5.32	6.03	12.8	9.46	48.7	80	66.4	45.5	108	130	128	130	127
Beryllium	mg/kg	0.1	8 [a]	<0.10	<0.10	0.16	0.78	0.6	0.63	0.78	<2.00 [3]	<2.00 [3]	2.53	0.74	<2.00 [3]	2.46
Boron	mg/kg	5	120 [c]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100 [3]	<100 [3]	<5.0	<5.0	<100 [3]	<5.0
Cadmium	mg/kg	0.02	1.9 [c]	0.024	0.038	0.068	0.033	0.207	0.146	0.195	<0.400 [3]	<0.400 [3]	*1.98*	0.058	<0.400 [3]	0.274
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	1.1	1.25	2.53	3.72	16.3	25.4	33.8	19.6	30.3	5.93	39.2	48.9	56.2
Cobalt	mg/kg	0.1	180 [c]	0.17	0.16	0.31	0.39	4.09	10.9	52.6	2.7	8.18	1.78	2.26	15.1	28.7
Copper	mg/kg	0.5	91 [b]	1.03	1	1.73	3.38	9.8	22.4	13.7	11.1	14.7	14.7	5.76	22.5	17.1
Iron	mg/kg	50	NGA	2,780	2,410	6,830	3,660	18,400	27,700	35,200	26,000	26,000	2,670	26,200	48,900	51,500
Lead	mg/kg	0.5	32 [c]	3.32	3.97	34.5	20.9	*98.4*	*105*	*173*	58.2	42.1	62.4	33.5	58.6	*126*
Manganese	mg/kg	1	220 [d]	65.2	69.5	37.2	26.9	*274*	*923*	*1,140*	177	*586*	*367*	*535*	*1,030*	*1,770*
Mercury	mg/kg	0.005	20 [c]	0.0256	0.0295	0.0286	0.0565	0.404	0.605	0.206	3.1	7.56	0.48	3.99	0.578	0.818
Molybdenum	mg/kg	0.1	40 [a]	0.24	0.22	0.33	0.46	1.1	0.52	1.78	<2.00 [3]	<2.00 [3]	1.19	0.26	<2.00 [3]	0.29
Nickel	mg/kg	0.5	89 [b]	<0.50	<0.50	1.02	1.27	6.36	15.6	8.73	<10.0 [3]	<10.0 [3]	5.6	8.56	24.8	34.2
Selenium	mg/kg	0.2	2.9 [b]	<0.20	<0.20	0.34	0.89	1.21	0.41	2.13	*<4.00* [3]	*<4.00* [3]	*3.89*	0.2	*<4.00* [3]	0.27
Silver	mg/kg	0.1	40 [a]	<0.10	<0.10	0.13	0.1	0.18	0.12	0.34	<2.00 [3]	<2.00 [3]	0.31	0.16	<2.00 [3]	0.16
Strontium	mg/kg	0.5	950 [e,f]	0.96	1.18	1.43	0.92	3.05	2.63	2.79	<10.0 [3]	<10.0 [3]	42.4	2.54	<10.0 [3]	7.86
Sulphur as S	mg/kg	1,000	500 [a]	<500	<500	<500	<500	<500	<500	<500	<10000	<10000	*3000*	<500	<10000	<500
Thallium	mg/kg	0.05	3.6 [b]	<0.050	<0.050	0.069	0.084	0.184	0.218	0.313	<1.00 [3]	<1.00 [3]	0.053	0.325	<1.00 [3]	0.317
Tin	mg/kg	2	300 [a]	<2.0	<2.0	<2.0	2.3	2.2	<2.0	<2.0	<40.0 [3]	<40.0 [3]	<2.0	2.3	<40.0 [3]	<2.0
Uranium	mg/kg	0.05	33 [c]	0.8	0.836	1.64	6.06	3.9	1.12	2.44	1.23	<1.00 [3]	18.5	3.25	1	1.06
Vanadium	mg/kg	0.2	18 [c]	5.63	5.16	7.47	5.94	29.6	35.4	*53.3*	*43.5*	38.1	5.83	*44.3*	*57.2*	*67.3*
Zinc	mg/kg	2	340 [c]	2.7	2.7	5.6	26	58.6	110	114	<40.0 [3]	41.8	87.8	85.6	80	165

Notes

Shaded cells denote an exceedance above the applicable guideline

Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH125		BH126	BH132	BH133	BH134	BH135
Sample ID				BH125 0-0.15m	BH DUP L 0-0.15m	BH126 0-0.15m	BH132 0-0.15m	BH133 0-0.15m	BH134 0-0.15m	BH135 0-0.15m
Sample Type				Normal	Duplicate	Normal	Normal	Normal	Normal	Normal
Date				25 May 2024		25 May 2024	24 May 2024	24 May 2024	24 May 2024	24 May 2024
Sample Area				Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil							
Metals										
Aluminium	mg/kg	50	NGA	21,300	21,500	21,000	18,700	13,500	10,200	12,400
Antimony	mg/kg	0.1	40 [a]	<2.00 [3]	<2.00 [3]	2.01	34.8	<2.00 [3]	3.41	4.64
Arsenic	mg/kg	0.1	26 [b]	509	471	*1,250*	*2,420*	*2,350*	*5,170*	*6,380*
Barium	mg/kg	0.5	670 [c]	49.8	48.3	102	117	131	88.7	93.8
Beryllium	mg/kg	0.1	8 [a]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]
Boron	mg/kg	5	120 [c]	<100 [3]	<100 [3]	<100 [3]	<100 [3]	<100 [3]	<100 [3]	<100 [3]
Cadmium	mg/kg	0.02	1.9 [c]	<0.400 [3]	<0.400 [3]	<0.400 [3]	0.51	<0.400 [3]	<0.400 [3]	<0.400 [3]
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	28.5	27.9	32.1	22.6	32.8	23.7	30.1
Cobalt	mg/kg	0.1	180 [c]	3.48	3.74	16	7.46	2.38	<2.00 [3]	<2.00 [3]
Copper	mg/kg	0.5	91 [b]	<10.0 [3]	<10.0 [3]	71.7	36.5	<10.0 [3]	<10.0 [3]	<10.0 [3]
Iron	mg/kg	50	NGA	33,100	31,100	36,500	34,400	25,300	22,300	26,100
Lead	mg/kg	0.5	32 [c]	52.2	49.7	*137*	*1,140*	68.6	86.4	*89*
Manganese	mg/kg	1	220 [d]	*307*	*305*	*966*	*377*	*404*	*266*	*379*
Mercury	mg/kg	0.005	20 [c]	0.412	0.452	3.08	*108*	5.84	*26.2*	*37.1*
Molybdenum	mg/kg	0.1	40 [a]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]
Nickel	mg/kg	0.5	89 [b]	<10.0 [3]	<10.0 [3]	19.5	21.3	<10.0 [3]	<10.0 [3]	<10.0 [3]
Selenium	mg/kg	0.2	2.9 [b]	*<4.00* [3]	*<4.00* [3]	<4.00 [3]	*<4.00* [3]	*<4.00* [3]	*<4.00* [3]	*<4.00* [3]
Silver	mg/kg	0.1	40 [a]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]	<2.00 [3]
Strontium	mg/kg	0.5	950 [e,f]	<10.0 [3]	<10.0 [3]	<10.0 [3]	<10.0 [3]	<10.0 [3]	<10.0 [3]	<10.0 [3]
Sulphur as S	mg/kg	1,000	500 [a]	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Thallium	mg/kg	0.05	3.6 [b]	<1.00 [3]	<1.00 [3]	<1.00 [3]	<1.00	<1.00 [3]	<1.00 [3]	<1.00 [3]
Tin	mg/kg	2	300 [a]	<40.0 [3]	<40.0 [3]	<40.0 [3]	53.5	<40.0 [3]	<40.0 [3]	<40.0 [3]
Uranium	mg/kg	0.05	33 [c]	1.07	1.13	5.96	1.21	<1.00 [3]	<1.00 [3]	<1.00 [3]
Vanadium	mg/kg	0.2	18 [c]	*46.1*	*44*	38.1	34.3	*38.7*	29.7	32.6
Zinc	mg/kg	2	340 [c]	50.6	51	224	176	<40.0 [3]	<40.0 [3]	<40.0 [3]

Notes

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Values in bold, italic and underline exceed both the guideline and the background.

SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Alberta Environment and Parks (AEP). (2019, updated 2024). Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Surface Soil Remediation Guideline Values for Commercial Land Use (Table A-4). Lands Policy and Programs Branch, Government of Alberta.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-17: Analytical data for metals in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQGE) Commercial, Coarse Soil	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances	Number of Exceedances over Guideline and Background
Metals												
Aluminium	mg/kg	50	NGA	120	0	120	740	740	36500	36500	0	0
Antimony	mg/kg	0.1	40 [a]	120	27	93	<2.00	0.1	48.1	48.1	1	*1*
Arsenic	mg/kg	0.1	26 [b]	120	0	120	2.39	2.39	20600	20600	111	*40*
Barium	mg/kg	0.5	670 [c]	120	0	120	4.89	4.89	198	198	0	0
Beryllium	mg/kg	0.1	8 [a]	120	29	91	<0.10	0.12	7.49	7.49	0	0
Boron	mg/kg	5	120 [c]	120	120	0	<5.0	-	<5.0	-	0	0
Cadmium	mg/kg	0.02	1.9 [c]	120	20	100	<0.400	0.024	2.63	2.63	5	*5*
Chromium (Total, III+VI)	mg/kg	0.5	87 [b]	120	0	120	0.99	0.99	61.3	61.3	0	0
Cobalt	mg/kg	0.1	180 [c]	120	2	118	<2.00 3	0.15	162	162	0	0
Copper	mg/kg	0.5	91 [b]	120	9	111	<10.0	1	99.6	99.6	1	*1*
Iron	mg/kg	50	NGA	120	0	120	960	960	112000	112000	0	0
Lead	mg/kg	0.5	32 [c]	120	0	120	3.32	3.32	1360	1360	87	*48*
Manganese	mg/kg	1	220 [d]	120	0	120	13	13	7510	7510	76	*76*
Mercury	mg/kg	0.005	20 [c]	120	0	116	0.006	0.006	2920	2920	11	*11*
Molybdenum	mg/kg	0.1	40 [a]	120	21	99	<2.00	0.11	29.5	29.5	0	0
Nickel	mg/kg	0.5	89 [b]	120	14	106	<10.0	1.02	48.5	48.5	0	0
Selenium	mg/kg	0.2	2.9 [b]	120	34	86	<0.20	0.2	11.1	11.1	10	*10*
Silver	mg/kg	0.1	40 [a]	120	42	78	<0.10	0.1	1.27	1.27	0	0
Strontium	mg/kg	0.5	950 [e,f]	120	21	99	<10.0	0.64	73.4	73.4	0	0
Sulphur as S	mg/kg	1,000	500 [a]	120	100	20	<500	500	8700	8700	19	*19*
Thallium	mg/kg	0.05	3.6 [b]	120	31	89	<0.050	0.053	1.47	1.47	0	0
Tin	mg/kg	2	300 [a]	120	92	28	<2.0	2.1	60.7	60.7	0	0
Uranium	mg/kg	0.05	33 [c]	120	8	111	<1.00	0.574	76.6	76.6	2	*2*
Vanadium	mg/kg	0.2	18 [c]	120	0	120	1.99	1.99	72.6	72.6	94	*31*
Zinc	mg/kg	2	340 [c]	120	6	114	<40.0	2.3	531	531	2	*2*

Notes

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SQG_E = oil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

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[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Available from parameter-specific fact sheets. SQG_E for commercial land use.

[c] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[d] US EPA EcoSoil Screening Level (EcoSSL) for manganese (US EPA, 2007). Lower of plant (220 mg/kg), soil invertebrate (450 mg/kg), avian (4300 mg/kg), and mammalian (4000 mg/kg) EcoSSLs. Available from https://www.epa.gov/sites/default/files/2015-09/documents/eco-ssl_manganese.pdf

[e] Oregon Department of Environmental Quality (2020) Risk Based Concentrations for Plants, Invertebrates and Wildlife Exposed to Soil. Derived from the LANL (Los Alamos National Laboratory), September 2017. ECORISK Database (Release 4.1), LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2017, 602538). Lowest of herbivore, omnivore, or mixed diet exposure scenarios. Retrieved from https://www.oregon.gov/deq/FilterDocs/EcoRiskTablesAppendices.pdf

[f] Selected benchmark is the lower of the ground feeding and top consumer mammal risk based concentrations. No vegetation, soil invertebrate or avian values were available.

Table C-18: Analytical data for PAHs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

	Location	BH 1	BH 2	24 MW-01	BH 9	BH10	BH11		BH12	BH 13	BH14	BH15	BH16
	Sample ID	BH1 0-0.15m	BH2 0-0.15m	24 MW-01-SS5 (2.4-3.1m)	BH9 0-0.15m	BH10 0-0.15m	BH11 0-0.15m	BH DUPB 0-0.15m	BH12 0-0.15m	BH13 0-0.15m	BH14 0-0.15m	BH15 0-0.15m	BH16 0-0.15m
	Depth (m bgs)	0-0.15	0-0.15	2.4-3.1	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
	Date	07 Nov 2023	07 Nov 2023	17 Jan 2024	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	10 Nov 2023	09 Nov 2023	08 Nov 2023	08 Nov 2023
	Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	FD (BH11 0-0.15m)	Normal	Normal	Normal	Normal	Normal
	Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Coarse Soil											
Polycyclic Aromatic Hydrocarbons (PAHs)														
1-Methylnaphthalene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.04	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
2-Methylnaphthalene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.04	0.02	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
1 & 2 Methylnaphthalene	mg/kg	0.015	NGA	<0.015	<0.015	<0.015	0.08	0.03	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Acenaphthene	mg/kg	0.005	46,000 [a]	<0.0052	<0.0054	<0.0050	<0.0078	<0.0051	<0.0060	<0.0058	<0.0050	<0.0063	<0.0056	<0.0050	<0.0065
Acenaphthylene	mg/kg	0.005	NGA	<0.0052	<0.0054	<0.0050	0.02	<0.0051	<0.0060	0.01	0.01	0.03	0.08	0.01	0.04
Acridine	mg/kg	0.01	NGA	<0.051	<0.050	<0.010	<0.136	<0.047	<0.052	<0.054	<0.046	<0.014	<0.052	<0.031	<0.069
Anthracene	mg/kg	0.004	32 [b]	<0.0052	<0.0054	<0.0040	0.02	0.01	<0.0104	0.02	0.01	0.04	0.07	0.02	0.05
Benz(a)anthracene	mg/kg	0.01	1 [a]	<0.010	<0.010	<0.010	0.07	0.03	0.04	0.08	0.01	0.22	0.15	0.03	0.12
Benzo(a)pyrene	mg/kg	0.01	72 [b]	<0.010	<0.010	<0.010	0.06	0.03	0.04	0.07	0.01	0.21	0.13	0.03	0.10
Benzo(b+j)fluoranthene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.09	0.04	0.05	0.10	0.04	0.42	0.36	0.07	0.17
Benzo(b+j+k)fluoranthene	mg/kg	0.015	15 [a]	<0.015	<0.015	<0.015	0.12	0.06	0.07	0.14	0.05	0.59	0.48	0.09	0.24
Benzo(g,h,i)perylene	mg/kg	0.01	13 [a]	<0.010	<0.010	<0.010	0.03	0.02	0.02	0.04	0.03	0.10	0.11	0.02	0.05
Benzo(k)fluoranthene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.03	0.01	0.02	0.04	0.01	0.17	0.12	0.03	0.07
Chrysene	mg/kg	0.01	14 [a]	<0.010	<0.010	<0.010	0.07	0.03	0.03	0.07	<0.034	<0.619	0.22	0.04	0.12
Dibenz(a,h)anthracene	mg/kg	0.005	10 [b,c]	<0.0052	<0.0054	<0.0050	<0.0100	<0.0051	<0.0065	0.01	0.01	0.04	0.03	0.01	0.02
Fluorene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	<0.022	<0.010	<0.017	<0.019	<0.010	0.01	<0.014	<0.010	<0.025
Fluoranthene	mg/kg	0.01	180 [b]	<0.010	<0.010	<0.010	0.10	0.06	0.06	0.14	0.02	0.55	0.33	0.08	0.27
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	0.76 [a]	<0.010	<0.010	<0.010	0.04	0.02	0.02	0.05	0.02	0.14	0.15	0.03	0.07
Naphthalene	mg/kg	0.01	22 [a]	<0.010	<0.010	<0.010	0.02	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Perylene	mg/kg	0.01	NGA	<0.010	<0.010	<0.010	0.02	<0.010	0.01	0.02	<0.010	0.05	0.03	<0.010	0.03
Phenanthrene	mg/kg	0.01	12 [a]	<0.010	<0.010	<0.010	0.07	0.04	0.02	0.03	<0.016	0.20	0.09	0.03	0.04
Pyrene	mg/kg	0.01	99,000 [a]	<0.010	<0.010	<0.010	0.10	0.06	0.06	0.13	0.02	0.41	0.25	0.07	0.20
Quinoline	mg/kg	0.01	NGA	<0.068	<0.075	<0.010	<0.090	<0.047	<0.052	<0.091	<0.046	<0.033	<0.055	<0.031	<0.090

Notes

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SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

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[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Polycyclic Aromiatic Hydrocarbons. SQG_E for commercial land use.

[c] Interim guideline from CCME (1991) applied in the absence of a guideline from other jurisdictions.

Table C-18: Analytical data for PAHs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

				Location	BH17	BH18	BH19	BH20	BH21	BH22	BH23	BH33	BH34	BH35	BH36	24 MW-02
				Sample ID	BH17 0-0.15m	BH18 0-0.15m	BH19 0-0.15m	BH20 0-0.15m	BH21 0-0.15m	BH22 0-0.15m	BH DUPC 0-0.15m	BH33 0-0.15m	BH34 0-0.15m	BH35 0-0.15m	BH36 0-0.15m	24 MW-02-SS3 (1.2-1.6m)
				Depth (m bgs)	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	1.2-1.6
				Date	09 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	16 Jan 2024
				Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Coarse Soil												
Polycyclic Aromatic Hydrocarbons (PAHs)																
	1-Methylnaphthalene	mg/kg	0.01	NGA	0.37	0.03	0.08	<0.010	0.01	<0.010	0.09	<0.010	<0.010	<0.010	0.01	<0.010
	2-Methylnaphthalene	mg/kg	0.01	NGA	0.41	0.03	0.08	0.01	0.01	<0.010	0.12	<0.010	<0.010	<0.010	0.01	<0.010
	1 & 2 Methylnaphthalene	mg/kg	0.015	NGA	0.78	0.06	0.17	<0.015	0.03	<0.015	0.20	<0.015	<0.015	<0.015	0.02	<0.015
	Acenaphthene	mg/kg	0.005	46,000 [a]	0.10	<0.0051	0.02	0.01	<0.0052	0.01	<0.0057	<0.0050	<0.0069	<0.0086	0.01	<0.0050
	Acenaphthylene	mg/kg	0.005	NGA	0.10	<0.0051	0.02	0.37	0.06	0.02	<0.0057	0.01	<0.0069	0.01	0.39	<0.0050
	Acridine	mg/kg	0.01	NGA	<0.081	<0.052	<0.052	<0.053	<0.055	<0.010	<0.029	<0.053	<0.072	<0.010	0.07	<0.010
	Anthracene	mg/kg	0.004	32 [b]	0.15	0.01	0.05	0.20	0.06	0.05	0.01	0.01	0.02	0.01	0.66	<0.0040
	Benz(a)anthracene	mg/kg	0.01	1 [a]	0.52	0.03	0.17	1.20	0.50	0.19	0.03	0.04	0.05	0.03	2.47	<0.010
	Benzo(a)pyrene	mg/kg	0.01	72 [b]	0.34	0.02	0.12	1.16	0.45	0.16	0.05	0.04	0.04	0.03	2.37	<0.010
	Benzo(b+j)fluoranthene	mg/kg	0.01	NGA	0.62	0.03	0.24	2.07	1.03	0.25	0.14	0.06	0.07	0.06	4.30	<0.010
	Benzo(b+j+k)fluoranthene	mg/kg	0.015	15 [a]	0.81	0.03	0.32	2.81	1.33	0.34	0.19	0.08	0.10	0.08	5.89	<0.015
	Benzo(g,h,i)perylene	mg/kg	0.01	13 [a]	0.19	0.01	0.08	0.78	0.54	0.11	0.09	0.03	0.03	0.02	1.31	<0.010
	Benzo(k)fluoranthene	mg/kg	0.01	NGA	0.20	<0.010	0.08	0.74	0.30	0.09	0.04	0.02	0.03	0.02	1.59	<0.010
	Chrysene	mg/kg	0.01	14 [a]	0.56	0.02	0.18	1.26	<0.663	0.17	0.07	0.04	0.04	0.03	2.90	<0.010
	Dibenz(a,h)anthracene	mg/kg	0.005	10 [b,c]	0.06	<0.0051	0.03	0.21	0.20	0.03	0.02	0.01	0.01	<0.0086	0.43	<0.0050
	Fluorene	mg/kg	0.01	NGA	0.06	<0.010	0.01	<0.041	<0.014	<0.010	<0.010	<0.010	<0.022	<0.030	0.06	<0.010
	Fluoranthene	mg/kg	0.01	180 [b]	0.87	0.04	0.31	2.30	1.04	0.32	0.07	0.07	0.08	0.07	5.92	<0.010
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	0.76 [a]	0.23	0.01	0.10	1.02	0.51	0.14	0.09	0.03	0.04	0.03	1.81	<0.010
	Naphthalene	mg/kg	0.01	22 [a]	0.27	0.02	0.05	0.04	0.02	<0.010	0.07	<0.010	<0.010	<0.010	0.02	<0.010
	Perylene	mg/kg	0.01	NGA	0.08	<0.010	0.03	0.35	0.13	0.05	0.01	0.01	<0.010	<0.010	0.56	<0.010
	Phenanthrene	mg/kg	0.01	12 [a]	0.71	0.07	0.14	0.31	0.13	0.13	0.09	0.02	0.05	0.03	1.39	<0.010
	Pyrene	mg/kg	0.01	99,000 [a]	0.85	0.05	0.27	1.97	0.93	0.28	0.06	0.06	0.07	0.05	4.43	<0.010
	Quinoline	mg/kg	0.01	NGA	<0.081	<0.052	<0.052	<0.053	<0.055	<0.010	<0.061	<0.010	<0.010	<0.010	<0.010	<0.010

Notes

Shaded cells denote an exceedance above the applicable gu

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Polycyclic Aromiatic Hydrocarbons. SQG_E for commercial land use.

[c] Interim guideline from CCME (1991) applied in the absence of a guideline from other jurisdictions.

Table C-18: Analytical data for PAHs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

				Location	24MW-03		24MW-04	Data Summary							
				Sample ID	24MW-03 SS1-SS2 (0-1.2m)	24MW-DUP C	24MW-04 SS2 (0-0.64m)	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
				Depth (m bgs)	0-1.2	0-1.2	0-0.64								
				Date	18 Jan 2024	18 Jan 2024	18 Jan 2024								
				Sample Type	Normal	FD (24MW-03 SS1-SS2 (0-	Normal								
				Sample Area	Site	Site	Site								
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Coarse Soil												
Polycyclic Aromatic Hydrocarbons (PAHs)															
1-Methylnaphthalene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	19	8	<0.010	0.01	0.373	0.373	0
2-Methylnaphthalene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	18	9	<0.010	0.01	0.411	0.411	0
1 & 2 Methylnaphthalene	mg/kg	0.015	NGA		<0.015	<0.015	<0.015	27	19	8	<0.015	0.022	0.784	0.784	0
Acenaphthene	mg/kg	0.005	46,000 [a]		<0.0081	<0.0050	<0.0068	27	22	5	<0.0052	0.0065	0.0958	0.0958	0
Acenaphthylene	mg/kg	0.005	NGA		<0.0081	<0.0050	<0.0068	27	12	15	<0.0052	0.0079	0.392	0.392	0
Acridine	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	26	1	<0.051	0.068	0.068	0.068	0
Anthracene	mg/kg	0.004	32 [b]		<0.0081	<0.0045	<0.0068	27	8	19	<0.0052	0.0069	0.661	0.661	0
Benz(a)anthracene	mg/kg	0.01	1 [a]		<0.010	<0.010	<0.010	27	7	20	<0.010	0.013	2.47	2.47	2
Benzo(a)pyrene	mg/kg	0.01	72 [b]		<0.010	<0.010	<0.010	27	7	20	<0.010	0.014	2.37	2.37	0
Benzo(b+j)fluoranthene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	7	20	<0.010	0.028	4.3	4.3	0
Benzo(b+j+k)fluoranthene	mg/kg	0.015	15 [a]		<0.015	<0.015	<0.015	27	7	20	<0.015	0.028	5.89	5.89	0
Benzo(g,h,i)perylene	mg/kg	0.01	13 [a]		<0.010	<0.010	<0.010	27	7	20	<0.010	0.011	1.31	1.31	0
Benzo(k)fluoranthene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	8	19	<0.010	0.012	1.59	1.59	0
Chrysene	mg/kg	0.01	14 [a]		<0.010	<0.010	<0.010	27	10	17	<0.010	0.023	2.9	2.9	0
Dibenz(a,h)anthracene	mg/kg	0.005	10 [b,c]		<0.0081	<0.0050	<0.0068	27	12	15	<0.0052	0.0055	0.43	0.43	0
Fluorene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	23	4	<0.010	0.012	0.061	0.061	0
Fluoranthene	mg/kg	0.01	180 [b]		<0.010	<0.010	<0.010	27	7	20	<0.010	0.02	5.92	5.92	0
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	0.76 [a]		<0.010	<0.010	<0.010	27	7	20	<0.010	0.01	1.81	1.81	2
Naphthalene	mg/kg	0.01	22 [a]		<0.010	<0.010	<0.010	27	18	9	<0.010	0.012	0.267	0.267	0
Perylene	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	13	14	<0.010	0.011	0.561	0.561	0
Phenanthrene	mg/kg	0.01	12 [a]		<0.010	<0.010	<0.010	27	8	19	<0.010	0.02	1.39	1.39	0
Pyrene	mg/kg	0.01	99,000 [a]		0.011	<0.010	<0.010	27	6	21	<0.010	0.011	4.43	4.43	0
Quinoline	mg/kg	0.01	NGA		<0.010	<0.010	<0.010	27	27	0	<0.068	-	<0.068	-	0

Notes

Shaded cells denote an exceedance above the applicable gu

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Ontario Ministry of the Environment and Climate Change (MOECC). (2011). Ontario Ministry of the Environment, 2011. Soil Components for Table 3 - Full Depth, Non-Potable Water Scenario. Commercial land use, coarse textured soil. Branch, Ontario Ministry of the Environment.

[b] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Soil Quality Guidelines for the Protection of Environmental and Human Health. Polycyclic Aromiatic Hydrocarbons. SQG_E for commercial land use.

[c] Interim guideline from CCME (1991) applied in the absence of a guideline from other jurisdictions.

Table C-19: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH 1	BH 2	24 MW-01		BH 9	BH10	BH11		BH12	BH 13
Sample ID				BH1 0-0.15m	BH2 0-0.15m	24 MW-01-SS5 (2.4-3.1m)	24 MW-Dup E	BH9 0-0.15m	BH10 0-0.15m	BH11 0-0.15m	BHDUPB 0-0.15m	BH12 0-0.15m	BH13 0-0.015m
Sample Type				Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal	Normal
Date				07 Nov 2023	07 Nov 2023	17 Jan 2024	17 Jan 2024	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	07 Nov 2023	10 Nov 2023
Sample Area				Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable										
BTEX													
Benzene	mg/kg	0.005	180 [a]	<0.0057	<0.0050	<0.0050	<0.0050	<0.0072	<0.0050	<0.0056	<0.0050	<0.0050	<0.0054
Toluene	mg/kg	0.05	250 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ethylbenzene	mg/kg	0.015	300 [a]	<0.015	<0.015	<0.015	<0.015	<0.018	<0.015	<0.015	<0.015	<0.015	<0.015
Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Xylene Total	mg/kg	0.05	350 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)													
VPH (C6-C10 - BTEX)	mg/kg	5	320 [a]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.4	<5.0	<5.0	<5.0
EPH >C10-C16	mg/kg	5	260 [a]	11	<5.0	<5.0	<5.0	11.8	<5.0	<5.0	<5.0	29.4	8.8
EPH >C16-C32[c]	mg/kg	5	1700 [a,b]	390	118.4	<5.0	<5.0	217.9	101.2	243.2	217.1	1338	1748
EPH >C34-C50	mg/kg	20	3300 [a]	532	132	<20	<20	248	190	285	272	638	1,030
Modified TPH (Tier 1)	mg/kg	10	NGA	401	118	<10	<10	230	101	249	217	1370	1760
Reached Baseline at C32	-	-	NGA	No	No	Yes	Yes	No	No	No	No	No	No
Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	N/A	N/A	LOF	LOF	LOF	LOF	LOF	LOF

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.

[b] Available guideline is for PHC F3 fraction (C16-C34).

Table C-19: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

				Location	BH14	BH15	BH16	BH17		BH18	BH19		BH20	BH21
				Sample ID	BH14 0-0.15m	BH15 0-0.15m	BH16 0-0.15m	BH17 0-0.15m		BH18 0-0.15m	BH19 0-0.15m		BH20 0-0.15m	BH21 0-0.15m
				Sample Type	Normal	Normal	Normal	Normal		Normal	Normal		Normal	Normal
				Date	09 Nov 2023	08 Nov 2023	08 Nov 2023	09 Nov 2023		08 Nov 2023	08 Nov 2023		08 Nov 2023	08 Nov 2023
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable											
BTEX														
Benzene	mg/kg	0.005	180 [a]		<0.0050	<0.0050	<0.0053	0.0344	-	<0.0059	0.015	-	<0.0050	<0.0051
Toluene	mg/kg	0.05	250 [a]		<0.050	<0.050	<0.050	0.217	-	<0.050	0.12	-	<0.050	<0.050
Ethylbenzene	mg/kg	0.015	300 [a]		<0.015	<0.015	<0.015	0.079	-	<0.015	0.044 [1]	-	<0.015	<0.015
Xylene (o)	mg/kg	0.03	NGA		<0.030	<0.030	<0.030	0.107	-	<0.030	0.061	-	<0.030	<0.030
Xylene (m & p)	mg/kg	0.03	NGA		<0.030	<0.030	<0.030	0.156	-	<0.030	0.098	-	<0.030	<0.030
Xylene Total	mg/kg	0.05	350 [a]		<0.050	<0.050	<0.050	0.263	-	<0.050	0.159	-	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)														
VPH (C6-C10 - BTEX)	mg/kg	5	320 [a]		<5.0	<5.0	<5.0	10.6	11.2	22.7	7.4	7.7	<5.0	6.3
EPH >C10-C16	mg/kg	5	260 [a]		12.4	5.7	<5.0	73.2	-	12	19.9	-	13.6	17.9
EPH >C16-C32[c]	mg/kg	5	1700 [a,b]		246.9	130.5	275.9	577	-	261.2	337.7	-	278	1596.6
EPH >C34-C50	mg/kg	20	3300 [a]		343	185	559	567	-	410	340	-	600	2,230
Modified TPH (Tier 1)	mg/kg	10	NGA		259	136	276	661	-	296.00	365.00	-	292	1620
Reached Baseline at C32	-	-	NGA		No	No	No	No	-	No	No	-	No	No
Hydrocarbon Resemblance	none	-	NGA		LOF	LOF	LOF	LOF	-	LOF	LOF	-	LOF	LOF

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.

[b] Available guideline is for PHC F3 fraction (C16-C34).

Table C-19: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

				Location	BH22	BH23	BH33	BH34	BH35	BH36	24 MW-02	24MW-03	24MW-04	24 MW-05
				Sample ID	BH22 0-0.15m	BH DUPC 0-0.15m	BH33 0-0.15m	BH34 0-0.15m	BH35 0-0.15m	BH36 0-0.15m	24 MW-02-SS3 (1.2-1.6m)	24MW-03 SS3	24MW-04 SS1 (0-0.61m)	24 MW-05-SS1 (0-0.58m)
				Sample Type	Normal	Field_D	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
				Date	08 Nov 2023	08 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	09 Nov 2023	16 Jan 2024	18 Jan 2024	18 Jan 2024	16 Jan 2024
				Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable										
BTEX														
	Benzene	mg/kg	0.005	180 [a]	<0.0050	<0.0050	<0.0050	<0.0079	<0.0075	<0.0057	<0.0050	<0.0050	<0.0050	<0.0050
	Toluene	mg/kg	0.05	250 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Ethylbenzene	mg/kg	0.015	300 [a]	<0.015	<0.015	<0.015	<0.020	<0.019	<0.015	<0.015	<0.015	<0.015	<0.015
	Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Xylene Total	mg/kg	0.05	350 [a]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)														
	VPH (C6-C10 - BTEX)	mg/kg	5	320 [a]	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	EPH >C10-C16	mg/kg	5	260 [a]	<5.0	8.2	<5.0	6.8	<5.0	9.6	<5.0	<5.0	<5.0	-
	EPH >C16-C32[c]	mg/kg	5	1700 [a,b]	16.4	195.6	140.7	338	164.8	429.4	<10	<11	<12	-
	EPH >C34-C50	mg/kg	20	3300 [a]	54	332	284	695	305	482	<20	<20	<20	-
	Modified TPH (Tier 1)	mg/kg	10	NGA	16	204	141	345	165	439	<10	<10	<10	-
	Reached Baseline at C32	-	-	NGA	No	No	No	No	No	No	Yes	Yes	Yes	-
	Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	LOF	LOF	LOF	LOF	N/A	N/A	N/A	-

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.

[b] Available guideline is for PHC F3 fraction (C16-C34).

Table C-19: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH127	BH128	BH129	BH130		BH131
Sample ID				BH127 0.35M	BH128 0-0.15M	BH129 0-0.15M	BH130 0-0.15M	BH DUPH	BH131 0-0.15M
Sample Type				Normal	Normal	Normal	Normal	Field_D	Normal
Date				22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024
Sample Area				Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable						
BTEX									
Benzene	mg/kg	0.005	180 [a]	0.0965	<0.0165	0.11	0.15	<0.0389	0.022
Toluene	mg/kg	0.05	250 [a]	0.498	<0.064	1.02	1.00	0.178	<0.162
Ethylbenzene	mg/kg	0.015	300 [a]	0.093	<0.022	0.63	0.30	<0.072	<0.039
Xylene (o)	mg/kg	0.03	NGA	0.119	<0.030	0.68	0.45	0.092	0.065
Xylene (m & p)	mg/kg	0.03	NGA	0.212	<0.046	1.34	0.76	<0.140	<0.108
Xylene Total	mg/kg	0.05	350 [a]	0.331	<0.055	2.02	1.21	<0.156	<0.112
Petroleum Hydrocarbons (PHCs)									
VPH (C6-C10 - BTEX)	mg/kg	5	320 [a]	7.6	<5.0	18	16.1	18.7	7.3
EPH >C10-C16	mg/kg	5	260 [a]	18.1	<48.5	105	53	64.2	18.6
EPH >C16-C32[c]	mg/kg	5	1700 [a,b]	143.9	2180	985	284.8	375.5	101
EPH >C34-C50	mg/kg	20	3300 [a]	164	12,100	383	216	353	116
Modified TPH (Tier 1)	mg/kg	10	NGA	170	2180	1110	354	458	127
Reached Baseline at C32	-	-	NGA	No	No	No	No	No	No
Hydrocarbon Resemblance	none	-	NGA	LOF	LOF	LOF+FOF	LOF	LOF	LOF

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.

[b] Available guideline is for PHC F3 fraction (C16-C34).

Table C-19: Analytical data for BTEX and PHCs in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
BTEX											
Benzene	mg/kg	0.005	180 [a]	34	28	6	<0.0057	0.015	0.152	0.152	0
Toluene	mg/kg	0.05	250 [a]	34	28	6	<0.050	0.12	1.02	1.02	0
Ethylbenzene	mg/kg	0.015	300 [a]	34	29	4	<0.015	0.079	0.634	0.634	0
Xylene (o)	mg/kg	0.03	NGA	34	27	7	<0.030	0.061	0.678	0.678	0
Xylene (m & p)	mg/kg	0.03	NGA	34	29	5	<0.030	0.098	1.34	1.34	0
Xylene Total	mg/kg	0.05	350 [a]	34	29	5	<0.050	0.159	2.02	2.02	0
Petroleum Hydrocarbons (PHCs)											
VPH (C6-C10 - BTEX)	mg/kg	5	320 [a]	36	24	12	<5.0	5.4	22.7	22.7	0
EPH >C10-C16	mg/kg	5	260 [a]	33	14	19	<5.0	5.7	105	105	0
EPH >C16-C32[c]	mg/kg	5	1700 [a,b]	33	5	28	<5.0	16.4	2180	2180	2
EPH >C34-C50	mg/kg	20	3300 [a]	33	5	28	<20	54	12100	12100	1
Modified TPH (Tier 1)	mg/kg	10	NGA	33	5	28	<10	16	2180	2180	0
Reached Baseline at C32	-	-	NGA	33	0	0	0	-	#N/A	-	0
Hydrocarbon Resemblance	none	-	NGA	33	0	0	0	-	#N/A	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Where applicable, guidelines from Atlantic RBCA Tier II Pathway-Specific Standards for Soil - Commercial/Industrial Land Use, Soil Contact/Ingestion (the lowest of the two values) were applied. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canada Wide Standards for Petroleum Hydrocarbons in Soil: Technical Supplement. SQG_E for commercial land use; lowest of applicable direct contact pathway values.

[b] Available guideline is for PHC F3 fraction (C16-C34).

Table C-20: Analytical data for energetics in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

Location				BH 37	BH 38	BH 39	BH 40	BH 41
Sample ID				BH 37 0-0.15M	BH 38 0-0.15M	BH 39 0-0.15M	BH 40 0-0.15M	BH 41 0-0.15M
Sample Type				Normal	Normal	Normal	Normal	Normal
Depth				0-0.15m	0-0.15m	0-0.15m	0-0.15m	0-0.15m
Date				19 Jan 2024	19 Jan 2024	19 Jan 2024	19 Jan 2024	20 Jan 2024
Sample Area				Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable					
Energetics								
1,3,5-Trinitrobenzene	mg/kg	0.05	NGA	<0.050	<0.050	<0.120	<0.750	<0.050
1,3-Dinitrobenzene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
2,4,6-Trinitrotoluene (TNT)	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
2,4-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
2,6-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
2-Amino-4,6-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
2-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
4-Amino-2,6-Dinitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
4-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
HMX	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
m-Nitrotoluene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
Nitrobenzene	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
Nitroglycerine	mg/kg	0.1	NGA	<0.10	<0.10	<0.10	<0.10	<0.10
PETN	mg/kg	0.1	NGA	<0.10	<0.10	<0.10	<0.10	<0.10
RDX	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
Tetryl	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050
3,5-Dinitroaniline	mg/kg	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Table C-20: Analytical data for energetics in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

				Data Summary							
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Energetics											
1,3,5-Trinitrobenzene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
1,3-Dinitrobenzene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
2,4,6-Trinitrotoluene (TNT)	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
2,4-Dinitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
2,6-Dinitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
2-Amino-4,6-Dinitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
2-Nitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
4-Amino-2,6-Dinitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
4-Nitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
HMX	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
m-Nitrotoluene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
Nitrobenzene	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
Nitroglycerine	mg/kg	0.1	NGA	5	5	0	<0.10	-	<0.10	-	0
PETN	mg/kg	0.1	NGA	5	5	0	<0.10	-	<0.10	-	0
RDX	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
Tetryl	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0
3,5-Dinitroaniline	mg/kg	0.05	NGA	5	5	0	<0.050	-	<0.050	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Table C-21: Analytical data for general chemistry in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

	Location	BH43	BH51	BH72	BH73	BH74	BH75	BH76	BH77	BH78	BH79
	Sample ID	BH 43 0-0.15m	BH 51 0-0.15m	BH72 0-0.15m	BH73 0-0.15m	BH74 0-0.15m	BH75 0-0.15m	BH76 0-0.15m	BH77 0-0.15m	BH78 0-0.15m	BH79 0-0.15m
	Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
	Date	07 Nov 2023	10 Nov 2023	21 May 2024	21 May 2024	21 May 2024	23 May 2024	23 May 2024	23 May 2024	24 May 2024	24 May 2024
	Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable								
Physical Properties											
% >75um	%	1	NGA	36.6	56.4	57.7	40.2	61.4	54.3	54.6	63.9	14.6	39.6
Sieve Analysis - 75 Âµm (passing)	%	1	NGA	63.4	43.6	42.3	59.8	38.6	45.7	45.4	36.1	85.4	60.4
Texture	N/A		NGA	Fine	Coarse	Coarse	Fine	Coarse	Coarse	Coarse	Coarse	Fine	Fine
General Chemistry											
Fraction Organic Carbon (FOC)	g/g	0.001	NGA	-	-	0.019	0.0414	0.0483	0.0576	0.0161	0.0258	0.248	0.0742
Total Organic Carbon (TOC)	mg/kg	1,000	NGA	-	-	19,000	41,400	48,300	57,600	16,100	25,800	248,000	74,200
pH (Lab)	pH Units	0.1	NGA	-	-	3.22	3.59	4.09	4.05	3.5	4.43	3.84	3.36

Notes

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Table C-21: Analytical data for general chemistry in soil for the former Country Harbour mine compared to ecological health-based soil quality guidelines.

						Data Summary							
			Location	BH80	BH81								
			Sample ID	BH80 0-0.15m	BH81 0-0.15m								
			Sample Type	Normal	Normal								
			Date	23 May 2024	25 May 2024								
			Sample Area	Site	Site								
	Unit	RDL	Soil Quality Guideline for Environmental Protection (SQG_E) Commercial, Potable			Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Physical Properties													
% >75um	%	1	NGA	72.8	63.1	12	0	12	14.6	14.6	72.8	72.8	0
Sieve Analysis - 75 Âµm (passing)	%	1	NGA	27.2	36.9	12	0	12	27.2	27.2	85.4	85.4	0
Texture	N/A		NGA	Coarse	Coarse	12	0	0	0	-	-	-	0
General Chemistry													
Fraction Organic Carbon (FOC)	g/g	0.001	NGA	0.0322	0.0464	10	0	10	0.0161	0.0161	0.248	0.248	0
Total Organic Carbon (TOC)	mg/kg	1,000	NGA	32,200	46,400	10	0	10	16100	16100	248000	248000	0
pH (Lab)	pH Units	0.1	NGA	3.82	4.09	10	0	10	3.22	3.22	4.43	4.43	0

Notes

SQG_E = soil quality guideline for the protection of environmental health; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate.

Table C-22: Analytical data for metals in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

			Field ID	24MW-01	24MW-02		24MW-03*	24MW-04*	24MW-05	Data Summary							
			Sample Type	Normal	Normal	24MW-DUPA Duplicate	Normal	Normal	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024								
			Sample Area	Site	Site	Site	Site	Site	Site								
	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life														
Metals																	
Aluminium	mg/L	0.001	0.005 [a,h,*]	0.259	0.22	0.497	0.0556	1.38	0.122	6	0	6	0.0556	0.0556	1.38	1.38	5
Antimony	mg/L	0.0001	0.009 [b]	<0.00010	<0.00010	<0.00010	<0.00010	0.0006	0.00011	6	4	2	<0.00010	0.00011	0.0006	0.0006	0
Arsenic	mg/L	0.0001	0.005 [a]	0.00017	0.0395	0.195	0.0391	0.0273	0.0123	6	0	6	0.00017	0.00017	0.195	0.195	5
Barium	mg/L	0.0001	1 [b,e]	0.007	0.00612	0.00737	0.00579	0.0201	0.0105	6	0	6	0.00579	0.00579	0.0201	0.0201	0
Beryllium	mg/L	0.00002	0.00015 [b]	0.000052	0.000163	0.000231	0.000048	0.000204	0.000056	6	0	6	0.000048	0.000048	0.000231	0.000231	3
Bismuth	mg/L	0.00005	NGA	<0.000050	<0.000050	0.000096	0.000155	0.000054	<0.000050	6	3	3	<0.000050	0.000054	0.000155	0.000155	0
Boron	mg/L	0.01000	1.5 [a]	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	6	6	0	<0.010	-	<0.010	-	0
Cadmium	mg/L	0.00001	0.00004 [a,f]	0.0000331	0.0000958	0.00011	0.000321	0.000102	0.000109	6	0	6	0.0000331	0.0000331	0.000321	0.000321	5
Calcium	mg/L	0.050000	NGA	0.268	1.44	1.42	2.63	3.95	0.793	6	0	6	0.268	0.268	3.95	3.95	0
Chromium (Total, III+VI)	mg/L	0.00	0.0089 [a]	<0.00050	<0.00050	0.00084	<0.00050	0.00095	<0.00050	6	4	2	<0.00050	0.00084	0.00095	0.00095	0
Cobalt	mg/L	0.0001	0.00078 [c,g]	0.00175	0.00045	0.0005	0.0047	0.00245	0.00963	6	0	6	0.00045	0.00045	0.00963	0.00963	4
Copper	mg/L	0.0002	0.002 [a,l]	0.0673	0.00728	0.0101	0.012	0.0558	0.00178	6	0	6	0.00178	0.00178	0.0673	0.0673	5
Iron	mg/L	0.0100	0.3 [a]	1.3	0.537	4.16	0.379	1.34	0.832	6	0	6	0.379	0.379	4.16	4.16	6
Lead	mg/L	0.0001	0.001 [a,j]	0.00007	0.00472	0.0207	0.00144	0.00197	0.000621	6	0	6	0.00007	0.00007	0.0207	0.0207	4
Magnesium	mg/L	0.00500	NGA	0.33	0.527	0.542	1.22	0.928	0.565	6	0	6	0.33	0.33	1.22	1.22	0
Manganese	mg/L	0.0001	0.21 [a,k]	0.144	0.0427	0.0451	0.34	0.0929	0.317	6	0	6	0.0427	0.0427	0.34	0.34	2
Mercury	mg/L	0.00001	0.000026 [a]	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000699	0.0000474	6	4	2	<0.0000050	0.0000474	0.0000699	0.0000699	2
Molybdenum	mg/L	0.000050	0.073 [a]	0.000059	0.000151	0.000257	0.000728	0.000091	0.000332	6	0	6	0.000059	0.000059	0.000728	0.000728	0
Nickel	mg/L	0.00050	0.025 [a,l]	0.00617	<0.00050	0.00058	0.00322	0.0045	0.00318	6	1	5	<0.00050	0.00058	0.00617	0.00617	0
Potassium	mg/L	0.05	NGA	0.231	0.316	0.338	0.62	1.74	0.658	6	0	6	0.231	0.231	1.74	1.74	0
Selenium	mg/L	0.0001	0.001 [a]	<0.000050	0.00011	0.000188	<0.000050	0.000074	<0.000050	6	3	3	<0.000050	0.000074	0.000188	0.000188	0
Cesium	mg/L	0.00001	NGA	0.000019	0.000117	0.000172	0.000662	0.000854	0.000113	6	0	6	0.000019	0.000019	0.000854	0.000854	0
Rubidium	mg/L	0.00020	NGA	0.00119	0.00155	0.00183	0.00266	0.00867	0.00294	6	0	6	0.00119	0.00119	0.00867	0.00867	0
Tellurium	mg/L	0.0002	NGA	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	6	6	0	<0.00020	-	<0.00020	-	0
Thorium	mg/L	0.0001	NGA	<0.00010	0.00011	0.00041	<0.00010	0.00019	<0.00010	6	3	3	<0.00010	0.00011	0.00041	0.00041	0
Tungsten	mg/L	0.0001	NGA	0.00964	0.00117	0.00647	0.00547	0.0644	0.00056	6	0	6	0.00056	0.00056	0.0644	0.0644	0
Lithium	mg/L	0.0010	NGA	<0.0010	0.002	0.0019	0.0049	0.0051	<0.0010	6	2	4	<0.0010	0.0019	0.0051	0.0051	0
Silver	mg/L	0.000	0.00025 [a]	0.000521	0.000098	0.000156	0.00008	0.000952	<0.000010	6	1	5	<0.000010	0.00008	0.000952	0.000952	2
Silicon	mg/L	0.05000	NGA	1.54	3.21	3.41	4.6	3.78	2.27	6	0	6	1.54	1.54	4.6	4.6	0
Sodium	mg/L	0.05	NGA	3.16	4.4	4.38	5.37	3.25	3.95	6	0	6	3.16	3.16	5.37	5.37	0
Strontium	mg/L	0.0002	21 [d]	0.00296	0.0111	0.0115	0.0154	0.0337	0.0086	6	0	6	0.00296	0.00296	0.0337	0.0337	0
Sulphur as S	mg/L	0.5000	NGA	<0.50	0.69	0.7	0.79	0.78	0.89	6	1	5	<0.50	0.69	0.89	0.89	0
Titanium	mg/L	0.0	NGA	0.00037	0.00122	0.00422	<0.00090	0.0459	0.00045	6	1	5	<0.00090	0.00037	0.0459	0.0459	0
Thallium	mg/L	0.0000	0.0008 [a]	0.00001	<0.000010	<0.000010	0.000012	<0.000050	0.000036	6	3	3	<0.000010	0.00001	0.000036	0.000036	0
Tin	mg/L	0.00010	NGA	<0.00010	<0.00010	0.00018	<0.00010	0.00029	<0.00010	6	4	2	<0.00010	0.00018	0.00029	0.00029	0
Uranium	mg/L	0.0000	0.015 [a]	0.000044	0.00753	0.0144	0.000486	0.000414	0.000119	6	0	6	0.000044	0.000044	0.0144	0.0144	0
Vanadium	mg/L	0.00050	0.12 [c]	<0.00050	<0.00050	0.0014	<0.00050	0.00127	<0.00050	6	4	2	<0.00050	0.00127	0.0014	0.0014	0
Zinc	mg/L	0.0010	0.007 [a]	0.0491	0.0223	0.0235	0.0662	0.0496	0.0154	6	0	6	0.0154	0.0154	0.0662	0.0662	6
Zirconium	mg/L	0.000	NGA	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	6	6	0	<0.00020	-	<0.00020	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Environment Canada. (2017). Federal Environmental Quality Guidelines: Cobalt.

[d] Michigan Department of Environmental Quality (MDEQ). (2008). Rule 57 Water Quality Values - Surface Water Quality Assessment Section.

[e] Guideline is based on a 30-day average.

[f] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 17 mg/L, the most conservative guideline was applied.

[g] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 52 mg/L, the most conservative guideline was applied.

[h] Guideline is pH-dependent. Given that the majority of site samples had a reported pH < 6.5, the most conservative guideline was applied.

[i] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 82 mg/L, the most conservative guideline was applied.

[j] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

[k] Guideline is pH and hardness-dependent. The most conservative guideline based on pH and hardness data across site samples was applied.

[l] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

[*] Aluminum guideline for 24MW-03 and 24-MW04 is 0.1 mg/L based on sample-specific pH.

Table C-23: Analytical data for PAHs in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

			Sample ID	24MW-01	24MW-DUPA	24MW-02	24MW-03	24MW-04	24MW-05
			Sample Type	Normal	Duplicate of 24MW-01	Normal	Normal	Normal	Normal
			Date	19 Jan 2024	19 Jan 2024	18 Jan 2024	20 Jan 2024	20 Jan 2024	19 Jan 2024
			Sample Area	Site	Site	Site	Site	Site	Site
	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life						
Polycyclic Aromatic Hydrocarbons (PAHs)									
1-Methylnaphthalene	mg/L	0.00001	NGA	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010
2-Methylnaphthalene	mg/L	0.00001	NGA	<0.000010	<0.000010	0.00002	<0.000010	<0.000010	<0.000010
1 & 2 Methylnaphthalene	mg/L	0.000015	0.002 [c,d]	<0.000015	<0.000015	0.000033	<0.000015	<0.000015	<0.000015
Acenaphthene	mg/L	0.00001	0.0058 [a]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acenaphthylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acridine	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Anthracene	mg/L	0.00001	0.000012 [a]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benz(a)anthracene	mg/L	0.00001	0.000018 [a]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(a)pyrene	mg/L	0.000005	0.000015 [a]	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000080	<0.0000050
Benzo(b+j)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	0.000015	NGA	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
Benzo(g,h,i)perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(k)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chrysene	mg/L	0.00001	0.0001 [b]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dibenz(a,h)anthracene	mg/L	0.000005	NGA	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Fluorene	mg/L	0.00001	0.003 [a]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Fluoranthene	mg/L	0.00001	0.00004 [a]	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Naphthalene	mg/L	0.00001	0.0011 [a]	<0.000010	<0.000010	0.000015	<0.000010	<0.000010	<0.000010
Perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Phenanthrene	mg/L	0.00001	0.0004 [a]	<0.000010	<0.000010	<0.000010	<0.000010	0.000019	<0.000010
Pyrene	mg/L	0.00001	0.000025 [a]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Quinoline	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Ontario Ministry of the Environment (OMOE). (1999). Provincial Water Quality Objectives - Table 2.

[d] Interim provincial water quality objective (PWQO).

Table C-23: Analytical data for PAHs in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Polycyclic Aromatic Hydrocarbons (PAHs)											
1-Methylnaphthalene	mg/L	0.00001	NGA	6	5	1	<0.000010	0.000013	0.000013	0.000013	0
2-Methylnaphthalene	mg/L	0.00001	NGA	6	5	1	<0.000010	0.00002	0.00002	0.00002	0
1 & 2 Methylnaphthalene	mg/L	0.000015	0.002 [c,d]	6	5	1	<0.000015	0.000033	0.000033	0.000033	0
Acenaphthene	mg/L	0.00001	0.0058 [a]	6	6	0	<0.000010	-	<0.000010	-	0
Acenaphthylene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Acridine	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Anthracene	mg/L	0.00001	0.000012 [a]	6	6	0	<0.000010	-	<0.000010	-	0
Benz(a)anthracene	mg/L	0.00001	0.000018 [a]	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(a)pyrene	mg/L	0.000005	0.000015 [a]	6	6	0	<0.0000050	-	<0.0000050	-	0
Benzo(b+j)fluoranthene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(b+j+k)fluoranthene	mg/L	0.000015	NGA	6	6	0	<0.000015	-	<0.000015	-	0
Benzo(g,h,i)perylene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Benzo(k)fluoranthene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Chrysene	mg/L	0.00001	0.0001 [b]	6	6	0	<0.000010	-	<0.000010	-	0
Dibenz(a,h)anthracene	mg/L	0.000005	NGA	6	6	0	<0.0000050	-	<0.0000050	-	0
Fluorene	mg/L	0.00001	0.003 [a]	6	6	0	<0.000010	-	<0.000010	-	0
Fluoranthene	mg/L	0.00001	0.00004 [a]	6	5	1	<0.000010	0.000014	0.000014	0.000014	0
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Naphthalene	mg/L	0.00001	0.0011 [a]	6	5	1	<0.000010	0.000015	0.000015	0.000015	0
Perylene	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0
Phenanthrene	mg/L	0.00001	0.0004 [a]	6	5	1	<0.000010	0.000019	0.000019	0.000019	0
Pyrene	mg/L	0.00001	0.000025 [a]	6	6	0	<0.000010	-	<0.000010	-	0
Quinoline	mg/L	0.00001	NGA	6	6	0	<0.000010	-	<0.000010	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Ontario Ministry of the Environment (OMOE). (1999). Provincial Water Quality Objectives - Table 2.

[d] Interim provincial water quality objective (PWQO).

Table C-24: Analytical data for BTEX and PHCs in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

				Sample ID	24MW-01	24MW-DUPA	24MW-02	24MW-03	24MW-04	24MW-05
				Sample Type	Normal	Duplicate of 24MW-01	Normal	Normal	Normal	Normal
				Date	19 Jan 2024	19 Jan 2024	18 Jan 2024	20 Jan 2024	20 Jan 2024	19 Jan 2024
				Sample Area	Site	Site	Site	Site	Site	Site
		Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life						
BTEX										
	Benzene	mg/L	0.0005	2.1 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Toluene	mg/L	0.0005	0.77 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Ethylbenzene	mg/L	0.0005	0.32 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylene (o)	mg/L	0.0003	NGA	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Xylene (m & p)	mg/L	0.0004	NGA	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Xylene Total	mg/L	0.0005	0.33 [a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Petroleum Hydrocarbons (PHCs)										
	VPH (C6-C10 - BTEX)	mg/L	0.025	NGA	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
	EPH >C10-C16	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	EPH >C16-C21	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	EPH >C21-C32	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	EPH >C34-C50	mg/L	0.10	NGA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Modified TPH (Tier 1)	mg/L	0.09	0.1 [a,b]	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
	Reached Baseline at C32	-	-	NGA	Yes	Yes	Yes	Yes	Yes	Yes
	Hydrocarbon Resemblance	-	-	NGA	N/A	N/A	N/A	N/A	N/A	N/A

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Atlantic RBCA Environmental Quality Standards (2021).

[b] Given that all concentrations were < RDL and therefore had no reported resemblances, the most conservative guideline (fuel/lube) was applied for reference.

Table C-24: Analytical data for BTEX and PHCs in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
BTEX											
Benzene	mg/L	0.0005	2.1 [a]	6	6	0	<0.00050	-	<0.00050	-	0
Toluene	mg/L	0.0005	0.77 [a]	6	6	0	<0.00050	-	<0.00050	-	0
Ethylbenzene	mg/L	0.0005	0.32 [a]	6	6	0	<0.00050	-	<0.00050	-	0
Xylene (o)	mg/L	0.0003	NGA	6	6	0	<0.00030	-	<0.00030	-	0
Xylene (m & p)	mg/L	0.0004	NGA	6	6	0	<0.00040	-	<0.00040	-	0
Xylene Total	mg/L	0.0005	0.33 [a]	6	6	0	<0.00050	-	<0.00050	-	0
Petroleum Hydrocarbons (PHCs)											
VPH (C6-C10 - BTEX)	mg/L	0.025	NGA	6	6	0	<0.025	-	<0.025	-	0
EPH >C10-C16	mg/L	0.05	NGA	6	6	0	<0.050	-	<0.050	-	0
EPH >C16-C21	mg/L	0.05	NGA	6	6	0	<0.050	-	<0.050	-	0
EPH >C21-C32	mg/L	0.05	NGA	6	6	0	<0.050	-	<0.050	-	0
EPH >C34-C50	mg/L	0.10	NGA	6	6	0	<0.10	-	<0.10	-	0
Modified TPH (Tier 1)	mg/L	0.09	0.1 [a,b]	6	6	0	<0.090	-	<0.090	-	0
Reached Baseline at C32	-	-	NGA	6	0	0	0	-	-	-	0
Hydrocarbon Resemblance	-	-	NGA	6	0	0	0	-	-	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Atlantic RBCA Environmental Quality Standards (2021).

[b] Given that all concentrations were < RDL and therefore had no reported resemblances, the most conservative guideline (fuel/lube) was applied for reference.

Table C-25: Analytical data for general chemistry in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

			Field ID	24MW-01			*Local Background Minimum*	*Local Background Maximum*	24MW-02			24MW-03	
			Sample Type	Background	24MW-DUPA FD: 24MW-01	Background			Normal	Normal	24MW-DUPA FD: 24MW-02	Normal	Normal
			Date	19 Jan 2024	19 Jan 2024	22 May 2024			18 Jan 2024	22 May 2024	22 May 2024	20 Jan 2024	22 May 2024
			Sample Area	Background	Background	Background			Site	Site	Site	Site	Site
		Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life									
Calculated Parameters													
	Anions Total (filtered)	meq/L	0.1	NGA	0.28	0.29	0.21	*0.21*	*0.29*	0.43	0.3	0.3	0.48	0.48
	Cations Total (filtered)	meq/L	0.1	NGA	0.39	0.39	0.27	*0.27*	*0.39*	0.41	0.36	0.52	0.45	0.52
	Ionic Balance (filtered)	%	0.01	NGA	139	134	128	*128*	*139*	95.3	120	173	93.8	108
	Langelier Index (@ 20C)	N/A	0.01	NGA	-4.33	-4.43	-5.46	*-5.46*	*-4.33*	Incalculable	-3.57	-3.62	-2.78	-2.66
	Langelier Index (@ 4C)	N/A	0.01	NGA	-4.58	-4.68	-5.7	*-5.7*	*-4.58*	Incalculable	-3.82	-3.87	-3.03	-2.91
	Saturation pH (@ 4C)	N/A	0.01	NGA	11	11	11.9	*11*	*11.9*	Incalculable	10.6	10.6	10	10
	Saturation pH (@ 20C)	N/A	0.01	NGA	10.7	10.7	11.7	*10.7*	*11.7*	Incalculable	10.4	10.4	9.76	9.75
General Chemistry														
	Carbonate	mg/L	1	NGA	<1.0	<1.0	<1.0	*<1.0*	*<1.0*	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity (total)	mg/L	1	NGA	5	5.4	1.5	*1.5*	*5.4*	10.8	5.8	5.7	11.9	13.6
	Bicarbonate	mg/L	1	NGA	6.1	6.6	1.8	*1.8*	*6.6*	13.2	7	6.9	14.5	16.6
	Hardness as CaCO3 (Measured)	mg/L	0.5	NGA	3.58	3.47	2.03	*2.03*	*3.58*	<0.50	5.76	5.78	11.3	11.6
	Ammonia as N	mg/L	0.005	NGA [a]	0.0066	0.0054	<0.0050	*<0.0050*	*0.0066*	0.0328	0.0053	0.0059	0.0113	<0.0050
	Total Organic Carbon (TOC)	mg/L	0.5	NGA	2.14	1.82	1.15	*1.15*	*2.14*	4.65	2.92	2.94	2.27	0.83
	Ortho Phosphate as P (filtered)	mg/L	0.001	NGA	<0.0010	<0.0010	<0.0010	*<0.0010*	*<0.0010*	0.0299	0.0053	0.0045	<0.0010	0.0015
	Phosphorus	mg/L		NGA	-	-	<0.050	*<0.050*	*<0.050*	-	<0.050	0.057	-	<0.050
	Phosphorus (filtered)	mg/L	0.05	NGA	<0.050	<0.050	<0.050	*<0.050*	*<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluoride	mg/L	0.02	0.12 [a]	<0.020	<0.020	<0.020	*<0.020*	*<0.020*	0.1	0.083	0.083	0.026	0.059
	Chloride (filtered)	mg/L	0.5	120 [a]	5.26	5.24	5.1	*5.1*	*5.26*	5.12	4.82	4.83	7.11	5.41
	Color	CU	2.0	NGA	112	117	16.5	*16.5*	*117*	258	35.9	36	30.8	15.9
	Electrical Conductivity (Lab)	µS/cm	1	NGA	33.5	34.6	24.6	*24.6*	*34.6*	49.1	36.1	35.6	53.3	54
	Hydroxide	mg/L	1	NGA	<1.0	<1.0	<1.0	*<1.0*	*<1.0*	<1.0	<1.0	<1.0	<1.0	<1.0
	Nitrate (as N)	mg/L	0.02	13 [a,b]	<0.020	<0.020	<0.020	*<0.020*	*<0.020*	0.025	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.01	0.06 [a]	<0.010	<0.010	<0.010	*<0.010*	*<0.010*	<0.010	<0.010	<0.010	<0.010	<0.010
	Nitrite + Nitrate as N	mg/L	0.0224	NGA	<0.0224	<0.0224	<0.0224	*<0.0224*	*<0.0224*	0.025	<0.0224	<0.0224	<0.0224	<0.0224
	pH (Lab)	pH Units	0.1	6.5 to 9 [a]	6.4	6.28	6.21	*6.21*	*6.4*	6.36	6.8	6.77	6.98	7.09
	Sulphate (filtered)	mg/L	0.3	128 [c]	1.68	1.65	1.65	*1.65*	*1.68*	2.88	2.36	2.32	1.84	2.71
	Total Dissolved Solids (TDS) - Measured	mg/L	10	NGA	26	27	20	*20*	*27*	85	32	33	31	39
	Turbidity	NTU	0.1	NGA	6.38	6.33	3.55	*3.55*	*6.38*	109	1.38	1.41	3.62	2.62

Notes

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] This benchmark does not protect against potential eutrophication.

[c] British Columbia Ministry of Environment and Climate Change Strategy (BC MOECCS). (2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary.

Table C-25: Analytical data for general chemistry in groundwater for the former Country Harbour mine compared to ecological health-based groundwater quality guidelines.

			Field ID	24MW-04		24MW-05		Data Summary							
			Sample Type	Normal	Normal	Normal	Normal	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
			Date	20 Jan 2024	22 May 2024	19 Jan 2024	22 May 2024								
			Sample Area	Site	Site	Site	Site								
		Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life											
Calculated Parameters															
	Anions Total (filtered)	meq/L	0.1	NGA	0.39	0.36	0.42	0.28	9	0	9	0.28	0.28	0.48	0.48	0
	Cations Total (filtered)	meq/L	0.1	NGA	0.37	0.67	0.42	0.33	9	0	9	0.33	0.33	0.67	0.67	0
	Ionic Balance (filtered)	%	0.01	NGA	94.9	186	100	118	9	0	9	93.8	93.8	186	186	0
	Langelier Index (@ 20C)	N/A	0.01	NGA	-2.78	-2.79	-3.99	-4.28	9	0	8	-4.28	-4.28	-2.66	-2.66	0
	Langelier Index (@ 4C)	N/A	0.01	NGA	-3.03	-3.04	-4.25	-4.53	9	0	8	-4.53	-4.53	-2.91	-2.91	0
	Saturation pH (@ 4C)	N/A	0.01	NGA	10.2	9.97	10.5	11.1	9	0	8	9.97	9.97	11.1	11.9	0
	Saturation pH (@ 20C)	N/A	0.01	NGA	9.93	9.72	10.3	10.8	9	0	8	9.72	9.72	10.8	11.7	0
General Chemistry																
	Carbonate	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	9	9	0	<1.0	-	<1.0	-	0
	Alkalinity (total)	mg/L	1	NGA	8.9	9.4	10.7	3.6	9	0	9	3.6	3.6	13.6	13.6	0
	Bicarbonate	mg/L	1	NGA	10.9	11.5	13	4.4	9	0	9	4.4	4.4	16.6	16.6	0
	Hardness as CaCO3 (Measured)	mg/L	0.5	NGA	9.3	13.7	3.65	4.31	9	1	8	<0.50	3.65	13.7	13.7	0
	Ammonia as N	mg/L	0.005	NGA [a]	0.0296	0.015	0.023	0.0092	9	1	8	<0.0050	0.0053	0.0328	0.0328	0
	Total Organic Carbon (TOC)	mg/L	0.5	NGA	2.55	2.5	2.04	1.56	9	0	9	0.83	0.83	4.65	4.65	0
	Ortho Phosphate as P (filtered)	mg/L	0.001	NGA	<0.0010	<0.0010	<0.0010	<0.0010	9	5	4	<0.0010	0.0015	0.0299	0.0299	0
	Phosphorus	mg/L		NGA	-	0.057	-	<0.050	5	3	2	<0.050	0.057	0.057	0.057	0
	Phosphorus (filtered)	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	9	9	0	<0.050	-	<0.050	-	0
	Fluoride	mg/L	0.02	0.12 [a]	0.026	<0.020	0.024	<0.020	9	2	7	<0.020	0.024	0.1	0.1	0
	Chloride (filtered)	mg/L	0.5	120 [a]	5.46	4.09	5.34	5.27	9	0	9	4.09	4.09	7.11	7.11	0
	Color	CU	2.0	NGA	13.9	117	302	30.1	9	0	9	13.9	13.9	302	302	0
	Electrical Conductivity (Lab)	µS/cm	1	NGA	45.3	41.8	48.6	34.3	9	0	9	34.3	34.3	54	54	0
	Hydroxide	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	9	9	0	<1.0	-	<1.0	-	0
	Nitrate (as N)	mg/L	0.02	13 [a,b]	<0.020	<0.020	<0.020	<0.020	9	8	1	<0.020	0.025	0.025	0.025	0
	Nitrite (as N)	mg/L	0.01	0.06 [a]	<0.010	<0.010	<0.010	<0.010	9	9	0	<0.010	-	<0.010	-	0
	Nitrite + Nitrate as N	mg/L	0.0224	NGA	<0.0224	<0.0224	<0.0224	<0.0224	9	8	1	<0.0224	0.025	0.025	0.025	0
	pH (Lab)	pH Units	0.1	6.5 to 9 [a]	7.15	6.93	6.29	6.55	9	0	9	6.29	6.29	7.15	7.15	2
	Sulphate (filtered)	mg/L	0.3	128 [c]	2.54	2.6	2.82	2.97	9	0	9	1.84	1.84	2.97	2.97	0
	Total Dissolved Solids (TDS) - Measured	mg/L	10	NGA	31	29	44	25	9	0	9	25	25	85	85	0
	Turbidity	NTU	0.1	NGA	2.25	24.2	35	2.2	9	0	9	1.38	1.38	109	109	0

Notes

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] This benchmark does not protect against potential eutrophication.

[c] British Columbia Ministry of Environment and Climate Change Strategy (BC MOECCS). (2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary.

Table C-26: Analytical data for metals in sediment for the former Country Harbour mine compared to ecological health-based sediment quality guidelines.

			Location	SED16	SED17	*Local Background Minimum*	*Local Background Maximum*	SED1	SED2	SED3		SED4	SED5	SED6	SED8	SED9	SED10	SED11	SED12
			Sample ID	SED16	SED17			SED1	SED2	SED3	SED-DUPA	SED4	SED5	SED6	SED8	SED9	SED10	SED11	SED12
			Sample Type	Local Background				Normal	Normal	Normal	FD: SED3	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023		06 Nov 2023	06 Nov 2023	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Background	Background			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) - Freshwater																
Metals																			
Aluminium	mg/kg	50	NGA	3,410	4,000	*3,410*	*4,000*	11,400	9,720	19,300	18,900	22,600	12,400	12,300	17,100	11,400	15,500	17,100	14,500
Antimony	mg/kg	0.1	25 [d,e]	<0.10	<0.10	<0.10	<0.10	1.8	4.68	0.44	1.6	1.18	0.33	4.46	<2.00	<2.00	<2.00	<2.00	<2.00
Arsenic	mg/kg	2/0.1*	17 [a,f]	49.5	8.21	*8.21*	*49.5*	*2050*	*5640*	*1440*	*5120*	*4410*	*1490*	*8,770*	*1,200*	*1,050*	*1,660*	*2,400*	*4,400*
Barium	mg/kg	0.5	NGA	21.3	35.7	*21.3*	*35.7*	63.3	82	113	254	285	85.8	70.8	443	87.4	105	162	120
Beryllium	mg/kg	0.1	NGA	0.17	0.34	*0.17*	*0.34*	0.71	0.5	1.1	1.11	1.39	0.49	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Bismuth	mg/kg	0.2	NGA	<0.20	<0.20	<0.20	<0.20	-	-	-	-	-	-	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00
Boron	mg/kg	5	NGA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<100	<100	<100	<100	<100	<100
Cadmium	mg/kg	0.02	3.5 [a,f]	0.022	0.227	*0.022*	*0.227*	0.088	0.064	0.098	0.186	0.218	0.054	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
Calcium	mg/kg	50.00	NGA	163	1,380	*163*	*1,380*	-	-	-	-	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Chromium (Total, III+VI)	mg/kg	0.5	90 [a,f]	6.26	2.27	*2.27*	*6.26*	19.6	20.9	38.7	34.1	38.3	26.7	22.8	26.6	19.6	29.9	30	22.8
Cobalt	mg/kg	0.1	NGA	1.86	1.06	*1.06*	*1.86*	15.3	5.76	67.3	120	93.5	53.5	20.8	56.4	93.3	29.8	71.7	93.1
Copper	mg/kg	0.5	197 [a,f]	1.16	4.71	*1.16*	*4.71*	7.51	4.61	10.3	11.8	26.5	5.19	<10.0	12.5	<10.0	<10.0	22.4	15.1
Iron	mg/kg	50	43,766 [c,g]	10,600	3,080	*3,080*	*10,600*	28,200	25,100	37,800	42,700	*58000*	35,900	30,400	28,900	25,500	31,300	*44,400*	38,800
Lead	mg/kg	0.5	91.3 [a,f]	12	23.4	*12*	*23.4*	57.3	60.4	74.4	*124*	*110*	78.8	52.4	75.2	78.4	50.1	85.4	*107*
Lithium	mg/kg	2.0	NGA	6.9	<2.0	<2.0	*6.9*	-	-	-	-	-	-	<40.0	48.2	<40.0	<40.0	<40.0	<40.0
Magnesium	mg/kg	20.0	NGA	1,190	455	*455*	*1,190*	-	-	-	-	-	-	6,660	8,100	5,300	8,310	8,540	6,470
Manganese	mg/kg	1	1100 [c,g]	155	54.5	*54.5*	*155*	*1210*	403	*3950*	*6270*	*4550*	*2410*	1,040	*4,340*	*6,910*	*1,870*	*4,420*	*5,840*
Mercury	mg/kg	0.005	0.486 [a,f]	0.0195	0.156	*0.0195*	*0.156*	*2.38*	*3.21*	0.314	*0.616*	0.24	0.0233	*0.738*	0.352	*0.489*	*0.925*	0.226	0.202
Molybdenum	mg/kg	0.1	NGA	0.65	0.56	*0.56*	*0.65*	0.69	0.45	0.91	1.41	5.87	1.33	<2.00	<2.00	<2.00	<2.00	2.09	<2.00
Nickel	mg/kg	0.5	75 [c,g]	3.04	2.37	*2.37*	*3.04*	10.6	8.88	17.1	16.3	18	10.7	19.6	13.6	12.5	12.8	13.8	11
Potassium	mg/kg	100.0	NGA	1,000	210	*210*	*1,000*	-	-	-	-	-	-	4,410	4,990	3,480	5,170	5,610	4,440
Selenium	mg/kg	0.2	2 [b]	0.27	1.41	*0.27*	*1.41*	0.2	0.28	0.28	0.41	1.07	0.38	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]	*<4.00* [#1]
Tungsten	mg/kg	0.5	NGA	<0.50	<0.50	<0.50	<0.50	-	-	-	-	-	-	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Silver	mg/kg	0.1	0.5 [c,h]	<0.10	0.1	<0.10	*0.1*	<0.10	0.2	<0.10	0.12	0.2	<0.10	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]	*<2.00* [#1]
Sodium	mg/kg	50.0	NGA	<50	160	<50	*160*	-	-	-	-	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Strontium	mg/kg	0.5	NGA	2.43	18.8	*2.43*	*18.8*	1.88	2.84	2.65	3.91	11.6	2.44	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Sulphur as S	mg/kg	1,000	NGA	<1,000	3,000	<1,000	*3,000*	<1,000	1,600	<1,000	<1,000	<1,000	<1,000	<20,000	<20,000	<20,000	<20,000	<20,000	<20,000
Titanium	mg/kg	1	NGA	321	34.1	*34.1*	*321*	-	-	-	-	-	-	878	943	835	1,200	1,130	759
Thallium	mg/kg	0.05	NGA	0.076	<0.050	<0.050	*0.076*	0.213	0.174	0.377	0.593	0.548	0.232	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Tin	mg/kg	2	NGA	<2.0	<2.0	<2.0	<2.0	<2.0	3	<2.0	6.7	<2.0	<2.0	<40.0	<40.0	<40.0	<40.0	<40.0	<40.0
Uranium	mg/kg	0.05	NGA	0.624	0.859	*0.624*	*0.859*	0.901	0.958	1.23	1.26	1.49	0.791	<1.00	1.67	1.27	<1.00	1.04	1.12
Vanadium	mg/kg	0.2	NGA	10.3	3.1	*3.1*	*10.3*	26.3	23.3	49.9	47.6	53.2	37	28.4	31.9	26.2	37.3	41.6	38.2
Zinc	mg/kg	2	315 [a,f]	12.9	12.2	*12.2*	*12.9*	53.9	45.7	88.7	89.6	109	62.4	44.1	65	59.6	57.6	72.4	62.8
Zirconium	mg/kg	1	NGA	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG = Sediment Quality Guideline for the Protection of Aquatic Life; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Atlantic RBCA Tier II Pathway-Specific Standards for Sediment - Freshwater. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater).

[b] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2014). Ambient Water Quality Guidelines for Selenium. Technical Report. Update. April, 2014. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, British Columbia Ministry of Environment. Alert Concentration.

[c] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2017; updated 2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Working Sediment Quality Guidelines.

[d] 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.

[e] Recommended SQG (high value).

[f] Probable Effect Level (PEL).

[g] Upper Working Sediment Quality Guideline.

[h] Lower Working Sediment Quality Guideline (upper guideline not available).

* RDL for arsenic is 0.1 mg/kg for 2024 lab results.

Table C-26: Analytical data for metals in sediment for the former Country Harbour mine compared to ecological health-based sediment quality guidelines.

Location				SED13		SED14	SED15	Data Summary										
Sample ID				SED13	SED - Dup CHQAOC04	SED14	SED15	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances	Number of Exceedances Over Guideline and Background
Sample Type				Normal	Duplicate	Normal	Normal									
Date				22 May 2024		22 May 2024	22 May 2024									
Sample Area				Site	Site	Site	Site									
	Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) - Freshwater													
Metals																
Aluminium	mg/kg	50	NGA	12,400	14,900	16,500	16,500	16	0	16	9720	9720	22600	22600	0	0
Antimony	mg/kg	0.1	25 [d,e]	0.19	0.18	0.18	0.11	16	5	11	<2.00	0.11	4.68	4.68	0	0
Arsenic	mg/kg	2/0.1*	17 [a,f]	*418*	*373*	*561*	*651*	16	0	16	373	373	8770	8770	16	*16*
Barium	mg/kg	0.5	NGA	62.7	71.7	96.6	93.9	16	0	16	62.7	62.7	443	443	0	0
Beryllium	mg/kg	0.1	NGA	0.59	0.68	0.75	0.59	16	6	10	<2.00	0.49	1.39	1.39	0	0
Bismuth	mg/kg	0.2	NGA	0.29	0.26	0.32	<0.20	10	7	3	<4.00	0.26	0.32	0.32	0	0
Boron	mg/kg	5	NGA	<5.0	<5.0	<5.0	<5.0	16	16	0	<5.0	-	<5.0	-	0	0
Cadmium	mg/kg	0.02	3.5 [a,f]	0.162	0.086	0.112	0.046	16	6	10	<0.400	0.046	0.218	0.218	0	0
Calcium	mg/kg	50.00	NGA	715	603	591	609	10	6	4	<1,000	591	715	715	0	0
Chromium (Total, III+VI)	mg/kg	0.5	90 [a,f]	20.3	24.4	27.8	29.5	16	0	16	19.6	19.6	38.7	38.7	0	0
Cobalt	mg/kg	0.1	NGA	21.9	8.12	21	8.61	16	0	16	5.76	5.76	120	120	0	0
Copper	mg/kg	0.5	197 [a,f]	7.7	7.51	9.35	6.58	16	3	13	<10.0	4.61	26.5	26.5	0	0
Iron	mg/kg	50	43,766 [c,g]	21,300	22,600	28,000	28,700	16	0	16	21300	21300	58000	58000	2	*2*
Lead	mg/kg	0.5	91.3 [a,f]	63.2	58.9	63.1	29.4	16	0	16	29.4	29.4	124	124	3	*3*
Lithium	mg/kg	2.0	NGA	26.1	30.3	36.5	37.1	10	5	5	<40.0	26.1	48.2	48.2	0	0
Magnesium	mg/kg	20.0	NGA	5,370	6,580	6,950	8,490	10	0	10	5300	5300	8540	8540	0	0
Manganese	mg/kg	1	1100 [c,g]	*1,290*	572	*1,160*	463	16	0	16	403	403	6910	6910	12	*12*
Mercury	mg/kg	0.005	0.486 [a,f]	0.145	0.173	0.056	0.0335	16	0	16	0.0233	0.0233	3.21	3.21	6	*6*
Molybdenum	mg/kg	0.1	NGA	1.07	0.83	0.96	0.38	16	5	11	<2.00	0.38	5.87	5.87	0	0
Nickel	mg/kg	0.5	75 [c,g]	9.17	10.4	17.1	18.7	16	0	16	8.88	8.88	19.6	19.6	0	0
Potassium	mg/kg	100.0	NGA	3,380	4,190	4,140	6,530	10	0	10	3380	3380	6530	6530	0	0
Selenium	mg/kg	0.2	2 [b]	1.06	1.06	0.87	0.2	16	6	10	<4.00 #1	0.2	1.07	1.07	0	0
Tungsten	mg/kg	0.5	NGA	<0.50	<0.50	<0.50	<0.50	10	10	0	<10.0	-	<10.0	-	0	0
Silver	mg/kg	0.1	0.5 [c,h]	0.14	0.16	0.12	<0.10	16	10	6	<0.10	0.12	0.2	0.2	0	0
Sodium	mg/kg	50.0	NGA	107	102	100	112	10	6	4	<1,000	100	112	112	0	0
Strontium	mg/kg	0.5	NGA	6.52	4.57	4.51	2.51	16	6	10	<10.0	1.88	11.6	11.6	0	0
Sulphur as S	mg/kg	1,000	NGA	<1,000	<1,000	<1,000	<1,000	16	15	1	<1,000	1600	1600	1600	0	0
Titanium	mg/kg	1	NGA	687	853	1,170	1,150	10	0	10	687	687	1200	1200	0	0
Thallium	mg/kg	0.05	NGA	0.204	0.209	0.261	0.231	16	6	10	<1.00	0.174	0.593	0.593	0	0
Tin	mg/kg	2	NGA	<2.0	<2.0	<2.0	<2.0	16	14	2	<2.0	3	6.7	6.7	0	0
Uranium	mg/kg	0.05	NGA	1.06	1.16	1.21	0.758	16	2	14	<1.00	0.758	1.67	1.67	0	0
Vanadium	mg/kg	0.2	NGA	25.7	28.2	39.9	34.9	16	0	16	23.3	23.3	53.2	53.2	0	0
Zinc	mg/kg	2	315 [a,f]	60.8	61.9	84.1	59.9	16	0	16	44.1	44.1	109	109	0	0
Zirconium	mg/kg	1	NGA	<1.0	<1.0	<1.0	<1.0	10	10	0	<20.0	-	<20.0	-	0	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG = Sediment Quality Guideline for the Protection of Aquatic Life; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Atlantic RBCA Tier II Pathway-Specific Standards for Sediment - Freshwater. Where the original source has been updated more recently than the Atlantic RBCA, the original source was consulted to confirm up to date guidelines. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater).

[b] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2014). Ambient Water Quality Guidelines for Selenium. Technical Report. Update. April, 2014. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, British Columbia Ministry of Environment. Alert Concentration.

[c] British Columbia Ministry of the Environment and Climate Change Strategy (BC MOECCS). (2017; updated 2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Working Sediment Quality Guidelines.

[d] 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.

[e] Recommended SQG (high value).

[f] Probable Effect Level (PEL).

[g] Upper Working Sediment Quality Guideline.

[h] Lower Working Sediment Quality Guideline (upper guideline not available).

* RDL for arsenic is 0.1 mg/kg for 2024 lab results.

Table C-27: Analytical data for BTEX and PHCs in groundwater for the former Country Harbour mine compared to ecological health-based sediment quality guidelines.

	Location	SED1	SED2	SED3		SED4	SED5
	Sample ID	SED1	SED2	SED3	SED-DUPA	SED4	SED5
	Sample Type	Normal	Normal	Normal	FD: SED3	Normal	Normal
	Date	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023
	Sample Area	Site	Site	Site	Site	Site	Site
	Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) (Freshwater)					
BTEX								
Benzene	mg/kg	0.005	1.2 [a,b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Toluene	mg/kg	0.05	1.4 [a,b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ethylbenzene	mg/kg	0.015	1.2 [a,b]	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Xylene (o)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Xylene (m & p)	mg/kg	0.03	NGA	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Xylene Total	mg/kg	0.05	1.3 [a,b]	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (PHCs)									
VPH (C6-C10 - BTEX)	mg/kg	5	NGA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG = Sediment Quality Guideline for the Protection of Aquatic Life; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Atlantic RBCA Ecological Tier II Pathway-Specific Standards for Sediments - Freshwater. The original source is indicated below.

[a] Atlantic PIRI. (2021). Atlantic RBCA (Risk-Based Corrective Action) for Impacted Sites in Atlantic Canada. Version 4. User Guidance.

[b] Chronic benchmark - narcosis-based (HC5) @ 1% organic carbon; EqP approach; typical sediment type.

Table C-27: Analytical data for BTEX and PHCs in groundwater for the former Country Harbour mine compared to ecological health-based sediment quality guidelines.

	Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) (Freshwater)	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
BTEX											
Benzene	mg/kg	0.005	1.2 [a,b]	6	6	0	<0.0050	-	<0.0050	-	0
Toluene	mg/kg	0.05	1.4 [a,b]	6	6	0	<0.050	-	<0.050	-	0
Ethylbenzene	mg/kg	0.015	1.2 [a,b]	6	6	0	<0.015	-	<0.015	-	0
Xylene (o)	mg/kg	0.03	NGA	6	6	0	<0.030	-	<0.030	-	0
Xylene (m & p)	mg/kg	0.03	NGA	6	6	0	<0.030	-	<0.030	-	0
Xylene Total	mg/kg	0.05	1.3 [a,b]	6	6	0	<0.050	-	<0.050	-	0
Petroleum Hydrocarbons (PHCs)											
VPH (C6-C10 - BTEX)	mg/kg	5	NGA	6	6	0	<5.0	-	<5.0	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

SQG = Sediment Quality Guideline for the Protection of Aquatic Life; NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Atlantic RBCA Ecological Tier II Pathway-Specific Standards for Sediments - Freshwater. The original source is indicated below.

[a] Atlantic PIRI. (2021). Atlantic RBCA (Risk-Based Corrective Action) for Impacted Sites in Atlantic Canada. Version 4. User Guidance.

[b] Chronic benchmark - narcosis-based (HC5) @ 1% organic carbon; EqP approach; typical sediment type.

Table C-28: Analytical data for general chemistry in groundwater for the former Country Harbour mine.

				Location	SED16	SED17	SED6	SED8	SED9	SED10	SED11	SED12	SED13	
				Sample ID	SED16	SED17	SED6	SED8	SED9	SED10	SED11	SED12	SED13	SED - Dup CHQAOC04
				Sample Type	Local Background		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate
				Date	23 May 2024	23 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	
				Sample Area	Background	Background	Site	Site	Site	Site	Site	Site	Site	Site
		Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) - Freshwater										
General Chemistry														
	Fraction Organic Carbon (FOC)	g/g	0.001	NGA	0.0212	0.334	0.0119	0.0427	0.022	0.0107	0.0876	0.106	0.109	0.0845
	Total Organic Carbon (TOC)	mg/kg	1,000	NGA	21,200	334,000	11,900	42,700	22,000	10,700	87,600	106,000	109,000	84,500
	Phosphorus	mg/kg	50	NGA	332	647	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	560	576
Grain Size														
	passing (0.002 mm)	%	1		-	-	1.2	-	-	-	-	-	-	-
	passing (0.004 mm)	%	1		-	-	1.2	-	-	-	-	-	-	-
	passing (0.005 mm)	%	1		-	-	1.2	-	-	-	-	-	-	-
	passing (0.020 mm)	%	1		-	-	1.2	-	-	-	-	-	-	-
	passing (0.0312 mm)	%	1		-	-	1.5	-	-	-	-	-	-	-
	passing (0.05 mm)	%	1		-	-	1.7	-	-	-	-	-	-	-
	passing (0.063 mm)	%	1		-	-	1.5	-	-	-	-	-	-	-
	passing (0.075 mm)	%	1		-	-	1.3	-	-	-	-	-	-	-
	passing (0.125 mm)	%	1		-	-	1.9	-	-	-	-	-	-	-
	passing (0.149 mm)	%	1		-	-	2.2	-	-	-	-	-	-	-
	passing (0.250 mm)	%	1		-	-	3.7	-	-	-	-	-	-	-
	passing (0.420 mm)	%	1		-	-	7	-	-	-	-	-	-	-
	passing (0.50 mm)	%	1		-	-	7.9	-	-	-	-	-	-	-
	passing (0.841 mm)	%	1		-	-	11.6	-	-	-	-	-	-	-
	passing (1.0 mm)	%	1		-	-	14.2	-	-	-	-	-	-	-
	passing (19 mm)	%	1		-	-	100	-	-	-	-	-	-	-
	passing (2.0 mm)	%	1		-	-	30.9	-	-	-	-	-	-	-
	passing (25.4 mm)	%	1		-	-	100	-	-	-	-	-	-	-
	passing (38.1 mm)	%	1		-	-	100	-	-	-	-	-	-	-
	passing (4.75 mm)	%	1		-	-	64	-	-	-	-	-	-	-
	passing (50.8 mm)	%	1		-	-	100	-	-	-	-	-	-	-
	passing (76.2 mm)	%	1		-	-	100	-	-	-	-	-	-	-
	passing (9.5 mm)	%	1		-	-	95	-	-	-	-	-	-	-

Notes

NGA denotes No Guideline Available

Table C-28: Analytical data for general chemistry in groundwater for the former Country Harbour mine.

			Location	SED14	SED15	Data Summary							
			Sample ID	SED14	SED15	Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
			Sample Type	Normal	Normal								
			Date	22 May 2024	22 May 2024								
			Sample Area	Site	Site								
		Unit	RDL	Sediment Quality Guideline for the Protection of Aquatic Life (SQG) - Freshwater									
General Chemistry													
	Fraction Organic Carbon (FOC)	g/g	0.001	NGA	0.0577	0.0257	10	0	10	0.0107	0.0107	0.109	0.109	0
	Total Organic Carbon (TOC)	mg/kg	1,000	NGA	57,700	25,700	10	0	10	10700	10700	109000	109000	0
	Phosphorus	mg/kg	50	NGA	518	414	10	6	4	<1,000	414	576	576	0
Grain Size														
	passing (0.002 mm)	%	1		-	1.3	2	0	2	1.2	1.2	1.3	1.3	0
	passing (0.004 mm)	%	1		-	1.3	2	0	2	1.2	1.2	1.3	1.3	0
	passing (0.005 mm)	%	1		-	1.3	2	0	2	1.2	1.2	1.3	1.3	0
	passing (0.020 mm)	%	1		-	1.7	2	0	2	1.2	1.2	1.7	1.7	0
	passing (0.0312 mm)	%	1		-	2.5	2	0	2	1.5	1.5	2.5	2.5	0
	passing (0.05 mm)	%	1		-	3.4	2	0	2	1.7	1.7	3.4	3.4	0
	passing (0.063 mm)	%	1		-	4.2	2	0	2	1.5	1.5	4.2	4.2	0
	passing (0.075 mm)	%	1		-	5.1	2	0	2	1.3	1.3	5.1	5.1	0
	passing (0.125 mm)	%	1		-	6.8	2	0	2	1.9	1.9	6.8	6.8	0
	passing (0.149 mm)	%	1		-	7.6	2	0	2	2.2	2.2	7.6	7.6	0
	passing (0.250 mm)	%	1		-	10.7	2	0	2	3.7	3.7	10.7	10.7	0
	passing (0.420 mm)	%	1		-	17.1	2	0	2	7	7	17.1	17.1	0
	passing (0.50 mm)	%	1		-	19.4	2	0	2	7.9	7.9	19.4	19.4	0
	passing (0.841 mm)	%	1		-	28.7	2	0	2	11.6	11.6	28.7	28.7	0
	passing (1.0 mm)	%	1		-	33.4	2	0	2	14.2	14.2	33.4	33.4	0
	passing (19 mm)	%	1		-	100	2	0	2	100	100	100	100	0
	passing (2.0 mm)	%	1		-	63.3	2	0	2	30.9	30.9	63.3	63.3	0
	passing (25.4 mm)	%	1		-	100	2	0	2	100	100	100	100	0
	passing (38.1 mm)	%	1		-	100	2	0	2	100	100	100	100	0
	passing (4.75 mm)	%	1		-	84.6	2	0	2	64	64	84.6	84.6	0
	passing (50.8 mm)	%	1		-	100	2	0	2	100	100	100	100	0
	passing (76.2 mm)	%	1		-	100	2	0	2	100	100	100	100	0
	passing (9.5 mm)	%	1		-	94.7	2	0	2	94.7	94.7	95	95	0

Notes

NGA denotes No Guideline Available

Table C-29: Analytical data for metals in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

			Sample ID	SW16	SW17	*Local Background Minimum*	*Local Background Maximum*	SW1	SW2	SW3	SW DUP A	SW4	SW5	CHQAQC03	SW6	SW7	SW8	SW9	SW10	SW12	SW13	SW14	SW15
			Sample Type	Normal	Normal			Normal	Normal	Normal	FD (SW3)	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	04 Jun 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Background	Background			Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life - Freshwater																			
Metals																						
Aluminium	mg/L	0.003	0.005 [a,h]	0.233	0.138	*0.138*	*0.233*	0.194	*0.325*	0.227	0.228	0.226	0.218	0.132	0.119	0.12	0.126	0.138	0.142	0.182	0.186	0.131	0.131
Antimony	mg/L	0.0001	0.009 [b]	<0.00010	<0.00010	*<0.00010*	*<0.00010*	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic	mg/L	0.0001	0.005 [a]	0.0013	0.00028	*0.00028*	*0.0013*	*0.0355*	*0.0633*	*0.0467*	*0.0473*	*0.0505*	*0.0558*	*0.031*	*0.0276*	*0.0295*	*0.0298*	*0.031*	*0.0328*	*0.0347*	*0.0394*	*0.0315*	*0.0263*
Barium	mg/L	0.0001	1 [b,e]	0.00286	0.002	*0.002*	*0.00286*	0.00392	0.00484	0.00419	0.00414	0.00359	0.00392	0.00244	0.00301	0.00304	0.00301	0.00331	0.00325	0.00295	0.00316	0.00243	0.00244
Beryllium	mg/L	0.00002	0.00015 [b]	0.000022	<0.000020	*<0.000020*	*0.000022*	0.00004	0.000067	0.000037	0.000042	0.000034	0.000032	0.00002	0.000029	0.00003	0.000024	0.000027	0.000028	0.00003	0.000024	0.000026	0.000021
Bismuth	mg/L	0.00005	NGA	<0.000050	<0.000050	*<0.000050*	*<0.000050*	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron	mg/L	0.01	1.5 [a]	<0.010	<0.010	*<0.010*	*<0.010*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	mg/L	0.000005	0.00004 [a,f]	0.0000155	0.0000142	*0.0000142*	*0.0000155*	0.0000289	0.0000341	0.000034	0.0000314	0.0000255	0.0000269	0.0000154	0.0000182	0.0000211	0.0000166	0.0000234	0.000022	0.0000202	0.0000195	0.0000144	0.0000138
Calcium	mg/L	0.1	NGA	0.376	0.364	*0.364*	*0.376*	0.586	0.368	0.58	0.584	0.43	0.503	0.382	0.564	0.583	0.712	0.55	0.526	0.447	0.412	0.384	0.398
Chromium (Total, III+VI)	mg/L	0.0005	0.0089 [a]	0.0005	<0.00050	*<0.00050*	*0.0005*	<0.00050	0.00159	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	<0.00050	<0.00050
Cobalt	mg/L	0.0001	0.008 [c,g]	0.0001	<0.00010	*<0.00010*	*0.0001*	0.00025	0.00034	0.00044	0.00047	0.00132	0.00092	0.00039	0.00012	0.00013	0.0002	0.00027	0.00032	0.00044	0.001	0.00038	0.00038
Copper	mg/L	0.0005	0.002 [a,i]	<0.00050	<0.00050	*<0.00050*	*<0.00050*	0.00059	<0.00050	0.00086	0.00084	<0.00050	0.00083	<0.00050	<0.00050	<0.00050	0.00053	0.00056	0.00058	<0.00050	<0.00050	<0.00050	<0.00050
Iron	mg/L	0.01	0.3 [a]	0.399	0.233	*0.233*	*0.399*	0.252	*0.609*	0.391	0.394	*0.562*	*0.621*	0.218	0.11	0.124	0.131	0.163	0.192	0.318	0.379	0.219	0.214
Lead	mg/L	0.00005	0.001 [a,j]	0.000879	0.00038	*0.00038*	*0.000879*	0.000539	*0.00208*	0.000722	0.000722	*0.00132*	*0.00109*	0.000412	0.000352	0.000353	0.000404	0.000456	0.000506	0.000782	*0.00144*	0.000425	0.000435
Magnesium	mg/L	0.005	NGA	0.316	0.292	*0.292*	*0.316*	0.373	0.347	0.402	0.403	0.352	0.377	0.3	0.342	0.35	0.368	0.347	0.341	0.324	0.319	0.308	0.294
Manganese	mg/L	0.0001	0.21 [a,k]	0.0141	0.014	*0.014*	*0.0141*	0.0284	0.0447	0.0454	0.0462	0.105	0.0811	0.0315	0.01	0.012	0.0173	0.0252	0.0282	0.0368	0.07	0.0317	0.0292
Mercury	mg/L	0.000005	0.000026 [a]	<0.0000050	<0.0000050	*<0.0000050*	*<0.0000050*	0.0000141	0.000023	0.0000177	0.0000195	0.0000054	<0.0000050	<0.0000050	0.0000084	0.0000079	0.0000107	0.0000097	0.0000134	0.000005	<0.0000050	<0.0000050	<0.0000050
Molybdenum	mg/L	0.00005	0.073 [a]	<0.000050	<0.000050	*<0.000050*	*<0.000050*	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050	<0.000050
Nickel	mg/L	0.0005	0.025 [a,l]	<0.00050	<0.00050	*<0.00050*	*<0.00050*	0.0009	<0.00050	0.00115	0.00114	<0.00050	0.00051	<0.00050	0.00055	0.00058	0.00082	0.00086	0.00088	<0.00050	<0.00050	<0.00050	<0.00050
Silica (SiO2)	mg/L	0.21	NGA	6.42	6.2	*6.2*	*6.42*	5.3	5.86	5.26	5.3	5.58	5.73	3.72	3.64	3.74	3.42	3.66	3.89	-	3.98	3.81	3.79
Potassium	mg/L	0.05	NGA	0.345	0.337	*0.337*	*0.345*	0.319	0.323	0.339	0.34	0.317	0.366	0.281	0.295	0.296	0.318	0.318	0.314	0.282	0.304	0.29	0.302
Selenium	mg/L	0.00005	0.001 [a]	0.000127	0.000093	*0.000093*	*0.000127*	0.000086	0.000118	0.000092	0.000098	0.000091	0.000108	0.000092	0.000078	0.000058	0.000065	0.000074	0.000071	0.000105	0.000073	0.000074	0.000078
Cesium	mg/L	0.00001	NGA	0.000142	0.000047	*0.000047*	*0.000142*	0.000108	0.000131	0.000124	0.000121	0.000092	0.000083	0.000069	0.000101	0.000103	0.000125	0.000113	0.000123	0.000078	0.000112	0.000072	0.000067
Rubidium	mg/L	0.0002	NGA	0.00172	0.00152	*0.00152*	*0.00172*	0.00158	0.00175	0.0016	0.00166	0.00161	0.00177	0.00145	0.00154	0.0015	0.00155	0.00157	0.00158	0.00134	0.0015	0.00147	0.0015
Tellurium	mg/L	0.0002	NGA	<0.00020	<0.00020	*<0.00020*	*<0.00020*	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thorium	mg/L	0.0001	NGA	<0.00010	<0.00010	*<0.00010*	*<0.00010*	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tungsten	mg/L	0.0001	NGA	<0.00010	<0.00010	*<0.00010*	*<0.00010*	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Lithium	mg/L	0.001	NGA	<0.0010	<0.0010	*<0.0010*	*<0.0010*	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver	mg/L	0.00001	0.00025 [a]	<0.000010	<0.000010	*<0.000010*	*<0.000010*	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Silicon	mg/L	0.1	NGA	3	2.9	*2.9*	*3*	2.48	2.74	2.46	2.48	2.61	2.68	1.74	1.7	1.75	1.6	1.71	1.82	2.03	1.86	1.78	1.77
Sodium	mg/L	0.05	NGA	3.35	3.4	*3.35*	*3.4*	3.26	3.35	3.21	3.33	3.2	3.33	3.3	3.44	3.43	3.33	3.26	3.18	3.31	3.33	3.31	3.37
Strontium	mg/L	0.0002	21 [d]	0.00451	0.00386	*0.00386*	*0.00451*	0.0056	0.00462	0.00562	0.00568	0.00462	0.00535	0.00408	0.00497	0.00505	0.00586	0.00506	0.00468	0.00452	0.00418	0.00411	0.00406
Sulphur as S	mg/L	0.5	NGA	0.65	0.6	*0.6*	*0.65*	0.61	0.56	0.53	0.51	<0.50	0.5	0.7	0.76	0.77	0.83	0.7	0.75	0.55	0.69	0.67	0.73
Titanium	mg/L	0.0003	NGA	0.0112	0.002	*0.002*	*0.0112*	0.00156	0.0115	0.00211	0.00187	0.00437	0.0035	0.00157	0.00099	0.00109	0.00106	0.0012	0.0012	0.00267	0.00479	0.00162	0.00172
Thallium	mg/L	0.00001	0.0008 [a]	<0.000010	<0.000010	*<0.000010*	*<0.000010*	<0.000010	<0.000010	0.000011	0.000012	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin	mg/L	0.0001	NGA	<0.00010	<0.00010	*<0.00010*	*<0.00010*	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium	mg/L	0.00001	0.015 [a]	0.000033	0.000021	*0.000021*	*0.000033*	0.000123	0.000261	0.000043	0.000044	0.000038	0.000039	0.000024	0.000097	0.000081	0.000045	0.000032	0.000027	0.000035	0.00003	0.000026	0.000024
Vanadium	mg/L	0.0005	0.12 [c]	<0.00050	<0.00050	*<0.00050*	*<0.00050*	<0.00050	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc	mg/L	0.003	0.007 [a]	<0.0030	<0.0030	*<0.0030*	*<0.0030*	0.0063	0.005	*0.0073*	*0.0075*	0.0045	*0.0088*	0.0032	0.0053	0.0049	0.0052	0.0053	0.0053	0.0048	0.004	0.0032	0.0032
Zirconium	mg/L	0.0002	NGA	<0.00020	<0.00020	*<0.00020*	*<0.00020*	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Environment Canada. (2017). Federal Environmental Quality Guidelines: Cobalt.

[d] Michigan Department of Environmental Quality (MDEQ). (2008). Rule 57 Water Quality Values - Surface Water Quality Assessment Section.

[e] Guideline is based on a 30-day average.

[f] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 17 mg/L, the most conservative guideline was applied.

[g] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 52 mg/L, the most conservative guideline was applied.

[h] Guideline is pH-dependent. Given that the majority of site samples had a reported pH < 6.5, the most conservative guideline was applied.

[i] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 82 mg/L, the most conservative guideline was applied.

[j] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

[k] Guideline is pH and hardness-dependent. The most conservative guideline based on pH and hardness data across site samples was applied.

[l] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

Table C-29: Analytical data for metals in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life - Freshwater	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances	Number of Exceedances over Guideline and Background
Metals												
Aluminium	mg/L	0.003	0.005 [a,h]	16	0	16	0.119	0.119	0.325	0.325	16	*1*
Antimony	mg/L	0.0001	0.009 [b]	16	16	0	<0.00010	-	<0.00010	-	0	0
Arsenic	mg/L	0.0001	0.005 [a]	16	0	16	0.0263	0.0263	0.0633	0.0633	16	*16*
Barium	mg/L	0.0001	1 [b,e]	16	0	16	0.00243	0.00243	0.00484	0.00484	0	0
Beryllium	mg/L	0.00002	0.00015 [b]	16	0	16	0.00002	0.00002	0.000067	0.000067	0	0
Bismuth	mg/L	0.00005	NGA	16	16	0	<0.000050	-	<0.000050	-	0	0
Boron	mg/L	0.01	1.5 [a]	16	16	0	<0.010	-	<0.010	-	0	0
Cadmium	mg/L	0.000005	0.00004 [a,f]	16	0	16	0.0000138	0.0000138	0.0000341	0.0000341	0	0
Calcium	mg/L	0.1	NGA	16	0	16	0.368	0.368	0.712	0.712	0	0
Chromium (Total, III+VI)	mg/L	0.0005	0.0089 [a]	16	14	2	<0.00050	0.00051	0.00159	0.00159	0	0
Cobalt	mg/L	0.0001	0.008 [c,g]	16	0	16	0.00012	0.00012	0.00132	0.00132	0	0
Copper	mg/L	0.0005	0.002 [a,j]	16	9	7	<0.00050	0.00053	0.00086	0.00086	0	0
Iron	mg/L	0.01	0.3 [a]	16	0	16	0.11	0.11	0.621	0.621	7	*3*
Lead	mg/L	0.00005	0.001 [a,j]	16	0	16	0.000352	0.000352	0.00208	0.00208	4	*4*
Magnesium	mg/L	0.005	NGA	16	0	16	0.294	0.294	0.403	0.403	0	0
Manganese	mg/L	0.0001	0.21 [a,k]	16	0	16	0.01	0.01	0.105	0.105	0	0
Mercury	mg/L	0.000005	0.000026 [a]	16	5	11	<0.0000050	0.000005	0.000023	0.000023	0	0
Molybdenum	mg/L	0.00005	0.073 [a]	16	15	1	<0.000050	0.000052	0.000052	0.000052	0	0
Nickel	mg/L	0.0005	0.025 [a,l]	16	7	9	<0.00050	0.00051	0.00115	0.00115	0	0
Silica (SiO2)	mg/L	0.21	NGA	15	0	15	3.42	3.42	5.86	5.86	0	0
Potassium	mg/L	0.05	NGA	16	0	16	0.281	0.281	0.366	0.366	0	0
Selenium	mg/L	0.00005	0.001 [a]	16	0	16	0.000058	0.000058	0.000118	0.000118	0	0
Cesium	mg/L	0.00001	NGA	16	0	16	0.000067	0.000067	0.000131	0.000131	0	0
Rubidium	mg/L	0.0002	NGA	16	0	16	0.00134	0.00134	0.00177	0.00177	0	0
Tellurium	mg/L	0.0002	NGA	16	16	0	<0.00020	-	<0.00020	-	0	0
Thorium	mg/L	0.0001	NGA	16	16	0	<0.00010	-	<0.00010	-	0	0
Tungsten	mg/L	0.0001	NGA	16	16	0	<0.00010	-	<0.00010	-	0	0
Lithium	mg/L	0.001	NGA	16	16	0	<0.0010	-	<0.0010	-	0	0
Silver	mg/L	0.00001	0.00025 [a]	16	16	0	<0.000010	-	<0.000010	-	0	0
Silicon	mg/L	0.1	NGA	16	0	16	1.6	1.6	2.74	2.74	0	0
Sodium	mg/L	0.05	NGA	16	0	16	3.18	3.18	3.44	3.44	0	0
Strontium	mg/L	0.0002	21 [d]	16	0	16	0.00406	0.00406	0.00586	0.00586	0	0
Sulphur as S	mg/L	0.5	NGA	16	1	15	<0.50	0.5	0.83	0.83	0	0
Titanium	mg/L	0.0003	NGA	16	0	16	0.00099	0.00099	0.0115	0.0115	0	0
Thallium	mg/L	0.00001	0.0008 [a]	16	13	3	<0.000010	0.000011	0.000012	0.000012	0	0
Tin	mg/L	0.0001	NGA	16	16	0	<0.00010	-	<0.00010	-	0	0
Uranium	mg/L	0.00001	0.015 [a]	16	0	16	0.000024	0.000024	0.000261	0.000261	0	0
Vanadium	mg/L	0.0005	0.12 [c]	16	15	1	<0.00050	0.0005	0.0005	0.0005	0	0
Zinc	mg/L	0.003	0.007 [a]	16	0	16	0.0032	0.0032	0.0088	0.0088	3	3
Zirconium	mg/L	0.0002	NGA	16	16	0	<0.00020	-	<0.00020	-	0	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Environment Canada. (2017). Federal Environmental Quality Guidelines: Cobalt.

[d] Michigan Department of Environmental Quality (MDEQ). (2008). Rule 57 Water Quality Values - Surface Water Quality Assessment Section.

[e] Guideline is based on a 30-day average.

[f] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 17 mg/L, the most conservative guideline was applied.

[g] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 52 mg/L, the most conservative guideline was applied.

[h] Guideline is pH-dependent. Given that the majority of site samples had a reported pH < 6.5, the most conservative guideline was applied.

[i] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 82 mg/L, the most conservative guideline was applied.

[j] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

[k] Guideline is pH and hardness-dependent. The most conservative guideline based on pH and hardness data across site samples was applied.

[l] Guideline is hardness-dependent. Given that all site samples had a reported hardness of < 60 mg/L, the most conservative guideline was applied.

Table C-30: Analytical data for PAHs in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

							Data Summary							
Sample ID				SW4	SW DUP B	SW5								
Sample Type				Normal	FD (SW4)	Normal								
Date				06 Nov 2023	06 Nov 2023	06 Nov 2023								
Sample Area				Site	Site	Site								
	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life - Freshwater				Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Polycyclic Aromatic Hydrocarbons (PAHs)														
1-Methylnaphthalene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
2-Methylnaphthalene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
1 & 2 Methylnaphthalene	mg/L	0.000015	0.002 [c,d]	<0.000015	<0.000015	<0.000015	3	3	0	<0.000015	-	<0.000015	-	0
Acenaphthene	mg/L	0.00001	0.0058 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Acenaphthylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Acridine	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Anthracene	mg/L	0.00001	0.000012 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Benz(a)anthracene	mg/L	0.00001	0.000018 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Benzo(a)pyrene	mg/L	0.000005	0.000015 [a]	<0.0000050	<0.0000050	<0.0000050	3	3	0	<0.0000050	-	<0.0000050	-	0
Benzo(b+j)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Benzo(b+j+k)fluoranthene	mg/L	0.000015	NGA	<0.000015	<0.000015	<0.000015	3	3	0	<0.000015	-	<0.000015	-	0
Benzo(g,h,i)perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Benzo(k)fluoranthene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Chrysene	mg/L	0.00001	0.0001 [b]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Dibenz(a,h)anthracene	mg/L	0.000005	NGA	<0.0000050	<0.0000050	<0.0000050	3	3	0	<0.0000050	-	<0.0000050	-	0
Fluorene	mg/L	0.00001	0.003 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Fluoranthene	mg/L	0.00001	0.00004 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Naphthalene	mg/L	0.00001	0.0011 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Perylene	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Phenanthrene	mg/L	0.00001	0.0004 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Pyrene	mg/L	0.00001	0.000025 [a]	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0
Quinoline	mg/L	0.00001	NGA	<0.000010	<0.000010	<0.000010	3	3	0	<0.000010	-	<0.000010	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] BC Contaminated Sites Regulation (BC CSR). (2023). Schedule 3.2, Generic Numerical Water Standards: Protection of Aquatic Life.

[c] Ontario Ministry of the Environment (OMOE). (1999). Provincial Water Quality Objectives - Table 2.

[d] Interim provincial water quality objective (PWQO).

Table C-31: Analytical data for BTEX and PHCs in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

							Data Summary							
Sample ID				SW4	SW DUP B	SW5								
Sample Type				Normal	FD (SW4)	Normal								
Date				06 Nov 2023	06 Nov 2023	06 Nov 2023								
Sample Area				Site	Site	Site								
	Unit	RDL	Water Quality Guideline (WQG) for the Protection of Aquatic Life - Freshwater											
BTEX														
Benzene	mg/L	0.0005	2.1 [a]	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-	0
Toluene	mg/L	0.0005	0.77 [a]	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-	0
Ethylbenzene	mg/L	0.0005	0.32 [a]	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-	0
Xylene (o)	mg/L	0.0003	NGA	<0.00030	<0.00030	<0.00030	3	3	0	<0.00030	-	<0.00030	-	0
Xylene (m & p)	mg/L	0.0004	NGA	<0.00040	<0.00040	<0.00040	3	3	0	<0.00040	-	<0.00040	-	0
Xylene Total	mg/L	0.0005	0.33 [a]	<0.00050	<0.00050	<0.00050	3	3	0	<0.00050	-	<0.00050	-	0
Petroleum Hydrocarbons (PHCs)														
VPH (C6-C10 - BTEX)	mg/L	0.025	NGA	<0.025	<0.025	<0.025	3	3	0	<0.025	-	<0.025	-	0
EPH >C10-C16	mg/L	0.05	NGA	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-	0
EPH >C16-C21	mg/L	0.05	NGA	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-	0
EPH >C21-C32	mg/L	0.05	NGA	<0.050	<0.050	<0.050	3	3	0	<0.050	-	<0.050	-	0
Modified TPH (Tier 1)	mg/L	0.09	0.1 [a,b]	<0.090	<0.090	<0.090	3	3	0	<0.090	-	<0.090	-	0
Reached Baseline at C32	-		NGA	Yes	Yes	Yes	3	0	0	0	-	-	-	0

Notes

Shaded cells denote an exceedance above the applicable guideline

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Atlantic RBCA Environmental Quality Standards (2021).

[b] Given that all concentrations were < RDL and therefore had no reported resemblances, the most conservative guideline (fuel/lube) was applied for reference.

Table C-32: Analytical data for general chemistry in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

			Sample ID	SW16	SW17	*Local Background Minimum*	*Local Background Maximum*	SW1	SW2	SW3	SW DUP A	SW4	SW5	CHQAQC03	SW6
			Sample Type	Normal	Normal			Normal	Normal	Normal	FD (SW3)	Normal	Normal	Normal	Normal
			Date	23 May 2024	23 May 2024			06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	06 Nov 2023	22 May 2024	22 May 2024
			Sample Area	Background	Background			Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Surface Water Quality Guideline - Freshwater												
Calculated Parameters															
Anions Total	meq/L	0.1	NGA	0.16	0.16	*0.16*	*0.16*	0.2	0.17	0.16	0.17	0.16	0.16	0.17	0.17
Cations Total	meq/L	0.1	NGA	0.24	0.23	*0.23*	*0.24*	0.24	0.26	0.26	0.26	0.25	0.27	0.22	0.23
Ionic Balance	%	0.01	NGA	150	144	*144*	*150*	120	153	162	153	156	169	129	135
Langelier Index (@ 20C)	N/A	0.01	NGA	Incalculable	-7.03	*Incalculable*	*-7.03*	-5.61	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
Langelier Index (@ 4C)	N/A	0.01	NGA	Incalculable	-7.28	*Incalculable*	*-7.28*	-5.87	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
Saturation @ 4c	-	0.01	NGA	Incalculable	12.2	*Incalculable*	*12.2*	11.6	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
Saturation pH (@ 20C)	N/A	0.01	NGA	Incalculable	12	*Incalculable*	*12*	11.3	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable	Incalculable
Colour, Apparent	CU	2.00	NGA	82.3	104	*82.3*	*104*	-	-	-	-	-	-	54.1	31.4
General Chemistry															
Carbonate	mg/L	1	NGA	<1.0	<1.0	*<1.0*	*<1.0*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (total)	mg/L	1	NGA	<1.0	<1.0	*<1.0*	*<1.0*	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bicarbonate	mg/L	1	NGA	<1.0	<1.0	*<1.0*	*<1.0*	1.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hardness as CaCO3 (Measured)	mg/L	0.5	NGA	2.24	2.11	*2.11*	*2.24*	3	2.35	3.1	3.12	2.52	2.81	2.19	2.82
Ammonia as N	mg/L	0.005	83.9 [a]	0.0064	0.0086	*0.0064*	*0.0086*	<0.0050	<0.0050	0.0084	0.005	0.0086	0.0126	<0.0050	<0.0050
Total Organic Carbon (TOC)	mg/L	0.5	NGA	10.8	7.67	*7.67*	*10.8*	7.01	7.15	9.42	9.5	9.24	10.3	4.86	3.5
Ortho Phosphate as P (filtered)	mg/L	0.001	NGA	0.0055	0.0058	*0.0055*	*0.0058*	0.0013	0.002	0.002	0.0035	0.0064	0.002	0.004	0.0014
Phosphorus	mg/L	0.05	NGA	<0.050	<0.050	*<0.050*	*<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phosphorus (filtered)	mg/L		NGA	<0.050	<0.050	*<0.050*	*<0.050*							<0.050	<0.050
Fluoride	mg/L	0.02	0.12 [a]	<0.020	<0.020	*<0.020*	*<0.020*	0.02	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	0.022
Chloride (filtered)	mg/L	0.5	120 [a]	4.42	4.38	*4.38*	*4.42*	4.58	4.64	4.59	4.64	4.58	4.62	4.52	4.56
Electrical Conductivity (Lab)	µS/cm	1	NGA	25.8	27.4	*25.8*	*27.4*	27.1	26.5	28.1	28.2	27.8	28.4	25.1	25.4
Hydroxide	mg/L	1	NGA	<1.0	<1.0	*<1.0*	*<1.0*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrate (as N)	mg/L	0.02	13 [a,b]	<0.020	<0.020	*<0.020*	*<0.020*	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.01	0.06 [a]	<0.010	<0.010	*<0.010*	*<0.010*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrite + Nitrate as N	mg/L	0.0224	NGA	<0.0224	<0.0224	*<0.0224*	*<0.0224*	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224	<0.0224
pH (Lab)	pH Units	0.1	6.5 to 9 [a]	5.3	4.96	*4.96*	*5.3*	5.73	5.51	5.36	5.38	5.3	5.18	5.51	5.82
Sulphate (filtered)	mg/L	0.3	128 [c]	1.86	1.71	*1.71*	*1.86*	1.92	1.78	1.73	1.76	1.67	1.57	2.05	2.16
Total Dissolved Solids (TDS) - Measured	mg/L	10	NGA	29	32	*29*	*32*	28	28	32	36	29	27	24	29
Turbidity	NTU	0.1	NGA	2.84	1	*1*	*2.84*	0.18	1.38	0.17	0.19	0.47	1.25	0.34	0.16

Notes

Shaded cells denote an exceedance above the ap

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] This benchmark does not protect against potential eutrophication.

[c] British Columbia Ministry of Environment and Climate Change Strategy (BC MOECCS). (2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary.

[d] Guideline is pH- and temperature dependent. Highest recorded temperature for all samples was approximately 8°C, and all recorded pH values were < 6.0; therefore, the selected guideline was 102 mg/L NH3 per CCME (2001). Calculated guideline was converted to mg/L total ammonia-N by multiplying the corresponding guideline value by 0.8224.

Table C-32: Analytical data for general chemistry in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

			Sample ID	SW7	SW8	SW9	SW10	SW12		SW13	SW14	SW15
			Sample Type	Normal	Normal	Normal	Normal	Normal		Normal	Normal	Normal
			Date	22 May 2024	22 May 2024	22 May 2024	22 May 2024	22 May 2024	04 Jun 2024	22 May 2024	22 May 2024	22 May 2024
			Sample Area	Site	Site	Site	Site	Site	Site	Site	Site	Site
	Unit	RDL	Human Health-Based Surface Water Quality Guideline - Freshwater									
Calculated Parameters												
Anions Total	meq/L	0.1	NGA	0.18	0.18	0.17	0.17	-	-	0.17	0.17	0.16
Cations Total	meq/L	0.1	NGA	0.23	0.24	0.23	0.23	-	-	0.24	0.22	0.22
Ionic Balance	%	0.01	NGA	128	133	135	135	-	-	141	129	138
Langelier Index (@ 20C)	N/A	0.01	NGA	Incalculable	Incalculable	Incalculable	-	-	-	Incalculable	Incalculable	Incalculable
Langelier Index (@ 4C)	N/A	0.01	NGA	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
Saturation @ 4c	-	0.01	NGA	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
Saturation pH (@ 20C)	N/A	0.01	NGA	Incalculable	Incalculable	Incalculable	Incalculable	-	-	Incalculable	Incalculable	Incalculable
Colour, Apparent	CU	2.00	NGA	31.6	29.4	34.2	38.7	54.5	-	45.3	54	53.8
General Chemistry												
Carbonate	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Alkalinity (total)	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Bicarbonate	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Hardness as CaCO3 (Measured)	mg/L	0.5	NGA	2.9	3.29	2.8	2.72	-	-	2.34	2.23	2.2
Ammonia as N	mg/L	0.005	83.9 [a]	<0.0050	<0.0050	<0.0050	<0.0050	0.0103	-	<0.0050	<0.0050	<0.0050
Total Organic Carbon (TOC)	mg/L	0.5	NGA	3.59	3.82	4.09	4.14	5.66	-	4.43	4.77	4.65
Ortho Phosphate as P (filtered)	mg/L	0.001	NGA	0.0015	0.0014	0.0014	0.0026	0.0026	-	0.0029	0.0027	0.0029
Phosphorus	mg/L	0.05	NGA	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Phosphorus (filtered)	mg/L		NGA	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050
Fluoride	mg/L	0.02	0.12 [a]	0.02	<0.020	<0.020	<0.020	<0.020	-	<0.020	<0.020	<0.020
Chloride (filtered)	mg/L	0.5	120 [a]	4.54	4.47	4.4	4.35	4.48	-	4.47	4.47	4.44
Electrical Conductivity (Lab)	µS/cm	1	NGA	25.4	26	25.3	25.5	25	-	24.9	25	25.4
Hydroxide	mg/L	1	NGA	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Nitrate (as N)	mg/L	0.02	13 [a,b]	<0.020	<0.020	0.028	0.042	<0.020	-	<0.020	<0.020	<0.020
Nitrite (as N)	mg/L	0.01	0.06 [a]	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010
Nitrite + Nitrate as N	mg/L	0.0224	NGA	<0.0224	<0.0224	0.028	0.042	<0.0224	-	<0.0224	<0.0224	<0.0224
pH (Lab)	pH Units	0.1	6.5 to 9 [a]	5.89	5.98	5.64	5.45	5.37	-	5.37	5.57	5.38
Sulphate (filtered)	mg/L	0.3	128 [c]	2.22	2.38	2.24	2.15	2.01	-	1.97	1.94	1.94
Total Dissolved Solids (TDS) - Measured	mg/L	10	NGA	22	26	26	23	23	-	27	29	30
Turbidity	NTU	0.1	NGA	0.18	0.18	0.19	0.26	1.67	-	0.37	0.37	0.47

Notes

Shaded cells denote an exceedance above the ap

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

[a] Canadian Council of Ministers of the Environment (CCME). Canadian Environmental Quality Guidelines (CEQG): Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater.

[b] This benchmark does not protect against potential eutrophication.

[c] British Columbia Ministry of Environment and Climate Change Strategy (BC MOECCS). (2021). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary.

[d] Guideline is pH- and temperature dependent. Highest recorded temperature for all samples was approximately 8°C, and all recorded pH values were < 6.0; therefore, the selected guideline was 102 mg/L NH3 per CCME (2001). Calculated guideline was converted to mg/L total ammonia-N by multiplying the corresponding guideline value by 0.8224.

Table C-32: Analytical data for general chemistry in surface water for the former Country Harbour mine compared to ecological health-based water quality guidelines.

	Sample ID Sample Type Date Sample Area	Unit	RDL	Human Health-Based Surface Water Quality Guideline - Freshwater	Data Summary: Number of Samples	Number of Non-Detects	Number of Detects	Minimum Concentration	Minimum Detected Concentration	Maximum Concentration	Maximum Detected Concentration	Number of Exceedances
Calculated Parameters												
Anions Total		meq/L	0.1	NGA	15	0	15	0.16	0.16	0.2	0.2	0
Cations Total		meq/L	0.1	NGA	15	0	15	0.22	0.22	0.27	0.27	0
Ionic Balance		%	0.01	NGA	15	0	15	120	120	169	169	0
Langelier Index (@ 20C)		N/A	0.01	NGA	14	0	1	-5.61	-5.61	-5.61	-5.61	0
Langelier Index (@ 4C)		N/A	0.01	NGA	15	0	1	-5.87	-5.87	-5.87	-5.87	0
Saturation @ 4c		-	0.01	NGA	15	0	1	11.6	11.6	11.6	11.6	0
Saturation pH (@ 20C)		N/A	0.01	NGA	15	0	1	11.3	11.3	11.3	11.3	0
Colour, Apparent		CU	2.00	NGA	10	0	10	29.4	29.4	54.5	54.5	0
General Chemistry												
Carbonate		mg/L	1	NGA	16	16	0	<1.0	-	<1.0	-	0
Alkalinity (total)		mg/L	1	NGA	16	15	1	<1.0	1.4	1.4	1.4	0
Bicarbonate		mg/L	1	NGA	16	15	1	<1.0	1.7	1.7	1.7	0
Hardness as CaCO3 (Measured)		mg/L	0.5	NGA	15	0	15	2.19	2.19	3.29	3.29	0
Ammonia as N		mg/L	0.005	83.9 [a]	16	11	5	<0.0050	0.005	0.0126	0.0126	0
Total Organic Carbon (TOC)		mg/L	0.5	NGA	16	0	16	3.5	3.5	10.3	10.3	0
Ortho Phosphate as P (filtered)		mg/L	0.001	NGA	16	0	16	0.0013	0.0013	0.0064	0.0064	0
Phosphorus		mg/L	0.05	NGA	16	16	0	<0.050	-	<0.050	-	0
Phosphorus (filtered)		mg/L		NGA	16	10	6	<0.050	-	0	-	0
Fluoride		mg/L	0.02	0.12 [a]	16	12	4	<0.020	0.02	0.022	0.022	0
Chloride (filtered)		mg/L	0.5	120 [a]	16	0	16	4.35	4.35	4.64	4.64	0
Electrical Conductivity (Lab)		µS/cm	1	NGA	16	0	16	24.9	24.9	28.4	28.4	0
Hydroxide		mg/L	1	NGA	16	16	0	<1.0	-	<1.0	-	0
Nitrate (as N)		mg/L	0.02	13 [a,b]	16	14	2	<0.020	0.028	0.042	0.042	0
Nitrite (as N)		mg/L	0.01	0.06 [a]	16	16	0	<0.010	-	<0.010	-	0
Nitrite + Nitrate as N		mg/L	0.0224	NGA	16	14	2	<0.0224	0.028	0.042	0.042	0
pH (Lab)		pH Units	0.1	6.5 to 9 [a]	16	0	16	5.18	5.18	5.98	5.98	18
Sulphate (filtered)		mg/L	0.3	128 [c]	16	0	16	1.57	1.57	2.38	2.38	0
Total Dissolved Solids (TDS) - Measured		mg/L	10	NGA	16	0	16	22	22	36	36	0
Turbidity		NTU	0.1	NGA	16	0	16	0.16	0.16	1.67	1.67	0

Notes

Shaded cells denote an exceedance above the ap

NGA = no guideline available; RDL = reportable detection limit; FD = field duplicate

Where applicable, guidelines taken from Nova Scotia Tier II Pathway-Specific Standards (PSS) for Surface Water and Groundwater Discharging to Surface Water - Freshwater (Including Groundwater < 10 m from Surface Water Body), Table 5. Where the original source has been updated more recently than the Nova Scotia PSS, the original source was consulted to confirm up to date guidelines and adjusted where required. The original source is indicated below.

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Appendix D

Bioavailability Data

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ANALYSIS REPORT COVER NOTE

Report Number: RMC-AR-ESG-0029
Report Date: 24 July 2024
Sample(s) reported: 11
Issue Status: Final
Analysis commenced on: 5 June 2024

The following data are reported in this report: total concentrations (Soil conc) of arsenic (As); extracted bioaccessible concentrations (BA conc) of As; and percent bioaccessibility (%BA) of As.

Methods

All samples were received in good condition. All samples were oven dried at 40°C and sieved (<150 µm) prior to analysis.

To obtain the bioaccessible element content for the human receptor exposed to soil, the United States Environmental Protection Agency (U.S. EPA) OLEM 9200.2-164 (April 2017, updated July 2017) method (U.S. EPA 2017a) was employed. Each dried and sieved sample was extracted in 100 mL extraction vessels with a 0.4 M glycine solution adjusted to pH 1.5 in a liquid-to-(dry) solid ratio of 100:1. The extraction was carried out with end-over-end mixing at body temperature (37°C) for 1 hour.

All extracts were analyzed for As concentrations by ICP-MS, and total concentrations of As in soil samples were obtained by aqua regia digestion and analysis using ICP-OES. Sieving and extraction were carried out in the ESG laboratory. Analysis of extracts and soils was carried out at the Analytical Services Unit (ASU) at Queen's University, a laboratory accredited by the Canadian Association for Laboratory Accreditation (CALA). The methods used for analysis (metals in solids by ICP-OES and metals in water by ICP-MS) are listed on ASU's scope of accreditation.

To convert extraction concentrations (from mg/L) to % bioaccessibility, the following equation was used, as provided in U.S. EPA 2017a and Health Canada 2017:

$$\%\ \text{Bioaccessibility} = \frac{\text{C}_{ext}\ (\text{mg/L}) \times V_{ext}\ (\text{L})}{Soil\ mass\ (\text{kg}) \times Total\ concentration\ (\text{mg/kg})} \times 100\%$$

$$= \frac{Bioaccessible\ concentration\ (\text{mg/kg})}{Total\ concentration\ (\text{mg/kg})} \times 100\%$$

Where:
% Bioaccessibility = %BA
C_{ext} = concentration in extract (mg/L)
V_{ext} = volume of extract (mL)
Soil mass = mass of soil used in extraction (g)
Note: the extract volume is 100 mL (0.1 L) and the soil is approximately 1 g (0.001 kg), so V_{ext}/soil mass ≈ 100
Bioaccessible concentration = BA conc
Total concentration = Soil conc

A sample calculation is shown for BH DUP:

$$\%\ \text{Bioaccessibility} = \frac{0.212\ \text{mg/L} \times 0.100\ \text{L}}{0.0010853\ \text{kg} \times Total\ concentration\ (\text{mg/kg})} \times 100$$

$$= \frac{20\ (\text{mg/kg})}{470\ (\text{mg/kg})} \times 100$$

$$= 4.2\%$$

Quality Assurance and Quality Control

Quality control samples (two standard reference materials, laboratory control sample, matrix spike, duplicate, method blank, and reagent blank) were included for each batch of 10 samples during the extraction of the soil samples.

The bioaccessibilities of two standard reference materials, NIST 2710 and NIST 2710a, were measured at the same time as the samples for each batch. NIST 2710a is recommended as a standard reference material when measuring As bioaccessibility (U.S. EPA 2017a), but occasionally the results for this material are lower than acceptance limits prescribed in U.S. EPA 2017a; therefore ESG includes a second standard reference material (NIST 2710). ESG has established acceptance limits for As in this material, and its inclusion in the analysis helps to ensure that the extraction is in control.

The acceptance limits for As in NIST 2710 were calculated from more than 15 years of data obtained in the ESG laboratory using the U.S. EPA In-Vitro Bioaccessibility (IVBA) method. An average of 38.3% and standard deviation of 10.8% were obtained from 64 results. Acceptance limits were derived in the same way as in U.S. EPA OLEM 9200.2-164 (2017a), by calculating the 99 percentile prediction interval around the mean:

$$\overline{Y} \pm t\sqrt{s^2\left(1+\frac{1}{n}\right)}$$

where Y is the mean value and the acceptance limits are defined by the term following it;
t = student's t for the degrees of freedom (DF = n-1 = 63);

s = standard deviation; and
n = 64 in the present case.

The acceptance limits interval was thus computed as: $1.998 \times \sqrt{(10.8)^2} \times (1+1/64) = 21.8$, giving an acceptance range of 17 to 60% bioaccessibility.

The As result for the NIST 2710 sample (50%) was within the acceptance range.

For comparison, only one literature report for IVBA bioaccessibility of As in NIST 2710 could be found: 55% with a SD of 4.1, n = 3 (Bradham et al. 2011). (Brattin et al. 2013 reported the same value but it is not clear whether it was the same measurement, and they did not report standard deviation and n). The value of n is too small in this case to use these data to compute a prediction interval.

NIST 2710a control limits for As bioaccessibility are specified in U.S. EPA 2017a. The percent bioaccessibility measured (29%) was outside the specified range (33–49%) but it was inside the CCME guidance acceptance limit of within 30% (CCME 2016) of the mean value (28.7–53.3% bioaccessibility). On the basis of these results and acceptable results found for NIST 2710, the CRM results overall were considered acceptable.

Two types of fortified samples were included in the analysis, following the prescribed U.S. EPA OLEM 9200.2-164 QC/QC procedures: a laboratory control sample (LCS) and a matrix or sample spike (MS). The LCS sample contained As in the extraction fluid (at a concentration of 10 mg/L) and was taken through the entire extraction procedure. The MS sample contained As (10 mg/L) and was prepared in a soil extract sample prior to analysis.

Results (92% for LCS, and 91% for the matrix spike) were within the ranges prescribed for As in the method (85–115% for LCS, and 75–125% for the matrix spike) (U.S. EPA 2017a), and were considered acceptable.

The method and reagent blank results were lower than the reporting limits specified in U.S. EPA 2017a. Precision from the analytical duplicate was deemed acceptable, with relative percent difference (RPD) of 1.4%.

The QC results were reviewed for ASU reports and the results for duplicates, blanks, and water and soil controls were all considered acceptable (CCME 2016).

Data Interpretation and Limitations

The samples were sieved to obtain the <150 µm fraction of soil, according to guidance from U.S. EPA (2016, 2017a) and Health Canada (2017). The total elemental content in this size fraction may be higher than concentrations in the size fraction typically analyzed in bulk (e.g., <2 mm) soil (U.S. EPA 2016 and references therein).

An equation relating As bioaccessibility results with relative bioavailability (RBA) results is provided in U.S. EPA OLEM 9200.2-164 (U.S. EPA 2017a) and is recommended by Health Canada (2017):

As: $RBA_{arsenic} = (0.79 \times IVBA) + 0.03$ ($R^2 = 0.87$)

Where:
$RBA_{arsenic}$ = relative bioavailability (expressed as a fraction)
IVBA = in vitro bioaccessibility (converted to a fraction, by dividing %BA in this report by 100)

Validation of the presently used bioaccessibility method and measurements with RBA measurements from animal studies have been carried out for As (U.S. EPA 2017b). For As, U.S. EPA (2017b) provides assay limitations, and one of them is the uncertainty associated with the use of the above equation for concentrations outside the concentration range used to establish the equation. For As, this concentration range is 40–13,000 mg/kg (total As in soil) (U.S. EPA 2017b). Only one sample (BH121) has an average concentration just under this range; thus its estimated RBA values might be subject to uncertainty.

Because of limitations with the current software used for reporting data, the number of significant figures quoted in the attached table may not be representative of the actual uncertainty. Data should be considered accurate to no more than two significant figures. This report is issued under final status.

The results given relate only to the items tested.

Report authorised by:



Iris Koch, Senior Analytical and Arsenic Research Manager, ESG



Taylor Vereecken, ESG Laboratory Technician

Date: 24 July 2024

References

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U.S. EPA 2017b. OLEM 9355.4-29 April 20, 2017. Validation Assessment of In Vitro Arsenic Bioaccessibility Assay for Predicting Relative Bioavailability of Arsenic in Soils and Soil-like Materials at Superfund Sites.

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Site/Client:	Dillon	**# Samples:**	11
Analyst:	Taylor Vereecken	**Reference Reports:**	
Extraction Date:	11-06-2024		ASU 18531 As GFE Extract-1
Method:	U.S. EPA IVBA OLEM 9200.2-164		ASU 18531 As GFE Extract-2
Ratio:	100:1		ASU 18531 Arsenic in Soil-1

RESULTS

Concentrations are in mg/kg, unless otherwise noted

BA conc = concentration of bioaccessible element in soil; Soil conc = concentration of total element (by acid digestion-ICPOES)

%BA = % bioaccessibility = 100 x bioaccessible element (BA conc)/total element (Soil conc)

e.g., for As in BH DUP: 100 x 20 mg/kg /470 mg/kg dw = 4.2%

CLIENT SAMPLE ID	ESG SAMPLE ID	BA conc (mg/kg)	Soil conc (mg/kg)	%BA
		As	As	As
BH DUP L 0-0.015m	BH DUP	20	470	4.2
BH DUP L 0-0.015m	BH DUP-Duplicate	19	470	4.1
BH117 0-0.015m	BH117	389	1300	30
BH118 0-0.015m	BH118	29	760	3.8
BH119 0-0.015m	BH119	67	1300	5.2
BH120 0-0.015m	BH120	676	1800	38
BH121 0-0.015m	BH121	12	33	37
BH122 0-0.015m	BH122	54	91	59
BH123 0-0.015m	BH123	549	1500	37
BH124 0-0.015m	BH124	90	310	29
BH125 0-0.015m	BH125*	19	430	4.4
BH126 0-0.015m	BH126†	228	1200	19

* "BA conc" is calculated from average extract concentration of analytical duplicates
(from Report "ASU 18531 As GFE Extract-1"); see Extract Analysis QAQC - ASU table below.

† "Soil conc" is average of analytical duplicates (from Report "ASU 18531 Arsenic in Soil-1"); see Soil Analysis QAQC - ASU table below.

Bioaccessibility Extraction QA/QC

	As
BLANK	
Method Blank (mg/L)*	<0.005
Reagent Blank (mg/L)*	<0.005
Blank EPA reporting limits (mg/L)^	0.05, 0.025
CONTROL SAMPLES	**%BA**
NIST 2710A	29
NIST 2710A EPA limits	33 - 49
NIST 2710A CCME limits	29 - 53
NIST 2710	50
NIST 2710 limits	17 - 60
SPIKES	**% Recovery**
LCS	92
BH DUP-duplicate-spike	91
DUPLICATES	**%RPD**
BH DUP	1.4

^Reporting limits are 0.05 mg/L in method blank extract and 0.025 mg/L in reagent blank extract

* "BA conc" is calculated from average extract concentration of analytical duplicates
(from Report "ASU 18531 As GFE Extract-1" and "ASU 18531 As GFE Extract-2");
see Extract Analysis QAQC - ASU table below.

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Extract Analysis QAQC - ASU

Report number ASU 18531 As GFE Extract-1

Sample	**As**
Blank (mg/L)	<0.005
Blank (mg/L)	<0.005
ACCEPTABLE?	OK
Control 1 Reported (mg/L)	0.025
Control 1 Reported (mg/L)	0.027
Control 1 Target (mg/L)	0.025
EU-H CRM (mg/L)	0.78
EU-H CRM (mg/L)	0.65
EU-H Target (mg/L)	0.69
Reference sample (mg/L)	0.049
Reference sample target (mg/L)	0.05
% Recovery	
Control 1 Reported	100
Control 1 Reported	108
EU-H CRM	113
EU-H CRM	94
Reference sample	98
Range % recovery	94 - 113
ACCEPTABLE?	OK
BH125 0-0.015m	0.204
BH125 0-0.015m Duplicate (Analytical)	0.178
AVERAGE	0.191
RPD (%)	14
ACCEPTABLE?	OK
Matrix Blank	<0.005
Matrix Blank Duplicate (Analytical)	<0.005
AVERAGE	<0.005
RPD (%)	both nd

Report number ASU 18531 As GFE Extract-2

Sample	**As**
Blank (mg/L)	<0.005
Blank (mg/L)	<0.005
ACCEPTABLE?	OK
Control 1 Reported (mg/L)	0.025
Control 1 Target (mg/L)	0.025
EU-H CRM (mg/L)	0.67
EU-H Target (mg/L)	0.69
% Recovery	
Control 1 Reported	100
EU-H CRM	97
Range % recovery	97 - 100
ACCEPTABLE?	OK
Reagent Blank	<0.005
Reagent Blank (Analytical) Duplicate	<0.005
AVERAGE	<0.005
RPD (%)	both nd
ACCEPTABLE?	OK

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Soil Analysis QAQC - ASU

Report number ASU 18531 Arsenic in Soil-1

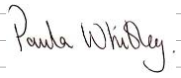
Sample	**As**
Blank (mg/kg)	<1.0
ACCEPTABLE?	OK
Control 1 (µg/mL)	4.1
Control 1 Target (ug/mL)	4.0
% Recovery of control	103
ACCEPTABLE?	OK
MESS-4 CRM	16
Target MESS-4 CRM	18
Certified MESS-4 CRM	21.7
% Recovery - Target	89
% Recovery - Certified	74
ACCEPTABLE?	n/a
BH126 0-0.015m	1300
BH126 0-0.015m Duplicate	1100
AVERAGE	1200
RPD (%)	17
ACCEPTABLE?	OK

Analytical Services Unit
School of Environmental Studies
Biosciences Complex, Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel: 613 533-2642 Fax: 613 533-2897

ASU #	18531		**Report ID:**	ASU 18531 Arsenic in Soil-1	
Client:	Dr Iris Koch		**Date Submitted:**	14-Jun-24	
	RMC, Kingston		**Date Testing Initiated:**	24-Jun-24	
ESG No:	24-029		**Date:**	26-Jun-24	
Technique:	ICP-OES		**Matrix:**	Soil	
Report of Analysis. Arsenic in Soil by ICP-OES; all results in ug/g (unless otherwise noted)					
Results relate only to the items tested					
Sample	**3 DUP L 0-0.015m**	**BH117 0-0.015m**	**BH118 0-0.015m**	**BH119 0-0.015m**	**BH120 0-0.015m**
As	470	1300	760	1300	1800
Sample	**BH121 0-0.015m**	**BH122 0-0.015m**	**BH123 0-0.015m**	**BH124 0-0.015m**	**BH125 0-0.015m**
As	33	91	1500	310	430
Sample	**BH126 0-0.015m**	**BH126 0-0.015m Duplicate**			
As	1300	1100			
Laboratory QA/QC					
Sample	**Control (mg/L)**	**Control Target (mg/L)**	**Blank**	**MESS-4**	**MESS-4 CRM Target**
As	4.121 (103.0%)	4.0	<1.0	16	18
Prepared by:			Authorization:		
MESS-4 (certified reference material) result was within the acceptable lab control limit					

Queen's University
PREPARING LEADERS AND CITIZENS FOR A GLOBAL SOCIETY

Analytical Services Unit
School of Environmental Studies
Biosciences Complex, Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel: 613 533-2642 Fax: 613 533-2897

ASU #	18531		Report ID:	ASU 18531 As GFE Extract-1
Client:	ESG		Date Submitted:	14-Jun-24
	24-029		Date Tested:	27-Jun-24
	Bioaccessibility		Date:	09-Jul-24
Technique:	ICP-MS		Matrix:	Extracts
Report of Analysis of Extracts: all results in ug/ml				
Results relate only to the items tested				
	3 DUP L 0-0.015m	**BH117 0-0.015m**	**BH118 0-0.015m**	**BH119 0-0.015m**
Arsenic	0.212	4.20	0.290	0.711
	BH120 0-0.015m	**BH121 0-0.015m**	**BH122 0-0.015m**	**BH123 0-0.015m**
Arsenic	6.85	0.128	0.548	5.59
	BH124 0-0.015m	**BH125 0-0.015m**	**BH125 0-0.015m Duplicate (Analytical)**	**BH126 0-0.015m**
Arsenic	0.942	0.204	0.178	2.3
	3 DUP L 0-0.015m DUP	**Matrix Blank**	**Matrix Blank Duplicate (Analytical)**	**NIST 2710A**
Arsenic	0.209	<0.005	<0.005	4.13
	NIST 2710	**NIST 2711**	**LCS**	**-3 DUP L 0-0.015m -Spike**
Arsenic	3.13	0.561	9.44	10.8
Laboratory QA/QC				
	Blank	**Reporting Limit**		
Arsenic	<0.005; <0.005	<0.005		
	Control 1	**Control 1 Target**	**EU-H CRM**	**EU-H CRM Target**
Arsenic	0.025; 0.027	0.025	0.78; 0.65	0.69
Additional QAQC				
	Reference Sample	**Reference Sample Target**		
Arsenic	0.049	0.050		
Scandium, Indium and Bismith were used as internal standards. Gas dilution (HMI) used: N.				
All extracts were diluted a minimum x 10 prior to analysis				
Prepared by:			Authorized by:	

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Analytical Services Unit
School of Environmental Studies
Biosciences Complex, Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel: 613 533-2642 Fax: 613 533-2897

ASU #	18531		Report ID:	ASU 18531 As GFE Extract-2
Client:	ESG		Date Submitted:	14-Jun-24
	24-029		Date Tested:	23-Jul-24
	Bioaccessibility		Date:	24-Jul-24
Technique:	ICP-MS		Matrix:	Extracts
Report of Analysis of Extracts: all results in ug/ml				
Results relate only to the items tested				
	Reagent Blank	**Reagent Blank (Analytical) Duplicate**		
Arsenic	<0.005	<0.005		
Laboratory QA/QC				
	Blank	**Reporting Limit**		
Arsenic	<0.005; <0.005	<0.005		
	Control 1	**Control 1 Target**	**EU-H CRM**	**EU-H CRM Target**
Arsenic	0.025	0.025	0.67	0.69
Scandium, Indium and Bismith were used as internal standards. Gas dilution (HMI) used: N.				
All extracts were diluted a minimum x 10 prior to analysis				
Prepared by:			Authorized by:	

Queen's UNIVERSITY | PREPARING LEADERS AND CITIZENS FOR A GLOBAL SOCIETY

ASU 18531

CHAIN OF CUSTODY/ ANALYTICAL REQUEST FORM

Project ID:	Bioaccessibility (ASU)		
Request #:	24-029	Due Date:	
Requested By:	Iris Koch		
Sampled by:	Taylor Vereecken	Date:	
Received by:		Date:	
Relinquished by:	P. Whalley	Date:	14 June
Received at lab by:		Date:	

Analysis Request

Page 1 of 1

Sample Number	Date	Time	Matrix	Container	30 element total	As Analysis	Analysis	Analysis	Analysis	Comments	Cooler ID
3 DUP L 0-0.015m NO1	11-Jun-24		Water	15mL C-tube		X					
BH117 0-0.015m NO2	11-Jun-24		Water	15mL C-tube		X					
BH118 0-0.015m NO3	11-Jun-24		Water	15mL C-tube		X					
BH119 0-0.015m NO4	11-Jun-24		Water	15mL C-tube		X					
BH120 0-0.015m NO5	11-Jun-24		Water	15mL C-tube		X					
BH121 0-0.015m NO6	11-Jun-24		Water	15mL C-tube		X					
BH122 0-0.015m NO7	11-Jun-24		Water	15mL C-tube		X					
BH123 0-0.015m NO8	11-Jun-24		Water	15mL C-tube		X					
BH124 0-0.015m NO9	11-Jun-24		Water	15mL C-tube		X					
BH125 0-0.015m NO10 rush 6pm	11-Jun-24		Water	15mL C-tube		X					
BH126 0-0.015m NO11	11-Jun-24		Water	15mL C-tube		X					
3 DUP L 0-0.015m DUP NO12	11-Jun-24		Water	15mL C-tube		X					
Matrix Blank NO13	11-Jun-24		Water	15mL C-tube		X					
NIST 2710A NO14	11-Jun-24		Water	15mL C-tube		X					
NIST 2710 NO15	11-Jun-24		Water	15mL C-tube		X					
NIST 2711 NO16	11-Jun-24		Water	15mL C-tube		X					
LCS NO17	11-Jun-24		Water	15mL C-tube		X					
-3 DUP L 0-0.015m DUP Spike NO18	11-Jun-24		Water	15mL C-tube		X					
3 DUP L 0-0.015m NO. error.	11-Jun-24		Soil	15mL C-tube		X					
BH117 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH118 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH119 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH120 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH121 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH122 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH123 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH124 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH125 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					
BH126 0-0.015m	11-Jun-24		Soil	15mL C-tube		X					

ENVIRONMENTAL SCIENCES GROUP

CHAIN OF CUSTODY / REQUEST FORM

Client Contact:	Nadine Wambolt	Client email: nwambolt@dillon.ca	Ship to: Mike DeArruda/Iris Koch Environmental Sciences Group Royal Military College R62 -12 Verite Ave P.O. Box 17000 Station Forces Kingston, ON K7K 7B4 Phone: 343-422-7650
ESG Contact:	Mike DeArruda mike.dearruda@rmc.ca	Iris Koch: koch-i@rmc.ca	
Cooler Identification:			
Project ID:	24E-002 236465-6000		
Prepared By:	**Jason Marsh**		
Signature/Date:		2024/_05_/_27_ (yyyymmdd)	
Relinquished By:			
Signature/Date:		2024/__/__ (yyyymmdd)	
Received By (Print Name):			
Signature/Date:		**2024/__/__ (yyyymmdd)**	

IN	Client ID	Storage Medium	Sample Matrix	Date Collected	Time Collected	Comments	ESG Comments	*Bioaccessibility (As)*	*Total As*	*Other (specify)*	*Other (specify)*	*Other (specify)*
	BH117 0-0.015m		Soil	23/05/2024				X	X			
	BH118 0-0.015m		Soil	23/05/2024				X	X			
	BH119 0-0.015m		Soil	23/05/2024				X	X			
	BH120 0-0.015m		Soil	23/05/2024				X	X			
	BH121 0-0.015m		Soil	23/05/2024				X	X			
	BH122 0-0.015m		Soil	23/05/2024				X	X			
	BH123 0-0.015m		Soil	25/05/2024				X	X			
	BH124 0-0.015m		Soil	25/05/2024				X	X			
	BH125 0-0.015m		Soil	25/05/2024				X	X			
	BH126 0-0.015m		Soil	25/05/2024				X	X			
	BH DUP L 0-0.015m		Soil	25/05/2024				X	X			
	Add rows as needed											

Notes: Other elements, sample issues, etc.

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Site/Client:	Dillon	# Samples: 11
Analyst:	Taylor Vereecken	Reference Reports:
Extraction Date:	11-06-2024	ASU 18531 As GFE Extract-1
Method:	U.S. EPA IVBA OLEM 9200.2-164	ASU 18531 As GFE Extract-2
Ratio:	100:1	ASU 18531 Arsenic in Soil-1

RESULTS

Concentrations are in mg/kg, unless otherwise noted
BA conc = concentration of bioaccessible element in soil; Soil conc = concentration of total element (by acid digestion-ICPOES)
%BA = % bioaccessibility = 100 x bioaccessible element (BA conc)/total element (Soil conc)
e.g., for As in BH DUP: 100 x 20 mg/kg /470 mg/kg dw = 4.2%

CLIENT SAMPLE ID	ESG SAMPLE ID	BA conc (mg/kg)	Soil conc (mg/kg)	%BA
		As	As	As
BH DUP L 0-0.015m	BH DUP	20	470	4.2
BH DUP L 0-0.015m	BH DUP-Duplicate	19	470	4.1
BH117 0-0.015m	BH117	389	1300	30
BH118 0-0.015m	BH118	29	760	3.8
BH119 0-0.015m	BH119	67	1300	5.2
BH120 0-0.015m	BH120	676	1800	38
BH121 0-0.015m	BH121	12	33	37
BH122 0-0.015m	BH122	54	91	59
BH123 0-0.015m	BH123	549	1500	37
BH124 0-0.015m	BH124	90	310	29
BH125 0-0.015m	BH125*	19	430	4.4
BH126 0-0.015m	BH126†	228	1200	19

* "BA conc" is calculated from average extract concentration of analytical duplicates
(from Report "ASU 18531 As GFE Extract-1"); see Extract Analysis QAQC - ASU table below.
† "Soil conc" is average of analytical duplicates (from Report "ASU 18531 Arsenic in Soil-1"); see Soil Analysis QAQC - ASU table below.

Bioaccessibility Extraction QA/QC

	As
BLANK	
Method Blank (mg/L)*	<0.005
Reagent Blank (mg/L)*	<0.005
Blank EPA reporting limits (mg/L)^	0.05, 0.025
CONTROL SAMPLES	%BA
NIST 2710A	29
NIST 2710A EPA limits	33 - 49
NIST 2710A CCME limits	29 - 53
NIST 2710	50
NIST 2710 limits	17 - 60
SPIKES	% Recovery
LCS	92
BH DUP-duplicate-spike	91
DUPLICATES	%RPD
BH DUP	1.4

^Reporting limits are 0.05 mg/L in method blank extract and 0.025 mg/L in reagent blank extract
* "BA conc" is calculated from average extract concentration of analytical duplicates
(from Report "ASU 18531 As GFE Extract-1" and "ASU 18531 As GFE Extract-2");
see Extract Analysis QAQC - ASU table below.

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Extract Analysis QAQC - ASU

Report number	ASU 18531 As GFE Extract-1
Sample	As
Blank (mg/L)	<0.005
Blank (mg/L)	<0.005
ACCEPTABLE?	OK
Control 1 Reported (mg/L)	0.025
Control 1 Reported (mg/L)	0.027
Control 1 Target (mg/L)	0.025
EU-H CRM (mg/L)	0.78
EU-H CRM (mg/L)	0.65
EU-H Target (mg/L)	0.69
Reference sample (mg/L)	0.049
Reference sample target (mg/L)	0.05
% Recovery	
Control 1 Reported	100
Control 1 Reported	108
EU-H CRM	113
EU-H CRM	94
Reference sample	98
Range % recovery	94 - 113
ACCEPTABLE?	OK
BH125 0-0.015m	0.204
BH125 0-0.015m Duplicate (Analytical)	0.178
AVERAGE	0.191
RPD (%)	14
ACCEPTABLE?	OK
Matrix Blank	<0.005
Matrix Blank Duplicate (Analytical)	<0.005
AVERAGE	<0.005
RPD (%)	both nd

Report number	ASU 18531 As GFE Extract-2
Sample	As
Blank (mg/L)	<0.005
Blank (mg/L)	<0.005
ACCEPTABLE?	OK
Control 1 Reported (mg/L)	0.025
Control 1 Target (mg/L)	0.025
EU-H CRM (mg/L)	0.67
EU-H Target (mg/L)	0.69
% Recovery	
Control 1 Reported	100
EU-H CRM	97
Range % recovery	97 - 100
ACCEPTABLE?	OK
Reagent Blank	<0.005
Reagent Blank (Analytical) Duplicate	<0.005
AVERAGE	<0.005
RPD (%)	both nd
ACCEPTABLE?	OK

ESG Bioaccessibility Report - RMC-AR-ESG-0029 - FINAL

Soil Analysis QAQC - ASU

Report number	ASU 18531 Arsenic in Soil-1
Sample	As
Blank (mg/kg)	<1.0
ACCEPTABLE?	OK
Control 1 (µg/mL)	4.1
Control 1 Target (ug/mL)	4.0
% Recovery of control	103
ACCEPTABLE?	OK
MESS-4 CRM	16
Target MESS-4 CRM	18
Certified MESS-4 CRM	21.7
% Recovery - Target	89
% Recovery - Certified	74
ACCEPTABLE?	n/a
BH126 0-0.015m	1300
BH126 0-0.015m Duplicate	1100
AVERAGE	1200
RPD (%)	17
ACCEPTABLE?	OK

Appendix E

Aquatic Habitat Assessment (Dillon, 2025b)

DILLON CONSULTING

BUILD NOVA SCOTIA

Former Country Harbour Mine Site

Aquatic Habitat Assessment Final Report



January 2025 – 23-6465

January 9, 2025

Build Nova Scotia (BNS)
PO Box 397, Stn Central
Halifax/Kjipuktuk, Nova Scotia
B3J 2P8

Attention: Mr. Dan Khan, P.Eng.
Project Manager, Mine Site Reclamation

Aquatic Habitat Assessment Report, Former Country Harbour Mine Site, Country Harbour Mines, Nova Scotia

Dillon Consulting Limited (Dillon) is pleased to submit this Aquatic Habitat Assessment for the portion of Johnston Brook that intersects the assessment site. The Aquatic Habitat Assessment will be used to inform the Human Health and Ecological Risk Assessment (HHERA) and will provide useful information to inform the remedial approach to be conducted on Property Identification (PID) Number 35091354 and a portion of PID Number 35094366, located in Country Harbour Mines, Nova Scotia.

Please do not hesitate to contact the undersigned at your convenience should you have any further questions or comments.

Sincerely,

DILLON CONSULTING LIMITED



Kelly Regan, M.Sc.
Associate

KSR:vrt

Our file: 23-6465-6000

DILLON CONSULTING

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Dillon Consulting Limited

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Table 3: Johnston Brook eDNA Analysis Results (June 4, 2024) 9

Appendices

A Site Photos

B Watercourse Assessment Data Sheets

C Laboratory Analytical Certificates

1.0 Introduction

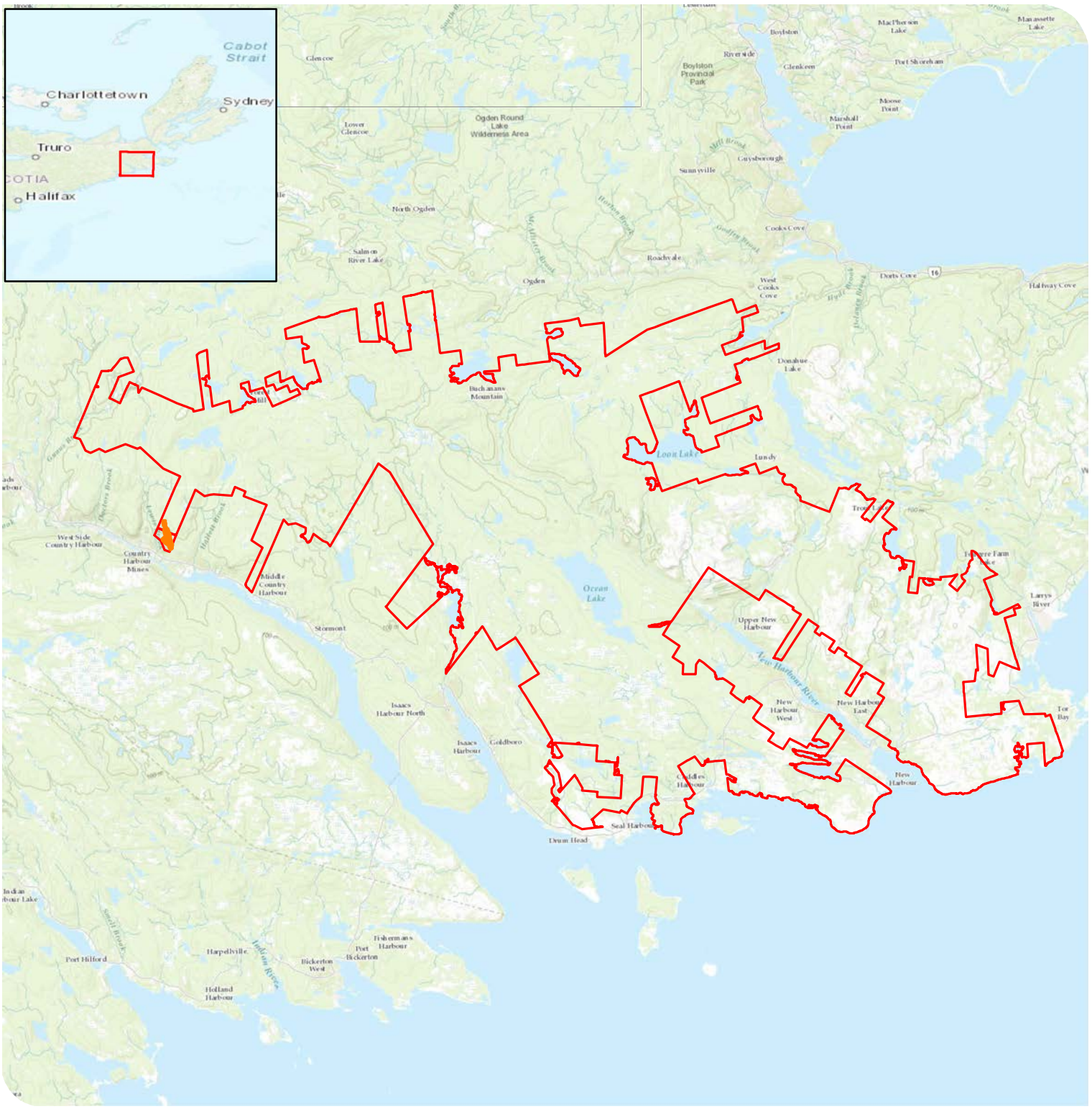
The following document has been prepared to present the findings of an aquatic habitat assessment for the portion of Johnston Brook that intersects the Former Country Harbour Mine Site in Country Harbour Mines, Nova Scotia (NS) (herein referred to as the "site"). The purpose of the survey is to map the portion of the Johnston Brook watercourse that intersects the assessment site, and to collect information to confirm the absence or presence of suitable habitat for fish and other aquatic receptors. The aquatic habitat assessment will be used to inform the Human Health and Ecological Risk Assessment (HHERA) and will provide useful information to inform the remedial approach.

An environmental screening report was completed for the Former Country Harbour Mine Site in 2023, which identified potential environmental constraints that may affect project activities. Watercourses, wetlands, Species at Risk (SAR) and Species of Conservation Concern (SoCC), which may be impacted by project activities, were identified through this screening. The interaction between these features and proposed project components (e.g., tree clearing, drilling) were assessed, and recommended mitigation measures to limit potential impacts to these species and environmental features during the Phase II Environmental Site Assessment (ESA) activities were provided.

1.1 Project Location and Background Information

The Former Country Harbour Mine site is located in Country Harbour Mines, Guysborough County, Nova Scotia. The subject properties (i.e., Property Identification (PID) No.: 35091354 and a portion of 35094366) are owned by the Department of Natural Resources and Renewables (DNRR) and classified as provincial forest. The site is approximately 42 hectares in size with 46 known abandoned mine openings (AMOs) and one reported tailings area, and can be accessed using John Fenton Loop Road off Highway 316. Surrounding land uses are primarily resource, with some residential properties located south of the site (Figure 1).

Known mining operations for gold ore are reported to have occurred at the site between 1862 and 1951; however, the site is no longer in operation. Mine workings were underground and included drifts and stopes, shafts access, and ramp accesses. Ore processing was reportedly completed by way of mercury amalgam. Several stamp mills operated at the site, including the Old Antigonish Mill, the Stuart Mill, and the Robertson Mill. In addition to gold stamp mills, buildings and infrastructure were constructed to support mining operations at the site. These buildings and infrastructure have been removed from the site, although portions of some foundations remain. Fencing, barricades, berms, and warning signs have been installed at the site due to the number of abandoned mine openings. The Primary land use for the site is for commercial forest harvesting and it is also being considered for future wind energy development.



BUILD NOVA SCOTIA

Former Country Harbour Mine Site
Aquatic Habitat Assessment Report

Assessment Area

Subject Parcels

PROJECT LOCATION

FIGURE E1

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY: GeoNova, ESRI, Build NS

MAP CREATED BY: SCM
MAP CHECKED BY: KSR
MAP PROJECTION: NAD 1983 UTM Zone 20N

N W E S

SCALE 1:215,000

0 1.25 2.5 5 Km

PROJECT: 236465
STATUS: FINAL
DATE: 2024-01-09

FILE LOCATION: \\dillon.ca\DILLON_DFS_projects\GIS\2023\236465\product\Client\Aquatic Habitat Assessment\FX-1_ProjectLocation.mxd

2.0 Methods

The aquatic habitat assessment involved the collection of data for the characterization of a portion of Johnston Brook that intersects the Former Country Harbour Mine Site in Country Harbour Mines, Nova Scotia. A Dillon Consulting Limited (Dillon) biologist with experience in aquatic habitat assessment conducted a field assessment on May 22 and 23, 2024 and environmental DNA (eDNA) samples were collected on June 4, 2024.

The brook assessment was broken up into five reaches that were determined during the assessment, either by similar habitat characteristics or by the presence of a barrier to fish passage. There was also an assessment of a background location, located upstream of the Former Mill Site.

A fish presence or absence visual survey was also conducted where potential sutible fish habitat was identified within the portion of Johnston Brook within the site. Representative photos (provided in *Section 3.1*) and global positioning system (GPS) points (using a handheld GPS unit and Arc Geographic Information Systems [ArcGIS] applications) were collected for each reach during the field assessments. The presence and/or the potential presence of fish in each aquatic feature was evaluated based on visual confirmation of fish during field surveys, watercourse characterizations conducted during low and mid-stage flow conditions, and the desktop evaluation for fish species potentially present within the site. The biophysical characteristics of each watercourse were evaluated for fish habitat potential based on the habitat requirements for brook trout (*Salvelinus fontinalis*) and other acid-tolerant fish species with the potential to occur within the watercourses that enter the project area.

Suitable habitat characteristics, along with water quality to support aquatic species and direct observations of fish, were the basis of considerations on the likelihood of the watercourse to support fish habitat. The watercourse reaches were classed with the following descriptors:

- Unlikely to provide suitable fish habitat;
- May provide seasonally accessible fish habitat;
- Likely provides fish habitat; or
- Fish presence confirmed (i.e., fish observed).

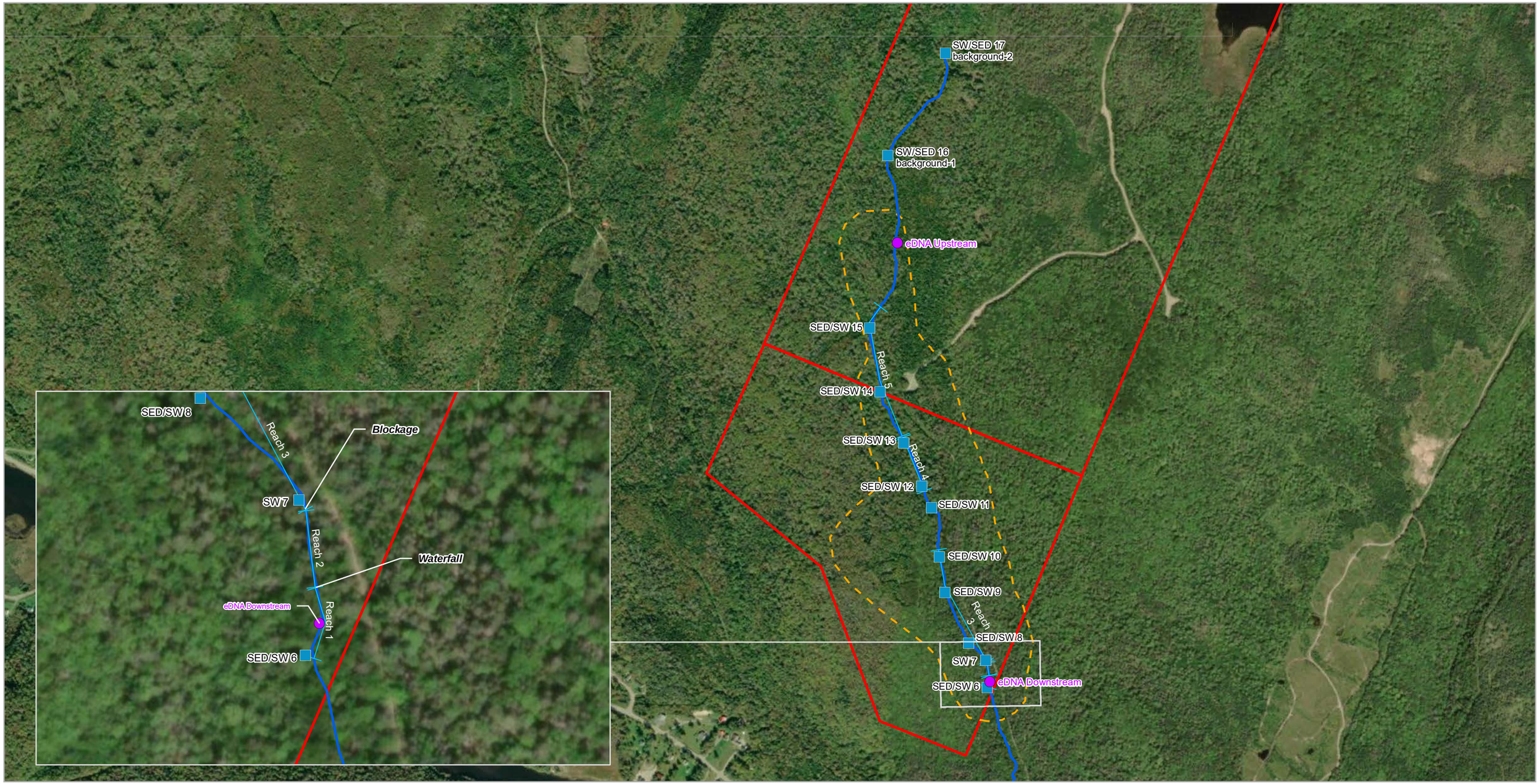
Water quality parameters were measured in-situ using a handheld Horiba water quality meter (e.g., dissolved oxygen [DO], conductivity, water temperature, and pH). The Canadian Council of Ministers of the Environment (CCME) has published guidelines for pH and DO, which were used as indicators of suitability for aquatic life. Watercourses with pH and DO within the recommended range from the CCME for the protection of aquatic wildlife were considered to have a higher likelihood to provide suitable fish habitat. The CCME freshwater aquatic life (FWAL) range for pH is 5.0 - 9.0 and a minimum DO

concentration of 6.5 mg/L is recommended for a watercourse to support cold water biota life stages (excluding early life stages) (CCME, 1999).

eDNA testing is a scientific tool available to augment or replace conventional ecological survey methods for the detection of species of management interest (Hobbs and Goldberg, 2017). Water samples collected are analyzed for genetic material from organisms living in the environment. A species-specific qPCR assay that confirms the detection of target species DNA in the water was undertaken by the contracted laboratory (Bureau Veritas [BV]). Given that the level of eDNA is so low in the environment, BV performs eight replicate tests to reduce error and provide statistical confidence in the assay result. Samples for eDNA were collected at two locations: one upstream and one downstream of the site (Figure 2). The samples were collected on June 4, 2024 and analyzed for the presence of eDNA for five aquatic or semiaquatic species. The species and rationale for their selection are provided in Table 1.

Table 1: **Species Selection for eDNA Analysis**

Species	Rationale
General fish assay	To confirm the presence/absence of fish within Johnston Brook.
Northern leopard frog (*Lithobates (Rana) pipiens*)	A common amphibian species to the region. Their presence indicates the presence of suitable habitat for amphibians.
American eel (*Anguilla rostrata*)	A threatened species under COSEWIC and under consideration for Schedule 1 of the *Species at Risk Act* (SARA). They are found in watercourses connected to the Atlantic Ocean and can tolerate a wide range of temperatures and salinities (DFO, 2016).
Wood turtle (*Glyptemys insculpta*)	A species at risk (SAR). If present, specific mitigation measures and *SARA* Authorization could be required for working within their habitat.
Dreissenid mussels (*Dreissena bugensis, Dreissena polymorpha*)	Invasive freshwater mussels. Not known to be present in the region; however, if present, additional mitigation measures would be required to limit their spread during future remedial activities.



BUILD NOVA SCOTIA
FORMER COUNTRY HARBOUR MINE SITE
AQUATIC HABITAT ASSESSMENT

AQUATIC HABITAT
ASSESSMENT LOCATIONS
FIGURE E2

Build NOVA SCOTIA

- eDNA Sample Location
- Surface Water/Sediment Sample Location
- AquaticHabitatReach
- Watercourse
- Assessment
- Subject Parcels

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: KSR
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres

SCALE 1:8,500

N W E S

PROJECT:23-6465

Date: 2024-08-14

Document Path: \\dillon.ca\DILLON_DFS_projects\GIS\2023\236465\product\Client\Aquatic Habitat Assessment\FX-2_AquaticHabitatAssessmentLocations.mxd

3.0 Results

Observations from the site visits undertaken by Dillon on May 22 and 23, 2024 and June 4, 2024, are summarized below. Representative photographs taken during these site visits are provided in Appendix A.

3.1 Fish and Fish Habitat

Johnston Brook is the main watercourse that flows through the site from northwest to southeast (NS DNRR, 2021). This watercourse has a steep grade and predominantly large substrate. A short waterfall exists at the furthest downstream extent of the watercourse in the site near the southern property line. Another waterfall approximately 500 metres (m) upstream of the southernmost property boundary. Given these characteristics (i.e., an elevation drop at the entry to the properties, generally steep grade, and intermittent nature), the section of Johnston Brook within the site was initially thought not to provide suitable habitat for aquatic species (i.e., Atlantic salmon, Eastern pearlshell) to complete their life cycles. Dillon staff noted that the section of Johnston Brook between Reach 3 and Reach 4 flowed underground. Surface water dried up or flowed underground beginning just past where sample SW12 was taken and did not return to the surface until just before sample location SW10. No fish were observed during these site visits.

Johnston Brook is located in the Country Harbour watershed. It receives water from the surrounding steep rocky hills and eventually drains into Country Harbour via the Country Harbour River. In general, the characteristics of Johnston Brook within the site include mainly riffles and runs with waterfalls and cascades in areas of steeper terrain, as well as a few pools. The substrate is primarily gravel and cobble throughout the watercourse. Most of the brook is shaded and the main sources of cover are from surrounding mature mixed wood forest, undercut banks, and woody debris. Based on evidence of washed-out sediment and large debris, as well as the surrounding topography, the brook is assumed to be influenced by variable flow conditions and flash flood conditions at times.

A summary of physical habitat characteristics by reach is provided in Table 2. The locations of the assessment reaches are identified on Figure 2 and discussed below. The water quality assessment included the collection of parameters with a hand-held Horiba multimeter. More details regarding the habitat assessment data can be found in Appendix B.

Table 2: **Physical Habitat Characteristics** and In-Situ Water Quality Results from Johnston Brook

Parameter	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5
Wetted Width (m)	2.5	2.6	2.5	1.83	2.5
Bankfull Width (m)	4.75	3.7	4.75	2.83	4.75
Wetted Depth (m)	0.16	0.16	0.16	0.18	0.16
Substrate	Gravel (30%) Cobbles (50%) Boulder (20%)	Gravel (15%) Cobbles (75%) Boulder (10%)	Gravel (15%) Cobbles (50%) Boulder (35%)	Gravel (20%) Cobbles (60%) Boulder (10%) Organics (10%)	Gravel (20%) Cobbles (40%) Boulder (25%) Organics (20%)
Water Temperature (°C)	9.13	8.97	7.74	10.96	12.5
Dissolved Oxygen (mg/L)	12.57	13.18	10.9	11.77	13.16
Conductivity (µS/cm)	29	27	28	28	27
pH	4.2	4.07	4.04	3.86	4.7
Suitability for Fish Habitat	Overall: Likely provides **fi**sh habitat. Poor spawning and over wintering habitat due to the absence of deep pools and loose gravel. Moderate habitat for rearing and foraging.	Overall: May provide seasonally accessible **fi**sh habitat. Poor spawning, rearing and over wintering habitat due to the absence of deep pool, loose gravel and limited habitat diversity or cover.	Overall: Likely provides **fi**sh habitat. Poor spawning and over wintering habitat due to the absence of deep pools and loose gravel. Moderate habitat for rearing due to the presence of small pools and available cover.	Overall: Likely provides fish habitat. Poor spawning and over wintering habitat due to the absence of deep pools and loose gravel. Moderate habitat for rearing, due to plentiful small pools, high habitat diversity and cover.	Overall: Likely provides fish habitat. Poor spawning and over wintering habitat due to the absence of deep pools and loose gravel. Moderate habitat for rearing due to plentiful small pools, high habitat diversity and cover.
Assessment Date	22-May-24	22-May-24	22-May-24	22-May-24	22-May-24

3.2 eDNA

Water samples for eDNA analysis of five targeted taxa groups were collected on June 4, 2024. The locations where eDNA samples were collected are shown on Figure 2 and laboratory certificates of analysis are provided in Appendix C.

Mussels, wood turtle, and northern leopard frog were not detected in the Johnston Brook eDNA samples. Fish eDNA was detected in 100% of the technical replicate results from the downstream samples and in only one out of eight replicate samples (i.e., 12.5 %) at the upstream sample location. A low detection of fish eDNA indicates that a combination of barriers to fish passage (i.e., debris and waterfalls) is limiting fish presence in the upstream reaches; however, it may be possible for some fish to be present at some times there. American eel eDNA was only detected at the downstream location and at a very low detection rate. A summary of the eDNA sampling results for the five selected taxa groups at the upstream and downstream sampling locations within Johnston Brook is provided in Table 3.

Table 3: Johnston Brook eDNA Analysis Results (June 4, 2024)

Species	Positive Detection Rate[1] (%)	
	Downstream	Upstream
General Fish Assay[2]	100	12.5
Northern Leopard Frog (*Lithobates (Rana) pipiens*)	0	0
American Eel (*Anguilla rostrata*)	12.5	0
Wood turtle (*Glyptemys insculpta*)	0	0
Dreissenid Mussels (*Dreissena bugensis, Dreissena polymorpha*)	0	0

Notes:
1. Results are reported as the percentage of positive detections out of a total of eight technical replicates.
2. General fish assay was designed to non-specifically detect the presence of any fish species. Positive detection may include any of 19 species (these are listed in the laboratory certificate).

3.3 Discussion

Overall, Johnston Brook provides suitable fish habitat for common small-bodied fish species that can tolerate acidic water and are capable of maneuvering through some debris and waterfalls. The underground section of flow from Johnston Brook represents a very effective fish barrier and it is unlikely that fish would be capable of crossing it. The eDNA results help to corroborate these observations.

The number of replicates included in the eDNA analysis is done for confidence in the assay result and to reduce error. The level of detection in the upstream sample shows very low confidence that fish species are present, especially when compared against the results of the downstream sample in which all

replicates identified fish eDNA. Based on the results of the general fish eDNA assay and observations in the field, occurrences of fish within the upstream reaches of the Brook are uncommon.

4.0 Closing

This report was prepared by Dillon on behalf of Build Nova Scotia. Dillon has used the degree of care and skill ordinarily exercised under similar circumstances at the time the work was performed by reputable members of the environmental consulting profession practicing in Canada. Dillon assumes no responsibility for conditions which were beyond its scope of work. There is no warranty expressed or implied by Dillon.

The material in the report reflects Dillon's best judgement in light of the information available to Dillon at the time of preparation. Any use which a third party makes of this report, or any reliance on, or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibilities for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

References

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

DFO (Department of Fisheries and Oceans Canada). 2016. The American Eel. Available at: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/365401.pdf Accessed July 2024

Jared Hobbs and Caren Goldberg. Environmental DNA Protocol for Freshwater Aquatic Ecosystems (Version 2.2). Prepared for: BC Ministry of Environment. November 2017

NS DNRR (Nova Scotia Department of Natural Resources and Renewables). 2021. Provincial Landscape Viewer. Available at: https://novascotia.ca/natr/landscape/ Accessed September 2023.

Appendix A

Site Photos

Former Country Harbour Mine Photo Log
23-6465

Reach 1



Photo 1: May 22, 2024 – Upstream towards waterfall (Reach ending).



Photo 2: May 22, 2024 – Downstream towards south project boundary.



Photo 3: May 22, 2024 – Waterfall at upstream end of reach.



Photo 4: May 22, 2024 – Sample substrate within reach.

Former Country Harbour Mine Photo Log
23-6465

Reach 2



Photo 5: May 22, 2024 – Upstream towards blockage (reach ending).



Photo 6: May 22, 2024 – Downstream towards Reach 1.



Photo 7: May 22, 2024 – Sample substrate of reach.



Photo 8: May 22, 2024 – Blockage at upstream end of reach.

Former Country Harbour Mine Photo Log
23-6465

Reach 3



Photo 9: May 22, 2024 – Upstream towards watercourse flowing from underground.



Photo 10: May 22, 2024 – Downstream towards reach 2.



Photo 11: May 22, 2024 – Sample substrate for reach.



Photo 12: May 22, 2024 – Flows from under this pile of rock.

Former Country Harbour Mine Photo Log
23-6465

Reach 4



Photo 13: May 22, 2024 – Upstream towards Reach 5.



Photo 14: May 22, 2024 – Downstream towards reach 3.



Photo 15: May 22, 2024 – Sample substrate for reach.



Photo 16: May 22, 2024 – Blockage at upstream border of reach 4.

Former Country Harbour Mine Photo Log
23-6465

Reach 5



Photo 17: May 23, 2024 – Upstream towards Background samples



Photo 18: May 23, 2024 – Downstream towards reach 4.



Photo 19: May 23, 2024 – Sample site where YSI data was gathered.

Former Country Harbour Mine Photo Log
23-6465

Background



Photo 20: May 23, 2024 – SW16 Upstream.



Photo 21: May 23, 2024 – SW16 Downstream.



Photo 22: May 23, 2024 – Bridge over watercourse DS of sample site.



Photo 23: May 23, 2024 – SW16 sample site with small blockage.

Former Country Harbour Mine Photo Log
23-6465

Background Continued



Photo 24: May 23, 2024 – SW17 upstream.



Photo 25: May 23, 2024 – SW17 downstream.



Photo 26: May 23, 2024 – SW17 Sample site.



Photo 27: May 23, 2024 – Sample riparian habitat

Former Country Harbour Mine Photo Log
23-6465

eDNA downstream (SW19)



Photo 28: June 4, 2024 – Upstream.



Photo 29: June 4, 2024 – Downstream.



Photo 30: June 4, 2024 – Sample site.

Former Country Harbour Mine Photo Log
23-6465

eDNA upstream (SW20)

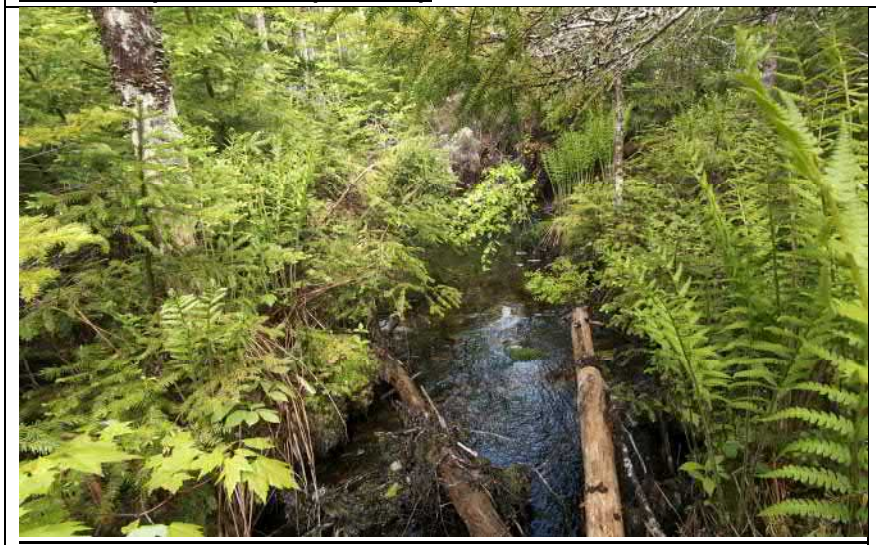


Photo 31: June 4, 2024 – Upstream.



Photo 32: June 4, 2024 – Downstream.



Photo 33: June 4, 2024 – Sample site.

Appendix B

Watercourse Assessment Data Sheets

Aquatic Assessment Data Reach 5

Date and Start Time of Assessment	May 22, 2024 - start: 15:31, end: 15:58
Watercourse/Waterbody	Johnston Brook (Country Harbour, Guysborough County)
Assessor(s)	Tyler Sims
Weather Conditions	23 ° C, 76 to 100 % Cloud Cover, None/Dry, wind – Beaufort Scale 1 - Light Air Movement, smoke drifts
Channel and Instream Habitat Characteristics	
Watercourse Type	Permanent - intermittent
Channel Gradient	1 - 4%
Degree of Embeddedness	Low
Erosion	Low to moderate
Substrate	Gravel (20%) Cobbles (40%) Boulder (25%) Organics (20%)
Average Wetted Width	2.5 m
Average Wetted Depth	0.16 m
Average Bankfull Width	4.75 m
Average Bankfull Depth	0.85 m
Instream Macrophytes	Other vegetation present. Mosses
Algae	None observed.
Habitat Complexity	☑ Woody Debris ☑ Undercut Banks ☑ Overhanging Vegetation ☑ Large Boulders ☐ Other
Potential Critical Habitat	None
Spawning Habitat	Quality: Poor Species and Rationale: Very few areas of loose gravel
Rearing Habitat	Quality: Moderate Species and Rationale: Plenty of small pools and hiding areas
Overwintering Habitat	Quality: Poor Species and Rationale: No deep pools
Overall Habitat	Quality: Moderate Species and Rationale: Good habitat diversity

Aquatic Assessment Data Reach 4

Date and Start Time of Assessment	May 22, 2024 - start: 15:15, end: 15:30
Watercourse/Waterbody	Johnston Brook (Country Harbour, Guysborough County)
Assessor(s)	Tyler Sims
Weather Conditions	23 ° C, 76 to 100 % Cloud Cover, None/Dry, wind – Beaufort Scale 1 - Light Air Movement, smoke drifts
Channel and Instream Habitat Characteristics	
Watercourse Type	Permanent - intermittent
Channel Gradient	1 - 4%
Degree of Embeddedness	Low
Erosion	Low to moderate
Substrate	Gravel (20%) Cobbles (60%) Boulder (10%) Organics (10%)
Average Wetted Width	1.83 m
Average Wetted Depth	0.18 m
Average Bankfull Width	2.83 m
Average Bankfull Depth	0.8 m
Instream Macrophytes	Other vegetation present. Mosses
Algae	None observed.
Habitat Complexity	☑ Woody Debris ☑ Undercut Banks ☑ Overhanging Vegetation ☑ Large Boulders ☐ Other
Potential Critical Habitat	None
Spawning Habitat	Quality: Poor Species and Rationale: Very few areas of loose gravel
Rearing Habitat	Quality: Moderate Species and Rationale: Plenty of small pools and hiding areas
Overwintering Habitat	Quality: Poor Species and Rationale: No deep pools
Overall Habitat	Quality: Moderate Species and Rationale: Good habitat diversity

Aquatic Assessment Data Reach 3

Date and Start Time of Assessment	May 22, 2024 - start: 13:22, end: 13:47
Watercourse/Waterbody	Johnston Brook (Country Harbour, Guysborough County)
Assessor(s)	Tyler Sims
Weather Conditions	21 ° C, 76 to 100 % Cloud Cover, None/Dry, wind – Beaufort Scale 1 - Light Air Movement, smoke drifts
Channel and Instream Habitat Characteristics	
Watercourse Type	Permanent - intermittent
Channel Gradient	1 - 4%
Degree of Embeddedness	Low
Erosion	Low to moderate
Substrate	Gravel (15%) Cobbles (50%) Boulder (35%)
Average Wetted Width	2.4 m
Average Wetted Depth	0.19 m
Average Bankfull Width	4.4 m
Average Bankfull Depth	0.83 m
Instream Macrophytes	Submergent, Other vegetation present. Mosses
Algae	None observed.
Habitat Complexity	☑ Woody Debris ☑ Undercut Banks ☑ Overhanging Vegetation ☑ Large Boulders ☐ Other Deeper pools near downstream limit, not deep enough for overwintering, more sinuous than reach before, more macrophytes
Potential Critical Habitat	None
Spawning Habitat	Quality: Poor Species and Rationale: Very few areas of loose gravel
Rearing Habitat	Quality: Poor Species and Rationale: Some pools and various hiding spots along edges of watercourse
Overwintering Habitat	Quality: Poor Species and Rationale: No deep pools >50cm
Overall Habitat	Quality: Moderate Species and Rationale: Moderate habitat diversity

Aquatic Assessment Data Reach 2

Date and Start Time of Assessment	May 22, 2024 - start: 12:03, end: 12:33
Watercourse/Waterbody	Johnston Brook (Country Harbour, Guysborough County)
Assessor(s)	Tyler Sims
Weather Conditions	21 ° C, 76 to 100 % Cloud Cover, None/Dry, wind – Beaufort Scale 1 - Light Air Movement, smoke drifts
Channel and Instream Habitat Characteristics	
Watercourse Type	Permanent - intermittent
Channel Gradient	1 - 4%
Degree of Embeddedness	Low
Erosion	Low to moderate
Substrate	Gravel (15%) Cobbles (75%) Boulder (10%)
Average Wetted Width	2.6 m
Average Wetted Depth	0.16 m
Average Bankfull Width	3.7 m
Average Bankfull Depth	0.69 m
Instream Macrophytes	Submergent, Other vegetation present. Mosses
Algae	None observed.
Habitat Complexity	☑ Woody Debris ☑ Undercut Banks ☑ Overhanging Vegetation ☑ Large Boulders ☐ Other Not a lot of diversity of habitat. Some undercut banks, few pools, no gravel beds
Potential Critical Habitat	None
Spawning Habitat	Quality: Poor Species and Rationale: Very few areas of loose gravel
Rearing Habitat	Quality: Poor Species and Rationale: Only very small hiding areas near edge, mostly shallow
Overwintering Habitat	Quality: Poor Species and Rationale: No deep pools
Overall Habitat	Quality: Poor Species and Rationale: Poor habitat diversity

Aquatic Assessment Data Reach 1

Date and Start Time of Assessment	May 22, 2024 - start: 11:22, end: 11:57
Watercourse/Waterbody	Johnston Brook (Country Harbour, Guysborough County, NS)
Assessor(s)	Tyler Sims
Weather Conditions	21 ° C, 76 to 100 % Cloud Cover, None/Dry, wind – Beaufort Scale 1 - Light Air Movement, smoke drifts
Channel and Instream Habitat Characteristics	
Watercourse Type	Intermittent
Channel Gradient	1 - 4%
Degree of Embeddedness	Low
Erosion	Low to moderate
Substrate	Gravel (30%) Cobbles (50%) Boulder (20%)
Average Wetted Width	2.5 m
Average Wetted Depth	0.16 m
Average Bankfull Width	4.75 m
Average Bankfull Depth	0.85 m
Instream Macrophytes	Other vegetation present. Mosses
Algae	None observed.
Habitat Complexity	☑ Woody Debris ☑ Undercut Banks ☑ Overhanging Vegetation ☑ Large Boulders ☐ Other
Potential Critical Habitat	None
Spawning Habitat	Quality: Poor Species and Rationale: Very few areas of loose gravel
Rearing Habitat	Quality: Moderate Species and Rationale: Plenty of small pools and hiding areas
Overwintering Habitat	Quality: Poor Species and Rationale: No deep pools
Overall Habitat	Quality: Moderate Species and Rationale: Good habitat diversity

Appendix C

Laboratory Analytical Certificates

Attention: **Shauna Gallant, Nadine Wambolt**
Dillon Consulting Limited
137 Chain Lake Drive Suite 100
Halifax, Nova Scotia
B3S 1B3, Canada

Client Project #: **23-6465**
Site Location: **Country Harbour**
C.O.C. #: **20240605-1**
Quote #: **N/A**
PO#: **N/A**

Report Date: **2024/06/13**
Report #: **DI20240613**
Version: **1**

ENVIRONMENTAL DNA - CERTIFICATE OF ANALYSIS

BV JOB #: **E20240605-1**
Received: **2024/06/05, 8:48 AM**

Sample Type: Water
Samples Received: 2

Analyses (eDNA Isolation - Species)	Test Requested	Test Performed	Date eDNA Extracted	Date Analyzed IntegritE-DNA™	Date Analyzed Target Species	Laboratory Method	Analytical Method (qPCR Primer/Probe set)
eDNA Isolation and IntegritE-DNA™	2	2	2024-06-06	2024-06-07	N/A	GUE SOP-00056	ePlant5
Northern Leopard Frog (*Lithobates(Rana) pipiens*)	2	2	N/A	N/A	2024-06-10	GUE SOP-00056	eLIPI1
American Eel (*Anguilla rostrata*)	2	2	N/A	N/A	2024-06-10	GUE SOP-00056	eANRO1
Wood turtle (*Glyptemys insculpta*)	2	2	N/A	N/A	2024-06-10	GUE SOP-00056	eGLIN1
General Fish Assay	2	2	N/A	N/A	2024-06-10	GUE SOP-00056	eFish1
Dreissenid Mussels (*Dreissena bugensis, Dreissena polymorpha*)	2	2	N/A	N/A	2024-06-10	GUE SOP-00056	eDRspp1

Remarks:

Bureau Veritas Laboratories (Animal DNA Department, DNA Services) is accredited to ISO17025:2017 for eDNA testing.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by industry professionals using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas Laboratories in writing). All data has met quality control and method performance criteria unless otherwise noted.

Bureau Veritas Laboratories' 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 Laboratories 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 Laboratories unless otherwise agreed in writing. Bureau Veritas Laboratories is not responsible for the accuracy or any data impacts that result from the information provided by the customer or their agent.

Results relate to supplied samples tested. This Certificate should not be reproduced except in full, without the written approval of the laboratory.

eDNA tests are used to confirm presence of eDNA in samples for the targeted species / species groups.

Collected eDNA samples will contain eDNA at various stages of degradation, being subject to environmental forces that breakdown DNA, including microbial activity, ultraviolet radiation, heat, hydrolysis, and enzymatic activity. eDNA is first evaluated for eDNA quality and presence of qPCR assay inhibitors using the IntegritE-DNA™ assay before testing for target species or genera to confirm that the eDNA is of sufficient quality for testing and to identify and address qPCR inhibition (if present) to avoid false negatives.

SAMPLE RETENTION: Samples and DNA extracts generated from the samples will be retained by Bureau Veritas Laboratories for a period of 90 days after which time they will be discarded unless prearrangement has been made by client with Bureau Veritas Laboratories for longer storage.

Attention: **Shauna Gallant, Nadine Wambolt**
Dillon Consulting Limited
137 Chain Lake Drive Suite 100
Halifax, Nova Scotia
B3S 1B3, Canada

Client Project #: **23-6465**
Site Location: **Country Harbour**
C.O.C. #: **20240605-1**
Quote #: **N/A**
PO#: **N/A**

Report Date: **2024/06/13**
Report #: **DI20240613**
Version: **1**

ENVIRONMENTAL DNA - CERTIFICATE OF ANALYSIS

BV JOB #: **E20240605-1**
Received: **2024/06/05, 8:48 AM**

Methodology for Sample Analysis

Water Samples were logged in upon receipt, and water filtration and filter preservation were conducted immediately. Preserved filters were stored in freezer until processing in the laboratory. Sample analysis is completed within 10 business days (as indicated by the client on the COC) following receipt of samples by the testing laboratory.

eDNA isolation is completed using the DNeasy Blood & Tissue Kit™ (QIAGEN). A negative control is included as a blank filter sample with each batch of eDNA isolation to monitor for potential laboratory contamination during the eDNA isolation process.

Following eDNA isolation (150µL) from a quarter of filter, the IntegritE-DNA™ assay[1] is used to avoid the potential of a false negative (Type II error) during target species or genera testing. The IntegritE-DNA™ assay evaluates the integrity of eDNA for suitability for qPCR and for presence of qPCR inhibitors which may reduce the effectiveness of the qPCR assay for target species or genera. This assay evaluates the quality of eDNA to assess whether it is amplifiable using a qPCR assay that targets the chloroplast genome derived from plants/algae that are ubiquitously found in fresh water systems. Four technical replicates per eDNA sample, four technical replicates of negative control (Ultrapure water), and two technical replicates of positive control are used for the IntegritE-DNA™ assay. The cut-off Ct (qPCR cycle threshold) value for the IntegritE-DNA™ assay is 27. If the IntegritE-DNA™ assay produces a positive detection frequency of ≥ 2 of the 4 technical replicates, this indicates that the eDNA for the target taxa is likely to be of sufficient quality to be detected (if present) with the target assay. If the IntegritE-DNA™ assay produces a positive detection frequency < 2 of the 4 technical replicates (eDNA is degraded or qPCR inhibitors are present), then sample cleanup is completed using the OneStep PCR Inhibitor Removal Kit™ (ZYMO Research) to remove potential qPCR assay inhibitors from the isolated eDNA. Subsequent to inhibitor removal, the IntegritE-DNA™ assay is repeated to re-assess whether the eDNA is of sufficient quality for qPCR. If a sample fails at the IntegritE-DNA™ assay for the second time the client will be informed that the quality of the sample is insufficient for the qPCR assay. eDNA indicator (IntegritE-DNA™) in the sample suggests that degradation has taken place and therefore the target species assay may be ineffective. Once a sample passes the IntegritE-DNA™ assay, then the target species or genera assay is performed. Eight technical replicates per eDNA sample, eight technical replicates of the negative control (Ultrapure water), and two technical replicates of positive control (total DNA or synthetic DNA) are used for the target species or genera assay to assess the detection or non-detection of DNA of the target species or genera. The cut-off Ct value for target species assay is 50.

[1] Hobbs J, Round JM, Allison MJ, Helbing CC (2019) Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei* , in British Columbia, Canada, using robust eDNA detection methods. PLOS ONE 14(3): e0213849.



BECKY HENDERSON
Senior Customer Service Representative, Bureau Veritas Laboratories, DNA Services
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Phone #: (519) 836 2400 Ext. 7067714

Please direct all questions regarding this Certificate of Analysis to your Customer Service Representative above.
==========
For Service Group specific validation please refer to the Validation Signature Page.

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BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

RESULTS - Coho Salmon (*Oncorhynchus kisutch*)

Client Sample ID	BV Case ID	Sampling Date	IntegritE-DNA™ Positive detection (Ct≤27)[1]	QC Batch	Clean-up required	IntegritE-DNA™ Positive detection (Ct≤27) after clean-up	QC Batch	Analytical Method (qPCR Primer/Probe set)	Target Species eDNA Positive detection (Ct≤50)[2]	QC Batch
SW 19	DI20240094	2023-07-12	4/4	240607Q1	No	N/A	N/A	eFish1[4]	8/8	240610Q2
SW 20	DI20240095	2023-07-12	4/4	240607Q1	No	N/A	N/A	eFish1	1/8	240610Q2
SW 19	DI20240094	2023-07-12	4/4	240607Q1	No	N/A	N/A	eANRO1[5]	1/8	240610Q3
SW 20	DI20240095	2023-07-12	4/4	240607Q1	No	N/A	N/A	eANRO1	0/8	240610Q3
SW 19	DI20240094	2023-07-12	4/4	240607Q1	No	N/A	N/A	eLIPI1[6]	0/8	240610Q4
SW 20	DI20240095	2023-07-12	4/4	240607Q1	No	N/A	N/A	eLIPI1	0/8	240610Q4
SW 19	DI20240094	2023-07-12	4/4	240607Q1	No	N/A	N/A	eGLIN1[7]	0/8	240610Q5
SW 20	DI20240095	2023-07-12	4/4	240607Q1	No	N/A	N/A	eGLIN1	0/8	240610Q5
SW 19	DI20240094	2023-07-12	4/4	240607Q1	No	N/A	N/A	eDRspp1[8]	0/8	240610Q6
SW 20	DI20240095	2023-07-12	4/4	240607Q1	No	N/A	N/A	eDRspp1	0/8	240610Q6
Filtration Blank Before 2024-06-05	FBB-240605	2024-06-05	0/4[3]	240607Q1	No	N/A	N/A	N/A	N/A	N/A
Filtration Blank After 2024-06-05	FBA-240605	2024-06-05	0/4[3]	240607Q1	No	N/A	N/A	N/A	N/A	N/A

[1] **IntegritE-DNA™ Assay:** Four technical replicates were assayed for each eDNA sample. **Field samples:** The cut-off Ct value for IntegritE-DNA assay is 27 based on previous observation and due to presence of inhibitors. **Post clean-up and field blank samples:** The cut-off Ct value for IntegritE-DNA assay is 30. Results are reported as the number of positive detections (n) out of a total of 4 technical replicates, n/4.

[2] **Target Species Assay:** Eight technical replicates were assayed per eDNA sample. The cut-off Ct value for target species assay was 50. Results are reported as the number of positive detections (n) out of a total of 8 technical replicates, n/8.

[3] The IntegritE-DNA assay failed for Filtration Blank samples as expected. Clean-up is not required.

[4] eFish1: qPCR primer/probe assay to assess the presence of Fish species eDNA (confirmed to detect several fish including 19 species; **Sockeye Salmon** (*Oncorhynchus nerka*), **Pink Salmon** (*Oncorhynchus gorbuscha*), **Chum Salmon** (*Oncorhynchus keta*), **Arctic Grayling** (*Thymallus arcticus*), **Cutthroat Trout** (*Oncorhynchus clarkii*), **Rainbow Trout** (*Oncorhynchus mykiss*), **Chinook Salmon** (*Oncorhynchus tshawytscha*), **Coho Salmon** (*Oncorhynchus kisutch*), **Atlantic Salmon** (*Salmo salar*), **Dolly Varden** (*Salvelinus malma*), **Round Whitefish** (*Prosopium cylindraceum*), **Slimy Sculpin** (*Cottus cognatus*), **American Eel** (*Anguilla rostrata*), **Northern Pike** (*Esox lucius*), **Smallmouth Bass** (*Micropterus dolomieu*), **Largemouth Bass** (*Micropterus salmoides*), **Bull Trout** (*Salvelinus confluentus*), **Eulachon** (*Thaleichthys pacificus*), **Three-spined stickleback** (*Gasterosteus aculeatus*)). This assay was designed to non-specifically detect the presence of any fish species. eFish may detect DNA from species not listed in the eFish Technical Bulletin. It is important to note that in keeping the eDNA assay design broad to detect the presence of any fish species it has been demonstrated to also detect presence of some amphibian species.

[5] eANRO1 qPCR primer/probe assay to assess the presence of American Eel (Anguilla rostrata) eDNA.

[6] eLIPI1 qPCR primer/probe assay to assess the presence of Northern Leopard Frog (*Lithobates(Rana) pipiens*) eDNA.

[7] eGLIN1 qPCR primer/probe assay to assess the presence of Wood turtle (*Glyptemys insculpta*) eDNA.

[8] eDRspp1 qPCR primer/probe assay to assess the presence of Dreissenid Mussels (*Dreissena bugensis, Dreissena polymorpha*) eDNA.

BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

GENERAL COMMENTS

eDNA is extracted (150 µL) from a quarter of filter, and 2 µL is used as a template for each technical replicate.

Two blank samples (Ultra-Pure water) were filtered before and after filtration (each batch) as a control for contamination. All filtration blanks did not detect any DNA by IntegritE-DNA assay as expected.

Based on recent experimentation we have observed that the eFish1 assay may detect some amphibian species. Please see the Fish Species Assay Validation Information for details.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			eDNA Isolation Negative Control[1]		qPCR Positive Controls[2]		qPCR Negative Controls[3]	
QC Batch	Parameter	Date	Detection at: Ct 27 (IntegritE-DNA™) Ct 50 (other assays)	Pass / Fail	Detection at: Ct 27 (IntegritE-DNA™) Ct 50 (other assays)	Pass / Fail	Detection at: Ct 27 (IntegritE-DNA™) Ct 50 (other assays)	Pass / Fail
240607Q1	IntegritE-DNA	2024-06-07	0 of 4 technical replicates	Pass	2 of 2 technical replicates	Pass	0 of 4 technical replicates	Pass
240610Q2	eFish1	2024-06-10	eDNA Isolation Negative Control is assessed using IntegritE-DNA only once for each extraction batch.	N/A	2 of 2 technical replicates	Pass	0 of 8 technical replicates	Pass
240610Q3	eANRO1	2024-06-10			2 of 2 technical replicates	Pass	0 of 8 technical replicates	Pass
240610Q4	eLIPI1	2024-06-10			2 of 2 technical replicates	Pass	0 of 8 technical replicates	Pass
240610Q5	eGLIN1	2024-06-10			2 of 2 technical replicates	Pass	0 of 8 technical replicates	Pass
240610Q6	eDRspp1	2024-06-10			2 of 2 technical replicates	Pass	0 of 8 technical replicates	Pass

[1]**eDNA Isolation Negative Control:** Blank filters were included for each batch of eDNA extraction to monitor for laboratory contamination during eDNA isolation. eDNA Isolation Negative Control is assessed using IntegritE-DNA™ only. QC results show no eDNA was isolated from the negative control, therefore there was no indication of sample contamination during handling. Acceptance criteria: 0 of 4 technical replicates

[2]**qPCR Positive Controls:** Two technical replicates of isolated eDNA from freshwater sample were used as positive controls for IntegritE-DNA™. Two technical replicates of total DNA or synthetic DNA from the target species were used as positive controls for eDNA assays. Results show that 100% of the technical replicates amplified the positive control eDNA as expected, therefore an observation of negative result in eDNA samples is not related to the qPCR performance. Acceptance criteria: 2 of 2 technical replicates

[3]**qPCR Negative Controls (Ultrapure water):** Four technical replicates for IntegritE-DNA™ and eight technical replicates for target species or genera were used to monitor for laboratory contamination. Results show that 0% of the technical replicates in the negative controls had amplified eDNA, indicating no contamination was detected. Acceptance criteria: 0 of 4 technical replicates for IntegritE-DNA™, and 0 of 8 technical replicates for other assays.

LABORATORY RESULTS VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Reporter: ALI MIRABZADEH, M.Sc.
Scientific Specialist, Bureau Veritas Laboratories, DNA Services

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BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

Northern Leopard Frog (*Lithobates(Rana) pipiens*) eDNA Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol at University of Victoria that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species: Northern Leopard Frog (*Lithobates(Rana) pipiens*)
Species Code: am-LIPI
eDNA qPCR Tool: eLIPI1
eDNA qPCR Format: TaqMan
Gene Target: MT-RNR1
Published in: N/A

eDNA Assay Sensitivity Test using gBlocks™ synthetic DNA

LOD **0.4** 95% CI **0.3-0.7** Copies LOQ **1.7** 95% CI **1.2-2.8** Copies
LOB **0** hits/8

Binomial-Poisson model for 8 technical replicates determined using eLowQuant R code[4].
When the LOQ < LOD, use the LOD for the LOQ.

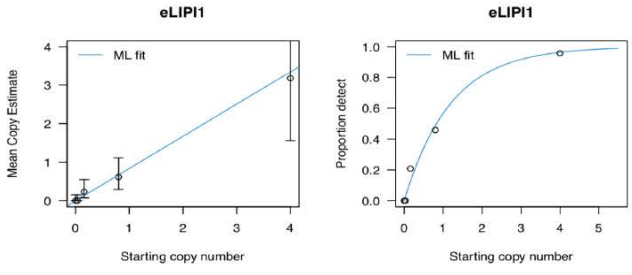
Enzyme: Immolase

eDNA Assay Specificity Test Information

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=25 technical replicates)

Species	Common Name (Species)	Detection	Specimens	Sample Sources/Locations
am-ANBO-VI	Western Toad (*Anaxyrus (Bufo) boreas*)	No	1	British Columbia
am-ASTR	Pacific Tailed frog (*Ascaphus truei*)	No	1	British Columbia
am-LICA	Bullfrog (*Lithobates (Rana) catesbeiana*)	No	1	British Columbia
am-LICL	Green Frog (*Lithobates (Rana) clamitans*)	No	1	British Columbia
am-LIPI	Northern Leopard Frog (*Lithobates (Rana) pipiens*)	Yes	1	British Columbia
am-PSRE	Pacific Chorus Frog (*Pseudacris (Hyla) regilla*)	No	1	British Columbia
am-RAAU	Northern Red-legged Frog (*Rana aurora*)	No	1	British Columbia
am-TAGR	Rough-skinned Newt (*Taricha granulosa*)	No	1	British Columbia
am-XELA	African Clawed Frog (*Xenopus laevis*)	No	1	South Africa
ma-HOSA	Human (*Homo sapiens*)	No	1	Netherlands

eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA



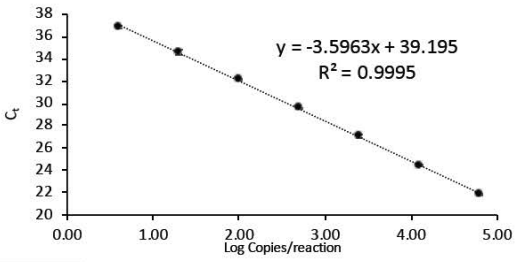
Binomial-Poisson model: No intercept
Determined using eLowQuant R code[4].
Based on a 2 µL DNA input in a total 15 µL reaction

From 8 Technical Replicates

# Detects	# Copies	SE
0	0	0
1	0.16	0.16
2	0.34	0.25
3	0.56	0.35
4	0.83	0.45
5	1.17	0.59
6	1.66	0.8
7	2.49	1.22

Determined using eLowQuant R code[4].

Applied to reactions with 100% positive hits



Efficiency 90%

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Field Sample Validation

Sample Type	Known presence	# Samples	Detected	Location
N/A	N/A	N/A	N/A	N/A

Abbreviations

95% CI	95% Confidence interval	LOQ	Limit of quantification
eDNA	Environmental DNA	MT-RNR1	Mitochondrial 12S ribosomal RNA gene
gDNA	Total genomic DNA extracted from voucher specimen	NTC	qPCR no template control
LOB	Limit of blank	qPCR	Quantitative real-time polymerase chain reaction
LOD	Limit of detection	SE	Standard error

References

1. Hobbs, J, Adams, IT, Round, JM, Goldberg, CS, Allison, MJ, Bergman, LC, Mirabzadeh, A, Allen, H, Helbing, CC (2020) Revising the range of Rocky Mountain tailed frog, *Ascaphus montanus* , in British Columbia, Canada, using environmental DNA methods. Environmental DNA. 2020; 2: 350-361. https://doi.org/10.1002/edn3.82
2. Hobbs, J, Round, JM, Allison, MJ, Helbing, CC (2019) Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei* , in British Columbia, Canada, using robust eDNA detection methods. PLOS ONE 14(3): e0213849. https://doi.org/10.1371/journal.pone.0213849
3. Langlois, VS, Allison, MJ, Bergman, LC, To, TA, and Helbing, CC (2020) The need for robust qPCR-based eDNA detection assays in environmental monitoring and risk assessments. Environmental DNA, 3: 519-527. doi: 10.1002/edn3.164
4. Lesperance, M, Allison, MJ, Bergman, LC, Hocking, MD, and Helbing, CC (2021) A statistical model for calibration and computation of detection and quantification limits for low copy number environmental DNA samples. Environmental DNA, 00: 1-12. doi: 10.1002/edn3.220

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BUREAU VERITAS

BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

American Eel (*Anguilla rostrata*) eDNA Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol at University of Victoria that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species: American Eel (*Anguilla rostrata*)
Species Code: te-ANRO
eDNA qPCR Tool: eANRO1
eDNA qPCR Format: TaqMan
Gene Target: MT-CYB
Published in: N/A

eDNA Assay Sensitivity Test using gBlocks™ synthetic DNA

LOD **0.4** 95% CI **0.3-0.7** Copies LOQ **1.5** 95% CI **1.1-2.6** Copies
LOB **0** hits/8

Binomial-Poisson model for 8 technical replicates determined using eLowQuant R code[4].
When the LOQ < LOD, use the LOD for the LOQ.

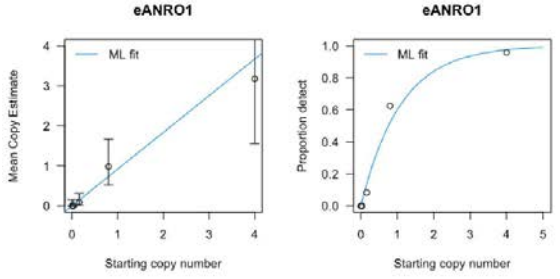
Enzyme: Immolase

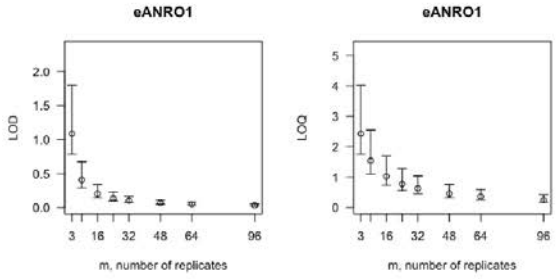
eDNA Assay Specificity Test Information

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=25 technical replicates)

Species	Common Name (Species)	Detection	Specimens	Sample Sources/Locations
ma-HOSA	Human (*Homo sapiens*)	No	1	Netherlands
te-ANRO	American Eel (*Anguilla rostrata*)	Yes	8	Prince Edward Island
te-COCO	Slimy Sculpin (*cottus cognatus*)	No	1	Yukon
te-ESLU	Northern Pike (*Esox lucius*)	No	1	British Columbia
te-MIDO	Smallmouth Bass (*Micropterus dolomieu*)	No	1	British Columbia
te-MISA	Largemouth Bass (*Micropterus salmoides*)	No	1	British Columbia
te-ONCL	Cutthroat Trout (*Oncorhynchus clarkii*)	No	1	British Columbia
te-ONGO	Pink Salmon (*Oncorhynchus gorbuscha*)	No	1	British Columbia
te-ONKE	Chum Salmon (*Oncorhynchus keta*)	No	1	British Columbia
te-ONKI	Coho Salmon (*Oncorhynchus kisutch*)	No	1	British Columbia
te-ONMY	Rainbow Trout (*Oncorhynchus mykiss*)	No	1	British Columbia
te-ONNE	Sockeye Salmon (*Oncorhynchus nerka*)	No	1	British Columbia
te-ONTS	Chinook Salmon (*Oncorhynchus tschawytscha*)	No	1	British Columbia
te-PRCY	Round Whitefish (*prosopium cylindraceum*)	No	1	Yukon
te-SACO	Bull Trout (*Salvelinus confluentus*)	No	1	Alberta
te-SAMA	Dolly Varden (*Salvelinus malma*)	No	1	British Columbia
te-SASA	Atlantic Salmon (*Salmo Salar*)	No	1	Nova Scotia
te-THAR	Arctic Grayling (*Thymallus arcticus*)	No	1	Alberta
te-THPA	Eulachon (*Thaleichthys pacificus*)	No	1	British Columbia

eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA





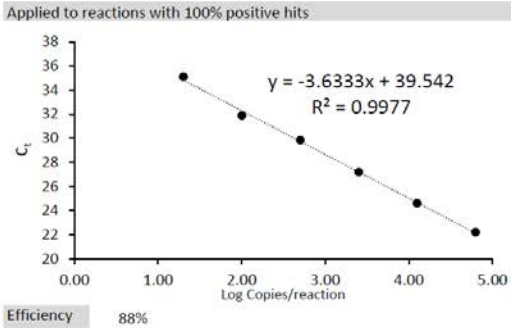
Binomial-Poisson model: No intercept
Determined using eLowQuant R code[4].

From 8 Technical Replicates

# Detects	# Copies	SE
0	0	0
1	0.15	0.14
2	0.31	0.23
3	0.51	0.32
4	0.76	0.41
5	1.07	0.54
6	1.51	0.73
7	2.27	1.12

Determined using eLowQuant R code[4].

Applied to reactions with 100% positive hits



Efficiency 88%

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Based on a 2 µL DNA input in a total 15 µL reaction

Field Sample Validation

Sample Type	Known presence	# Samples	Detected	Location
Water	Yes	30	Y	Prince Edward Island

Abbreviations

95% CI	95% Confidence interval	LOQ	Limit of quantification
eDNA	Environmental DNA	MT-CYB	Mitochondrial cytochrome B gene
gDNA	Total genomic DNA extracted from voucher specimen	NTC	qPCR no template control
LOB	Limit of blank	qPCR	Quantitative real-time polymerase chain reaction
LOD	Limit of detection	SE	Standard error

References

1. Hobbs, J, Adams, IT, Round, JM, Goldberg, CS, Allison, MJ, Bergman, LC, Mirabzadeh, A, Allen, H, Helbing, CC (2020) Revising the range of Rocky Mountain tailed frog, *Ascaphus montanus* , in British Columbia, Canada, using environmental DNA methods. Environmental DNA. 2020; 2: 350-361. https://doi.org/10.1002/edn3.82
2. Hobbs, J, Round, JM, Allison, MJ, Helbing, CC (2019) Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei* , in British Columbia, Canada, using robust eDNA detection methods. PLOS ONE 14(3): e0213849. https://doi.org/10.1371/journal.pone.0213849
3. Langlois, VS, Allison, MJ, Bergman, LC, To, TA, and Helbing, CC (2020) The need for robust qPCR-based eDNA detection assays in environmental monitoring and risk assessments. Environmental DNA, 3: 519-527. doi: 10.1002/edn3.164
4. Lesperance, M, Allison, MJ, Bergman, LC, Hocking, MD, and Helbing, CC (2021) A statistical model for calibration and computation of detection and quantification limits for low copy number environmental DNA samples. Environmental DNA, 00: 1-12. doi: 10.1002/edn3.220

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BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

Wood turtle (*Glyptemys insculpta*) Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol at University of Victoria that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species: Wood turtle (*Glyptemys insculpta*)
Species Code: re-GLIN
eDNA qPCR Tool: eGLIN1
eDNA qPCR Format: TaqMan
Gene Target: MT-CYB
Published in: N/A

eDNA Assay Sensitivity Test using gBlocks™ synthetic DNA

LOD **0.4** 95% CI **0.3-0.7** Copies LOQ **1.7** 95% CI **1.2-2.7** Copies
LOB **0** hits/8

Binomial-Poisson model for 8 technical replicates determined using eLowQuant R code[4].
When the LOQ < LOD, use the LOD for the LOQ.

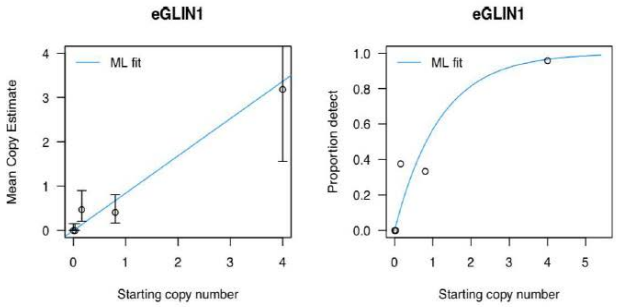
Enzyme: Immolase

eDNA Assay Specificity Test Information

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=25 technical replicates)

Species	Common Name (Species)	Detection	Specimens	Sample Sources/Locations
am-LICA	Bullfrog (*Lithobates catesbeianus*)	No	1	British Columbia
ma-HOSA	Human (*Homo sapiens*)	Np	1	Netherlands
re-CHPI	Painted turtle (*Chrysemys picta*)	Yes	1	Ontario
re-CHSE	Snapping turtle (*Chelydra serpentina*)	No	1	Nova Scotia
re-COTE	Sharp-Tailed Snake (*Contia tenuis*)	No	1	British Columbia
re-ELCO	Common Wall Lizard (*Podarcis muralis*)	No	1	British Columbia
re-EMBL	Blandings turtle (*Emydoidea blandingii*)	No	1	Nova Scotia
re-GLIN	Wood turtle (*Glyptemys insculpta*)	Yes	2	Nova Scotia
re-POMU	Common Wall Lizard (*Podarcis muralis*)	No	1	British Columbia
re-THEL	Western Terrestrial Garter Snake (*Thamnophis elegans*)	No	1	British Columbia
re-THOR	Northwestern Garter Snake (*Thamnophis ordinoides*)	No	1	British Columbia
re-THSI	Common Garter Snake (*Thamnophis sirtalis*)	No	1	British Columbia

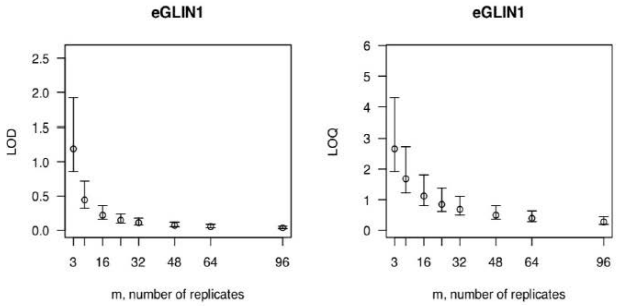
eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA



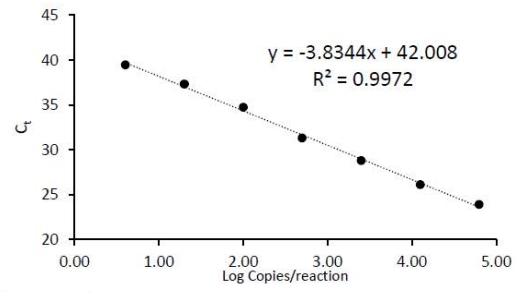
From 8 Technical Replicates

# Detects	# Copies	SE
0	0	0
1	0.16	0.16
2	0.34	0.25
3	0.56	0.34
4	0.82	0.45
5	1.16	0.59
6	1.65	0.8
7	2.47	1.21

Determined using eLowQuant R code[4].



Applied to reactions with 100% positive hits



Binomial-Poisson model: No intercept
Determined using eLowQuant R code[4].
Based on a 2 µL DNA input in a total 15 µL reaction

Efficiency 82%

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Field Sample Validation

Sample Type	Known presence	# Samples	Detected	Location
N/A	N/A	N/A	N/A	N/A

Abbreviations

95% CI	95% Confidence interval	LOQ	Limit of quantification
eDNA	Environmental DNA	MT-CYB	Mitochondrial cytochrome B gene
gDNA	Total genomic DNA extracted from voucher specimen	NTC	qPCR no template control
LOB	Limit of blank	qPCR	Quantitative real-time polymerase chain reaction
LOD	Limit of detection	SE	Standard error

References

1. Hobbs, J, Adams, IT, Round, JM, Goldberg, CS, Allison, MJ, Bergman, LC, Mirabzadeh, A, Allen, H, Helbing, CC (2020) Revising the range of Rocky Mountain tailed frog, *Ascaphus montanus* , in British Columbia, Canada, using environmental DNA methods. Environmental DNA. 2020; 2: 350-361. https://doi.org/10.1002/edn3.82
2. Hobbs, J, Round, JM, Allison, MJ, Helbing, CC (2019) Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei* , in British Columbia, Canada, using robust eDNA detection methods. PLOS ONE 14(3): e0213849. https://doi.org/10.1371/journal.pone.0213849
3. Langlois, VS, Allison, MJ, Bergman, LC, To, TA, and Helbing, CC (2020) The need for robust qPCR-based eDNA detection assays in environmental monitoring and risk assessments. Environmental DNA, 3: 519-527. doi: 10.1002/edn3.164
4. Lesperance, M, Allison, MJ, Bergman, LC, Hocking, MD, and Helbing, CC (2021) A statistical model for calibration and computation of detection and quantification limits for low copy number environmental DNA samples. Environmental DNA, 00: 1-12. doi: 10.1002/edn3.220

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BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

Fish Species Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol at University of Victoria that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species: Various Fish Species
Species Code: te-Fish
eDNA qPCR Tool: eFish1
eDNA qPCR Format: TaqMan
Gene Target: MT-RNR1
Published in: 5

eDNA Assay Sensitivity Test using gBlocks™ synthetic DNA (Bureau Veritas)

LOD **0.25** 95% CI **0.17-0.44** Copies LOQ **0.94** 95% CI **0.65-1.67** Copies
LOB **0** hits/8

Binomial-Poisson model for 8 technical replicates determined using eLowQuant R code[4].
When the LOQ < LOD, use the LOD for the LOQ.

Enzyme: Immolase

eDNA Assay Specificity Test Information (University of Victoria, Dr. Caren Helbing Laboratory)

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=25 technical replicates)

Species	Common Name (Species)	Detection	# Voucher Specimens	Sample Sources/Locations
am-LICA	North American bullfrog (*Lithobates (Rana) catesbeiana*)	No	1	British Columbia
ma-HOSA	Human (*Homo Sapiens*)	No	1	Netherlands
te-ANRO	American Eel (*Anguilla rostrata*)	Yes	1	Prince Edward Island
te-COCO	Slimy Sculpin (*Cottus cognatus*)	Yes	1	Yukon
te-ESLU	Northern Pike (*Esox lucius*)	Yes	1	British Columbia
te-GAAC	Three-spined stickleback (*Gasterosteus aculeatus*)	Yes	2	British Columbia
te-MIDO	Smallmouth Bass (*Micropterus dolomieu*)	Yes*	1	British Columbia
te-MISA	Largemouth Bass (*Micropterus salmoides*)	Yes	1	British Columbia
te-ONCL	Cutthroat Trout (*Oncorhynchus clarkii*)	Yes	2	Alberta and British Columbia
te-ONGO	Pink Salmon (*Oncorhynchus gorbuscha*)	Yes	1	British Columbia
te-ONKE	Chum Salmon (*Oncorhynchus keta*)	Yes	1	British Columbia
te-ONKI	Coho Salmon (*Oncorhynchus kisutch*)	Yes	1	British Columbia
te-ONMY	Rainbow Trout (*Oncorhynchus mykiss*)	Yes	1	Alberta and British Columbia
te-ONNE	Sockeye Salmon (*Oncorhynchus nerka*)	Yes	1	British Columbia
te-ONTS	Chinook Salmon (*Oncorhynchus tshawytscha*)	Yes	1	British Columbia
te-PRCY	Round Whitefish (*Prosopium cylindraceum*)	Yes	1	Alberta
te-SACO	Bull Trout (*Salvelinus confluentus*)	Yes	1	British Columbia
te-SAMA	Dolly Varden (*Salvelinus malma*)	Yes	1	British Columbia
te-SASA	Atlantic Salmon (*Salmo salar*)	Yes	1	Nova Scotia
te-THAR	Arctic grayling (*Thymallus arcticus*)	Yes	1	Alberta
te-THPA	Eulachon (*Thaleichthys pacificus*)	Yes*	1	British Columbia

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=2 technical replicates)

Species	Common Name (Species)	Detection	# Voucher Specimens	Sample Sources/Locations
am-AMMA	Long toed salamander (*Ambystoma macrodactylum*)	Yes**	1	British Columbia
am-AMMV	Eastern tiger salamander (*Ambystoma mavortium*)	No	1	British Columbia
am-AMTI	Barred tiger salamander (*Ambystoma tigrinum*)	No	1	British Columbia
am-ANBO	Western toad (*Anaxyrus (Bufo) boreas*)	Yes***	1	British Columbia
am-ANVA	Wandering salamander (*Aneides vagrans*)	No	1	British Columbia
am-ASMO	Rocky Mountain tailed frog (*Ascaphus montanus*)	Yes**	1	British Columbia
am-ASTR	Pacific (coastal) tailed frog (*Ascaphus truei*)	Yes**	1	British Columbia
am-ENES	Monterey ensatina (*Ensatina eschscholtzii*)	No	1	British Columbia
am-LICL	Green frog (*Lithobates (Rana) clamitans*)	No	1	British Columbia
am-LIPI	Northern leopard frog (*Lithobates (Rana) pipiens*)	No	1	Alberta
am-LISY	Wood frog (*Lithobates (Rana) sylvaticus*)	No	1	British Columbia
am-PSMA	Boreal chorus frog (*Pseudacris maculata*)	No	1	British Columbia
am-RAAU	Northern red-legged frog (*Rana aurora*)	No	1	British Columbia
am-RACA	Cascades frog (*Rana cascadae*)	No	1	British Columbia
am-RALU	Columbia spotted frog (*Rana luteiventris*)	No	1	British Columbia
am-RAPR	Oregon spotted frog (*Rana pretiosa*)	No	1	British Columbia
am-SPIN	Great basin spadefoot toad (*Spea (Scaphiopus) intermontana*)	Yes**	1	British Columbia
am-TAGR	Rough-skinned newt (*Taricha granulosa*)	No	1	British Columbia
am-XELA	African clawed frog (*Xenopus laevis*)	No	1	South Africa
ma-SOBE	Pacific water/marsh shrew (*Sorex bendirii*)	No	1	British Columbia
ma-SOTR	Trowbridge's shrew (*Sorex trowbridgii*)	No	1	British Columbia
mo-COFL	Asian clam (*Corbicula fluminea*)	No	1	Ontario
mo-DRBU	Quagga mussels (*Dreissena bugensis*)	No	1	Ontario
mo-DRPO	Zebra mussels (*Dreissena polymorpha*)	No	1	Ontario

*This tool weakly detects Smallmouth Bass and Eulachon DNA
**This tool may detect Long-toed Salamander, Rocky Mountain Tailed Frog, Coastal Tailed Frog, and Great Basin Spadefoot DNA if present
***This tool weakly detects Western toad DNA if present

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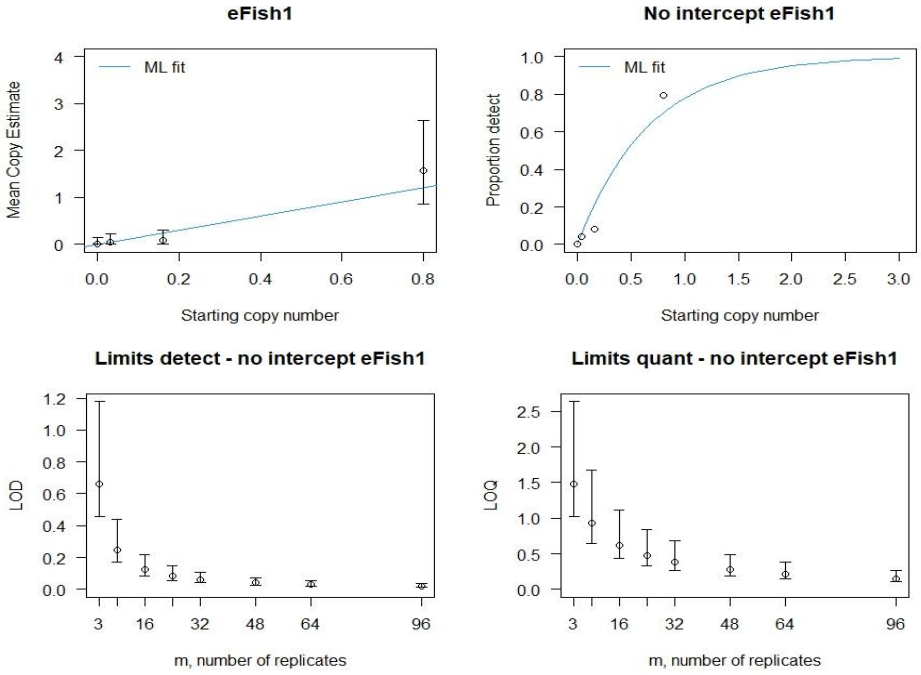
Field Sample Validation

Sample Type	Known presence	# Samples	Detected	Location
Water	Y	3	Y	Nebraska, United States of America
Water	Y	80	Y	British Columbia
Water	Y	36	Y	Alberta

Abbreviations

95% CI	95% Confidence interval	LOQ	Limit of quantification
eDNA	Environmental DNA	MT-RNR1	Mitochondrially Encoded 12S RNA
gDNA	Total genomic DNA extracted from voucher specimen	NTC	qPCR no template control
LOB	Limit of blank	qPCR	Quantitative real-time polymerase chain reaction
LOD	Limit of detection	SE	Standard error

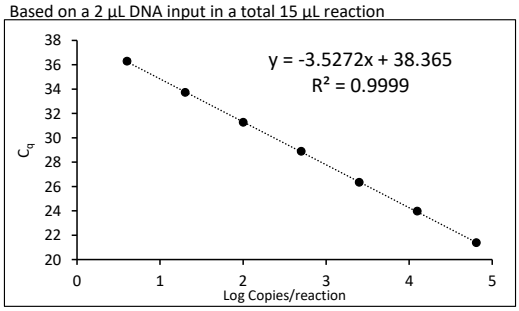
eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA (Bureau Veritas)



Binomial-Poisson model: **No intercept**

Determined using eLowQuant R code[4].

Based on a 2 µL DNA input in a total 15 µL reaction



Efficiency **93%**

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eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA (Bureau Veritas)

	Number of Technical Replicates							
	n=8		n=16		n=24		n=32	
# Detects	# Copies	SE	# Copies	SE	# Copies	SE	# Copies	SE
0	0.000	N/A	0.000	N/A	0.000	N/A	0.000	N/A
1	0.088	0.090	0.043	0.044	0.028	0.029	0.021	0.022
2	0.190	0.141	0.088	0.066	0.058	0.043	0.043	0.032
3	0.310	0.194	0.137	0.085	0.088	0.055	0.065	0.040
4	0.458	0.255	0.190	0.104	0.120	0.066	0.088	0.048
5	0.648	0.335	0.248	0.124	0.154	0.077	0.112	0.056
6	0.915	0.454	0.310	0.146	0.190	0.089	0.137	0.064
7	1.373	0.690	0.380	0.169	0.228	0.101	0.163	0.072
8			0.458	0.195	0.268	0.113	0.190	0.080
9			0.547	0.224	0.310	0.126	0.218	0.088
10			0.648	0.258	0.356	0.139	0.247	0.096
11			0.768	0.300	0.405	0.154	0.278	0.105
12			0.915	0.352	0.458	0.170	0.310	0.114
13			1.105	0.424	0.515	0.187	0.344	0.124
14			1.373	0.535	0.578	0.206	0.380	0.134
15			1.831	0.760	0.648	0.227	0.418	0.144
16					0.725	0.251	0.458	0.156
17					0.814	0.279	0.500	0.168
18					0.915	0.311	0.546	0.180
19					1.036	0.351	0.595	0.194
20					1.183	0.402	0.648	0.209
21					1.373	0.472	0.705	0.226
22					1.641	0.579	0.768	0.244
23					2.099	0.800	0.838	0.265
24							0.915	0.288
25							1.004	0.315
26							1.105	0.347
27							1.226	0.387
28							1.373	0.436
29							1.563	0.505
30							1.831	0.611
31							2.288	0.829

Binomial-Poisson model, determined using eLowQuant R code[4].

LOD and LOQ with confidence intervals, by number of replicates, no intercept model

	3	8	16	24	32	48	64	96
LOD	0.66	0.25	0.12	0.08	0.06	0.04	0.03	0.02
LOD_lower	0.46	0.17	0.09	0.06	0.04	0.03	0.02	0.01
LOD_upper	1.18	0.44	0.22	0.15	0.11	0.07	0.06	0.04
LOQ	1.47	0.94	0.62	0.47	0.38	0.28	0.22	0.15
LOQ_lower	1.02	0.65	0.43	0.33	0.26	0.19	0.15	0.11
LOQ_upper	2.63	1.67	1.11	0.84	0.68	0.49	0.39	0.27

References

1. Hobbs, J, Adams, IT, Round, JM, Goldberg, CS, Allison, MJ, Bergman, LC, Mirabzadeh, A, Allen, H, Helbing, CC (2020) Revising the range of Rocky Mountain tailed frog, *Ascaphus montanus* , in British Columbia, Canada, using environmental DNA methods. Environmental DNA. 2020; 2: 350-361. https://doi.org/10.1002/edn3.82
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3. Langlois, VS, Allison, MJ, Bergman, LC, To, TA, and Helbing, CC (2020) The need for robust qPCR-based eDNA detection assays in environmental monitoring and risk assessments. Environmental DNA, 3: 519-527. doi: 10.1002/edn3.164
4. Lesperance, M, Allison, MJ, Bergman, LC, Hocking, MD, and Helbing, CC (2021) A statistical model for calibration and computation of detection and quantification limits for low copy number environmental DNA samples. Environmental DNA, 00: 1-12. doi: 10.1002/edn3.220

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BUREAU VERITAS

BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

Dreissenid Mussels (*Dreissena bugensis, Dreissena polymorpha*) Assay Validation Information

eDNA assay Validation

All eDNA assays are validated through a rigorous multi-step evaluation protocol at University of Victoria that includes tests of DNA target specificity and amplification sensitivity. All eDNA tests available at Bureau Veritas Laboratories have been validated for performance using interlaboratory verification.

General eDNA Assay Information

Target Species: Dreissenid Mussels (*Dreissena bugensis, Dreissena polymorpha*)
Species Code: mo-DRBU and mo-DRPO
eDNA qPCR Tool: eDRspp1
eDNA qPCR Format: TaqMan
Gene Target: MT-RNR2
Published in: N/A

eDNA Assay Sensitivity Test using gBlocks™ synthetic DNA

LOD **0.3** 95% CI **0.2-0.6** Copies LOQ **1.3** 95% CI **0.8-2.4** Copies
LOB **0** hits/8

Binomial-Poisson model for 8 technical replicates determined using eLowQuant R code[4].
When the LOQ < LOD, use the LOD for the LOQ.

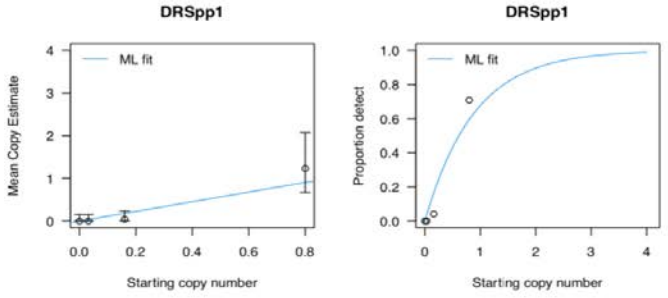
Enzyme: Immolase

eDNA Assay Specificity Test Information

Each qPCR reaction in the specificity assay contained 10 picograms of voucher target gDNA (n=25 technical replicates)

Species	Common Name (Species)	Detection	Specimens	Sample Sources/Locations
ma-HOSA	Human (*Homo Sapiens*)	No	1	Netherlands
mo-DRBU	Quagga mussels (*Dreissena bugensis*)	Yes	6	Ontario
mo-DRPO	Zebra mussels (*Dreissena polymorpha*)	Yes	6	Ontario
mo-COFL	Asian clam (*Corbicula fluminea*)	No	6	Ontario

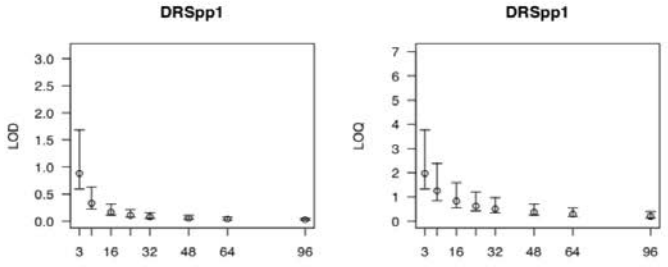
eDNA Assay Sensitivity Test Details using gBlocks™ synthetic DNA



From 8 Technical Replicates

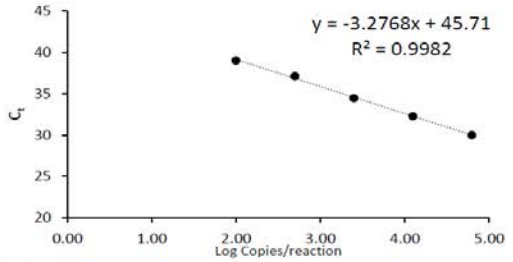
# Detects	# Copies	SE
0	0	0
1	0.12	0.12
2	0.25	0.19
3	0.42	0.26
4	0.61	0.35
5	0.87	0.46
6	1.23	0.62
7	1.84	0.94

Determined using eLowQuant R code[4].



Binomial-Poisson model: No intercept
Determined using eLowQuant R code[4].
Based on a 2 µL DNA input in a total 15 µL reaction

Applied to reactions with 100% positive hits



Efficiency 102%

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Field Sample Validation

Sample Type	Known presence	# Samples	Detected	Location
N/A	N/A	N/A	N/A	N/A

Abbreviations

95% CI	95% Confidence interval	LOQ	Limit of quantification
eDNA	Environmental DNA	MT-RNR2	Mitochondrial 16S gene
gDNA	Total genomic DNA extracted from voucher specimen	NTC	qPCR no template control
LOB	Limit of blank	qPCR	Quantitative real-time polymerase chain reaction
LOD	Limit of detection	SE	Standard error

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BV JOB #: E20240605-1
Report Date: 2024/06/13
Report #: DI20240613
Version: 1

Client Name: Dillon Consulting Limited
Client Project #: 23-6465
Site Location: Country Harbour
Sampler Initials: TS

From Canada, send to:
Bureau Veritas, DNA Services
335 Laird Rd #2
Guelph, ON N1G 4P7
eDNA@bureauveritas.com

From USA, send to:
Bureau Veritas
240 Portage Rd
Po Box 670, PMB 19
Lewiston NY 149092-1604

ENVIRONMENTAL DNA (eDNA) CHAIN OF CUSTODY RECORD

Page 1 of 1

«An incomplete or incorrect form may lead to delays in testing»

ENV COC - 00020/3

COC #: 20240605-1

1 Invoice Information (Required)	2 Report Information (if differs from Invoice)	3 Project Information (where applicable)	4 Turnaround Time (TAT) (Required)
Company Name: Dillon Consulting	Company Name:	Quotation #:	Regular TAT (Most analyses)
Contact Name: Shauna Gallant	Contact Name: Shauna Gallant, Nadine Wambolt	P.O. #:	✓ 10 business days (Sample # ≤ 50)
Address: 137 Chain Lake Drive	Address:	Project #: 23-6465	15 business days (Sample # > 50)
City: HALIFAX Prov or State: NS	City: Prov or State:	Site Location: Country Harbour	From date received
Postal or ZIP Code: B3S 1B3	Phone: Fax:	Sampled By: Tyler Sims	PLEASE REQUEST RUSH FROM CUSTOMER SERVICE
Phone: 902-478-8291 Fax: halifax@dillon.ca	Email: nwambolt@dillon.ca, sgallant@dillon.ca	Note:	Rush TAT (Surcharges will be applied)
Email: sgallant@dillon.ca			5 business days (Sample # ≤ 50)
			10 business days (Sample # > 50)
			From date received

eDNA ANALYSIS

5 IMPORTANT INFORMATION	6 CLIENT SPECIAL INSTRUCTIONS
• Water samples should be kept cool and filtered as soon as possible (within 24 hours of collection). • Cellulose Nitrate (CN) filter is recommended to use for eDNA test because of higher eDNA recovery. • Preserve filter in self-indicating silica beads (2-4 mm diameter) or molecular grade ethanol (95 to 100%) immediately following sample filtration.	

7 Number	Sample Identification	8 Date Sampled YYYY MM DD	9 Date Filtered and Preserved YYYY MM DD	10 Filter Material	11 Filter Size (Diameter)	12 Filter Pore Size (µm)	13 Preservation Method (Ethanol / Silica)	14 Assays Requested[1]	15 Comments
1	~~UPSTREAM eDNA~~	~~2024 06 03~~						Both Samples are requested to have the following 5 assays:	Both Samples require filtering
2	~~DOWNSTREAM eDNA~~	~~2024 06 03~~							
3									
4	SW19 11:45	2024 06 03							
5	SW20 11:25 time sampled	2024 06 03							
6								ANRO - American eel (Anguilla rostrata)	
7									
8									
9								eFish1 general fish assay	
10									
11								eLIPI1 Northern Leopard Frog (Lithobates (Rana) pipiens)	
12									
13									
14								eDRspp1 Mussel species (Dreissena spp.)	
15									
16									
17								eGLIN1 Wood Turtle (Glyptemys insculpta)	
18									
19									
20									

16 RELINQUISHED BY: (Signature/Print)	17 DATE: (YYYY/MM/DD)	18 TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
Tyler Sims	2024 06 03	14 47	JL - LD Laura Dirks	For Lab Use Only JUN 05 2024	8:48 am

[1] See instruction guide for the available eDNA assays at Bureau Veritas.

Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Bureau Veritas' standard Terms and Conditions. Signing of this Chain of Custody document is acknowledgment and acceptance of our terms which are available for viewing at https://www.bvna.com/coc-terms-and-conditions

Appendix F

Human Health Model

Former Country Harbour Mine

HHRA (Draft) Risk Assessment Model

Receptor Parameters

Parameter	INFANT	TODDLER	CHILD	TEEN	ADULT	Reference
body weight (kg)	8.2	16.5	32.9	59.7	70.7	Health Canada, 2024
breathing rate (m^3/d)	2.2	8.3	14.5	15.6	16.6	Health Canada, 2024
water ingestion rate (L/d)	0.3	0.6	0.8	1	1.5	Health Canada, 2024
soil ingestion rate (g/d)	0.02	0.08	0.02	0.02	0.02	Health Canada, 2024
hand surface area (m^2)	0.032	0.043	0.059	0.08	0.089	Health Canada, 2024
hand soil adherence factor (g/m^2/d)	1	1	1	1	1	Health Canada, 2024
skin surface area other than hands - arms and legs (m^2)	0.146	0.258	0.455	0.72	0.822	Health Canada, 2024
skin (non-hand) soil adherence factor (g/m^2/d)	0.1	0.1	0.1	0.1	0.1	Health Canada, 2024
Age Group Duration	0.5	4.5	7	8	60	Health Canada, 2024

Time on Site per Receptor Group	Hours/Day	Days/Week	Weeks/Year	Notes
Outdoor Site Visitor	2	1	26	*May to October*
Outdoor Site Worker	10	5	48	*Assumed working on site 2 years of 40 year worker lifestage*

Currently Displayed Scenario: Outdoor Site Visitor

Currently Displayed Receptor: ADULT

Exposure Time (outdoors)	Value	Reference	Notes
exposure term for soil ingestion & dermal contact pathway (unitless)	0.07143	Assumed	
exposure term for soil inhalation pathway (unitless)	0.00595	Assumed	
exposure term for direct contact pathway (developmental) (unitless)	0.14286	Assumed	*Amortization limited to days/week for developemental toxicants (i.e., lead)*

Environmental Parameters

Parameter	Value	Reference	Notes
outdoor dust level (g/m3)	7.60E-06	Health Canada, 2024	*default value of respirable particulate matter*
Fraction of airborne dust generated from soil	1	Assumed	
Fraction of inside dust from outside dust	0	Assumed	

Hazard Parameters

	TRVs for Non-Carcinogens (µg/kg BW/day for non-carcinogens)				TRVs for Carcinogens (µg/kg BW/d)$^{-1}$			
Parameter	oral - noncancer	Reference	inhalation - noncancer	Reference2	oral - cancer	Reference3	inhalation - cancer	Reference4
Arsenic	-	-	-		0.0018	HC, 2021	0.027	HC, 2021
Cobalt	3	US EPA PPTRV, 2008	2.35E-02	ATSDR MRL, 2023; Route to route from oral	-	-	0.0328	CALEPA OEHHA, 2023
Lead	0.5	HC, 2021	0.5	HC, 2021	-	-	-	-
Mercury	0.3	HC, 2021	-	-	-	-	-	-

RAFs

Parameter	RAF_{dermal}	Reference	RAF_{oral}	Reference2	$RAF_{inhalation}$	Reference3
Arsenic	0.03	HC, 2021	0.42	Calculated*	1	Assumed
Cobalt	0.01	MECP, 2011	1	MECP, 2011	1	Assumed
Lead	0.006	HC, 2021	0.6	HC, 2017	1	Assumed
Mercury	1	HC, 2021	0.5	MECP, 2011	1	Assumed

*Oral RAF for arsenic calculated from the Health Canada recommended equation for estimating relative bioavailability (RBA) below. The calculated RBA is used as the oral RAF in this model for arsenic.

$RBA_{arsenic} = 0.79(IVBA) + 0.03$

Where:

RBA = Relative Bioavailability

IVBA = In Vitro Bioaccessibility

The 95th percentile of analyzed IVBA data (0.4955) for arsenic in soil was used for the IVBA

Exposure Point Concentrations	Surface Soil (µg/g) - for Outdoor Site Visitor		Soil, full depth (µg/g) - for Outdoor Site Worker		Groundwater (µg/L)	
Parameter	EPC - soil	Rationale1	EPC - soil2	Rationale2	EPC - GW2	Rationale3
Arsenic	1.52E+03	95% Approximate Gamma UCL	1.60E+03	95% Approximate Gamma UCL	3.91E-02	24MW-03
Cobalt	1.23E+01	95% H-UCL	1.21E+01	95% H-UCL	4.70E-03	24MW-03
Lead	1.61E+02	95% H-UCL	1.54E+02	95% H-UCL	1.44E-03	24MW-03
Mercury	3.80E+01	95th Percentile	3.67E+01	95th Percentile	5.00E-06	24MW-03

*Mercury was reported <RDL in GW, assumed concentration equal to RDL.

		=(Inhalation Rate*Cs*Outdoor Dust Level*Fraction*Etinh*RAFinh)/BW			=(Soil Ing. Rate*Cs*Eting*RAForal)/BW			=(Ahand*Hand adherence*Cs*ETderm*RAFderm)/BW			=(Abody*Adherence body*Cs*RAFderm*Etderm)/BW					
Exposure and Risk Calculations (Direct Soil Contact Pathways)	C_s	Outdoor Dust Inhalation	Indoor Dust Inhalation	Total Dust Inhalation	Outdoor Soil Ingestion	Indoor Dust Ingestion	Total soil/dust ingestion	Outdoor Dermal Contact (hand)	Indoor Dermal Contact (hand)	Total Dermal Contact (hand)	Outdoor Dermal Contact (arms and legs)	Indoor Dermal Contact (arms and legs)	Total Dermal Contact (arms and legs)	Total Soil Oral + Dermal	Total Oral + Dermal	Total Dust Inhalation
Contaminant	Soil EPC (µg/g)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)	Exposure (µg/kg BW-d)
Arsenic	1515.2714	1.60947E-05	0.00000E+00	1.60947E-05	1.29037E-02	0.00000E+00	1.29037E-02	4.08747E-03	0.00000E+00	4.08747E-03	3.77517E-03	0.00000E+00	3.77517E-03	2.07663E-02	2.08E-02	1.61E-05
Cobalt	12.25227	1.30140E-07	0.00000E+00	1.30140E-07	2.47571E-04	0.00000E+00	2.47571E-04	1.10169E-05	0.00000E+00	1.10169E-05	1.01752E-05	0.00000E+00	1.01752E-05	2.68763E-04	2.69E-04	1.30E-07
Lead	160.53031	1.70510E-06	0.00000E+00	1.70510E-06	3.89243E-03	0.00000E+00	3.89243E-03	1.73213E-04	0.00000E+00	1.73213E-04	1.59979E-04	0.00000E+00	1.59979E-04	4.22562E-03	4.23E-03	1.71E-06
Mercury	38.03	4.03942E-07	0.00000E+00	4.03942E-07	3.84219E-04	0.00000E+00	3.84219E-04	3.41955E-03	0.00000E+00	3.41955E-03	3.15828E-03	0.00000E+00	3.15828E-03	6.96205E-03	6.96E-03	4.04E-07

=(Cw*Water Intake Rate*ETing*RAFo)/BW

Exposure and Risk Calculations (Drinking Water Ingestion Pathways)	C_w	Drinking Water Ingestion
Contaminant	Drinking Water EPC (µg/L)	Exposure (µg/kg BW-d)
Arsenic	0.0391	5.93E-05
Cobalt	0.0047	7.12E-06
Lead	0.00144	2.62E-06
Mercury	0.000005	3.79E-09

Assume an RAF_{oral} of 1 for drinking water for arsenic as RAF_{oral} is based on soil BA data.

Total Exposure and Risk (all site pathways)

Exposure Summary by Pathway	Arsenic	Cobalt	Lead	Mercury	
ADULT: total soil (oral + dermal) exposure (ug/kg BW-d)	2.08E-02	2.69E-04	4.23E-03	6.96E-03	=TotalExposure (oral + dermal)
soil ingestion (ug/kg BW-d)	1.3E-02	2.5E-04	3.9E-03	3.8E-04	
soil hand (ug/kg BW-d)	4.1E-03	1.1E-05	1.7E-04	3.4E-03	
soil body (ug/kg BW-d)	3.8E-03	1.0E-05	1.6E-04	3.2E-03	
ADULT: soil inhalation exposure (ug/kg BW-d)	1.6E-05	1.3E-07	1.7E-06	4.0E-07	=TotalExposure (soil inhalation)
ADULT: drinking water exposure (ug/kg BW-d)	5.9E-05	7.1E-06	2.6E-06	3.8E-09	=TotalExposure (drinking water)
Risk by Route					
HQ (oral + dermal)	-	9.2E-05	8.5E-03	2.3E-02	=TotalExposure / TRV
HQ (inhalation)	-	4.3E-08	3.4E-06	1.3E-06	=TotalExposure / TRV
ILCR (oral + dermal)	2.8E-05	-	-	-	=TotalExposure * TRV * (Age Group Duration/80 years)
ILCR (inhalation	3.3E-07	3.2E-09	-	-	=TotalExposure * TRV * (Age Group Duration/80 years)

For the worker, also multiplied 2/40, assuming worker will be on site for 2 years out of their working life.

Threshold Values	
Non-Cancer (THQ)	0.2
Cancer (TCRL)	1.00E-05

Summary Table - Risk Estimates for Outdoor Site Visitor

	Parameter (exposure route)	INFANT	TODDLER	CHILD	TEEN	ADULT
Non-Carcinogenic Risk	Cobalt (oral + dermal)		1.4E-03	1.9E-04	1.1E-04	9.2E-05
	Cobalt (inhalation)		9.3E-08	8.1E-08	4.8E-08	4.3E-08
	Lead (oral + dermal)		1.3E-01	1.8E-02	9.9E-03	8.5E-03
	Lead (inhalation)		7.3E-06	6.4E-06	3.8E-06	3.4E-06
	Mercury (oral + dermal)		6.0E-02	3.2E-02	2.5E-02	2.3E-02
	Mercury (inhalation)		2.9E-06	2.5E-06	1.5E-06	1.3E-06
Carcinogenic Risk	Arsenic (oral + dermal)		2.4E-05	6.0E-06	4.2E-06	2.8E-05
	Arsenic (inhalation)		2.5E-08	3.8E-08	4.4E-08	3.3E-07
	Cobalt (inhalation)		2.4E-10	3.7E-10	4.3E-10	3.2E-09

Notes

Lifestage not assessed for the Outdoor Site Visitor

BOLD AND RED values denote an exceedance of the THQ or TCRL

Acronyms

TRV	Toxicity Reference Value
RAF	Relative Absorption Factor
US EPA	United States Environmental Protection Agency
PPRTV	Provisional Peer-Reviewed Toxicity Values
CALEPA	California Environmental Protection Agency
OEHHA	Office of Environmental Health Hazard Assessment
ATSDR MRL	Agency for Toxicity Substances and Disease Registry Minimal Risk Levels
HC	Health Canada
MECP	(Ontario) Ministry of the Environment, Conservation and Parks
HQ	Hazard Quotient
THQ	Target Hazard Quotient
ICLR	Incremental Cancer Risk Level
TCRL	Target Cancer Risk Level

Arsenic

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
As	99	0	2.39	20600	1194.7213	394.33778	2364.0272	237.59368	676.50111	6.1086506	1.9787269

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	99%ile
As	99	0	36.48	84.9	121	496	1270	1530	2364	4219	7438.6

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

As

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	97
Minimum	2.39
Maximum	20600
Mean of Raw Data	1247.0913
Standard Deviation of Raw Data	2385.8289
Khat	0.5497195
Theta hat	2268.5956
Kstar	0.5400872
Theta star	2309.0553
Mean of Log Transformed Data	5.9897782
Standard Deviation of Log Transformed Data	1.7511353

Normal GOF Test Results

Correlation Coefficient R	0.6769364
Approximate Shapiro Wilk Test Statistic	0.50616
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.3009375
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9065929
A-D Test Statistic	0.6866636
A-D Critical (0.0500000) Value	0.813813
K-S Test Statistic	0.0688314
K-S Critical(0.0500000) Value	0.0937343

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9867155
Approximate Shapiro Wilk Test Statistic	0.9671443
Approximate Shapiro Wilk P Value	0.0818681
Lilliefors Test Statistic	0.1001041
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

As

General Statistics

Total Number of Observations	99	Number of Distinct Observations	94
		Number of Missing Observations	0
Minimum	2.39	Mean	1194.7213
Maximum	20600	Median	496
SD	2364.0272	Std. Error of Mean	237.59368
Coefficient of Variation	1.9787269	Skewness	6.1086506

Normal GOF Test

Shapiro Wilk Test Statistic	0.4769217	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3070026	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.1032595	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	1589.2578	95% Adjusted-CLT UCL (Chen-1995)	1741.3911
		95% Modified-t UCL (Johnson-1978)	1613.5693

Gamma GOF Test

A-D Test Statistic	0.6712237	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.8125123	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.073343	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.094691	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.5627654	k star (bias corrected MLE)	0.5524459
Theta hat (MLE)	2122.9474	Theta star (bias corrected MLE)	2162.6033
nu hat (MLE)	111.42755	nu star (bias corrected)	109.38429
MLE Mean (bias corrected)	1194.7213	MLE Sd (bias corrected)	1607.3917
		Approximate Chi Square Value (0.05)	86.244443
Adjusted Level of Significance	0.0475758	Adjusted Chi Square Value	85.942494

Assuming Gamma Distribution

95% Approximate Gamma UCL	1515.2714	95% Adjusted Gamma UCL	1520.5952

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9630924	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.0422232	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.101971	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0817097	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.8712934	Mean of logged Data	5.9772079
Maximum of Logged Data	9.9330464	SD of logged Data	1.7294402

Assuming Lognormal Distribution

95% H-UCL	3011.0277	90% Chebyshev (MVUE) UCL	3001.094
95% Chebyshev (MVUE) UCL	3591.9147	97.5% Chebyshev (MVUE) UCL	4411.9511
99% Chebyshev (MVUE) UCL	6022.7536		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1585.5281	95% BCA Bootstrap UCL	1769.2171
95% Standard Bootstrap UCL	1580.3306	95% Bootstrap-t UCL	1953.929
95% Hall's Bootstrap UCL	3274.8324	95% Percentile Bootstrap UCL	1614.5404
90% Chebyshev(Mean, Sd) UCL	1907.5023	95% Chebyshev(Mean, Sd) UCL	2230.3681
97.5% Chebyshev(Mean, Sd) UCL	2678.4933	99% Chebyshev(Mean, Sd) UCL	3558.7485

Suggested UCL to Use

95% Approximate Gamma UCL 1515.2714 Selected as data appear gamma 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.

Cobalt

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Co	99	0	0.15	162	9.0040404	3.4816984	19.622441	1.9721295	3.0392884	5.6093031	2.1792929

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	99%ile
Co	99	0	0.74	1.312	1.805	3.09	8.125	9.762	16.14	34.69	68.116

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Co

Raw Statistics	102
Number of Valid Observations	97
Number of Distinct Observations	0.15
Minimum	162
Maximum	8.977451
Mean of Raw Data	19.373095
Standard Deviation of Raw Data	0.6542683
Khat	13.721361
Theta hat	0.641561
Kstar	13.993137
Theta star	1.2621545
Mean of Log Transformed Data	1.3334573
Standard Deviation of Log Transformed Data	

Normal GOF Test Results

Correlation Coefficient R	0.6300832
Approximate Shapiro Wilk Test Statistic	0.4415756
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.324319
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.8803395
A-D Test Statistic	3.6253197
A-D Critical (0.0500000) Value	0.8040204
K-S Test Statistic	0.1398807
K-S Critical(0.0500000) Value	0.0930406

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9933505
Approximate Shapiro Wilk Test Statistic	0.9806026
Approximate Shapiro Wilk P Value	0.5534444
Lilliefors Test Statistic	0.0682941
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

Co

General Statistics

Total Number of Observations	99	Number of Distinct Observations	93
		Number of Missing Observations	0
Minimum	0.15	Mean	9.0040404
Maximum	162	Median	3.09
SD	19.622441	Std. Error of Mean	1.9721295
Coefficient of Variation	2.1792929	Skewness	5.6093031

Normal GOF Test

Shapiro Wilk Test Statistic	0.4395384	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3259155	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.1032595	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	12.278863	95% Adjusted-CLT UCL (Chen-1995)	13.435879
		95% Modified-t UCL (Johnson-1978)	12.464163

Gamma GOF Test

A-D Test Statistic	3.6411211	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.8048952	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.1549357	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0941496	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.6436638	k star (bias corrected MLE)	0.6308928
Theta hat (MLE)	13.988733	Theta star (bias corrected MLE)	14.271902
nu hat (MLE)	127.44543	nu star (bias corrected)	124.91678
MLE Mean (bias corrected)	9.0040404	MLE Sd (bias corrected)	11.335995
		Approximate Chi Square Value (0.05)	100.10366
Adjusted Level of Significance	0.0475758	Adjusted Chi Square Value	99.777398

Assuming Gamma Distribution

95% Approximate Gamma UCL	11.23591	95% Adjusted Gamma UCL	11.27265

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9800347	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.5318423	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.066359	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0817097	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.89712	Mean of logged Data	1.2475202
Maximum of Logged Data	5.0875963	SD of logged Data	1.3436885

Assuming Lognormal Distribution

95% H-UCL	12.25227	90% Chebyshev (MVUE) UCL	12.976667
95% Chebyshev (MVUE) UCL	15.030234	97.5% Chebyshev (MVUE) UCL	17.880505
99% Chebyshev (MVUE) UCL	23.479311		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	12.247905	95% BCA Bootstrap UCL	13.857879
95% Standard Bootstrap UCL	12.221943	95% Bootstrap-t UCL	15.068345
95% Hall's Bootstrap UCL	24.809612	95% Percentile Bootstrap UCL	12.405051
90% Chebyshev(Mean, Sd) UCL	14.920429	95% Chebyshev(Mean, Sd) UCL	17.600354
97.5% Chebyshev(Mean, Sd) UCL	21.319985	99% Chebyshev(Mean, Sd) UCL	28.626481

Suggested UCL to Use

95% H-UCL 12.25227 Selected as data appear to be lognormal 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.

Lead

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Pb	99	0	3.56	1360	127.72232	63.474059	212.32435	21.3394	51.000741	3.8564685	1.6623903

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	99%ile
Pb	99	0	20.7	25.26	27.05	55.3	128.5	138.8	237.2	459.6	1144.4

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Pb

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	94
Minimum	3.56
Maximum	1360
Mean of Raw Data	124.50304
Standard Deviation of Raw Data	209.83852
Khat	0.8400979
Theta hat	148.20063
Kstar	0.8219251
Theta star	151.47735
Mean of Log Transformed Data	4.1223585
Standard Deviation of Log Transformed Data	1.1347528

Normal GOF Test Results

Correlation Coefficient R	0.7087243
Approximate Shapiro Wilk Test Statistic	0.5274214
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.310252
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9231725
A-D Test Statistic	3.7802355
A-D Critical (0.0500000) Value	0.7906987
K-S Test Statistic	0.1558963
K-S Critical(0.0500000) Value	0.0921211

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9884917
Approximate Shapiro Wilk Test Statistic	0.9714182
Approximate Shapiro Wilk P Value	0.1685105
Lilliefors Test Statistic	0.0750801
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

Pb

General Statistics

Total Number of Observations	99	Number of Distinct Observations	92
		Number of Missing Observations	0
Minimum	3.56	Mean	127.72232
Maximum	1360	Median	55.3
SD	212.32435	Std. Error of Mean	21.3394
Coefficient of Variation	1.6623903	Skewness	3.8564685

Normal GOF Test

Shapiro Wilk Test Statistic	0.5339648	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3123132	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.1032595	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	163.15749	95% Adjusted-CLT UCL (Chen-1995)	171.66012
		95% Modified-t UCL (Johnson-1978)	164.53598

Gamma GOF Test

A-D Test Statistic	3.5167156	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.7904389	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.15974	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0931389	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.8430189	k star (bias corrected MLE)	0.8242069
Theta hat (MLE)	151.50589	Theta star (bias corrected MLE)	154.96392
nu hat (MLE)	166.91774	nu star (bias corrected)	163.19296
MLE Mean (bias corrected)	127.72232	MLE Sd (bias corrected)	140.68529
		Approximate Chi Square Value (0.05)	134.65646
Adjusted Level of Significance	0.0475758	Adjusted Chi Square Value	134.27606

Assuming Gamma Distribution

95% Approximate Gamma UCL	154.78933	95% Adjusted Gamma UCL	155.22785

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9719229	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.1912168	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0794105	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0817097	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.2697605	Mean of logged Data	4.1506313
Maximum of Logged Data	7.21524	SD of logged Data	1.1413414

Assuming Lognormal Distribution

95% H-UCL	160.53031	90% Chebyshev (MVUE) UCL	172.24555
95% Chebyshev (MVUE) UCL	195.70397	97.5% Chebyshev (MVUE) UCL	228.26334
99% Chebyshev (MVUE) UCL	292.21993		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	162.82251	95% BCA Bootstrap UCL	173.79364
95% Standard Bootstrap UCL	162.73085	95% Bootstrap-t UCL	181.64737
95% Hall's Bootstrap UCL	180.37763	95% Percentile Bootstrap UCL	164.6697
90% Chebyshev(Mean, Sd) UCL	191.74052	95% Chebyshev(Mean, Sd) UCL	220.73861
97.5% Chebyshev(Mean, Sd) UCL	260.98683	99% Chebyshev(Mean, Sd) UCL	340.04667

Suggested UCL to Use

95% H-UCL 160.53031 Selected as data appear to be lognormal 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.

Mercury

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Hg	99	0	0.0127	2920	35.913642	0.7201479	293.38443	29.486244	0.5684211	9.8923563	8.1691638

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	99%ile
Hg	99	0	0.06792	0.0972	0.112	4.52E-01	3.475	6.06	15.76	38.03	164.24

95%ile was selected as the dataset is highy skewed by elevated hot spots of contamination; while data distribution is non-parametric, most non-parametric UCLs are nonsensical and therefore all calculated UCL options are rejected

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Hg

Raw Statistics

Number of Valid Observations	102		
Number of Distinct Observations	98		
Minimum	0.006		
Maximum	2920		
Mean of Raw Data	34.936267		
Standard Deviation of Raw Data	289.05035		
Khat	0.1879449		
Theta hat	185.88565		
Kstar	0.1889531		
Theta star	184.89386		
Mean of Log Transformed Data	-0.400002		
Standard Deviation of Log Transformed Data	2.3514211		

Normal GOF Test Results

Correlation Coefficient R	0.2879885		
Approximate Shapiro Wilk Test Statistic	0.1219194		
Approximate Shapiro Wilk P Value	0		
Lilliefors Test Statistic	0.4519069		
Lilliefors Critical (0.0500000) Value	0.0879893		

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.6599828		
A-D Test Statistic	14.391555		
A-D Critical (0.0500000) Value	0.9293733		
K-S Test Statistic	0.2571943		
K-S Critical(0.0500000) Value	0.0991597		

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9763075		
Approximate Shapiro Wilk Test Statistic	0.9531779		
Approximate Shapiro Wilk P Value	4.72E-03		
Lilliefors Test Statistic	0.0956543		
Lilliefors Critical (0.0500000) Value	0.0879893		

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

UCL Statistics for Uncensored Full Data Sets

Hg

General Statistics

Total Number of Observations	99	Number of Distinct Observations	95
		Number of Missing Observations	0
Minimum	0.0127	Mean	35.913642
Maximum	2920	Median	0.452
SD	293.38443	Std. Error of Mean	29.486244
Coefficient of Variation	8.1691638	Skewness	9.8923563

Normal GOF Test

Shapiro Wilk Test Statistic	0.1236033	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.4513037	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.1032595	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	84.877062	95% Adjusted-CLT UCL (Chen-1995)	115.73855
		95% Modified-t UCL (Johnson-1978)	89.763027

Gamma GOF Test

A-D Test Statistic	14.517394	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.9273701	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.2656506	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.1001658	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.189781	k star (bias corrected MLE)	0.1907641
Theta hat (MLE)	189.23729	Theta star (bias corrected MLE)	188.26209
nu hat (MLE)	37.576638	nu star (bias corrected)	37.771285
MLE Mean (bias corrected)	35.913642	MLE Sd (bias corrected)	82.22638
		Approximate Chi Square Value (0.05)	24.698742
Adjusted Level of Significance	0.0475758	Adjusted Chi Square Value	24.542679

Assuming Gamma Distribution

95% Approximate Gamma UCL	54.922004	95% Adjusted Gamma UCL	55.271244

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9344458	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	7.03E-05	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.1042774	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0817097	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.366153	Mean of logged Data	-0.328299
Maximum of Logged Data	7.9793389	SD of logged Data	2.2826223

Assuming Lognormal Distribution

95% H-UCL	23.328563	90% Chebyshev (MVUE) UCL	19.176582
95% Chebyshev (MVUE) UCL	23.82298	97.5% Chebyshev (MVUE) UCL	30.271999
99% Chebyshev (MVUE) UCL	42.939849		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	84.414199	95% BCA Bootstrap UCL	126.27482
95% Standard Bootstrap UCL	82.948273	95% Bootstrap-t UCL	781.98696
95% Hall's Bootstrap UCL	502.69791	95% Percentile Bootstrap UCL	93.926437
90% Chebyshev(Mean, Sd) UCL	124.37238	95% Chebyshev(Mean, Sd) UCL	164.4412
97.5% Chebyshev(Mean, Sd) UCL	220.05518	99% Chebyshev(Mean, Sd) UCL	329.29807

Suggested UCL to Use

95% Student's-t UCL 84.877062 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.

Arsenic

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
As	102	0	2.39	20600	1247.0913	399.32603	2385.8289	236.23226	664.1957	5.7574487	1.9131149

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	99%ile
As	102	0	37.54	78.96	104.25	488	1360	1614	2689	4366.5	7162.1

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

As

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	97
Minimum	2.39
Maximum	20600
Mean of Raw Data	1247.0913
Standard Deviation of Raw Data	2385.8289
Khat	0.5497195
Theta hat	2268.5956
Kstar	0.5400872
Theta star	2309.0553
Mean of Log Transformed Data	5.9897782
Standard Deviation of Log Transformed Data	1.7511353

Normal GOF Test Results

Correlation Coefficient R	0.6769364
Approximate Shapiro Wilk Test Statistic	0.50616
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.3009375
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9065929
A-D Test Statistic	0.6866636
A-D Critical (0.0500000) Value	0.813813
K-S Test Statistic	0.0688314
K-S Critical(0.0500000) Value	0.0937343

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9867155
Approximate Shapiro Wilk Test Statistic	0.9671443
Approximate Shapiro Wilk P Value	0.0818681
Lilliefors Test Statistic	0.1001041
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

As

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	97.000000
		Number of Missing Observations	0
Minimum	2.3900000	Mean	1247.0913
Maximum	20600.000	Median	488.00000
SD	2385.8289	Std. Error of Mean	236.23226
Coefficient of Variation	1.9131149	Skewness	5.7574487

Normal GOF Test

Shapiro Wilk Test Statistic	0.5061600	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3009375	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	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	1639.2558	95% Adjusted-CLT UCL (Chen-1995)	1779.5551
		95% Modified-t UCL (Johnson-1978)	1661.7008

Gamma GOF Test

A-D Test Statistic	0.6866636	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.8138130	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0688314	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0937343	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.5497195	k star (bias corrected MLE)	0.5400872
Theta hat (MLE)	2268.5956	Theta star (bias corrected MLE)	2309.0553
nu hat (MLE)	112.14278	nu star (bias corrected)	110.17780
MLE Mean (bias corrected)	1247.0913	MLE Sd (bias corrected)	1696.9392
		Approximate Chi Square Value (0.05)	86.949683
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	86.655534

Assuming Gamma Distribution

95% Approximate Gamma UCL	1580.2446	95% Adjusted Gamma UCL	1585.6087

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9671443	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.0818681	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.1001041	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.8712934	Mean of logged Data	5.9897782
Maximum of Logged Data	9.9330464	SD of logged Data	1.7511353

Assuming Lognormal Distribution

95% H-UCL	3120.6502	90% Chebyshev (MVUE) UCL	3161.7320
95% Chebyshev (MVUE) UCL	3785.9502	97.5% Chebyshev (MVUE) UCL	4652.3408
99% Chebyshev (MVUE) UCL	6354.1974		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1635.6588	95% BCA Bootstrap UCL	1815.6061
95% Standard Bootstrap UCL	1627.9238	95% Bootstrap-t UCL	1897.2504
95% Hall's Bootstrap UCL	3304.5441	95% Percentile Bootstrap UCL	1670.1825
90% Chebyshev(Mean, Sd) UCL	1955.7881	95% Chebyshev(Mean, Sd) UCL	2276.8038
97.5% Chebyshev(Mean, Sd) UCL	2722.3613	99% Chebyshev(Mean, Sd) UCL	3597.5726

Suggested UCL to Use

95% Approximate Gamma UCL	1580.2446	Selected as data appear Gamma 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.

Cobalt

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Co	100	0	0.15	162	8.977451	3.5330251	19.373095	1.9182223	3.1875463	5.6588862	2.1579728

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	99%ile
Co	100	0	0.761	1.364	1.8475	3.185	8.1525	9.734	15.96	33.26	66.119

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Co

Raw Statistics

Number of Valid Observations	101
Number of Distinct Observations	96
Minimum	0.15
Maximum	162
Mean of Raw Data	9.0060396
Standard Deviation of Raw Data	19.467557
Khat	0.6490545
Theta hat	13.87563
Kstar	0.6363763
Theta star	14.152066
Mean of Log Transformed Data	1.2567635
Standard Deviation of Log Transformed Data	1.3389904

Normal GOF Test Results

Correlation Coefficient R	0.6309424
Approximate Shapiro Wilk Test Statistic	0.4425134
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.324586
Lilliefors Critical (0.0500000) Value	0.0884172

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.8819466
A-D Test Statistic	3.6448309
A-D Critical (0.0500000) Value	0.8044916
K-S Test Statistic	0.1456538
K-S Critical(0.0500000) Value	0.0933448

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9933163
Approximate Shapiro Wilk Test Statistic	0.9803664
Approximate Shapiro Wilk P Value	0.5436054
Lilliefors Test Statistic	0.0681178
Lilliefors Critical (0.0500000) Value	0.0884172

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

Co

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	97.000000
		Number of Missing Observations	0
Minimum	0.1500000	Mean	8.9774510
Maximum	162.00000	Median	3.1850000
SD	19.373095	Std. Error of Mean	1.9182223
Coefficient of Variation	2.1579728	Skewness	5.6588862

Normal GOF Test

Shapiro Wilk Test Statistic	0.4415756	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3243190	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	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	12.161854	95% Adjusted-CLT UCL (Chen-1995)	13.281091
		95% Modified-t UCL (Johnson-1978)	12.340989

Gamma GOF Test

A-D Test Statistic	3.6253197	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.8040204	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.1398807	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0930406	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.6542683	k star (bias corrected MLE)	0.6415610
Theta hat (MLE)	13.721361	Theta star (bias corrected MLE)	13.993137
nu hat (MLE)	133.47072	nu star (bias corrected)	130.87845
MLE Mean (bias corrected)	8.9774510	MLE Sd (bias corrected)	11.208153
		Approximate Chi Square Value (0.05)	105.45107
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	105.12592

Assuming Gamma Distribution

95% Approximate Gamma UCL	11.142180	95% Adjusted Gamma UCL	11.176643

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9806026	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.5534444	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0682941	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.897120	Mean of logged Data	1.2621545
Maximum of Logged Data	5.0875963	SD of logged Data	1.3334573

Assuming Lognormal Distribution

95% H-UCL	12.031171	90% Chebyshev (MVUE) UCL	12.890180
95% Chebyshev (MVUE) UCL	14.897737	97.5% Chebyshev (MVUE) UCL	17.684148
99% Chebyshev (MVUE) UCL	23.157513		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	12.132646	95% BCA Bootstrap UCL	13.510784
95% Standard Bootstrap UCL	12.184066	95% Bootstrap-t UCL	14.938999
95% Hall's Bootstrap UCL	24.590353	95% Percentile Bootstrap UCL	12.332941
90% Chebyshev(Mean, Sd) UCL	14.732118	95% Chebyshev(Mean, Sd) UCL	17.338788
97.5% Chebyshev(Mean, Sd) UCL	20.956745	99% Chebyshev(Mean, Sd) UCL	28.063522

Suggested UCL to Use

95% H-UCL 12.031171 Selected as data appear Lognormal 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.

Lead

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Pb	102	0	3.56	1360	124.89029	61.930387	209.806	20.77389	51.000741	3.9140511	1.6799224

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	99%ile
Pb	102	0	19.95	24.34	26.8	55.05	126.75	138	231.7	444.15	1136.51

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Pb

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	94
Minimum	3.56
Maximum	1360
Mean of Raw Data	124.89029
Standard Deviation of Raw Data	209.806
Khat	0.8406782
Theta hat	148.55898
Kstar	0.8224883
Theta star	151.84446
Mean of Log Transformed Data	4.126011
Standard Deviation of Log Transformed Data	1.1364864

Normal GOF Test Results

Correlation Coefficient R	0.7097341
Approximate Shapiro Wilk Test Statistic	0.5288391
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.3109777
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9235055
A-D Test Statistic	3.7260678
A-D Critical (0.0500000) Value	0.7906707
K-S Test Statistic	0.1569508
K-S Critical(0.0500000) Value	0.0921193

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9885126
Approximate Shapiro Wilk Test Statistic	0.9713438
Approximate Shapiro Wilk P Value	0.1665367
Lilliefors Test Statistic	0.0763865
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

Pb

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	94.000000
		Number of Missing Observations	0
Minimum	3.5600000	Mean	124.89029
Maximum	1360.0000	Median	55.050000
SD	209.80600	Std. Error of Mean	20.773890
Coefficient of Variation	1.6799224	Skewness	3.9140511

Normal GOF Test

Shapiro Wilk Test Statistic	0.5288391	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3109777	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	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	159.37662	95% Adjusted-CLT UCL (Chen-1995)	167.66280
		95% Modified-t UCL (Johnson-1978)	160.71844

Gamma GOF Test

A-D Test Statistic	3.7260678	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.7906707	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.1569508	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0921193	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.8406782	k star (bias corrected MLE)	0.8224883
Theta hat (MLE)	148.55898	Theta star (bias corrected MLE)	151.84446
nu hat (MLE)	171.49835	nu star (bias corrected)	167.78762
MLE Mean (bias corrected)	124.89029	MLE Sd (bias corrected)	137.70947
		Approximate Chi Square Value (0.05)	138.83512
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	138.46025

Assuming Gamma Distribution

95% Approximate Gamma UCL	150.93475	95% Adjusted Gamma UCL	151.34340

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9713438	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.1665367	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0763865	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.2697605	Mean of logged Data	4.1260110
Maximum of Logged Data	7.2152400	SD of logged Data	1.1364864

Assuming Lognormal Distribution

95% H-UCL	153.82111	90% Chebyshev (MVUE) UCL	166.21446
95% Chebyshev (MVUE) UCL	188.53878	97.5% Chebyshev (MVUE) UCL	219.52407
99% Chebyshev (MVUE) UCL	280.38867		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	159.06030	95% BCA Bootstrap UCL	168.46696
95% Standard Bootstrap UCL	160.49208	95% Bootstrap-t UCL	175.59297
95% Hall's Bootstrap UCL	177.19050	95% Percentile Bootstrap UCL	162.49441
90% Chebyshev(Mean, Sd) UCL	187.21196	95% Chebyshev(Mean, Sd) UCL	215.44158
97.5% Chebyshev(Mean, Sd) UCL	254.62320	99% Chebyshev(Mean, Sd) UCL	331.58789

Suggested UCL to Use

95% H-UCL 153.82111 Selected as data appear Lognormal 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.

Mercury

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Hg	102	0	0.006	2920	34.937541	0.6705341	289.05021	28.620235	0.5387695	10.041014	8.2733415

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	99%ile
Hg	102	0	0.06348	0.08954	0.108	0.428	3.6375	6.28	14.82	36.65	107.96

95%ile was selected as the dataset is highy skewed by elevated hot spots of contamination; while data distribution is non-parametric, most non-parametric UCLs are nonsensical and therefore all calculated UCL options are rejected

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Hg

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	98
Minimum	0.006
Maximum	2920
Mean of Raw Data	34.937541
Standard Deviation of Raw Data	289.05021
Khat	0.1879567
Theta hat	185.88082
Kstar	0.1889645
Theta star	184.88946
Mean of Log Transformed Data	-0.399681
Standard Deviation of Log Transformed Data	2.3516665

Normal GOF Test Results

Correlation Coefficient R	0.2879918
Approximate Shapiro Wilk Test Statistic	0.1219217
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.4519052
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.6599756
A-D Test Statistic	14.386844
A-D Critical (0.0500000) Value	0.9293618
K-S Test Statistic	0.2572113
K-S Critical(0.0500000) Value	0.0991593

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9763052
Approximate Shapiro Wilk Test Statistic	0.9531654
Approximate Shapiro Wilk P Value	0.0047074
Lilliefors Test Statistic	0.0956866
Lilliefors Critical (0.0500000) Value	0.0879893

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

UCL Statistics for Uncensored Full Data Sets

Hg

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	98.000000
		Number of Missing Observations	0
Minimum	0.0060000	Mean	34.937541
Maximum	2920.0000	Median	0.4280000
SD	289.05021	Std. Error of Mean	28.620235
Coefficient of Variation	8.2733415	Skewness	10.041014

Normal GOF Test

Shapiro Wilk Test Statistic	0.1219217	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.4519052	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	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	82.449436	95% Adjusted-CLT UCL (Chen-1995)	112.41767
		95% Modified-t UCL (Johnson-1978)	87.191850

Gamma GOF Test

A-D Test Statistic	14.386844	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.9293618	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.2572113	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0991593	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.1879567	k star (bias corrected MLE)	0.1889645
Theta hat (MLE)	185.88082	Theta star (bias corrected MLE)	184.88946
nu hat (MLE)	38.343162	nu star (bias corrected)	38.548755
MLE Mean (bias corrected)	34.937541	MLE Sd (bias corrected)	80.371531
		Approximate Chi Square Value (0.05)	25.328987
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	25.175534

Assuming Gamma Distribution

95% Approximate Gamma UCL	53.172229	95% Adjusted Gamma UCL	53.496331

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9531654	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.0047074	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0956866	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.115996	Mean of logged Data	-0.399681
Maximum of Logged Data	7.9793389	SD of logged Data	2.3516665

Assuming Lognormal Distribution

95% H-UCL	25.510043	90% Chebyshev (MVUE) UCL	21.169822
95% Chebyshev (MVUE) UCL	26.373655	97.5% Chebyshev (MVUE) UCL	33.596374
99% Chebyshev (MVUE) UCL	47.784007		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	82.013639	95% BCA Bootstrap UCL	148.08890
95% Standard Bootstrap UCL	82.861638	95% Bootstrap-t UCL	713.52673
95% Hall's Bootstrap UCL	451.57182	95% Percentile Bootstrap UCL	91.957724
90% Chebyshev(Mean, Sd) UCL	120.79825	95% Chebyshev(Mean, Sd) UCL	159.69026
97.5% Chebyshev(Mean, Sd) UCL	213.67085	99% Chebyshev(Mean, Sd) UCL	319.70529

Suggested UCL to Use

95% Student's-t UCL 82.449436 Rejected as data do not appear normal

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.

EPC determinations for groundwater. All values presented in mg/L.

Data removed from EPC calculation			Location	24MW-01			24MW-02			24MW-03		24MW-04		24MW-05	
			Sample Type	Normal	24MW-DUPA (FD: 24MW-01)	Normal	Normal	Normal	24MW-DUPB (FD: 24MW-02)	Normal	Normal	Normal	Normal	Normal	Normal
			Date	19 Jan 2024		22 May 2024	18 Jan 2024	22 May 2024		20 Jan 2024	22 May 2024	20 Jan 2024	22 May 2024	19 Jan 2024	22 May 2024
		Unit	RDL												
Metals															
	Arsenic	mg/L	0.0001	-	-	0.00017	-	0.0395	0.195	-	0.0391	-	0.0273	-	0.0123
	Cobalt	mg/L	0.0001	-	-	0.00175	-	0.00045	0.0005	-	0.0047	-	0.00245	-	0.00963
	Lead	mg/L	0.00005	-	-	0.00007	-	0.00472	0.0207	-	0.00144	-	0.00197	-	0.000621
	Mercury	mg/L	0.000005	-	-	<0.0000050	-	<0.0000050	<0.0000050	-	<0.0000050	-	0.0000699	-	0.0000474

*Values for 24MW-03 were used to represent the concentrations of contaminants in groundwater closest to the nearest off site potable well (located 50 m south of the site).

Arsenic	Cobalt	Lead	Mercury
0.0391	0.0047	0.00144	<0.0000050

Appendix G

Food Chain Modelling

Meadow Vole - Herbivorous Small Mammal Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	0.0349	FCSAP, 2012.
Average Water Content in Food Items	%	85	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.012	FCSAP, 2012. Calculated based on provided equation of 0.33 kg wet food/kg of BW
Plant Diet Proportion (P_{Plant})	unitless factor	1	FCSAP, 2012. Diet consists of majority berries and seeds with grasses and mushrooms making up the remainder of diet.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0	FCSAP, 2012.
Mammal Diet Proportion (P_{Mam})	unitless factor	0	FCSAP, 2012.
Soil Ingestion Rate (IR_{Soil})	kg/day dw	4.15E-05	FCSAP, 2012. 2.4% of dry food ingestion rate.
Foraging Range	ha	0.35	FCSAP, 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	20.6	0	0	1.9	22.5
Lead	1.54	0	0	0.183	1.72
Vanadium	0.0542	0	0	0.0386	0.0928

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Expousre/TRV)
Arsenic	22.5	9.7	FCSAP, 2021; US EPA, 2005	LOAEL	**2.30E+00**
Lead	1.72	35	FCSAP, 2021; US EPA, 2005; Dillon, 2013	LOAEL	4.90E-02
Vanadium	0.0928	6.7	FCSAP, 2021; US EPA, 2005; Dillon, 2013; Allaway and Stodola, 2011	LOAEL	1.40E-02

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Snowshoe Hare - Herbivorous Small Mammal Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	1.3	FCSAP, 2012.
Average Water Content in Food Items	%	85	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.52	FCSAP, 2012. Calculated from the published value of 0.06 kg dry food/kg wet body weight/day, adjusted for average water content.
Plant Diet Proportion (P_{Plant})	unitless factor	1	FCSAP, 2012.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0	FCSAP, 2012.
Mammal Diet Proportion (P_{Mam})	unitless factor	0	FCSAP, 2012.
Soil Ingestion Rate (IR_{Soil})	kg/day dw	4.91E-03	FCSAP, 2012. 6.3% of dry food ingestion rate, adjusted for average water content.
Foraging Range	ha	1.6	FCSAP, 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	24	0	0	6.03	30
Lead	1.79	0	0	0.581	2.37
Vanadium	0.063	0	0	0.123	0.186

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Exposure/TRV)
Arsenic	30	9.7	FCSAP, 2021; US EPA, 2005	LOAEL	**3.10E+00**
Lead	2.37	35	FCSAP, 2021; US EPA, 2005; Dillon, 2013	LOAEL	6.80E-02
Vanadium	0.186	6.7	FCSAP, 2021; US EPA, 2005; Dillon, 2013; Allaway and Stodola, 2011	LOAEL	2.80E-02

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Ermine - Carnivorous Small Mammal Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	0.089	FCSAP, 2012.
Average Water Content in Food Items	%	68.8	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.031	FCSAP, 2012. Calculated from the published value of 0.11 kg dry food/kg wet body weight/day, adjusted for average water content.
Plant Diet Proportion (P_{Plant})	unitless factor	0	FCSAP, 2012.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.05	FCSAP, 2012. 5% other (amphibians, insects, bird eggs)
Mammal Diet Proportion (P_{Mam})	unitless factor	0.95	FCSAP, 2012. 50% small mammals, 25% birds, 20% rabbits
Soil Ingestion Rate (IR_{Soil})	kg/day dw	3.92E-04	4% based on US EA, 2005b using the long-tailed weasel as a surrogate species; No value provided in FCSAP, 2012.
Foraging Range	ha	1	FCSAP, 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	0	0.768	1.09	7.02	8.88
Lead	0	0.815	3.31	0.677	4.8
Vanadium	0	0.0238	0.132	0.143	0.299

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Expousre/TRV)
Arsenic	8.88	9.7	FCSAP, 2021; US EPA, 2005	**LOAEL**	9.20E-01
Lead	4.8	35	FCSAP, 2021; US EPA, 2005; Dillon, 2013	**LOAEL**	1.40E-01
Vanadium	0.299	6.7	FCSAP, 2021; US EPA, 2005; Dillon, 2013; Allaway and Stodola, 2011	**LOAEL**	4.50E-02

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Ruffed Grouse - Herbivorous Bird Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	0.552	FCSAP, 2012.
Average Water Content in Food Items	%	84.85	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.22	FCSAP, 2012. Calculated based on provided equation of 0.06 kg dry food/kg of BW/day, adjusted for average water content.
Plant Diet Proportion (P_{Plant})	unitless factor	0.85	FCSAP, 2012. Diet for vegetation includes leaves, and berries.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.15	FCSAP, 2012. Diet consists primarily of insects.
Mammal Diet Proportion (P_{Mam})	unitless factor	0	FCSAP, 2012.
Soil Ingestion Rate (IR_{Soil})	kg/day dw	6.62E-04	FCSAP, 2012. No soil ingestion rate provided, a default value was used instead. 2% of dry food ingestion rate. Ingestion rate is 0.06 kg dry food/kg BW/day.
Foraging Range	ha	1	FCSAP , 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	20.3	2.63	0	1.92	24.9
Lead	1.51	2.8	0	0.185	4.5
Vanadium	0.0534	0.0816	0	0.039	0.174

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Expousre/TRV)
Arsenic	24.9	7.3	FCSAP, 2021; CEAEQ, 2012	LOAEL	**3.40E+00**
Lead	4.5	9.9	FCSAP, 2021; US EPA, 2005	LOAEL	4.50E-01
Vanadium	0.174	1.9	FCSAP, 2021; US EPA, 2005; Dillon, 2013	LOAEL	9.20E-02

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Dark-Eyed Junco - Insectivorous Bird Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	0.0188	Dunning, 1993.
Average Water Content in Food Items	%	84.4	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.032	Based on US EPA, 1993 and assumed average food item water content.
Plant Diet Proportion (P_{Plant})	unitless factor	0.4	Martin et al., 1951.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.6	Martin et al., 1951.
Mammal Diet Proportion (P_{Mam})	unitless factor	0	Martin et al., 1951.
Soil Ingestion Rate (IR_{Soil})	kg/day dw	4.66E-04	Beyer et al. 1994; 9.3% based on wild turkey as a surrogate.
Foraging Range	ha	0.833	Reichard and Ketterson, 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	40.8	45	0	39.6	125
Lead	3.04	47.8	0	3.81	54.7
Vanadium	0.107	1.39	0	0.805	2.3

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Expousre/TRV)
Arsenic	125	7.3	FCSAP, 2021; CEAEQ, 2012	LOAEL	**1.70E+01**
Lead	54.7	9.9	FCSAP, 2021; US EPA, 2005	LOAEL	**5.50E+00**
Vanadium	2.3	1.9	FCSAP, 2021; US EPA, 2005; Dillon, 2013	LOAEL	**1.20E+00**

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Common (Masked) Shrew - Insectivorous Small Mammal Food Chain Modelling

Former Country Harbour Mine

Site Media Exposure Point Concentrations

COPC	COPC Concentrations						
	Soil (C_s) (mg/kg dw)[1]	Terrestrial Plants (C_p) (mg/kg ww)[2]		Terrestrial Invertebrate (C_e) (mg/kg ww)[3]		Terrestrial Mammals (C_m) (mg/kg ww)[4]	
Arsenic	1596	Cp=0.03752*Cs	59.9	ln(Ce)=0.706*ln(Cs)+(-1.421)	44	ln(Cm)=0.8188*ln(Cs)+(-4.8471)	3.293
Lead	153.82111	ln(Cp)=0.561*ln(Cs)+(-1.328)	4.469	ln(Ce)=0.807*ln(Cs)+(-0.218)	46.80	ln(Cm)=0.4422*ln(Cs)+0.0761	10.00
Vanadium	32.481392	Cp=0.00485*Cs	0.158	Ce=0.042*Cs	1.36	Cm=0.0123*Cs	0.39952
Water Content of Food Items [5]		85%		84%		84%	

Notes

1. UCLM95 of reported soil concentrations.

2. Terrestrial plant concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Invertebrate concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

2. Mammal concentrations determined using uptake equations from US EPA, 2007; Attachment 4-1 Guidance for Developing ECO SSLs - Table 4a.

5. Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants

Receptor and Diet Parameters

Parameter	Units	Value	Reference
Body weight (BW)	kg	0.0041	FCSAP, 2012.
Average Water Content in Food Items	%	83.2	Terrestrial Plants: 85%; Terrestrial Invertebrates: 84%; Small Mammals: 68% (Sample & Suter, 1994)
Food Ingestion Rate (IR_{Food})	kg/day ww	0.0082	FCSAP, 2012. Calculated based on provided equation of 0.34 kg dry food/kg wet BW/day
Plant Diet Proportion (P_{Plant})	unitless factor	0	FCSAP, 2012.
Invertebrate Diet Proportion (P_{Inv})	unitless factor	0.95	FCSAP, 2012. Inclusive of insects and larvae as well as terrestrial slugs, snails and earthworms.
Mammal Diet Proportion (P_{Mam})	unitless factor	0.05	FCSAP, 2012. 5% of the diet of the shrew consists of amphibians, small mammals and vegetation. Conservatively set this value to 5%
Soil Ingestion Rate (IR_{Soil})	kg/day dw	2.75E-05	FCSAP, 2012. No soil ingestion rate provided, a default value was used instead. 2% of dry food ingestion rate. Ingestion rate is 0.34 kg dry food/kg BW/day.
Foraging Range	ha	0.6	FCSAP, 2012.
Temporal Use Factor (TUF)	unitless factor	1	Assumed
Site Area (A_{site})	ha	32	Assumed
Residency Factor (R)	unitless factor	1	=Asite / Foraging Range

COPC Exposures (mg/kg body weight/day)

Exposure Pathway	Terrestrial Plant Ingestion	Invertebrate Ingestion	Mammal Ingestion	Soil Ingestion Exposure	Total COPC Exposure
Exposure Equation	$E_{Plant} = \frac{C_p \cdot IR_{Food} \cdot P_{Plant}}{BW}$	$E_{Inv} = \frac{C_e \cdot IR_{Food} \cdot P_{Inv}}{BW}$	$E_{Mam} = \frac{C_m \cdot IR_{Food} \cdot P_{Mam}}{BW}$	$E_{Soil} = \frac{C_S \cdot IR_{soil}}{BW}$	$E_{TOTAL} = (E_{Plant}+E_{Inv}+E_{Mam}+E_{soil}) \cdot TUF \cdot R$
Arsenic	0	83.7	0.329	10.7	94.7
Lead	0	88.9	1	1.03	90.9
Vanadium	0	2.59	0.04	0.218	2.85

Ecological Hazard Quotients (EHQs)

COPC	Total COPC Exposure	TRV (mg/kg BW /day)	TRV Reference	TRV Basis	EHQ (Total COPC Expousre/TRV)
Arsenic	94.7	9.7	FCSAP, 2021; US EPA, 2005	LOAEL	**9.80E+00**
Lead	90.9	35	FCSAP, 2021; US EPA, 2005; Dillon, 2013	LOAEL	**2.60E+00**
Vanadium	2.85	6.7	FCSAP, 2021; US EPA, 2005; Dillon, 2013; Allaway and Stodola, 2011	LOAEL	4.30E-01

List of Acronyms

COPC - Contaminant of Potential Concern
dw - Dry Wight
ww - Wet Weight
C_{Soil} - Concentration in soil
C_P - Concentration in plants
C_{Inv} - Concentration in invertebrates
C_{Mam} - Concentration in mammals
E_{Soil} - Exposure from soil ingestion
E_{Plant} - Exposure from plant ingestion
E_{Inv} - Exposure from invertebrate ingestion
E_{Mam} - Exposure from fish ingestion
E_{Total} - Total exposure from all assessed pathways
TRV - Toxicological Reference Value
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EHQ - Ecological Hazard Quotient

RED denotes an exceedance of the target ecological hazard quotient of 1.0.

Arsenic

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
As	102	0	2.39	20600	1247.0913	399.32603	2385.8289	236.23226	664.1957	5.7574487	1.9131149

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	99%ile
As	102	0	37.54	78.96	104.25	488	1360	1614	2689	4366.5	7162.1

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

As

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	97
Minimum	2.39
Maximum	20600
Mean of Raw Data	1247.0913
Standard Deviation of Raw Data	2385.8289
Khat	0.5497195
Theta hat	2268.5956
Kstar	0.5400872
Theta star	2309.0553
Mean of Log Transformed Data	5.9897782
Standard Deviation of Log Transformed Data	1.7511353

Normal GOF Test Results

Correlation Coefficient R	0.6769364
Approximate Shapiro Wilk Test Statistic	0.50616
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.3009375
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9065929
A-D Test Statistic	0.6866636
A-D Critical (0.0500000) Value	0.813813
K-S Test Statistic	0.0688314
K-S Critical(0.0500000) Value	0.0937343

Data appear Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9867155
Approximate Shapiro Wilk Test Statistic	0.9671443
Approximate Shapiro Wilk P Value	0.0818681
Lilliefors Test Statistic	0.1001041
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Approximate_Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

As

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	97.000000
		Number of Missing Observations	0
Minimum	2.3900000	Mean	1247.0913
Maximum	20600.000	Median	488.00000
SD	2385.8289	Std. Error of Mean	236.23226
Coefficient of Variation	1.9131149	Skewness	5.7574487

Normal GOF Test

Shapiro Wilk Test Statistic	0.5061600	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3009375	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	1639.2558	**95% UCLs (Adjusted for Skewness)**	
		95% Adjusted-CLT UCL (Chen-1995)	1779.5551
		95% Modified-t UCL (Johnson-1978)	1661.7008

Gamma GOF Test

A-D Test Statistic	0.6866636	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.8138130	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0688314	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0937343	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.5497195	k star (bias corrected MLE)	0.5400872
Theta hat (MLE)	2268.5956	Theta star (bias corrected MLE)	2309.0553
nu hat (MLE)	112.14278	nu star (bias corrected)	110.17780
MLE Mean (bias corrected)	1247.0913	MLE Sd (bias corrected)	1696.9392
		Approximate Chi Square Value (0.05)	86.949683
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	86.655534

Assuming Gamma Distribution

95% Approximate Gamma UCL	1580.2446	95% Adjusted Gamma UCL	1585.6087

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9671443	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.0818681	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.1001041	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.8712934	Mean of logged Data	5.9897782
Maximum of Logged Data	9.9330464	SD of logged Data	1.7511353

Assuming Lognormal Distribution

95% H-UCL	3120.6502	90% Chebyshev (MVUE) UCL	3161.7320
95% Chebyshev (MVUE) UCL	3785.9502	97.5% Chebyshev (MVUE) UCL	4652.3408
99% Chebyshev (MVUE) UCL	6354.1974		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1635.6588	95% BCA Bootstrap UCL	1815.6061
95% Standard Bootstrap UCL	1627.9238	95% Bootstrap-t UCL	1897.2504
95% Hall's Bootstrap UCL	3304.5441	95% Percentile Bootstrap UCL	1670.1825
90% Chebyshev(Mean, Sd) UCL	1955.7881	95% Chebyshev(Mean, Sd) UCL	2276.8038
97.5% Chebyshev(Mean, Sd) UCL	2722.3613	99% Chebyshev(Mean, Sd) UCL	3597.5726

Suggested UCL to Use

95% Approximate Gamma UCL 1580.2446 Selected as data appear Gamma 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.

Lead

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
Pb	102	0	3.56	1360	124.89029	61.930387	209.806	20.77389	51.000741	3.9140511	1.6799224

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	99%ile
Pb	102	0	19.95	24.34	26.8	55.05	126.75	138	231.7	444.15	1136.51

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

Pb

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	94
Minimum	3.56
Maximum	1360
Mean of Raw Data	124.89029
Standard Deviation of Raw Data	209.806
Khat	0.8406782
Theta hat	148.55898
Kstar	0.8224883
Theta star	151.84446
Mean of Log Transformed Data	4.126011
Standard Deviation of Log Transformed Data	1.1364864

Normal GOF Test Results

Correlation Coefficient R	0.7097341
Approximate Shapiro Wilk Test Statistic	0.5288391
Approximate Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.3109777
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9235055
A-D Test Statistic	3.7260678
A-D Critical (0.0500000) Value	0.7906707
K-S Test Statistic	0.1569508
K-S Critical(0.0500000) Value	0.0921193

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9885126
Approximate Shapiro Wilk Test Statistic	0.9713438
Approximate Shapiro Wilk P Value	0.1665367
Lilliefors Test Statistic	0.0763865
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

Pb

General Statistics

Total Number of Observations	102.00000	Number of Distinct Observations	94.000000
		Number of Missing Observations	0
Minimum	3.5600000	Mean	124.89029
Maximum	1360.0000	Median	55.050000
SD	209.80600	Std. Error of Mean	20.773890
Coefficient of Variation	1.6799224	Skewness	3.9140511

Normal GOF Test

Shapiro Wilk Test Statistic	0.5288391	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.3109777	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.1017530	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	159.37662	95% Adjusted-CLT UCL (Chen-1995)	167.66280
		95% Modified-t UCL (Johnson-1978)	160.71844

Gamma GOF Test

A-D Test Statistic	3.7260678	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.7906707	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.1569508	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0921193	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.8406782	k star (bias corrected MLE)	0.8224883
Theta hat (MLE)	148.55898	Theta star (bias corrected MLE)	151.84446
nu hat (MLE)	171.49835	nu star (bias corrected)	167.78762
MLE Mean (bias corrected)	124.89029	MLE Sd (bias corrected)	137.70947
		Approximate Chi Square Value (0.05)	138.83512
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	138.46025

Assuming Gamma Distribution

95% Approximate Gamma UCL	150.93475	95% Adjusted Gamma UCL	151.34340

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9713438	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.1665367	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0763865	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0805176	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.2697605	Mean of logged Data	4.1260110
Maximum of Logged Data	7.2152400	SD of logged Data	1.1364864

Assuming Lognormal Distribution

95% H-UCL	153.82111	90% Chebyshev (MVUE) UCL	166.21446
95% Chebyshev (MVUE) UCL	188.53878	97.5% Chebyshev (MVUE) UCL	219.52407
99% Chebyshev (MVUE) UCL	280.38867		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	159.06030	95% BCA Bootstrap UCL	168.46696
95% Standard Bootstrap UCL	160.49208	95% Bootstrap-t UCL	175.59297
95% Hall's Bootstrap UCL	177.19050	95% Percentile Bootstrap UCL	162.49441
90% Chebyshev(Mean, Sd) UCL	187.21196	95% Chebyshev(Mean, Sd) UCL	215.44158
97.5% Chebyshev(Mean, Sd) UCL	254.62320	99% Chebyshev(Mean, Sd) UCL	331.58789

Suggested UCL to Use

95% H-UCL 153.82111 Selected as data appear Lognormal 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.

Vanadium

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	SEM	MAD/0.675	Skewness	CV
V	102	0	1.99	72.6	29.856863	24.2969	15.966964	1.580965	14.825797	0.4262562	0.5347837

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	99%ile
V	102	0	7.483	15.88	19.2	29.3	38.55	40.66	48.35	61.19	68.29

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

V

Raw Statistics

Number of Valid Observations	102
Number of Distinct Observations	95
Minimum	1.99
Maximum	72.6
Mean of Raw Data	29.856863
Standard Deviation of Raw Data	15.966964
Khat	2.5808925
Theta hat	11.568425
Kstar	2.5115199
Theta star	11.887966
Mean of Log Transformed Data	3.1903488
Standard Deviation of Log Transformed Data	0.7504194

Normal GOF Test Results

Correlation Coefficient R	0.9892764
Approximate Shapiro Wilk Test Statistic	0.9612774
Approximate Shapiro Wilk P Value	0.0267141
Lilliefors Test Statistic	0.0583122
Lilliefors Critical (0.0500000) Value	0.0879893

Data appear Approximate Normal at (0.0500000) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.9798363
A-D Test Statistic	1.7071327
A-D Critical (0.0500000) Value	0.7612985
K-S Test Statistic	0.1034492
K-S Critical(0.0500000) Value	0.0897874

Data not Gamma Distributed at (0.0500000) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.9374415
Approximate Shapiro Wilk Test Statistic	0.8712976
Approximate Shapiro Wilk P Value	1.15E-12
Lilliefors Test Statistic	0.1509573
Lilliefors Critical (0.0500000) Value	0.0879893

Data not Lognormal at (0.0500000) Significance Level

UCL Statistics for Uncensored Full Data Sets

V

General Statistics

Total Number of Observations	102	Number of Distinct Observations	95
		Number of Missing Observations	0
Minimum	1.99	Mean	29.856863
Maximum	72.6	Median	29.3
SD	15.966964	Std. Error of Mean	1.580965
Coefficient of Variation	0.5347837	Skewness	0.4262562

Normal GOF Test

Shapiro Wilk Test Statistic	0.9612774	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0.0267141	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0583122	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.101753	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32.481392	95% Adjusted-CLT UCL (Chen-1995)	32.528616
		95% Modified-t UCL (Johnson-1978)	32.492513

Gamma GOF Test

A-D Test Statistic	1.7071327	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.7612985	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.1034492	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0897874	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.5808925	k star (bias corrected MLE)	2.5115199
Theta hat (MLE)	11.568425	Theta star (bias corrected MLE)	11.887966
nu hat (MLE)	526.50207	nu star (bias corrected)	512.35005
MLE Mean (bias corrected)	29.856863	MLE Sd (bias corrected)	18.839782
		Approximate Chi Square Value (0.05)	460.85805
Adjusted Level of Significance	0.0476471	Adjusted Chi Square Value	460.16487

Assuming Gamma Distribution

95% Approximate Gamma UCL	33.192792	95% Adjusted Gamma UCL	33.242792

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.8712976	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.15E-12	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.1509573	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0805176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.6881346	Mean of logged Data	3.1903488
Maximum of Logged Data	4.2849649	SD of logged Data	0.7504194

Assuming Lognormal Distribution

95% H-UCL	37.378138	90% Chebyshev (MVUE) UCL	40.09075
95% Chebyshev (MVUE) UCL	43.716868	97.5% Chebyshev (MVUE) UCL	48.74978
99% Chebyshev (MVUE) UCL	58.63596		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	32.457319	95% BCA Bootstrap UCL	32.735686
95% Standard Bootstrap UCL	32.520172	95% Bootstrap-t UCL	32.730648
95% Hall's Bootstrap UCL	32.763349	95% Percentile Bootstrap UCL	32.599216
90% Chebyshev(Mean, Sd) UCL	34.599758	95% Chebyshev(Mean, Sd) UCL	36.74813
97.5% Chebyshev(Mean, Sd) UCL	39.729986	99% Chebyshev(Mean, Sd) UCL	45.587266

Suggested UCL to Use

95% Student's-t UCL	32.481392	Selected as data appear normal.

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.

Appendix H

Worked Example

Worked Example of HHRA Exposure and Risk Calculations – Arsenic

This appendix provides a worked example of HHRA exposure and risk calculations for arsenic for a toddler receptor in the Outdoor Site Visitor Scenario for the former Country Harbor.

Parameters for the Risk Calculations

Exposure Point Concentrations, RAFs, and Adjustment Factors

Table H-1 below provides the exposure point concentrations (EPCs) that were used to estimate exposure and risk in the HHRA for arsenic in site media.

Relative absorption factors (RAFs) that were used in the HHRA are presented in Table H-2.

Human exposure parameters used in the HHRA are presented in Table H-3.

Arsenic toxicity reference values (TRVs) are presented in Table H-4.

Table H-1: Arsenic Exposure Point Concentrations (EPCs) for the HHRA

Media	Units	EPC	Comments
Soil	µg/g	1,520	UCLM95 concentration (95% Approximate Gamma UCL)
Drinking Water	µg/L	0.0391	Reported concentration from 24MW-03 [1]

Notes:
[1] Insufficient data were available to obtain a UCLM95. The reported concentration in groundwater from 24MW-03 was used as an EPC instead as it is the closest monitoring well to the off site potable well.

Table H-2: Relative Absorption Factors (RAFs) for arsenic in the HHRA

Exposure Pathway	Value (unitless)	Comments
Dermal contact with soil	0.03	Health Canada, 2021a
Soil/Drinking Water Ingestion	0.42	Calculated from HC recommended equation to calculate RBA from IVBA data (95th percentile).[1]
Soil/Dust Inhalation	1	Assumed

Notes:
[1] Oral RAF calculated from Health Canada, 2017. (RBA=0.79(IVBA)+0.03).

Table H-3: Key Receptor and Environmental Parameters for the Hypothetical Human Receptors

Parameter	Value	Reference
Age Group Duration (years)	Toddler: 6 months to <5 years (4.5)	Health Canada, 2024
Body Weight (kg)	Toddler: 16.5	Health Canada, 2024
Inhalation Rate (m^3/day)	Toddler: 8.3	Health Canada, 2024
Water Ingestion Rate (L/day)	Toddler: 0.6	Health Canada, 2024
Soil Ingestion (mg/day)	Toddler: 80	Health Canada, 2024
Hand Surface area (m^2)	Toddler: 0.043	Health Canada, 2024
Skin surface area (upper and lower arms) (m^2)	Toddler: 0.089	Health Canada, 2024
Skin surface area (upper and lower legs) (m^2)	Toddler: 0.169	Health Canada, 2024

Hand soil adherence factor (kg/cm^2-day)	1×10^{-7}	Health Canada, 2024
Skin-soil adherence factor (other than hands) (kg/cm^2-day)	1×10^{-6}	Health Canada, 2024
Outdoor dust level from soil ($\mu g/m^3$)	0.76	Health Canada, 2024
Age Group Duration (years)	Toddler: 4.5	Health Canada, 2024
Life Expectancy (years)	80	Health Canada, 2024
Time spent on site	*Outdoor Site Visitor (all ages, all land uses)* 2 hours/day, 1 day/week, for 6 months/year (May to October)	Assumed
Fraction of airborne dust generated from site soil	1.0	Assumed
Exposure Term (ingestion and dermal contact pathway)	0.07143	$\frac{1\ days\ per\ week}{7} \times \frac{26\ weeks\ per\ year}{52}$
Exposure Term (inhalation pathway)	0.00595	$\frac{2\ hours\ per\ day}{24} \times \frac{1\ day\ per\ week}{7} \times \frac{26\ weeks\ per\ year}{52}$

Table H-4: Summary of TRVs used in the HHRA

Chemical	Route	Toxicity Reference Value (TRV)	Health Endpoint	Reference
Arsenic	Oral	SF = 1.8 mg/kg_{BW}/day	Cancer of the bladder, lung, liver; (based on Morales et al.,2000; Chen et al., 1985; Wu et al., 1989).	Health Canada, 2021b
	Inhalation	IUR = 6.4 mg/m^3	Lung cancer; (based on Higgins et al., 1986).	Health Canada, 2021b

Worked Example of Exposure and Risk Calculations

The following section presents the equations used in the HHRA to estimate the arsenic exposure and risk using an illustrative worked example for the toddler outdoor site worker. The exposure and risk to other receptors can be similarly calculated using the parameters from Table H-3. The results of each exposure calculation are provided in bold below the equation boxes.

Outdoor Dust Inhalation Exposure

$$EXP_{ODInh} = \frac{(C_s \cdot R_{Inh} \cdot DL \cdot DL_{Fraction} \cdot RAF_{Inh} \cdot ET_{Inh})}{BW}$$

EXP_{ODInh}	=	Exposure via inhalation of outdoor dust	µg/kg body weight/day	
Cs	=	Concentration of contaminant in soil	mg/kg	1520 (UCLM95)
R_{Inh}	=	Breathing rate	m^3/day	8.3
DL	=	Outdoor dust level	g/m^3	0.0000076
$DL_{Fraction}$	=	Fraction of outdoor dust generated from outdoor soil	unitless	1 (assumed)

ET_{Inh}	=	Exposure term outdoors (inhalation)	unitless	0.00595
RAF_{Inh}	=	Relative absorption factor (inhalation)	unitless	1 (assumed)
BW	=	Body weight	kg	16.5

EXP_{ODInh} = 3.45 x 10^{-5} µg/kg body weight/day

Outdoor Soil Ingestion Exposure

$$EXP_{OSIng} = \frac{(C_s \cdot R_{Ing} \cdot RAF_o \cdot ET_{Ing})}{BW}$$

EXP_{OSIng}	=	Exposure via ingestion of outdoor soil	µg/kg body weight/day	
Cs	=	Concentration of contaminant in soil	mg/kg	1520 (UCLM95)
R_{Ing}	=	Soil ingestion rate	g/day	0.08
RAF_o	=	Relative absorption factor (oral, soil)	Unitless	0.42 (Calculated)
ET_{Ing}	=	Exposure term (ingestion)	Unitless	0.07143
BW	=	Body weight	kg	16.5

EXP_{OSIng} = 2.21 x 10^{-1} µg/kg body weight/day

Outdoor Dermal Contact Exposure (Hand)

$$EXP_{ODH} = \frac{(C_s \cdot A_{Hand} \cdot AF_{Hand} \cdot ET_{Derm} \cdot RAF_{Derm})}{BW}$$

EXP_{ODH}	=	Exposure via dermal contact of hands with outdoor soil	µg/kg body weight/day	
Cs	=	Concentration of contaminant in soil	mg/kg	1520 (UCLM95)
A_{Hand}	=	Hand surface area	m^2	0.043
AF_{Hand}	=	Hand soil adherence factor	g/m^2/day	1
RAF_{Derm}	=	Relative absorption factor (dermal)	unitless	0.03
ET_{Derm}	=	Exposure term (dermal contact)	unitless	0.07143
BW	=	Body weight	kg	16.5

EXP_{ODH} = 8.46 x 10^{-3} µg/kg body weight/day

Outdoor Dermal Contact Exposure (Body)

$$EXP_{ODB} = \frac{(C_s \cdot A_{Body} \cdot AF_{Body} \cdot ET_{Derm} \cdot RAF_{Derm})}{BW}$$

EXP_{ODB}	=	Exposure via dermal contact of body skin (not including hands) with outdoor soil	µg/kg body weight/day	
Cs	=	Concentration of contaminant in soil	mg/kg	1520 (UCLM95)
A_{Body}	=	Skin surface area (arms and legs)	m^2	0.258
AF_{Body}	=	Skin soil adherence factor (non-hand)	g/m^2/day	0.1
RAF_{Derm}	=	Relative absorption factor (dermal)	unitless	0.03
ET_{Derm}	=	Exposure term (dermal contact)	unitless	0.07143
BW	=	Body weight	kg	16.5

EXP_{ODB} = 5.07 x 10^{-3} µg/kg body weight/day

Drinking Water Pathway Exposure (Body)

$$EXP_{Water} = \frac{(C_w \cdot R_{WIR} \cdot ET_{Ing} \cdot RAF_o)}{BW}$$

EXP_{Water}	=	Exposure via drinking water	µg/kg body weight/day	
Cw	=	Concentration of contaminant in drinking water	µg/L	0.0391 (Max concentration)
Rwir	=	Water ingestion rate	L/day	0.6
RAF_o	=	Relative absorption factor (oral)	unitless	1 (Assumed as RAF oral is calculated from IVBA soil data)
ET_{Ing}	=	Exposure term (ingestion)	unitless	0.07143
BW	=	Body weight	Kg	16.5

EXP_{Water} = 1.02 x 10^{-4} µg/kg body weight/day

Estimation of Total Site-Related Exposures

Total Oral and Dermal Contact and Diet Exposure

$$EXP_{O+D} = EXP_{OSIng} + EXP_{ODH} + EXP_{ODB} + EXP_{Water}$$

EXP_{O+D}	=	Total exposure via oral and dermal contact pathways	µg/kg body weight/day	
EXP_{OSIng}	=	Exposure via ingestion of outdoor soil	µg/kg body weight/day	2.21 x 10^{-1}
EXP_{ODH}	=	Exposure via dermal contact of hands with outdoor soil	µg/kg body weight/day	8.46 x 10^{-3}
EXP_{ODB}	=	Exposure via dermal contact of body skin (not including hands) with outdoor soil	µg/kg body weight/day	5.07 x 10^{-3}
EXP_{Water}	=	Exposure via drinking water ingestion	µg/kg body weight/day	1.02 x 10^{-4}

EXP_{O+D} = 2.35 x 10^{-1} µg/kg body weight/day

Total Inhalation Exposure

$$EXP_{Inh} = EXP_{ODInh}$$

EXP_{Inh}	=	Total exposure via inhalation pathway	µg/kg body weight/day	
EXP_{ODInh}	=	Exposure via inhalation of outdoor dust	µg/kg body weight/day	3.45 x 10^{-5}

EXP_{Inh} = 3.45 x 10^{-5} µg/kg body weight/day

Risk Characterization Calculations

For COPCs with non-carcinogenic effects, the risk characterization stage of a human health risk assessment consists of a comparison between estimated exposures and the acceptable or "safe" intake level (*i.e.*, the toxicity reference value (TRV)). The numerical value associated with this comparison is called the hazard quotient (HQ) and is calculated as follows:

$$Hazard\ Quotient\ (HQ) = \frac{Estimated\ Exposure\ (\mu g/kg_{BW}/day)}{TRV\ (\mu g/kg_{BW}/day)}$$

For COPCs with carcinogenic effects, incremental lifetime cancer risk (ILCR) levels are used to communicate the estimated cancer risks associated with exposure estimates as follows:

$$ILCR = Estimated\ Lifetime\ Exposure\ (\mu g/kg_{BW}/day) \cdot Cancer\ Slope\ Factor(\mu g/kg_{BW}/day)^{-1}$$

The estimated lifetime exposure is in turn calculated from the dose (exposure) of a given pathway at the site adjusted by an age dependent adjustment factor (ADAF) which is calculated as follows:

$$ADAF = \frac{Age\ Group\ Duration}{Life\ Expectancy}$$

For a toddler, the age group duration is 4.5 years and the life expectancy of a human receptor is 80 years which yields an ADAF of 0.5625.

The following equations illustrate the calculation of risk estimates in the HHRA.

Human Health Risks Associated with Carcinogenic Effects – Oral Pathway

$ILCR_{O+D} = EXP_{O+D} * ADAF * SF$

$ILCR_{O+D}$	=	Incremental Lifetime Cancer Risk (oral and dermal)	µg/kg body weight/day	
EXP_{ODInh}	=	Exposure via inhalation of outdoor dust	µg/kg body weight/day	2.35×10^{-1}
SF	=	Oral Slope Factor	(µg/kg body weight/day)$^{-1}$	0.0018
ADAF	=	Age Dependent Adjustment Factor	Unitless	0.05625

$ILCR_{O+D} = 2.4 \times 10^{-5}$

Human Health Risks Associated with Carcinogenic Effects – Inhalation Pathway

$ILCR_{Inh} = EXP_{Inh} * ADAF * IUR$

$ILCR_{Inh}$	=	Incremental Lifetime Cancer Risk (oral and dermal)	µg/kg body weight/day	
EXP_{Inh}	=	Exposure via inhalation of outdoor dust	µg/kg body weight/day	3.45×10^{-5}
IUR	=	Inhalation Unit Risk	(µg/kg body weight/day)$^{-1}$	0.013
ADAF	=	Age Dependent Adjustment Factor	Unitless	0.05625

$ILCR_{Inh} = 2.5 \times 10^{-8}$

References Cited

All references cited herein are provided in the main report reference list.

Appendix I

Environmental Site Investigation (Dillon, 2024)

DILLON CONSULTING

BUILD NOVA SCOTIA

Environmental Site Assessment (Final)

Former Country Harbour Mine Site, Guysborough County, Nova Scotia, **Property Identification Designation Numbers: 35091354 and a Portion of 35094366**



January 2025 – 23-6465-6000

January 9, 2025

Build Nova Scotia
PO Box 397, Station Central
Halifax/Kjipuktuk, Nova Scotia
B3J 2P8

Attention: Dan Khan, P.Eng.
Project Manager, Mine Site Reclamation
Strategic Infrastructure and Development Division

Environmental Site Assessment - Final
Former Country Harbour Mine Site, County Harbour Mines
Guysborough County, Nova Scotia
Parcel Identification Designation Nos.: 35091354 and a Portion of 35094366

Dillon Consulting Limited is pleased to provide Build Nova Scotia, on behalf of the Department of Natural Resources and Renewables, this Environmental Site Assessment of the Former Country Harbour Mine property located in Country Harbour Mines, Guysborough County, Nova Scotia, and identified by Parcel Identification Designation Nos. 35091354 and a portion of 35094366.

Should you have any questions, please do not hesitate to contact us.

Sincerely,

DILLON CONSULTING LIMITED

Nadine Wambolt, B.Tech, CET
Project Manager

BCT/NJW:jb

Our file: 23-6465-6000

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Executive Summary

Dillon Consulting Limited (Dillon) was retained by Build Nova Scotia (BNS), on behalf of the Department of Natural Resources and Renewables (DNRR), to complete a Phase I/II Environmental Site Assessment (ESA) and Supplemental ESA at the former Country Harbour Mine (i.e., Parcel Identification Designation Nos.: 35091354 and a portion of 35094366), herein referred to as the "subject property" or the "site", which is located in Guysborough County, Nova Scotia.

Mining operations for gold ore occurred at the site between 1862 and 1951. Currently, the site is used for commercial forest harvesting as a primary land use and is also being considered for wind energy development.

Dillon completed a Phase I ESA at the site in 2023 that indicated the presence of potentially contaminating activities on-site. Four (4) areas of potential environmental concern (APECs) were identified, along with associated contaminants of potential concern (COPCs), as summarized in the following table.

Table ES-1: Phase I ESA Summary of Identified Relevant APECs and COPCs

APEC No.	APEC	COPCs	Media of Concern	Comments
1	Tailings Area	Metals, General Chemistry*, Sulphur	Soil, GW, Sed, SW	• One (1) former waste tailings area with potentially sulphide bearing materials. • Surface water discharge location in Johnston Brook, downstream of the cross-culverts along John Fenton Loop Road.
2	Stamp Milling Area	Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW, Sed, SW	• Three (3) former stamp milling areas where potentially sulphide bearing materials may have been processed. • Processing of materials, heavy equipment storage, and petroleum storage. • Surface water is directed to Johnston Brook.
3	Waste Rock Piles	Metals, General Chemistry*, Sulphur	Soil, Sed, SW	• Two (2) waste rock areas with potentially sulphide bearing slates, one (1) of which is located in Johnston Brook.
4	Domestic Waste Dumping Areas	Metals, PHCs, PAHs	Soil	• Three (3) locations where domestic waste and discarded fuel drums were identified during the Phase I ESA site visit.

APEC No.	APEC	COPCs	Media of Concern	Comments
Assessment of Naturally Occurring Background Conditions				
	Initial Background Location	Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW	Based on available topographic data and inferred groundwater flow direction, initial background conditions were assessed at an upgradient location within the assessment boundary that was safely accessible.
	Initial Upstream Background Location	Metals, General Chemistry*, Sulphur, PHCs, PAHs	Sed, SW	Surface water and sediment conditions were assessed at an upstream location within the assessment boundary that is safely accessible.[7]

Notes:
1. *General chemistry analysis is only completed on water;
2. GW denotes groundwater, Sed denotes sediment, SW denotes surface water;
3. PHCs denotes petroleum hydrocarbons (i.e., BTEX, modified TPH), PAHs denotes polycyclic aromatic hydrocarbons;
4. Metals analysis included mercury and sulphur;
5. Metals analysis of SW included total metals, while analysis of GW entailed dissolved metals;
6. Of note, due to difficult terrain, the background SW and SED location had to be adjusted for health and safety considerations; and
7. As previously noted, due to physical site constraints, the planned background surface water and sediment sampling location (i.e., SW/SED 5) was unable to be located up gradient of all historical site operations, and therefore, was ultimately not considered a background station.

Based on the findings of the Phase I ESA, further assessment was recommended, which included the advancement of five (5) boreholes, each completed as monitoring wells, and surface water, sediment, soil and groundwater sampling. Media analysis included: general chemistry (water only), metals (including sulphur and mercury), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and/or energetics (soil only). The generalized groundwater flow direction in the assessment area is interpreted to be southerly towards Country Harbour River. For comparison to the Nova Scotia Contaminated Sites Regulations (NS CSRs) Tier I Environmental Quality Standards (EQS), the site is considered to be commercial, potable with both fine and coarse-grained soil conditions. Findings of the ESA activities to date are as follows:

- Surface water samples collected from Johnston Brook had metal concentrations (i.e., aluminum, arsenic, iron, lead and/or zinc) that exceed the Tier I EQS for surface water at each sample location. In addition, lab pH was low at each location. There were no other metals exceedances, nor exceedances for other contaminants of potential concern (COPCs) (i.e., benzene, toluene, ethylbenzene, xylenes (collectively referred to as BTEX), modified total petroleum hydrocarbons (TPH) or PAHs) reported for the analyzed surface water samples. Surface water metals impacts are delineated to the north, but not to the south.
- Metals concentrations in sediment were generally either below laboratory detection limits, or within the applicable Tier I EQS, with the exception of arsenic, iron, lead, manganese and/or mercury exceedances observed at each sediment sampling location. Iron and manganese concentrations were generally of similar magnitude in each of the sediment samples. The highest arsenic concentration was reported at SED6. The highest mercury concentration was reported at SED2. No BTEX or C6-C10 detections were reported for sediment during the Phase II ESA. Although PAH

analysis could not be completed due to the stream substrate composition, PAH exceedances were not reported in surface water, or in nearby soil samples, therefore, PAHs are not expected to be a concern in the sediment. Metals impacts in sediment are delineated to the north, but not to the south.

- One hundred and twenty-two (122) soil samples (including nine (9) field duplicate samples) were submitted for metals analysis, including sulphur and mercury. Twenty-two (22) additional soil samples, including two (2) field duplicate samples were also collected for evaluation of local background soil concentrations for metals. Metals exceedances in soil above the Tier I EQS (for a commercial, potable site with both coarse and fine-grained soils), and above the maximum local on-site background concentrations are present across the site assessment area (i.e., the areas of former mining operations). Notable, widespread exceedances, when looking at the overall data set in comparison to both the Tier I EQS and background, include aluminum, arsenic, beryllium, iron, lead, manganese, selenium, vanadium and zinc. Although not widespread, mercury exceeded the applicable Tier I EQS at ten (10) locations, and each of these locations are in the central portion of the study area (at or between MW4 and MW5). The highest arsenic was reported at BH111, highest iron at BH18, highest lead and mercury at BH15, and highest zinc at BH23. Metals impacts in soil are laterally delineated to the north and south. Lateral delineation of impacts to the east and west have been partially delineated on the southern portion of the assessment site; however, are not delineated to the east and west on the northern portion of the assessment site. Further sampling would be required to achieve lateral delineation of soil impacts. The inferred extent of metals impacts in soil is 147,380 square meters (m^2), noting that lateral delineation has not been fully achieved. Vertically soil impacts are delineated by the presence of bedrock, which ranged from 0.53 meters below ground surface (mbgs) (APEC #1) to 1.37 mbgs (APEC #2).
- Ethylbenzene in soil exceeded the Tier I EQS at BH17 (0-0.15 m), which was advanced in an area of refuse (e.g., household waste, plastic and metal (including a drum and lawnmower)) underlain by waste rock. As part of the Supplemental ESA, four (4) step out samples and a deeper sample were collected in the location of BH17. Findings indicated BTEX and/or Modified TPH exceedances of the Tier I EQS in the deeper sample (i.e., BH127 (0.35 m)) and in three (3) of the four (4) step out samples (i.e., BH129 (0-0.15 m) and BH130 (0-0.15 m) (noting that there were no exceedances were found in the duplicate sample collected from BH130), and BH128 (0-0.15 m). Based on these findings, lateral delineation of petroleum hydrocarbon impacts has not been achieved to the north, south or west. Vertical delineation has not been achieved, noting the refusal on waste rock at BH127.
- As there is no Tier I EQS for sulphur, a comparison value of 4000 mg/kg was taken from the Sulphide Bearing Material Disposal Regulations. Three (3) soil samples, BH30 0-0.15, BH111 0-0.15 m and its field duplicate, with concentrations ranging from 4,500 mg/kg to 8,700 mg/kg, exceeded the 4000 mg/kg comparison value.
- Dissolved metals concentrations in groundwater were generally either below laboratory detection limits or within the applicable Tier I EQS, with some exceptions (i.e., arsenic, cobalt, iron, lead,

and/or manganese). Delineation of metals impacts in groundwater has not been achieved. Further groundwater assessment would be required to achieve delineation.

1.0 Introduction

Dillon Consulting Limited (Dillon) completed a Phase I/II Environmental Site Assessment (ESA)[1] and Supplemental ESA activities for Build Nova Scotia (BNS), on behalf of the Department of Natural Resources and Renewables (DNRR), at the former Country Harbour Mine (i.e., Parcel Identification Designation Nos.: 35091354 and a portion of 35094366; herein referred to as the "subject property" or the "site"), which is located in Country Harbour Mines, Guysborough County, Nova Scotia (see Figure 1, appended, for the site location). The assessment portion of the site was approximately 69 hectares in size. The ESA was completed in two parts, with the Phase I/II ESA completed 2023-2024, followed by Supplemental ESA activities in 2024.

During assessment activities, the site was observed to be generally covered with dense forest, rock and heavy vegetation. Based on discussions with BNS, the site is to remain as commercial use. Based on visual observations, the site consists principally of coarse-grained soil; with grain size analysis indicating a mix of both coarse and fine-grained soil conditions. The site is categorized as potable; however, there are no on-site potable water supplies, and reportedly none are envisioned in the future.

Findings of the Phase I ESA identified four areas of potential environmental concern (APECs) recommended for further assessment via a Phase II ESA as follows:

- APEC 1: Tailings Area
- APEC 2: Stamp Milling Areas
- APEC 3 Waste Rock Piles
- APEC 4: Domestic Waste Dumping Areas

Findings of the ESA activities to date indicated metals exceedances of the Nova Scotia Contaminated Sites Regulations (NS CSRs) Tier I Environmental Quality Standards (EQS) in surface water and sediment samples collected from Johnston Brook, and in on-site groundwater. Metals exceedances in soil above the Tier I EQS and local on-site background concentrations were found to be present across the site assessment area (i.e., in areas of former mining operations). Petroleum hydrocarbons in soil exceeded the Tier I EQS on the central portion of the site in an area of refuse underlain by waste rock.

The Phase I ESA was performed following the Phase I ESA guideline document produced by the Canadian Standards Association (CSA Z768-01, R2022). The Phase II and Supplemental ESA was completed in accordance with the Canadian Standards Association (CSA) Standard No. Z769-00 (R2023) and the Nova Scotia Contaminated Sites Regulations (NS CSRs) and associated Ministerial Protocols to identify and, where possible, delineate potential environmental contamination that may have resulted from historical activities on the former Country Harbour Mine site.

[1] The Phase I ESA was prepared as a standalone report and submitted as Appendix A of the Phase II ESA report in March 2024. Both the Phase II ESA findings and the Supplemental ESA findings are discussed herein.

The ESA findings presented in this report are based on limited visual observations made during the ESA site visits, and associated intrusive investigations, which consisted of hand-augering boreholes (including the background borehole locations); drilling and installation of monitoring wells; soil, sediment, and surface water sampling; and groundwater monitoring and sampling.

The Phase I ESA findings were presented in Dillon's report "Phase I Environmental Site Assessment, Former Country Harbour Mine, Guysborough County, Nova Scotia, Property Identification Designation Numbers: 35091354 and a Portion of 35094366 (Final Report)", dated October 6, 2024. The following document has been prepared to summarize the findings of the Phase II[2] ESA and Supplemental ESA activities. This report presents a summary of historical assessment findings (Section 2.0), methodology (Section 3.3), results (Section 4.0), conceptual site model (CSM) (Section 5.0), and summary (Section 6.0). Limitations are presented in Section 7.0.

1.1 Background

Known mining operations for gold ore are reported to have occurred at the site between 1862 and 1951; however, the site is no longer in operation. Mine workings were underground and included drifts and stopes, shafts access, and ramp accesses. Ore processing was reportedly completed by way of mercury amalgam. Approximately 26,301 tons of ore was processed on-site, producing approximately 9,960 ounces of gold, and resulting in an estimated 14,225 tons of tailings remaining on-site (BNS Request for Proposal RFQ BNS-2324-0201, 2023). Several stamp mills operated at the site, including the Old Antigonish Mill, the Stuart Mill, and the Robertson Mill. In addition to gold stamp mills, buildings and infrastructure were constructed to support mining operations at the site. These buildings and infrastructure have been removed from the site, although portions of some foundations remain. Fencing, barricades, berms, and warning signs have been installed at the site due to the number of abandoned mine openings (as shown on Figure 2, appended). Currently, the site is used for commercial forest harvesting as a primary land use and is also being considered for wind energy development.

Surrounding land uses are primarily resource, with some residential properties located south of the site (i.e., the nearest property is located approximately 50 meters (m) south and downgradient of the south site boundary). The site is not serviced by municipal water and sewer. The topographic gradient suggests that the regional groundwater flow direction is south towards Country Harbour River.

[2] Note: The findings of the Phase II ESA were previously presented in Dillon's report "Phase II Environmental Site Assessment (Final), Former Country Harbour Mine Site, County Harbour Mines, Guysborough County, Nova Scotia, Parcel Identification Designation No.: 35091354 and a Portion of 35094366", dated March 27, 2024. As additional information pertaining to local background concentrations was obtained during the 2024 Supplemental ESA, the Phase II ESA findings have been updated and are discussed herein.

1.2 Regulatory Framework

1.2.1 Nova Scotia Contaminated Sites Regulations and Associated Ministerial Protocols

The ESA activities for the site were conducted in accordance with the NS CSRs and associated Ministerial Protocols. The assessment work was conducted in accordance with the Ministerial Protocol PRO-200 (Environmental Site Assessment for Limited Remediation), specifically for an L3 ESA, which applies to the assessment of contamination from a single source or multiple sources with single or multiple contaminants of concern. Specifically, the criteria used to assess impacts at the site were the Tier I EQS for soil, sediment, groundwater (October 2022) and surface water (September 2021) for a property having commercial land-use, potable groundwater usage and both coarse and fine-grained soil conditions[3].

During the 2023-2024 Phase II ESA, the "background" area selected for the site was located approximately 1.5 kilometers (km) north of Highway 316. One (1) background surface water and sediment location (i.e., SW/SED5), two (2) background soil locations (i.e., BH1 and BH2), and one (1) background monitoring well location (i.e., MW24-01) were planned. Due to physical site constraints, the planned background surface water and sediment sampling location (i.e., SW/SED 5) was unable to be located up gradient of all historical site operations, and therefore, was ultimately not considered a background station. While soil locations BH1, BH2 and MW24-01 were preliminarily considered background, subsequent background sampling at the site during the 2024 Supplemental ESA activities has deemed that these samples are not representative of background. Therefore, these data sets will henceforth be considered with the collected assessment data. Soil data obtained during the Supplemental ESA from ten (10) on-site background soil samples (i.e., BH62 (0.15 and 0.5 m) through BH71 (0.15 m and 0.5 m)) were used for comparison. In particular, the highest concentrations from these ten (10) sources were used as the maximum background threshold values (Max BTVs). As part of Supplemental ESA activities, two (2) background surface water and sediment samples (i.e., SW/SED16 and SW/SED17) were successfully collected and were considered during the evaluation of on-site surface water and sediment data exceedances (as Max BTVs).

1.2.2 Other Jurisdictions

For petroleum hydrocarbons in soil, when results did not return to baseline and Petroleum Hydrocarbon F4 analysis was requested, the F4 concentrations were compared to the relevant Canadian Council of Ministers of the Environment (CCME) Canada Wide Standards for Petroleum Hydrocarbons in Soil (i.e., commercial – coarse or fine).

[3] Twelve (12) grain-size samples were collected in different areas of the site and the results indicated eight (8) samples were classified as coarse-grained and four (4) samples were classified as fine-grained. As such, the Tier I EQS for both coarse and fine-grained soils have been considered for the site. Two (2) sediment samples from Johnston Brook were submitted for grain size analysis, each having a coarse-grained classification.

As there are no provincial guidelines available for energetics in soil, the Health Canada Draft Guideline Screening Values and Interim Toxicological Reference Values (TRVs) for Energetic Chemicals (November 2022) were used for comparison of this criteria.

The Index of Additive Cancer Risk (IACR) assesses potential threats to potable groundwater from leaching of carcinogenic PAH mixtures from soil. There is no Tier I EQS for IACR as Nova Scotia Environment and Climate Change (NSECC) deemed that specific provincial standards were not warranted in instances where appropriate guidelines were available from the Canadian Council of Ministers of the Environment (CCME) or other Canadian and international jurisdictions. Therefore, for comparison purposes, the CCME criteria for IACR was used.

As there is no Tier I EQS for sulphur, a comparison value is taken from the Sulphide Bearing Material Disposal Regulations under Section 66 of the Environment Act, April 11, 1995.

2.0 Previous Site Assessment Summary

2.1 Phase I ESA

Based on the findings of the Phase I ESA (Dillon, 2024), which included a review of available records, photographs/images and documents associated with the site, and a site visit, Dillon identified APECs and their corresponding contaminants of potential concern (COPCs) related to the historical mining operations that required assessment, as presented in below in Table 1 and on Figure 2, appended.

Table 1: Summary of Identified Relevant APECs and COPCs

APEC No.	APEC	COPCs	Media of Concern	Comments
1	Tailings Area	Metals, General Chemistry*, Sulphur	Soil, GW, Sed, SW	• One (1) former waste tailings area with potentially sulphide bearing materials. • Surface water discharge location in Johnston Brook, downstream of the cross-culverts along John Fenton Loop Road.
2	Stamp Milling Area	Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW, Sed, SW	• Three (3) former stamp milling areas where potentially sulphide bearing materials may have been processed. • Processing of materials, heavy equipment storage, and petroleum storage. • Surface water is directed to Johnston Brook.

APEC No.	APEC	COPCs	Media of Concern	Comments
3	Waste Rock Piles	Metals, General Chemistry*, Sulphur	Soil, Sed, SW	• Two (2) waste rock areas with potentially sulphide bearing slates, one (1) of which is located in Johnston Brook.
4	Domestic Waste Dumping Areas	Metals, PHCs, PAHs	Soil	• Three (3) locations where domestic waste and discarded fuel drums were identified during the Phase I ESA site visit.
Assessment of Naturally Occurring Background Conditions				
Initial Background Location		Metals, General Chemistry*, Sulphur, PHCs, PAHs	Soil, GW	Based on available topographic data and inferred groundwater flow direction, initial background conditions were assessed at an upgradient location within the assessment boundary that was safely accessible.
Initial Upstream Background Location		Metals, General Chemistry*, Sulphur, PHCs, PAHs	Sed, SW	Surface water and sediment conditions were assessed at an upstream location within the assessment boundary that is safely accessible.[7]

Notes:

1. *General chemistry analysis is only completed on water;
2. GW denotes groundwater, Sed denotes sediment, SW denotes surface water;
3. PHCs denotes petroleum hydrocarbons (i.e., BTEX, modified TPH), PAHs denotes polycyclic aromatic hydrocarbons;
4. Metals analysis included mercury and sulphur;
5. Metals analysis of SW included total metals, while analysis of GW entailed dissolved metals; and,
6. Of note, due to difficult terrain, the background SW and SED location had to be adjusted for health and safety considerations.
7. As previously noted, due to physical site constraints, the planned background surface water and sediment sampling location (i.e., SW/SED 5) was unable to be located up gradient of all historical site operations, and therefore, was ultimately not considered a background station.

It is noted that several waste rock piles were identified as being on-site. Based on the age of the historical mining operations at the site (1862 to 1951), the potential for acid rock drainage (ARD) (from waste rock piles) to be present at the site was considered to be low, as associated potential leaching has likely already occurred. Further, no visual evidence of leaching related to ARD was observed during the Phase I ESA site visit; however, it is noted that the site is heavily vegetated.

The results of the Phase I ESA indicated that further assessment via Phase II ESA was required to characterize the APECs identified.

3.0 Environmental Site Assessment Activities

3.1 Phase II ESA Objectives

The 2023-2024 Phase II ESA included the advancement of five (5) boreholes, each completed as monitoring wells, and soil, groundwater, surface water and sediment sampling. The generalized groundwater flow direction in the assessment area was interpreted to be southerly towards Country Harbour River. As noted above, for comparison to the Tier I EQS, the site is considered to be commercial, potable with both coarse and fine-grained soil conditions. Findings of the 2023-2024 Phase II ESA, which are further discussed herein, were as follows:

- Surface water samples collected from Johnston Brook had metal concentrations (i.e., aluminum, arsenic, iron, lead and/or zinc) that exceed the Tier I EQS for surface water at each sample location. In addition, lab pH was low at each location. There were no other metals exceedances, nor exceedances for other COPCs (i.e., BTEX, modified TPH or PAHs) reported for the analyzed surface water samples.
- Metals concentrations in sediment were generally either below laboratory detection limits, or within the applicable Tier I EQS, with the exception of arsenic, iron, lead, manganese and/or mercury. Iron and manganese concentrations were generally of similar magnitude in each of the sediment samples. The highest arsenic and mercury concentrations were reported at SED2. No BTEX or C6-C10 detections[3] were reported for sediment. Although PAH analysis could not be completed due to the stream substrate composition[4], PAH exceedances were not reported in surface water, or in nearby soil samples, therefore, PAHs were not expected to be a concern in the sediment.
- Sixty-four (64) soil samples (including five (5) field duplicate samples) were submitted for metals analysis, including sulphur and mercury. Metals exceedances in soil above the Tier I EQS (for a commercial, potable site with both coarse and fine-grained soils), and above the Environment Canada (EC) Background Soil Database concentrations (Dillon, 2011) and/or local on-site background concentrations are present across the site assessment area (i.e., the areas of former mining operations). Notable, widespread exceedances, when looking at the overall data set in comparison to both the Tier I EQS and background, include arsenic, beryllium, iron, lead, and selenium. Although not widespread, mercury exceeded the applicable Tier I EQS at four (4) locations, and each of these locations were in the central portion of the study area (at or between MW4 and MW5). The highest arsenic was reported at BH7, highest iron at BH18, highest lead and mercury at BH15, and highest zinc at BH23. One (1) manganese concentration also exceeded both the Tier I EQS and background (i.e., BH28 0-0.15 m). Metals impacts in soil were not delineated laterally. Vertically soil impacts were considered delineated by the presence of bedrock, which ranged from 0.53 meters below ground surface (mbgs) (APEC #1) to 1.37 mbgs (APEC #2) in the area of former mining operations.

[4] Sediment encountered during the Phase II ESA consisted mainly of rock/gravel with little fines, that limited the amount of sample available to the laboratory for analysis. Due to high rock content, only BTEX and C6-C10 analysis could be completed by the laboratory. PAH analysis could not be completed on sediment.

- Ethylbenzene in soil exceeded the Tier I EQS at BH17 (0-0.15 m), which was advanced in an area of refuse (e.g., household waste, plastic, and metal (including a drum and lawnmower)) underlain by waste rock. As no other petroleum exceedances were identified on-site, this exceedance was expected to be localized.
- One (1) sulphur concentration (at BH30 (0-0.15 m) exceeded the Sulphide Bearing Material Disposal Regulation comparison criteria.
- Dissolved metals concentrations in groundwater were generally either below laboratory detection limits or within the applicable Tier I EQS, with some exceptions (i.e., arsenic, cobalt, iron, and manganese). It is noted that the turbidity in some of the newly installed monitoring wells was high (up to 109 NTU), and that the presence of turbidity in a sample can lead to higher metals concentrations being reported, as metals tend to adhere to sediment within a sample.

Following the 2023-2024 Phase II Environmental Site Assessment work, Dillon completed a qualitative risk review of the site to identify relevant contaminants of concern (CoCs), media, pathways, receptors and potential risk. Based on the initial data obtained in the Phase II ESA, Dillon recommended further consideration of the remedial approach including completion of Supplemental ESA activities to better refine the liability estimate, including:

- Obtain supplemental soil background data.
- Obtain supplemental surface soil data to establish lateral delineation of metals impacts in soil.
- Complete additional surface water and possible sediment sampling (depending on the substrate encountered) to establish background conditions in these media.
- Complete a confirmatory groundwater sampling event.
- Complete a Human Health and Ecological Risk Assessment (HHERA[5]).

3.2 Supplemental ESA Objectives

The Supplemental ESA completed at the Former Country Harbour Mine in 2024 included the following tasks:

- To further characterize naturally occurring background conditions, collection of two (2) background surface water and sediment samples from Johnston Brook, which intersects the site, for metals (including mercury) and total organic carbon (TOC) analysis for sediment, and general chemistry, total and dissolved metals (including mercury) analysis for surface water.
- Completion of one (1) surface water and sediment sampling event within the on-site portion of Johnston Brook to further characterize site conditions (up to ten (10) samples, including one (1) field duplicate), with samples submitted for metals (including mercury) and TOC analysis for sediments, and general chemistry, total and dissolved metals (including mercury) for surface water.
- Collection of a surface water sample from the former location of an on-site water line pipe (removed Spring 2024) for general chemistry, and total metals (including mercury).

[5] Findings of the HHERA conducted by Dillon are presented in a separate standalone report.

- As naturally occurring background metals concentrations in soil had not been fully characterized, the advancement of ten (10) additional shallow test holes, with the collection of twenty-two (22) additional surface soil samples (including two (2) field duplicate samples) was recommended for metals (including mercury) analysis to further assess background metals concentrations in the vicinity of the site. Soil samples were planned to be collected manually (e.g., via shovel or auger) at a depth of 0-0.15 mbgs and 0.15-0.5 mbgs (or to bedrock, if bedrock occurred before 0.5 mbgs).
- Collection of ten (10) site surface soil samples (0-0.15 mbgs) for pH, TOC and grain size analysis.
- Collection of supplemental data to establish lateral delineation of metals impacts in on-site soil. The manual advancement of approximately thirty-five (35) test holes, collection of three (3) soil samples per test hole (i.e., at 0-0.15 mbgs, 0.5 mbgs, 1.0 mbgs) with up to thirty-eight (38) surface soil samples (i.e., 0-0.15 mbgs) (including three (3) duplicate samples) e submitted for metals (including mercury) analysis. The remaining soil samples were placed on hold for potential future analysis.
- Collection of six (6) soil samples (including one (1) field duplicate sample) for BTEX and modified TPH analysis to laterally (0-0.15 m) and vertically (0.50 m) delineate one (1) identified ethylbenzene soil exceedance at borehole BH17 (0-0.15 m) (Dillon, 2023). The ethylbenzene exceedance was identified in an area of refuse (e.g., household waste, plastic and metal (including a drum and lawnmower)) underlain by waste rock. As no other petroleum exceedances were identified on-site, this exceedance was expected to be localized; however, delineation had not been achieved.
- The highest mercury concentration reported in soil was 2,920 mg/kg at borehole BH15 (0-0.15 m) (Dillon, 2023). A deeper sample (i.e., 0.50 m) analysed at this location, while still exceeding the applicable comparison criteria was significantly lower (i.e., concentration of 30.9 mg/kg). It was recommended that four (4) step out samples be collected for metals (including mercury) analysis in the area of BH15 for lateral delineation.
- Completion of one (1) confirmatory low flow groundwater sampling event at five (5) existing monitoring wells for general chemistry, and both dissolved and total metals (including mercury)6 analysis. Collection of one (1) field duplicate sample and equipment blank for general chemistry, total and dissolved metals (including mercury) analysis.

Further assessment activities were also completed in support of the HHERA:

- Analysis of surface soil samples for arsenic and arsenic in vitro bioaccessibility (IVBA); and
- Completion of an aquatic habitat assessment for the portion of Johnston Brook that intersects the study area of the site to map the Johnston Brook watercourse and to collect information to confirm the absence or presence of suitable habitat for fish and other aquatic receptors.

The findings of the IVBA analysis are presented within the HHERA report, while the aquatic habitat study is presented in a standalone report appended to the HHERA.

[6] Inclusion of groundwater samples for both dissolved and total metals aids in determination of how much of the total metal concentrations are in a dissolved metals sample, and therefore likely in a more bioavailable form.

3.3 Methodologies

The following sections describe the methodologies associated with the ESA activities to date. Test hole, monitor well and borehole logs are presented in Appendix A. Site photographs are presented in Appendix B.

3.3.1 Utility Locates

Prior to each intrusive investigation, Dillon contacted public utilities including Bell Fiber 360, Bell Aliant, Rogers, Guysborough County, and Nova Scotia Power Incorporated (NSPI) to confirm the presence/ absence of their services at the site. Underground utilities were reviewed prior to commencing intrusive activities.

3.3.2 Surface Water Sampling

Johnston Brook intersects the site from north to the southeast. On November 6, 2023, seven (7) surface water samples were collected including two (2) duplicate samples (i.e., SW1 through SW5, SW DUP A and SW DUP B). On May 22, 2024[7], two (2) background surface water samples were collected (i.e., SW16 and SW17) from Johnston Brook, to the north of the site (i.e., within PID No. 35094366 north of known former mining activities). Also on May 22, 2024, ten (10) surface water samples, including one (1) duplicate sample (i.e., SW6, SW8 through SW10, SW12 through SW15, and field duplicate sample CHQAQC03 collected at SW14) were collected[8] from the portion of Johnston's Brook that intersects the site. One (1) surface water sample (i.e., SW7) was collected from the former location of an on-site water line pipe (removed Spring 2024) in a tributary of Johnston Brook.

The surface water samples were collected as grab samples placed directly into laboratory-provided sample bottles containing the appropriate preservatives. Care was taken to collect surface water into the sample bottles at an angle slightly above horizontal such that preservatives were not lost. The sample bottles were placed into a cooler containing ice for shipment to ALS Environmental Analytical (ALS) Lab in Dartmouth, Nova Scotia for general chemistry and metals (both total and dissolved) analysis. ALS is accredited by the Canadian Association of Laboratory Accreditation (CALA). The surface water sample locations are presented on Figure 3, appended. Field water quality readings (i.e., conductivity, turbidity, pH, dissolved oxygen, and temperature) and Global Positioning System (GPS) coordinates were recorded at each surface water sampling station.

3.3.3 Sediment Sampling

On November 6, 2023, six (6) representative sediment samples, including one (1) field duplicate sample, were collected (i.e., SED1 through SED5, and SED-DUP A) from Johnston Brook. On May 22, 2024, two

[7] Due to a field oversight, general chemistry was sampled on May 22, 2024 at location SW12, with metals sampled at this location on June 4, 2024.
[8] Note, one (1) additional surface water sample planned at the correlating location of sediment sample SED11 could not be collected due to dry conditions.

(2) background sediment samples were collected (i.e., SED16 and SED17) from Johnston Brook to the north of the site (i.e., within PID No. 35094366 north of known former mining activities). On May 22, 2024, ten (10) representative sediment samples were also collected (i.e., SED6, SED8 through SED15, and field duplicate) from the portion of Johnston Brook that intersects the site. Where possible, sediment samples were collected at the same location as the surface water samples with the correlating identification and as shown on Figure 3, attached, with the surface water sampling being completed prior to the sediment sampling.

Sediment samples were collected using a trowel. The sample bottles were placed into a cooler containing ice for transport to ALS Lab for metals, total organic carbon and/or grain size analysis.

3.3.4 Shallow Surface Soil Sampling

As part of the Phase II ESA, shallow surface soil sampling was completed between November 7 and 10, 2023, and between January 18 and 20, 2024. Boreholes were completed using a hand auger to a maximum depth of 1 m. Representative samples were collected at surface and at the final borehole depth. Additional step out surface soil samples (0-0.15 m) were collected for potential future analysis following identification of any contamination in the originally analyzed surficial samples. Five (5) soil samples (0-0.15 mbgs) were also collected for energetics screening purposes.

As part of the Supplemental ESA, shallow surface soil sampling was completed between May 21 and 25, 2024. Boreholes were completed using a hand auger to targeted depths up to a maximum of 1 m. Ten (10) background soil samples (i.e., BH62 through BH71, plus two (2) field duplicate samples: BH DUP F collected at BH66 and BH DUP G collected at BH67) were collected north of the site (i.e., within PID No. 35094366 but north of known former mining activities) and analyzed for metals including mercury. Ten (10) soil samples (i.e., BH72 through BH81) were collected across the site for grain size, pH, fraction of organic carbon and total organic carbon analysis in support of the HHERA. Thirty-five (35) soil samples (i.e., BH82 through BH116, including two (2) field duplicate samples: BH DUP I collected at BH88, and BH DUP J collected at BH111) were advanced to assess lateral delineation of metals impacts in on-site soil as identified during previous assessment activities. Eleven (11) soil samples (i.e., BH117 to BH126, including field duplicate sample BH DUP L collected at BH125) were collected for metals analysis in support of the arsenic in IVBA undertaken as part of the HHERA. Six (6) soil samples were collected (BH127 through BH131, plus duplicate sample BH DUP H collected from BH130) to laterally delineate a localized ethylbenzene exceedance identified during the Phase II ESA. Four (4) step out samples were collected (i.e., BH132 to BH135) at the location of the highest mercury concentration reported in soil during the Phase II ESA.

To the extent possible, surface vegetation and root material were not included in the soil samples. A continuous geological log was recorded during the advancement of each borehole and described the stratigraphy encountered. The presence/absence of evidence of potential contamination (i.e., visual staining and olfactory indications) was documented. Field screening was completed with the collection

of VOC headspace measurements where petroleum hydrocarbon (PHC) impacts were suspected based on the summary of Phase I ESA findings. Samples collected for analysis of PHCs were collected using Terra Core™ samplers and placed directly into laboratory supplied containers preserved with methanol. Samples collected for other analyses were collected as a grab sample and placed directly into laboratory supplied containers. Standard industry best practices regarding sample preservation and storage, and the cleaning of sampling apparatus were followed. Select surface soil samples were submitted to ALS Labs for metals (including mercury), petroleum hydrocarbon, pH, fraction of organic carbon, total organic carbon, and/or grain size analysis.

3.3.5 Monitoring Well Installation

Between January 16 and 18, 2024, Dillon coordinated with Logan Drilling Group (Logan) of Stewiacke, Nova Scotia to advance a total of five (5) boreholes across the site to be completed as monitoring wells. The monitor wells (i.e., 24MW-01 through 24MW-05) were installed to depths ranging from 4.88 mbgs (24MW-02, 24MW-03 and 24MW-05) to 6.4 mbgs (24MW01)). Boreholes were advanced a combination of standard split spoons, auger methods and coring. Soil stratigraphy was recorded along with soil observations such as the presence of debris, odours and staining. During coring, the bedrock core was also logged.

Due to the remoteness of the site and difficult on-site terrain that presents access challenges, prior to commencing the drilling program, Dillon explored the feasibility of using on-site surface water from Johnston Brook in the event that coring was required during drilling. Dillon reviewed the surface water analytical data for the samples collected by Dillon on November 6, 2023, and concluded that surface water in the vicinity of SW1 would be suitable for coring during the drilling program. Based on the analytical results, SW1 exhibited the best water quality overall (i.e., less parameter exceedances compared to the other surface water samples collected from Johnston Brook). Additionally, moderate to high flow was observed in the brook at this location and was relatively easy to access. BNS approved this approach.

Prior to the drilling program Dillon reviewed NSECC water course alteration regulations, and based on our interpretation, a permit was not required if the withdrawal was kept to less than 23,000 liters (L) per day and the source was not dewatered. Daily surface water removal from the on-site watercourse was approximately 2000 L on January 16 and 17, 2024, with approximately 4000 L removed on January 18, 2024. The surface water intake pipe was also screened to avoid fish mortality (noting that fish were not observed to be present).

Continuous discrete split-spoon soil samples were collected at 0.6 m intervals when possible. Soil samples proposed for analysis of PHCs were collected using a 10 mL Terracore sampler and stored in two 40 mL vials containing a methanol preservation agent, as well as a 60 mL laboratory-supplied glass sample container and a re-sealable plastic bag. Soil samples proposed for other analysis were collected and placed directly into one or more laboratory-supplied 150 mL, 120 mL, and/or 60 mL glass sample

container, depending on the proposed analysis. Dillon field personnel logged subsurface conditions encountered in each borehole at the time of sampling. Volatile organic compound (VOC) concentration measurements were obtained from the headspace of appropriate recovered soil samples using an RKI Eagle vapour meter with methane elimination and calibrated to hexane. Select soil samples from the drilling program were submitted to ALS Lab in Dartmouth, Nova Scotia for PHC, metals, and/or PAH analysis.

Upon completion of the drilling, monitoring wells were installed using 50 mm diameter, Schedule 40, PVC screen (0.025 cm slot) and casing with silica sand filter pack and a bentonite seal near surface. Each monitor well was sealed with a J-plug and finished with a steel monument style protective casing. Borehole and monitoring well locations are presented on Figure 4 (appended). Borehole logs describing observations made during the drilling program and monitoring well construction details are presented in Appendix A.

3.3.6 Monitoring Well Development

Between January 17 and 19, 2024, monitoring wells at the site were developed to remove water that was disturbed during the drilling process, water that was introduced during coring, and to enhance the operation of the screen and sand pack as an effective particulate filter system. Well development involved removal of a minimum of five (5) times the water column volume. At locations where purging five (5) times the water column was not feasible due to recharge conditions; the well was purged dry a minimum of five times. In order to reduce the potential of cross contamination between monitoring wells, each well was equipped with dedicated Waterra tubing and an inertial foot valve. A period of at least twenty-four (24) hours was left between the initial well development and sampling to allow the wells to recover.

3.3.7 Groundwater Monitoring and Sampling

As part of the ESA, two groundwater monitoring sampling events were completed (i.e., January 19-20, 2024 and on May 22, 2024). To reduce the potential of cross contamination between monitoring wells, each well was equipped with dedicated low-density, HDPE tubing as well as silicone tubing. Prior to purging the well, the depth to groundwater was measured from an established reference point (top of PVC casing) using an oil-water interface probe. Low flow sampling was used to minimize sample turbidity. Sample turbidity has the potential to bias the dissolved phase analytical results, as targeted substances present within or sorbed to soil particles may be released during sample preparation/ analysis, resulting in an artificially high measurement.

A battery powered peristaltic pump set at a low pumping rate (e.g., 0.1 L/min) to minimize drawdown was utilized to purge and sample the monitoring wells. Monitoring wells were purged according to Dillon Standard Environmental Field Procedures and industry standards for low-flow groundwater sampling. Groundwater field parameters were measured using a Horiba U-52 multimeter calibrated according to the manufacture's published instructions and a flow-through cell. Field parameters

recorded from the instrument included: pH, conductivity, dissolved oxygen, oxidation-reduction potential, turbidity and temperature. Groundwater field parameters and drawdown were monitored and recorded typically every three to five minutes. Once the monitored parameters had stabilized such that successive measurements were within 10%, a groundwater sample was collected.

The collected groundwater samples were directly placed into laboratory supplied containers. Dissolved metals and mercury samples were field filtered and preserved. The sample containers were filled, labeled, and stored in a sample cooler containing ice pending delivery to ALS Labs in Dartmouth, Nova Scotia for general chemistry and dissolved metals (including mercury) analysis.

3.3.8 Quality Assurance and Quality Control

Quality Assurance/Quality Control (QA/QC) protocols were established and followed throughout the monitoring program. This included the collection of duplicate samples in each media (i.e., surface water, sediment, soil and groundwater) and the use of an equipment blank. As discussed in sections above, non-dedicated equipment, such as the oil-water interface probe, were decontaminated between sampling locations using a phosphate free detergent and distilled water. Methods used during the field work followed Dillon's Standard Environmental Field Procedures which are based on industry standards and described in the respective sections above.

An equipment blank was collected during each of the groundwater monitoring events. The equipment blank samples were submitted for analysis of groundwater COCs at the site. Blind field duplicate samples were also collected during the assessment activities including: two (2) duplicate surface water samples, two (2) duplicate sediment samples, eleven (11) duplicate soil samples, and two (2) duplicate groundwater samples. A trip blank was also collected during the January 2024 sampling event and submitted for petroleum hydrocarbon analysis[9].

Sample bottles were labelled with sample/location ID, project name and number, company name (Dillon), and time and date of collection. Once collected, samples were immediately placed in coolers containing ice to maintain a temperature of less than 10ºC. To minimize the potential for cross contamination, new nitrile gloves were used to collect each sample, and non-dedicated sampling equipment was decontaminated between each sampling location.

To evaluate the precision associated with sampling and analytical methods, the samples and their duplicates were used to calculate the relative percent difference (RPD). The RPD is defined as the absolute value of the variation between a sample's analytical concentration and its duplicate, when

$$= \frac{|V_1 - V_2|}{\frac{(V_1+V_2)}{2}} \times 100$$

[9] Note, as sampling of volatiles in groundwater was not completed as part of Supplemental ESA activities, a trip blank was not included during this second monitoring and sampling event.

compared to the average concentration of the original and the duplicate in detected samples. The RPD is calculated using the following equation:

RPD is used to assess the validity of the field and laboratory analytical procedures for parameters analyzed that are greater than five (5) times the reportable detection limit (RDL). Dillon set a screening-level RPD acceptance criterion of less than 40% for surface water and groundwater, and 60% for soil/sediment. As noted above, field duplicates were collected during the assessment, with RPDs calculated for the parent and duplicate samples.

4.0 Environmental Site Assessment Results

The following sections present the results of the ESA activities to date (i.e., the 2023-2024 Phase II ESA and the 2024 Supplemental ESA to meet the objectives noted above).

4.1 Surface Water Quality

Surface water analytical results for metals are presented in Table C-1, PAHs in Table C-2, and petroleum hydrocarbons in Table C-3, Appendix C, and are summarized in the sections below. Laboratory certificates of analysis are provided in Appendix D. Surface water sample locations are presented on Figure 3, appended.

4.1.1 General Chemistry and Metals

A total of sixteen (16) surface water samples (i.e., SW1 through SW15), including two (2) field duplicates (i.e., SW DUP A, duplicate of SW3 and CHQAQC03, duplicate of SW14), were submitted for general chemistry and total and/or dissolved[10] metals analysis, which included sulphur and mercury. General chemistry and metals concentrations in surface water were generally either below laboratory detection limits, or within the applicable Tier I EQS, with the following exceptions:

- The pH (lab) values were below the recommended range associated with the on-site watercourse (i.e., Johnston Brook) ranging from 5.18 to 5.98, indicating acidic conditions. The pH (lab) readings for background ranged from 4.96 to 5.30.
- Total aluminum concentrations ranging from 0.119 mg/L (in SW6) to 0.325 mg/L (in SW2) in each of the analyzed samples exceeded the Tier I EQS of 0.005 mg/L. Dissolved aluminum concentrations ranging from 0.116 mg/L (in SW8) to 0.169 mg/L (in SW12) in each of the analyzed samples also exceeded the Tier I EQS of 0.005 mg/L. With the exception of SW2, the total aluminum concentrations are below the Max BTV of 0.233 mg/L for total aluminum; however, some dissolved aluminum concentration exceedances were above the Max BTV of 0.127 mg/L.

[10] Dissolved metals analysis was not included as part of the Phase II ESA, but included as was part of the Supplemental ESA to assess for potential sediment bias.

- Total arsenic concentrations ranging from 0.0263 mg/L (in SW15) to 0.0633 mg/L (in SW2) in each of the analyzed samples exceeded the Tier I EQS of 0.005 mg/L. Dissolved arsenic concentrations ranging from 0.0264 mg/L (in SW15) to 0.0346 mg/L (in SW12) exceeded the Tier I EQS of 0.005 mg/L. The total and dissolved arsenic exceedances are above the Max BTV concentrations of 0.00130 mg/L (total) and 0.00088 mg/L (dissolved).
- Total iron concentrations of 0.318 mg/L (in SW12) and 0.621 mg/L (in SW5) exceeded the Tier I EQS of 0.3 mg/L. With the exception of SW2, these exceedances are below the Max BTV concentration of 0.399 mg/L for total iron. There were no dissolved iron exceedances of the Tier I EQS.
- The total lead concentrations 0.00208 mg/L (in SW2) and 0.00144 mg/L (in SW13) marginally exceeded the Tier I EQS of 0.001 mg/L and exceeded the Max BTV total lead concentration of 0.000879 mg/L. There were no reported dissolved lead exceedances of the Tier I EQS.
- The total zinc concentration of 0.0088 mg/L in SW5 exceeded the applicable Tier I EQS of 0.007 mg/L. It is noted that SW15 (tested in the same general area as SW5 in May 2024) did not exceed for zinc (total or dissolved). One sample (SW9) exhibited a dissolved zinc concentration of 0.0073 mg/L considered analytically equivalent to the Tier I EQS. Total zinc was not detected in the background samples.

The aluminum and iron exceedances are considered to be naturally occurring.

Mercury was detected at four (4) of the five (5) surface water sampling locations (i.e., except for SW5) during the Phase II ESA, and at six (6) of the nine (9) surface water sampling locations (i.e., except SW13, SW14, and SW15; noting that SW15 is the same general area as SW5) during the Supplemental ESA. There were no Tier I EQS exceedances. Mercury was not detected in the local background samples (i.e., SW16 and SW17).

Total and dissolved sulphur was detected in each of the analyzed samples, with the exception of total sulphur in SW4 and dissolved sulphur in SW12. The total sulphur concentration was also reported at the laboratory detection limit of 0.5 mg/L at SW5. With the exception of SW5, total sulphur concentrations ranged from 0.53 mg/L (SW3; with the duplicate reported at 0.51 mg/L) to 0.83 mg/L (in SW8), with dissolved sulphur concentrations[11] ranging from 0.52 (SW15) to 0.71 mg/L (in SW8). There is no Tier I EQS for sulphur.

4.1.2 Polycyclic Aromatic Hydrocarbons

Three (3) surface water samples (i.e., SW4, the field duplicate sample of SW4 (i.e., SW DUP B), and SW5) were submitted for PAH analysis as part of the Phase II ESA. PAH concentrations in surface water were below the laboratory detection limits and the applicable Tier I EQS. As PAH concentrations in surface water were below the laboratory detection limits and the applicable Tier I EQS, this analysis was not included as part of the Supplemental ESA.

[11] Note, dissolved sulphur was not analyzed as part of the Phase II ESA.

4.1.3 Petroleum Hydrocarbons

Three (3) surface water samples (i.e., SW4, the field duplicate sample of SW4 (i.e., SW DUP B), and SW5) were submitted for BTEX and modified TPH analysis as part of the Phase II ESA. BTEX and modified TPH concentrations in surface water were below the laboratory detection limits and the applicable Tier I EQS. As BTEX and TPH concentrations in surface water were below the laboratory detection limits and the applicable Tier I EQS, this analysis was not included as part of the Supplemental ESA.

4.2 Sediment Quality

Sediment analytical results for metals are presented in Table C-4, and petroleum hydrocarbon data is presented in Table C-5, Appendix C, and are summarized in the sections below. Laboratory Certificates of Analysis are provided in Appendix D. Sediment sample locations are presented on Figure 3, appended.

4.2.1 Metals

A total of seventeen (17) sediment samples (i.e., SED1 through SED15, two (2) field duplicate samples (SED DUP A, collected at SED3 and CHQAQC04, collected at SED13) and two (2) background samples (SED16 and to SED17)) were submitted for metals analysis. Grain size analysis was completed on two samples (i.e., SED6 and SED15) both of which indicated coarse-grained conditions. Select sediment samples (SED6 to SED17) were also submitted for fraction organic carbon and total organic carbon analysis.

Metals concentrations in sediment were generally either below laboratory detection limits or within the applicable Tier I EQS, with the following exceptions:

- Arsenic concentrations, ranging from 373 mg/kg (in duplicate sample of SED13; CHQAQC04) to 8,870 mg/kg (in SED6) exceeded the Tier I EQS of 17 mg/kg and the Max BTV of 49.5 mg/kg at each sampling location.
- Iron concentrations of 58,000 mg/kg in SED4 and 44,400 mg/kg in SED11 exceeded the Tier I EQS of 43,766 mg/kg and the Max BTV of 10,600 mg/kg.
- Lead concentrations of 124 mg/kg in the field duplicate sample of SED3, 110 mg/kg in SED4, and 107 mg/kg in SED12 exceeded the Tier I EQS of 91.3 mg/kg. It is noted that the lead concentration in SED3, the primary sample at 74.4 mg/kg, was below the Tier I EQS. The lead exceedances were also above the Max BTV of 23.4 mg/kg.
- Manganese concentrations ranging from 1,160 mg/kg (in SED14) to 6,910 mg/kg (in SED9) in sediment samples SED1, SED3 through SED5 (including the duplicate sample of SED3), SED8 through SED13 and SED14 exceeded the Tier I EQS of 1,100 mg/kg. It is noted that the manganese concentration in the duplicate sample of SED13 was below the Tier I EQS. The manganese exceedances were also above the Max BTV of 155 mg/kg.
- Mercury concentrations ranging from 0.489 mg/kg (in SED9) to 0.925 mg/kg (in SED10) exceeded the Tier I EQS of 0.486 mg/kg in SED1, SED2, the duplicate sample of SED3, SED6, SED9, and SED10. It is

noted that the SED3 mercury concentration, in the primary sample at 0.314 mg/kg, was below the Tier I EQS. The mercury exceedances were also above the Max BTV of 0.156 mg/kg.

4.2.2 BTEX and Petroleum Hydrocarbons

A total of six (6) sediment samples, including one field duplicate (i.e., SED DUP-A), were submitted for petroleum hydrocarbon analysis as part of the Phase II ESA. Due to high rock content, only BTEX and C6-C10 analysis could be completed by the laboratory. The BTEX and C6-C10 concentrations were below laboratory detection limits and below the Tier I EQS. As petroleum hydrocarbon concentrations in surface water were below the laboratory detection limits and the applicable Tier I EQS, this analysis was not included as part of the Supplemental ESA.

4.3 Soil Quality

Soil analytical results for metals are presented in Table C-6a, background results for metals are presented in Table C-6b, grain size analysis is presented in Table C-6c, petroleum hydrocarbon results are presented in Table C-7, and PAH results are presented in Table C-8, Appendix C, and are summarized in the sections below. Laboratory Certificates of Analysis are provided in Appendix D. Soil sample locations are presented on Figure 4, appended.

4.3.1 Soil Stratigraphy

As noted previously, soil stratigraphy varies considerably across the site. For clarity purposes, site stratigraphy has been grouped into areas of the site that had previously served similar purposes when the site was operating as a mining and/or milling facility and is further discussed in Section 5.5.1. Twelve (12) representative grain-size samples were collected in different areas of the site and the results indicated eight (8) samples were classified as coarse-grained and four (4) samples were classified as fine-grained. As such, the Tier I EQS for both fine and coarse-grained soils have been considered for on-site soil.

4.3.2 Metals

The 2023-2024 Phase II ESA included submission of sixty-nine (69) soil samples, including five (5) field duplicate samples (i.e., BH DUPA, BH DUPB, BH DUPC, BH DUPD, and BH DUP E), for metals analysis. The Supplemental ESA consisted of the submission of fifty-three (53) additional soil samples, including four (4) field duplicate samples (i.e., BH Dup I, BH DUP J, BH DUP K, and BH DUP L). Twenty-two (22) additional soil samples, including two (2) field duplicate samples (BH DUP F and BH DUP G) were also collected for evaluation of local background soil concentrations for metals.

Metals exceeded the applicable Tier I EQS for at least one (1) parameter in each of the analyzed samples from the Phase II ESA and Supplemental ESA combined dataset, with the exception of two (2) locations: BH86 (0-0.15 m), and BH104 (0-0.15 m). When compared to local background maximum concentrations (see Section 1.2.1), eighty-six (86) samples still exceed; however, the number of parameters exceeding

at each location is reduced. Notable, widespread exceedances (considering the full data set) are summarized below:

- Aluminum concentrations, with exceedances ranging from 15,500 mg/kg to 36,500 mg/kg (the highest concentration at BH56 0-0.15 m), exceeded the applicable Tier I EQS (15,400 mg/kg) in forty-seven (47) of the analyzed samples (including three (3) field duplicates). When compared to the Max BTV of 26,200 mg/kg, exceedances remain at twelve (12) locations (i.e., BH11 (0.90 m), BH16 (0-0.15 m), BH24 (0-0.15 m), BH27 (0-0.15 m and 0.45 m), BH29 (0-0.15 m and 0.35 m), BH30 (0-0.15 m), BH31 (0-0.15 m and 0.50 m), BH56 (0-0.15 m), and BH124 (0-0.15 m)).
- Arsenic concentrations, with exceedances ranging from 10.2 mg/kg to 20,600 mg/kg (the highest concentration at DUP J 0-0.15 m, the field duplicate sample of BH111, with the parent sample having an arsenic concentration of 18,700 mg/kg) exceeded the applicable Tier I EQS (10 mg/kg) in each of the analyzed samples, except for BH86 (0-0.15 m) and BH104 (0-0.15 m). When compared to the Max BTV of 1,050 mg/kg, thirty-nine (39) sample exceedances remain (including four (4) duplicate samples; however, one (1) of the duplicate samples has a parent sample (i.e., BH11 (0-0.5 m) that exceeds the Tier I EQS but is below the local Max BTV).
- Beryllium concentrations, with exceedances ranging from 1.03 mg/kg to 7.49 mg/kg (the highest concentration at BH92 (0-0.15 m)), exceeded the applicable Tier I EQS and the Max BTV of 1 mg/kg in twenty-eight (28) of the analyzed samples (including three (3) duplicate samples; however, one (1) of the duplicate samples has a parent sample (i.e., BH11 (0-0.5 m)) that is below the Tier I EQS for beryllium).
- Iron concentrations, with exceedances ranging from 12,200 mg/kg to 112,000 mg/kg (the highest concentration at BH18 0-0.15 m) exceeded the applicable Tier I EQS of 11,000 mg/kg in ninety-seven (97) samples (including seven (7) duplicate samples). When compared to background (i.e., maximum local background concentration 30,000 mg/kg), exceedances remain at forty-one (41) locations (including six (6) field duplicate samples; however, the parent sample of one (1) of the duplicate samples (i.e., BH11 0-0.15 m) exhibited an iron concentration within the local background value).
- Lead concentrations, with exceedances ranging from 126 mg/kg to 1,360 mg/kg (the highest concentration at BH15 (0-0.15 m) exceeded the applicable Tier I EQS of 120 mg/kg in thirty-three (33) of the analyzed samples (four (4) of which were duplicate samples, noting that one of four (4) had a parent sample (BH11 (0-0.15m)) that did not exceed the comparison criteria for lead). The same samples exceed the Max BTV of 88.1 mg/kg.
- Manganese in fifty-five (55) soil samples (including four (4) duplicate samples) had concentrations ranging from 367 mg/kg to 7,510 mg/kg (with the highest concentration reported for BH28 (0-0.15 m)) that exceeded the Tier I EQS for manganese of 360 mg/kg and the Max BTV of 218 mg/kg.
- Selenium concentrations, with exceedances ranging from 1.02 mg/kg to 11.1 mg/kg (the highest concentration at BH92 0-0.15 m), exceeded the applicable Tier I EQS of 1 mg/kg in forty-one (41) soil samples (including two (2) duplicate samples; noting that the concentration in one parent sample (BH111 0-0.15 m) exceeded with the correlating duplicate sample below the Tier I EQS). When compared to the Max BTV of 1.44 mg/kg, twenty-four (24) exceedances remain.

- Vanadium concentrations in twenty-nine (29) samples (including two (2) duplicates), with exceedances ranging from 39.5 mg/kg to 72.6 mg/kg (the highest concentration at BH29 0.35 m), exceeded the applicable Tier I EQS of 39 mg/kg and the Max BTV of 38.6 mg/kg).
- Zinc concentrations in eleven (11) samples (including one (1) duplicate), with exceedances ranging from 201 mg/kg to 531 mg/kg (the highest concentration at BH23 0-0.15 m), exceeded the applicable Tier I EQS of 200 mg/kg and the Max BTV of 44.2 mg/kg.

Although not widespread, it is important to note that mercury exceeded the applicable Tier I EQS at ten (10) locations (i.e., BH14 (0-0.15 m), BH15 (0-0.15 m and 0.50 m), BH20 (0-0.15 m), BH21 (0-0.15 m) and the field duplicate BH Dup D collected at BH21 (0-0.15 m), BH54 (0-0.15 m), BH132 (0-0.15 m), BH134 (0-0.15 m), and BH135 (0-0.15 m)), with concentrations ranging from 28.1 mg/kg (at BH14) to 2,920 mg/kg (at BH15). Four (4) step out samples were collected (i.e., BH132 to BH135) at the location of the highest mercury concentration reported in soil during the Phase II ESA (i.e., BH15). Mercury was detected above the Tier I EQS and the Max BTV in each of the step out samples, except BH133 (0-0.15 m); however, concentrations were much lower than those reported in BH15 (0-0.15 m), ranging from 26.2 mg/kg to 108 mg/kg.

Other Tier I EQS exceedances included: antimony (nine (9) samples including two (2) field duplicates), cadmium (ten (10) samples including one (1) field duplicate), cobalt (nine (9) samples), molybdenum (one (1) sample), and thallium (three (3) samples).

For metals that exceeded both the Tier I EQS and background (Max BTV), and are most likely associated with mining activities and/or sulphide bearing rock, the following observations are noted:

- The highest arsenic concentration was reported at duplicate sample BH DUP J, collected at BH111 (0-0.15 m).
- The highest iron concentration was reported at BH18 (0-0.15 m), with the deeper sample at this location (1.0 m) also exceeding the Tier I EQS and the Max BTV.
- The highest lead and mercury concentrations were reported at BH15 (0-0.15 m), with the deeper sample at this location (0.50 m) below the comparison criteria for lead, and the mercury concentration, while still exceeding, was significantly lower.
- The highest zinc concentration was reported at BH23 (0-0.15 m), with the zinc concentration in the deeper sample (0.95 m) at this location also exceeding the Tier I EQS and the Max BTV.
- As there is no Tier I EQS for sulphur, a comparison value of 4000 mg/kg was taken from the Sulphide Bearing Material Disposal Regulations. Three (3) soil samples, BH30 0-0.15, BH111 0-0.15 m and its field duplicate, with concentrations ranging from 4,500 mg/kg to 8,700 mg/kg, exceeded the 4000 mg/kg comparison value. As noted previously, the potential for ARD on-site is considered low; however, further assessment for ARD may be warranted at these two locations (i.e., BH30 and BH111).

Metals impacts in soil are laterally delineated to the north and south. Lateral delineation of impacts to the east and west has been partially achieved on the southern portion of the assessment site; however, are not delineated to the east and west on the northern portion of the assessment site. Vertically soil impacts are delineated by the presence of bedrock, which ranged from 0.53 mbgs (APEC #1) to 1.37 mbgs (APEC #2)[12].

4.3.3 Petroleum Hydrocarbons

During the 2023-2024 Phase II ESA, twenty-six (26) soil samples (i.e., including two (2) field duplicates) were submitted for petroleum hydrocarbon analysis (i.e., initial analysis was Atlantic RBCA, with subsequent CCME Petroleum Hydrocarbon Fraction F4 requested when results did not return to baseline). Findings indicate that BTEX concentrations were below laboratory detection limits and/or below the Tier I EQS in twenty-four (24) of the analyzed samples. The ethylbenzene concentration of 0.079 mg/kg at BH17 (0-0.15 m) exceeded the Tier I EQS of 0.043 mg/kg (for coarse-grained conditions, which are most applicable at this location based on field observations). The detected ethylbenzene concentration of 0.044 mg/kg in sample BH19 (0-0.15 m) was considered to be analytically equivalent to the Tier I EQS of 0.043 mg/kg. The modified TPH results for soil were below the Tier I EQS. Of note, where modified TPH was reported, the most relevant criteria for comparison was lube oil and, in each instance, the sample did not return to baseline. When results did not return to baseline and F4 analysis was requested, the reported values were compared to the relevant CCME Canada Wide Standards for Petroleum Hydrocarbons in Soil and found to be below these values.

The Supplemental ESA included additional sampling in the vicinity of BH17 for delineation of the ethylbenzene exceedance identified during the Phase II ESA. Four (4) step out samples (BH128 to BH131, and one field duplicate sample, BH DHP H, collected at BH130) were collected from 0-0.15 m, and one deeper sample was collected in the location of BH17 (i.e., BH127 at 0.35 m, noting refusal on waste rock was encountered at that depth). Findings indicated benzene, toluene, ethylbenzene and/or xylene exceedances of the Tier I EQS in BH127 (0.35 m), BH129 (0-0.15 m) and BH130 (0-0.15 m (noting there were no exceedances found in the duplicate sample collected from BH130). Where these samples did not return to baseline and F4 analysis was requested, one soil sample (BH128 (0-0.15 m)) had a modified TPH exceedance to the CCME Canada Wide Standard. Based on these findings, lateral delineation of petroleum hydrocarbon impacts has not been achieved to the north, south or west. Vertical delineation has not been achieved, noting the refusal on waste rock at BH127.

It is noted during the Phase II ESA, no petroleum hydrocarbons were detected in the groundwater samples collected from on-site monitoring wells.

[12] Note bedrock was not encountered in APEC #3 or #4; however, is assumed to be present at similar depths to those observed in APEC #1 and #2.

4.3.4 Polycyclic Aromatic Hydrocarbons

A total of twenty-eight (28) soil samples (including two (2) field duplicate samples), were submitted for PAH analysis as part of the 2023-2024 Phase II ESA. Findings indicated that PAH concentrations were below the Tier I EQS in the analyzed samples.

There were no exceedances of the Benzo(a)pyrene Total Potency Equivalents (B(a)P), which is the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs.

The Index of Additive Cancer Risk (IACR) assesses potential threats to potable groundwater from leaching of carcinogenic PAH mixtures from soil. There is no Tier I EQS for IACR as NSECC deemed that specific provincial standards were not warranted in instances where appropriate guidelines were available from the CCME or other Canadian and international jurisdictions. Therefore, for comparison purposes, the CCME IACR of 1 mg/kg was used. In comparison to the CCME criteria, twelve (12) samples exceed the IACR suggesting the potential to leach to groundwater. However, results for the groundwater samples collected from on-site monitor wells did not exceed the Tier I EQS, with the majority of the PAH parameters below the laboratory detection limits. Therefore, the potential for PAHs to leach to the groundwater on-site is considered low. It is further noted that no potable wells are located on-site.

Based on the above noted findings, PAH analysis was not included in the Supplemental ESA.

4.3.5 Energetics

As part of the 2023-2024 Phase II ESA, a total of five (5) soil samples were submitted for energetics analysis. Energetics were not detected in any of the analyzed soil samples and, therefore, did not exceed the Health Canada Draft Guideline Screening Values and Interim Toxicological Reference Values (TRVs) for Energetic Chemicals. No further testing for energetics was completed as part of the Supplemental ESA.

4.4 Groundwater Quality

Groundwater analytical results for metals are presented in Table C-10, Appendix C and are summarized in the sections below. Groundwater data for petroleum hydrocarbons is presented in Table C-11 and PAH data is presented in Table C-12, Appendix C, and are summarized in the sections below. Laboratory Certificates of Analysis are provided in Appendix D. Monitor well locations and groundwater contours are presented on Figure 4, appended.

4.4.1 Groundwater Elevations

During the 2023-2024 Phase II ESA, groundwater was encountered at depths ranging from 0.62 meters below top of casing (mbtoc) (i.e., in 24MW-05) to 2.78 mbtoc (i.e., in 24MW-04) in January 2024. During

the Supplemental ESA, groundwater was encountered at depths ranging from 0.82 mbtoc (i.e., in 24MW-05) to 4.13 mbtoc (i.e., in 24MW-04) in May 2024. Non-aqueous phase liquids (NAPL) were not measured or observed in on-site monitoring wells during the groundwater monitoring events.

Groundwater contours have been prepared based on survey and groundwater monitoring data and are presented in Figure 5 (appended). Based on the most recent calculated groundwater elevations (i.e., May 22, 2024) (as shown in Table 2 below), the generalized groundwater flow direction in the assessment area is interpreted to be to the south towards Country Harbour River.

Table 2: Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (mASL)	Top of PVC Casing Elevation (mASL)	Depth to Groundwater (mbtoc)	Groundwater Elevation (mASL)
24MW-01	122.059	122.433	2.12	120.313
24MW-02	57.292	57.837	1.37	56.467
24MW-03	42.729	43.338	2.27	41.07
24MW-04	65.839	66.326	4.13	62.196
24MW-05	70.214	70.620	0.82	69.8

Notes:

1. mbtoc – meters below top of casing
2. masl – meters above sea level
3. The Trimble survey unit uses survey grade GPS with vertical and horizontal accuracy of less than 10 cm based on the active control network coordinates system - 6 degree UTM CSRS 1997 vertical datum (UTM NAD 83, Zone 20). The monitoring wells were surveyed in January 2024 as part of the Phase II ESA.
4. The monitoring wells were surveyed on January 20, 2024.
5. Water levels were collected on May 22, 2024.

4.4.2 Metals

A total of six (6) groundwater samples, including one field duplicate, were submitted for dissolved metals analysis, which included dissolved sulphur and dissolved mercury, for each of the analyzed samples during January 2024 and May 2024. The groundwater samples were also submitted for total metals analysis during May 2024.

Metals concentrations in groundwater were generally either below laboratory detection limits or within the applicable Tier I EQS, with some exceptions:

- During January 2024, the dissolved aluminum concentration of 0.167 ug/L at 24MW-02 marginally exceeded the Tier I EQS of 0.1 mg/L. It is noted that the turbidity in this well during January 2024 was high (109 NTU), and that the presence of turbidity in a sample can lead to higher metals concentrations being reported, as metals tend to adhere to sediment within a sample. During May 2024, total aluminum concentrations ranging from 0.122 mg/L to 0.497 mg/L exceeded the Tier I EQS at each monitoring well, with the exception of 24MW-03. Dissolved aluminum concentrations reported in May 2024 ranging from 0.185 mg/L to 0.208 mg/L exceeded the Tier I EQS at 24MW-01, 24MW02 and the field duplicate sample collected at 24MW-02. However, the Tier I EQS (0.1 mg/L) is based on the Health Canada Canadian Drinking Water Quality (CDWQ) Guideline for aluminum,

which is an operational guidance value related to the use of aluminum-based coagulants at water treatment plants. Therefore, this guideline is not applicable to monitoring wells.

- During January 2024, dissolved arsenic concentrations ranging from 0.0272 mg/L to 0.0422 mg/L in monitoring wells 24MW-02, 24MW-03 and 24MW-05, exceeded the Tier I EQS of 0.01 mg/L. As noted above, the turbidity was high in 24MW-02 and in 24MW-05 (35 NTU) in January 2024, which may have biased the metals results high. During the May 2024 monitoring event, total arsenic concentrations ranging from 0.0123 mg/L to 0.195 mg/L exceeded the Tier I EQS of 0.01 mg/L in each of the monitoring wells, with the exception of 24MW-01. The dissolved arsenic concentrations reported in May 2024 ranging from 0.0118 mg/L to 0.0368 mg/L exceeded the Tier I EQS in monitoring wells 24MW-02, the field duplicate sample collected at 24MW-02, 24MW-03 and 24MW-05.
- During January 2024, dissolved cobalt concentrations in two monitoring wells ranging from 0.00449 mg/L (in 24MW-01 and its field duplicate) to 0.00650 mg/L (in 24MW-05) exceeded the applicable Tier I EQS (0.0038 mg/L), noting turbidity may have elevated the reported concentrations. During May 2024, total cobalt concentrations of 0.00470 mg/L in 24MW-03 and 0.00963 mg/L in 24MW-05 exceeded the Tier I EQS. The dissolved cobalt concentrations of 0.00437 mg/L in 24MW-03 and 0.00898 mg/L in 24MW-05 also exceeded the Tier I EQS during the May 2024 sampling event.
- During January 2024, dissolved iron concentrations in two monitoring wells ranging from 0.509 mg/L (in 24MW-05) to 3.84 mg/L (in 24MW-01 and its field duplicate) exceeded the applicable Tier I EQS (0.3 mg/L), noting turbidity may have elevated the reported concentrations. During May 2024, total iron concentrations ranging from 0.379 mg/L to 4.16 mg/L exceeded the applicable Tier I EQS (0.3 mg/L) in each of the monitoring well locations. The dissolved iron concentrations reported for May 2024 ranging from 0.433 mg/L to 0.846 mg/L exceeded the Tier I EQS at 24MW-01, 24MW-02 and its duplicate, and 24MW-05.
- During May 2024, a total lead concentration of 0.0207 mg/L in the duplicate sample collected from 24MW-02 exceeded the Tier I EQS (0.005 mg/L). It is noted that while lead was detected in the correlating parent sample at 24MW-02, the concentration was below the Tier I EQS. No other total or dissolved lead exceedances were reported.
- During January 2024, dissolved manganese concentrations ranging from 0.190 mg/L to 0.556 mg/L, in monitoring wells 24MW-01 and its field duplicate, 24MW-03, and 24MW-05 exceeded the applicable Tier I EQS (0.12 mg/L), noting that turbidity may have elevated the reported concentrations at some locations. During May 2024, total manganese concentrations ranging from 0.144 mg/L to 0.340 mg/L, in monitoring wells 24MW-01, 24MW-03, and 24MW-05 exceeded the applicable Tier I EQS. Dissolved manganese also exceeded the Tier I EQS in May 2024 at the same three monitoring wells with concentrations ranging from 0.138 mg/L to 0.314 mg/L.

Mercury was not detected in the groundwater samples, with the exception of two wells (MW24-04 and MW24-05) during both the January 2024 and May 2024 monitoring events. When detected, mercury concentrations were well below the Tier I EQS.

In January 2024, dissolved sulphur concentrations ranged from 0.6 mg/L (in 24MW-01 and its field duplicate) to 1.04 mg/L (in MW24-05). In May 2024, total sulphur concentrations ranged from 0.69 mg/L to 0.89 mg/L, with dissolved sulphur concentrations ranging from 0.76 mg/L to 0.95 in each of the sampled wells, with the exception of 24MW-01 where total or dissolved sulphur was not detected. There is no Tier I EQS for sulphur.

As noted above, during the January 2024 monitoring event, turbidity in the newly installed monitoring wells was generally elevated (particularly at 24MW-02 and 24MW-05). Elevated turbidity has the potential to bias the dissolved phase analytical results, as targeted substances present within or sorbed to soil particles may be released during sample preparation/analysis, resulting in an artificially high measurement. Turbidity was notably lower during the May 2024 monitoring event, ranging from 1.38 NTU (at 24MW-02) to 24.2 NTU (at 24MW-04).

Overall, for the May 2024 event where total and dissolved metals were reported, the dissolved concentrations were lower. The most notable difference being iron concentrations (with the exception of the 24MW-02 parent sample and 24MW-05).

4.4.3 Petroleum Hydrocarbons

During January 2024, six (6) groundwater samples, including one (1) field duplicate, were submitted for analysis of petroleum hydrocarbons including BTEX and Modified TPH. Petroleum hydrocarbon concentrations were below laboratory detection limits, as well as the applicable Tier I EQS, and as a result bore no hydrocarbon resemblance.

As no petroleum hydrocarbons were found, sampling for this COPC was not included as part of the Supplemental ESA May 2024 monitoring event.

4.4.4 Polycyclic Aromatic Hydrocarbons

During January 2024, six (6) groundwater samples, including one (1) field duplicate, were submitted for analysis of PAHs. PAH concentrations were below laboratory detection limits in the majority of the analyzed samples, with each sample below the applicable Tier I EQS.

In 24MW-02, detections of 1-Methylnaphthalene, 2-Methynaphthalene and naphthalene were reported; however, the concentrations were well below the Tier I EQS. In 24MW-04, detections of fluoranthene and phenanthrene were reported, noting there are no Tier I EQS for these parameters.

There were no exceedances of the Benzo(a)pyrene Total Potency Equivalents (B(a)P), which is the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs. As no PAHs were found, sampling for this COPC was not included as part of the Supplemental ESA May 2024 monitoring event.

4.5 Quality Assurance and Quality Control

A program to ensure quality assurance and control (QA/QC) was implemented throughout the ESA. The QA/QC program consisted of a number of elements:

- Collection of samples using protocols consistent with Dillon Standard Environmental Field Procedures and/or industry standards.
- Use of dedicated sampling equipment and/or adherence to established equipment cleaning protocols, where applicable.
- Use of laboratory supplied containers.
- Collection of blind field duplicates.
- Implementation of laboratory QA/QC procedures including analysis of reference standards, laboratory blanks and replicates.

Validation criteria were established that required the analytical data to have an acceptable and documented level of precision, accuracy, representativeness, comparability and completeness (the PARCC criteria). The precision of the data for the samples collected was evaluated by calculating the Relative Percent Difference (RPD) between the original samples and its duplicate when the samples had concentrations greater than 5x the laboratory Reportable Detection Limit (RDL). A summary of the PARCC criteria comparison and calculated RPD values are presented below.

Laboratory QA/QC was performed on the following samples:

- January 2024:
  - Surface water samples SW3 and SW4 and their field duplicates, SW DUP A and SW DUP B.
  - Sediment sample SED3 and its field duplicate SED-DUPA.
  - Soil samples BH6, BH11, BH21, BH23, and BH61 and their corresponding field duplicates DUPA, DUPB, DUPD, DUPC, and DUP E, respectively.
  - Groundwater sample 24MW-01 and its field duplicate 24MW-Dup A.
- May 2024:
  - Surface water sample SW14 and its field duplicate CHQAQC03.
  - Sediment sample SED13 and its field duplicate CHQAQC04.
  - Soil samples BH66, BH67, BH80, BH111, BH113 BH125, and BH130 and their corresponding field duplicates BH DUP F, BH DUP G, BH DUP I, BH DUP J, BH DUP K, BH DUP L and BH DUP H.
  - Groundwater sample 24MW-02 and its field duplicate 24MW-DUPB.

In order to assess the precision and accuracy of the laboratory results, the relative percent difference (RPD) was calculated for each parameter, where acceptable limits for field duplicate RPD in sediment and soil is 60%, and for surface water and groundwater it is 40%. RPD values were not calculated for parameters that had concentrations that were less than five (5) times the RDL. Calculated RPD values are presented in Tables C-13 through Table C-16 (see Appendix C) for surface water, sediment, soil, and groundwater, respectively. A summary of RPD results, where calculated, is presented below:

- RPDs for surface water were below 40% for each parameter where they were calculated.
- RPDs for sediment were generally below 60% for each parameter where they were calculated, with some exceptions:
  - SED3 – SED-DUP A: The calculated RPDs for arsenic, barium, and mercury were 112%, 77% and 65%, respectively.
  - SED13 – CHQAQC04: The calculated RPDs for cobalt and manganese were 61%, 92% and 77%, respectively.
- RPDs for soil were generally below 40% for each parameter where they were calculated, with some exceptions:
  - BH11 – BH DUP B: The calculated RPDs were 63% for benzo(b+j)fluoranthene, 78% for fluoranthene, and 76% for pyrene.
  - BH23 – BH DUP C: The calculated RPDs were 66% for cadmium and 194% for mercury.
  - BH21 – BH DUP D: The calculated RPDs were 71% for antimony and 64% for tin.
  - BH111 – BH DUP J: The calculated RPDs were 67% for cadmium.
- Calculated RPDs for groundwater were well below 40%, with the exception of:
  - 24MW-02 – 24MW-DUPB: The calculated RPDs were 77% for total aluminium, 133% for total arsenic, 154% for total iron, 126% for total lead, and 63% for dissolved uranium.

Elevated RPD values for sediment and soil may be attributed to the heterogeneity of sediment/soil, and of waste rock piles, laydown areas, and infrastructure areas.

A trip blank was submitted for analysis of petroleum hydrocarbons (i.e., BTEX and modified TPH) as part of the Phase II ESA. An equipment blank was submitted for analysis of general chemistry, metals, petroleum hydrocarbons (i.e., BTEX and modified TPH) and/or PAHs as part of both the Phase II ESA and Supplemental ESA.

Trip blank concentrations for analyzed parameters were below laboratory detection limits and Tier I EQS.

During the Phase II ESA, there were no detections of general chemistry parameters, with minor metal detections (potassium, silicon and uranium) observed in the equipment blank collected as part of the Phase II ESA; however, detected concentrations were well below the applicable Tier I EQS. The equipment blank concentrations for petroleum hydrocarbons (i.e., BTEX and modified TPH) and PAHs were below laboratory detection limits and the applicable Tier I EQS.

During the Supplemental ESA[13], general chemistry parameters ammonia and fluoride were detected in the equipment blank. Both total and dissolved aluminum, barium, calcium, magnesium, manganese,

[13] During the Supplemental ESA, due to a laboratory oversight, the equipment blank water was not included with the groundwater sampling bottle sets and was shipped separately arriving during the field program. Therefore, the last monitoring well, 24MW-01, was sampled at the end of the day on May 22, 2024, with the equipment blank collected using the interface probe the following morning, on May 23, 2024.

sodium and strontium were detected in the equipment blank. The detected concentrations were well below the applicable Tier I EQS, with the exception of the aluminum concentrations (i.e., 0.0131 mg/L (total) and 0.0128 mg/L (dissolved)) which exceeded the Tier I EQS of 0.005 mg/L. As noted above, the Tier I EQS is based on an operational guidance value related to the use of aluminum-based coagulants at water treatment plants and, therefore, is not applicable to monitoring wells. The monitoring well sampled prior to the equipment blank (i.e., 24MW-01) had ammonia and fluoride concentrations below laboratory detection limits, with aluminum (total and dissolved) and manganese concentrations above the Tier I EQS and total and dissolved barium, calcium, magnesium, sodium and strontium concentrations detected, but below the Tier I EQS. Based on this, the detected concentrations in the equipment blank sample are expected to have no, or a very low, bias on groundwater results. Analytical results for the trip blank and equipment blank samples are presented in Tables C-17 through Table C-19, Appendix D. Laboratory certificates of analysis are presented in Appendix C.

5.0 ESA Conceptual Site Model

5.1 Regional Geology and Hydrogeology

To describe the regional physiography and expected hydrogeologic conditions beneath the subject property, the following documents were reviewed:

- Stea, R.R., Conley, H., and Brown, Y. (compilers) 1992: Surficial Geology of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Map 92-3, Scale 1:500,000.
- Keppie, J.D. (compiler) 2000: Geological Map of the Province of Nova Scotia; Nova Scotia Department of Natural Resources, Minerals and Energy Branch, Map ME 2000-1, Scale 1:500,000.

The surficial geology of the subject area is mapped as of Stony Till Plain and drumlins. Till is stony, sandy and consists of material derived from local bedrock sources, ranging in thickness from 2 m to 20 m. Drumlin facies are siltier due to erosion and incorporation of older till units by glaciers. Soil observed during the ESA generally consisted of an organic/peat layer at surface, underlain by silty sand or sand and gravel.

The regional bedrock geology of the subject area is primarily mapped as the Goldenville Formation of the Cambrian period, consisting of sandstone, turbidites and slate. Continental rise prism is present in areas metamorphosed to schist and gneiss. Of note, the northern portion of PID 35094366 is mapped as Middle to Late Devonian muscovite biotite monzogranite (from the area of Johnston Lake northward). Bedrock was encountered during the Phase II ESA drilling program between 0.53 mbgs (at 24MW-05) and 4.27 mbgs (at 24MW-01). On-site bedrock was a mixture of granite and slate, with quartz and pyrite seams periodically observed.

The topography of the site is steep, converging on Johnston's Brook from the east and the west, and also sloping to the south towards Highway 316. Regional topography suggests the regional shallow groundwater flow is likely south towards Country Harbour River. Based on an elevation survey, completed for the on-site monitoring wells in January 2024, the interpreted groundwater flow is to the south.

5.1.1 Former Tailings Area: APEC #**1**

Soil stratigraphy in this area generally consisted of a layer of organics with peat, underlain by silty sand or sand with varying amounts of gravel. Granite bedrock was encountered at approximately 2.13 mbgs (24MW-02). During the ESA, five (5) representative soil samples were collected from the area denoted as APEC 1 and were submitted for grain size analysis. Based on the grain-size analysis, the samples were classified as a mix of coarse and fine-grained soil.

5.1.2 Former Stamp Milling Areas: APEC #**2**

Soil stratigraphy in these areas generally consisted of a layer of organics/peat, underlain by sand and gravel, with slate bedrock encountered at between 0.53 mbgs (24MW-05) and 1.37 mbgs (24MW-03). Granite bedrock was encountered at 0.88 mbgs at one location (24MW-04). Three (3) representative soil samples were collected from the area denoted as APEC 2 (Stuart Mill Area) and were submitted for grain size analysis. Based on the grain-size analysis, the samples were classified as a mix of coarse and fine-grained soil.

5.1.3 Waste Rock Piles: APEC #**3**

Soil stratigraphy in these areas generally consisted of a thin layer of rootmat and organics underlain by waste rock or silty sand with varying amounts of gravel. Intermittent coal fragments and iron oxides were observed. One (1) representative soil sample was collected from the area denoted as APEC #3 and was submitted for grain size analysis. Based on the grain size analysis, the sample was classified as coarse-grained.

5.1.4 **Domestic Waste Dumping Area: APEC #4**

Soil stratigraphy in this area generally consisted of a thin layer of rootmat and organics underlain by silty sand with varying amounts of gravel. Intermittent waste rock was also observed. One (1) representative soil sample was collected from the area denoted as APEC #4 and was submitted for grain size analysis. Based on the grain size analysis, the sample was classified as coarse-grained.

5.1.5 Background Area

The "background" area selected for the site was located approximately 1.5 kilometers (km) north of Highway 316. Soil stratigraphy in this area generally consists of a thin layer of organics/peat underlain with silty sand and gravel with varying amounts of sand atop fractured/weathered slate bedrock and then competent granite bedrock. Minor slate bedrock (approximately 1 m) was encountered in the

background area at a depth of approximately 3.2 mbgs, followed by granite bedrock at 4.27 mbgs (24MW-01). Two (2) representative soil samples collected from the background area and were submitted for grain size analysis. Based on the grain size analysis, the samples were classified as both coarse and fine-grained.

5.2 Description of Contaminants

Surface water concentrations of metals (i.e., aluminum, arsenic, iron, lead, and/or zinc) have been detected above Tier I EQS based on samples collected on-site from Johnston Brook.

Sediment concentrations of metals (i.e., arsenic, iron, lead, manganese, and/or mercury) have been detected above Tier I EQS based on samples collected on-site from Johnston Brook.

Soil concentrations of metals (i.e., aluminum, antimony, arsenic, beryllium, cadmium, cobalt, iron, lead, manganese, mercury, molybdenum, selenium, thallium, vanadium, and/or zinc) have been detected above Tier I EQS based on soil samples collected from surface and drilled boreholes at the site. Some of these metals may be attributed to natural background concentrations of till and underlying bedrock. Benzene, toluene, ethylbenzene, xylene and/or modified TPH in soil on one area of the site (i.e., BH17 (0-0.15 m), BH127 (0.35 m), BH128 (0-0.15 m), BH129 (0-0.15 m) and BH130 (0-0.15 m) exceeded the Tier I EQS. As there is no Tier I EQS for sulphur, a comparison value of 4000 mg/kg was taken from the Sulphide Bearing Material Disposal Regulations. Three (3) soil samples, BH30 0-0.15, BH111 0-0.15 m and its field duplicate, with concentrations ranging from 4,500 mg/kg to 8,700 mg/kg, exceeded the 4000 mg/kg comparison value.

Groundwater concentrations of metals (i.e., arsenic, cobalt, iron, lead, and/or manganese) have been detected above the Tier I EQS based on groundwater samples collected from monitoring wells located at the site. As noted above, the guideline for aluminum is not considered to be relevant for monitoring wells.

5.3 Receptors

The site is zoned for commercial land use, and neighbouring properties are zoned for residential and commercial land use. The site is currently vacant with no buildings present. Potential receptors for this pathway include workers (should intrusive work be conducted on-site) who may come in contact with metals soil in the subsurface or potential recreational users (on-site, where access is not restricted).

No potable wells are currently located on site; however, the surrounding properties are serviced by individual potable wells with nearest residential building located approximately 50 m south and down gradient of the southern site boundary.

The closest ecological receptor is Johnston Brook, which intersects the site and flows south to Country Harbour River, which is located approximately 250 m south, and downgradient, of the site. Johnston Brook is identified as an ecological habitat of potential concern as it intersects the site.

5.4 Operable Pathways

5.4.1 Surface Water

Results of the ESA activities conducted for the site to date indicate that the documented residual metals impacts (i.e., aluminum, arsenic, iron, lead, and/or zinc) pose a potential unacceptable risk to commercial receptors via surface water based on the applicable pathway specific standards (PSS). As noted previously, Johnston Brook intersects the site, therefore this pathway would be considered operable.

5.4.2 Sediment

Results of the ESA activities conducted for the site indicate that the documented residual metals impacts (i.e., arsenic, iron, lead, manganese, and/or mercury) pose a potential unacceptable risk to commercial receptors via freshwater sediment based on the applicable PSS.

5.4.3 Soil

Results of the ESA activities conducted for the site indicate that the documented residual metals impacts (i.e., aluminum, antimony, arsenic, beryllium, cadmium, cobalt, iron, lead, manganese, mercury, molybdenum, selenium, sulphur, thallium, vanadium, and/or zinc) pose a potential unacceptable risk to commercial receptors via soil ingestion or direct contact based on the applicable PSS. Some of these metals may be attributed to natural background concentrations of till and underlying bedrock. The site is currently vacant and on-site buildings have been removed; however, the site is not secure and as a result the pathway of soil ingestion or direct contact is operable.

Documented residual metals impacts (i.e., arsenic, beryllium, lead, manganese, selenium, and zinc) also pose a potential unacceptable risk to commercial receptors via soil leaching to potable groundwater based on the applicable PSS. No potable wells are present on-site; therefore, this pathway is not operable. If there were to be a potable well installed on-site in the future, this pathway would be considered operable. It is further noted that the majority of the above noted metals impacts were not present in groundwater at concentrations above the Tier I EQS (the exception being arsenic and manganese).

BTEX and/or modified TPH in soil (at one area on the central portion of the assessment site) exceeded the Tier I EQS, which is based on the leaching to potable groundwater pathway; however, no PHCs were detected in the groundwater samples collected from on-site monitoring wells. The concentrations of BTEX are below the applicable soil contact/ingestion PSS.

Twelve soil (12) samples exceed the CCME IACR, suggesting the potential for PAHs in soil to leach to groundwater. However, the PAH results for the groundwater samples collected from on-site monitor wells did not exceed the Tier I EQS, with the majority of the PAH parameters below the laboratory detection limits. Therefore, the potential for PAHs to leach to the groundwater on-site is considered low. It is further noted that no potable wells are located on-site, making this pathway inoperable.

5.4.4 Groundwater

Results of the ESA activities conducted for the site indicate that the documented residual metals impacts (i.e., arsenic, cobalt, iron, lead, and/or manganese) pose an unacceptable risk to commercial receptors via potable groundwater as drinking water based on the applicable PSS. As noted previously, no potable wells are present on-site, therefore this pathway is not operable. If there were to be a potable well installed on-site in the future, this pathway would be considered operable.

A water pipe was previously present on-site in Johnston Brook (near 24MW-03) that reportedly may have been accessed by a local property owner, possibly for drinking water. This pipe was removed in Spring 2024.

For the furthest down gradient monitoring well (i.e., 24MW-03), where dissolved arsenic, cobalt and manganese were present in the groundwater sample collected in May 2024, the Tier I EQS are equivalent to the CDWQ Guidelines for arsenic and manganese (based on health). There is no CDWQ Guideline for cobalt. The area is mapped as high risk for arsenic in bedrock well water due to the local geology.

6.0 Summary and Conclusions

The ESA activities included drilling, with monitoring well installations; shallow test holes; and soil, groundwater, surface water and sediment sampling. Media analysis included: general chemistry (water only), metals (including sulphur and mercury), PHCs, PAHs and/or energetics (soil only). Based on the calculated groundwater elevations, the generalized groundwater flow direction in the assessment area is interpreted to be southerly towards Country Harbour River. For comparison to the NS CSRs, the site is considered to be commercial, potable with both coarse and fine-grained soil conditions. Findings of the ESA are as follows:

- Surface water samples collected from Johnston Brook had metal concentrations (i.e., aluminum, arsenic, iron, lead and/or zinc) that exceed the Tier I EQS for surface water at each sample location. In addition, lab pH was low at each location. There were no other metals exceedances, nor exceedances for other COPCs (i.e., BTEX, modified TPH or PAHs) reported for the analyzed surface water samples. Surface water metals impacts are delineated to the north, but not to the south.

- Metals concentrations in sediment were generally either below laboratory detection limits, or within the applicable Tier I EQS, with the exception of arsenic, iron, lead, manganese and/or mercury exceedances observed at each sediment sampling location. Iron and manganese concentrations were generally of similar magnitude in each of the sediment samples. The highest arsenic concentration was reported at SED6. The highest mercury concentration was reported at SED2. No BTEX or C6-C10 detections were reported for sediment during the Phase II ESA. Although PAH analysis could not be completed during the Phase II ESA due to the stream substrate composition, PAH exceedances were not reported in surface water, or in nearby soil samples, therefore, PAHs are not expected to be a concern in the sediment. Metals impacts in sediment are delineated to the north, but not to the south.
- One hundred and twenty-two (122) soil samples (including nine (9) field duplicate samples) were submitted for metals analysis, including sulphur and mercury. Twenty-two (22) additional soil samples, including two (2) field duplicate samples were also collected for evaluation of local background soil concentrations for metals. Metals exceedances in soil above the Tier I EQS (for a commercial, potable site with both coarse and fine-grained soils), and above the maximum local on-site background concentrations (Dillon, 2024) are present across the site assessment area (i.e., the areas of former mining operations). Notable, widespread exceedances, when looking at the overall data set in comparison to both the Tier I EQS and background, include aluminum, arsenic, beryllium, iron, lead, manganese, selenium, vanadium and zinc. Although not widespread, mercury exceeded the applicable Tier I EQS at ten (10) locations, and each of these locations are in the central portion of the study area (at or between MW4 and MW5). The highest arsenic was reported at BH111, highest iron at BH18, highest lead and mercury at BH15, and highest zinc at BH23. Metals impacts in soil are laterally delineated to the north and south. Lateral delineation of impacts to the east and west have been partially delineated on the southern portion of the assessment site; however, are not delineated to the east and west on the northern portion of the assessment site. Further sampling would be required to achieve lateral delineation of soil impacts. The inferred extent of metals impacts in soil is 147,380 m^2, noting that lateral delineation has not been fully achieved. Vertically soil impacts are delineated by the presence of bedrock, which ranged from 0.53 mbgs (APEC #1) to 1.37 mbgs (APEC #2).
- Ethylbenzene in soil exceeded the Tier I EQS at BH17 (0-0.15 m), which was advanced in an area of refuse (e.g., household waste, plastic and metal (including a drum and lawnmower)) underlain by waste rock. Four (4) step out samples and a deeper sample were collected in the location of BH17 as part of the Supplemental ESA. Findings indicated benzene, toluene, ethylbenzene, xylene and/or Modified TPH exceedances of the Tier I EQS in the deeper sample (i.e., BH127 (0.35 m)) and in three (3) of the four (4) step out samples (i.e., BH129 (0-0.15 m) and BH130 (0-0.15 m) (noting that there were no exceedances were found in the duplicate sample collected from BH130), and BH128 (0-0.15 m). Based on these findings, lateral delineation of petroleum hydrocarbon impacts has not been achieved to the north, south or west. Vertical delineation has not been achieved, noting the refusal on waste rock at BH127.

- As there is no Tier I EQS for sulphur, a comparison value of 4000 mg/kg was taken from the Sulphide Bearing Material Disposal Regulations. Three (3) soil samples, BH30 0-0.15, BH111 0-0.15 m and its field duplicate, with concentrations ranging from 4,500 mg/kg to 8,700 mg/kg, exceeded the 4000 mg/kg comparison value.
- Dissolved metals concentrations in groundwater were generally either below laboratory detection limits or within the applicable Tier I EQS, with some exceptions (i.e., arsenic, cobalt, iron, lead, and/or manganese). Delineation of metals impacts in groundwater has not been achieved. Further groundwater assessment would be required to achieve delineation.

6.1 Phase II Environmental Site Assessment Checklist

As per the NS CSRs, a CHK400 Phase 2 Environmental Site Assessment Checklist has been prepared for the site (Appendix E).

7.0 Limitations

This report was prepared exclusively for the purposes, project and site location(s) outlined in the report. The report is based on information provided to or obtained by Dillon Consulting Limited ("Dillon") as indicated in the report and applies solely to site conditions existing at the time of the site investigation(s). Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of any contaminants from the site(s). Rather, 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(s), and that the levels of contamination or hazardous materials may vary across the site(s). 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 sole benefit of our client Build Nova Scotia. The material in the 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 our Client) 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.

Respectfully Submitted,

DILLON CONSULTING LIMITED



Nadine Wambolt, B.Tech, CET
Project Manager

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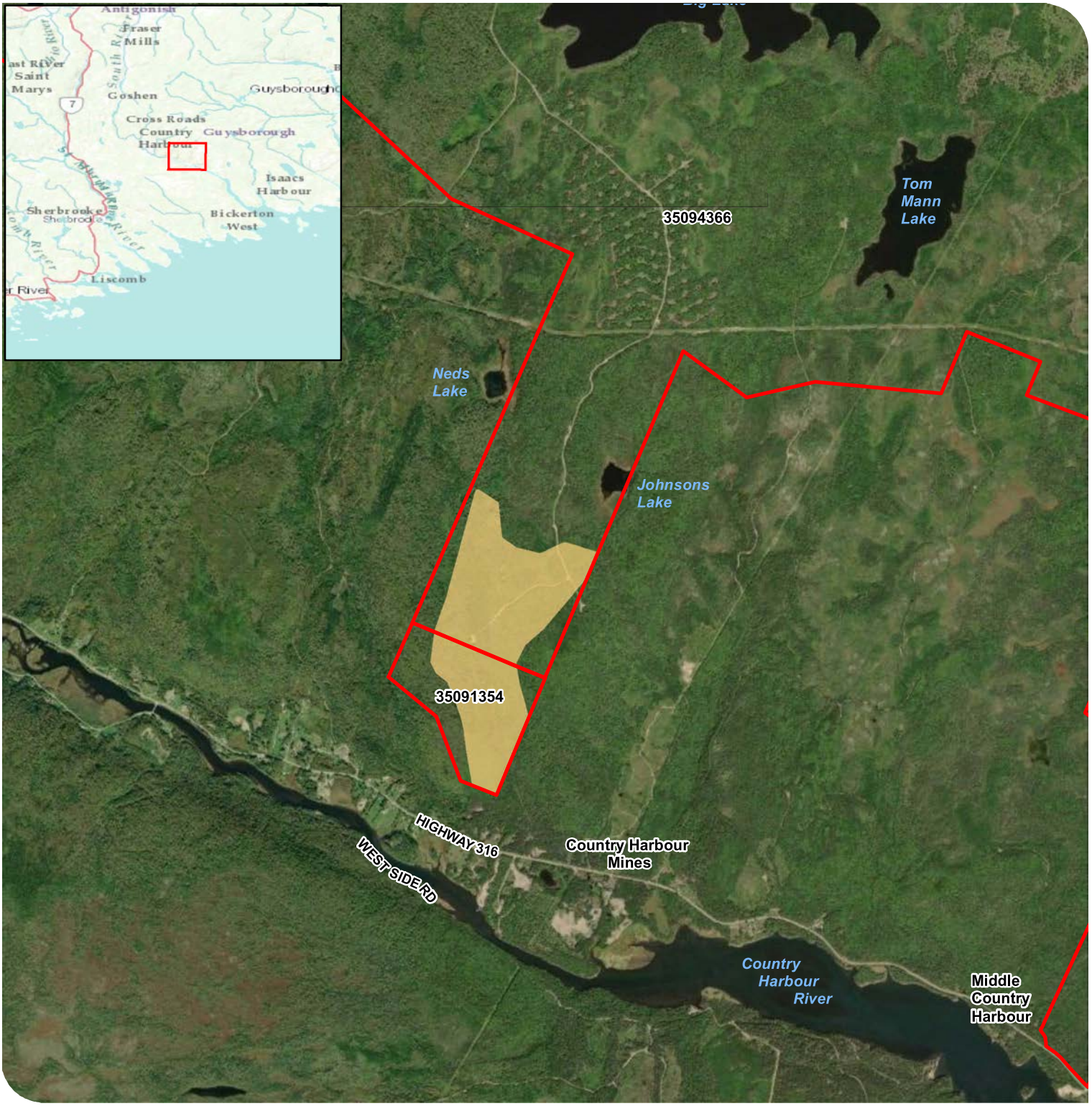
Site Professional

Figures



BUILD NOVA SCOTIA

Former Country Harbour Mine
Environmental
Site Assessment

Subject Parcels

Approximate Boundary of the Assessment Area

PROJECT LOCATION

FIGURE 1

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY: GeoNova, ESRI, Build NS

MAP CREATED BY: SCM
MAP CHECKED BY: NJW
MAP PROJECTION: NAD 1983 UTM Zone 20N

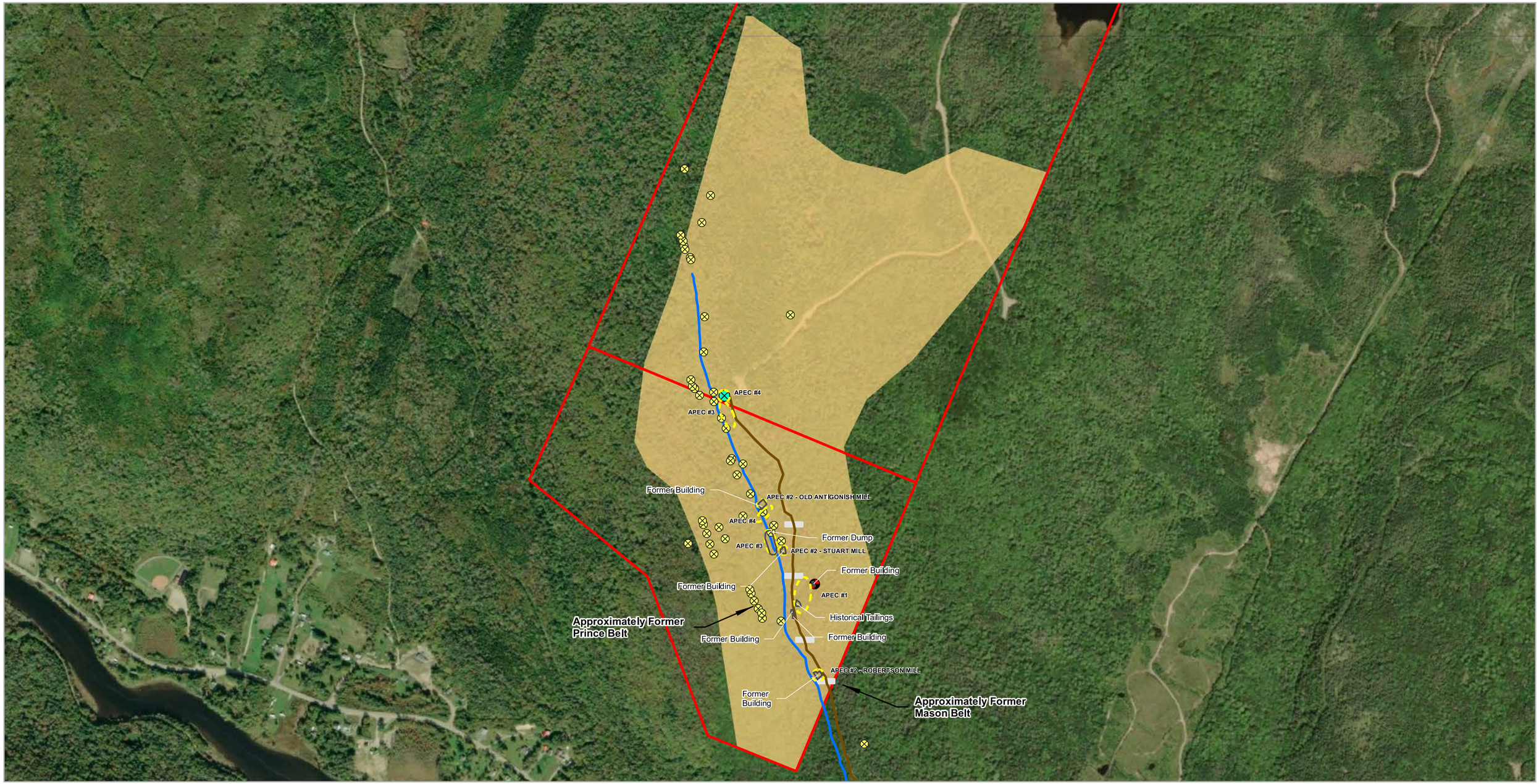
N W E S

SCALE 1:30,000

0 200 400 800 m

PROJECT: 236465
STATUS:FINAL
DATE: 2025-01-09

FILE LOCATION: \\dillon.ca\DILLON_DFS_projects\GIS\2023\236465\product\Client\Supplemental Environmental Site Assessment\September 2024 Report Figures\F1_ProjectLocation.mxd



BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR MINE
ENVIRONMENTAL SITE ASSESSMENT

PHASE I ESA IDENTIFIED APECS

FIGURE 2

APEC (Phase1 ESA, Dillon 2023)
John Fenton Loop Road
Known Abandoned Mine Opening (NSDNRR)
Johnston Brook
Drum
Cross Culvert
Open Pit/Trench or Mine Opening (Field Identified)
Subject Parcel
Assessment Area
Historical Feature

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: BT
MAP PROJECTION: NAD 1983 UTM Zone 20N

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SCALE 1:8,250

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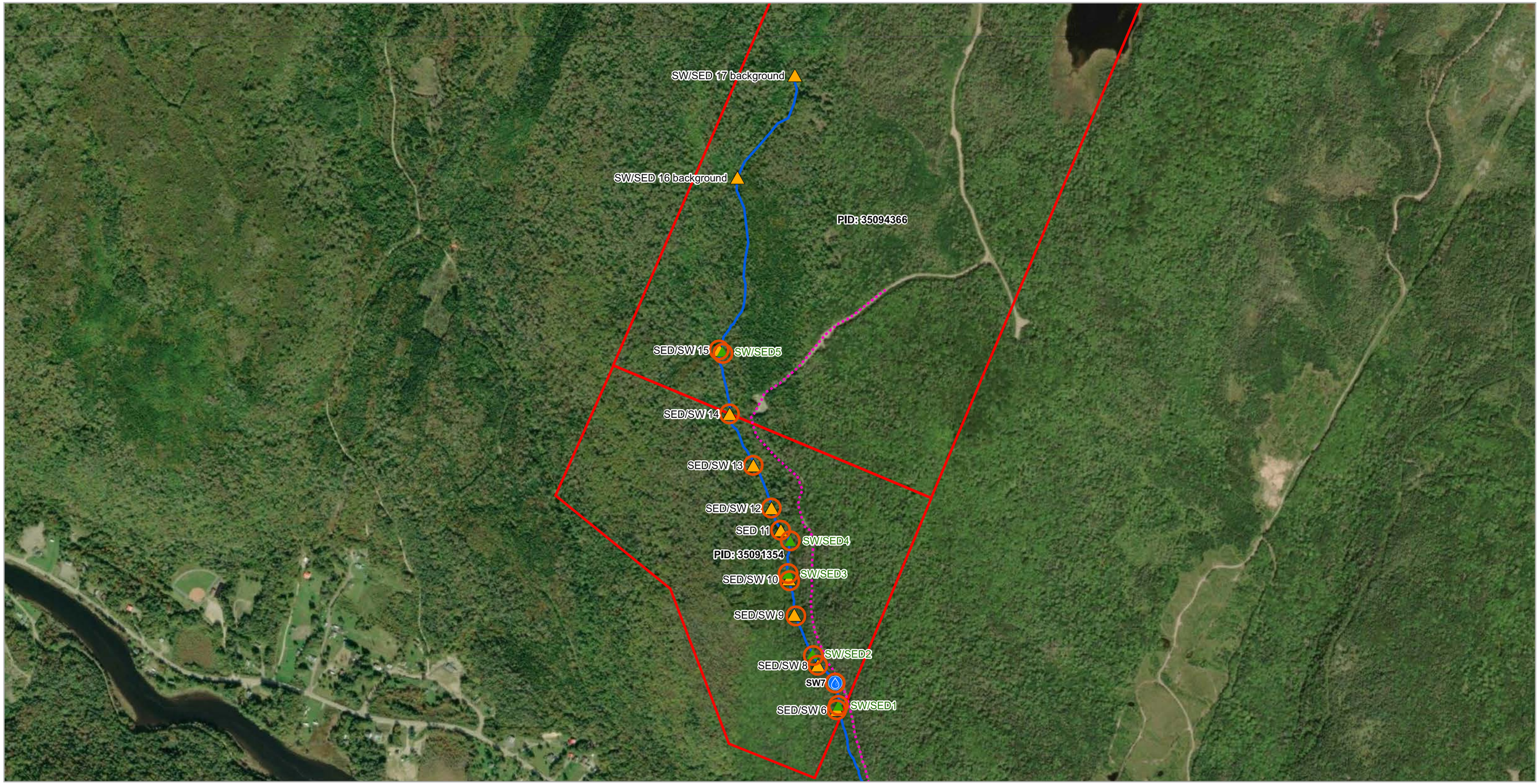
W E
S

PROJECT: 23-6465 STATUS: FINAL Date: 2025-01-09

Document Path: \\dillon.ca\DILLON_DFS_projects\GIS\2023\236465\product\Client\Supplemental Environmental Site Assessment\September 2024 Report Figures\F2_ Phase I ESA Identified APECs.mxd



BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR MINE
ENVIRONMENTAL SITE ASSESSMENT

SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

FIGURE 3

Build NOVA SCOTIA

- Sediment/Surface Water Sample Location (Supplemental ESA, 2024)
- Surface Water Sample Location
- Surface Water and Sediment Sample Location (Phase II ESA, 2024)
- Watercourse
- Site Access Road
- Subject Parcel
- Metals Exceedance of the Tier 1 EQS and Local Background Maximum Threshold Value

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: NJW
MAP PROJECTION: NAD 1983 UTM Zone 20N

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SCALE 1:8,492

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W E
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PROJECT: 23-6465 STATUS: FINAL Date: 2025-01-09

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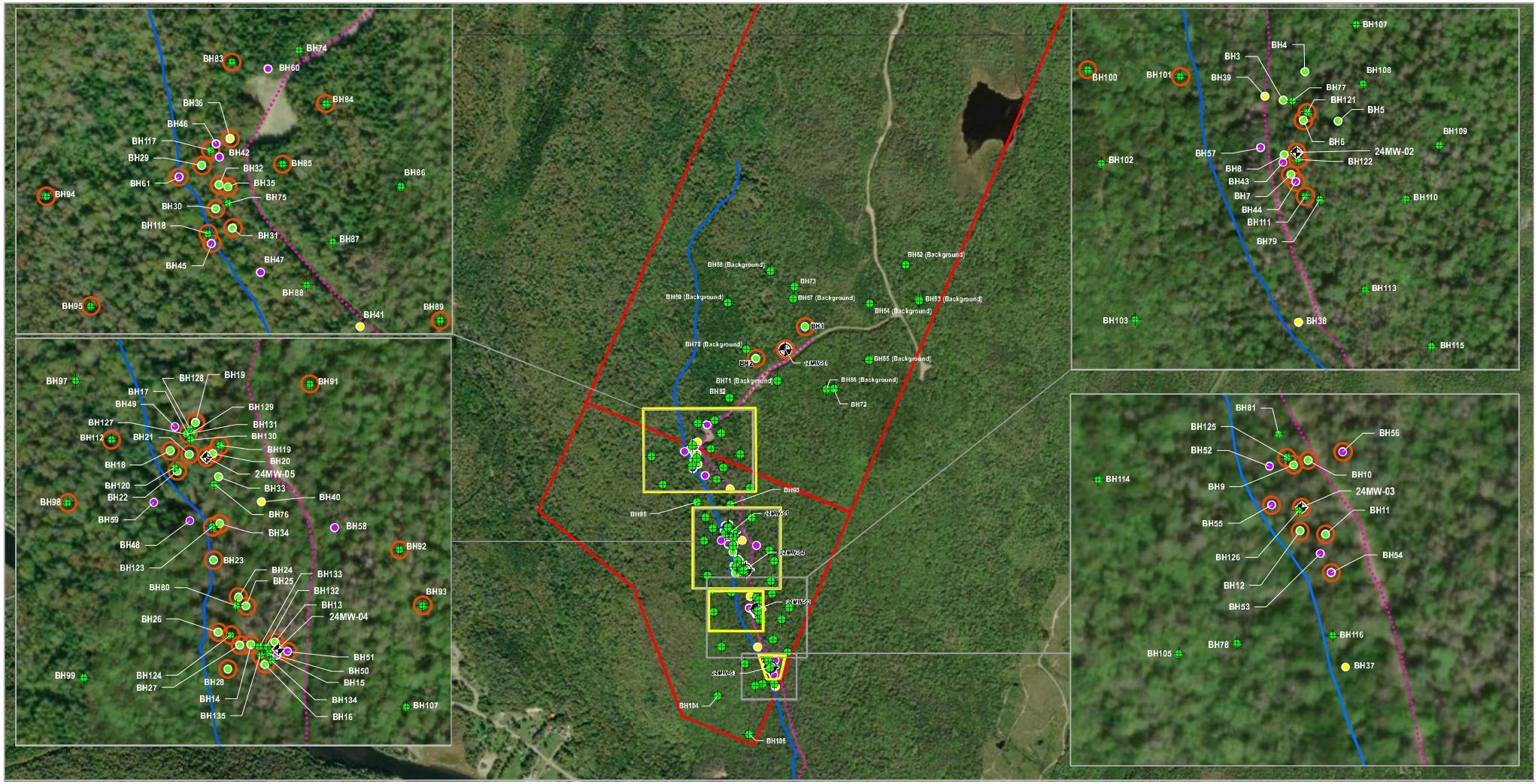

BUILD NOVA SCOTIA

FORMER COUNTRY HARBOUR MINE
ENVIRONMENTAL SITE ASSESSMENT

SOIL SAMPLE LOCATIONS

FIGURE 4

BuildX NOVA SCOTIA

Shallow Test Hole Sample

- Shallow Test Hole Sample Dillon 2023-2024
- Step Out Sample Dillon 2023-2024
- Energetics Sample Dillon 2023-2024

- Monitoring Well (Dillon, 2024)
- Delineation Borehole Location (May 2024)
- Metals Exceedance of the Tier I EQS and Local Background Maximum Threshold Value

- Inferred Aerial Extent of Metals Impacts in Soil (147,380 m^2)*
- Subject Parcel
- Site Access
- Watercourse

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSDNRR

MAP CREATED BY: SCM
MAP CHECKED BY: NJW
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Metres
SCALE 1:2,000

PROJECT:23-6465 STATUS: FINAL Date: 2025-01-09

* Boundary not yet confirmed

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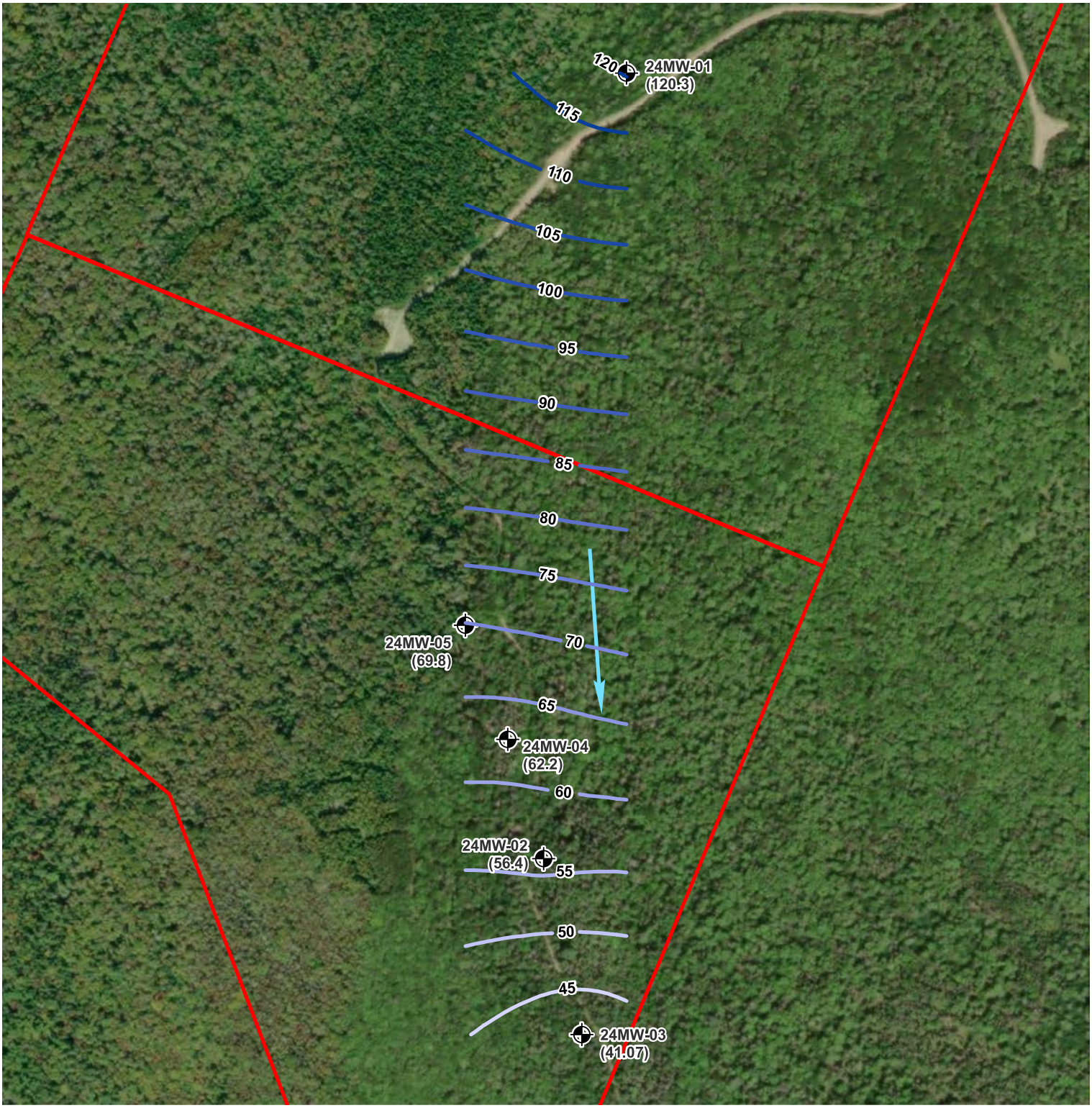

BUILD NOVA SCOTIA

Former Country Harbour Mine Site
Environmental Site Assessment

Monitoring Well Location (Jan 2024)

Groundwater Elevation Contour

Groundwater Flow Direction

Subject Parcels

(41.07) - Groundwater Elevation (masl) (May 22, 2024)

GROUNDWATER ELEVATIONS

FIGURE 5

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY: GeoNova, ESRI, Build NS

MAP CREATED BY: SCM
MAP CHECKED BY: NJW
MAP PROJECTION: NAD 1983 UTM Zone 20N

N
W E
S

SCALE 1:5,000

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PROJECT: 236465
STATUS: FINAL
DATE: 2025-01-09

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