HUMAN HEALTH RISK ASSESSMENT PROBLEM FORMULATION FOR THE NORTHERN PULP NOVA SCOTIA CORPORATION REPLACEMENT EFFLUENT TREATMENT FACILITY PROJECT

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1.0 INTRODUCTION

EcoMetrix Incorporated (EcoMetrix) was retained by Northern Pulp Nova Scotia Corporation (NPNS) to complete a human health risk assessment (HHRA) to support NPNS' Replacement Effluent Treatment Facility Project (the Project). The purpose of the Project is to replace an existing effluent treatment facility at Boat Harbour (BHETF) with a new treatment facility. The Project also includes the construction of a pipeline that will transport treated effluent from the new ETF for discharge in the Northumberland Strait.

Northern Pulp Nova Scotia Corporation operates a northern bleached softwood kraft pulp mill at Abercrombie Point in Pictou County, Nova Scotia. The mill has been in operation since 1967.

The existing ETF is owned by the Government of Nova Scotia. In 1967, the Nova Scotia Government built the BHETF to treat effluent from industrial sources. The Nova Scotia Government operated the facility until December 1995. The ETF was then leased to and operated by NPNS starting in January 1996 to today.

The *Boat Harbour Act*[1] of May 2015 legislates the closure of the BHETF by January 31, 2020.

In accordance with the provincial *Environment Act*, the design and construction of the new treatment facility is considered a 'modification to an existing undertaking'[2]. Therefore, the design and construction of the new facility has followed the provincial Class 1 Environmental Assessment (EA) process. The EA process was formally initiated in the fall of 2017 and the Project was registered on February 7, 2019.

On March 29, 2019 the Minister of Environment determined that the EA Registration Document was insufficient to make a decision on the Project and that a Focus Report is required to address these insufficiencies. Nova Scotia Environment (NSE) issued a Terms of Reference on April 23, 2019 for the Focus Report. One of the Terms (Number 9.2) requires a Human Health Risk Assessment (HHRA):

> *Commence a Human Health Risk Assessment (HHRA) to assess potential project-related impacts on human health. The risk assessment must consider human consumption of fish and other seafood, consumption of potentially contaminated drinking water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The*

[1] https://nslegislature.ca/sites/default/files/legc/statutes/boat%20harbour.pdf

[2] https://novascotia.ca/just/regulations/regs/envassmt.htm

analysis must inform the identification of contaminants of concern and updating of the receiving water study.

The Problem Formulation identifies the Study Area and summarizes the framework and general methodology of the HHRA. The Problem Formulation includes the development of a Conceptual Site Model (CSM). The CSM outlines the contaminants of potential concern (COPCs), sources, human receptors, and their COPC exposure pathways within the Study Area. The CSM provides the blueprint for the subsequent HHRA.

1.1 Summary of the Project

The Project is summarized from the EA Registration Document (Dillon, 2019). The production of pulp produces wastewater that requires treatment. Treatment of pulp mill wastewater is required by the Pulp and Paper Effluent Regulations under the *Fisheries Act* as well as other federal and provincial discharge regulations.

The new ETF will be built adjacent to the mill on NPNS property. This facility will include primary and secondary treatment. Sludge from the primary clarifier, secondary clarifiers, and activated sludge treatment basin will be dewatered, and the liquid from dewatering will be returned to secondary treatment. The remaining biosludge will be used as fuel for the biomass (power) boiler.

An approximate 15.5 km long pipeline is planned to convey treated effluent from the new ETF to a discharge located in the Northumberland Strait. The overland portion of the pipeline will follow Highway 106 for approximately 11.4 km. The pipeline will enter the marine environment adjacent to the Northumberland Ferries terminal in Caribou, and continue for approximately 4.1 km through Caribou Harbour to the Northumberland Strait for discharge via a diffuser.

Discharge will be through a diffuser set perpendicular to the predominant flow in the Northumberland Strait. The diffuser will be approximately 50 m long, with three nozzles approximately 1 m off of the seafloor with port openings of 0.3 m. The peak discharge velocity is estimated to be 4.6 m/s, predicting a dilution ratio of 144:1 at 100 m from the diffuser. Estimates may change somewhat with the forthcoming update to the Receiving Water Study.

The addition of ETF biosludge as biomass boiler fuel will result in boiler fuel with an approximate 7:1 biomass fuel to ETF biosludge ratio

1.2 Site Characteristics

Pictou County

The pulp mill is located at Abercrombie Point in Pictou County, Nova Scotia, approximately 3 km south of the town of Pictou (**Figure 1.1**). Abercrombie Point is the land between the

mouths of the Middle and East River of Pictou that discharge into Pictou Harbour. Pictou Harbour drains into Pictou Road, which is part of the Northumberland Strait.

Pictou County is located in the Northumberland Lowlands Ecodistrict. This area has imperfectly drained soils on compact, slowly permeable, basal tills derived from red sandstones and shales. The area consists of coniferous forests of black and red spruce. It is sheltered from storms from the south and east, and receives the lowest precipitation on average for the province (Neily *et al.,* 2005). The ocean moderates the climate of Pictou County, with warmer winters and cooler summers than other areas inland. 30-year climate normals are average temperatures of 6.6°C, rain of 953.3 mm, and frozen snowfall of 279 cm per year (ECCC, 2019).

The mill is directly surrounded by residential land use. Pictou County has a population of 43,748 (SC, 2019). Across Pictou Harbour, north of Abercrombie Point, is the Town of Pictou with a population of 3,186 (SC, 2019). North of the town, the landscape is largely forest and wetlands with some agricultural and residential land use.

Across the East River from Abercrombie Point is Pictou Landing First Nation. This area includes the reserves of Boat Harbour West 37, Fisher's Grant 24, and Fisher's Grant 24G, which border the current ETF. The Mi'kmaq community (which includes 2 reserves other than Pictou Landing) has 487 members living on reserve and 161 members living off reserve (INAC, 2019).

Pipeline

There are a number of watercourses and wetlands along the proposed pipeline route. Most of the watercourses are small, intermittent, or ephemeral. As such, few are considered to be fish habitat. The majority of the wetlands are small shrub swamp, but there are a few fens and bogs. Minnow species rear, feed, and spawn in the majority of non-intermittent watercourses, with the potential for Brook Trout (*Salvelinus fontinalis*) and American Eel (*Anguilla rostrata*) to inhabit these non-intermittent watercourses. Pictou Harbour (Causeway crossing) is the only watercourse confirmed to have multiple marine and diadromous fish species (Dillon, 2019).

Northumberland Strait

The Northumberland Strait is a part of the Gulf of St. Lawrence, a coastal marine ecosystem attributed to river influences (JWEL, 2001). The oceanic environment of the Northumberland Strait is characterized by mixed semi-diurnal tides and circulation dynamics influenced by the larger Gulf of St. Lawrence (Dillon 2019). Stantec (2019b) completed an underwater benthic habitat survey in 2019 and classified the substrate type within the proposed diffuser area as mixed sediment, specifically sand, shell hash, and gravel. The depth of water from the ferry terminal to the diffuser increases from approximately 3 m to 20 m deep.

The Northumberland Strait supports a productive phytoplankton community in the summer (Dillon, 2019). A recent underwater benthic habitat survey conducted by Stantec (2019b) observed macroflora and macrofauna within the proposed diffuser area. Macroflora included *Laminaria* sp., *Rhodophyta* sp., *Cladophora rupestri*s, and other brown algae. Macrofauna included rock crab (*Cancer irroratus*), sand dollar (*Echinarachnius parma*) and blue mussel (*Mytilus edulis*).

Benthic infauna within the Northumberland Strait includes polychaetes, nematodes, crustaceans, marine spiders, molluscs, and echinoderms. Epifauna include clams, oysters, quahog, mussels, cockles, scallops, snails, shrimp, crab, lobster, sponges, sea stars, sand dollars, sea urchins, sea anemone, and jellyfish (Dillon, 2019).

Diverse populations of groundfish, pelagic and migratory fish inhabit the Northumberland Strait. Common commercially important species include cod, White Hake (*Urophycis tenius*), American Plaice (*Hippoglossoides platessoides*), Atlantic Halibut (*Hippoglossoides hippoglossus*), Winter Flounder (*Pseudopleuronectes americanus*), Witch Flounder (*Glyptocephalus cynoglossus*), Yellowtail Flounder (*Pleuronectes ferruginea*), Atlantic Salmon (*Salmo salar*), herring, mackerel, Bluefin Tuna (*Thunnus thynnus*), Gaspereau (alewife; *Alosa pseudoharengus*), American Eel, and Rainbow Smelt (*Osmerus mordax*; JWEL, 2001).

Marine mammals observed in the Northumberland Strait include harbour seal (*Phoca vitulina*), grey seal (*Halichoerus grypus*), hooded seal (*Cystophora cristata*), harp seal (*Pagophilus groenlandicus*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), harbour porpoise (*Phocoena phocoena*), fin whale (*Balaenoptera physalus*), pilot whale, and sperm whale (*Physeter macrocephalus*; AMEC, 2007). Inshore seabirds common in the Northumberland Strait include cormorants, gulls, and terns (AMEC, 2007). Offshore or pelagic seabirds are less common in the strait. The leatherback sea turtle (*Dermochelys coriacea*) visits the Northumberland Strait during summer months to feed on jellyfish and is the only known reptile to occur in the Strait (AMEC, 2007).

Commercial fishing in the Gulf area in 2017 had a landed value of over $175 million, with queen crab (*Chionoecetes opilio*) and lobster having the largest landings value followed by herring, tuna, and halibut (DFO, 2019b). Near Caribou Point, lobster, rock crab, seaweed, scallops, and herring are harvested (**Figure 1.2**; JWEL, 2001).

The majority of the nearshore of the Northumberland Strait is considered a sea scallop buffer zone. The area near Caribou Point is within SFA 24 (DFO, 2019a). This buffer zone prohibits scallop dragging for the protection of American lobster nursery habitat.

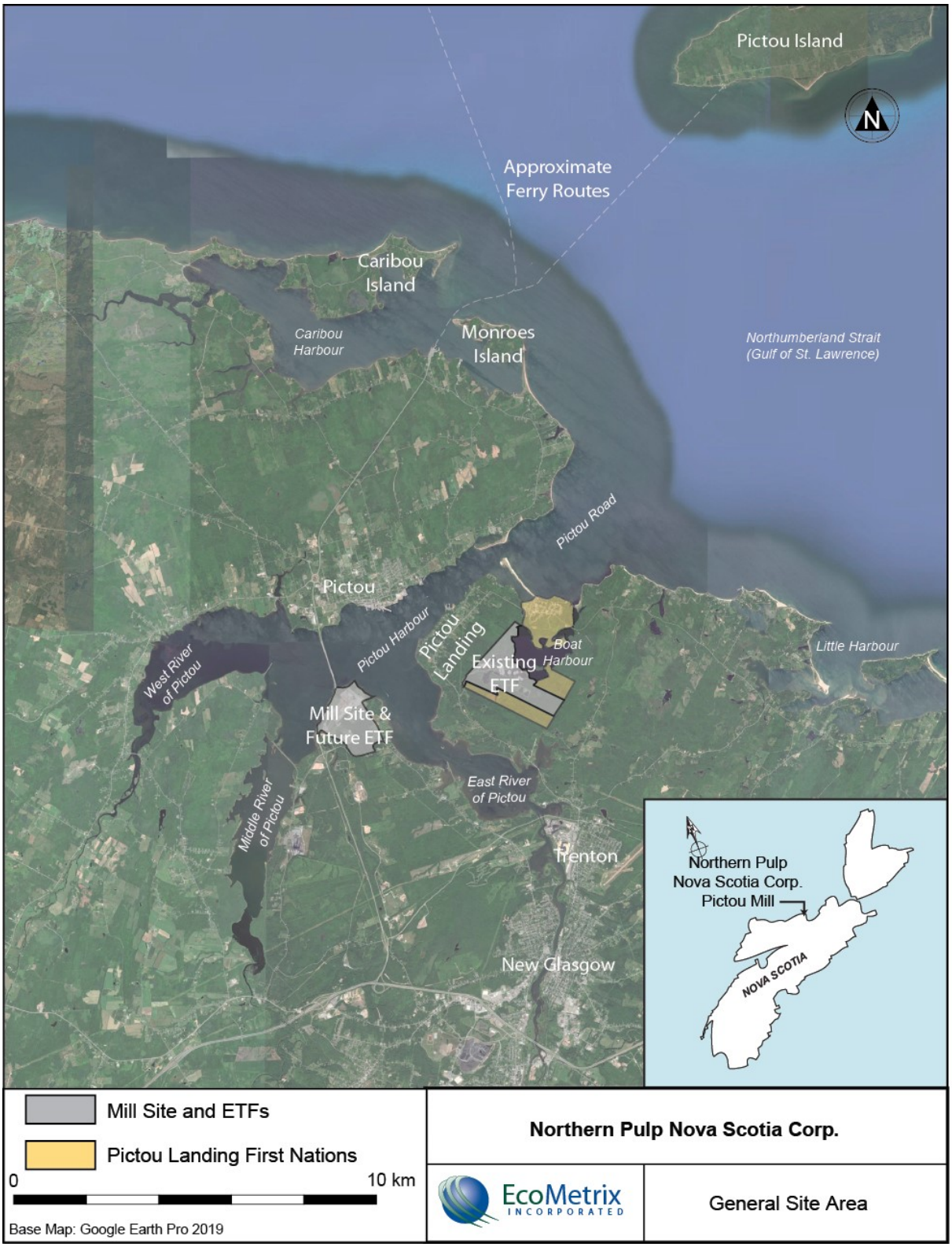

Figure 1.1: General Area Around Northern Pulp Nova Scotia Corporation Mill

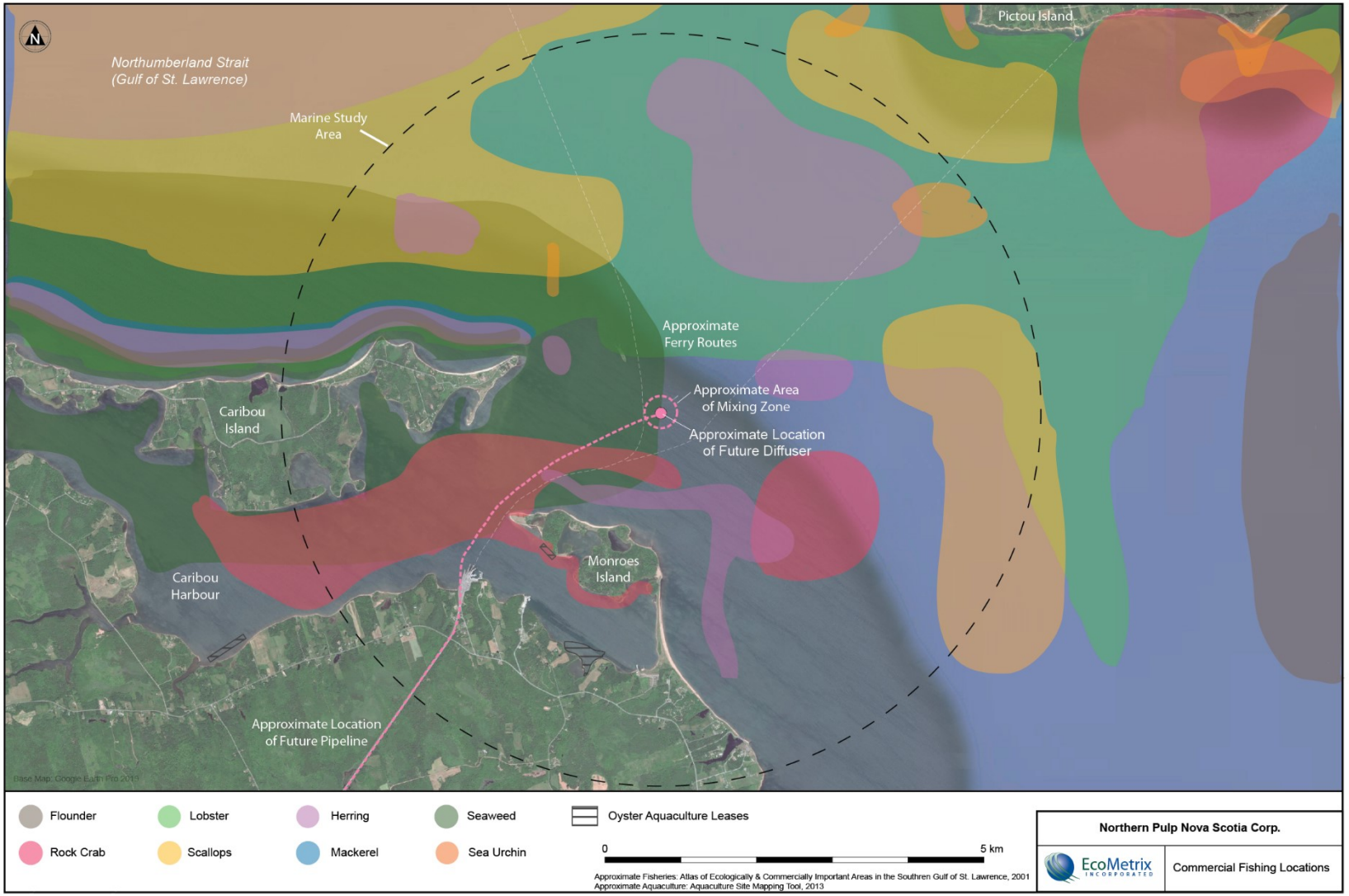

Figure 1.2: Approximate Commercial Fishing Locations in the Vicinity of the of the Proposed Diffuser

2.0 PROBLEM FORMULATION

Risk assessment is the process of estimating the likelihood of undesirable effects on human health resulting from exposure to chemical contaminants. The Problem Formulation provides the objective, framework, and general methodology for the HHRA, including identification and justification of:

- the contaminants of potential concern (COPCs) and their sources;
- the human receptors to be addressed; and
- the exposure pathways by which the human receptors may be exposed to the COPCs.

A conceptual site model (CSM) that illustrates the relationships between the COPCs, receptors and exposure pathways is developed within the Problem Formulation. The CSM is the blueprint for the HHRA.

2.1 Objective and Scope of Risk Assessment

This HHRA will follow a standard risk assessment approach as defined in the Detailed Quantitative Risk Assessment guidance from Health Canada (HC, 2010a). The objective of the HHRA is to characterize and evaluate potential health risks to human receptors from exposure to emissions from the new ETF. This includes exposure from the air emissions from the burning of biosludge in the boilers and effluent discharge in the Northumberland Strait.

For the air emissions exposure pathway, only outdoor air inhalation by receptors within the future dispersion area of the new ETF will be considered. For the future effluent discharge exposure pathway, a multi-media approach will be taken to consider exposure from all relevant environment components such as water, sediment, and sea foods.

2.2 Study Area

Spatial boundaries for the assessment of human health risks are a combination of the offsite residential areas potentially influenced by atmospheric emissions from the new ETF and biomass boiler, and the area potentially influenced by the marine treated effluent diffuser discharge.

Air Emissions Study Area

An approximate Air Emissions Study Area is the area surrounding the mill and is provided in **Figure 2.1**. An air dispersion model is currently being finalized to support the Focus Report (Stantec, 2019a). When available, this model will be

relied upon for the HHRA to define the areas potentially influenced by atmospheric emissions from the new ETF.

Marine Study Area

Although the mixing zone, within which effluent is distinguishable from background, is estimated to be approximately a 20 m radius around the diffuser, the HHRA will consider a Marine Study Area of a 5 km radius around the future diffuser (**Figure 2.2**). This Marine Study Area is conservative because the potential exposure to effluent parameters above background is likely only within 2% of this area. The water depth is approximately 20 m at the diffuser and it is not anticipated that the effluent will come into contact with sediment within the mixing zone (Stantec, 2018).

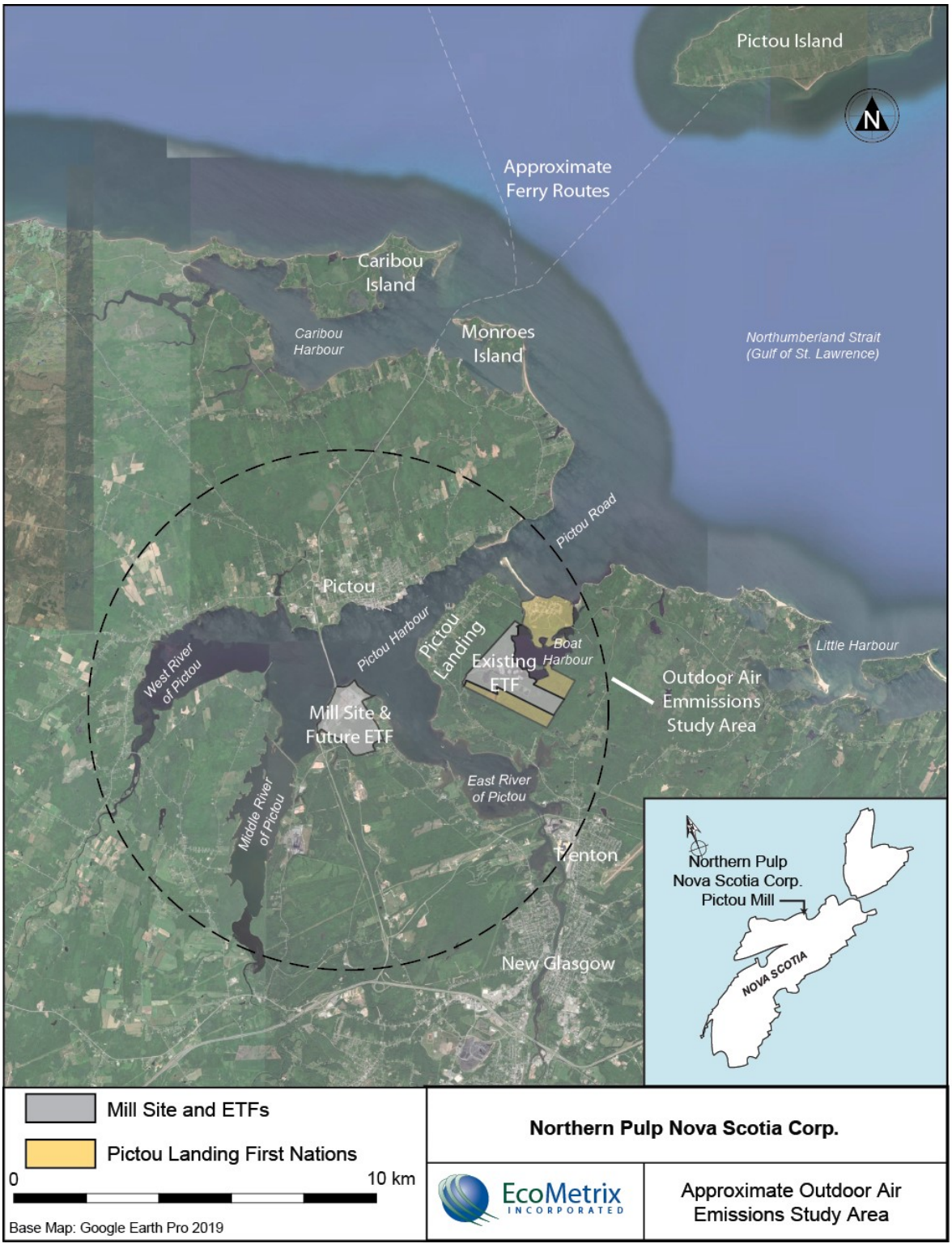

Figure 2.1: Approximate Study Area for Outdoor Air Inhalation of Emissions from Northern Pulp Nova Scotia

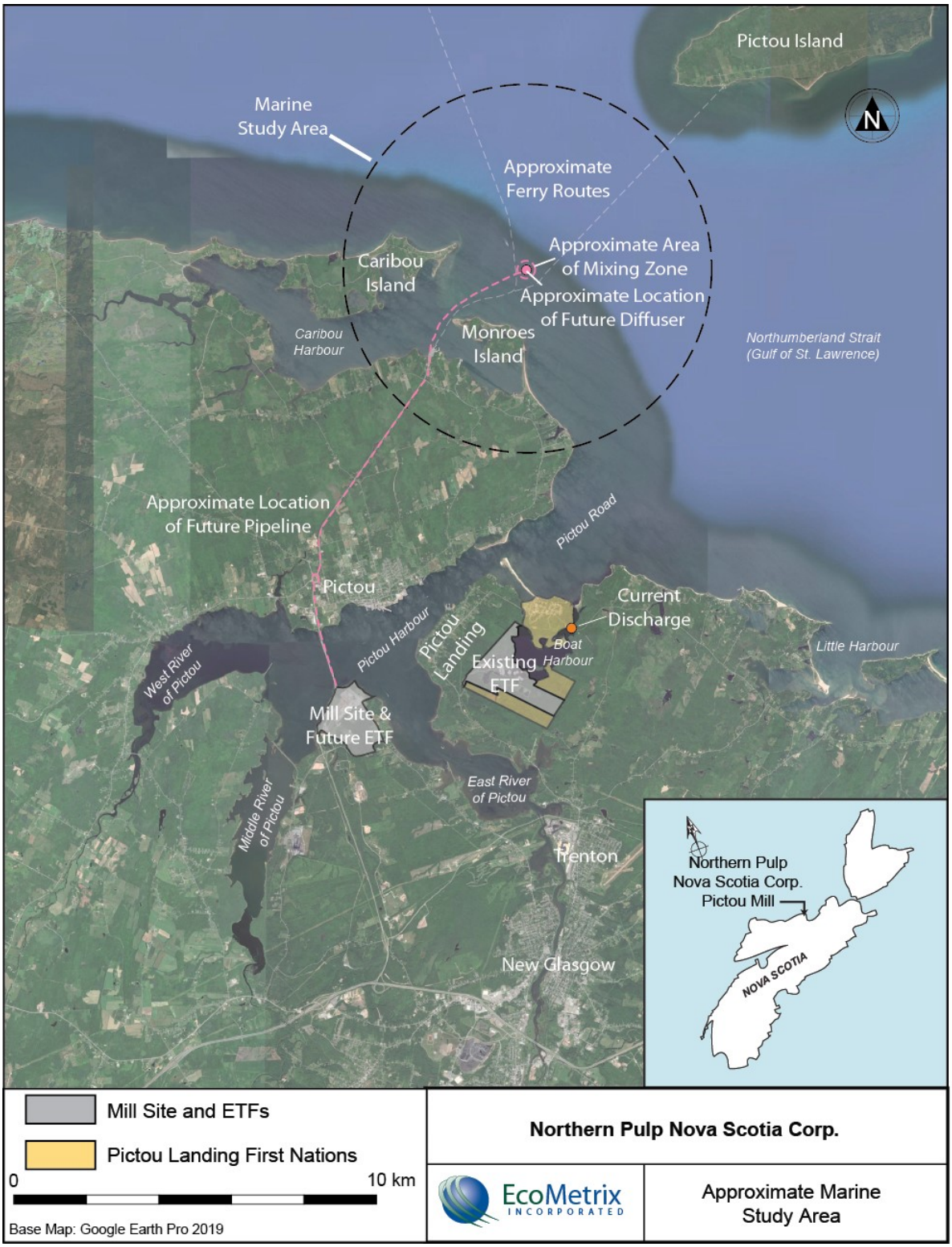

Figure 2.2: Approximate Study Area for Effluent Discharge from Northern Pulp Nova Scotia

2.3 Identification of Contaminants of Potential Concern

There are two sources of COPCs from the Project that will be considered for the HHRA:

- atmospheric emissions from the mill due to use of biosludge from the future ETF as fuel for the boiler (along with biomass fuel) and the new ETF activated sludge treatment process; and
- marine discharge comprised of treated effluent released to the Northumberland Strait offshore of Caribou Point through a multiport diffuser.

The selection and identification of COPCs for the air emissions and marine effluent discharges relevant to human health are discussed below.

2.3.1 Contaminants of Potential Concern in Project Air Emissions

A screening process was carried out to identify COPCs in the future air emissions from the Project. The approach is depicted in **Figure 2.3** and described in detail in **Appendix A**. An initial list of parameters was pre-screened to remove parameters that were represented by others or not of human toxicological concern. A parameter was identified as a COPC in outdoor air if the estimated air quality of emissions from the Project exceeded background outdoor air quality concentrations, or if there were no background outdoor air quality concentration data available for comparison, and the parameter also exceeded health-based air quality criteria.

The initial list of parameters and concentrations used for the screening were the sixty-six (66) parameters considered by Stantec (2019a) in their air dispersion modelling study. Fifty-seven (57) of these parameters were considered to potentially cause human health effects (**Table A.1**). All of these parameters either exceeded background outdoor air quality concentrations or did not have background outdoor air quality concentrations available (**Table A.2**). When compared to air quality criteria, nine (9) parameters exceeded air quality criteria and became air emission COPCs for the Project (**Table A.3**). Criteria are still under consideration for seven (7) parameters, which may also be COPCs for the Project.

The estimated maximum emission concentrations during the operation of the Project were below their respective Nova Scotia Reg. 150/2017 limits. For $PM_{2.5}$ and PM_{10}, the estimated maximum emission concentrations were above their respective National Ambient Air Quality Objectives Reference Level (CCME, 1999). For the contaminants compared to Ontario Ambient Air Quality Criteria (MECP, 2019), ammonia, calcium oxide, hexavalent chromium, manganese, chloroform, benzo(a)pyrene, and total reduced sulphide were found to be above applicable limits at discrete receptors infrequently.

A summary of emissions COPCs that will be used in the HHRA is presented in **Table 2.1**.

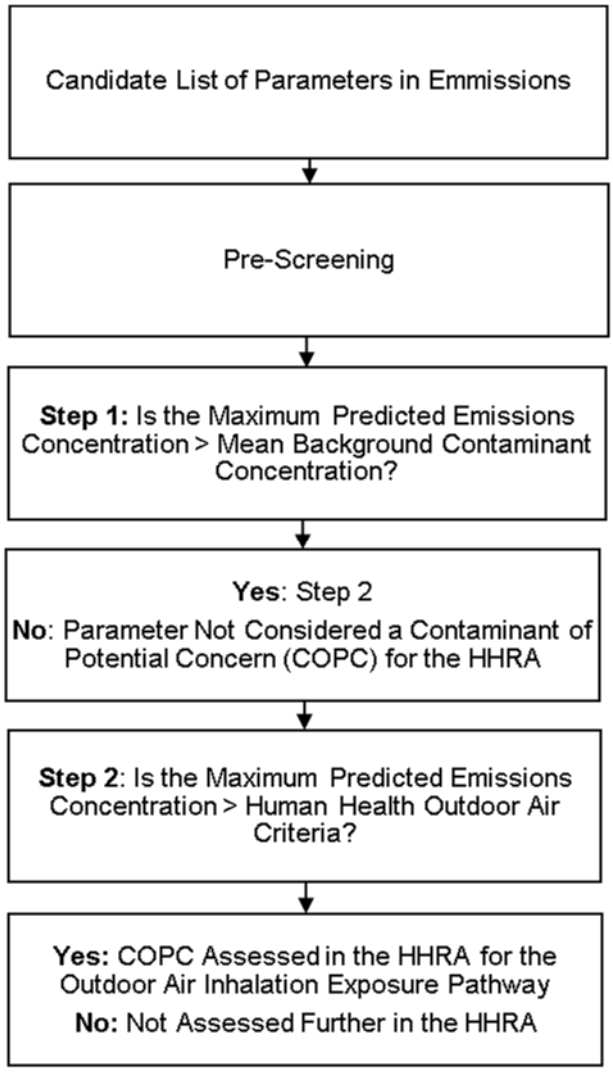

Figure 2.3: Overall Process for Identifying COPCs for Outdoor Air Exposure in the HHRA

Table 2.1: Summary of Emissions COPCs in the HHRA

Parameter	Outdoor Air Inhalation Pathway
Inorganics	
$PM_{2.5}$	Yes
PM_{10}	Yes
Ammonia	Yes
Metals	
Aluminum	Yes - Criteria Under Consideration
Calcium Oxide	Yes
Hexavalent Chromium	Yes
Magnesium	Yes - Criteria Under Consideration
Manganese	Yes
Phosphorous	Yes - Criteria Under Consideration
Volatile Organics	
Chloroform	Yes
a-pinene	Yes - Criteria Under Consideration
b-pinene	Yes - Criteria Under Consideration
Hexachlorobenzene	Yes - Criteria Under Consideration
Quinoline	Yes - Criteria Under Consideration
Benzo(a)pyrene	Yes
Total Reduced Sulphide	Yes

2.3.2 Contaminants of Potential Concern in Project Effluent Discharge

A screening process was carried out to identify COPCs in the future treated effluent. The approach is depicted in **Figure 2.4** and described in detail in **Appendix A**. Parameters analyzed in current effluent samples collected from the current compliance point of the ETF, Point C, in Boat Harbour, were used as the initial list of candidate parameters for the identification of the future effluent COPCs.

The initial parameter list included over 300 parameters measured by NPNS. Parameters that were represented by others or are not of human toxicological concern were removed. Parameters with concentrations greater than the median background concentration, based on samples from the proposed diffuser area, or with no background concentration to compare to, were identified as possible future effluent COPCs, to be further screened against water quality guidelines for protection of seafood consumption and recreational water use. The current treated effluent is a reasonable representation of the future treated effluent: the current treated effluent is comparable to other mills' effluent and the future ETF is expected to have comparable performance to other pulp and paper mills' treatment systems in Canada (KSH, 2019). The effluent will be diluted quickly within the receiving water (Stantec, 2018) and potential receptors will be exposed to lower concentrations than the values used for screening.

The pre-screening and background screening for the identification of the future effluent COPCs are summarized in **Table A.4** and **Table A.5**, respectively, in **Appendix A**. Parameters retained at this stage were compared to water quality guidelines (**Figure 2.3** and **Tables A.6a** and **b**, **Table A.7**, and **Table A.8**). A parameter with an effluent concentration exceeding one or more water quality guidelines was retained as a COPC for further assessment in the HHRA. A summary of effluent COPCs that will be used in the HHRA is presented in **Table 2.2**.

For the seafood ingestion exposure pathway, when there was no health-based water guideline protective of seafood consumption, the potential for a parameter to bioaccumulate in the food chain was assessed. The approach for assessing bioaccumulation potential of a parameter is explained in **Appendix A**. As summarized in **Table A.6a** and **Table A.6b**, the following effluent COPCs will be quantitively assessed in the HHRA for the ingestion of seafood exposure pathway: manganese, mercury, dioxins and furans, phenanthrene, and pentachlorophenol. The remaining COPCs will be qualitatively assessed in the HHRA for this exposure pathway.

The screening process for seafood ingestion is protective of fish and shell fish ingestion. According to the commercial harvest areas (**Figure 1.2**), seaweed may also be harvested in the Marine Study Area. The guidelines used in the screening process did not consider the protection of humans consuming aquatic plants. EcoMetrix is currently conducting a food intake survey. If the survey indicates that people harvest and eat seaweed from the Marine Study Area, we will assess this pathway as part of the HHRA.

For the recreational use of water pathways, a guideline for incidental water intake while swimming was considered to be protective. This guideline, where applicable, was derived from drinking water guidelines as described in **Appendix A**. This guideline was also considered to be protective of the surface water dermal contact exposure pathway, and the incidental ingestion of sediment and dermal contact with sediment exposure pathways, because these pathways are considered to be negligible when compared to the incidental ingestion of surface water exposure pathway. As summarized in **Table A.7**, the following COPCs will be quantitively assessed in the HHRA for the above-mentioned pathways: manganese, ethylene dibromide, catechol, and guaiacol.

Potential for tainting of seafood was also considered, based on comparison of effluent concentrations to guidelines for taste and odour in water, and to thresholds for tainting of fish. Any parameter that exceeded one these organoleptic guidelines was considered to have potential for tainting of seafood, and was retained as a COPC to be qualitatively assessed in the HHRA with respect to tainting. While not a health effect, tainting of seafood is of concern related to viability of the resource. If no organoleptic guideline was available for a parameter, it was considered not to represent a tainting concern. As summarized in **Table A.8**, the following COPCs will be qualitatively assessed in the HHRA for organoleptic effects: iron, 2-chlorophenol, 2,3 dichlorophenol, 2,6 dichlorophenol, 3,4 dichlorophenol, 2,3,4,6 tetrachlorophenol, and 2,4,5 trichlorophenol.

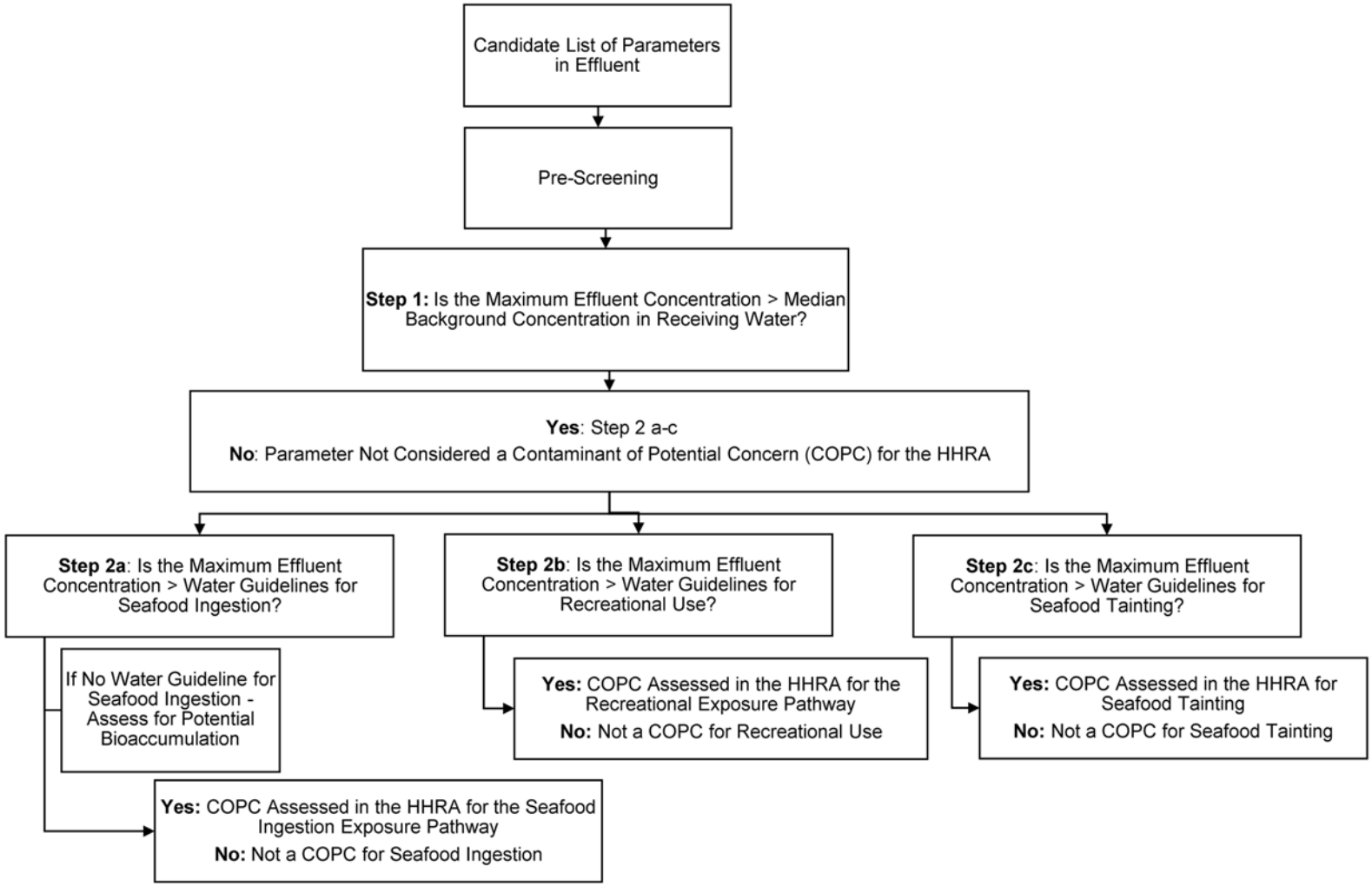

Figure 2.4: Overall Process for Identifying COPCs for Effluent Exposure in the HHRA

Table 2.2: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
Metals			
Total Iron (Fe)	No	No	Yes
Total Manganese (Mn)	Yes	Yes	No
Total Mercury (Hg)	Yes	No	No
Dioxins & Furans			
2,3,7,8-Tetra CDD	Yes	NA	No
1,2,3,7,8-Penta CDD	Yes	NA	No
1,2,3,4,7,8-Hexa CDD	Yes	NA	No
1,2,3,6,7,8-Hexa CDD	Yes	NA	No
1,2,3,7,8,9-Hexa CDD	Yes	NA	No
1,2,3,4,6,7,8-Hepta CDD	Yes	NA	No
2,3,7,8-Tetra CDF	Yes	NA	No
1,2,3,7,8-Penta CDF	Yes	NA	No
2,3,4,7,8-Penta CDF	Yes	NA	No
1,2,3,4,7,8-Hexa CDF	Yes	NA	No
1,2,3,6,7,8-Hexa CDF	Yes	NA	No
2,3,4,6,7,8-Hexa CDF	Yes	NA	No
1,2,3,7,8,9-Hexa CDF	Yes	NA	No
1,2,3,4,7,8,9-Hepta CDF	Yes	NA	No
Polycyclic Aromatic Hydrocarbons			
Phenanthrene	Yes	No	No
Volatile Organics			
Ethylene Dibromide	No	Yes	No
Phenols			
Catechol	No	Yes	No
2-Chlorophenol	No	No	Yes
2,3 Dichlorophenol	No	No	Yes
2,6 Dichlorophenol	No	No	Yes
3,4 Dichlorophenol	No	No	Yes
Guaiacol	No	Yes	No
Pentachlorophenol	Yes	No	No
2,3,4,6 Tetrachlorophenol	No	No	Yes
2,4,5 Trichlorophenol	No	No	Yes

2.4 Identification of Potential Human Receptors

Considering that a range of potential receptors could frequent the Study Areas, or consume seafood harvested from the Marine Study Area, a conservative approach has been taken in the selection of receptors to ensure that the "critical" receptors, which are assumed to have the highest frequency and duration of exposure, will be captured in the HHRA. These receptors include First Nations Communities, Residents, Commercial Fisheries Workers, and Recreational Users.

2.4.1 First Nations Communities

The First Nations Community of Pictou Landing First Nation (PLFN) is directly east of NPNS and currently adjacent to Boat Harbour. First Nation members are assumed to participate in traditional food harvesting and in recreational activities such as going to the beach, swimming, boating and fishing in the Marine Study Area. They also live within the Air Emissions Study Area. Although, many age groups of First Nation members may reside in and/or use the Study Areas, toddlers are the most sensitive age group due to their exposure characteristics (HC, 2010b). The toddler will be used to evaluate risks to the First Nation Communities exposed to non-carcinogenic COPCs in the Study Areas. A lifetime composite receptor will be used to evaluate risks to First Nation Communities exposed to carcinogenic COPCs in the Study Areas.

2.4.2 Residents

Non-First Nations Residents live within the Air Emissions Study Area and may consume food harvested from the Marine Study Area. They may also participate in recreational activities (going to the beach, swimming, boating) within the Marine Study Area. The toddler will be used to evaluate risks to Residents exposed to non-carcinogenic COPCs in these Study Areas. A lifetime, composite receptor will be used to evaluate risk for Residents exposed to carcinogenic COPCs.

2.4.3 Commercial Fisheries Workers

Commercial Fisheries Workers collect various seafoods for retail sale. They use boats to travel between harvesting locations and use various gear to harvest food. They may come into direct contact with water that has been exposed to effluent. The adult and pregnant female will be used to evaluate risk to Commercial Fisheries Workers exposed to COPCs in the Marine Study Area.

2.4.4 Recreational Users

Recreational Users may beach, boat, swim, or fish in the Marine Study Area. Exposure of the Recreational User will not be quantified in the HHRA because the Resident has a higher exposure frequency and duration than the Recreational User (HC, 2010b), and protection of residential exposure to the effluent COPCs would be protective of the Recreational User.

2.4.5 Receptor Characteristics

The characteristics of each of the critical receptors, apart from the food ingestion rates, will be obtained from Health Canada (HC, 2010b). The food ingestion rates for the HHRA will be derived using data collected from a food survey, created specifically for this project (**Appendix B**).

2.5 Receptor Exposure Pathways

When a receptor comes into contact with a COPC and that COPC enters the receptor's body, this is defined as a complete exposure pathway. In contrast, an incomplete pathway occurs when contact with the COPC is unlikely, resulting in no exposure.

The sources of COPCs in this HHRA include the 1) atmospheric emissions from the co-combustion of ETF biosludge in the biomass boiler and the new ETF activated sludge treatment process, and 2) the marine discharge of treated effluent from the diffuser near Caribou Point.

2.5.1 Atmosphere

The complete exposure pathways for COPCs in air emissions include the inhalation of outdoor air by First Nation Members and Residents.

This exposure pathway will be quantitively assessed for the HHRA.

Exposure locations will include a theoretical dwelling directly adjacent to the mill in the preferential wind path, a representative dwelling within the Air Emissions Study Area, a dwelling at Pictou Landing, and a dwelling outside the area of mill influence.

2.5.2 Marine Water

The complete exposure pathways for COPCs in the effluent include:

- Incidental ingestion of and dermal contact with surface water by First Nation Members, Residents, Commercial Fishers, and Recreational Users;
- Incidental ingestion of and dermal contact with beach sediment through the partitioning of effluent COPCs in surface water to sediment by First Nation Members, Residents, and Recreational Users; and
- Ingestion of seafoods that have accumulated COPCs from surface water, sediments or prey by First Nation Members and Residents.

These exposure pathways will be quantitively assessed for the HHRA.

Receptor exposure locations will include:

- Beach areas along the shoreline of the Marine Study Area for the recreational exposure pathway assessment (i.e., incidental ingestion of and dermal contact with surface water and sediment), and

- Harvest areas within the Marine Study Area for the seafood ingestion exposure pathway and for exposures during harvesting (i.e., incidental ingestion of and dermal contact with surface water and sediment).

With respect to the seafood ingestion exposure pathway the harvest areas as shown in **Figure 1.2** will be further refined based on the results of the local food survey and the habitat characterization study being currently completed by EcoMetrix.

Aquatic dispersion modelling will be undertaken to estimate COPC concentrations in water at the receptor exposure and seafood harvest locations. Uptake of COPCs into seafood will be estimated using water-based bioaccumulation factors, which implicitly represent uptake from all relevant aquatic media.

2.5.3 Drinking Groundwater

Drinking groundwater is considered a malfunction scenario for the HHRA because under normal operating procedures there is no contact between the treated effluent and groundwater.

There is potential for ocean intrusion into wells that are close to shore (GNS, 2019), but residents would likely stop drinking their groundwater due to taste from the salt and would therefore have minimal exposure.

There are a number of residential wells near the pipeline route. There is the possibility of a leak leading to treated pulp mill effluent infiltrating into groundwater that is used as drinking water. Although there will be spill contingency plans in place to stop and clean up any spill caused by ruptured pipelines or leaks along the pipeline corridor, the possibility of exposure was assessed. This malfunction scenario is discussed in **Appendix C**.

2.6 Conceptual Site Model

The elements identified above, namely COPCs, exposure pathways, and receptors, collectively comprise the CSM for the HHRA. The human health CSM is illustrated in **Figure 2.5**.

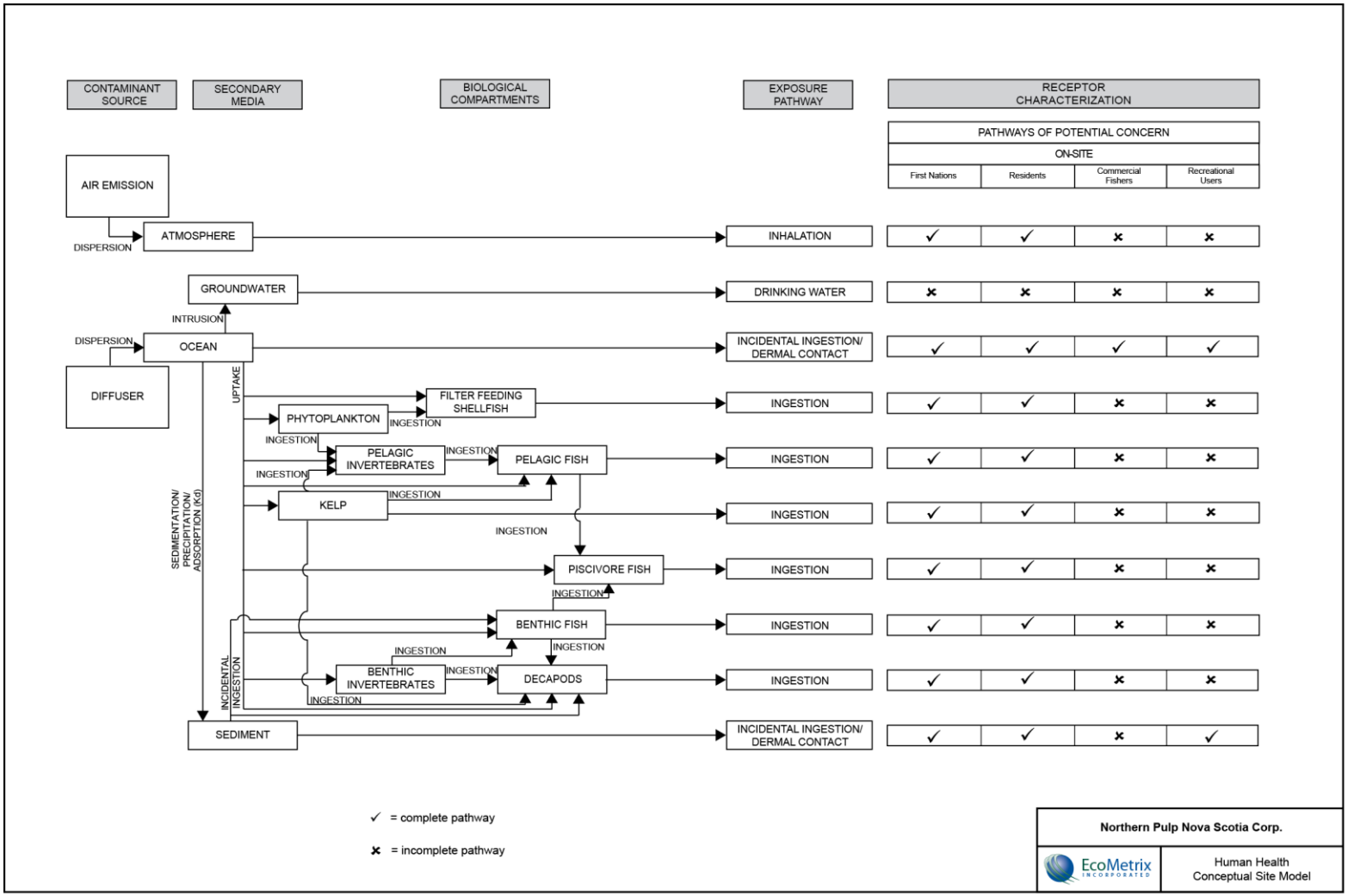

Figure 2.5: Human Health Conceptual Site Model for Northern Pulp Nova Scotia Corporation Replacement Effluent Treatment Facility

2.7 Uncertainties

Throughout the HHRA process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure that human health is protected. Therefore, when all of the assumptions are combined, the actual risks, if any, are overestimated rather than underestimated.

The predicted air emissions presented in this HHRA are from the updated air dispersion modelling study (Stantec, 2019a). The emission rates were estimated by using the existing emissions from the 2019 stack test, anticipated biomass fuel feed rates, and adjusting to include anticipated ETF biosludge in the biomass boiler. Stantec found little information related to the combustion of pulp and paper sludge but used a sewage sludge incineration guidance to assist with predicting emissions for volatile organic compounds and NSE criteria air contaminants. As such, there is uncertainty in the predicted emission rates. The air dispersion was modeled using AERMOD. This model applied a worse-case scenario to estimate air emission concentrations where scientific knowledge was lacking. This approach leads to an over estimation of air emission concentrations.

The maximum concentrations in the existing treated effluent were used to represent the future effluent concentration for the new ETF. The current effluent is considered to be representative of the future effluent. The future effluent from the new ETF is expected to equal to or better than the existing BHETF (KSH,2019). Therefore, the assumed performance is conservative. The effluent screening process used the maximum treated effluent concentration instead of a diluted concentration. As the effluent mixes rapidly with marine water, receptors will be exposed to lower concentrations of parameters than what was used for screening. Therefore, the screening process is conservative. This likely results in the inclusion of more COPCs in the HHRA than would be necessary if the analysis was based on lower concentrations in the receiving water.

Apart from the food ingestion rates, the receptor characteristics that will be used for the HHRA are the values used by Health Canada (2010b). These values are considered reasonable to avoid underestimating exposures for certain individuals who may have higher than average exposure frequencies or durations.

3.0 NEXT STEPS

The Problem Formulation will be circulated to stakeholders for review and comment in 2019. Response to reviewer comments on the Problem Formulation will be addressed by EcoMetrix prior to completing the HHRA.

The following information is needed to support the HHRA:

- The final air dispersion model report to update the estimated air emission concentrations and the estimated concentrations at receptor locations (First Nations Communities, Non-First Nations Residents).
- The final mixing zone assessment report to support the estimation of water concentrations at receptor locations in the Marine Study Area (beaches, seafood harvest areas).
- The results of a baseline study being completed by EcoMetrix near the proposed diffuser to better define the seafood species that are likely to inhabit the diffuser area.
- The results of the seafood intake survey to determine the types of seafood consumed by the critical receptors and the quantity of seafood consumed by the critical receptors. Thus far we have 300 respondents utilizing the results of a phone survey. Consultation with Pictou Landing First Nation is ongoing and a digital survey option is also available on the NPNS website. Further description of the survey, as well as comments received from Health Canada, are included in **Appendix B**.

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Appendix A Selection of Contaminants of Potential Concern

A.1 Selection of Contaminants of Potential Concern for Project Air Emissions

A screening process was carried out to identify Contaminants of Potential Concern (COPCs) in the future air emissions. The approach is depicted in **Figure 2.3** and the results are presented in **Table A.1** to **Table A.3**.

The initial list of parameters and concentrations include the sixty-six (66) parameters from the air dispersion modelling study (Stantec, 2019). The initial list of parameters were pre-screened to remove parameters that were represented by others or not of human toxicological concern (**Table A.1**). Total suspended particulates (TSP), boron, magnesium oxide, strontium, titanium, zinc, methyl isobtyl ketone, and propionaldehyde were not carried forward in the screening process as they are not of human health concern. A brief explanation for each of these is described below.

Particulate matter less than 10 µM diameter is pertinent to human health effects (WHO, 2013; Kim *et al.*, 2015). TSP is generally monitored for aesthetic reasons (to ensure visibility) since smaller particles are usually measured concurrently. As particulate matter that is less than 2.5 and 10 µM in diameter ($PM_{2.5}$ and PM_{10}, respectively) were included in the dispersion modelling, TSP will not be carried forward in the screening process.

Air quality guidelines for magnesium oxide (Fitch, 1971) and zinc (Kupa, 1971) are based on reducing irritation due to particulate inhalation. These substances are not considered toxic to humans.

For the remaining parameters, ambient air criteria are based on particulate or odour inhalation. We are waiting for rationales for these parameters from the Ontario Ministry of the Environment, Conservation, and Parks (MECP), who said they would provide them by the end of October, 2019. These will be incorporated in the HHRA report. Those parameters with health effects will be carried forward in the screening process.

Although ferric oxide ambient air criteria are based on soiling, ferric oxide can also cause health effects at higher concentrations (Closkey, 1985). Therefore, ferric oxide was carried forward in the screening process.

Although total reduced sulphur (TRS) includes hydrogen sulphide, it also includes other sulphide compounds that can affect human health. Therefore, to be comprehensive, total reduced sulphur was carried forward in the screening process.

The remaining fifty-seven (57) parameters were carried forward in the screening process. Only five (5) of the remaining parameters had ambient (outdoor) air quality available and the estimated emissions from the operations were compared to them (**Table A.2**). Nova

Scotia Environment (NSE) and Environment and Climate Change Canada (ECCC) have multiple air quality monitoring stations around the province and the data are accessible through an NSE website. Data were extracted from the website as 24 hour means from January 1, 2018 to June 20, 2019 (NSE, 2018) to represent background.

The estimated 24 hour sulphur dioxide and $PM_{2.5}$ concentrations exceeded their respective 24 hour background concentrations of non-detectable values and were carried forward for comparison to human health criteria. The estimated 24 hour TRS concertation exceeded the 24 hour background concentration and was carried forward for comparison to the human health criteria. The estimated 1 hour and 8 hour emission concentration of carbon monoxide and the estimated annual nitrogen dioxide concentration exceeded their 24 hour background concentrations, so it is likely that estimated 24 hour concentrations would exceed the 24 hour background concentrations. Consequently, carbon monoxide and nitrogen dioxide were carried forward for comparison to human health criteria as well. Therefore, all fifty-seven (57) parameters that have the potential for human health effects were carried forward in the screening process.

The ambient air criteria consisted of The Maximum Permissible Ground Level Concentrations (MPGLC) in the Nova Scotia Air Quality Regulation (NS Reg. 150/2017 *Environment Act*). The National Ambient Air Quality Objective (NAAQO) reference level (CCME, 1999), which is based on human health, was used in lieu of a NS value. If a MPGLC and NAAQO were not available, the Ontario Ambient Air Quality Criteria (AAQC; MECP, 2019) was selected.

The NAAQO reference levels of 15 $\mu g/m^3$ for $PM_{2.5}$ and 25 $\mu g/m^3$ for PM_{10} were considered appropriate for screening because they are set to be protective of human health. A precautionary principal was used to develop these objectives because there is not a known threshold below which adverse health effects do not occur (CEPA/FPAC, 2008).

The AAQCs were considered appropriate to screen COPCs because they are based on science and are set at concentrations that are protective against adverse effects, including both human health and environmental effects, as outlined in the MOECC document entitled “Guideline for the Implementation of Air Standards in Ontario” (MOECC, 2017). In setting air standards for a contaminant, the MOECC considers all potential effects, and then defines the standard based on one or more limiting or critical effects of that contaminant. For example, as outlined in MOE (2009), the development of the standards considered biomagnification and/or bioaccumulation; contamination of soil, terrestrial vegetation, and surface water by constituents depositing from air (i.e., particle deposition effects); and soiling and corrosion of building surfaces. The limiting effect(s) could be based on health, environmental, or nuisance effects. The AAQC values (MECP, 2019) account for the most sensitive human sub-populations (seniors, children, etc.) and also assume that exposure is over the entire lifetime of the receptor (MOE, 2007).

The parameters that had estimated emissions that may exceed ambient air criteria are $PM_{2.5}$, PM_{10}, ammonia, calcium oxide, hexavalent chromium, manganese, chloroform, benzo(a)pyrene, and TRS (**Table A.3**). These parameters will be considered COPCs for the evaluation of residential outdoor air inhalation.

Criteria are lacking for aluminum, magnesium, phosphorous, a-pinene, b-pinene, hexachlorobenzene, quinoline, and carbonyl sulphide. If criteria cannot be found or if estimated emissions exceed suitable criteria that are found, these parameters will be considered COPCs for the evaluation of residential outdoor air inhalation.

A.2 Selection of Contaminants of Potential Concern for Project Effluent Discharge

A screening process was carried out to identify COPCs in the future treated effluent. The approach is depicted in **Figure 2.4**. Effluent concentrations sampled from the compliance point, Point C, located in Boat Habour, were used for screening purposes.

The initial parameter list included over 300 parameters collected by NPNS. This list was first examined to remove parameters that were ancillary parameters of water quality, not chemicals, or were represented by other parameters. These parameters include: pH, colour, salinity, ion balance, alkalinity, total dissolved solids, total suspended solids, volatile suspended solids, turbidity, conductivity, hardness, oil and grease, total organic carbon, dissolved organic carbon, biochemical oxygen demand, chemical oxygen demand, total nitrogen, nitrate + nitrite, total Kjeldahl Nitrogen, orthophosphate, and absorbable organic halogen.

The list was then pre-screened for parameters that were not found to be of human toxicological concern (**Table A.4**). The parameters that are not of human concern include: total residual chlorine, chloride, total phosphorus, ammonia nitrogen, calcium, sulphide as H_2S, sulphide, sulphite, sulphate, reactive silica, aluminum, calcium, iron, magnesium, potassium, sodium, zinc, fatty acids, and resin acids. Where a parameter was not identified as a human health concern, but a Health Canada (2017) drinking water aesthetic objective for taste and odour was identified for the parameter, that parameter was carried forward for further assessment. These parameters included: chloride, sulphide, sulphate, iron, sodium, and zinc. The rationale for a parameter not being considered a human health concern is summarized in **Table A.4**.

Parameters carried forward in the screening process were compared to background water concentrations from samples collected near the future diffuser off Caribou Point (**Table A.5**). Water in the future diffuser location was collected in October 2018 and May 2019 by NPNS personnel and in June 2019 by EcoMetrix. The median concentration of results from these events was used as background for screening purposes.

The current effluent concentrations from the compliance point, Point C, located in Boat Harbour, were used to characterize the future effluent. The current treated effluent is a reasonable representation of the future treated effluent: the current treated effluent is

comparable to other mills' effluent and the future ETF is expected to have comparable performance to other pulp and paper mills' treatment systems in Canada (KSH, 2019). Effluent concentrations collected in May and October 2018 and May 2019, and regulated parameters measured more regularly (i.e., metals, dioxins, furans) since 2014, were included in the data set. The maximum effluent concentration of these samples was used for screening purposes.

Parameters with maximum concentrations greater than the median background concentration were carried forward for further screening against water quality guidelines relevant to human health and water use. If there was no background concentration to compare to, the parameter was also carried forward. Parameters that exceeded background but had no human health concerns were only carried forward for the water and seafood tainting pathway. The parameters exceeding median background are presented in **Table A.5**.

Remaining parameters were then compared to water quality guidelines protective of the seafood ingestion exposure pathway, the recreational water use exposure pathway (incidental ingestion while swimming), and taste and odour in water and fish. Guidelines for taste and odour in water were conservatively considered to represent the potential for fish tainting. Any effluent parameter found to exceed one or more of these guidelines was considered to be a COPC.

A) Seafood Ingestion

For the seafood ingestion pathway, the maximum effluent concentration was compared to the United States Environmental Protection Agency (US EPA) National Recommended Water Quality Criteria for human health based on consumption of aquatic organisms only (US EPA, 2019a; **Table A.6a**). This water quality guideline is protective of human seafood consumption. Where a US EPA (2019a) guideline for the consumption of organisms was not available, the US EPA (2019a) criterion for human health based on the consumption of water and organisms was selected. This guideline is also protective of the seafood ingestion pathway.

For dioxins and furans, the US EPA (2019a) 2,3,7,8- tetrachlorodibenzo-p-dioxin (2,3,7,8 -Tetra CDD) human health water criterion for the consumption of organisms was used to derive human health water criteria for the consumption of organisms for each of the dioxin and furan congeners. These individual human health criteria were determined by dividing the US EPA (2019a) 2,3,7,8- Tetra CDD criterion by the product of the US EPA (2010) Toxicity Equivalence Factor (TEF) and New York State (Litten, 2009) Bioaccumulation Equivalency Factor (BEF) for each congener.

Parameters that did not have a water quality guideline protective of seafood ingestion, but were detected above the parameter's detection limit, were assessed for potential bioaccumulation (**Table A.6b**).

Parameters were considered bioaccumulative based on the same criteria defined in Section 4 of the Persistence and Bioaccumulative Regulations under the *Canadian Environmental Protection Act* (CEPA):

> *A substance is bioaccumulative a) when its bioaccumulation factor is equal to or greater than 5,000; b) if its bioaccumulation factor cannot be determined in accordance with a method referred to in Section 5, when its bioconcentration factor is equal to or greater than 5,000; and c) if neither its bioaccumulation factor nor its bioconcentration factor can be determined in accordance with a method referred to in section 5, when the logarithm of its octanol-water partition coefficient is equal to or greater than 5.*

The US EPA (2016) framework for selecting methods for deriving national bioaccumulation factors (BAF) factors was used to assess if a parameter was considered to be bioaccumulative based on CEPA's definition.

Parameters retained from **Table A.6a** or Table **A.6b** were considered to be COPCs based on concern for health effects from seafood ingestion.

Parameters that will be carried forward in the HHRA for the seafood ingestion pathway include: manganese, mercury, dioxins and furans, phenanthrene, and pentachlorophenol.

B) Recreational Use

For the recreational exposure pathway, there are Canadian recreational water quality guidelines (HC, 2012). However, there are no Canadian recreational guidelines available for our parameters of interest (**Table A.5**). As such, Canadian drinking water guidelines protective of potable water were considered to be protective of recreational users that may incidentally ingest water while engaging in recreational activities such as swimming. The drinking water guideline was also considered to be protective of the surface water dermal contact exposure pathway, and the incidental ingestion of sediment and dermal contact with sediment exposure pathways, because these pathways are considered to be negligible when compared to the incidental ingestion of surface water exposure pathway. As such, the drinking water quality guidelines were used as a first step in identifying COPCs for the recreational water use exposure pathway.

The maximum effluent concentration for each parameter was compared to the Canadian Drinking Water Quality Guidelines (CDWQG; HC, 2017; **Table A.7**). The CDWQOs are the same guidelines adopted by province of Nova Scotia (GNS, 2017) for the protection of human health from the drinking water exposure pathway.

Where a CDWQG was not available, the maximum effluent concentration for a parameter was compared to the Nova Scotia Environment (NSE, 2014) potable

groundwater drinking water environment quality standards (EQS) protective of human receptors exposed to contaminants in groundwater through direct ingestion. These drinking water EQS are considered appropriate because they were derived using the following hierarchy: CDWQGs, Atlantic RBCA Tier 1 Risk Based Screening Levels, Alberta Environment Tier 1 Groundwater Remediation Guidelines, the Ontario Ministry of the Environment, Conservation and Parks (MECP) groundwater, and the US EPA Regional Screening Tables. In some cases, the NSE (2014) adopted the CCME (2013 draft (now 2016)) recommended maximum laboratory reporting limit (LRL) for water as the potable groundwater drinking water EQS.

Where a NSE (2014) potable groundwater drinking water EQS was not available or the NSE (2014) EQS was based on a recommended maximum LRL, we used the Ontario MECP drinking water component value (GW1) protective of the drinking water exposure pathway (MOE, 2011). The GW1 component values from the MECP (MOE, 2011) are considered appropriate as these values were obtained using the following hierarchy: Ontario Drinking Water Standards, CDWQGs, the US EPA Maximum Contaminant Level (MCL), the California EPA, the European Union, and the World Health Organization, in order of preference. Where there was no value from the above jurisdictions, the MECP (MOE, 2011) calculated the GW1 values using a drinking water exposure model, human health toxicity values and oral cancer slope factors, and a target incremental lifetime cancer risk (ILCR) level of 1 in 1 million (10^{-06}) for carcinogenic parameters. The toxicity values and slope factors used by the MECP (MOE, 2011) were obtained from reputable and peer-reviewed sources such as the US EPA. The MECP target cancer risk level (ILCR) is more conservative when compared to NSE (2014) EQS that accepts an ILCR of 1 in 100, 000 (10^{-5}). The MECP GW1 component values for carcinogenic parameters were not adjusted to reflect a target risk level of 1 in 100,000.

For dioxins and furans, the NSE (2014) potable groundwater drinking EQS is expressed as a toxic equivalent (TEQ) of 2,3,7,8-TCDD. For comparison with the NSE (2014) guideline, the effluent concentration was also expressed as a TEQ of 2,3,7,8-TCDD. This was accomplished by multiplying the effluent concentration of each congener with its US EPA (2010) toxic equivalency factor (TEF) for 2,3,7,8-TCDD and summing the products.

Where a maximum effluent concentration exceeded its drinking water quality guideline, a recreational criterion was derived. This recreational criterion was derived by multiplying the drinking water guideline by the ratio of the drinking water intake used to develop the drinking criterion and an incidental water ingestion rate of 0.187 L/day (US EPA, 2019b) while swimming. The incidental ingestion rate while swimming is an upper percentile (95^{th}) value of water ingested per swimming event (assumed to be per day for this assessment) for marine beach goers of all ages, from the De-Florio-Barker *et al*. (2017) study (US EPA, 2019a).

Recreational criteria were derived for chlorite, manganese, 1,1-dichloroethylene, and ethylene dibromide (**Table A.7**). For chlorite and 1,1-dichloroethylene, Health Canada (1994, 2008) used a drinking water intake rate of 1.5 L/day to derive the CDWQGs. As such, the CDWQGs for chlorite and 1,1-dichloroethylene were multiplied by a factor of 8 (8 = 1.5L/0.187L) to derive a recreational criterion for these parameters.

For manganese, Health Canada (2019) used a drinking water intake rate of 0.75 L/day for a bottle-fed infant (0-6 months) to derive the CDWQG. As such, the CDWQG for manganese was multiplied by a factor of 4 (4 = 0.75 L/0.187L) to derive a recreational criterion for manganese.

For ethylene dibromide, the drinking water quality guideline was based on the MECP (MOE, 2011) GW1 component value, which was based on the US EPA (2009) MCL. When deriving MCLs, the US EPA assumes a drinking rate of 2 L/day for a 70 kg adult. As such, the ethylene dibromide MCL was multiplied by a factor of 10.7 (10.7 = 2 L/0.187L) to derive a recreational criterion for ethylene dibromide.

Where a maximum effluent concentration did not exceed the drinking water quality guidelines or the recreational criteria, the parameter was not considered to be a COPC based on concern for health effects from incidental water ingestion during recreational activity.

For parameters that did not have a drinking water quality guideline, but were detected above background concentration, these parameters were considered for further evaluation in the risk assessment.

Parameters retained from **Table A.7** were considered to be COPCs based on concern for health effects from incidental water ingestion during recreational activity.

Parameters that will be carried forward in the HHRA for the recreational water use pathway include: manganese, ethylene dibromide, catechol, and guaiacol.

C) Tainting

Although tainting, the alteration of taste and smell of seafood, is not a human health concern, this pathway was assessed to ensure the viability of the seafood resource. The maximum effluent concentration was compared to a water quality guideline that is protective of fish tainting (**Table A.8**). Guidelines were taken from the US EPA National Recommended Water Quality Criteria for organoleptic effects (taste and odour of water; US EPA, 2019c) or from Shumway and Palensky (1973; threshold for tainting of fish). If both values were available, the lower value was used, which was generally the US EPA value.

Parameters retained from **Table A.8** were considered to be COPCs based on concern for the viability of the seafood resource.

Parameters that will be carried forward in the HHRA for qualitative assessment of possible effects on seafood resource viability include: iron, 2-chlorophenol, 2,3 dichlorophenol, 2,6 dichlorophenol, 3,4 dichlorophenol, 2,3,4,6 tetrachlorophenol, and 2,4,5 trichlorophenol (**Table A.8**).

A summary of COPCs to be addressed in the HHRA, and the pathways for which they are considered, is presented in **Table A.9**.

Although cadmium is of concern to the public, it is not considered an effluent COPC for human receptors. Although the parameter can cause human health effects it is not a COPC in this assessment because:

- The bioconcentration factor for cadmium is below the CEPA definition for a bioaccumulative substance: therefore, cadmium is not a seafood ingestion COPC;
- The maximum effluent concentration of cadmium was below water drinking criteria: therefore, cadmium is not a recreational use COPC; and
- Cadmium is not considered to be organoleptic: therefore, it is not a tainting COPC.

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Table A.1: Air Emissions Pre-Screening

Parameter	Is Parameter Considered to be of Potential Human Health Concern?	Carried Forward in Screening Process?
Inorganics		
Carbon Monoxide	Yes	Yes
TSP	Particles that are less than 10 µm in diameter can penetrate the lungs. TSP includes all suspended particles (less than and greater than 10 µm).	No. $PM_{2.5}$ and PM_{10} will evaluate particles less than 10 µm.
$PM_{2.5}$	Yes	Yes
PM_{10}	Yes	Yes
Nitrogen Dioxide	Yes	Yes
Sulphur Dioxide	Yes	Yes
Ammonia	Yes	Yes
Hydrochloric Acid	Yes	Yes
Metals		
Aluminum	Yes	Yes
Antimony	Yes	Yes
Arsenic	Yes	Yes
Barium	Yes	Yes
Beryllium	Yes	Yes
Boron	No *	No *
Cadmium	Yes	Yes
Calcium Oxide	Yes	Yes
Chromium	Yes	Yes
Hexavalent Chromium	Yes	Yes
Cobalt	Yes	Yes
Copper	Yes	Yes
Iron	Yes	Yes
Ferric Oxide	Yes	Yes
Lead	Yes	Yes
Lithium	Yes	Yes
Magnesium	Yes	Yes
Magnesium Oxide	No	No
Manganese	Yes	Yes
Mercury	Yes	Yes
Nickel	Yes	Yes
Phosphorus	Yes	Yes
Selenium	Yes	Yes
Silver	Yes	Yes
Strontium	No *	No *
Titanium	No *	No *
Vanadium	Yes	Yes
Zinc	No	No
Dioxins and Furans		
Dioxins and Furans	Yes	Yes

Table A.1: Air Emissions Pre-Screening

Volatile Organics		
Acetaldehyde	Yes	Yes
Acetone	Yes	Yes
Acrolein	Yes	Yes
Benzene	Yes	Yes
1,3-Butadiene	Yes	Yes
Butanol, n	Yes	Yes
Chloroform	Yes	Yes
Chloromethane (Methyl Chloride)	Yes	Yes
Cyclohexane	Yes	Yes
Dichloromethane (Methylene Chloride)	Yes	Yes
Ethyl Benzene	Yes	Yes
1,2-Dichloroethane (Ethylene Dichloride)	Yes	Yes
Formaldehyde	Yes	Yes
Hexane, n	Yes	Yes
Methanol	Yes	Yes
Methyl Ethyl Ketone	Yes	Yes
Methyl Isobutyl Ketone	No *	No *
Phenol	Yes	Yes
Propionaldehyde	No *	No *
a-pinene	Yes	Yes
b-pinene	Yes	Yes
Toluene	Yes	Yes
Xylenes	Yes	Yes
Hexachlorobenzene	Yes	Yes
Naphthalene	Yes	Yes
Quinoline	Yes	Yes
Benzo(a)pyrene	Yes	Yes
Total Reduced Sulphur	Yes	Yes
Hydrogen Sulphide	Yes	Yes

Notes:
* Air criteria is based on particulate or odour. Waiting for rationale to determine if there is also a human health concern. If there is, the parameter will be carried forward.

Table A.2: Comparision of Estimated Emissions for the Future NPNS Operations to Available Background Concentations

Parameter	Estimated Emissions for Future Operations (µg/m^3) [1]				Background (µg/m^3) [2]	Carried Forward in Screening Process?
	1 hour	8 hour	24 hour	Annual	24 hour	
Carbon Monoxide	665	391	NV	NV	1.20E-04	Yes
Nitrogen Dioxide	189	NV	NV	4.5	0.041	Yes
Sulphur Dioxide	87	NV	23	2	ND	Yes
Total Reduced Sulphur	NV	NV	**106**	NV	**0.063**	Yes
Fine Particulate Matter ($PM_{2.5}$)	NV	NV	20	1.7	ND	Yes

Notes:

NV - No Value

ND - Not Detected

1 - Stantec Consulting Ltd. 2019. Expanded Air Dispersion Modelling Study – Replacement Effluent Treatment Facility. File No. 121416276. August

2 - Mean minimum 24 hour Ambient Air Quality from January 2018 to June 2019 (Nova Scotia Environment. 2018. Nova Scotia Environment Ambient Air Quality Data: All Stations. https://novascotia.ca/nse/airdata/.)

Table A.3: Comparision of Estimated Emissions for the Future NPNS Operations to Air Quailty Criteria

Parameter	Estimated Emissions for Future Operations (µg/m^3) [1]							Ambient Air Criteria (µg/m^3)							COPC for Outdoor Air Inhalation?
	10 min	30 min	1 hour	8 hour	24 hour	30 day	Annual	10 min	30 min	1 hour	8 hour	24 hour	30 day	Annual	
Inorganics															
Carbon Monoxide [2]	NV	NV	665	391	NV	NV	NV	NV	NV	34,600	12,700	NV	NV	NV	No
$PM_{2.5}$ [3]	NV	NV	NV	NV	**20**	NV	1.7	NV	NV	NV	NV	**15**	NV	NV	**Yes**
PM_{10} [3]	NV	NV	NV	NV	**47**	NV	NV	NV	NV	NV	NV	**25**	NV	NV	**Yes**
Nitrogen Dioxide [2]	NV	NV	43	NV	NV	NV	1.9	NV	NV	400	NV	NV	NV	100	No
Sulphur Dioxide [2]	NV	NV	87	NV	23	NV	2.0	NV	NV	900	NV	300	NV	60	No
Ammonia [4]	NV	NV	NV	NV	**406**	NV	NV	NV	NV	NV	NV	**100**	NV	NV	**Yes**
Hydrochloric Acid [4]	NV	NV	NV	NV	1.2	NV	NV	NV	NV	NV	NV	20	NV	NV	No
Metals															
Aluminum	NV	NV	NV	NV	0.83	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Antimony [4]	NV	NV	NV	NV	8.40E-04	NV	NV	NV	NV	NV	NV	25	NV	NV	No
Arsenic [4]	NV	NV	NV	NV	3.05E-03	NV	NV	NV	NV	NV	NV	0.30	NV	NV	No
Barium [4]	NV	NV	NV	NV	0.020	NV	NV	NV	NV	NV	NV	10	NV	NV	No
Beryllium [4]	NV	NV	NV	NV	3.00E-05	NV	NV	NV	NV	NV	NV	0.01	NV	NV	No
Cadmium [4]	NV	NV	NV	NV	2.22E-03	NV	NV	NV	NV	NV	NV	0.025	NV	0.005	No
Calcium Oxide [4]	NV	NV	NV	NV	**11**	NV	NV	NV	NV	NV	NV	**10 ***	NV	NV	**Yes**
Chromium [4]	NV	NV	NV	NV	6.75E-03	NV	NV	NV	NV	NV	NV	0.5	NV	NV	No
Hexavalent Chromium [4]	NV	NV	NV	NV	**2.89E-03**	NV	**2.20E-04**	NV	NV	NV	NV	**3.50E-04**	NV	**7.00E-05**	**Yes**
Cobalt [4]	NV	NV	NV	NV	5.60E-04	NV	NV	NV	NV	NV	NV	0.1	NV	NV	No
Copper [4]	NV	NV	NV	NV	0.010	NV	NV	NV	NV	NV	NV	50	NV	NV	No
Iron [4]	NV	NV	NV	NV	0.84	NV	NV	NV	NV	NV	NV	4	NV	NV	No
Ferric Oxide [4]	NV	NV	NV	NV	1.1	NV	NV	NV	NV	NV	NV	25 *	NV	NV	No
Lead [4]	NV	NV	NV	NV	0.010	1.93E-03	NV	NV	NV	NV	NV	0.5	0.2	NV	No
Lithium [4]	NV	NV	NV	NV	2.70E-04	NV	NV	NV	NV	NV	NV	20	NV	NV	No
Magnesium	NV	NV	NV	NV	3.8	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Manganese [4]	NV	NV	NV	NV	**0.22**	NV	NV	NV	NV	NV	NV	**0.1**	NV	0.04	**Yes**
Mercury [4]	NV	NV	NV	NV	4.70E-04	NV	NV	NV	NV	NV	NV	2	NV	NV	No
Nickel [4]	NV	NV	NV	NV	5.84E-03	NV	4.40E-04	NV	NV	NV	NV	0.1	NV	0.04	No
Phosphorus	NV	NV	NV	NV	2.0	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Selenium [4]	NV	NV	NV	NV	5.90E-04	NV	NV	NV	NV	NV	NV	10	NV	NV	No
Silver [4]	NV	NV	NV	NV	4.42E-03	NV	NV	NV	NV	NV	NV	1	NV	NV	No
Vanadium [4]	NV	NV	NV	NV	3.45E-03	NV	NV	NV	NV	NV	NV	2	NV	NV	No
Dioxins and Furans															
Dioxins and Furans (pg TEQ/m^3) [4]	NV	NV	NV	NV	0.013	NV	NV	NV	NV	NV	NV	0.1	NV	NV	No

Table A.3: Comparision of Estimated Emissions for the Future NPNS Operations to Air Quailty Criteria

Volatile Organics															
Acetaldehyde [4]	NV	106	NV	NV	11	NV	NV	NV	500	NV	NV	500	NV	NV	No
Acetone [4]	NV	NV	NV	NV	919	NV	NV	NV	NV	NV	NV	11,880	NV	NV	No
Acrolein [4]	NV	NV	0.78	NV	0.11	NV	NV	NV	NV	4.5	NV	0.4	NV	NV	No
Benzene [4]	NV	NV	NV	NV	0.14	NV	0.010	NV	NV	NV	NV	2.3	NV	0.45	No
1,3-Butadiene [4]	NV	NV	NV	NV	0.19	NV	0.040	NV	NV	NV	NV	10	NV	2	No
Butanol, n [4]	1,413	NV	NV	NV	NV	NV	NV	2,100 *	NV	NV	NV	920	NV	NV	No
Chloroform [4]	NV	NV	NV	NV	**2.6**	NV	NV	NV	NV	NV	NV	**1**	NV	0.2	**Yes**
Chloromethane (Methyl Chloride) [4]	NV	NV	NV	NV	0.040	NV	NV	NV	NV	NV	NV	320	NV	NV	No
Cyclohexane [4]	NV	NV	NV	NV	32	NV	NV	NV	NV	NV	NV	6,100	NV	NV	No
Dichloromethane (Methylene Chloride) [4]	NV	NV	NV	NV	0.80	NV	NV	NV	NV	NV	NV	220	NV	44	No
Ethyl Benzene [4]	2.84E-03	NV	NV	NV	NV	NV	NV	1,900 *	NV	NV	NV	1,000	NV	NV	No
1,2-Dichloroethane (Ethylene Dichloride) [4]	NV	NV	NV	NV	0.020	NV	NV	NV	NV	NV	NV	2	NV	0.4	No
Formaldehyde [4]	NV	NV	NV	NV	0.50	NV	NV	NV	NV	NV	NV	65	NV	NV	No
Hexane, n [4]	NV	NV	NV	NV	919	NV	NV	NV	NV	NV	NV	7,500	NV	NV	No
Methanol [4]	NV	NV	NV	NV	38	NV	NV	NV	NV	NV	NV	4,000	NV	NV	No
Methyl Ethyl Ketone [4]	NV	NV	NV	NV	1.2	NV	NV	NV	NV	NV	NV	1,000	NV	NV	No
Phenol [4]	NV	NV	NV	NV	10	NV	NV	NV	NV	NV	NV	30	NV	NV	No
a-pinene	NV	NV	NV	NV	965	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
b-pinene	NV	NV	NV	NV	244	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Toluene [4]	NV	NV	NV	NV	0.14	NV	NV	NV	NV	NV	NV	2,000 *	NV	NV	No
Xylenes [4]	1.0	NV	NV	NV	0.14	NV	NV	3,000 *	NV	NV	NV	730	NV	NV	No
Hexachlorobenzene	NV	NV	NV	NV	1.20E-06	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Naphthalene [4]	8.4	NV	NV	NV	0.88	NV	NV	50 *	NV	NV	NV	22.5	NV	NV	No
Quinoline	NV	NV	NV	NV	6.00E-05	NV	NV	NV	NV	NV	NV	NV	NV	NV	Yes [+]
Benzo(a)pyrene [4]	NV	NV	NV	NV	**0.07**	NV	7.82E-06	NV	NV	NV	NV	**5.00E-05**	NV	1.00E-05	**Yes**
Total Reduced Sulphur [4]	**941**	NV	NV	NV	**106**	NV	NV	**13 ***	NV	NV	NV	**14**	NV	NV	**Yes**
Hydrogen Sulphide [2]	NV	NV	17	NV	3.9	NV	NV	NV	NV	42	NV	8	NV	NV	No

Notes:
NV - No Value
* - Criteria is not health based, but is used in liu of a health based crtieria
+ - Criteria could not be found
1 - Stantec, 2019
2 - Air Quality Regulation under Sections 25 and 112 of the NS Reg. 150/2017 *Environment Act*
3 - National Ambient Air Quality Objectives Reference Level (CCME, 1999)
4 - Ontario Ambient Air Quality Criteria (MECP, 2019)

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
Total Residual Chlorine	mg/L	No	No	Health Canada (2017a) has not developed a guideline for chlorine in drinking water, stating that a guideline value is not necessary due to low toxicity at concentrations found in drinking water. Free chlorine concentrations in most Canadian drinking water distribution systems range from 0.04 to 2.0 mg/L (HC, 2017a).	No
Dissolved Chlorate (ClO3-)	mg/L	Yes	NA	NA	Yes
Dissolved Chloride (Cl-)	mg/L	No	Yes	Naturally abundant dissolved ion in seawater and considered to be non-toxic to humans. Health Canada (2017a) defines an aesthetic objective (AO) for chloride of 250 mg/L for taste and potential for corrosion in the distribution system. Therefore, not a human health concern but will be carried forward for potentail tainting concerns.	Yes
Dissolved Chlorite (ClO2-)	mg/L	Yes	NA	NA	Yes
Dissolved Fluoride (F-)	mg/L	Yes	NA	NA	Yes
Total Phosphorus	mg/L	No	No	Phosphorus is a required dietary mineral. Phosphorus exists in the environment as phosphate anion, where it acts as a nutrient, and has not been associated with adverse effects in humans. Human health concerns are primarily related to increased productivity (eutrophication) in aquatic systems, which is outside the scope of this human health risk assessment (CCME, 2004).	No
Nitrogen (Ammonia Nitrogen)	mg/L	No	No	Health Canada (2017a) has not developed a guideline for ammonia in drinking water, stating that a guideline value is not necessary as it is produced in the body and efficiently metabolized in healthy people.	No
Nitrite (N)	mg/L	Yes	NA	NA	Yes
Nitrate (N)	mg/L	Yes	NA	NA	Yes
Sulphide (as H_2S)	mg/L	No	No	Inhalation is the predominant route of exposure to hydrogen sulphide (ECCC & HC, 2017). Sulphide (as H_2S) is not a concern to human health via exposure through water resources/aquatic environment because concentrations in surface water are low because hydrogen sulfide readily evaporates from water (ATSDR, 2016).	No
Sulphide	mg/L	No	Yes	Sulphide is considered non-toxic to humans. Health Canada (2017a) defines an aesthetic objective (AO) of 500 mg/L for sulphide in drinking water, based on taste and odour. Therefore, not a human health concern but will be carried forward for potential tainting concerns.	Yes
Dissolved Sulphite (SO3)	mg/l	No	No	Sulphites are a food allergen for people with sensitivities, however they are not a human heath concern when consumed (HC, 2017b).	No
Dissolved Sulphate (SO4)	mg/L	No	Yes	Health Canada (2017a) defines an aesthetic objective (AO) of 500 mg/L for sulphate in drinking water based on taste. Health Canada (2017a) also notes that high levels of sulphate above the AO can cause physiological effects such as diarrhoea or dehydration. Therefore, not a human health concern but will be carried forward for potential tainting concerns.	Yes
Reactive Silica (SiO2)	mg/L	No	No	No health effects are shown to occur in humans from eating food or drinking water contaminated with c-silica or a-silica or from exposure of the skin to these compounds (ATSDR, 2017).	No
Total Cyanide (CN)	mg/L	Yes	NA	NA	Yes

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
Metals					
Total Aluminum	µg/L	No	No	Health Canada (2017a) notes that there is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in human.	No
Total Antimony (Sb)	µg/L	Yes	NA	NA	Yes
Total Arsenic (As)	µg/L	Yes	NA	NA	Yes
Total Barium (Ba)	µg/L	Yes	NA	NA	Yes
Total Beryllium (Be)	µg/L	Yes	NA	NA	Yes
Total Bismuth (Bi)	µg/L	Yes	NA	NA	Yes
Total Boron (B)	µg/L	Yes	NA	NA	Yes
Total Cadmium (Cd)	µg/L	Yes	NA	NA	Yes
Total Calcium (Ca)	µg/L	No	NA	Health Canada (2017a) notes no evidence of adverse health effects from calcium in drinking water.	No
Total Chromium (Cr)	µg/L	Yes	NA	NA	Yes
Total Cobalt (Co)	µg/L	Yes	NA	NA	Yes
Total Copper (Cu)	µg/L	Yes	NA	NA	Yes
Total Iron (Fe)	µg/L	No	Yes	Health Canada (2017a) notes no evidence of dietary iron toxicity in the general population. Iron is naturally occurring. Health Canada (2017a) defines an aesthetic objective (AO) of 0.3 mg/L for iron based on taste and staining of laundry and plumbing fixtures. Therefore, not a human health concern but will be carried forward for potential tainting concerns.	Yes
Total Lead (Pb)	µg/L	Yes	NA	NA	Yes
Total Magnesium (Mg)	µg/L	No	No	Health Canada (2017a) notes no evidence of adverse health effects from magnesium in drinking water.	No
Total Manganese (Mn)	µg/L	Yes	NA	NA	Yes
Total Mercury (Hg)	µg/L	Yes	NA	NA	Yes
Total Molybdenum (Mo)	µg/L	Yes	NA	NA	Yes
Total Nickel (Ni)	µg/L	Yes	NA	NA	Yes
Total Potassium (K)	µg/L	No	No	Health Canada (2017a) notes that potassium is not a concern for the general population. Potassium is only of concern to those individuals with kidney disease or other conditions, such as heart disease, coronary artery disease, hypertension or diabetes, or those who are taking medication that interferes with normal potassium handling, where those people are cautioned to avoid excessive exposure to potassium (HC, 2017a).	No
Total Selenium (Se)	µg/L	Yes	NA	NA	Yes
Total Silver (Ag)	µg/L	Yes	NA	NA	Yes
Total Sodium (Na)	µg/L	No	Yes	Health Canada (2017a) defines an aesthetic objective (AO) of 200 mg/L for sodium in drinking water, based on taste. Health Canada (2017a) also notes that for persons on a reduced sodium diet that levels in drinking water should be below 20 mg/L. Therefore, not a human health concern but will be carried forward for potential tainting concerns. Therefore, generally not a human health concern but will be carried forward for potential tainting concerns.	Yes
Total Strontium (Sr)	µg/L	Yes	NA	NA	Yes
Total Thallium (Tl)	µg/L	Yes	NA	NA	Yes
Total Tin (Sn)	µg/L	Yes	NA	NA	Yes
Total Titanium (Ti)	µg/L	Yes	NA	NA	Yes
Total Uranium (U)	µg/L	Yes	NA	NA	Yes
Total Vanadium (V)	µg/L	Yes	NA	NA	Yes
Total Zinc (Zn)	µg/L	No	Yes	Health Canada (2017a) considers zinc to be non-toxic to humans but defines an aesthetic objective (AO) of 5 mg/L in drinking water based on taste. Therefore, not a human health concern but will be carried forward for potential tainting concerns.	Yes

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
Dioxins & Furans					
2,3,7,8-Tetra CDD	pg/L	Yes	NA	NA	Yes
1,2,3,7,8-Penta CDD	pg/L	Yes	NA	NA	Yes
1,2,3,4,7,8-Hexa CDD	pg/L	Yes	NA	NA	Yes
1,2,3,6,7,8-Hexa CDD	pg/L	Yes	NA	NA	Yes
1,2,3,7,8,9-Hexa CDD	pg/L	Yes	NA	NA	Yes
1,2,3,4,6,7,8-Hepta CDD	pg/L	Yes	NA	NA	Yes
Octa CDD	pg/L	Yes	NA	NA	Yes
2,3,7,8-Tetra CDF	pg/L	Yes	NA	NA	Yes
1,2,3,7,8-Penta CDF	pg/L	Yes	NA	NA	Yes
2,3,4,7,8-Penta CDF	pg/L	Yes	NA	NA	Yes
1,2,3,4,7,8-Hexa CDF	pg/L	Yes	NA	NA	Yes
1,2,3,6,7,8-Hexa CDF	pg/L	Yes	NA	NA	Yes
2,3,4,6,7,8-Hexa CDF	pg/L	Yes	NA	NA	Yes
1,2,3,7,8,9-Hexa CDF	pg/L	Yes	NA	NA	Yes
1,2,3,4,6,7,8-Hepta CDF	pg/L	Yes	NA	NA	Yes
1,2,3,4,7,8,9-Hepta CDF	pg/L	Yes	NA	NA	Yes
Octa CDF	pg/L	Yes	NA	NA	Yes
Glycols					
Ethylene Glycol	mg/L	Yes	NA	NA	No
Diethylene Glycol	mg/L	Yes	NA	NA	No
Triethylene Glycol	mg/L	Yes	NA	NA	No
Propylene Glycol	mg/L	Yes	NA	NA	No
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	µg/L	Yes	NA	NA	Yes
Acenaphthylene	µg/L	Yes	NA	NA	Yes
Anthracene	µg/L	Yes	NA	NA	Yes
Benzo(a)anthracene	µg/L	Yes	NA	NA	Yes
Benzo(a)pyrene	µg/L	Yes	NA	NA	Yes
Benzo(b)fluoranthene	µg/L	Yes	NA	NA	Yes
Benzo(b/j)fluoranthene	µg/L	Yes	NA	NA	Yes
Benzo(g,h,i)perylene	µg/L	Yes	NA	NA	Yes
Benzo(j)fluoranthene	µg/L	Yes	NA	NA	Yes
Benzo(k)fluoranthene	µg/L	Yes	NA	NA	Yes
1-Chloronaphthalene	µg/L	Yes	NA	NA	Yes
2-Chloronaphthalene	µg/L	Yes	NA	NA	Yes
Chrysene	µg/L	Yes	NA	NA	Yes
Dibenz(a,h)anthracene	µg/L	Yes	NA	NA	Yes
Fluoranthene	µg/L	Yes	NA	NA	Yes
Fluorene	µg/L	Yes	NA	NA	Yes
Indeno(1,2,3-cd)pyrene	µg/L	Yes	NA	NA	Yes
1-Methylnaphthalene	µg/L	Yes	NA	NA	Yes
2-Methylnaphthalene	µg/L	Yes	NA	NA	Yes
Naphthalene	µg/L	Yes	NA	NA	Yes
Perylene	µg/L	Yes	NA	NA	Yes
Phenanthrene	µg/L	Yes	NA	NA	Yes
Pyrene	µg/L	Yes	NA	NA	Yes

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
Volatile Organics					
Benzene	µg/L	Yes	NA	NA	Yes
Bromodichloromethane	µg/L	Yes	NA	NA	Yes
Bromoform	µg/L	Yes	NA	NA	Yes
Bromomethane	µg/L	Yes	NA	NA	Yes
Carbon Tetrachloride	µg/L	Yes	NA	NA	Yes
Chlorobenzene	µg/L	Yes	NA	NA	Yes
Chloroethane	µg/L	Yes	NA	NA	Yes
Chloroform	µg/L	Yes	NA	NA	Yes
Chloromethane	µg/L	Yes	NA	NA	Yes
1,2-Dichlorobenzene	µg/L	Yes	NA	NA	Yes
1,3-Dichlorobenzene	µg/L	Yes	NA	NA	Yes
1,4-Dichlorobenzene	µg/L	Yes	NA	NA	Yes
1,1-Dichloroethane	µg/L	Yes	NA	NA	Yes
1,2-Dichloroethane	µg/L	Yes	NA	NA	Yes
1,1-Dichloroethylene	µg/L	Yes	NA	NA	Yes
cis-1,2-Dichloroethylene	µg/L	Yes	NA	NA	Yes
trans-1,2-Dichloroethylene	µg/L	Yes	NA	NA	Yes
1,2-Dichloropropane	µg/L	Yes	NA	NA	Yes
cis-1,3-Dichloropropene	µg/L	Yes	NA	NA	Yes
trans-1,3-Dichloropropene	µg/L	Yes	NA	NA	Yes
Dibromochloromethane	µg/L	Yes	NA	NA	Yes
Ethylbenzene	µg/L	Yes	NA	NA	Yes
Ethylene Dibromide	µg/L	Yes	NA	NA	Yes
Methyl t-butyl ether (MTBE)	µg/L	Yes	NA	NA	Yes
Methylene Chloride(Dichloromethane)	µg/L	Yes	NA	NA	Yes
Styrene	µg/L	Yes	NA	NA	Yes
1,1,2,2-Tetrachloroethane	µg/L	Yes	NA	NA	Yes
Tetrachloroethylene	µg/L	Yes	NA	NA	Yes
Toluene	µg/L	Yes	NA	NA	Yes
1,1,1-Trichloroethane	µg/L	Yes	NA	NA	Yes
1,1,2-Trichloroethane	µg/L	Yes	NA	NA	Yes
Trichloroethylene	µg/L	Yes	NA	NA	Yes
Trichlorofluoromethane (FREON 11)	µg/L	Yes	NA	NA	Yes
Total Trihalomethanes	µg/L	Yes	NA	NA	Yes
Total Xylenes	µg/L	Yes	NA	NA	Yes
Vinyl Chloride	µg/L	Yes	NA	NA	Yes
PHC with Atl. RBCA V3.1 method					
Benzene	µg/L	Yes	NA	NA	Yes
Toluene	µg/L	Yes	NA	NA	Yes
Ethylbenzene	µg/L	Yes	NA	NA	Yes
Total Xylenes	µg/L	Yes	NA	NA	Yes
C6 - C10 (less BTEX)	mg/L	Yes	NA	NA	Yes
>C10-C16 Hydrocarbons	mg/L	Yes	NA	NA	Yes
>C16-C21 Hydrocarbons	mg/L	Yes	NA	NA	Yes
>C21-<C32 Hydrocarbons	mg/L	Yes	NA	NA	Yes
Modified TPH (Tier1)	mg/L	Yes	NA	NA	Yes
Polychlorinated Biphenyls					
Total PCBs	µg/L	Yes	NA	NA	Yes
Fatty Acids					

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
Total Fatty Acids	mg/L	No	No	Fatty acids are not considered harmful to humans. Chlorinated fatty acids such as oleic acid and linoleic acid in bleached pulp extracts have been found to have low acute toxicity. For example an acute LD_{50} for rats of approximately 20 and 17 g/kg body weight for chlorinated oleic acid and linoleic acid, respectively, was identified (RTP, 1994).	No
Resin Acids					
Total Resin Acids	mg/L	No	No	Resin acids are not considered to be harmful to humans. For example a chronic LOAEL of 1000 mg/kg/bw for the rat has been identified (EC/HC, 2011), suggesting that resin acids are likely not harmful to humans.	No
Phenols					
Total of Reg.P&P phenols	µg/L	Yes	NA	NA	Yes
Catechol	µg/L	Yes	NA	NA	Yes
4 Chlorocatechol	µg/L	Yes	NA	NA	Yes
4-Chloroguaiacol	µg/L	Yes	NA	NA	Yes
2-Chlorophenol	µg/L	Yes	NA	NA	Yes
3-Chlorophenol	µg/L	Yes	NA	NA	Yes
4-Chlorophenol	µg/L	Yes	NA	NA	Yes
3 & 4-Chlorophenol	µg/L	Yes	NA	NA	Yes
o-Cresol	µg/L	Yes	NA	NA	Yes
m-Cresol	µg/L	Yes	NA	NA	Yes
p-Cresol	µg/L	Yes	NA	NA	Yes
m/p-Cresol	µg/L	Yes	NA	NA	Yes
6-Chlorovanillin	µg/L	Yes	NA	NA	Yes
3,5 Dichlorocatechol	µg/L	Yes	NA	NA	Yes
4,5 Dichlorocatechol	µg/L	Yes	NA	NA	Yes
4,5 Dichloroguaiacol	µg/L	Yes	NA	NA	Yes
4,6 Dichloroguaiacol	µg/L	Yes	NA	NA	Yes
2,3 Dichlorophenol	µg/L	Yes	NA	NA	Yes
2,4-Dichlorophenol	µg/L	Yes	NA	NA	Yes
2,5-Dichlorophenol	µg/L	Yes	NA	NA	Yes
2,4 +2.5- Dichlorophenol	µg/L	Yes	NA	NA	Yes
2,6 Dichlorophenol	µg/L	Yes	NA	NA	Yes
3,4 Dichlorophenol	µg/L	Yes	NA	NA	Yes
3,5 Dichlorophenol	µg/L	Yes	NA	NA	Yes
2,4 Dimethylphenol	µg/L	Yes	NA	NA	Yes
5,6-Dichlorovanillin	µg/L	Yes	NA	NA	Yes
4,5 Dichloroveratrol	µg/L	Yes	NA	NA	Yes
2,4-Dinitrophenol	µg/L	Yes	NA	NA	Yes
4,6-Dinitro-2-methylphenol	µg/L	Yes	NA	NA	Yes
Eugebol	µg/L	Yes	NA	NA	Yes
Guaiacol	µg/L	Yes	NA	NA	Yes
Isoeugenol	µg/L	Yes	NA	NA	Yes
2-Nitrophenol	µg/L	Yes	NA	NA	Yes
4-Nitrophenol	µg/L	Yes	NA	NA	Yes
Pentachlorophenol	µg/L	Yes	NA	NA	Yes
Tetrachlorocatechol	µg/L	Yes	NA	NA	Yes
Tetrachloroguaiacol	µg/L	Yes	NA	NA	Yes
2,3,4,5 Tetrachlorophenol	µg/L	Yes	NA	NA	Yes
2,3,4,6 Tetrachlorophenol	µg/L	Yes	NA	NA	Yes
2,3,5,6 Tetrachlorophenol	µg/L	Yes	NA	NA	Yes
3,4,5,6 Tetrachloroveratrol	µg/L	Yes	NA	NA	Yes
2,3,4,5 Trichlorocatechol	µg/L	Yes	NA	NA	Yes
3,4,5 Trichloroguaiacol	µg/L	Yes	NA	NA	Yes
4,5,6 Trichloroguaiacol	µg/L	Yes	NA	NA	Yes
2,3,4 Trichlorophenol	µg/L	Yes	NA	NA	Yes
2,3,5 Trichlorophenol	µg/L	Yes	NA	NA	Yes
2,3,6 Trichlorophenol	µg/L	Yes	NA	NA	Yes
2,4,5 Trichlorophenol	µg/L	Yes	NA	NA	Yes
2,4,6-Trichlorophenol	µg/L	Yes	NA	NA	Yes
3,4,5 Trichlorophenol	µg/L	Yes	NA	NA	Yes
3,4,5 Trichlorosyringol	µg/L	Yes	NA	NA	Yes

Table A.4: Treated Effluent Pre-screening

Parameter	Unit	Parameter Considered to be of Potential Human Health Concern?	Is the Parameter Considered to be of Aesthetic Taste Concern?	Rationale Why Not a Human Health Concern	Carried Forward to Screening Process?
3,4,5 Trichloroveratrol	µg/L	Yes	NA	NA	Yes
Semi-Volatile Organics					
Benzyl butyl phthalate	µg/L	Yes	NA	NA	Yes
Biphenyl	µg/L	Yes	NA	NA	Yes
Bis(2-chloroethoxy)methane	µg/L	Yes	NA	NA	Yes
Bis(2-chloroethyl)ether	µg/L	Yes	NA	NA	Yes
Bis(2-chloroisopropyl)ether	µg/L	Yes	NA	NA	Yes
Bis(2-ethylhexyl)phthalate	µg/L	Yes	NA	NA	Yes
4-Bromophenyl phenyl ether	µg/L	Yes	NA	NA	Yes
p-Chloroaniline	µg/L	Yes	NA	NA	Yes
4-Chlorophenyl phenyl ether	µg/L	Yes	NA	NA	Yes
3,3'-Dichlorobenzidine	µg/L	Yes	NA	NA	Yes
Diethyl phthalate	µg/L	Yes	NA	NA	Yes
Dimethyl phthalate	µg/L	Yes	NA	NA	Yes
2,4-Dinitrotoluene	µg/L	Yes	NA	NA	Yes
2,6-Dinitrotoluene	µg/L	Yes	NA	NA	Yes
Di-N-butyl phthalate	µg/L	Yes	NA	NA	Yes
di-n-octyl phthalate	µg/L	Yes	NA	NA	Yes
Diphenyl Ether	µg/L	Yes	NA	NA	Yes
Hexachlorobenzene	µg/L	Yes	NA	NA	Yes
Hexachlorobutadiene	µg/L	Yes	NA	NA	Yes
Hexachlorocyclopentadiene	µg/L	Yes	NA	NA	Yes
Hexachloroethane	µg/L	Yes	NA	NA	Yes
Isophorone	µg/L	Yes	NA	NA	Yes
Nitrobenzene	µg/L	Yes	NA	NA	Yes
Nitrosodiphenylamine/Diphenylamine	µg/L	Yes	NA	NA	Yes
N-Nitroso-di-n-propylamine	µg/L	Yes	NA	NA	Yes
Pentachlorobenzene	µg/L	Yes	NA	NA	Yes
1,2,3,4-Tetrachlorobenzene	µg/L	Yes	NA	NA	Yes
1,2,3,5-Tetrachlorobenzene	µg/L	Yes	NA	NA	Yes
1,2,4,5-Tetrachlorobenzene	µg/L	Yes	NA	NA	Yes
1,2,3-Trichlorobenzene	µg/L	Yes	NA	NA	Yes
1,2,4-Trichlorobenzene	µg/L	Yes	NA	NA	Yes
1,3,5-Trichlorobenzene	µg/L	Yes	NA	NA	Yes

Notes:

NA - Not Applicable

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Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
Inorganics								
Dissolved Chlorate (ClO3-)	mg/L	<1	10	10	<1	1	1	No
Dissolved Chloride (Cl-)	mg/L	14,000	14	0	180	2	0	No
Dissolved Chlorite (CLO2-)	mg/L	<1	14	14	2.1	2	1	Yes
Dissolved Fluoride (F-)	mg/L	<0.1	1	1	<0.1	1	1	No
Nitrite (N)	mg/L	<0.01	14	14	3.15	1,986	1,754	Yes
Nitrate (N)	mg/L	<0.05	14	13	4.21	1,986	1,776	Yes
Dissolved Sulphate (SO4)	mg/L	2,100	14	0	400	285	0	No
Total Cyanide (CN)	mg/L	<0.005	14	14	<0.005	2	1	No
Metals								
Total Antimony (Sb)	µg/L	<10	14	14	<2	5	5	No
Total Arsenic (As)	µg/L	<10	14	14	<2	5	2	No
Total Barium (Ba)	µg/L	10	14	5	450	5	0	Yes
Total Beryllium (Be)	µg/L	<10	14	14	<2	5	5	No
Total Bismuth (Bi)	µg/L	<20	14	14	<2	5	5	No
Total Boron (B)	µg/L	3,950	14	0	94	5	0	No
Total Cadmium (Cd)	µg/L	<0.1	14	13	1.4	5	0	Yes
Total Chromium (Cr)	µg/L	<10	14	14	3	5	0	No
Total Cobalt (Co)	µg/L	<4	14	14	<1	5	2	No
Total Copper (Cu)	µg/L	<5	14	14	7.5	5	0	Yes
Total Iron (Fe)	µg/L	<500	14	14	718	5	0	Yes *
Total Lead (Pb)	µg/L	<5	14	14	3	5	0	No
Total Manganese (Mn)	µg/L	<20	14	14	2,800	5	0	Yes
Total Mercury (Hg)	µg/L	<0.00225	14	12	0.028	3	0	Yes
Total Molybdenum (Mo)	µg/L	<20	14	14	4	5	2	No
Total Nickel (Ni)	µg/L	<20	14	14	5	5	0	No
Total Selenium (Se)	µg/L	<10	14	14	2	5	4	No
Total Silver (Ag)	µg/L	<1	14	14	0.37	5	0	No
Total Sodium (Na)	µg/L	8,600,000	14	0	3,600,000	282	0	No
Total Strontium (Sr)	µg/L	6,050	14	0	163	5	0	No
Total Thallium (Tl)	µg/L	<1	14	14	<0.1	5	5	No
Total Tin (Sn)	µg/L	<20	14	14	<2	4	4	No

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
Total Titanium (Ti)	µg/L	<20	14	14	14	4	0	No
Total Uranium (U)	µg/L	2.6	14	0	0.9	4	0	No
Total Vanadium (V)	µg/L	<20	14	14	5	5	0	No
Total Zinc (Zn)	µg/L	<50	14	14	160	5	0	Yes *
Dioxins & Furans								
2,3,7,8-Tetra CDD	pg/L	<1	13	13	<2	7	7	Yes
1,2,3,7,8-Penta CDD	pg/L	<1	13	13	<3	7	7	Yes
1,2,3,4,7,8-Hexa CDD	pg/L	<1	13	13	<2	7	7	Yes
1,2,3,6,7,8-Hexa CDD	pg/L	<1	13	13	<2	7	7	Yes
1,2,3,7,8,9-Hexa CDD	pg/L	<1	13	13	<2	7	7	Yes
1,2,3,4,6,7,8-Hepta CDD	pg/L	<2	13	13	10.4	7	3	Yes
Octa CDD	pg/L	<11	13	5	28.9	7	1	Yes
2,3,7,8-Tetra CDF	pg/L	<1	13	13	4.6	7	4	Yes
1,2,3,7,8-Penta CDF	pg/L	<1	13	13	<1	7	6	Yes
2,3,4,7,8-Penta CDF	pg/L	<1	13	13	<1	7	7	Yes
1,2,3,4,7,8-Hexa CDF	pg/L	<1	13	13	<2	7	6	Yes
1,2,3,6,7,8-Hexa CDF	pg/L	<0.938	13	13	<2	7	6	Yes
2,3,4,6,7,8-Hexa CDF	pg/L	<1	13	13	<2	7	7	Yes
1,2,3,7,8,9-Hexa CDF	pg/L	<1	13	13	<3	7	6	Yes
1,2,3,4,6,7,8-Hepta CDF	pg/L	<1	13	13	<3	7	6	Yes
1,2,3,4,7,8,9-Hepta CDF	pg/L	<2	13	13	<4	7	7	Yes
Octa CDF	pg/L	<2	13	13	3.5	7	4	Yes
Glycols								
Ethylene Glycol	mg/L	<3	1	1	<3	1	1	No
Diethylene Glycol	mg/L	<5	1	1	<5	1	1	No
Triethylene Glycol	mg/L	<5	1	1	<5	1	1	No
Propylene Glycol	mg/L	<5	1	1	<5	1	1	No
Polycyclic Aromatic Hydrocarbons								
Acenaphthene	µg/L	<0.01	14	14	<0.01	2	2	No
Acenaphthylene	µg/L	<0.01	14	14	<0.03	2	2	Yes
Anthracene	µg/L	<0.01	14	14	<0.02	2	2	Yes
Benzo(a)anthracene	µg/L	<0.01	14	14	<0.01	2	2	No

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
Benzo(a)pyrene	µg/L	<0.01	14	14	<0.01	2	2	No
Benzo(b)fluoranthene	µg/L	<0.01	14	14	<0.01	2	2	No
Benzo(b/j)fluoranthene	µg/L	<0.02	14	14	<0.02	2	2	No
Benzo(g,h,i)perylene	µg/L	<0.01	14	14	<0.01	2	2	No
Benzo(j)fluoranthene	µg/L	<0.01	14	14	<0.01	2	2	No
Benzo(k)fluoranthene	µg/L	<0.01	14	14	<0.01	2	2	No
1-Chloronaphthalene	µg/L	<4	1	1	<4	1	1	No
2-Chloronaphthalene	µg/L	<2	1	1	<2	1	1	No
Chrysene	µg/L	<0.01	14	14	<0.01	2	2	No
Dibenz(a,h)anthracene	µg/L	<0.01	14	14	<0.01	2	2	No
Fluoranthene	µg/L	<0.01	14	14	0.037	2	0	Yes
Fluorene	µg/L	<0.01	14	14	<0.1	2	2	Yes
Indeno(1,2,3-cd)pyrene	µg/L	<0.01	14	14	<0.01	2	2	No
1-Methylnaphthalene	µg/L	<0.05	14	14	<0.05	2	2	No
2-Methylnaphthalene	µg/L	<0.05	14	14	<0.05	2	2	No
Naphthalene	µg/L	<0.2	14	14	<0.2	2	2	No
Perylene	µg/L	<0.01	14	14	<0.01	2	2	No
Phenanthrene	µg/L	<0.01	14	14	0.049	2	0	Yes
Pyrene	µg/L	<0.01	14	14	<0.02	2	1	Yes
Volatile Organics								
Benzene	mg/L	<0.001	14	14	<0.001	2	2	No
Bromodichloromethane	µg/L	<1	14	14	<1	2	2	No
Bromoform	µg/L	<1	14	14	<1	2	2	No
Bromomethane	µg/L	<0.5	14	14	<0.5	2	2	No
Carbon Tetrachloride	µg/L	<0.5	14	14	<0.5	2	2	No
Chlorobenzene	µg/L	<1	14	14	<1	2	2	No
Chloroethane	µg/L	<8	14	14	<8	2	2	No
Chloroform	µg/L	<1	14	14	<1	2	2	No
Chloromethane	µg/L	<8	14	14	<8	2	2	No
1,2-Dichlorobenzene	µg/L	<0.5	14	14	<0.5	2	2	No
1,3-Dichlorobenzene	µg/L	<1	14	14	<1	2	2	No
1,4-Dichlorobenzene	µg/L	<1	14	14	<1	2	2	No

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
1,1-Dichloroethane	µg/L	<2	14	14	<2	2	2	No
1,2-Dichloroethane	µg/L	<1	14	14	<1	2	2	No
1,1-Dichloroethylene	µg/L	<0.5	14	14	<71	2	2	Yes
cis-1,2-Dichloroethylene	µg/L	<0.5	14	14	<0.5	2	2	No
trans-1,2-Dichloroethylene	µg/L	<0.5	14	14	<0.5	2	2	No
1,2-Dichloropropane	µg/L	<0.5	14	14	<0.5	2	2	No
cis-1,3-Dichloropropene	µg/L	<0.5	14	14	<0.5	2	2	No
trans-1,3-Dichloropropene	µg/L	<0.5	14	14	<0.5	2	2	No
Dibromochloromethane	µg/L	<1	14	14	<1	2	2	No
Ethylbenzene	mg/L	<0.001	14	14	<0.001	2	2	No
Ethylene Dibromide	µg/L	<0.2	14	14	<1	2	2	Yes
Methyl t-butyl ether (MTBE)	µg/L	<2	14	14	<2	2	2	No
Methylene Chloride(Dichloromethane)	µg/L	<3	14	14	<3	2	2	No
Styrene	µg/L	<1	14	14	<1	2	2	No
1,1,2,2-Tetrachloroethane	µg/L	<0.5	14	14	<0.5	2	2	No
Tetrachloroethylene	µg/L	<1	14	14	<1	2	2	No
Toluene	mg/L	<0.001	14	14	<0.001	2	2	No
1,1,1-Trichloroethane	µg/L	<1	14	14	<1	2	2	No
1,1,2-Trichloroethane	µg/L	<1	14	14	<1	2	2	No
Trichloroethylene	µg/L	<1	14	14	<1	2	2	No
Trichlorofluoromethane (FREON 11)	µg/L	<8	14	14	<8	2	2	No
Total Trihalomethanes	µg/L	<1	14	14	<1	2	2	No
Total Xylenes	mg/L	<0.001	14	14	<0.001	2	2	No
Vinyl Chloride	µg/L	<0.5	14	14	<0.5	2	2	No
PHC with Atl. RBCA V3.1 method								
Benzene	mg/L	<0.001	14	14	<0.001	2	2	No
Toluene	mg/L	<0.001	14	14	<0.001	2	2	No
Ethylbenzene	mg/L	<0.001	14	14	<0.001	2	2	No
Total Xylenes	mg/L	<0.002	14	14	<0.002	2	2	No
C6 - C10 (less BTEX)	mg/L	<0.1	14	14	<0.01	2	2	No
>C10-C16 Hydrocarbons	mg/L	<0.05	14	14	0.13	2	0	Yes
>C16-C21 Hydrocarbons	mg/L	<0.05	14	14	0.13	2	0	Yes

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
>C21-<C32 Hydrocarbons	mg/L	<0.1	14	13	0.26	2	0	Yes
Modified TPH (Tier1)	mg/L	<0.1	14	13	0.53	2	0	Yes
Polychlorinated Biphenyls								
Total PCBs	µg/L	<0.05	5	5	<0.05	2	2	No
Phenols								
Total of Reg.P&P phenols	µg/L	<2	14	12	9.6	2	1	Yes
Catechol	µg/L	<1	4	4	3.7	1	0	Yes
4 Chlorocatechol	µg/L	<1	4	4	<0.5	1	1	No
4-Chloroguaiacol	µg/L	<1	4	4	<0.5	1	1	No
2-Chlorophenol	µg/L	<1	5	5	<1	2	1	Yes
3-Chlorophenol	µg/L	<1	4	4	<0.5	1	1	No
4-Chlorophenol	µg/L	<1	4	4	<0.5	1	1	No
3 & 4-Chlorophenol	µg/L	<0.4	1	1	<0.4	1	1	No
o-Cresol	µg/L	<0.5	5	5	<3	2	1	Yes
m-Cresol	µg/L	<1	4	4	<0.5	1	1	No
p-Cresol	µg/L	<1	4	4	0.71	1	0	No
m/p-Cresol	µg/L	<2	1	1	<2	1	1	No
6-Chlorovanillin	µg/L	<1	4	4	0.75	1	0	No
3,5 Dichlorocatechol	µg/L	<1	4	4	<0.5	1	1	No
4,5 Dichlorocatechol	µg/L	<1	4	4	<0.5	1	1	No
4,5 Dichloroguaiacol	µg/L	<1	4	4	<0.5	1	1	No
4,6 Dichloroguaiacol	µg/L	<1	4	4	<6	1	1	Yes
2,3 Dichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,4-Dichlorophenol	µg/L	<1	1	1	<1	1	1	No
2,5-Dichlorophenol	µg/L	<2	1	1	<2	1	1	No
2,4 +2.5- Dichlorophenol	µg/L	<1	4	4	<0.5	1	1	No
2,6 Dichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
3,4 Dichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
3,5 Dichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,4 Dimethylphenol	µg/L	<1	5	5	<2	2	1	Yes
5,6-Dichlorovanillin	µg/L	<1	4	4	<0.5	1	1	No
4,5 Dichloroveratrol	µg/L	<1	4	4	<0.5	1	1	No

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
2,4-Dinitrophenol	µg/L	<25	1	1	<25	1	1	No
4,6-Dinitro-2-methylphenol	µg/L	<8	1	1	<8	1	1	No
Eugebol	µg/L	<1	4	4	<0.5	1	1	No
Guaiacol	µg/L	<1	4	4	1.2	1	0	Yes
Isoeugenol	µg/L	<1	4	4	<0.5	1	1	No
2-Nitrophenol	µg/L	<2	5	5	<2	2	2	No
4-Nitrophenol	µg/L	<10	5	5	<6	2	2	No
Pentachlorophenol	µg/L	<1	5	5	<4	2	2	Yes
Tetrachlorocatechol	µg/L	<1	4	4	<0.5	1	1	No
Tetrachloroguaiacol	µg/L	<1	5	5	<2	2	2	Yes
2,3,4,5 Tetrachlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,3,4,6 Tetrachlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,3,5,6 Tetrachlorophenol	µg/L	<1	5	5	<2	2	2	Yes
3,4,5,6 Tetrachloroveratrol	µg/L	<1	4	4	<0.5	1	1	No
23,4,5 Trichlorocatechol	µg/L	<1	4	4	<0.5	1	1	No
3,4,5 Trichloroguaiacol	µg/L	<1	4	4	<0.5	1	1	No
4,5,6 Trichloroguaiacol	µg/L	<1	4	4	<0.5	1	1	No
2,3,4 Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,3,5 Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,3,6 Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,4,5 Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
2,4,6-Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
3,4,5 Trichlorophenol	µg/L	<1	5	5	<2	2	2	Yes
3,4,5 Trichlorosyringol	µg/L	<1	4	4	<0.5	1	1	No
3,4,5 Trichloroveratrol	µg/L	<1	4	4	<0.5	1	1	No
Semi-Volatile Organics								
Benzyl butyl phthalate	µg/L	<2	1	1	<2	1	1	No
Biphenyl	µg/L	<2	1	1	<2	1	1	No
Bis(2-chloroethoxy)methane	µg/L	<2	1	1	<2	1	1	No
Bis(2-chloroethyl)ether	µg/L	<2	1	1	<2	1	1	No
Bis(2-chloroisopropyl)ether	µg/L	<2	1	1	<2	1	1	No
Bis(2-ethylhexyl)phthalate	µg/L	<8	1	1	<8	1	1	No

Table A.5: Comparision of Maximum Effluent Concentrations to Background Concentrations

Parameter	Unit	Background Concentrations (Proposed Diffuser Location)			Treated Effluent Concentrations (Point C)			Carried Forward in Screening Process?
		Median	Total Count	Count (<RDL)	Maximum	Total Count	Count (<RDL)	
4-Bromophenyl phenyl ether	µg/L	<1	1	1	<1	1	1	No
p-Chloroaniline	µg/L	<4	1	1	<4	1	1	No
4-Chlorophenyl phenyl ether	µg/L	<2	1	1	<2	1	1	No
3,3'-Dichlorobenzidine	µg/L	<2	1	1	<2	1	1	No
Diethyl phthalate	µg/L	<4	1	1	<4	1	1	No
Dimethyl phthalate	µg/L	<4	1	1	<4	1	1	No
2,4-Dinitrotoluene	µg/L	<2	1	1	<2	1	1	No
2,6-Dinitrotoluene	µg/L	<2	1	1	<2	1	1	No
Di-N-butyl phthalate	µg/L	<8	1	1	<8	1	1	No
di-n-octyl phthalate	µg/L	<3	1	1	<3	1	1	No
Diphenyl Ether	µg/L	<1	1	1	<1	1	1	No
Hexachlorobenzene	µg/L	<2	1	1	<2	1	1	No
Hexachlorobutadiene	µg/L	<2	1	1	<2	1	1	No
Hexachlorocyclopentadiene	µg/L	<8	1	1	<8	1	1	No
Hexachloroethane	µg/L	<2	1	1	<2	1	1	No
Isophorone	µg/L	<2	1	1	<2	1	1	No
Nitrobenzene	µg/L	<2	1	1	<2	1	1	No
Nitrosodiphenylamine/Diphenylamine	µg/L	<4	1	1	<4	1	1	No
N-Nitroso-di-n-propylamine	µg/L	<2	1	1	<2	1	1	No
Pentachlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,2,3,4-Tetrachlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,2,3,5-Tetrachlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,2,4,5-Tetrachlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,2,3-Trichlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,2,4-Trichlorobenzene	µg/L	<2	1	1	<2	1	1	No
1,3,5-Trichlorobenzene	µg/L	<2	1	1	<2	1	1	No

Notes:

* Carried forward for taste and odour considerations only

Table A.6a: Comparison of Maximum Effluent Concentration to Water Guidelines for Seafood Ingestion

Parameter	Unit	Treated Effluent Concentrations (Point C)			US EPA WQC Consumption of Organism Only [1]	COPC for Seafood Ingestion Pathway?
		Maximum	Total Count	Count (<RDL)		
Inorganics						
Dissolved Chlorite (CLO2-)	mg/L	2.1	2	1	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Nitrite (N)	mg/L	3.15	1,986	1,754	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Nitrate (N)*	mg/L	4.21	1,986	1,776	10	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Metals						
Total Barium (Ba)*	µg/L	450	5	0	1,000	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Total Cadmium (Cd)	µg/L	1.4	5	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Total Copper (Cu)*	µg/L	7.5	5	0	1,300	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Total Manganese (Mn)	µg/L	**2,800**	5	0	**100**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
Total Mercury (Hg)	µg/L	0.028	3	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Dioxins & Furans**						
2,3,7,8-Tetra CDD	pg/L	**<1.9**	7	7	**0.0051**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,7,8-Penta CDD	pg/L	**<2.5**	7	7	**0.0057**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,4,7,8-Hexa CDD	pg/L	**<1.5**	7	7	**0.17**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,6,7,8-Hexa CDD	pg/L	**<1.8**	7	7	**0.51**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,7,8,9-Hexa CDD	pg/L	**<1.8**	7	7	**0.51**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,4,6,7,8-Hepta CDD	pg/L	**10.4**	7	3	**10.3**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
Octa CDD	pg/L	28.9	7	1	1709	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,7,8-Tetra CDF	pg/L	**4.6**	7	4	**0.064**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,7,8-Penta CDF	pg/L	**<1.34**	7	6	**0.85**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
2,3,4,7,8-Penta CDF	pg/L	**<1.36**	7	7	**0.011**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,4,7,8-Hexa CDF	pg/L	**<2.1**	7	6	**0.64**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,6,7,8-Hexa CDF	pg/L	**<2.2**	7	6	**0.26**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
2,3,4,6,7,8-Hexa CDF	pg/L	**<1.9**	7	7	**0.073**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,7,8,9-Hexa CDF	pg/L	**<2.7**	7	6	**0.085**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
1,2,3,4,6,7,8-Hepta CDF	pg/L	<3.1	7	6	51.3	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
1,2,3,4,7,8,9-Hepta CDF	pg/L	**<4.4**	7	7	**1.3**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
Octa CDF	pg/L	3.5	7	4	855	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Polycyclic Aromatic Hydrocarbons						
Acenaphthylene	µg/L	<0.03	2	2	NV	No. Guideline not available and parameter was not detected.
Anthracene	µg/L	<0.02	2	2	400	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Fluoranthene	µg/L	0.037	2	0	20	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Fluorene	µg/L	<0.1	2	2	70	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Phenanthrene	µg/L	0.049	2	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Pyrene	µg/L	<0.02	2	1	30	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Volatile Organics						
1,1-Dichloroethylene	µg/L	<71	2	2	20,000	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Ethylene Dibromide	µg/L	<1	2	2	NV	No. Guideline not available and parameter was not detected.
PHC with Atl. RBCA V3.1 method						
>C10-C16 Hydrocarbons	mg/L	0.13	2	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
>C16-C21 Hydrocarbons	mg/L	0.13	2	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
>C21-<C32 Hydrocarbons	mg/L	0.26	2	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Modified TPH (Tier1)	mg/L	0.53	2	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).

Table A.6a: Comparison of Maximum Effluent Concentration to Water Guidelines for Seafood Ingestion

Parameter	Unit	Treated Effluent Concentrations (Point C)			US EPA WQC Consumption of Organism Only [1]	COPC for Seafood Ingestion Pathway?
		Maximum	Total Count	Count (<RDL)		
Phenols						
Total of Reg.P&P phenols	µg/L	9.6	2	1	300,000	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Catechol	µg/L	3.7	1	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
2-Chlorophenol	µg/L	<1.2	2	1	800	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
o-Cresol	µg/L	<3	2	1	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
4,6 Dichloroguaiacol	µg/L	<5.6	1	1	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3 Dichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,6 Dichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
3,4 Dichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
3,5 Dichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,4 Dimethylphenol	µg/L	<2	2	1	3000	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
Guaiacol	µg/L	1.2	1	0	NV	Guideline not available. Assessed for potential bioaccumulation (Table A.6b).
Pentachlorophenol	µg/L	**<4**	2	2	**0.04**	**Yes. COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.**
Tetrachloroguaiacol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,4,5 Tetrachlorophenol	µg/L	<1.6	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,4,6 Tetrachlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,5,6 Tetrachlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,4 Trichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,5 Trichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,3,6 Trichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,4,5 Trichlorophenol	µg/L	<2	2	2	600	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
2,4,6-Trichlorophenol	µg/L	<2	2	2	2.8	No. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.
3,4,5 Trichlorophenol	µg/L	<2	2	2	NV	No. Guideline not available and parameter was not detected. Not a COPC assessed in the HHRA for the Seafood Ingestion Exposure Pathway.

Notes:

NV - No Value

1 - National Recommended Water Quality Criteria – Human Health Criteria Table - Human Health for the Consumption of Organism Only. (US EPA (United States Environmental Protection Agency). 2019. National Recommended Water Quality Criteria – Human Health Criteria Table. https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table. February 20, 2019.)

* Human Health for the Consumption of Water + Organism (US EPA, 2019).

** Dioxins and furans are typically present in the environment as a mixture of dioxin and furan congeners. US EPA (2019) provides a Human Health Criteria for the Consumption of Organism Only for 2,3,7,8- TCDD in water. For comparison with the effluent concentrations for each dioxin and furan congener, a human health criteria for the consumption of organisms only, as described in **Appendix A**, was derived for each dioxin and furan congener using available toxic equivalency factors (TEF) and bioaccumulation equivalency factor (BEF) for 2,3,7,8-TCDD.

Table A.6b: Assessment for Potential Bioaccumulation for Parameters

Parameter	Bioconcentration Factor (BCF)	BCF Source	log K_{ow}	log K_{ow} Source	Food Chain Multipler *	Food Chain Multipler Source	Estimated BAF (K_{ow} * FCM)	COPC for Seafood Ingestion Pathway?
Inorganics								
Dissolved Chlorite (CLO2-)	NA	NA	NA	NA	NA	NA	NA	No. Chlorite is a strong oxidizer and will not bioaccumulate in the food chain (ATSDR, 2004).
Nitrite (N)	NA	NA	NA	NA	NA	NA	NA	No. Nitrite does not bioaccumulate. Apart from infants, nitrite is readily oxidized to nitrate by humans (HC, 2013).
Metals								
Total Cadmium (Cd)	907	US EPA, 1999	NV	NA	NA	NA	NA	No. Although there is evidence for food chain bioaccumulation of cadmium by animals (ATSDR, 2012), the BCF for cadmium is less then 5,000.
Total Mercury (Hg)	NV	NV	NV	NV	NA	NA	NA	**Yes. Mercury is known to bioconcentrate and biomagnify in aquatic food chains. Most of the mercury that is found to bioaccumulate in aquatic organisms is in the organic form of mercury, methylmercury (ATSDR, 1999). Concentration of methylmercury was not measured in surface water because methylmercury is known to be rapidly accumulated by aquatic organisms (ATSDR, 1999). Mercury will be assessed further in the HHRA for the Seasfood Ingestion Exposure Pathway, as methylmercury, assuming the proportion of mercury from the effluent that is converted to methylmercury in the receiving environment.**
Polycyclic Aromatic Hydrocarbons								
Phenanthrene	NV	NV	4.55	CCME, 2008a	1.87	US EPA, 2016	66,350	**Yes. The estimated bioaccumulation factor (BAF) using the US EPA (2016) K_{ow} Method was greater than 5,000.**
PHC with Atl. RBCA V3.1 method								
>C10-C16 Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	No. Most PHCs are readily metabolize by vertebrates into a readily excretable form (CCME, 2008b).
>C16-C21 Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	
>C21-<C32 Hydrocarbons	NA	NA	NA	NA	NA	NA	NA	
Modified TPH (Tier1)	NA	NA	NA	NA	NA	NA	NA	
Phenols								
Catechol (1,2-dihydroxybenzene or pyrocatechol)	NV	NV	0.88	US EPA, 2012 (experimental database)	NA	NA	NA	No. The log Kow is < 5
o-Cresol	NV	NV	1.95	ATSDR, 2008; US EPA, 2012 (experimental database)	NA	NA	NA	No. Available experimental data suggests that cresols will not bioconcentrate to any significant extent in the food chain (ATSDR, 2008). Also the log Kow is < 5.
	NV	NV	1.32	US EPA, 2012 (experimental database)	NA	NA	NA	No. The log Kow <5

Notes:
NV - No Value
NA - Not Applicable
* US EPA (2016) has three FCMs for TL2, 3 and 4. The highest FCM was selected for the screening to determine the bioaccumulation potential.

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US EPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.
US EPA. 2016. Development of National Bioaccumulation Factors: Supplemental Information for EPA's 2015 Human Health Criteria Update. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC. January, 2016. EPA 822-R-16-001

Table A.7: Comparison of Maximum Effluent Concentration to Water Guidelines for Recreational Use

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	Recreational Guideline [4]	COPC for Recreational Use Pathway?
		Maximum	Total Count	Count (<RDL)					
Inorganics									
Dissolved Chlorite (ClO2-)	mg/L	2.1	2	1	1	NA	NA	8.0	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Nitrite (N)	mg/L	3.15	1,986	1,754	1	NA	NA	NA	No. Health Canada value is based on bottle-fed infants less than six months of age exposed to nitrite through consumption of formula reconstituted with drinking water. Because infants are not likely to be swimming or participating in recreational activities, and toddlers to adults are able to metabolize nitrite, this COPC is not assessed further for the recreational exposure pathway.
Nitrate (N)	mg/L	4.21	1,986	1,776	10	NA	NA	NA	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Metals									
Total Barium (Ba)	µg/L	450	5	0	1,000	NA	NA	NA	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Total Cadmium (Cd)	µg/L	1.4	5	0	5	NA	NA	NA	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Total Copper (Cu)	µg/L	7.5	5	0	2,000	NA	NA	NA	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Total Manganese (Mn)	µg/L	**2,800**	5	0	120	NA	NA	**481**	**Yes. COPC assessed in the HHRA for the Recreational Use Exposure Pathway.**
Total Mercury (Hg)	µg/L	0.028	3	0	1	NA	NA	NA	No. Not assessed further in the HHRA for the Recreational Use Exposure Pathway.
Dioxins & Furans**									
2,3,7,8-Tetra CDD	pg/L	<1.9	7	7	NV	NA	NA	NA	NA
1,2,3,7,8-Penta CDD	pg/L	<2.5	7	7	NV	NA	NA	NA	NA
1,2,3,4,7,8-Hexa CDD	pg/L	<1.5	7	7	NV	NA	NA	NA	NA
1,2,3,6,7,8-Hexa CDD	pg/L	<1.8	7	7	NV	NA	NA	NA	NA
1,2,3,7,8,9-Hexa CDD	pg/L	<1.8	7	7	NV	NA	NA	NA	NA
1,2,3,4,6,7,8-Hepta CDD	pg/L	10.4	7	3	NV	NA	NA	NA	NA
Octa CDD	pg/L	28.9	7	1	NV	NA	NA	NA	NA
2,3,7,8-Tetra CDF	pg/L	4.6	7	4	NV	NA	NA	NA	NA
1,2,3,7,8-Penta CDF	pg/L	<1.34	7	6	NV	NA	NA	NA	NA
2,3,4,7,8-Penta CDF	pg/L	<1.36	7	7	NV	NA	NA	NA	NA
1,2,3,4,7,8-Hexa CDF	pg/L	<2.1	7	6	NV	NA	NA	NA	NA
1,2,3,6,7,8-Hexa CDF	pg/L	<2.2	7	6	NV	NA	NA	NA	NA
2,3,4,6,7,8-Hexa CDF	pg/L	<1.9	7	7	NV	NA	NA	NA	NA
1,2,3,7,8,9-Hexa CDF	pg/L	<2.7	7	6	NV	NA	NA	NA	NA
1,2,3,4,6,7,8-Hepta CDF	pg/L	<3.1	7	6	NV	NA	NA	NA	NA
1,2,3,4,7,8,9-Hepta CDF	pg/L	<4.4	7	7	NV	NA	NA	NA	NA
Octa CDF	pg/L	3.5	7	4	NV	NA	NA	NA	NA
Dioxin & Furans (TEQ- 2,3,7,8-TCDD)	pg TEQ/L	6.9	-	-	NV	120	NA	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Polycyclic Aromatic Hydrocarbons									
Acenaphthylene	µg/L	<0.03	2	2	NV	4.5	NA	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Anthracene	µg/L	<0.02	2	2	NV	NV	890	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Fluoranthene	µg/L	0.037	2	0	NV	NV	0.41	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Fluorene	µg/L	<0.1	2	2	NV	940	NA	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Phenanthrene	µg/L	0.049	2	0	NV	NV	1	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Pyrene	µg/L	<0.02	2	1	NV	710	NA	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Volatile Organics									
1,1-Dichloroethylene	µg/L	<71	2	2	14	NA	NA	112	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Ethylene Dibromide	µg/L	**<1**	2	2	NV	LRL	0.05	**0.5**	**Yes. COPC assessed in the HHRA for the Recreational Use Exposure Pathway.**
PHC with Atl. RBCA V3.1 method									
>C10-C16 Hydrocarbons	mg/L	0.13	2	0	NV	NV	0.3	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
>C16-C21 Hydrocarbons	mg/L	0.13	2	0	NV	NV	1	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
>C21-<C32 Hydrocarbons	mg/L	0.26	2	0	NV	NV	1	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Modified TPH (Tier1)	mg/L	0.53	2	0	NV	3.2	NA	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Phenols									
Total of Reg.P&P phenols	µg/L	9.6	2	1	NV	LRL	890	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
Catechol	µg/L	3.7	1	0	NV	NV	NV	NV	**Yes. Guideline not available. COPC assessed in HHRA for the Recreational Use Exposure Pathway.**
2-Chlorophenol	µg/L	<1.2	2	1	NV	NV	8.9	NA	No. Not Assessed further in the HHRA for the Recreational Use Exposure Pathway.
o-Cresol	µg/L	<3	2	1	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
4,6 Dichloroguaiacol	µg/L	<5.6	1	1	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,6 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
3,4 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
3,5 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,4 Dimethylphenol	µg/L	<2	2	1	NV	NV	59	NA	No. Not Assessed further in the HHRA for the Recreational Exposure Pathway.
Guaiacol	µg/L	1.2	1	0	NV	NV	NV	NV	**Yes. Guideline not available. COPC assessed in HHRA for the Recreational Use Exposure Pathway.**
Pentachlorophenol	µg/L	<4	2	2	60	NA	NA	NA	No. Not Assessed further in the HHRA for the Recreational Exposure Pathway.
Tetrachloroguaiacol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3,4,5 Tetrachlorophenol	µg/L	<1.6	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3,4,6 Tetrachlorophenol	µg/L	<2	2	2	100	NA	NA	NA	No. Not Assessed further in the HHRA for the Recreational Exposure Pathway.
2,3,5,6 Tetrachlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3,4 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,3,6 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.
2,4,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	8.9	NV	No. Not Assessed further in the HHRA for the Recreational Exposure Pathway.
2,4,6-Trichlorophenol	µg/L	<2	2	2	5	NA	NA	NA	No. Not Assessed further in the HHRA for the Recreational Exposure Pathway.
3,4,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	NV	No. Guideline not available and parameter was not detected. COPC not sssessed further in the HHRA for the Recreational Use Exposure Pathway.

Table A.7: Comparison of Maximum Effluent Concentration to Water Guidelines for Recreational Use

Notes:
NV - No Value
NA - Not Applicable
LRL - Laboratory Reporting Limit
1- HC (Health Canada). 2017. Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
2 - NSE (Nova Scotia Environment). 2014. Environmental Quality Standards for Contaminated Sites: Rationale and Guidance Document. Version 1.0 April 2014.
3 - MOE (Ontario Ministry of the Environment). 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. Standards Development Branch. Toronto, ON. April 15, 2011.
4 - Derived from drinking water quality guidelines as described in **Appendix A**.
* The NSE (2014) guideline for Modified TPH for fuel. The lowest value of the Modified TPH for gas, fuel and lube was selected for the screening.
** The NSE (2014) guideline is expressed as a toxic equivalent (TEQ) of 2,3,7,8- TCDD. For comparison with the NSE (2014) guideline, the effluent concentration was also expressed as a TEQ of 2,3,7,8-TCDD. This was accomplished by multiplying the effluent concentration of each congener with a toxic equivalency factor (TEF) for 2,3,7,8- TCDD and summing the concentrations.

Table A.8: Comparison of Maximum Effluent Concentration to Water Guidelines for Water Tainting

Parameter	Unit	Treated Effluent Concentrations (Point C)			US EPA Organoleptic Effect Criteria [1]	Shumway & Palensky [2]	COPC for Tainting Pathway?
		Maximum	Total Count	Count (<RDL)	Guideline	Guideline	
Inorganics							
Dissolved Chlorite (ClO2-)	mg/L	2.1	2	1	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Nitrite (N)	mg/L	3.15	1,986	1,754	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Nitrate (N)	mg/L	4.21	1,986	1,776	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Metals							
Total Barium (Ba)	µg/L	450	5	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Total Cadmium (Cd)	µg/L	1.4	5	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Total Copper (Cu)	µg/L	7.5	5	0	1,000	NV	No. Not a COPC assessed in the HHRA for tainting pathway.
Total Iron (Fe)	µg/L	**718**	5	0	**300**	NV	**Yes. COPC assessed in the HHRA for tainting pathway.**
Total Manganese (Mn)	µg/L	2,800	5	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Total Mercury (Hg)	µg/L	0.028	3	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Total Zinc (Zn)	µg/L	160	5	0	5,000	NV	No. Not a COPC assessed in the HHRA for tainting pathway.
Dioxins & Furans							
2,3,7,8-Tetra CDD	pg/L	<1.9	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,7,8-Penta CDD	pg/L	<2.5	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,4,7,8-Hexa CDD	pg/L	<1.5	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,6,7,8-Hexa CDD	pg/L	<1.8	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,7,8,9-Hexa CDD	pg/L	<1.8	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,4,6,7,8-Hepta CDD	pg/L	10.4	7	3	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Octa CDD	pg/L	28.9	7	1	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,7,8-Tetra CDF	pg/L	4.6	7	4	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,7,8-Penta CDF	pg/L	<1.34	7	6	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,4,7,8-Penta CDF	pg/L	<1.36	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,4,7,8-Hexa CDF	pg/L	<2.1	7	6	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,6,7,8-Hexa CDF	pg/L	<2.2	7	6	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,4,6,7,8-Hexa CDF	pg/L	<1.9	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,7,8,9-Hexa CDF	pg/L	<2.7	7	6	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,4,6,7,8-Hepta CDF	pg/L	<3.1	7	6	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
1,2,3,4,7,8,9-Hepta CDF	pg/L	<4.4	7	7	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Octa CDF	pg/L	3.5	7	4	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Polycyclic Aromatic Hydrocarbons							
Acenaphthylene	µg/L	<0.03	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Anthracene	µg/L	<0.02	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Fluoranthene	µg/L	0.037	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Fluorene	µg/L	<0.1	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Phenanthrene	µg/L	0.049	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Pyrene	µg/L	<0.02	2	1	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Volatile Organics							
1,1-Dichloroethylene	µg/L	<71	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Ethylene Dibromide	µg/L	<1	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.

Table A.8: Comparison of Maximum Effluent Concentration to Water Guidelines for Water Tainting

Parameter	Unit	Treated Effluent Concentrations (Point C)			US EPA Organoleptic Effect Criteria [1]	Shumway & Palensky [2]	COPC for Tainting Pathway?
		Maximum	Total Count	Count (<RDL)	Guideline	Guideline	
PHC with Atl. RBCA V3.1 method							
>C10-C16 Hydrocarbons	mg/L	0.13	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
>C16-C21 Hydrocarbons	mg/L	0.13	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
>C21-<C32 Hydrocarbons	mg/L	0.26	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Modified TPH (Tier1)	mg/L	0.53	2	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Phenols							
Total of Reg.P&P phenols	µg/L	9.6	2	1	300	NV	No. Not a COPC assessed in the HHRA for tainting pathway.
Catechol	µg/L	3.7	1	0	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2-Chlorophenol	µg/L	**<1**	2	1	**0.1**	NV	**Yes. COPC assessed in the HHRA for tainting pathway.**
o-Cresol	µg/L	<3	2	1	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
4,6 Dichloroguaiacol	µg/L	<5.6	1	1	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3 Dichlorophenol	µg/L	**<2**	2	2	**0.04**	32	**Yes. COPC assessed in the HHRA for tainting pathway.**
2,6 Dichlorophenol	µg/L	**<2**	2	2	**0.2**	10	**Yes. COPC assessed in the HHRA for tainting pathway.**
3,4 Dichlorophenol	µg/L	**<2**	2	2	**0.3**	NV	**Yes. COPC assessed in the HHRA for tainting pathway.**
3,5 Dichlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,4 Dimethylphenol	µg/L	<2	2	1	400	NV	No. Not a COPC assessed in the HHRA for tainting pathway.
Guaiacol	µg/L	1.2	1	0	NV	100	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
Pentachlorophenol *	µg/L	<4	2	2	30	NV	No. Not a COPC assessed in the HHRA for tainting pathway.
Tetrachloroguaiacol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,4,5 Tetrachlorophenol	µg/L	<1.6	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,4,6 Tetrachlorophenol	µg/L	**<2**	2	2	**1**	NV	**Yes. COPC assessed in the HHRA for tainting pathway.**
2,3,5,6 Tetrachlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,4 Trichlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,3,6 Trichlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.
2,4,5 Trichlorophenol	µg/L	**<2**	2	2	**1**	320	**Yes. COPC assessed in the HHRA for tainting pathway.**
2,4,6-Trichlorophenol	µg/L	<2	2	2	2	10	No. Not a COPC assessed in the HHRA for tainting pathway.
3,4,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	No. COPC not organoleptic. Not a COPC assessed in the HHRA for tainting pathway.

Notes:
NV - No Value

* Guideline based on Health Canada's Drinking Water Quality Aesthetic Objective (HC. 2017. Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario). The US EPA did not identify an organoleptic guideline for Pentachlorophenol. Source document found no taste or odour concerns.

1 - US EPA (United States Environmental Protection Agency). 1986. National Recommended Water Quality Criteria - Organoleptic Effects. https://www.epa.gov/wqc/national-recommended-water-quality-criteria-organoleptic-effects

2 - Shumway DL, and Palensky JR. 1973. Impairment of the Flavor of Fish by Water Pollutants. Oregon State University. February 1973.

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
Inorganics			
Dissolved Chlorate (ClO3-)	No	No	No
Dissolved Chloride (Cl-)	No	No	No
Dissolved Chlorite (CLO2-)	No	No	No
Dissolved Fluoride (F-)	No	No	No
Nitrite (N)	No	No	No
Nitrate (N)	No	No	No
Dissolved Sulphate (SO4)	No	No	No
Total Cyanide (CN)	No	No	No
Metals			
Total Antimony (Sb)	No	No	No
Total Arsenic (As)	No	No	No
Total Barium (Ba)	No	No	No
Total Beryllium (Be)	No	No	No
Total Bismuth (Bi)	No	No	No
Total Boron (B)	No	No	No
Total Cadmium (Cd)	No	No	No
Total Chromium (Cr)	No	No	No
Total Cobalt (Co)	No	No	No
Total Copper (Cu)	No	No	No
Total Iron (Fe)	No	No	Yes
Total Lead (Pb)	No	No	No
Total Manganese (Mn)	Yes	Yes	No
Total Mercury (Hg)	Yes	No	No
Total Molybdenum (Mo)	No	No	No
Total Nickel (Ni)	No	No	No
Total Selenium (Se)	No	No	No
Total Silver (Ag)	No	No	No
Total Sodium (Na)	No	No	No
Total Strontium (Sr)	No	No	No
Total Thallium (Tl)	No	No	No
Total Tin (Sn)	No	No	No
Total Titanium (Ti)	No	No	No
Total Uranium (U)	No	No	No
Total Vanadium (V)	No	No	No
Total Zinc (Zn)	No	No	No

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
Dioxins & Furans			
2,3,7,8-Tetra CDD	Yes	NA	No
1,2,3,7,8-Penta CDD	Yes	NA	No
1,2,3,4,7,8-Hexa CDD	Yes	NA	No
1,2,3,6,7,8-Hexa CDD	Yes	NA	No
1,2,3,7,8,9-Hexa CDD	Yes	NA	No
1,2,3,4,6,7,8-Hepta CDD	Yes	NA	No
Octa CDD	No	NA	No
2,3,7,8-Tetra CDF	Yes	NA	No
1,2,3,7,8-Penta CDF	Yes	NA	No
2,3,4,7,8-Penta CDF	Yes	NA	No
1,2,3,4,7,8-Hexa CDF	Yes	NA	No
1,2,3,6,7,8-Hexa CDF	Yes	NA	No
2,3,4,6,7,8-Hexa CDF	Yes	NA	No
1,2,3,7,8,9-Hexa CDF	Yes	NA	No
1,2,3,4,6,7,8-Hepta CDF	No	NA	No
1,2,3,4,7,8,9-Hepta CDF	Yes	NA	No
Octa CDF	No	NA	No
Dioxin & Furans (TEQ- 2,3,7,8-TCDD)	NA	No	NA
Glycols			
Ethylene Glycol	No	No	No
Diethylene Glycol	No	No	No
Triethylene Glycol	No	No	No
Propylene Glycol	No	No	No
Polycyclic Aromatic Hydrocarbons			
Acenaphthene	No	No	No
Acenaphthylene	No	No	No
Anthracene	No	No	No
Benzo(a)anthracene	No	No	No
Benzo(a)pyrene	No	No	No
Benzo(b)fluoranthene	No	No	No
Benzo(b/j)fluoranthene	No	No	No
Benzo(g,h,i)perylene	No	No	No
Benzo(j)fluoranthene	No	No	No
Benzo(k)fluoranthene	No	No	No
1-Chloronaphthalene	No	No	No
2-Chloronaphthalene	No	No	No
Chrysene	No	No	No
Dibenz(a,h)anthracene	No	No	No
Fluoranthene	No	No	No
Fluorene	No	No	No
Indeno(1,2,3-cd)pyrene	No	No	No
1-Methylnaphthalene	No	No	No
2-Methylnaphthalene	No	No	No
Naphthalene	No	No	No
Perylene	No	No	No

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
Phenanthrene	Yes	No	No
Pyrene	No	No	No
Volatile Organics			
Benzene	No	No	No
Bromodichloromethane	No	No	No
Bromoform	No	No	No
Bromomethane	No	No	No
Carbon Tetrachloride	No	No	No
Chlorobenzene	No	No	No
Chloroethane	No	No	No
Chloroform	No	No	No
Chloromethane	No	No	No
1,2-Dichlorobenzene	No	No	No
1,3-Dichlorobenzene	No	No	No
1,4-Dichlorobenzene	No	No	No
1,1-Dichloroethane	No	No	No
1,2-Dichloroethane	No	No	No
1,1-Dichloroethylene	No	No	No
cis-1,2-Dichloroethylene	No	No	No
trans-1,2-Dichloroethylene	No	No	No
1,2-Dichloropropane	No	No	No
cis-1,3-Dichloropropene	No	No	No
trans-1,3-Dichloropropene	No	No	No
Dibromochloromethane	No	No	No
Ethylbenzene	No	No	No
Ethylene Dibromide	No	Yes	No
Methyl t-butyl ether (MTBE)	No	No	No
Methylene Chloride(Dichloromethane)	No	No	No
Styrene	No	No	No
1,1,2,2-Tetrachloroethane	No	No	No
Tetrachloroethylene	No	No	No
Toluene	No	No	No
1,1,1-Trichloroethane	No	No	No
1,1,2-Trichloroethane	No	No	No
Trichloroethylene	No	No	No
Trichlorofluoromethane (FREON 11)	No	No	No
Total Trihalomethanes	No	No	No
Total Xylenes	No	No	No
Vinyl Chloride	No	No	No

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
PHC with Atl. RBCA V3.1 method			
Benzene	No	No	No
Toluene	No	No	No
Ethylbenzene	No	No	No
Total Xylenes	No	No	No
C6 - C10 (less BTEX)	No	No	No
>C10-C16 Hydrocarbons	No	No	No
>C16-C21 Hydrocarbons	No	No	No
>C21-<C32 Hydrocarbons	No	No	No
Modified TPH (Tier1)	No	No	No
Polychlorinated Biphenyls			
Total PCBs	No	No	No
Phenols			
Total of Reg.P&P phenols	No	No	No
Catechol	No	Yes	No
4 Chlorocatechol	No	No	No
4-Chloroguaiacol	No	No	No
2-Chlrophenol	No	No	Yes
3-Chlorophenol	No	No	No
4-Chlorophenol	No	No	No
3 & 4-Chlorophenol	No	No	No
o-Cresol	No	No	No
m-Cresol	No	No	No
p-Cresol	No	No	No
m/p-Cresol	No	No	No
6-Chlorovanillin	No	No	No
3,5 Dichlorocatechol	No	No	No
4,5 Dichlorocatechol	No	No	No
4,5 Dichloroguaiacol	No	No	No
4,6 Dichloroguaiacol	No	No	No
2,3 Dichlorophenol	No	No	Yes
2,4-Dichlorophenol	No	No	No
2,5-Dichlorophenol	No	No	No
2,4 +2.5- Dichlorophenol	No	No	No
2,6 Dichlorophenol	No	No	Yes
3,4 Dichlorophenol	No	No	Yes
3,5 Dichlorophenol	No	No	No
2,4 Dimethylphenol	No	No	No
5,6-Dichlorovanillin	No	No	No
4,5 Dichloroveratrol	No	No	No
2,4-Dinitrophenol	No	No	No
4,6-Dinitro-2-methylphenol	No	No	No
Eugebol	No	No	No
Guaiacol	No	Yes	No
Isoeugenol	No	No	No
2-Nitrophenol	No	No	No

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
4-Nitrophenol	No	No	No
Pentachlorophenol	Yes	No	No
Tetrachlorocatechol	No	No	No
Tetrachloroguaiacol	No	No	No
2,3,4,5 Tetrachlorophenol	No	No	No
2,3,4,6 Tetrachlorophenol	No	No	Yes
2,3,5,6 Tetrachlorophenol	No	No	No
3,4,5,6 Tetrachloroveratrol	No	No	No
23,4,5 Trichlorocatechol	No	No	No
3,4,5 Trichloroguaiacol	No	No	No
4,5,6 Trichloroguaiacol	No	No	No
2,3,4 Trichlorophenol	No	No	No
2,3,5 Trichlorophenol	No	No	No
2,3,6 Trichlorophenol	No	No	No
2,4,5 Trichlorophenol	No	No	Yes
2,4,6-Trichlorophenol	No	No	No
3,4,5 Trichlorophenol	No	No	No
3,4,5 Trichlorosyringol	No	No	No
3,4,5 Trichloroveratrol	No	No	No

Table A.9: Summary of Effluent COPCs in the HHRA

Parameter	Seafood Ingestion Pathway	Recreational Use Pathway	Tainting Pathway
Semi-Volatile Organics			
Benzyl butyl phthalate	No	No	No
Biphenyl	No	No	No
Bis(2-chloroethoxy)methane	No	No	No
Bis(2-chloroethyl)ether	No	No	No
Bis(2-chloroisopropyl)ether	No	No	No
Bis(2-ethylhexyl)phthalate	No	No	No
4-Bromophenyl phenyl ether	No	No	No
p-Chloroaniline	No	No	No
4-Chlorophenyl phenyl ether	No	No	No
3,3'-Dichlorobenzidine	No	No	No
Diethyl phthalate	No	No	No
Dimethyl phthalate	No	No	No
2,4-Dinitrotoluene	No	No	No
2,6-Dinitrotoluene	No	No	No
Di-N-butyl phthalate	No	No	No
di-n-octyl phthalate	No	No	No
Diphenyl Ether	No	No	No
Hexachlorobenzene	No	No	No
Hexachlorobutadiene	No	No	No
Hexachlorocyclopentadiene	No	No	No
Hexachloroethane	No	No	No
Isophorone	No	No	No
Nitrobenzene	No	No	No
Nitrosodiphenylamine/Diphenylamine	No	No	No
N-Nitroso-di-n-propylamine	No	No	No
Pentachlorobenzene	No	No	No
1,2,3,4-Tetrachlorobenzene	No	No	No
1,2,3,5-Tetrachlorobenzene	No	No	No
1,2,4,5-Tetrachlorobenzene	No	No	No
1,2,3-Trichlorobenzene	No	No	No
1,2,4-Trichlorobenzene	No	No	No
1,3,5-Trichlorobenzene	No	No	No

Notes:
NA - Not Applicable

Appendix B Local Seafood Intake Survey

The seafood intake survey was created to focus on questions that would provide answers that could be used quantitatively in the HHRA. It focused on finding the consumption rates of seafood that were harvested in the Marine Study Area (referred to as the Local Area in the survey).

The participants in the survey would be adults in the Pictou area. Energy requirements for other age groups are well understood and adult intake rates will be scaled for other age groups. Targeting adult respondents makes the survey simpler to administer.

Although the effluent mixing models suggest a 20 m mixing zone, focusing only on this small mixing area would make it difficult to get realistic intake rates. Therefore, we expanded the Local Area to a 5 km radius. The larger Local Area will have more variety in habitat and therefore, likely more food items sourced within it, providing a conservative intake rate for the smaller actual exposure area.

We considered that some commercial fishing may occur in the Local Area, and asked respondents if they did commercial fishing in this area. This would help to identify if the general public may consume seafood items that were potentially exposed to effluent.

The specified food items included in the survey were the most eaten items in the Atlantic Region First Nation Environment Study (Chan *et al*., 2017). Space was provided to indicate if there were other items also consumed beyond those listed in the survey.

The survey asks if other organs such as roe, liver, or kidney, are also consumed. Depending on the results from this question, modeling of non-muscle tissue consumption may be undertaken.

We did not include food preparation in the survey because food processing effects are generally poorly understood, and are difficult to represent in the HHRA. Cooking also generally decreases concentrations of most COPCs, so for most parameters it is more conservative to not use a food processing factor.

B.1 References

Chan, Laurie, Olivier Receveur, Malek Batal, William David, Harold Schwartz, Amy Ing, Karen Fediuk, and Constantine Tikhonov. 2017. First Nations Food, Nutrition, and Environment Study: Results from the Atlantic Region 2014. Ottawa: University of Ottawa.

Local Seafood Intake Survey for the Northern Pulp Nova Scotia Replacement Effluent Treatment Facility

(a) Purpose

We are interested in finding out how much locally sourced seafood is consumed by local residents and First Nation community members.

(b) Survey Participant

The participant is an adult. Fill out a separate survey for each individual participant.

(1) Ethnic Origin

Please indicate ethnic origin(s) of the person this survey is for:

First Nation	Other
☐	☐

(2) Gender

Please indicate what gender you identify as:

Male	Female	Prefer to self describe as	Prefer not to say
☐	☐		☐

(3) Age

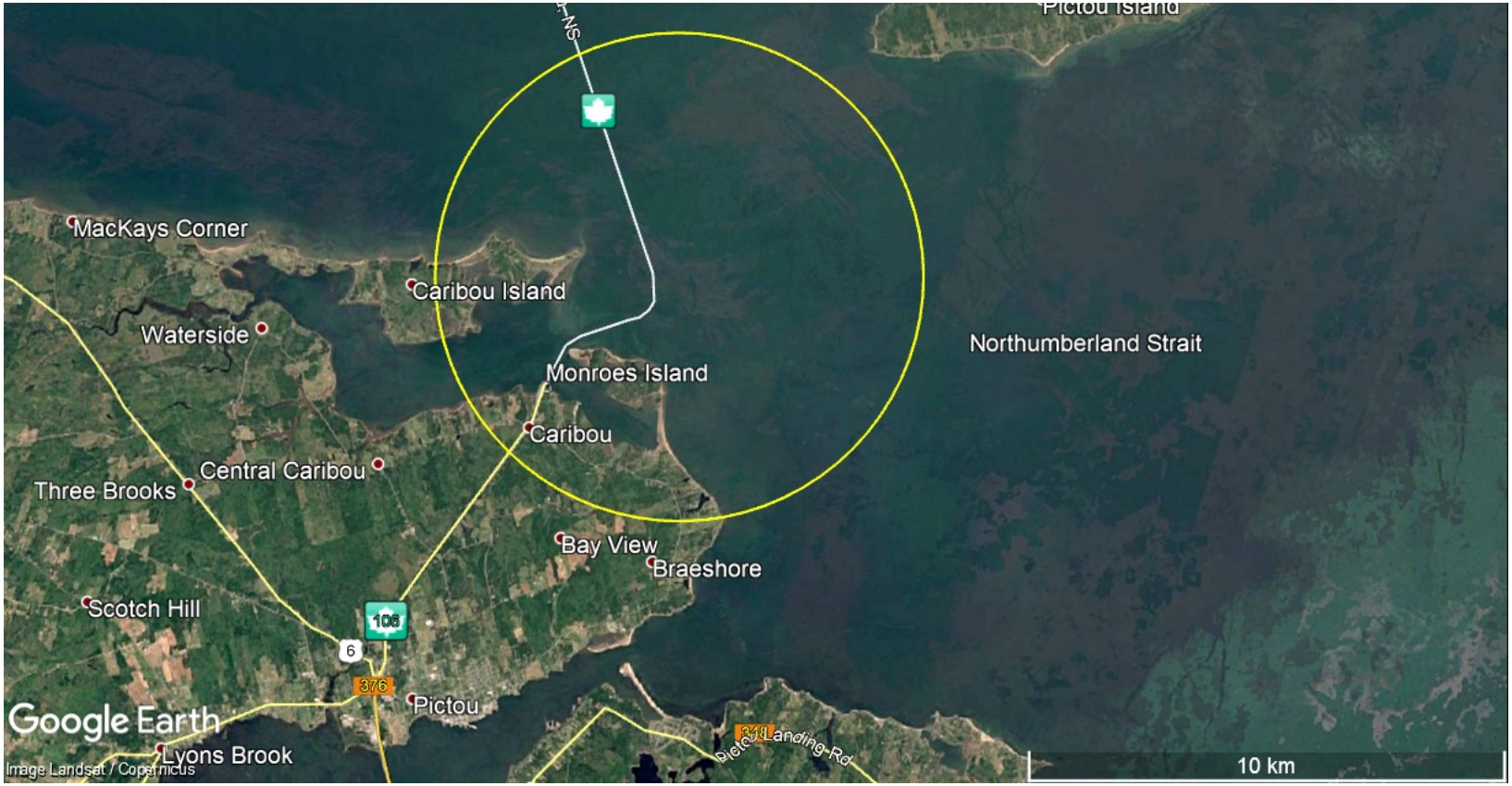
Please indicate your age:

18-34	35-54	55+	Prefer not to say
☐	☐	☐	☐

(c) Definition of Local Area and Locally Sourced

The local area is defined as being with 5 kilometres (3.1 miles) of the proposed diffuser location for the replacement effluent discharge, as depicted by the yellow outline in the map below.

If you have harvested seafood within this area yourself or if you have purchased / were gifted food from someone else who harvested the seafood within this area, the food would be considered locally sourced.



(d) Local Harvest

(1) If you harvest in the local area, please fill out the table

Species	Amount Harvested (lbs/yr)	Portion of Harvest Sold	Species	Amount Harvested (lbs/yr)	Portion of Harvest Sold

(e) Definition of Serving Size

We are interested in finding out how many servings a week a person eats, for each of the locally sourced seafood items. To make sure we are all thinking about the same serving sizes, the following has been defined.

Seafood (approximate serving)

Serving of fish = palm of hand or 1/2 cup (125 ml, 75g, 2 ½ oz)

Serving of scallops = 6 medium scallops or 1/2 cup (125 ml, 75g, 2 ½ oz)

Serving of lobster = ½ of the meat from a 1.5 lb lobster or 1/2 cup (125 ml, 75g, 2 ½ oz)

Serving of mussels = 15 small mussels or 1/2 cup (125 ml, 75g, 2 ½ oz)

(f) Seafood Intake

(1) Using the above definition, please estimate how many servings each week you eat of the following fish and shellfish that have been harvested from the local area, either by yourself or someone else.

FISH	Per Week 0	1	2	3	4	5	6	7	Other #/week (specify)	Only in Specific Season (specify)?
Atlantic Salmon	☐	☐	☐	☐	☐	☐	☐	☐	☐ _____	_____
Flounder	☐	☐	☐	☐	☐	☐	☐	☐	☐ _____	_____
Smelt	☐	☐	☐	☐	☐	☐	☐	☐	☐ _____	_____
Haddock	☐	☐	☐	☐	☐	☐	☐	☐	☐ _____	_____
Cod	☐	☐	☐	☐	☐	☐	☐	☐	☐ _____	_____

FISH	Per Week										
	0	1	2	3	4	5	6	7	Other #/week (specify)		Only in Specific Season (specify)?
Brook Trout (speckle)	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Mackerel	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Rainbow Trout	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Striped Bass	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Halibut	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
American Eel	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Lake Trout	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Brown Trout	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Herring	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Other fish _____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Other fish _____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Other fish _____	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____

SHELLFISH	Per Week										
	0	1	2	3	4	5	6	7	Other #/week (specify)		Only in Specific Season (specify)?
Lobster	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Scallops	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Mussels	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____
Crab	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____	_____

SHELLFISH	Per Week 0	1	2	3	4	5	6	7	Other #/week (specify)		Only in Specific Season (specify)?
Shrimp	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Soft Clam	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Quahog (surf clam)	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Oysters	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Other shellfish ______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Other shellfish ______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
Other shellfish ______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______

OTHER SEAFOODS (specify)	Per Week 0	1	2	3	4	5	6	7	Other #/week (specify)		Only in Specific Season (specify)?
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______
______	☐	☐	☐	☐	☐	☐	☐	☐	☐	______	______

(2) Do you consume any organs or other parts of seafood items (examples: roe, liver, kidneys, etc.)?
If yes, please indicate which parts and approximately how many servings per week of each part.

_____
_____
_____
_____
_____

(g) Submission Process

Once you have completed the Questionnaire please return it to:

ATTENTION: Seafood Survey
EcoMetrix Incorporated
6800 Campobello Road,
Mississauga, Ontario, L6S 1 M6

info@ecometrix.ca

Fish Consumption Survey
Northern Pulp

This questionnaire was last modified on August 9, 2019

SAMPLING PLAN DETAILS

French Translation Required: **No**

Survey Population and Sample Source:

- ☐ General Population 18 years of age or older
- ☐ Pictou County

Quotas and Sample Size:

- Representative by age and gender
- n=300

Weighting Required: **Yes**

Age/Gender weighting (if required)

Imported Variables:

Phone Number
Cell/Landline
Province
Region

List others:

TELEPHONE INTRODUCTION – GENERAL POPULATION

*Hello, my name is *** from MQO Research, a professional research firm in Atlantic Canada. Today we are conducting a <5-10 minute> survey about fish consumption in Nova Scotia.*

IF LANDLINE SAMPLE CONTINUE:

Because 18 to 34 year olds are a little more difficult to reach, we first ask if there is someone in your household between 18 and 34 years of age.

IF NO ONE IN HOUSEHOLD BETWEEN 18-34, CONTINUE: *In that case, may I please to speak with someone in your household who is 35 years of age or older, would that be you?*

ONCE CORRECT PERSON IS ON THE LINE: *Please be assured that we are not selling or promoting any products or services, but are simply interested in your opinions.*

May I proceed with you now?

IF UNAVAILABLE: ARRANGE CALLBACK – *When is the best time to call back and who should we ask for? First name is fine.*

IF CELL SAMPLE, CONTINUE:

Before we begin, are you a resident of <province> and 18 years of age and older?

IF NO, THANK AND TERMINATE.

Please be assured that we are not selling or promoting any products or services but are simply interested in your opinions.

May I proceed with you now?

IF UNAVAILABLE: ARRANGE CALLBACK – *When is the best time to call back and who should we ask for? First name is fine.*
****

IF RESPONDENT AGREES TO CONTINUE ADD:

This call may be monitored for quality purposes.

INTERVIEWER NOTES:
If necessary, add: The survey could take 5-10 minutes to complete.

If a respondent questions the validity of the survey, the call or MQO, please state: MQO Research has been conducting research studies in Canada and abroad for 30 years. We are a Member of the Canadian Research Insights Council which is responsible for developing and approving market and research standards and supportive programs; providing effective promotion and advocacy for the market and insights research

industry; serving as a source of information for the industry; and being a forum for collective industry action.

If a respondent questions the confidentiality of the information that they are providing, please state the following: As a member of the Canadian Research Insights Council we adhere to strict standards of privacy and confidentiality. Our data is presented to our client in aggregate form. Information will never be released to our client or any other third party in a manner that could be used to disclose your identity or violate your privacy.

Other relevant interviewer notes:

This survey is being conducted on behalf of Northern Pulp (if needed).

SECTION A: SCREENING AND QUOTA MANAGEMENT (AGE/GENDER/GEOGRAPHY)

First, I have a few questions about you and your household.

PROGRAMMING NOTE: IF SAMPLE INCLUDES CELLPHONES, S2 IS MANDATORY.

S2a. **[IF PROVINCE=NOVA SCOTIA]** In which county of Nova Scotia do you live?

Annapolis	1	**THANK AND TERMINATE.**
Antigonish	2	**THANK AND TERMINATE.**
Cape Breton	3	**THANK AND TERMINATE.**
Colchester	4	**THANK AND TERMINATE.**
Cumberland	5	**THANK AND TERMINATE.**
Digby	6	**THANK AND TERMINATE.**
Guysborough	7	**THANK AND TERMINATE.**
Halifax	8	**THANK AND TERMINATE.**
Hants	9	**THANK AND TERMINATE.**
Inverness	10	**THANK AND TERMINATE.**
Kings	11	**THANK AND TERMINATE.**
Lunenburg	12	**THANK AND TERMINATE.**
Pictou	13	
Queens	14	**THANK AND TERMINATE.**
Richmond	15	**THANK AND TERMINATE.**
Shelburne	16	**THANK AND TERMINATE.**
Victoria	17	**THANK AND TERMINATE.**
Yarmouth	18	**THANK AND TERMINATE.**
Do not live in Nova Scotia	99	**THANK AND TERMINATE.**

PROGRAMMING NOTE: CALCULATE NEW REGIONAL VARIABLE (REG2) BASED ON RESPONSES TO S2a.

S3. Note Gender:

Male 1
Female 2

S4a. In what year were you born?

Year Born _____ **GO TO Q1**
Refused

S4b. Into which of the following categories does your age fall?

18 – 24 1
25 – 34 2
35 – 44 3
45 – 54 4
55 – 64 5
65 or older 6
Refused 8

SECTION B: FISH CONSUMPTION

Next, I have a few questions about your fish and shellfish consumption.

B1. On average, how frequently do you consume fish or shellfish?

INTERVIEWER NOTES: Read first five choices

Daily 1
A few times a week 2
At few times a month 3
A few times a year 4
Never ..... 5 **GO TO DEMOGRAPHICS**
VOLUNTEERED RESPONSES
Refused 8
Don't know 9

B2. We are particularly interested in the consumption of locally sourced fish and shellfish. By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI. To the best of your knowledge,

a) Have you harvested fish or shellfish from that area?
b) Have you purchased fish or shellfish that has been harvested from that area?
c) Have you been given or gifted fish or shellfish that has been harvested from that area?

Yes 1
No 2
VOLUNTEERED RESPONSES
Refused 8
Don't know 9

B3 **[IF B2=1]** What species of fish and/or shellfish have you harvested in the past year? Please consider locally sourced fish and shellfish only.

INTERVIEWER NOTES: Select all that apply; Do not read

If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

Atlantic Salmon 1
American Eel 2
Brook Trout (Speckle) 3
Brown Trout 4
Cod 5
Crab 6

Flounder 7
Halibut 8
Haddock 9
Herring 10
Lake Trout 11
Lobster 12
Mackerel 13
Mussels 14
Oysters 15
Rainbow Trout 16
Scallops 17
Shrimp 18
Smelt 19
Soft Clam 20
Striped Bass 21
Quahog (Surf Clam) 22
Other (please specify): _____ 90
Don't know 98
Prefer not to say 99

Programming note: Allow 10 other responses

B4 **[ASK FOR EACH IN B3 SELECTED]** Please consider locally sourced fish and shellfish harvested in the past year.

> **INTERVIEWER NOTES:**
> If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

a. How much **[RECALL B3]** did you harvest? _____lbs/year
b. Was any **[RECALL B3]** sold? If so, how much? _____lbs/year

Programming note: Include "don't know" and "prefer not to say" response options.

B5. We are interested in finding out how many servings a week a person eats, for each of the ***locally sourced*** seafood items. Fish and shellfish will be discussed separately.

a. First, please consider your consumption of **fish**. One serving size of fish would be approximately the size of the palm of your hand, or about ½ cup (125 milliliters, 75 grams, or 2.5 ounces). Approximately how many servings per week would you eat of each of the following ***locally sourced*** fish?

> **INTERVIEWER NOTES:**
> If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

	#/week	Only in season (VOL)	Specify season
i. Atlantic Salmon	_____	☐	_____
ii. American Eel	_____	☐	_____
iii. Brook Trout (Speckle)	_____	☐	_____
iv. Brown Trout	_____	☐	_____
v. Cod	_____	☐	_____
vi. Flounder	_____	☐	_____
vii. Haddock	_____	☐	_____
viii. Halibut	_____	☐	_____
ix. Herring	_____	☐	_____
x. Lake Trout	_____	☐	_____
xi. Mackerel	_____	☐	_____
xii. Rainbow Trout	_____	☐	_____
xiii. Smelt	_____	☐	_____
xiv. Striped Bass	_____	☐	_____
xv. Other, please specify: _____	_____	☐	_____

Programming note: Allow 5 other responses

b. Next, please consider your consumption of **shellfish**. Serving sizes for scallops, lobster, and mussels are provided as examples of serving sizes for shellfish.

One serving size of ***scallops*** would be approximately 6 medium scallops or about ½ cup (125 milliliters, 75 grams, or 2.5 ounces).

One serving size of ***lobster*** would be approximately half of the meet from a 1.5 lb lobster or about ½ cup (125 milliliters, 75 grams, or 2.5 ounces).

One serving size of ***mussels*** would be approximately 15 small mussels or about ½ cup (125 milliliters, 75 grams, or 2.5 ounces).

Approximately how many servings per week would you eat of each of the following ***locally sourced*** shellfish?

INTERVIEWER NOTES:
If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

	#/week	Only in season (VOL)	Specify season
i. Crab	_____	☐	_____
ii. Lobster	_____	☐	_____
iii. Mussels	_____	☐	_____
iv. Oysters	_____	☐	_____
v. Scallops	_____	☐	_____
vi. Shrimp	_____	☐	_____
vii. Soft Clam	_____	☐	_____
viii. Quahog (Surf Clam)	_____	☐	_____
ix. Other, please specify: _____	_____	☐	_____

Programming note: Allow 5 other responses

c. Are there any other ***locally sourced*** seafoods that you consume?

INTERVIEWER NOTES:
If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

Yes.....1
No .....2 **GO TO B6**
VOLUNTEERED RESPONSES
Refused.....8 **GO TO B6**
Don't know .....9 **GO TO B6**

d. Approximately how many servings per week would you eat of other ***locally sourced*** seafood?

INTERVIEWER NOTES:
If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

	#/week	Only in season (VOL)	Specify season
i. Other, please specify: _____	_____	☐	_____

Programming note: Allow 5 other responses

B6. Do you consume any organs or other parts of the ***locally sourced*** seafood items? This may include roe, liver, kidneys, etc.

INTERVIEWER NOTES:
If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

Yes.....1
No .....2 **GO TO DEMOS**
VOLUNTEERED RESPONSES
Refused.....8 **GO TO DEMOS**
Don't know .....9 **GO TO DEMOS**

B7. Approximately how many servings per week would you eat of each organ or part of the ***locally sourced*** seafood items?

INTERVIEWER NOTES:
If needed at any time: "By locally sourced we are referring to fish and/or shellfish that has been harvested in the Northumberland Strait in the area of Caribou island to Pictou island, in the vicinity of the Ferry route between Nova Scotia and PEI."

	#/week
ii. Other, please specify: _____	_____

Programming note: Allow 5 other responses

SECTION C: DEMOGRAPHICS

Finally, I would like to ask you a few more questions about you and your household. All this information will be used only to help us analyse the results and will be kept in the strictest confidence.

D1. Do you identify as First Nation, indigenous, or aboriginal? This would include Mi'kmaq and Metis.

First Nation/Indigenous/Aboriginal (including Mi'kmaq and Metis) 1
No/None of these..... 2
Other (please specify): _____ 90
Don't know..... 98
Prefer not to say..... 99

STANDARD QUESTIONS FOR DUAL FRAME SAMPLING

PROGRAMMING NOTE: ADD STANDARD QUESTIONS FOR DUAL FRAME SAMPLING.

For this survey, we need to make sure that we get a good representation of people with cellphones and landline telephones.

IF SAMPLE = LANDLINE: ASK F11a, 11b and 11c

D11a. Do you own a cell phone that you use for either work or personal reasons? Yes/No

D11b. Excluding your cell numbers, how many different telephone numbers do you have in your household? _____ (default on "1"?)

F11c **Including yourself**, how many individuals ***19 years of age*** or older live in your household? ____

IF SAMPLE = CELL PHONE ASK F 12a and b

D12a. Excluding your cell numbers, does your household currently subscribe to a landline telephone service that you personally use? Yes/No

INTERVIEWER NOTES: If a respondent asks what we mean by a landline, please state: A landline telephone is a traditional telephone line in which a telephone is connected to the network by cables.

D12b. How many cell phones do you personally use for either work or personal reasons? _____

That's all my questions for today. Thank you very much for your time.

Appendix C Effluent to Groundwater used as Drinking Water Pathway

During a pipeline malfunction, treated pulp mill effluent may leak and infiltrate into groundwater that is used as drinking water by residents near the pipeline. The approximate locations of drinking water wells that are near the pipeline are shown in **Figure C.1**.

A screening process was carried out to identify COPCs in the future treated effluent that may be of concern in this malfunction scenario. The process to remove ancillary parameters and parameters that are not of human health concern is the same as that conducted for the normal scenario of treated effluent discharged at the diffuser. **Table A.4** shows the parameters carried forward in the screening process.

The maximum concentration of each parameter was compared to the Canadian Drinking Water Quality Guidelines (CDWQG; HC, 2017; **Table C.1**) to determine COPCs in the drinking groundwater malfunction scenario. The CDWQOs are the same guidelines adopted by province of Nova Scotia (GNS, 2017) for the protection of human health from the drinking water exposure pathway.

Where a CDWQG was not available, the maximum effluent concentration for a parameter was compared to the Nova Scotia Environment (NSE, 2014) potable groundwater drinking water environment quality standards (EQS) protective of human receptors exposed to contaminants in groundwater through direct ingestion. These drinking water EQS are considered appropriate because they were derived using the following hierarchy: CDWQGs, Atlantic RBCA Tier 1 Risk Based Screening Levels, Alberta Environment Tier 1 Groundwater Remediation Guidelines, the Ontario Ministry of the Environment, Conservation and Parks (MECP) groundwater standards, and the US EPA Regional Screening Tables. In some cases, the NSE (2014) adopted the CCME (2013 draft (now 2016)) recommended maximum laboratory reporting limit (LRL) for water as the potable groundwater drinking water EQS.

Where a NSE (2014) potable groundwater drinking water EQS was not available or the NSE (2014) EQS was based on a recommended maximum LRL, we used the Ontario MECP drinking water component value (GW1) protective of the drinking water exposure pathway (MOE, 2011). The GW1 component values from the MECP (MOE, 2011) are considered appropriate as these values were obtained using the following hierarchy: Ontario Drinking Water Standards, CDWQGs, the US EPA Maximum Contaminant Level (MCL), the California EPA, the European Union, and the World Health Organization, in order of preference. Where there was no value from the above jurisdictions, the MECP (MOE, 2011) calculated the GW1 values using a drinking water exposure model, human health toxicity values and oral cancer slope factors, and a target incremental lifetime cancer risk (ILCR) level of 1 in 1 million ($1x10^{-6}$) for carcinogenic parameters. The toxicity values and slope factors used by the MECP (MOE, 2011) were obtained from reputable and peer-reviewed sources such as the US EPA. The MECP target cancer risk level (ILCR) is the

more conservative value of 1 in 100,000 ($1x10^{-5}$) used by NSE (2014) in developing EQS for potable groundwater. The MECP GW1 component values for carcinogenic parameters were not adjusted to reflect a target risk level of 1 in 100,000.

If none of these agencies had a guideline available and the parameter was detected, the parameters was considered a COPC. Parameters that did not have guidelines and were not detected in effluent were not considered COPCs.

The COPCs for the malfunction scenario of treated effluent infiltrating in to groundwater that is used as drinking water includes dissolved chlorite, nitrite, manganese, titanium, ethylene glycol, 1,1-dichloroethylene, 1.3-dichloropropene, ethylene dibromide, catechol, p-cresol, 6-chlorovanillin, 2,4-dinitrophenol, guaiacol, bis(2-chloroethyl)ether, bis(2-ethylhexyl)phthalate, 2,4 + 2,6-dinitrotoluene, hexachlorobenzene, and hexachlorobutadiene. In the HHRA these COPCs will be assessed further for residents who may drink groundwater from wells near the pipeline.

C.1 References

CCME (Canadian Council of Ministers of the Environment). 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 4 Analytical Methods. Canadian Council of Ministers of the Environment.

GNS (Government of Nova Scotia). 2017. Canadian Drinking Water Quality Guidelines. https://novascotia.ca/nse/water/waterquality.asp. December 10, 2017.

HC (Health Canada). 2017. Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch.

MOE (Ontario Ministry of the Environment). 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. Standards Development Branch. April 15, 2011.

NSE (Nova Scotia Environment). 2014. Environmental Quality Standards for Contaminated Sites: Rationale and Guidance Document. Version 1.0 April 2014.

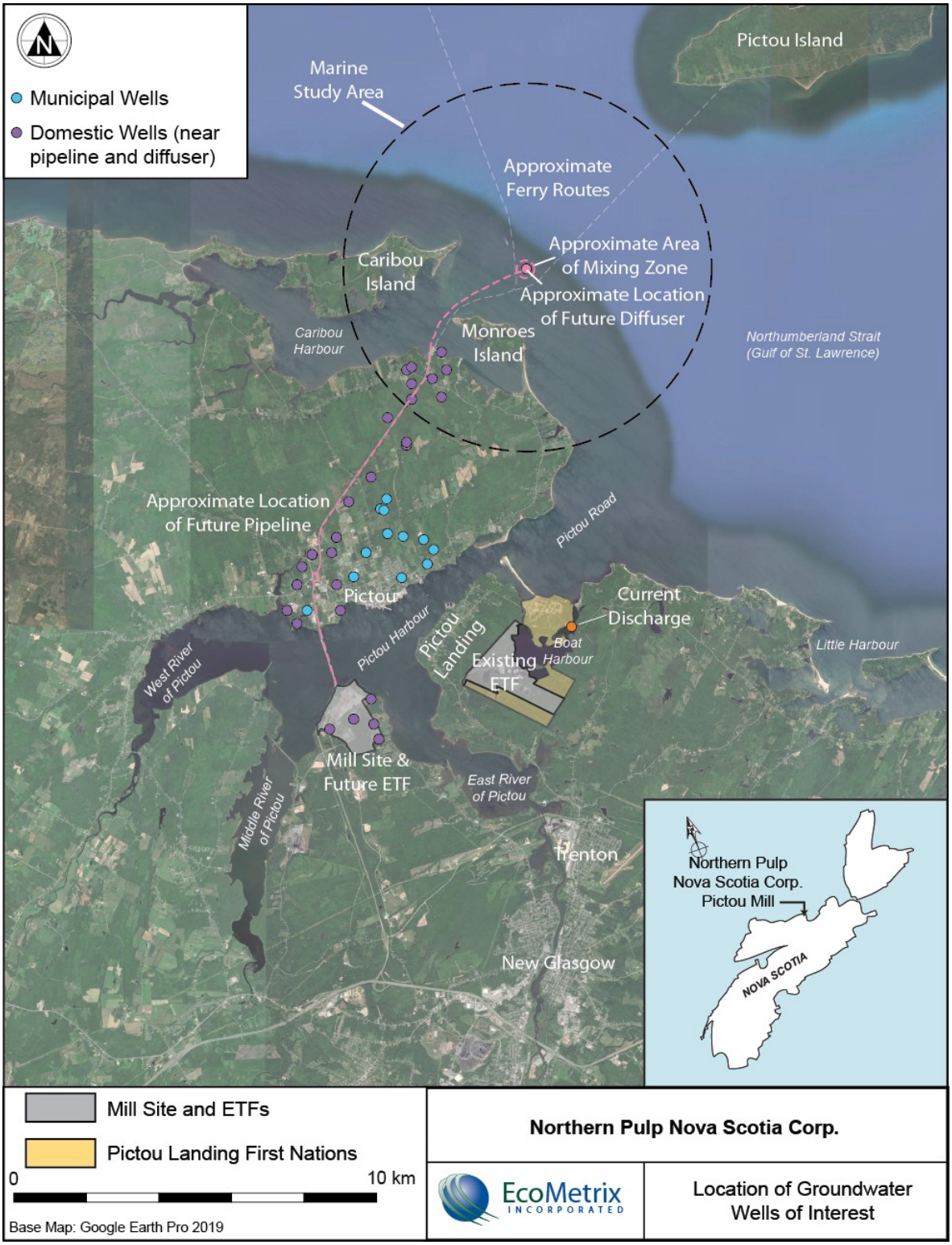


Figure C.1: Approximate Location of Wells that may be used for Drinking Water along the NPNS Pipeline

Table C.1: Comparision of Maximum Effluent Concentrations to Drinking Water Guidelines for a Spill Sceanrio of Drinking Groundwater Exposure Pathway

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	COPC for Drinking Water in Spill Scenario
		Maximum	Total Count	Count (<RDL)				
Inorganics								
Dissolved Chlorate (ClO3-)	mg/L	<1	1	1	1	NA	NA	No
Dissolved Chlorite (CLO2-)	mg/L	**2.1**	2	1	**1**	NA	NA	**Yes**
Dissolved Fluoride (F-)	mg/L	<0.1	1	1	1.5	NA	NA	No
Nitrite (N)	mg/L	**3.2**	1,986	1,754	**1**	NA	NA	**Yes**
Nitrate (N)	mg/L	4.2	1,986	1,776	10	NA	NA	No
Total Cyanide (CN)	mg/L	<0.005	2	1	0.2	NA	NA	No
Metals								
Total Antimony (Sb)	µg/L	<2	5	5	6	NA	NA	No
Total Arsenic (As)	µg/L	<2	5	2	10	NA	NA	No
Total Barium (Ba)	µg/L	450	5	0	1,000	NA	NA	No
Total Beryllium (Be)	µg/L	<2	5	5	NV	4	NA	No
Total Bismuth (Bi)	µg/L	<2	5	5	NV	NV	NV	No
Total Boron (B)	µg/L	94	5	0	5,000	NA	NA	No
Total Cadmium (Cd)	µg/L	1.4	5	0	5	NA	NA	No
Total Chromium (Cr)	µg/L	3.0	5	0	50	NA	NA	No
Total Cobalt (Co)	µg/L	<1	5	2	NV	10	NA	No
Total Copper (Cu)	µg/L	7.5	5	0	2,000	NA	NA	No
Total Lead (Pb)	µg/L	3.0	5	0	5	NA	NA	No
Total Manganese (Mn)	µg/L	**2,800**	5	0	**120**	NA	NA	**Yes**
Total Mercury (Hg)	µg/L	0.028	3	0	1	NA	NA	No
Total Molybdenum (Mo)	µg/L	4.0	5	2	NV	70	NA	No
Total Nickel (Ni)	µg/L	5.0	5	0	NV	100	NA	No
Total Selenium (Se)	µg/L	2.0	5	4	50	NA	NA	No
Total Silver (Ag)	µg/L	0.37	5	0	NV	100	NA	No
Total Strontium (Sr)	µg/L	163	5	0	NV	4,400	NA	No
Total Thallium (Tl)	µg/L	<0.1	5	5	NV	2	NA	No
Total Tin (Sn)	µg/L	<2	4	4	NV	4,400	NA	No
Total Titanium (Ti)	µg/L	14	4	0	NV	NV	NA	**Yes - no guideline exists**
Total Uranium (U)	µg/L	0.9	4	0	20	NA	NA	No
Total Vanadium (V)	µg/L	5.0	5	0	NV	6.2	NA	No
Dioxins & Furans								
2,3,7,8-Tetra CDD	pg/L	<1.9	7	7	NV	NA	NA	NA
1,2,3,7,8-Penta CDD	pg/L	<2.5	7	7	NV	NA	NA	NA
1,2,3,4,7,8-Hexa CDD	pg/L	<1.5	7	7	NV	NA	NA	NA
1,2,3,6,7,8-Hexa CDD	pg/L	<1.8	7	7	NV	NA	NA	NA
1,2,3,7,8,9-Hexa CDD	pg/L	<1.8	7	7	NV	NA	NA	NA
1,2,3,4,6,7,8-Hepta CDD	pg/L	10.4	7	3	NV	NA	NA	NA
Octa CDD	pg/L	28.9	7	1	NV	NA	NA	NA
2,3,7,8-Tetra CDF	pg/L	4.6	7	4	NV	NA	NA	NA
1,2,3,7,8-Penta CDF	pg/L	<1.34	7	6	NV	NA	NA	NA
2,3,4,7,8-Penta CDF	pg/L	<1.36	7	7	NV	NA	NA	NA
1,2,3,4,7,8-Hexa CDF	pg/L	<2.1	7	6	NV	NA	NA	NA
1,2,3,6,7,8-Hexa CDF	pg/L	<2.2	7	6	NV	NA	NA	NA

Table C.1: Comparision of Maximum Effluent Concentrations to Drinking Water Guidelines for a Spill Sceanrio of Drinking Groundwater Exposure Pathway

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	COPC for Drinking Water in Spill Scenario
		Maximum	Total Count	Count (<RDL)				
2,3,4,6,7,8-Hexa CDF	pg/L	<1.9	7	7	NV	NA	NA	NA
1,2,3,7,8,9-Hexa CDF	pg/L	<2.7	7	6	NV	NA	NA	NA
1,2,3,4,6,7,8-Hepta CDF	pg/L	<3.1	7	6	NV	NA	NA	NA
1,2,3,4,7,8,9-Hepta CDF	pg/L	<4.4	7	7	NV	NA	NA	NA
Octa CDF	pg/L	3.5	7	4	NV	NA	NA	NA
Dioxin & Furans (TEQ- 2,3,7,8-TCDD)	pg TEQ/L	6.90	-	-	120	NA	NA	No
Glycols								
Ethylene Glycol	mg/L	**<3**	1	1	NV	**0.031**	NA	**Yes**
Diethylene Glycol	mg/L	<5	1	1	NV	NV	NV	No
Triethylene Glycol	mg/L	<5	1	1	NV	NV	NV	No
Propylene Glycol	mg/L	<5	1	1	NV	NV	NV	No
Polycyclic Aromatic Hydrocarbons								
Acenaphthene	µg/L	<0.01	2	2	NV	1,400	NA	No
Acenaphthylene	µg/L	<0.03	2	2	NV	4.5	NA	No
Anthracene	µg/L	<0.02	2	2	NV	NV	890	No
Benzo(a)anthracene	µg/L	<0.01	2	2	NV	NV	1	No
Benzo(a)pyrene	µg/L	<0.01	2	2	0.04	NA	NA	No
Benzo(b/j)fluoranthene	µg/L	<0.02	2	2	NV	NV	0.1	No
Benzo(g,h,i)perylene	µg/L	<0.01	2	2	NV	NV	1	No
Benzo(k)fluoranthene	µg/L	<0.01	2	2	NV	NV	0.1	No
1-Chloronaphthalene	µg/L	<4	1	1	NV	NV	NV	No
2-Chloronaphthalene	µg/L	<2	1	1	NV	NV	NV	No
Chrysene	µg/L	<0.01	2	2	NV	NV	0.1	No
Dibenz(a,h)anthracene	µg/L	<0.01	2	2	NV	NV	0.01	No
Fluoranthene	µg/L	0.037	2	0	NV	NV	0.41	No
Fluorene	µg/L	<0.1	2	2	NV	940	NA	No
Indeno(1,2,3-cd)pyrene	µg/L	<0.01	2	2	NV	NV	0.1	No
1-Methylnaphthalene	µg/L	<0.05	2	2	NV	72	NA	No
2-Methylnaphthalene	µg/L	<0.05	2	2	NV	72	NA	No
Naphthalene	µg/L	<0.2	2	2	1,800	NA	NA	No
Perylene	µg/L	<0.01	2	2	NV	NV	NV	No
Phenanthrene	µg/L	0.049	2	0	NV	NV	1	No
Pyrene	µg/L	<0.02	2	1	NV	710	NA	No
Volatile Organics								
Benzene	mg/L	<0.001	2	2	0.005	NA	NA	No
Bromodichloromethane	µg/L	<1	2	2	NV	100	NA	No
Bromoform	µg/L	<1	2	2	NV	100	NA	No
Bromomethane	µg/L	<0.5	2	2	NV	0.89	NA	No
Carbon Tetrachloride	µg/L	<0.5	2	2	2	NA	NA	No
Chlorobenzene	µg/L	<1	2	2	NV	30	NA	No
Chloroethane	µg/L	<8	2	2	NV	NV	NV	No
Chloroform	µg/L	<1	2	2	NV	100	NA	No
Chloromethane	µg/L	<8	2	2	NV	38	NA	No
1,2-Dichlorobenzene	µg/L	<0.5	2	2	200	NA	NA	No

Table C.1: Comparision of Maximum Effluent Concentrations to Drinking Water Guidelines for a Spill Sceanrio of Drinking Groundwater Exposure Pathway

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	COPC for Drinking Water in Spill Scenario
		Maximum	Total Count	Count (<RDL)				
1,3-Dichlorobenzene	µg/L	<1	2	2	NV	59	NA	No
1,4-Dichlorobenzene	µg/L	<1	2	2	5	NA	NA	No
1,1-Dichloroethane	µg/L	<2	2	2	NV	5	NA	No
1,2-Dichloroethane	µg/L	<1	2	2	5	NA	NA	No
1,1-Dichloroethylene	µg/L	**<71**	2	2	**14**	NA	NA	**Yes**
cis-1,2-Dichloroethylene	µg/L	<0.5	2	2	NV	20	NA	No
trans-1,2-Dichloroethylene	µg/L	<0.5	2	2	NV	20	NA	No
1,2-Dichloropropane	µg/L	<0.5	2	2	NV	5	NA	No
1,3-Dichloropropene	µg/L	**<1.0**	2	2	NV	**0.5**	NA	**Yes**
Dibromochloromethane	µg/L	<1	2	2	NV	NV	25	No
Ethylbenzene	mg/L	<0.001	2	2	0.14	NA	NA	No
Ethylene Dibromide	µg/L	**<1**	2	2	NV	LRL	**0.05**	**Yes**
Methyl t-butyl ether (MTBE)	µg/L	<2	2	2	15	NA	NA	No
Methylene Chloride (Dichloromethane)	µg/L	<3	2	2	50	NA	NA	No
Styrene	µg/L	<1	2	2	NV	100	NA	No
1,1,2,2-Tetrachloroethane	µg/L	<0.5	2	2	NV	1	NA	No
Tetrachloroethylene	µg/L	<1	2	2	10	NA	NA	No
Toluene	mg/L	<0.001	2	2	0.06	NA	NA	No
1,1,1-Trichloroethane	µg/L	<1	2	2	NV	200	NA	No
1,1,2-Trichloroethane	µg/L	<1	2	2	NV	5	NA	No
Trichloroethylene	µg/L	<1	2	2	5	NA	NA	No
Trichlorofluoromethane (FREON 11)	µg/L	<8	2	2	NV	NV	150	No
Total Trihalomethanes	µg/L	<1	2	2	100	NA	NA	No
Total Xylenes	mg/L	<0.001	2	2	0.09	NA	NA	No
Vinyl Chloride	µg/L	<0.5	2	2	2	NA	NA	No
PHC with Atl. RBCA V3.1 method								
Benzene	mg/L	<0.001	2	2	0.005	NA	NA	No
Toluene	mg/L	<0.001	2	2	0.06	NA	NA	No
Ethylbenzene	mg/L	<0.001	2	2	0.14	NA	NA	No
Total Xylenes	mg/L	<0.002	2	2	0.09	NA	NA	No
C6 - C10 (less BTEX)	mg/L	<0.01	2	2	NV	NV	0.82	No
>C10-C16 Hydrocarbons	mg/L	0.13	2	0	NV	NV	0.3	No
>C16-C21 Hydrocarbons	mg/L	0.13	2	0	NV	NV	1	No
>C21-<C32 Hydrocarbons	mg/L	0.26	2	0	NV	NV	1	No
Modified TPH (Tier1)	mg/L	0.53	2	0	NV	3.2	NA	No
Polychlorinated Biphenyls								
Total PCBs	µg/L	<0.05	2	2	NV	9.4	NA	No
Phenols								
Total of Reg.P&P phenols	µg/L	9.6	2	1	NV	LRL	890	No
Catechol	µg/L	3.7	1	0	NV	NV	NV	**Yes - no guideline exists**
4 Chlorocatechol	µg/L	<0.5	1	1	NV	NV	NV	No
4-Chloroguaiacol	µg/L	<0.5	1	1	NV	NV	NV	No
2-Chlorophenol	µg/L	<1.2	2	1	NV	NV	8.9	No
3-Chlorophenol	µg/L	<0.5	1	1	NV	NV	NV	No

Table C.1: Comparision of Maximum Effluent Concentrations to Drinking Water Guidelines for a Spill Sceanrio of Drinking Groundwater Exposure Pathway

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	COPC for Drinking Water in Spill Scenario
		Maximum	Total Count	Count (<RDL)				
4-Chlorophenol	µg/L	<0.5	1	1	NV	NV	NV	No
3 & 4-Chlorophenol	µg/L	<0.4	1	1	NV	NV	NV	No
o-Cresol	µg/L	<3	2	1	NV	NV	NV	No
m-Cresol	µg/L	<0.5	1	1	NV	NV	NV	No
p-Cresol	µg/L	0.71	1	0	NV	NV	NV	**Yes - no guideline exists**
m/p-Cresol	µg/L	<2	1	1	NV	NV	NV	No
6-Chlorovanillin	µg/L	0.75	1	0	NV	NV	NV	**Yes - no guideline exists**
3,5 Dichlorocatechol	µg/L	<0.5	1	1	NV	NV	NV	No
4,5 Dichlorocatechol	µg/L	<0.5	1	1	NV	NV	NV	No
4,5 Dichloroguaiacol	µg/L	<0.5	1	1	NV	NV	NV	No
4,6 Dichloroguaiacol	µg/L	<5.6	1	1	NV	NV	NV	No
2,3 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
2,4-Dichlorophenol	µg/L	<1.2	1	1	NV	NV	NV	No
2,5-Dichlorophenol	µg/L	<2	1	1	NV	NV	NV	No
2,4 +2.5- Dichlorophenol	µg/L	<0.5	1	1	NV	NV	NV	No
2,6 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
3,4 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
3,5 Dichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
2,4 Dimethylphenol	µg/L	<2	2	1	NV	NV	59	No
5,6-Dichlorovanillin	µg/L	<0.5	1	1	NV	NV	NV	No
4,5 Dichloroveratrol	µg/L	<0.5	1	1	NV	NV	NV	No
2,4-Dinitrophenol	µg/L	**<25**	1	1	NV	NV	**5.9**	**Yes**
4,6-Dinitro-2-methylphenol	µg/L	<8	1	1	NV	NV	NV	No
Eugebol	µg/L	<0.5	1	1	NV	NV	NV	No
Guaiacol	µg/L	1.2	1	0	NV	NV	NV	**Yes - no guideline exists**
Isoeugenol	µg/L	<0.5	1	1	NV	NV	NV	No
2-Nitrophenol	µg/L	<2	2	2	NV	NV	NV	No
4-Nitrophenol	µg/L	<5.6	2	2	NV	NV	NV	No
Pentachlorophenol	µg/L	<4	2	2	60	NA	NA	No
Tetrachlorocatechol	µg/L	<0.5	1	1	NV	NV	NV	No
Tetrachloroguaiacol	µg/L	<2	2	2	NV	NV	NV	No
2,3,4,5 Tetrachlorophenol	µg/L	<1.6	2	2	NV	NV	NV	No
2,3,4,6 Tetrachlorophenol	µg/L	<2	2	2	100	NA	NA	No
2,3,5,6 Tetrachlorophenol	µg/L	<2	2	2	NV	NV	NV	No
3,4,5,6 Tetrachloroveratrol	µg/L	<0.5	1	1	NV	NV	NV	No
23,4,5 Trichlorocatechol	µg/L	<0.5	1	1	NV	NV	NV	No
3,4,5 Trichloroguaiacol	µg/L	<0.5	1	1	NV	NV	NV	No
4,5,6 Trichloroguaiacol	µg/L	<0.5	1	1	NV	NV	NV	No
2,3,4 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
2,3,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
2,3,6 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
2,4,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	8.9	No
2,4,6-Trichlorophenol	µg/L	<2	2	2	5	NA	NA	No
3,4,5 Trichlorophenol	µg/L	<2	2	2	NV	NV	NV	No
3,4,5 Trichlorosyringol	µg/L	<0.5	1	1	NV	NV	NV	No

Table C.1: Comparision of Maximum Effluent Concentrations to Drinking Water Guidelines for a Spill Sceanrio of Drinking Groundwater Exposure Pathway

Parameter	Unit	Treated Effluent Concentrations (Point C)			Health Canada Drinking Water Guideline [1]	Nova Scotia Environment Potable Groundwater Drinking Water [2]	Ontario Regulation 153/04 [3]	COPC for Drinking Water in Spill Scenario
		Maximum	Total Count	Count (<RDL)				
3,4,5 Trichloroveratrol	µg/L	<0.5	1	1	NV	NV	NV	No
Semi-Volatile Organics								
Benzyl butyl phthalate	µg/L	<2	1	1	NV	NV	NV	No
Biphenyl	µg/L	<2	1	1	NV	NV	110	No
Bis(2-chloroethoxy)methane	µg/L	<2	1	1	NV	NV	NV	No
Bis(2-chloroethyl)ether	µg/L	**<2**	1	1	NV	NV	**0.012**	**Yes**
Bis(2-chloroisopropyl)ether	µg/L	<2	1	1	NV	NV	120	No
Bis(2-ethylhexyl)phthalate	µg/L	**<8**	1	1	NV	NV	**6**	**Yes**
4-Bromophenyl phenyl ether	µg/L	<1.2	1	1	NV	NV	NV	No
p-Chloroaniline	µg/L	<4	1	1	NV	NV	5.9	No
4-Chlorophenyl phenyl ether	µg/L	<2	1	1	NV	NV	NV	No
3,3'-Dichlorobenzidine	µg/L	<2	1	1	NV	NV	NV	No
Diethyl phthalate	µg/L	<4	1	1	NV	NV	15,000	No
Dimethyl phthalate	µg/L	<4	1	1	NV	NV	15,000	No
2,4 + 2,6-Dinitrotoluene	µg/L	**<4**	1	1	NV	NV	**0.044**	**Yes**
Di-N-butyl phthalate	µg/L	<8	1	1	NV	NV	NV	No
di-n-octyl phthalate	µg/L	<3.2	1	1	NV	NV	NV	No
Diphenyl Ether	µg/L	<1.2	1	1	NV	NV	NV	No
Hexachlorobenzene	µg/L	**<2**	1	1	NV	NV	**1**	**Yes**
Hexachlorobutadiene	µg/L	**<1.6**	1	1	NV	NV	**0.6**	**Yes**
Hexachlorocyclopentadiene	µg/L	<8	1	1	NV	NV	NV	No
Hexachloroethane	µg/L	<2	1	1	NV	NV	2.1	No
Isophorone	µg/L	<2	1	1	NV	NV	NV	No
Nitrobenzene	µg/L	<2	1	1	NV	NV	NV	No
Nitrosodiphenylamine/Diphenylamine	µg/L	<4	1	1	NV	NV	NV	No
N-Nitroso-di-n-propylamine	µg/L	<2	1	1	NV	NV	NV	No
Pentachlorobenzene	µg/L	<2	1	1	NV	NV	NV	No
1,2,3,4-Tetrachlorobenzene	µg/L	<2	1	1	NV	NV	NV	No
1,2,3,5-Tetrachlorobenzene	µg/L	<2	1	1	NV	NV	NV	No
1,2,4,5-Tetrachlorobenzene	µg/L	<2	1	1	NV	NV	NV	No
1,2,3-Trichlorobenzene	µg/L	<2	1	1	NV	NV	NV	No
1,2,4-Trichlorobenzene	µg/L	<2	1	1	NV	NV	70	No
1,3,5-Trichlorobenzene	µg/L	<2	1	1	NV	NV	NV	No

Notes:

NV - No Value

NA - Not Applicable

LRL - Laboratory Reporting Limit

1- HC (Health Canada). 2017. Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontar

2 - NSE (Nova Scotia Environment). 2014. Environmental Quality Standards for Contaminated Sites: Rationale and Guidance Document. Version 1.0 April 2014.

3 - MOE (Ontario Ministry of the Environment). 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. Standards Development Branch. Toronto, ON. A

4 - Derived from drinking water quality guidelines as described in **Appendix A**.

* The NSE (2014) guideline for Modified TPH for fuel. The lowest value of the Modified TPH for gas, fuel and lube was selected for the screening.

The NSE (2014) guideline is expressed as a toxic equivalent (TEQ) of 2,3,7,8- TCDD. For comparison with the NSE (2014) guideline, the effluent concentration was also expressed as a TEQ of 2,3,7,8-TCDD. multiplying the effluent concentration of each congener with a toxic equivalency factor (TEF) for 2,3,7,8- TCDD and summing the concentrations.

Appendix D Response to Health Canada Comments

Table D.1: Health Canada Comments on NPNS Seafood Intake Survey and Responses

No.	Health Canada Comments on Seafood Intake Survey (Email July 10, 2019 from Allison Denning (HC/SC) addressed to Michael Wilson (NPNS) and Email July 10, 2019 from Sara Rumbolt (HC/SC) addressed to Michael Wilson (NPNS)	EcoMetrix Response to Initial Comments (Email dated July 15, 2019 addressed to Allison Denning (HC/SC) and Sara Rumbolt (HC/SC) from Carolyn Brown (EcoMetrix)	Health Canada Response to EcoMetrix' Response (Email July 17, 2019 from Allison Denning (HC/SC) addressed to Carolyn Brown (EcoMetrix) and Sara Rumbolt (HC/SC))	EcoMetrix Response to Health Canada's Response (Email July 18, 2019 addressed to Allison Denning (HC/SC) and Sara Rumbolt (HC/SC) from Lara Alves Beese(EcoMetrix))	Change to Seafood Intake Survey	Follow-up by Health Canada (Email dated July 18, 2019 from Allison Denning (HC/SC) addressed to Lara Alves Beese (EcoMetrix))
1	I was wondering if people consume any marine plants (thinking dulse for example) and also any freshwater aquatic species along the pipeline route (in the event of an accidental leak along the route) – if I recall correctly, there were several watercourse crossings along the proposed pipeline route.	a) The Atlantic FN survey did not indicate that anyone ate marine plants, so dulse was not explicitly mentioned in the survey. There is space for respondents to add other seafood types, such as dulse, if they do consume other seafoods. b) We believe the majority of the freshwater crossings do not support fish, but even if they did, a pipeline leak is considered an accident scenario. Exposure would be very short and there would be insufficient exposure time for appreciable bioaccumulate in tissue. This scenario will be discussed qualitatively in an appendix to the HHRA.	a) Health Canada is satisfied with the response. b) It would be useful to include a question on the survey to support the statement above that fishing is not conducted in these freshwater streams to validate the 'belief' described above (i.e. "do you collect fish from any freshwater stream along the land-based portion of the pipeline route?"). Given that there have been leakages in the previous effluent pipeline discharging to Boat Harbour, this may be a concern from a public perception perspective, particularly if fish or other aquatic species are harvested from these watercourses. Health Canada is satisfied that this will be evaluated as an accident scenario.	NA	None	NA
2	The First Nations Food Nutrition and Environment Survey that was used in Atlantic Canada consisted of two types of dietary intake questionnaires, a food frequency questionnaire (FFQ) and a 24 hour recall. There does not appear to be a 24-hour recall component to your survey. First Nations Food, Nutrition and Environment Study. (2012). FNFNES Questionnaire 2012. www.fnfnes.ca/docs/Forms/FNFNES%20Ontario%202012%20Questionnaire.pdf	24 recall was not considered useful for our purposes, since seafood harvest tends to be seasonal. Our questions were about frequency of food consumption (e.g. servings per week).	Health Canada is satisfied with the response.	NA	None	NA
3	According to Health Canada. (2018). Guidance for Evaluating Human Health Impacts in Environmental Assessment: Country Foods. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario, the following information should be collected as part of any country food consumption survey (the bullets that are bolded do not appear to have been fully captured in your survey:	We were aware of the documents mentioned by Health Canada, and they were considered when designing our survey.	NA	NA	None	NA
a	**receptor characteristics (i.e., age, gender, cultural affiliation, etc.), including receptors with atypical consumption patterns due to occupational, recreational, and cultural activities relevant to country food consumption (e.g., hunters, trappers, fishers)**	The survey will be completed by adult respondents. We do not ask their age or gender. The HHRA will address a generic adult receptor (not male or female specifically) and results will be scaled for other age groups based on their physiological needs. Energy requirements for different age groups are well known. We do ask about ethnic origin (FN or other) so we can evaluate if FN consumption is different.	Health Canada disagrees with this approach as age and gender would have an influence on the results of the HHRA. These are simple questions that can be asked at the start of the interview (with a 'no response/refused to answer' option). Given that women of child-bearing age and elders may have greater sensitivities to exposure to contaminants, this information would be very useful for statistical purposes and to use in the HHRA. Also, if there are a disproportionate number of males sampled (for example), this may bias the results and not capture consumption patterns by females.	We understand your concerns. In the phone survey conducted thus far, we did ask respondents for their age and gender. We have also revised our paper copy/electronic survey (attached) to include questions on gender and age.	Revised survey to include age and gender.	All of my additional comments/questions have been answered. I look forward to seeing the results of the survey and to see how it compares with the results of the FNFNES study that was conducted in Atlantic Canada a couple of years ago.
b	a list of the country foods consumed, including common and scientific names of species	The general public would not know scientific names, so we use common names in the survey. Scientific names will be added in our reports.	Health Canada is satisfied with the response.	NA	None	NA
c	the source of country foods (i.e., where the food is typically harvested and how it is obtained—hunted, fished, gathered, etc.)	We have tried to focus on questions that will be useful to us in our quantitative HHRA, which are the rates of consumption of fish and shellfish harvested from the region around the proposed new discharge (within a 5 km radius).	NA	NA	None	NA
d	specific tissues (skin, fatty flesh, muscular flesh or organs) or parts of plants (roots, leaves, flowers, berries, seeds, etc.) that are consumed	There is a question asking about consumption of specific organs. Depending on the results, we may model such consumption in the HHRA.	NA	NA	None	NA
e	the typical portion size for each tissue or part of plants consumed, using standard measures such as measuring cups or spoons, or weights	NA	NA	NA	None	NA
f	the frequency of consumption (i.e., the number of servings per week or month or season, and if there are any seasonal patterns and variations due to special events such as celebrations or holidays)	Our questions were about frequency of food consumption (e.g. servings per week) and we do ask if the rates provided are specific to a particular season.	Health Canada is satisfied with the response.	NA	None	NA
g	**the typical method of preparation: skin on/off, washing, peeling, cooking (raw, fried, baked, etc.), drying, fermenting, and any other preparation methods that may affect the COPC concentration of the foods consumed**	We have not asked about food preparation, because we will not be using food processing factors in the HHRA. In general, food processing effects on COPC levels are poorly known and difficult to model. No credit will be taken for reduced concentrations as a result of food processing.	Health Canada disagrees with aspects of this comment. The cooking method can have an impact on the contaminants that may available to the individual. For example, if seafood is cured via smoking, this can substantially increase the concentrations of PAHs. Another example would be certain fat-soluble contaminants, which may be reduced/removed from the food when it is fried.	We acknowledge that there are many different food preparation practices that may introduce and/or reduce COPC concentrations in food items. Considering that our phone survey to the general public has now been completed, it is too late to obtain information about these practices. As noted, we will assume no reduction in concentration due to food preparation. In the HHRA, we will discuss the uncertainties related to food preparation, and their effects on the conclusions of the HHRA.	None	All of my additional comments/questions have been answered. I look forward to seeing the results of the survey and to see how it compares with the results of the FNFNES study that was conducted in Atlantic Canada a couple of years ago.
h	traditional knowledge (i.e., species consumed, when the foods are consumed, their residence times, and times of increased consumption of specific foods such as, seasonal patterns or migration periods)	We have tried to focus on questions that will be useful to us in our quantitative HHRA, which are the rates of consumption of fish and shellfish harvested from the region around the proposed new discharge (within a 5 km radius). Our survey is aimed at the community. It is not specifically focused on First Nations or traditional knowledge.	NA	NA	None	NA
	Health Canada (2012) (Appendix A) contains an example of information that should be collected as part of a country foods survey.	We were aware of the documents mentioned by Health Canada, and they were considered when designing our survey.	NA	NA	None	NA
4	Choice of impact area. With the influence of currents and tidal action I suspect that the most heavily impacted area would actually follow the predominant current and be influenced by tidal action and not be equally diffused from the end of the pipe. I would suggest modelling or reference to tide and current maps to model likely "plume" dispersion or extending the potentially impacted area further in the direction of the predominant currents or tides if this isn't possible.	The effluent mixing model suggests that the effluent will be mixed within ~20 m of the diffuser in the predominate current (southeast). It is our understanding that the model is being updated to include other tidal conditions. We think it is unlikely that mixing will have not been achieved within 100 m. Focusing only on this small mixing area would be difficult to get realistic intake rates. Therefore, we expanded the Local Area to a 5 km radius. The larger Local Area will have more variety in habitat and therefore, likely more food items sourced within it. We believe this is a more conservative approach.	Provided that the modelling will be validated with actual monitoring at various distances from the diffuser, Health Canada is satisfied with the response. The comment from Health Canada also took into consideration the possibility that the final outfall location may change and the final diffuser type may also change, and as such, the current model results may not account for these variations in design and location.	NA	None	NA