DILLON CONSULTING

NORTHERN PULP NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

NORTHERN PULP NOVA SCOTIA

FOCUS REPORT

Replacement Effluent Treatment Facility

October 2019

Executive Summary

In 1967, Scott Paper began operating a bleached Kraft pulp mill at Abercrombie Point, leading to job opportunities and improvements in the local economy. Since that time, the wastewater from the pulping process has been managed at the provincially owned Boat Harbour Effluent Treatment Facility (BHETF). In 2015, the closure of the existing treatment facility was mandated by the Province of Nova Scotia with the passing of the *Boat Harbour Act*. To remain in operation, Northern Pulp Nova Scotia (NPNS or Northern Pulp), the current owner, must replace the BHETF with a new treatment system.

The proposed project will consist of the construction and subsequent operation of a new effluent treatment facility (ETF) including a pipeline to transport treated effluent for discharge into the Northumberland Strait, further out from the current discharge location. The ETF will be an Activated Sludge Treatment (AST) system located on Northern Pulp property. The pipeline will begin at the ETF and will be installed generally parallel to Highway 106, along the outermost eastern portion of the TIR right-of-way until it meets Caribou Harbour and eventually the Northumberland Strait. As has been the case since 1967 via the existing facility, the treated effluent discharge will continue to be discharged into the Northumberland Strait. However, the proposed project will consist of a modernized treatment system enhancing protection of the local receiving environment (water discharge).

In January 2019, Northern Pulp submitted an environmental assessment registration document (EARD) for the approval to replace the BHETF with an on-site ETF. Following the submission of the EARD, Nova Scotia Environment (NSE) requested additional information to support a final decision regarding the approval of the environmental assessment. The request for additional information was provided as a Terms of Reference for a Focus Report.

This document, the Focus Report, provides a science-based review including additional data beyond what was in Northern Pulp's EARD submission in January 2019. Over twenty different science-based investigations and analyses have been conducted to provide additional evidence in describing the potential environmental impacts and their mitigation measures for the new proposed ETF. These scientific analyses include environmental baseline studies, archaeological investigations, receiving water modeling, engineering designs, and Mi'kmaq Ecological Knowledge Studies and many more. Overall, the culmination of this work provides science-based evidence that will enable the environmental assessment to be approved. Additionally, as requested in the Terms of Reference, a re-aligned treated effluent pipeline route was also determined, and subject to science based analyses.

Figure E-1: Summary of Science-Based Evidence Used in the Focus Report

The development of a new ETF is fundamental to the continued operation of the Northern Pulp mill. Project components will be designed to meet the federal Pulp and Paper Effluent Regulations (PPER), the National Building Code of Canada, the Canadian Standards Association, best practices for effluent treatment and pipeline construction, and other design codes and standards. All future facility operations will also be conducted under a provincial Industrial Approval.

A receiving water study was completed to determine the optimum location for the treated effluent outfall that would achieve diffusion to meet or exceed applicable regulations and guidelines. Alternative sites were considered within and outside of Pictou Harbour and the preferred location is outside Caribou Harbour in the

Northumberland Strait. The installation of a modern engineered diffuser provides a significant improvement in effluent dispersion compared to the current BHETF, which does not have an engineered diffuser.

An updated inventory of current emissions was developed for Northern Pulp, as well as for the future operation of Northern Pulp once the ETF is operational. These emissions were then put into a computer model to predict what future air quality in the receiving environment might be as a result of the continued operation of Northern Pulp and the operation of the ETF (including burning of sludge in the power boiler). Emissions of the regulated air contaminants are predicted to be below the provincially-regulated maximum permissible ground-level concentrations, and no significant effects on the atmospheric environment are predicted.

The pipeline design was adjusted, as a risk management measure, with respect to the potential for leaks within the land-based portion of the re-aligned pipeline. The design and material selection for this pipeline are very robust and resistant to catastrophic failure and leak propagation. However, the pipeline material specification will be increased to 900 mm (36 inch) SDR 13.5, providing a heavier wall thickness and increased factor of safety for the entire portion of the land-based pipeline between Pictou and Caribou. The thicker-walled pipe increases the design safety factor over operating pressures. This, coupled with a modern leak detection system using advanced detection technologies that can detect very small leaks, provides a robust system design that can be operated with confidence.

A variety of environmental protection and management measures have been adopted through the development of the project to date in order to guide the planning, design, construction, operation and maintenance, and ultimate decommissioning of the project. These include, but are not limited to, the following measures:

1. Siting the project components to avoid sensitive areas such as wetlands, watercourses and important habitat types, where possible, and to reduce the size and number of natural drainages that may be affected;
2. Minimizing the “footprint” of project facilities and activities to consequently reduce the amount of disturbed land, wetlands and water resources;
3. Siting of the marine outfall to minimize potential impact to marine water quality;

4. Employing good planning, design and management practices to comply with regulatory standards for air emissions, water releases, storage or disposal of solid wastes, and handling and disposal of hazardous materials;
5. Constructing and operating methodologies conducted in a manner consistent with Northern Pulp Environmental Management System (EMS) which incorporates operational policies and practices for monitoring and management of, for example, land and soil resources, air and water, noise and vibration, hazardous materials and waste, community health and safety, and cultural heritage; and
6. Developing and implementing an overall Environmental Management Plan (EMP) and Environmental Protection Plan (EPP) for construction activities that will be included in, and enforced through, construction contracts.

Northern Pulp has emphasized project design and siting so that the location and configuration of the project facilities considers the above measures wherever possible so as to avoid or minimize the potential environmental effects of the project. Where avoidance is not possible, mitigation or compensation measures have been developed as part of the Environmental Assessment (EA), and will be implemented in consultation with the applicable regulatory authorities.

Environmental management does not end once the project construction is complete. A follow-up and monitoring program will be developed as part of the project. The objectives of this program are to:

1. Verify the environmental effects predictions included in the EARD and Focus Report or to assess the effectiveness of mitigation, as required;
2. Propose environmental monitoring measures aimed at monitoring the project's environmental effects;
3. Demonstrate compliance with environmental acts, regulations, and approvals/permits/authorizations issued for the project; and,
4. Provide a basis for long-term adaptation to changing environmental conditions occurring naturally or as a result of the project.

It is expected that this program would be adjusted as required over the life of the project in response to the results of follow-up or monitoring initiatives, changes in regulatory requirements, or other factors.

The impact assessment conducted for the EARD (NPNS, 2019) is herein based on the revised project description presented in the Focus Report. Project changes required a reassessment of six of the Valued Environmental Components (VECs). The following summarizes the effects assessments conducted and results associated with the re-assessed VECs, included as part of the preparation for the Focus Report.

- Atmospheric Environment - the additional air contaminant emissions assessment undertaken for the Focus Report was reviewed to determine if adjustments were necessary to the Atmospheric Environment VEC assessment. Four additional parameters were modelled as exceeding criteria from Ontario, in the absence of any Nova Scotia standards for these parameters. The frequency of exceedances was low (<0.5%), below significance criteria, and no significant adverse residual environmental effects were predicted.
- Surface Water (Freshwater), Freshwater Fish and Fish Habitat, and Wetlands - potential impacts to watercourses and wetlands (which include fish habitat) were re-assessed along the land-based re-aligned pipeline route based on the identification of trenching as a preferred watercourse crossing method. Mitigation associated with trenched crossing methods was incorporated in the assessment, along with meeting regulatory requirements such as provincial watercourse and wetland approvals and *Fisheries Act* authorizations including compensation and offsets for habitat loss. No significant adverse residual effects were identified.
- Harbour Physical Environment, Water Quality, and Sediment Quality (Marine) and Marine Fish and Fish Habitat - potential impacts to these marine VECs were evaluated in light of minor adjustments to the marine pipeline route and the updated receiving water assessment and comparison to the current outfall. Based on the receiving water study results and with identified mitigation, including meeting *Fisheries Act* authorization requirements, no significant residual adverse environmental effects were identified. The receiving water study at the existing Boat Harbour dam discharge into the Northumberland Strait undertaken to assess environmental impacts has concluded that existing dilution factors are low and insufficient for effluent mixing with the ambient water. A diffused outfall near outside of Caribou Harbour in the Northumberland Strait is considered to have much less potential effluent impact on the receiving environment and represents an improvement.

In summary, the Focus Report answers each of the Terms of Reference items specifically, providing additional information and scientific analyses to support the approval of the environmental assessment. The impact assessment conducted for the EARD has been updated based on the revised project description and similar to the EARD, through appropriate mitigation, no significant adverse residual environmental impacts have been predicted.

Table of Contents

Figures

Tables

Appendices

Acronyms, Abbreviations

Acronym	Definition
ADCP	Acoustic Doppler Current Profiler
AS	Activated Sludge
AST	Activated sludge treatment
AOX	Adsorbable Organic Halides
ASB	Aerated stabilization basin
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ARIA	Archaeological Resource Impact Assessment
BATEA	Best Available Technology Economically Achievable
BOD	Biochemical oxygen demand
BAS	Biological Activated Sludge
BAS™	Biological Activated Sludge ™
BHETF	Boat Harbour Effluent Treatment Facility
CAC	Criteria Air Contaminants
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CFIA	Canadian Food Inspection Agency
CN	Canadian National
CSQG	Canadian Sediment Quality Guideline
CWQG	Canadian Water Quality Guidelines
C	Celsius
COD	Chemical oxygen demand
CDD	chlorinated dibenzo-p-dioxin
CDF	chlorodibenzofuran
CRA	Commercial, Recreational, or Aboriginal
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COPC	Contaminants of potential concern
CORMIX	Cornell Mixing Zone Model
CAC	Criteria air contaminants
CRM	Cultural Resource Management
CSD	Cutting Suction Dredging
DFO	Department of Fisheries and Oceans
DOC	Dissolved organic carbon
DO	Dissolved oxygen

Acronym	Definition
ETF	Effluent Treatment Facility
ECF	Elemental Chlorine Free
ECCC	Environment and Climate Change Canada
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EEM	Environmental Effects Monitoring
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
GIS	Geographic information system
GLC	Ground-level concentrations
HDPE	High-density polyethylene
HH	Human Health
HHRA	Human health risk assessment
IA	Industrial Approval
ISQG	Interim Sediment Quality Guideline
LDP	Leak Detection Programs
LiDAR	Light Detection and Ranging
LAA	Local Assessment Area
MAL	Marine Aquatic Life
MEKS	Mi'kmaq Ecological Knowledge Study
µg/L	microgram/ litre
mg/L	Milligram/litre
MBBR	Moving Bed Biofilm Reactor
NBSK	Northern bleached softwood kraft
NPNS	Northern Pulp Nova Scotia
NSE	Nova Scotia Environment
NSTIR	Nova Scotia Transportation and Infrastructure Renewal
OAA	Office of Aboriginal Affairs
PE	Paper Excellence
PT	Particle Tracking
pg/L	picogram/litre
PLFN	Pictou Land First Nation
PCB	Polychlorinated Biphenyls
PAH	Polycyclic Aromatic Hydrocarbons
psu	Practical Salinity Unit

Acronym	Definition
PID	Premise Identification Number
PEI	Prince Edward Island
PEL	Probable Effects Level
PFA	Project Footprint Area
P&P	Pulp and paper
PPER	Pulp and Paper Effluent Regulations
RWS	Receiving water studies
RPR	Reference production rate
RAA	Regional Assessment Area
ROW	Right-of-way
sVOC	Semi-Volatile Organic Compounds
SWPP	Source Water Protection Plan
SAR	Species at Risk
SARA	Species At Risk Act
SOCC	Species of Conservation Concern
SW	Spectral Wind-Wave
SEP	Stakeholder engagement plan
SOP	Standard operating procedure
TCU	Total Colour Units
TDS	Total Dissolved Solids
TEU	Total Equivalent Units
TKN	Total Kjeldahl nitrogen
TME	Total mill effluent
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TRS	Total Reduced Sulphur
TSP	Total suspended particulate
TSS	Total suspended solids
TEF	Toxic equivalency factor
UBHS	Underwater Benthic Habitat Survey
US	United States
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compounds

Understanding Water Measurement Units

Scientific Prefix				Understanding Measurements in Water			
Prefix	Symbol	Multiplying Factor	Exponent Form	Parameter Measurements	Units	Part per	Time Analogy
Base Unit	*Base Unit*	1	1.0E+00	Gram/Litre	g/L	1 part per thousand	1 second in 16.8 minutes.
deci	d	0.1	1.0E-01	Decigram/Litre	dg/L	1 part per ten thousand	1 second in 2.8 hours.
centi	c	0.01	1.0E-02	Centigram/Litre	cg/L	1 part per hundred thousand	1 second in 28 hours.
milli	m	0.001	1.0E-03	Milligram/Litre	mg/L	1 part per million (ppm)	1 second in 280 hours.
micro	u	0.000001	1.0E-06	Microgram/Litre	ug/L	1 part per billon (ppb)	1 second in 32 years.
nano	n	0.000000001	1.0E-09	Nanogram/Litre	ng/L	1 part per trillion (ppt)	1 second in 320 centuries.
pico	p	0.000000000001	1.0E-12	Picogram/Litre	pg/L	1 part per quadrillion (ppq)	1 second in 32 million years.

Project Overview

In January 2019, Northern Pulp Nova Scotia submitted an Environmental Assessment Registration Document (EARD) for the approval to replace the Boat Harbour Effluent Treatment Facility (BHETF) with a new effluent treatment facility (ETF). Following the submission of the EARD, Nova Scotia Environment (NSE) requested additional information to support a final decision regarding the approval of the Environmental Assessment. The request for additional information was provided as a Terms of Reference for a Focus Report.

Figure 0.0-1: Summary of Science Based Evidence Used in the Focus Report

This document, the Focus Report, provides a science based review including additional data beyond what was in the Northern Pulp's EARD submission in January 2019. Over 20 different science based analyses have been conducted to provide additional evidence in describing the potential environmental impacts and their mitigation measures for the new proposed ETF. These scientific analyses include environmental baseline studies, archaeological investigations, receiving water modelling, engineering designs, and

Mi'kmaq Ecological Knowledge Studies and many more. Overall, we believe that the culmination of this work provides science based evidence that will enable the Environmental Assessment to be approved.

The following summary describes the context and history behind the proposed replacement ETF project, and presents the proposed approach and path forward for construction and operation activities. We believe it presents a clear and balanced approach that considers community values, legislative requirements, business operations, and economic impact in Pictou County, and the Province of Nova Scotia.

Northern Pulp Nova Scotia Connectivity with the Forest Industry

Northern Pulp manufactures 280,000 tonnes of kraft pulp annually, primarily for export. Customers around the world are supplied with this pulp to manufacture common household products such as tissue, towel and toilet paper, writing and photocopy paper. With more than 300 dedicated employees, Northern Pulp generates over $315 million annually into the Nova Scotia economy. The cornerstone of Nova Scotia's forestry industry, Northern Pulp's partnerships with local sawmills and forest contractors generates thousands of jobs province-wide. Northern Pulp responsibly manages hundreds of thousands of hectares of forest land as well as Nova Scotia's largest tree nursery, located in Debert, running a truly sustainable business.

Nova Scotia's forestry industry has always been tightly interconnected. Each player is extremely integrated and dependent on each other. Sawmills and pulp mills depend on each other to survive. Partners in Nova Scotia's forestry span across the province and are key to maintaining the health and vitality of the sector, as well as the key to responsible forest management.

Origins of Northern Pulp in Pictou County

In 1965, the Nova Scotia government envisioned a heavy industrial park in Abercrombie Point, Pictou County, Nova Scotia. The provincial government offered raw water supply and effluent treatment to incentivize any prospective industries. Three companies were attracted to the County through these incentives. Scott Paper Company (now Northern Pulp Nova Scotia Corporation) and Canso Chemicals took advantage of both the raw water supply and the effluent treatment. Michelin Tire opted for the raw water supply only.

The mill was commissioned in 1967 by Scott Paper Company, situated at Abercrombie Point, adjacent Pictou Harbour. As is typical of pulp mills, wastewater ('effluent') is produced as a by-product of the industrial process and after treatment is returned to the waterway, in this case the Northumberland Strait. The Boat Harbour Effluent Treatment Facility (BHETF) has been used to treat effluent from the mill facility from 1967 to present. Treatment of Canso Chemicals wastewater at the Boat Harbour Treatment facility occurred from 1971 through to 1992.

The government owned and operated treatment facility lead to good job opportunities, and promise for the provincial economy. Although it offered opportunities, it also impacted residents surrounding Boat Harbour (A'se'k), including the people of Pictou Landing First Nation (PLFN). The proposed replacement ETF project outlined in this Focus Report and associated Environmental Assessment documentation provides a new path forward.

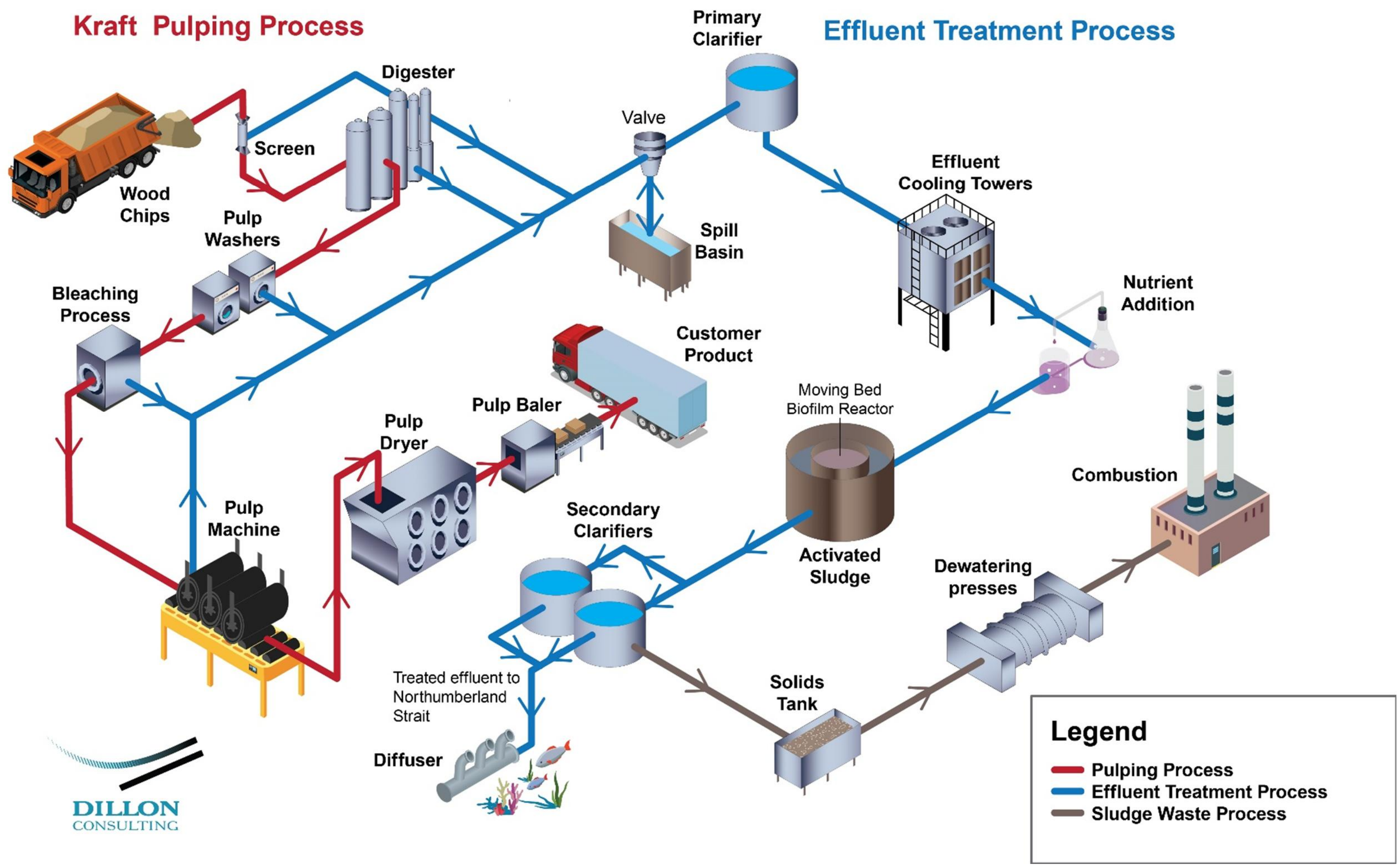
Ownership History

Northern Pulp Nova Scotia (NPNS) Corporation has had several owners over the years, including Kimberly-Clark Corporation and Neenah Paper Company of Canada. Under its current name, NPNS Corporation, the plant was held by Atlas Holdings and Blue Wolf Capital Management (2008), prior to its current ownership under Paper Excellence Canada Holdings Corporation (Paper Excellence; 2011).

Northern Pulp Basic Processes

The manufacturing process used by Northern Pulp is shown schematically in Figure 0.0-2 below. Northern Pulp utilizes a kraft sulphide pulping process that uses a pressure vessel called a digester to cook wood chips at high temperature and in an alkaline solution to dissolve the natural lignin glue in wood from the wood fibres. Brown cooked pulp and spent pulping liquor (made up of dissolved lignin) are extracted from the cooking digester. The liquor is burned as fuel in the mill's recovery boiler to generate steam and to recover the pulping chemical for reuse. The brown pulp is further washed and then bleached using chlorine dioxide solution, much like adding bleach to a washing machine. After the pulp is fully bleached and cleaned, it is dried and converted into 280 kilogram bales for export.

Figure 0.0-2: Kraft Pulping Process and proposed Effluent Treatment Process



Managing Environmental Emissions

The kraft process creates wastewater, air emissions, and solid waste, all of which require appropriate disposal.

Use of water to convert wood chips into pulp fibre and finally into bleached pulp results in the water getting contaminated with wood-based and chemical-based compounds. This untreated effluent is cleansed in a process that first separates out floatable and settable materials and then treats the remainder of the effluent with live microscopic-organisms (called biological Activated Sludge) that eat the dissolved contaminants. The organisms grow in population, and over a 24-hour period, the facility converts about 40 tonnes of settable and dissolved contamination into 20 tonnes of settable solids and biological microorganisms (called sludge) that can then be combusted in the mill's biomass boiler.

Air contaminant emissions associated with a kraft facility include odorous sulphur based gases from the pulping area and combustion of pulping liquor, bleach plant emissions from the bleaching process, and combustion gases from the boilers burning the spent pulping liquor, bark and microorganisms. Emissions controls in place at Northern Pulp include collection and incineration devices for odour based gases, and liquid scrubbers and electrostatic precipitators for removing particulate emissions from boiler discharges.

Northern Pulp also generates solid waste materials, mostly dominated by wood ash from burning biomass and contaminated lime waste from its liquor recycling process. All solid waste is disposed of in a fully engineered and lined landfill with groundwater monitoring wells.

Paper Excellence's Vision for the Future of Northern Pulp

Paper Excellence, a Canadian company with headquarters in Richmond, British Columbia, viewed mills such as Northern Pulp as a long-term opportunity to supply customers in growing Asian and European markets. Paper Excellence saw an opportunity to purchase older mills and invest in operational and environmental improvements to extend the life of the assets and the associated economic activity and employment. Knowing that the facility needed a considerable amount of work, Paper Excellence took over Northern Pulp's operation with a goal to improve safety, efficiency, productivity and environmental improvements. More than $70 million has been invested since 2011 toward: reducing effluent flow; reducing odorous, particulate, and greenhouse gas emissions; and to improve air quality monitoring. From the onset of its ownership, Paper Excellence has been committed to investing in business and environmental improvements which have led to:

- Reduced odorous emissions by more than 90% on average;
- Reduced recovery boiler particulate emissions by 99% on average;
- Reduced mill wide particulate emissions by more than 80% on average;
- Reduced greenhouse gas emissions through the conversion from fuel oil to natural gas;
- Reduced organics loading to the effluent so that Biochemical Oxygen Demand is now less than 20% of the federal Pulp and Paper Effluent Regulations (PPER); and
- Reduced solids loading to the effluent so that total suspended solids (TSS) is now less than 15% of the Federal PPER.

Current Boat Harbour Effluent Treatment Facility

Untreated effluent is currently piped from Abercrombie Point under the East River and across land to the BHETF. Many upgrades to the BHETF have occurred since its opening, and are described below. For its entire 50 year history, the BHETF has discharged into the Northumberland Strait at the outlet of the Boat Harbour estuary.

The BHETF was originally owned and operated by the Province of Nova Scotia. In 1995, NPNS's predecessor took over the operation of the BHETF under a 10 year lease, which was later extended to 2030. Today, the facility is still owned by the province and is operated under lease agreement by NPNS.

In 1967, there was no formal treatment process at the BHETF as it was believed that nature and time were enough to treat the effluent from the industries using the facility. What is now operated as the BHETF is very different from its original state. Several major changes have occurred over the years improving treated effluent quality leaving the BHETF.

In 1972, the treatment process was significantly modified with the inclusion of settling ponds, an aeration basin and a dam structure to discharge to the Northumberland Strait. Prior to installing the dam in 1972 the Boat Harbour Basin was under tidal influence. Canso Chemicals also used the BHETF from 1972 until the manufacturing operations concluded in 1992. Canso Chemicals was a chlor-alkali electrolysis facility that generated sodium hydroxide, chlorine, and hydrogen using a mercury cell process and brine solution.

From 1992 to 1996, the federal government implemented new regulations under the *Fisheries Act* that called for significant improvements to effluent, specifically for the pulp and paper industry. Multiple upgrades were made at the BHETF including: additional aeration, separation curtains in the aeration basin, and the addition of a nutrient feed system to optimize microbiological treatment activity. The effect of these upgrades, along with process improvements at NPNS itself, resulted in significantly improved effluent quality that met, and continues to meet, all applicable regulations.

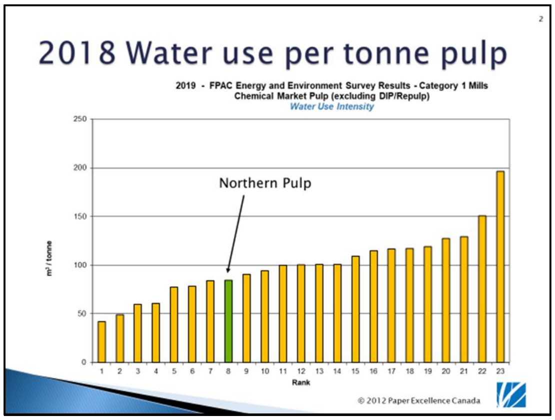
In 1997, Northern Pulp moved away from elemental chlorine to chlorine dioxide for bleaching to meet new federal *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*. The BHETF that exists today meets all Federal and Provincial regulations.

Mill Benchmarking – Northern Pulp is a Typical Pulp Mill

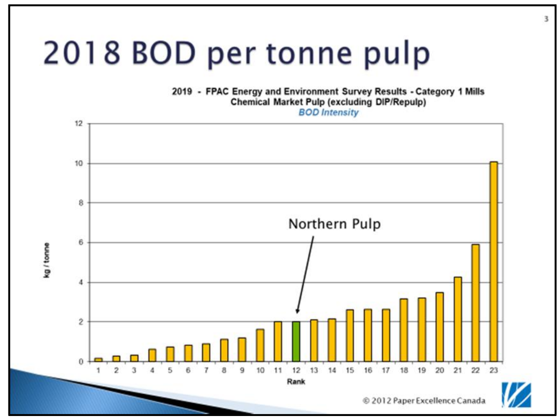
Today in Canada, 89 pulp and paper mills are in operation from British Columbia to Atlantic Canada, in most instances discharging treated air emissions, creating solid waste and discharging treated wastewater into either rivers, lakes or marine environments. Northern Pulp is a very typical kraft pulp mill compared to the other Canadian mills in terms of its emissions footprint and processes.

As an approach to understanding Northern Pulp's emissions with respect to other facilities, a comparison of its wastewater, air emissions, and solid waste has been shown in Table 0.0-1 and Table 0.0-2. 2018 treated effluent data collected in July 2019 by the independent organization, Forest Products Association of Canada, was used to compare Northern Pulp's effluent performance to Canada's other 22 standalone kraft facilities. Similarly, Northern Pulp's parent company, Paper Excellence, provided air contaminant emissions and solid waste data for its nine other facilities in Canada and France. Those graphics are provided below, indicating Northern Pulp's performance in green.

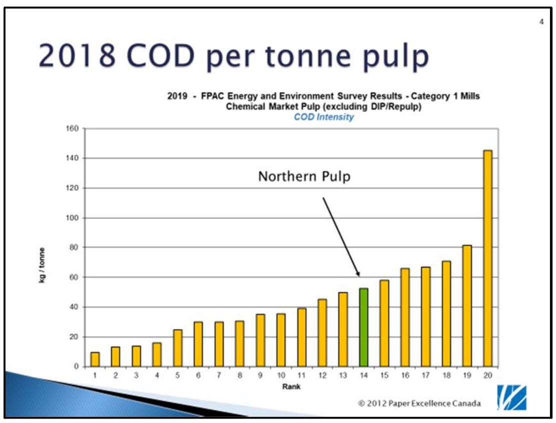
Table 0.0-1 Comparison of NPNS's (green) Treated Effluent Performance to Other Canadian Kraft Mills



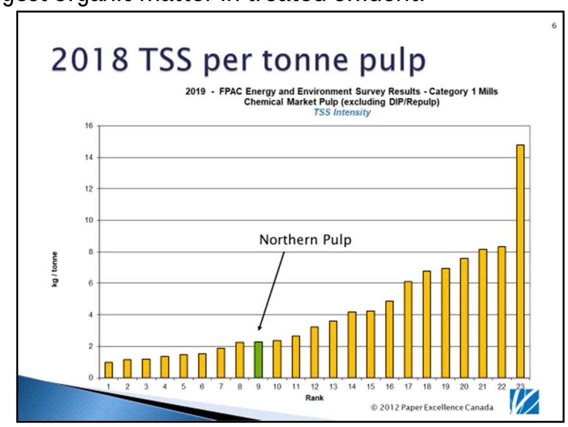
Water use measures the total amount of fresh water consumed per tonne of finished pulp at the facility.



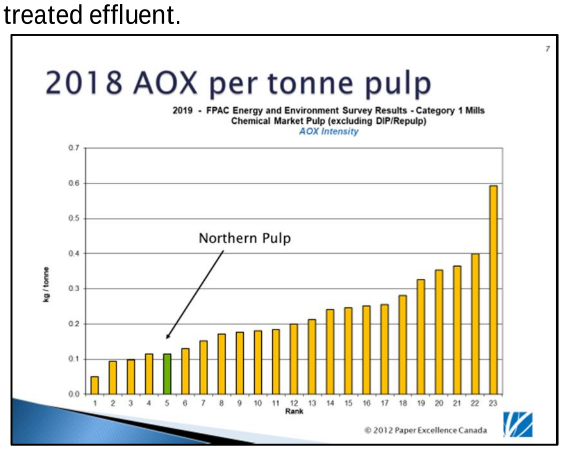
Biochemical oxygen demand (BOD) is a measure of the amount of dissolved oxygen demanded by organisms to digest organic matter in treated effluent.



Chemical oxygen demand (COD) is a measure of the amount of oxygen that can be consumed by reactions in in treated effluent.



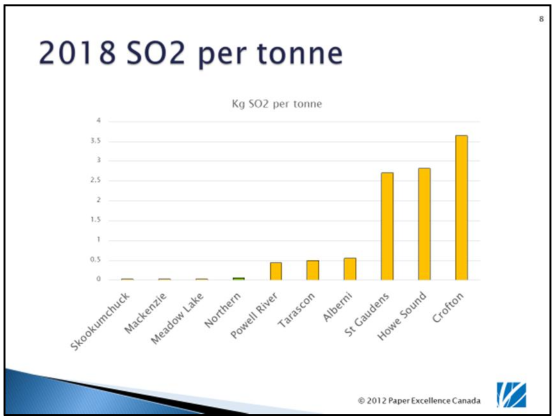
Total suspended solids (TSS) is a measure of the amount of total sediment in treated effluent.



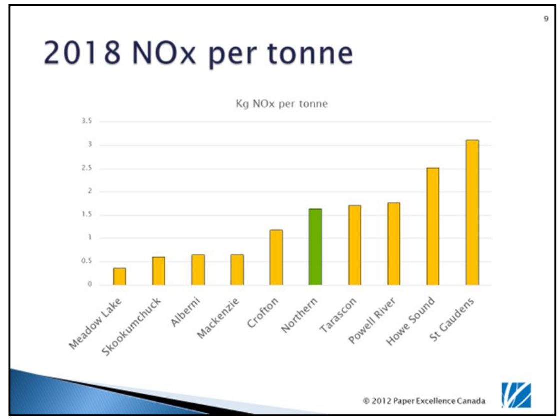
Adsorbable Organic Halides (AOX) is a measure of the organic chlorine load in treated effluent.

Source Data: Data was provided by Forest Products Association of Canada in 2019.

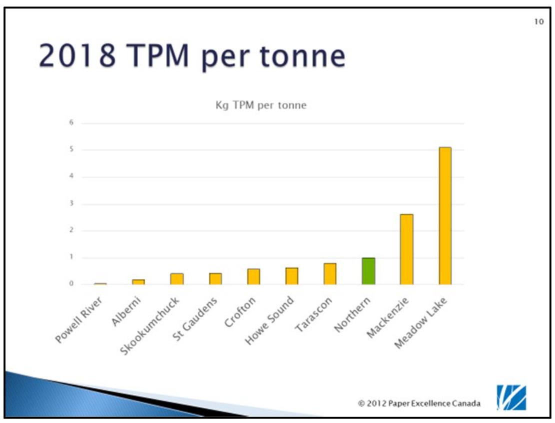
Table 0.0-2: Comparison of NPNS's Mill Emissions to Other Global Paper Excellence Kraft Mills



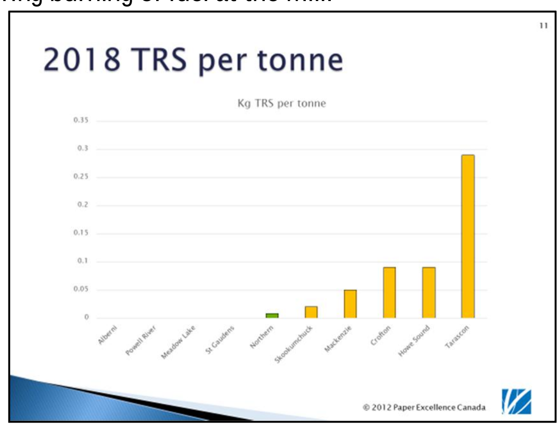
Sulphur dioxide (SO_X) gases are made up of sulphur and oxygen atoms and is produced when coal or oil is burned at the Mill.



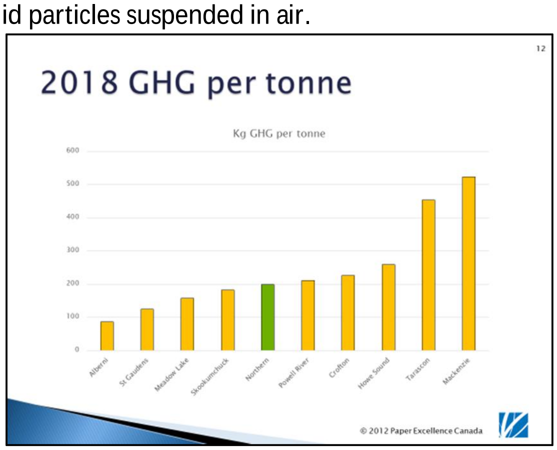
Nitrogen oxides (NO_X) gases are grennhouse gases made up of nitrogran and oxygen atoms that are produced during burning of fuel at the Mill.



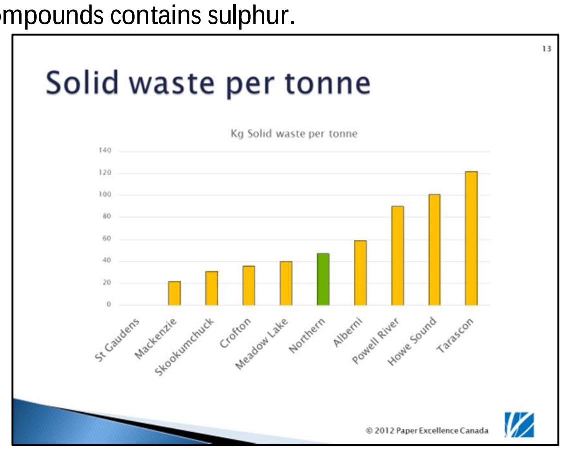
Total particulate matter (TPM) is the sum of liquid and solid particles suspended in air.



Total Reduced Sulphur (TRS) are a mixture of gas compounds contains sulphur.



Greenhouse gases are a family of gas that trap energy from the sun.



Mill solid wastes that cannot be recycled and must go to landfill.

Source Data: Paper Excellence.

Call for a Replacement Effluent Treatment Facility

The *Boat Harbour Act*

The introduction of the *Boat Harbour Act*, which received Royal Assent on May 11, 2015, prohibits the use of the provincially-owned facility for the receipt and treatment of effluent from NPNS after January 31, 2020. To remain in operation, Northern Pulp must replace the BHETF with a new treatment system as the *Boat Harbour Act* will prohibit the use of the existing provincially-owned facility for the receiving and treatment of effluent from Northern Pulp.

Engagement with government agencies related to a replacement ETF has been ongoing since the introduction of the *Boat Harbour Act* in May 2015. Regulatory departments from Federal and Provincial governments have been consulted for feedback on regulatory requirements and to seek regional or topical expertise.

Northern Pulp Considers its Options

Closure of the Northern Pulp mill would have a significant adverse effect on the Nova Scotia forestry industry, the local community, surrounding communities, reaching across the province. Northern Pulp directly employs over 300 persons. Through its direct and spinoff activities, Northern Pulp creates approximately $100 million in labour income in Nova Scotia (Gardiner Pinfold, 2018). Northern Pulp provides over 2,050 indirect and induced jobs to Pictou County and the Province of Nova Scotia in general. Northern Pulp operations maintain jobs in the forestry sector which employs over 11,500 annually (Gardiner Pinfold, 2016). Northern Pulp is uniquely connected with many partners in the forest industry, for example, by both producing materials for and purchasing materials from sawmills across the province. Together with its supply chain companies, Northern Pulp produces a total annual value output of $535 million.

Northern Pulp exports over $200 million worth of goods annually, which constitutes a significant portion of the Province’s total forestry exports. Northern Pulp is the single largest exporter out of the Port of Halifax, exporting in excess of 1,700 TEU (twenty-foot equivalent unit) containers per month. Northern Pulp exported over $193 million to China in 2018, making wood pulp and NPNS exports approximately 1/4 of the Province’s exports to China.

A global market study shows that the pulp produced by Northern Pulp will remain a viable product. Closing an operational mill is not a preferred option for the company or the Nova Scotia forestry industry as a suitable effluent treatment option used in similar mills and regions throughout Canada has been proposed.

Replacing the Boat Harbour Effluent Treatment Facility

Modern effluent treatment systems exist for bleached kraft pulp mills, which are able to treat effluent to meet water environmental guidelines while being protective of the local receiving environment. Different treatment processes are used around the world, all involving a treated discharge to the receiving environment (either marine or freshwater). Alternative technologies (processes) were identified based on their potential to meet PPER, minimize environmental risks, and be cost effective. The recommended process was then selected based on the following criteria:

- Optimization and Reliability - What process will reliably result in required treatment quality, given the characteristics of the effluent needing to be treated?
- Efficiency - Can the process treat the volume of effluent?
- Economic Viability - Can the process allow for the continued viable operation of the mill?
- Flexibility - Can the process operate across operating conditions? (e.g., seasons)
- Footprint - Can the process fit on the Northern Pulp or other public property, without affecting adjacent natural features and property owners off the mill site?

Paper Excellence determined that building a new modern ETF to treat Northern Pulp's effluent once the BHETF is closed was the best option, and the company proceeded to identify and evaluate alternative methods for a new effluent treatment facility, including discharge options.

The planning and design view was to have a new ETF operational to coincide with the closure of the BHETF. A new ETF would improve environmental conditions in comparison to the conditions related to those of the existing BHETF. From a technical and environmental perspective, the considerations for a modern facility included the following:

1. A detailed alternatives assessment of effluent treatment technologies, means, and locations for conveying the treated effluent, and methods and locations for releasing treated effluent to the receiving environment;
2. Meeting current – and proposed future - environmental laws and regulations for release of treated effluent from the pulp and paper mill;
3. Best practices considering local requirements and site-specific mitigation;
4. Evaluating the environmental effects of a new treatment facility;
5. Implementing technically and economically feasible components and technologies that are proven, and which limit the footprint and visual effects of the project; and
6. Implementing progressive environmental protection, mitigation, and management strategies and concepts that avoid or minimize adverse environmental effects, and enhance positive ones.

Identifying and Evaluating International Best Practices

As part of the design process, several facilities were visited to confirm if the chosen system was suitable for the Northern Pulp application. A group, including individuals from Paper Excellence, Northern Pulp and the project design team, visited an integrated kraft pulp and paper mill in Northeastern USA that is similar in size to that of Northern Pulp and discharges its treated effluent into the neighbouring river. The mill uses an Activated Sludge Treatment (AST) system for their kraft mill effluent and the discharge of the ETF is into a freshwater river.

An engineering team from Northern Pulp also visited two NBSK pulp mills that operate Veolia BAS™ treatment systems in Sweden in May 2018. Both of these mills successfully manage the BAS™ treatment system to meet applicable regulations and have ocean discharges for their treated effluent. These visits confirmed that the proposed Veolia BAS™ treatment system will provide the required treatment needs for Northern Pulp to meet current and anticipated future regulations. The information gathered during these visits was incorporated into the design of the replacement ETF.

The same group also visited with the research laboratory of Veolia/AnoxKaldnes in Lund, Sweden in May, 2018. The purpose of the visit was to review the lab trials that were performed on NPNS's raw effluent to ensure the proper design and sizing of the replacement ETF. The BAS™ system offers proven technology with comparable kraft mill references worldwide. In addition, it offers improvements over the existing BHETF, with respect to odour, colour, and organic removal efficiencies.

Planning a Modern Effluent Treatment Facility

The development of a modern, ETF is fundamental to the continued operation of the Northern Pulp mill. Project components would be designed to meet the Federal PPER, the National Building Code of Canada, the Canadian Standards Association, best practices for effluent treatment and pipeline construction, and other design codes and standards. All future facility operations would also be conducted under a provincial Industrial Approval.

The Proposed Replacement Effluent Treatment Facility Project

The proposed project will consist of the construction and subsequent operation of a new replacement ETF that will discharge treated effluent by way of a pipeline to the Northumberland Strait. The replacement ETF will be located on NPNS property, adjacent to the mill, and will employ an AnoxKaldnes™ Biological Activated Sludge (BAS™) process, which combines Moving Bed Biofilm Reactor (MBBR) technology with conventional Activated Sludge (AS). The effluent discharge will continue to be into the Northumberland Strait, as has been the case since 1967 via the existing facility.

This undertaking is to be known as the "Northern Pulp Nova Scotia Replacement ETF". It is important to note that the proposed project does not include the decommissioning of the existing BHETF effluent treatment system, effluent piping system downstream of the existing standpipe, and ancillary components, which is covered under a separate regulatory process.

The primary components associated with the new ETF include:

1. Coarse screening;
2. Feed system (existing effluent lift pumping system);
3. Primary clarifier;
4. Effluent cooling tower;
5. Activated Sludge aeration tank (including the MBBR chamber);
6. Two secondary clarifiers;
7. Sludge management system; and,
8. Spill collection system.

Cooling towers will be installed as an in-mill improvement to recycle non-contact, clean cooling water for reuse within the mill processes during the summer months. Peak summer water flow rates at Northern Pulp will be reduced by approximately 5,000 m^3/day. This water reduction will help to even out seasonal variation in effluent flow.

Treated Effluent Transmission Pipeline

The effluent transmission pipeline will be a 36 inch (900 millimetre (mm)) diameter High-Density Polyethylene (HDPE) pipe, and will extend approximately 15 km.

HDPE is an “industry standard” (best practice) material used for applications that require a long service life and low maintenance. It is flexible, reducing the need for mechanical fittings and allow it to adapt to changes in elevation. It is resistant to attack from many chemicals and is compatible with pulp mill effluent.

HDPE like other prefabricated pipe materials are produced to a certain length in order to allow for transport to site. The joints where two pieces of pipe are joined together will be heat fused for this project. Fused joints do not leak, and create a strong seal that industry testing has shown to be as strong and durable as the pipe itself. During construction, the pipe and joints will be tested before the pipe sections are buried.

HDPE is well suited to Nova Scotia climate, and the marine application portion of this project. It is able to perform under hot and cold climates when other pipe materials are known to crack or be more prone to damage (Plastic Pipe Institute, 2019).

Land-based Pipeline Portion

The pipeline will begin on-land at a pump station where treated effluent from the ETF is pumped into the pipeline. For approximately the first kilometre of the pipeline, the pipe will be located on NPNS property until it meets and enters Pictou Harbour. The pipeline will be submerged across Pictou Harbour, aligned immediately to the east of the Pictou Causeway until it meets the north bank of Pictou Harbour. On the north side of Pictou Harbour, it enters the Nova Scotia Department of Transportation and Infrastructure Renewal’s (TIR’s) Highway 106 (Trans-Canada Highway, also known as Jubilee Highway) right-of-way (ROW) and follows Highway 106 north toward Caribou, NS.

The pipeline will be installed generally parallel to Highway 106, along the outermost eastern portion of the NSTIR ROW. It will be situated predominantly on the east side until it reaches Caribou. At this point, the pipeline will cross under Highway 106 to the west side and enter the marine environment at Caribou Harbour to the north, and to the west of the Northumberland Ferries marine terminal building and parking area.

There will be automated leak detection of the land-based pipe between Pictou and Caribou to identify issues in the unlikely event that a leak does occur.

Marine-based Pipeline Portion

The marine-based portion of the pipeline will be approximately 4 km in length. The pipe will enter the marine environment to the west of the Northumberland Ferries marine terminal. Once within the marine environment, the treated effluent pipe will be generally aligned to the northeast, and will extend to the outfall location. The pipeline will be buried, adjacent to and west of the navigation channel for the Northumberland Ferries. It is anticipated that the marine portion of the pipeline will be placed in a trench and backfilled with existing material. At the end of the pipeline will be the 'outfall location'.

Marine Outfall and Diffuser

A receiving water study was completed to determine the optimum location for the effluent outfall that would achieve effluent diffusion to meet or exceed applicable regulations and guidelines. Alternative sites were considered within and outside of Pictou Harbour and the preferred location is outside Caribou Harbour.

The installation of a modern engineered diffuser provides a significant improvement in effluent dispersion compared to the current BHETF which does not have an engineered diffuser. Engineered diffusion is the industry standard of today and the best available technology worldwide. Diffusion allows the effluent plume to meet the applicable Canadian Council of Ministers of Environment (CCME) guidelines within 100 m of the diffuser.

Environmental Planning and Management

A variety of environmental protection and management measures have been adopted through the development of the project to date in order to guide the planning, design, construction, operation and maintenance, and ultimate decommissioning of the project. These include, but are not limited to, the following measures:

1. Siting the project components to avoid sensitive areas such as wetlands, watercourses and important habitat types, where possible, and to reduce the size and number of natural drainages that may be affected;
2. Minimizing the “footprint” of project facilities and activities to consequently reduce the amount of disturbed land, wetlands and water resources;
3. Siting of the marine outfall to minimize potential impact to marine water quality;
4. Employing good planning, design and management practices to comply with regulatory standards for air emissions, water releases, storage or disposal of solid wastes, and handling and disposal of hazardous materials;
5. Constructing and operating methodologies conducted in a manner consistent with NPNS’ Environmental Management System (EMS) which incorporates operational policies and practices for monitoring and management of, for example, land and soil resources, air and water, noise and vibration, hazardous materials and waste, community health and safety, and cultural heritage; and
6. Developing and implementing an overall Environmental Management Plan (EMP) and Environmental Protection Plan (EPP) for construction activities that will be included in, and enforced through, construction contracts.

Northern Pulp has emphasized project design and siting so that the location and configuration of the project facilities considers the above measures wherever possible so as to avoid or minimize the potential environmental effects of the project. Where avoidance is not possible, mitigation or compensation measures have been developed as part of the Environmental Assessment (EA), and will be implemented in consultation with the applicable regulatory authorities.

Follow-up and Monitoring

Environmental Management does not end once the project is complete. A follow-up and monitoring program will be developed as part of the project. The objectives of this program will intend to:

1. Verify the environmental effects predictions included in the EARD and the Focus Report to assess the effectiveness of mitigation, as required;

2. Propose environmental monitoring measures aimed at monitoring the project's environmental effects;
3. Demonstrate compliance with environmental acts, regulations, and approvals/permits/authorizations issued for the project; and
4. Provide a basis for long-term adaptation to changing environmental conditions occurring naturally or as a result of the project.

It is expected that this program would be adjusted as required over the life of the project in response to the results of follow-up or monitoring initiatives, changes in regulatory requirements, or other factors.

Future Steps

Project Construction

The construction phase will be initiated following the receipt of EA approval and the receipt of all additional required permits, approvals, licences, authorizations, or leases for the project. The ETF, pipeline, and marine outfall are estimated to be completed within 21 months of the beginning of construction.

Throughout construction, environmental controls (e.g., erosion and sediment control structures, silt curtain) will be utilized as required and as prescribed in environmental permits and approvals.

Throughout the construction phase, site inspections will be undertaken by the contractor, Northern Pulp's Environmental Team and/or designate. Site inspections will include environmental monitoring and compliance with the EMP, and legislation. During construction, fulltime site personnel will have environmental protection as their responsibility; this individual or group of individuals will complete inspections regularly to ensure that mitigative controls are in place and other EMP measures are followed and maintained. Checklists will be developed for this purpose.

Following construction, disturbed areas will be restored to match pre-construction conditions.

Operation and Maintenance

The ETF will accept an estimate of 62,000 m^3/day annual average (85,000 m^3/day peak flow) of effluent that is created through the Kraft pulp mill process. The process is automated with online instrumentation and adjusted either manually or automatically as influent parameters change. Confirmation of ETF performance will be dictated by NSE permits and will require effluent sampling consistent with the conditions of the Industrial Approval.

Northern Pulp will be responsible for:

1. Operation, maintenance, and inspection of ETF components, the effluent pipeline, and marine outfall and diffuser assembly;
2. Sludge management and operation of the facility's power boiler for incineration of sludge, including air quality monitoring;
3. Monitoring of effluent quality discharged to the receiving environment;
4. Ensuring the effluent pipeline system is operated in accordance with applicable regulations;
5. Maintenance of above and below ground facilities;
6. Emergency response; and
7. Awareness and education of local stakeholders, including members of the public and emergency responders.

Northern Pulp will operate and maintain the effluent pipeline in accordance with standard procedures designed to ensure the integrity of system components, and will be designed for a minimum 50 year design life. HDPE pipelines depending on local conditions can have an operational service life that could reach 100 years. Treated effluent will be pumped to the diffused outfall from the new ETF. An inspection program will be developed and implemented by Northern Pulp, based on specified standard procedures and design recommendations.

Impacts and Mitigations

The impact assessment conducted for the EARD (NPNS 2019) is updated based on the revised project description presented in the Focus Report. Project changes required a reassessment of six of the Valued Environmental Components (VECs). The assessment methodology was consistent with that undertaken for the EARD. A summary of project mitigation is provided. The following summarizes the effects assessments conducted associated with the Focus Report findings.

- Atmospheric Environment - the additional air contaminant emissions assessment undertaken for the Focus Report was reviewed to determine if adjustments were necessary to the atmospheric environment VEC assessment. Four additional parameters were modelled as exceeding criteria from Ontario, in the absence of any Nova Scotia standards for these parameters. The frequency of exceedances was low (<0.5%), below significance criteria, and no significant adverse residual environmental effects were predicted.
- Surface Water (Freshwater), Freshwater Fish and Fish Habitat, and Wetlands - potential impacts to watercourses and wetlands (which include fish habitat) were re-assessed along the land-based realigned pipeline route location based on the identification of trenching as a preferred watercourse crossing method. Mitigation associated with trenched crossing methods was incorporated in the assessment, along with meeting regulatory requirements such as provincial watercourse and wetland approvals and *Fisheries Act* authorizations including compensation and offsets for habitat loss. No significant adverse residual effects were identified.
- Harbour Physical Environment, Water Quality, and Sediment Quality (Marine) and marine fish and fish habitat - potential impacts to these marine VECs were evaluated in light of minor adjustments to the marine pipeline route and the updated receiving water assessment and comparison to the current outfall. Based on the receiving water study results and with identified mitigation, including meeting *Fisheries Act* authorization requirements, no significant residual adverse environmental effects were identified. The receiving water study at the existing Boat Harbour dam discharge into the Northumberland Strait undertaken to assess environmental impacts has concluded that existing dilution factors are low and insufficient for effluent mixing with the ambient water. A diffused outfall outside of Caribou Harbour in the Northumberland Strait is considered to have much less potential effluent impact on the receiving environment and represents an improvement.

In Closing

Today in Canada, 89 pulp and paper mills are in operation from British Columbia to the Atlantic Provinces in most instances discharging treated air emissions, creating solid waste, and discharging treated wastewater into either rivers, lakes or marine environments. In virtually all respects, Northern Pulp is a very typical kraft pulp mill compared to the other Canadian mills. Northern Pulp's energy usage is made up of over 92% renewable energy. Northern Pulp has reduced its greenhouse gas emissions by 44% since 1990, and produces over 23 megawatts (MW) of green electricity.

Economists believe the entire Nova Scotian forest industry is hinged on the daily operation of Northern Pulp and its consumption of local Nova Scotian wood chips. With the introduction of this proposed state-of-the-art wastewater treatment facility, Northern Pulp's environmental footprint is significantly reduced with forestry and fishing industries continuing to co-exist and a negative environmental legacy that has tarnished the region ends; allowing community healing and rebuilding to begin.

Focus Report Format

The Focus Report responds to each item within the NSE Terms of Reference (TOR) (April 23, 2019). The NSE TOR item (Bolded and Italized) and a summary of the response are provided in the main document (numbered by the NSE TOR item number). Additional technical appendices are provided as required to detail the response.

1.0 PUBLIC, MI'KMAQ, AND GOVERNMENT ENGAGEMENT

1.1 Concordance Table

Provide a response (via a concordance table) to questions and comments raised by the public, Mi'kmaq and government departments, and incorporate these comments in the Focus Report where applicable. Comments may be summarized prior to providing the response.

NPNS proposes to build a new replacement ETF to facilitate and support the Province's rehabilitation of A'se'k (Boat Harbour). On February 7, 2019 NPNS registered the Replacement ETF project for Environmental Assessment (EA), in accordance with Part IV of the *Nova Scotia Environment Act*. The Environmental Assessment Registration Document (EARD) for the proposed replacement ETF was submitted to the Province for approval of the project. The Province has requested additional information be submitted, in the form of a Focus Report, to allow for a fulsome review of the project. The public was invited to review the submitted EARD, and submit written comments on or before March 9, 2019 to the EA Branch of the Nova Scotia Government.

During the public consultation period (from February 7 to March 9 of 2019), approximately 846 public comments were received by Nova Scotia Environment (NSE). Comments were most commonly submitted by email, fax, or mail. In total, over 4,000 pages of questions and comments were received through the EA process. Comments that are similar have been grouped together and organized by VEC in a correspondence table. The concordance table in Appendix 1.2 provides the responses to the unique question submitted. Additionally, content in the Focus Report will also help to address the questions submitted.

Figure 1.1-1 provides a graphical representation of the municipal, provincial, and government agencies that submitted comments sorted for each VEC.

The final count of questions/comments are a subset of the original group. Duplicate questions were grouped together. Figure 1.1-2 provides a similar graph for the comments provided by the public.

Figure 1.1-1: Government Comments by VEC

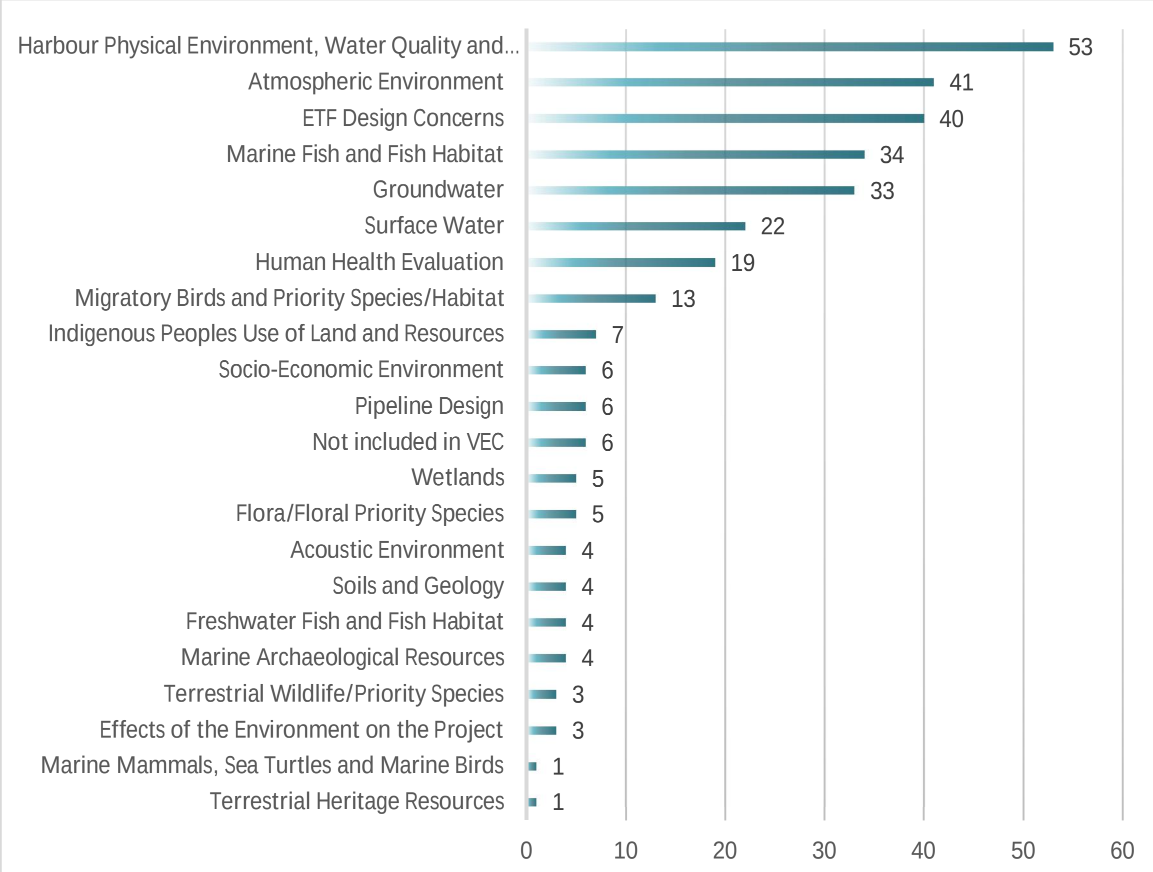
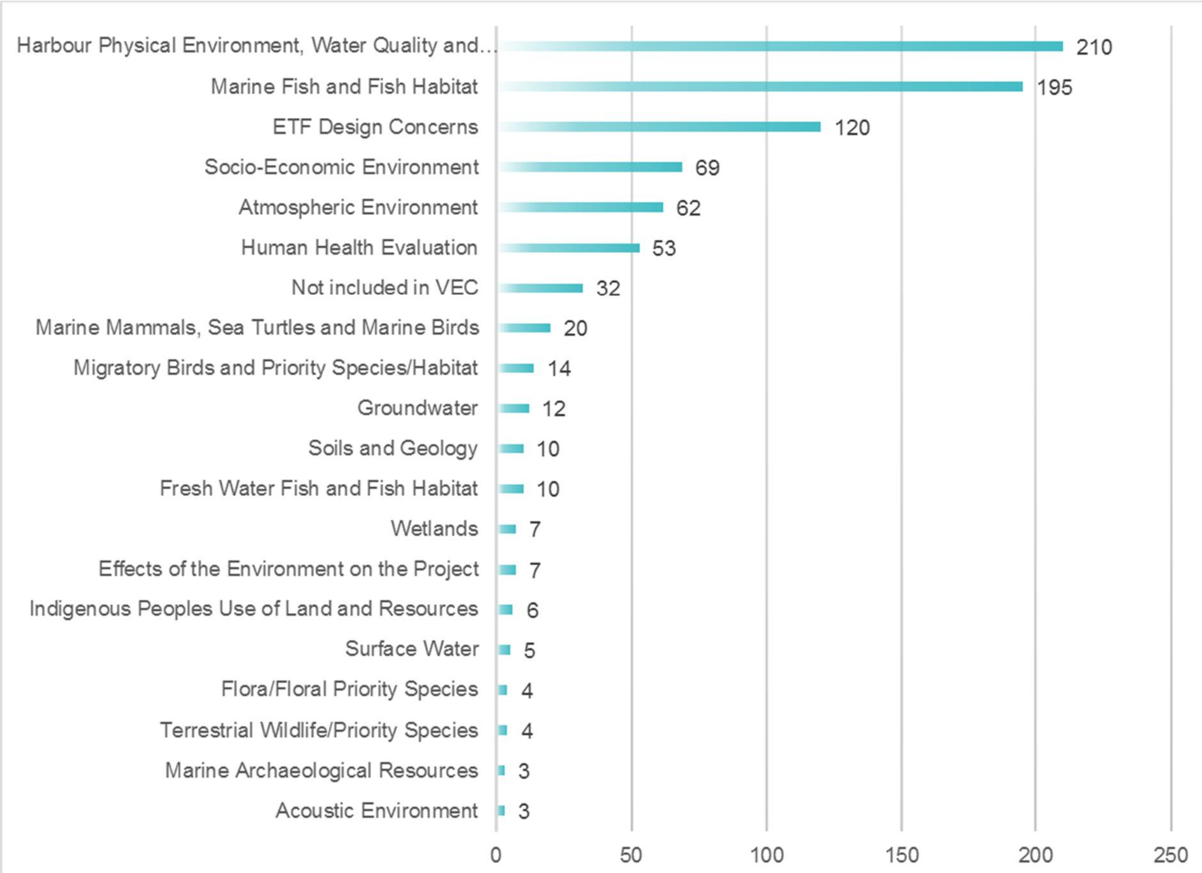


Figure 1.1-2: Public Comments by VEC



1.1.1 Key Environmental Considerations

The most public comments received with respect to potential for environmental effects related to three general categories:

- Air emissions effects;
- Groundwater impacts and particularly in relation to potential for leaks within the Town of Pictou groundwater water supply watershed; and,
- Marine water quality impacts which could have effects on the marine ecosystem and on economic resources that depend on it.

The following is a summary of mitigative factors that minimize the potential for impact to these valued environmental components (VECs).

Air Emissions

During construction, emissions of contaminants to the atmospheric environment will be limited to fugitive dust from earth moving activities and combustion gas and greenhouse gas emissions from the combustion of fossil fuels in heavy equipment used during construction. These minor emissions are expected to be short-term, very localized, transient (i.e., moving from one area to another as construction progresses to other areas), and of a low magnitude such that exceedances of the Nova Scotia *Air Quality Regulations* are not expected. Therefore, significant effects to air quality from construction are not expected. Appropriate mitigative measures will be taken when required to ensure nuisance dust levels are controlled. It is unlikely that emissions will exceed Nova Scotia or federal ambient air quality objectives.

For the operation and maintenance phase, emissions are primarily related to existing emission sources at the facility (assumed to be relatively the same as current), fugitive emissions from the replacement ETF, and combustion gas emissions from boilers and other sources at the mill. The only new sources of emissions from the operation of the mill include fugitive emissions of potential odours from the replacement ETF itself, and emissions of combustion gases from the burning of sludge from the replacement ETF in the power boiler. These activities have the potential to result in some limited changes in the local air quality. However, there are no features of the effluent pipeline on-land or in the marine environment that would be expected to affect air quality during the operation and maintenance phases.

Releases of the contaminants listed in the Nova Scotia *Air Quality Regulations* from the NPNS mill have previously been modelled. Because sludge from the replacement ETF will be combusted in the power boiler as part of the project, the updated environmental effects assessment needs to compare the predicted impact of overall emissions from the pulp mill currently versus those that will occur once the replacement ETF is operational. Therefore, emissions at the existing BHETF were considered for the baseline scenario, and emissions estimated for the proposed replacement ETF are considered for the future operation scenario. The co-combustion of sludge with hog fuel in the power boiler is also considered in the future operation scenario.

An updated inventory of emissions from the mill currently as well as for the future operation of the mill once the replacement ETF is operational was developed. The inventory included common air contaminants as well as other potential contaminants that might arise from the operation of the replacement ETF and the burning of sludge from the ETF in the power boiler at the mill (Stantec 2019). These emissions were then put into a computer model to predict what air quality in the receiving environment might be in the future as a result of the continued operation of the mill and the operation of the replacement ETF (including burning of sludge in the power boiler). Based on the computer model results, the predicted concentrations of the common air contaminants from the mill (i.e., CO, NO_2, SO_2, TSP, $PM_{2.5}$ and H_2S) in ambient air within 30 km of the mill, both from the operation of the existing mill and the future mill (with replacement ETF and sludge burning), all met the ambient air quality standards identified in the Nova Scotia *Air Quality Regulations* at the representative locations outside the mill property (Stantec 2019). Emissions of the regulated air contaminants are therefore predicted to be below the provincially-regulated maximum permissible ground-level concentrations, and no significant effects on the atmospheric environment are predicted.

For other contaminants, the model predicted that concentrations of ammonia, chloroform, total reduced sulphur (TRS, a collection of sulphur based compounds that can result in a rotten cabbage type of odour) during the operation and maintenance phase exceeded the Ontario criteria for these contaminants (in the absence of Nova Scotia guidelines recognizing that Ontario criteria have no force of law in Nova Scotia) for very infrequent periods (i.e., less than 0.5% of the time). Acknowledging that the emissions inventory was conservative, included factors of safety, and the computer models typically over-predicts ground-level concentrations, it is not predicted that the operation and maintenance of the mill and replacement ETF will cause a significant effect on the atmospheric environment. The diversion of sludge for combustion in the power boiler may, in fact, displace the use of fossil fuels, thereby reducing the overall greenhouse gas(GHG) emissions and reducing the potential for odours from the pulp mill.

In consideration of the above, and in light of the proposed mitigation, no significant residual environmental effects of the project on the atmospheric environment are expected.

Groundwater Supplies

The pipeline design was adjusted as a risk management measure with respect to the potential for leaks within the land-based portion of the realigned pipeline. This was a result of the concerns raised regarding the Town of Pictou water supply (groundwater) and recognizing the presence of municipal and residential water wells in the area of the pipeline corridor. The design and material selection for this pipeline are very robust and resistant to catastrophic failure and leak propagation. However, the pipeline material specification will be increased to 900 mm (36 inch) SDR 13.5, providing a heavier wall thickness and increased factor of safety for the entire portion of the land-based pipeline between Pictou and Caribou. The thicker-walled pipe increases the design safety factor over operating pressures.

This, coupled with a modern leak detection system using advanced detection technologies that can detect small leaks, provides a robust system design that can be operated with confidence.

Due to this robust design, there is not expected to be any residual environmental effects of the project on the groundwater supplies.

Marine Water Quality

One of the key concerns with respect to the project is the potential impact of the release of treated effluent on the marine water quality, and on thus on the integrated ecological communities and fisheries resources within the Northumberland Strait. Prior to actual effluent release, in order to understand what the potential for effects of the treated effluent discharge on water quality, a computer model was used to simulate conditions in the marine environment and examine what might happen when the treated effluent is introduced. The computer modelling looked at factors that affect how the effluent discharge interacts with the ocean water, such as:

- Changes in tidal conditions, currents, and waves, over time;
- Changes in wind conditions and air temperatures; and
- Differences in density between the surface and deeper water as a result of changes in salinity (salt concentration in marine water) and temperature.
- Modelling included looking at how the treated effluent discharge enters the marine environment in both a two-dimensional model and a three-dimensional approach.

Two-Dimensional Modelling (Far-Field)

The two-dimensional modelling to simulate far-field conditions extended over 58 km from the proposed outfall along an east-west axis (along the Northumberland Strait) and over 42 km along a north-south axis (across the Strait heading to PEI). This model also looked at the effect of different seasonal conditions on how the effluent interacts with the environment. The modelling reflected a one-month period which included continuous environmental data inputs over typical spring and neap tides. Two conditions were considered to reflect a wide range of conditions that will occur in real life:

- Summer(July) when water temperatures are warmer and wind and waves are present but the scenario represents a period with reduced wind driven surface mixing (therefore conservative assessment of potential for impacts); and
- Winter (February) when ice is present reducing wind mixing and wave effects (again a condition reflecting conservative assessment of potential for impacts) and the variation in water temperature and salinity results in water density higher than in summer.

The marine environment was modelled based on the bathymetry (water depth) of the area as well as a number of government sources of information and 2019 field measurements of currents, water temperature and salinity. The 2019 field survey data were used to calibrate the model (to make model conditions match real life conditions, particularly tides, currents and waves), and the calibrated model was found to confidently reproduce complex water movement conditions in relation to the proposed outfall. Modelling was conservative (likely predicts conditions equal to or worse than actual) as it did not incorporate a diffuser (which increases mixing) and does not assume any decay over time of potential discharge.

Section 4.2 shows the results of the model runs. The model shows that over the one-month summer period, flow from the proposed outfall area is predominately northwestward (flood currents) and southeastward (ebb currents). The flow from the outfall area is well mixed, remains outside of Caribou Harbour, and generally does not accumulate along the shorelines. The circulation pattern identified in the winter scenario is similar to the summer circulation. The higher density of the marine water in winter compared to the effluent density may increase the mixing of the effluent (improved dilution) in winter under ice. For both the summer and winter scenarios, the dilution factor was generally above 100 times (e.g. if a given parameter left the outfall at a concentration of 100 mg/L, the concentration within the marine environment would be 1 mg/L or less, assuming background concentrations are not present). Therefore, water quality in the far-field is unlikely to be affected by the release of treated effluent in Northumberland Strait.

Three-Dimensional Modelling (Near-Field)

The three-dimensional model builds on the flow, tide, current, and wind conditions established in two-dimensional (far-field) model described above, as well as actual bottom profile and substrate conditions identified for the proposed outfall location. The three-dimensional mixing conditions were modelled to look at how mixing occurs as the treated effluent leaves the outfall pipe located near the bottom, and how mixing occurs with the marine environment within 100 m of the pipe (near-field). The 100 m distance is consistent with a defined "mixing zone" established for municipal wastewater effluent discharges in Canada. The near-field modelling (within about 200 m of the outfall location) was conducted, incorporating the three-port diffuser configured in optimal direction in relation to currents as identified for the project, to provide a more detailed prediction of mixing with respect to established Water Quality Guidelines (WQG).

The near-field model did not include decay, and scenarios included a maximum design flow and maximum effluent limits for the wastewater discharge and thus provides a conservative estimate of water quality in the mixing zone. In order to assess the extent of dilution for a given effluent parameter, the amount of that parameter already present in the marine environment needs to be included (background water quality). For the near-field modelling, background water quality data was collected in May and June 2019 (see Section 4.1 of the Focus Report).

Modelled data looked at both summer and winter ice conditions and under summer conditions included average and a more conservative slack tide current velocities. An additional scenario was also run to assess a reduced effluent flow rate (50,000 m^3/day versus the maximum 85,000 m^3/day) with a lower discharge velocity. Specific water quality parameters modelled were consistent with those identified as potentially of concern in the effluent (see Section 3.3 of the Focus Report).

Even for the most conservative of the three summer discharge scenarios (slack tide between incoming and outgoing tidal periods), the model predicted water quality at the end of the 100 m mixing zone will meet applicable federal water quality guidelines and/or background conditions. Therefore, with respect to water quality, it is not anticipated that the proposed treated effluent discharge will result in significant residual adverse environmental impacts.

1.2 Engagement Plan

Provide a plan to share future reports and/or studies relevant to this Project with the public and the Mi'kmaq such as the Pictou Landing First Nation, including but not limited to the future Environmental Effects Monitoring results for the new Effluent Treatment Facility.

A stakeholder engagement plan (SEP) for sharing future reports and/or studies has been developed and is provided in Appendix 1.2. The SEP defines how NPNS will communicate and provide information on the replacement Effluent Treatment Plant project at different stages of the project including approval(s), construction, commissioning, and operations. The objective of the SEP is to outline how information will be provided to multiple stakeholders and rights holders in a timely manner so that these groups can voice their opinions and concerns. These opinions and concerns can then be considered in project decisions.

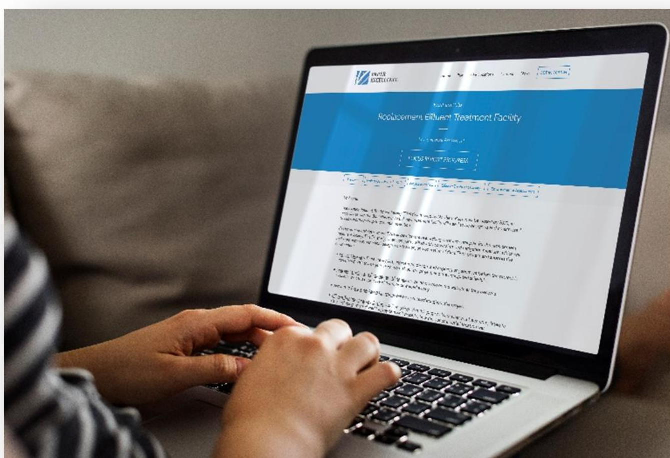


Figure 1.2-1: Online Engagement Material

As key reports are prepared for each phase of the project, they will be provided to the appropriate stakeholders and rights holders. Table 1.2-1 below summarizes how the draft reports prepared through the development of the Focus Report were shared.

Table 1.2-1: Summary of Focus Report Documents Shared

	Information Sent	Date	PLFN	Federal Government	NSE
1	Draft PLFN Engagement Document	June 12, 2019	ü		
2	Draft copy of the Country Food Survey	July 2, 2019	ü	ü	ü
3	Summary of Methodology for Impact Assessment of Treated Effluent on Key Marine Species	July 3, 2019	ü	ü	ü
4	Internet Link to Environmental Report conducted for Södra Cell Värö Mill in Sweden	July 4, 2019	ü		ü
5	EEM Monitoring Program for the proposed Effluent discharge location submitted in original EARD	July 4, 2019	ü		ü
6	Follow-Up Monitoring Plan for the proposed Effluent discharge location submitted in original EARD	July 4, 2019	ü		ü
7	Draft copy of original MEKS that was completed in 2018 and sent to KNKNO	July 9, 2019	ü		
8	List of potential air dispersion contaminants of potential concern (COPC's) for Air Dispersion Model	July 9, 2019	ü	ü	ü
9	Draft KSH report on Engineered Wetlands	July 17, 2019	ü	ü	ü
10	Draft Underwater Benthic Habitat Study	July 22, 2019	ü	ü	ü
11	Draft Marine Sediment Sampling Program	July 22, 2019	ü	ü	ü
12	Draft copy of the new MEKS	August 1, 2019	ü		
13	Temperature Profile of Caribou Harbour	August 7, 2019	ü		ü
14	Draft Air Dispersion Modelling Study	September 6, 2019	ü	ü	ü
15	Draft Freshwater Fish & Fish Habitat	August 30, 2019	ü	ü	ü
16	2.3 - Effluent Characterization (FINAL)	September 20, 2019	ü		ü
17	2.4 - Efficacy of Treatment Plant plus KSH ETF Design Specs, Veolia Lab Report (FINAL) (3 documents)	September 20, 2019	ü		ü
18	3.1 - Optimum Design Ranges (FINAL)	September 20, 2019	ü		ü
19	3.2 - Effluent Design Flow (FINAL)	September 20, 2019	ü		ü
20	3.4 - Spill Basin Design (plus five referenced drawings attached) (FINAL)	September 20, 2019	ü		ü
21	3.6 - Waste Dangerous Goods (FINAL)	September 20, 2019	ü		ü
22	2.2 - CSR Marine Survey Study (FINAL)	September 23, 2019	ü		ü

Moving forward, reports will be similarly shared with stakeholders and rights holders. Table 1.2-2 lists reports that are anticipated to be produced during the next project stages and outlines how the information will be shared with stakeholders and First Nations. As reports become available, they will be added to NPNS website and emailed out to select stakeholders.

Table 1.2-2: Engagement Plan after the Focus Report

Recipient	Project Phases					Engagement Level / Frequency
	Project Milestones	Results of Regulatory Approvals	Additional Studies	Construction Complete	Environmental Effects Monitoring Results	
NPNS Employees/ Retirees	Email Notification	Email Notification	Email Notification	Email Notification	Email Notification Post report online	High
Provincial Government	Email Notification	Email Notification	Email Notification	Email Notification	Post report online	High
Local NSE Officials	Email Notification	Email Notification	Email Notification	Email Notification	Post report online	High
Local MLA/ MPs	Email Notification	Email Notification	Email Notification	Email Notification	Post Report online	High
PLFN	Email Notification	Email Notification	Email Notification	Email Notification	Post report online	High
Local Municipalities	Email Notification	Email Notification	Email Notification	Email Notification	Post report online	High
Suppliers/ Vendors	Post report online	Post report online	Post report online	Post report online	Post report online	Medium
Civic Community	Post report online	Post report online	Post report online	Post report online	Post report online	Medium
Key Business Leaders	Post report online	Post report online	Post report online	Post report online	Post report online	Medium
Other	Post report online	Post report online	Post report online	Post report online	Post report online	Low

Engagement Specific to Pictou Landing First Nation

Pictou Landing First Nation (PLFN) is a key rights holder with respect to the ETF project proposed by Northern Pulp. Northern Pulp has undertaken steps to improve the level of engagement and communication with PLFN.

Under the Current Consultation Protocol with Canada, the Province and Mi'kmaq (the Made in Nova Scotia Treaty Process) ("Made-In-Nova Scotia Process". Mi'Kmaq - Nova Scotia - Canada Framework Agreement. February 23, 2007. Membertou, Nova Scotia.) there is a proposed process for consultation for project proponents when dealing with projects which may have impacts on Indigenous rights and/or title. Northern Pulp has reviewed this process and incorporated the principles for consultation into this project.

As part of the Consultation process, the Office of Aboriginal Affairs (OAA) facilitates regular consultation meetings with the Pictou Landing First Nation, both Federal and Provincial agencies involved with this project, and Northern Pulp. Formal consultation led by OAA involving PLFN and Northern Pulp commenced in April 2017 and has been ongoing since. These meetings provide an opportunity for an exchange of information, reports, studies, and other information to the PLFN.

Northern Pulp has engaged various contractors to perform work associated with the Focus Report requirements. Northern Pulp attempted to involve the Mi'kmaq community where possible. Three examples of such practice are the Land-based Archeological Survey, the Mi'kmaq Ecological Knowledge Study (MEKS), and the baseline studies in the marine environment. Within the Archeological Investigation, Mi'kmaq students were hired to perform digging activities under the direction of the lead archeologist. Mi'kmaq participants were interviewed and performed field investigations, to give those students an opportunity to gain invaluable Mi'kmaq input and learn field collection. Additionally, Mi'kmaq fishers were engaged in fishing activities used in the baseline marine habitat analyses. Moving forward, Northern Pulp will continue to involve the Mi'kmaq community where possible.

Northern Pulp will use its website as a medium to post reports and studies upon the submission of the Focus Report to Nova Scotia Environment.

2.0 PROJECT DESCRIPTION

2.1 On-Land Pipeline Info

Provide the following information regarding the on-land portion of the effluent pipeline:

2.1.1 Re-alignment Route

A re-alignment route for the effluent pipeline, given Department of Transportation and Infrastructure Renewal does not permit the pipeline to be placed on the shoulder of Highway 106;

Appendix 2.1 provides a letter from the Department of Transportation and Infrastructure Renewal (TIR) that notes that conversations between NPNS and TIR regarding installation of the pipeline within the right-of-way (ROW) are ongoing.

The description of the on-land portion of the treated effluent pipeline provided below is a conservative estimate of the scope, footprint, and environmental considerations of the realigned route. The on-land portion of the treated effluent pipeline that was previously proposed in the EARD to cross the Pictou Causeway in the Highway 106 ROW has been relocated to a marine crossing in Pictou Harbour. Refinement in scope and minor adjustments will occur as detailed design progresses. Specific design features of the realigned route of the treated effluent pipeline include:

- Less than 1 km of the on-land proposed pipeline is at the existing NPNS facility (to be designed by KSH Solutions).
- Approximately 1.5 km will be a marine installation adjacent to the Pictou Causeway (to be designed by Makai Ocean Engineering).
- In addition to other regulatory approvals, the marine portion adjacent to the Pictou Causeway falls under Nova Scotia Lands and Forestry permitting processes.
- Approximately 8.7 km of the on-land proposed pipeline is proposed to be installed in the TIR ROW between Pictou and Caribou (to be designed by Wood Environment & Infrastructure Solutions; Wood's current design report can be found in Appendix 3.5).

- Land-based installation outside of NPNS property will occur predominantly within the existing NSTIR's ROW adjacent to and paralleling provincial Highway 106.
- The on-land pipeline will be placed at the eastern most edge of the Highway 106 ROW for the majority of the route.
- The on-land pipeline will be installed below ground with a nominal depth of cover of 1.6 m in overland portions.

The pipeline begins at the ETF pump station at the NPNS facility. The pipeline will run on NPNS property until it meets and enters Pictou Harbour. The pipeline is submerged across Pictou Harbour, aligned immediately to the east of the Pictou Causeway until it meets the north bank of Pictou Harbour. On the north side of Pictou Harbour, it enters NSTIR's Highway 106 (Trans-Canada Highway, also known as Jubilee Highway) ROW and follows Highway 106 north to Caribou, NS, mostly on the eastern side of the Highway 106 ROW.

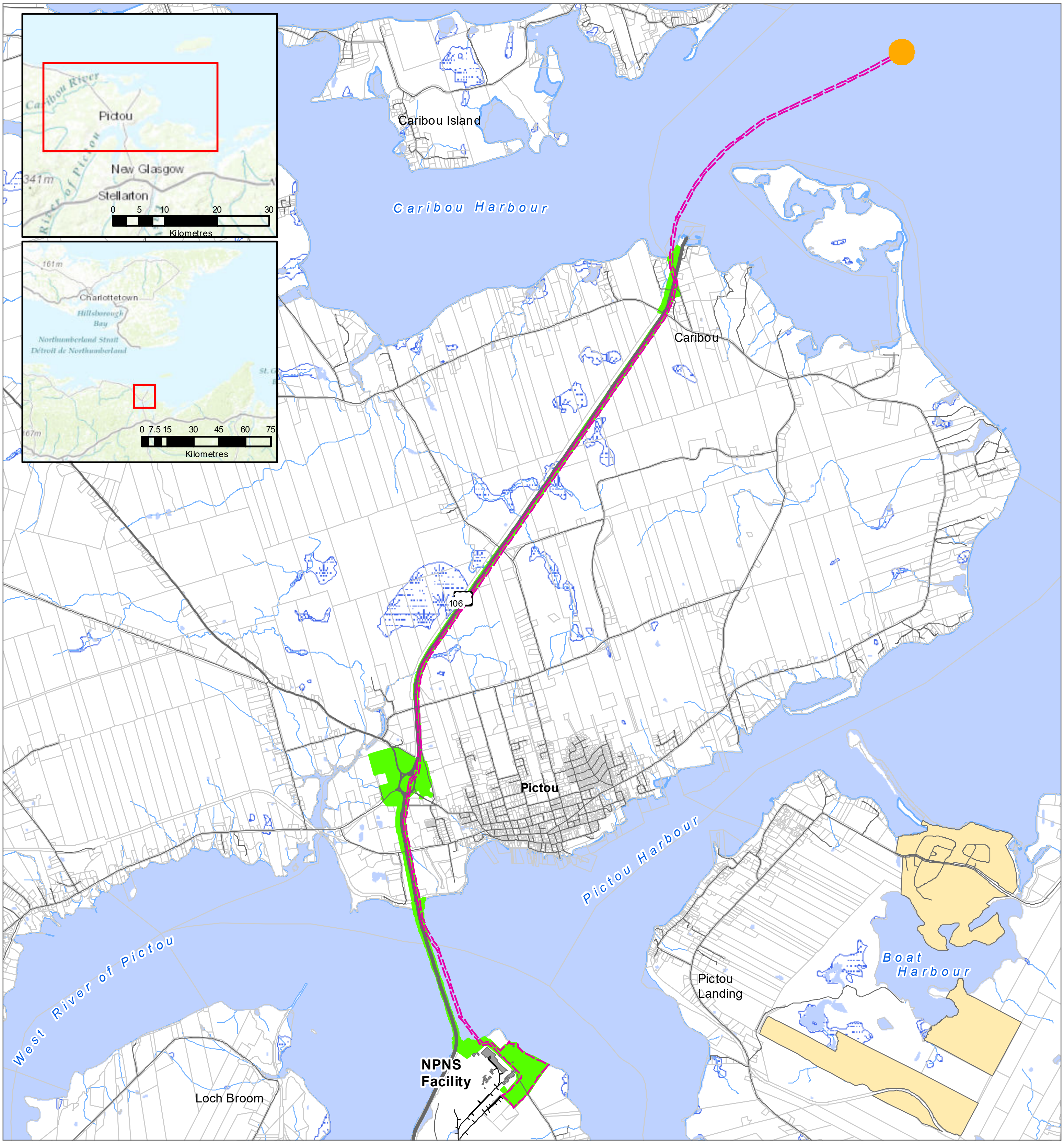
The pipeline will be installed generally parallel to Highway 106, along the outermost eastern portion of the NSTIR ROW. It will be situated predominantly on the east side until it reaches Caribou. At this point, the pipeline will cross under Highway 106 to the west side and enter the marine environment at Caribou Harbour to the north, and to the west of the Northumberland Ferries marine terminal building and parking area. The exact location where the pipeline will enter the marine environment will be determined in consultation with the marine designer, the land-based designer, the construction contractor, and Northumberland Ferries Limited in an effort to reduce impact on ferry operations.

Construction of the on-land portion of the treated effluent pipeline will require an approximate working area width of 10 m. Along Highway 106, the pipe will be generally installed in undeveloped and unmaintained areas. The pipe will be located outside the existing road shoulder but within the ROW, and specific details of the location will be determined in agreement with NSTIR.

Construction of the pipeline will primarily utilize trench and bury construction techniques, with the possibility of using trenchless construction methods at road and utility crossings.

It is expected that pipe sections will be delivered to the ROW by trucks with trailers designed to haul large diameter pipe. The pipe stringing crew is responsible for offloading of the individual pipe sections and positioning them along the edge of the workspace on skids in preparation for connection crews. Pipe joints are then fused together.

Additional information on construction in the ROW is presented in Appendix 2.1. Figure 2.1-1 shows the proposed realigned effluent pipeline route.



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

	Approximate Project Footprint Area*		Wetland		Roads
	Approximate Diffuser Location		Open Water		Watercourse
	Pictou Landing First Nation		Properties Intersecting Project		Rail
	Property Parcels				

Proposed Realigned Effluent Pipeline Route

Figure 2.1-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, GeoNova, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

N E S W

0 0.5 1 2 km

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-10-02

2.1.2 Pipeline Location

Maps and/or drawings of the new pipeline location;

See Figure 2.1-1 above for the new proposed realigned effluent pipeline route.

2.1.3 Pipeline Property Crossing

A list of properties (i.e., Premises Identification number or PID) that will intersect with the new pipeline alignment.

Table 2.1-1 presented below provides a list of the properties intersecting the proposed realigned pipeline route and the premise identification number (PID) for each property. Figure 2.1-1 shows proposed realigned effluent pipeline route.

Table 2.1-1: List of Properties/ PIDs intersecting the realigned Pipeline Alignment

PID	Property ID Holder's Name	Route (Preferred or Alternate)[1]
65097099	Water Parcel - No Owner Identified	Preferred
65094914	Road Parcel Owner Undetermined	Preferred
65055139	Her Majesty The Queen (Canada)	Preferred
65094880	Road Parcel Owner Undetermined	Preferred
65094906	Road Parcel Owner Undetermined	Preferred
65094922	Road Parcel Owner Undetermined	Preferred
65094930	Road Parcel Owner Undetermined	Preferred
65094971	Road Parcel Owner Undetermined	Preferred and Alternate (Rotary PID)
65097065	Water Parcel - No Owner Identified	Preferred
65094948	Road Parcel Owner Undetermined	Preferred
65095010	Road Parcel Owner Undetermined	Preferred
65131336	Road Parcel Owner Undetermined	Alternate
65131328	Road Parcel Owner Undetermined	Alternate
65096851	Road Parcel Owner Undetermined (Jitney Trail)*	Preferred
00889162	NS Transportation And Public Works	Preferred
65095036	Road Parcel Owner Undetermined	Preferred
00864538	Northern Pulp Nova Scotia Corporation	Preferred
65103798	Road Parcel Owner Undetermined	Preferred
65106288	Water Parcel - No Owner Identified	Preferred
65166753	Her Majesty The Queen (Canada)	Preferred
65166746	Her Majesty The Queen (Canada)	Preferred
65049850	Her Majesty The Queen (Canada)	Preferred
65131252	Road Parcel Owner Undetermined	Preferred

1. An alternate route was identified, as the design has not been finalized.

*The Jitney Trail was formerly part of the Canadian National (CN) rail spur (secondary rail line in addition to the primary rail line). The Province granted the spur to the Town of Pictou in a quitclaim deed. In the deed, the Province reserved title where the trail crossed over a number of streets or roads, in addition to Highway 106. This means, that the Province has the authority with respect to the area of Jitney Trail where the proposed pipeline will pass (PID 65096851). See Appendix 2.1 for the quitclaim deed.

2.2 Marine Geotechnical Survey

Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.

There is considerable historical evidence of ice scour in the Northumberland Strait and its presence must be considered by pipeline designers. In light of environmental due diligence taken by NPNS, engineering concerns related to potential for ice scour damage of the pipeline in relation to a proposed marine location (in the Pictou Road area of the Northumberland Strait) prompted the need to consider a deeper alternative outfall location near Caribou and complete additional geophysical survey work in the spring of 2019.

Marine geotechnical surveys of the Caribour Harbour and Picotu Harbour pipeline locations were conducted by CSR GeoSurveys Ltd in 2019.

Geotechnical surveys are required as part of any pipeline construction. They provide details of the physical condition of the land where the pipeline will be constructed. There are two locations (Figure 2.2-1) where investigations were required: in Pictou Harbour, east of the Pictou Causeway; and in Caribou Harbour, extending from the ferry terminal to the proposed outfall location approximately 4.0 kilometres offshore within the Northumberland Strait as shown in Figure 2.2-1 below. The main geotechnical concern in the marine environment is the geology of the harbour bottom where the pipe is planned to be installed. The geology includes the type of sediment or rock that is present. The investigation conducted also provided information on the bathymetry (depth of water and the ocean floor), surficial features, benthic (bottom of a body of water) habitats, and archaeological resources.

Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Marine Geotechnical Survey Study Areas
Figure 2.2-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Marine Geotechnical Study Areas

MAP DRAWING INFORMATION:
DATA PROVIDED BY CSR, Northern Pulp Nova Scotia Limited, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

DILLON CONSULTING

N W E S

0 250 500 1,000 Meters

PROJECT: 17-6461

Date: 2019-09-26

In water, the main methods used to determine this information is through sonar and seismic tools, supplemented by videos, grab sediment samples, and core sediment samples. The sonar and seismic tools used sound and seismic waves, respectively, to detect objects (e.g., bedrock) under the surface of the water.

Surveys were completed for the portion of pipe adjacent to Pictou Harbour at the causeway as well as for the outfall that is being constructed in Caribou Harbour. The Pictou Harbour survey corridor parallels the Pictou Causeway from Abercrombie Point to the northern end of the Pictou Causeway. There were some restrictions in portions of the survey near the shorelines due to the shallow water in these areas. The Caribou Harbour survey corridor extends from the ferry terminal located on the southern shoreline of Caribou Harbour to the proposed outfall location in the Northumberland Strait.

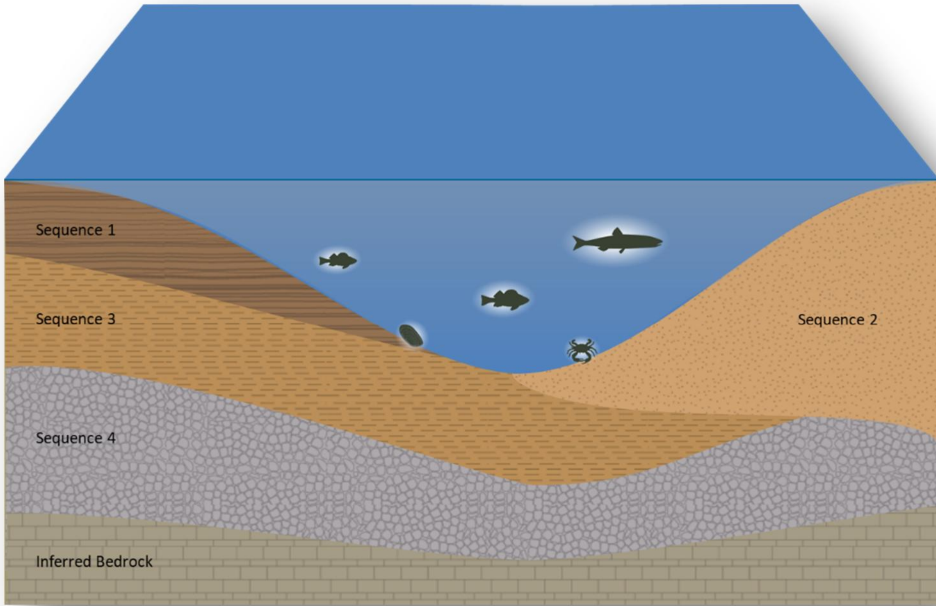
The bathymetry (underwater depth) over the proposed Pictou Harbour pipeline route is relatively flat and shallow with the channel of the West River flowing through with a maximum depth of 9.9 m. The bathymetry along the Caribou Harbour proposed pipeline route has a maximum depth of 19.1 m.

The surficial (upper) geology of the Pictou Harbour survey corridor has mostly silt (fine-grained sediment) with local areas of cobble and boulders interpreted as outcropping glacial till. The surficial geology of the Caribou Harbour survey corridor is mostly sand and gravel, with finer-grained sediments observed nearshore.

Four main sub-bottom (below surficial) geological sequences (i.e., layers) were identified, as follows:

- Sequence 1 is made up of mainly soft silt and clay with occasional thin sandy layers;
- Sequence 2 is made up of sand and gravel, which is common throughout the Caribou Harbour survey corridor;
- Sequence 3 is made up of proglacial sediments composed of clay, silty sand and gravel;
    - Sequence 3a/3b: distinct tops of proglacial (i.e., leading sediments); and,
- Sequence 4 is made up of glacial till consisting of varying grain-sized coarse gravel with finer sediment. Cobbles and boulders may also be present in this sequence.

Figure 2.2-2: Pictorial Representation of Sequences found in the Marine Geology



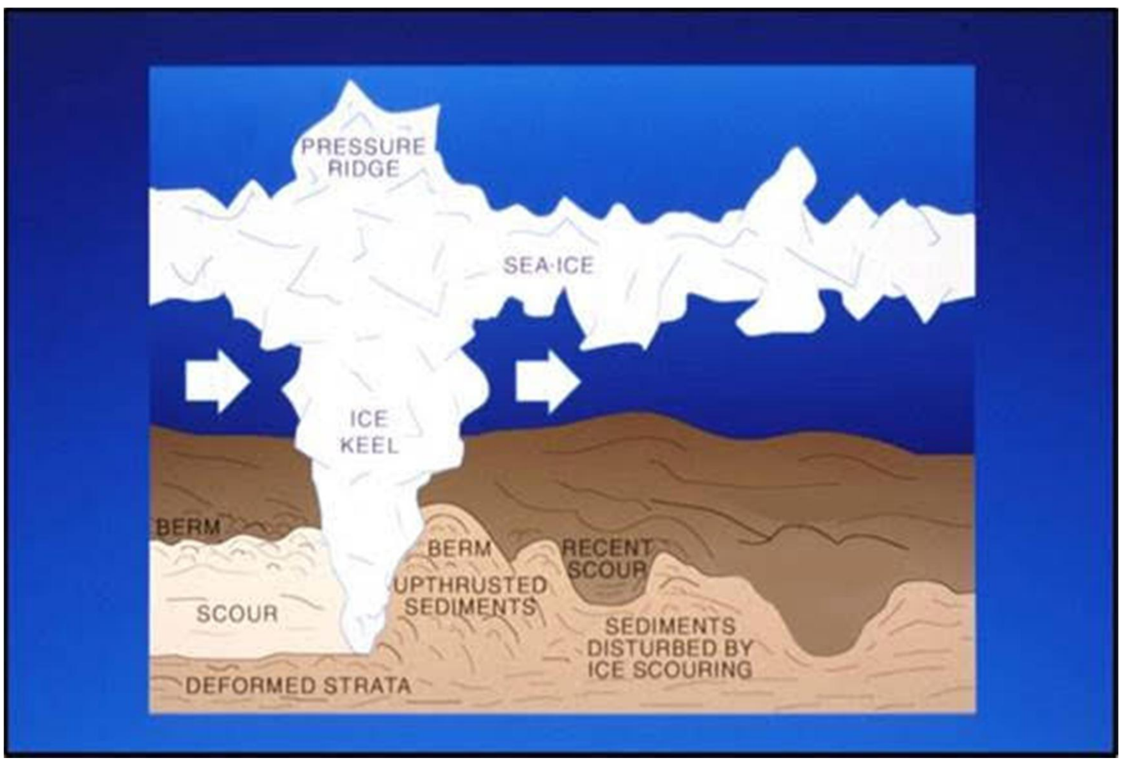
There are three areas along the proposed Caribou Harbour pipeline route where glacial till encroaches within the planned trench depth of up to 3 m; however, the depth to bedrock is not known and may be encountered during the pipeline installation. Areas have been identified on select geological profiles as an area where dredging may be limited due to the sub-bottom geology. The glacial till sequence in Caribou Harbour is interpreted as sub-angular to angular coarse gravel, sand, silt, cobble and possible boulders overlying weathered bedrock. The marine geophysical and geotechnical survey report is provided in Appendix 2.2. The geology type is relevant in determining appropriate construction methodology.

Ice scouring is the process whereby ice ridges contact the seabed forming linear ditches in the seabed sediments. The extent and thickness of ice is influenced by natural process such as: winter temperatures; the severity and duration of storms; as well as wind direction. Strong winds can cause ice to fracture and pile-up into ridges. Subsequent movement of these ridges can cause their keels to scour the seabed sediments. The scour depth parameter is perhaps the most important measurement in estimating the minimum trenching depths required for a pipeline installation. Figure 2.2-3 illustrates the formation of an ice scour, where:

- Pressure ridge = pile-up of sea ice fragments visible at surface.
- Sea ice = frozen ocean water.
- Ice keel = pile-up of sea ice fragments below the surface (i.e., submerged counterpart of the pressure ridge).
- Scour = narrow ditch on the seabed caused by the movement (plowing) of the ice keel.
- Up thrusted sediments = sediments that have been forcefully moved (plowed) upward.
- Berm = the mounds of sediment pushed up to either side of the scour.

Deformed strata = changes in the “layers” caused by the plowing of the soft sediments by the ice keel.

Figure 2.2-3: The Process of Pressure Ridge Ice Scouring (modified from Blasco, 2006)



Ice scour features were identified during the 2019 geophysical survey in to identify areas on the marine seabed where scours could pose a risk to the pipeline. The geophysical results identified 146 ice scours. Of the 146 ice scours identified, 13 scours occur within the Pictou survey corridor, while 133 ice scours were observed within the Caribou area. The ice scour survey was conducted in early spring, soon after the break-up of ice in the Northumberland Strait, which is the ideal time to survey in order to identify and measure the recently formed ice scours before they degrade.

The ice scours observed within the Pictou Harbour survey corridor occur offshore of Abercrombie Point within water depths ranging from 2 m to 3 m (Figure 2.2-2). The deepest ice scour observed on the marine floor bed was 0.3 m. The ice scours observed within the Caribou area occur within water depths ranging from 1 m to 9 m likely formed during the winter of 2018/2019. Ice scours were not observed within the area of the proposed diffuser. Of the 133 scours observed in the Caribou area, 15 had a maximum-recorded scour depth on the marine floor of 0.4 m. Ice scour depth information was required to determine the depth of burial of the pipeline. The results of the ice scour investigation indicate that burying the pipeline 3 m under the seabed in Caribou Harbour is appropriate, given the ice scour conditions present. Detailed engineering will be completed to determine final burial depths, with design standards in accordance with the DNV Submarine Pipeline Systems standard (DNV-OS-F101).

2.3 Characterization of Effluent

Submit data regarding the complete physical and chemical characterization of NPNS' raw wastewater (i.e., influent at Point A for the project), to support the assessment of the appropriateness of the proposed treatment technology. The influent characterization results must be compared against the proposed treatment technology specifications.

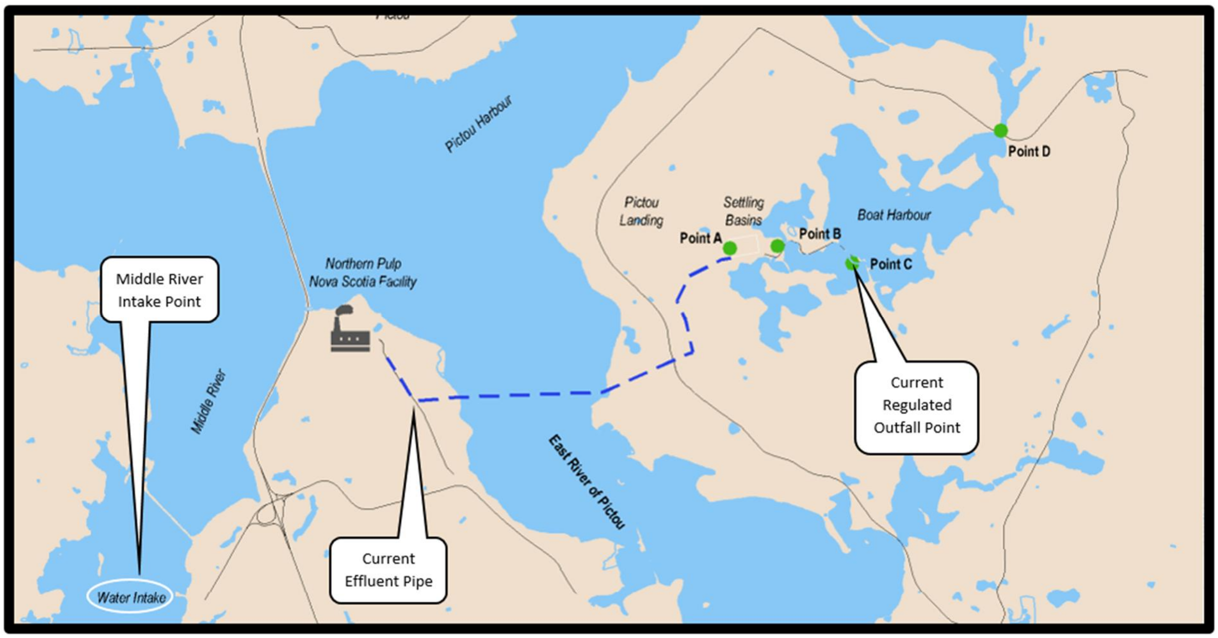
2.3.1 What is Pulp Mill Effluent?

KSH Solutions completed a characterization of the raw effluent with analytical data provided by Maxxam Laboratories (now Buena Veritas Laboratories).

Pulp mill effluent is a complex combination of compounds. The primary volume of pulp mill effluent comes from a water source. NPNS's water source is Middle River (Figure 2.3-1). Water is drawn from Middle River and used in processes within the mill. Effluent is generated from mill processes such as debarking, pulp washing, bleaching, regeneration of cooking chemicals, and products from the breakdown of carbohydrates, lignin, and extractives contained in the natural wood fibre. Parameters that end up in the effluent are generated from three sources:

1. Parameters that are already present in the raw water supply drawn from Middle River;
2. Parameters naturally found in wood; and/or
3. Parameters used within the mill for pulping and bleaching processes.

Figure 2.3-1: Location of Raw Water Intake and Current Effluent Sampling Points



Effluent is produced during the kraft pulping and bleaching processes during many stages as shown in the Project Overview ETF Process in Figure 0-1. In kraft pulping, chemicals are used in high temperature and pressure conditions to separate the cellulose fibres (i.e., the desired product that becomes pulp) from the lignin (i.e., the "glue" that binds cellulose fibres together). Cellulose is what is present in plants that give them strength just as fibres make wood strong. In regards to the pulping process, the wood chips have cellulose fibres present, which contain the lignin. Through the pulping process, the lignin that formerly bound the cellulose fibres together becomes dissolved in the pulping chemicals. The lignin and chemicals are then washed out of the pulp using water. The lignin present in the wash water is burned in a recovery boiler, after which the chemicals are recycled and reused in the ETF process. However, some of the wash water ends up as untreated effluent from the pulping process. This effluent contains residual cooking chemicals, lignin by-products, resins and fatty acids, and other naturally occurring wood extractives. The presence of lignin and its degradation products in the wash water gives pulp mill effluent its characteristic dark brown colour. Other parameters include chlorinated and non-chlorinated phenolic compounds, polycyclic aromatic hydrocarbons, suspended solids (mainly fibres and lime), fatty acids, tannins, resin acids, and sulphur and sulphur compounds. Many of the parameters listed above are parameters naturally occurring in the wood supply.

The bleaching process is designed to brighten the pulp by removing all of the residual lignin from the pulp in a step generally referred to as “delignification.” Up until the mid-1990s, elemental chlorine (Cl_2) was used to bleach the pulp to produce the desired brightness. However, concerns about the nature of organochlorine compounds in the environment prompted one of the most important implemented changes within pulp and paper mills, whereby elemental chlorine was completely replaced by chlorine dioxide (ClO_2) as the bleaching chemical. Chlorine dioxide was key to the development of the Elemental Chlorine Free (ECF) bleaching process. NPNS converted to the ECF bleaching process in 1997, with this technology currently being the most common bleaching method worldwide. Several studies have reported that with the replacement of elemental chlorine with chlorine dioxide, the effluent quality has improved in AOX levels and has resulted in the virtual elimination of detectable amounts of dioxins and furans. The majority of the organic compounds identified in bleaching effluent are derived from lignin or other wood components such as extractives or carbohydrates.

A comparison of the untreated and treated effluent components against published effluent composition data showed that the mill’s effluent is not appreciably different from effluent characteristics from other bleached kraft mills in Canada, as demonstrated in the Project Overview section at the beginning of the Focus Report.

2.3.2 Why and how is Effluent Treated?

The contents in the effluent must be treated according to acceptable methods prior to release, to protect the receiving environment. Industrial effluent treatment systems need to accomplish three objectives:

1. They need to remove suspended particles (solids) from the effluent;
2. They need to remove solubilized (mainly dissolved organic) contaminants; and
3. They need to eliminate acute toxicity (single exposure, or multiple exposure in a short time period).

In Canada, the discharge of effluents from pulp and paper mills into waters frequented by fish is regulated by the *Pulp and Paper Effluent Regulations* (PPER) under the federal *Fisheries Act*. These regulations aim at protecting water quality that sustains fish, fish habitat, benthic invertebrate communities, and the use of fisheries resources. The PPER set limits on the amounts of TSS and BOD that can be released from mills, and prohibit the release of effluents that could cause potential immediate and severe harm (acute lethality to fish) (Environment and Climate Change Canada 2016). In 1996, the addition of secondary treatment for the breakdown of biological material and other components resulted in substantial reductions in BOD, acute toxicity, and TSS in treated effluent at the NPNS facility.

NPNS currently operates an aerated stabilization basin (ASB) as the secondary treatment system, whereby untreated effluent is treated by biological (bacterial) degradation in a large aerated pond over several days before being discharged to the Boat Harbour Basin. Based on proposed design criteria, the replacement ETF would also be expected to provide performance that is comparable to other mills in Canada and elsewhere. The replacement ETF will use an Activated Sludge Treatment (AST) that is a proven technology for kraft pulp mills. The AST system involves aeration and the recirculation of a portion of the bacterial population back to the intake of the system, a process that operates at a much higher rate and efficiency than the current ASB at NPNS. In the new replacement ETF with AST, the settling of the "bugs" in the secondary clarifiers produces a sludge, which is recirculated back to the Activated Sludge tank, and known as the "Activated Sludge" process. These systems have been shown to biodegrade the resin and fatty acids, non-chlorinated and chlorinated phenolics, and polycyclic aromatic hydrocarbons contained in the untreated effluent to a level where the treated effluent is non-toxic and meets regulated (PPER) effluent discharge parameters.

Figure 2.3-1 shows the location of the Middle River intake and certain NPNS Points across the property. NPNS is currently required to do sampling of key pulp mill parameters at Point A and Point C as required under PPER regulations and NPNS's current Industrial Approval (IA) (2015). Table 2.3-1 shows how often these key parameters are sampled at Point A and Point C by NPNS. After submitting the EARD, it was recommended that additional parameters be sampled that analyzed for a diverse suite of parameters that are not part of the kraft mill process, but are perceived as important for the public.

The results of the multiple sampling events since 2015 shown in Table 2.3-1 have been combined with additional sampling completed in 2018 and 2019 to help support the assessment of the appropriateness of the proposed treatment technology. Table 2.3-2 shows a summary of additional parameters collected at Point A, and Appendix 2.3 by KSH Consulting provides a full list of additional parameters analyzed to provide a complete physical and chemical characterization of untreated effluent.

Table 2.3-1 Summary of key parameters and their sampling frequency as required by PPER and NPNS's IA (2015).

Table 2.3-1: NPNS's Current Sampling Requirements from their IA or under PPER

Parameter	Sampling Frequency	
	Untreated (Point A)	Treated (Point C)
Total Suspended Solids (TSS)	Daily	Daily
Chemical Oxygen Demand (COD)	Daily	3 times a week
Biochemical Oxygen Demand (BOD)	3 times a week	3 times a week
Metals	-	Once a year
Dioxins and Furans	-	Once a year
Total Phosphors	-	Daily
Total Nitrogen	-	Daily
Colour	-	Daily
pH	Daily	Daily

Notes:
"-"indicates parameter not analyzed.

Table 2.3-2 shows a summary of additional parameters collected at Point A.

Table 2.3-2: Select Parameter Results from Point A (KSH, 2019)

Parameter	Unit	Point A Result
Absorbable Organic Halides (AOX)	mg/L	1.2
Total Nitrogen (TN)	mg/L	3.2
Total Phosphorus (TP)	mg/L	1.4
Colour	TCU	590
Chemical Oxygen Demand (COD)	mg/L	723
Biochemical Oxygen Demand (BOD)	mg/L	209
Total Suspended Solids (TSS)	mg/L	365
Dissolved Oxygen (DO)	mg/L	290
pH	-	7.1
Temperature (raw, before cooling)	°C	40-55
Temperature (after cooling)	°C	28-37
Salinity	psu	*ND*
Cadmium	µg/L	1.4
Toxic Equivalency Factor (TEF: Dioxins, Furans, And PCBs)	pg/L	4.1
Phenanthrene (PAH, Polycyclic Aromatic Hydrocarbons)	µg/L	0.019
Total Resin Acids	mg/L	*ND*
Total Fatty Acids	mg/L	*ND*
Total Pulp and Paper (P&)Phenols	µg/L	1400

ND = Non-Detect. A non-detect value is a laboratory assigned concentration that indicates the concentration of that parameter in the sample is below the level that could be detected or reliably quantified by the laboratory using a particular analytical method. mg/L= milligrams per litre, µg/L = micrograms per litre, TCU = total colour units, °C = degrees Celsius, psu = practical salinity unit, pg/L= pictogram per litre.

The same additional parameters sampled at Point A, were also sampled at Middle River, Point C, and Caribou Harbour and the full results, including laboratory certificates can be found in Appendix 2.3. As stated above, these new parameter results were also combined with the multiple years of sampling data that NPNS is regulated to sample (Table 2.3-1).

Table 2.3-3 provided below shows the following details:

- The proposed effluent treatment design criteria (proposed treatment technology);
- 2018 averaged untreated effluent characterization (at Point A);
- 2018 treated effluent characterization (at Point C); and
- The results of the Bench Test conducted on the proposed biological treatment system (2018).

The treated and untreated effluent characterization is provided in Appendix 2.3. Further details of the results and the Bench Test are available in Appendix 2.4.

Table 2.3-3: Laboratory Analytical Results Summary

Parameter	Units	Design Specifications[1]	2018 Full Untreated Influent Characterization (Point A)[2,3]	2018 Full Effluent Characterization (Point C)[3,4]	Bench Test Biological Treatment System[5]	
					Untreated Effluent	Treated Effluent
Production	ADMT/d	802	777	777	---	---
Flow Rate	m3/d	85,000	63,580	63,580	58,000 to 90,000	
pH	---	8.0	7.7	7.6	---	---
Temperature (Raw Effluent)	°C	55	---	---	37	---
AOX	mg/L	12	1.2	1.02	4.6	2.2
BOD_5	mg/L	350	209	26	---	<3
COD	mg/L	1,250	723	628	1,300	<500
TSS	mg/L	800	365	29	600	>20
Total Nitrogen	mg/L	3.0	3.2	4.7	5.4	5
Total Phosphorus	mg/L	0.5	1.4	1.5	1.9	1.6
Total Colour	TCU	1,500	735	983	---	---

Notes:

1. Design specifications were developed by KSH (2016) and described in details in Appendix 2.4.
2. Point A denotes point of raw wastewater sample collection prior to treatment for the proposed project. Laboratory results are provided in Appendix 2.3.
3. Parameters are tested either daily or weekly by an accredited third party laboratory. The above noted concentrations are the averages of the 2018 data that were collected.

4. Point C denotes the current discharge location, which is used as a surrogate of what the effluent from the new ETF will resemble. Laboratory results are provided in Appendix 2.3.
5. The lab test was carried out at Veolia Water Technologies – AnoxKaldnes laboratories in Lund Sweden. Effluent from NPNS was received in three 20 L containers on April 2, 2018. The temperature was controlled to 37°C. Dissolved oxygen in the reactors was controlled manually with hand-held instruments, as was the pH on a number of occasions. No adjustment of the pH was necessary to keep it within optimal biological range in the reactors.

.

The design parameters (proposed treatment technology) developed by KSH (Appendix 2.3) in Table 2.3-3 are shown next to the characterization of untreated effluent (Point A) in addition to the Bench Test completed by Veolia Labs. KSH solicited treatment technology providers, and Veolia BAS™ was the chosen technology to design an ETF that would treat effluent at NPNS. To demonstrate that design specifications could be met, bench scale testing was conducted and compared to the design specifications, and the results are presented above in Table 2.3-3. The side-by-side comparison of design specifications and Point A shows that the system has been designed to handle concentrations that are higher than the current concentrations in untreated effluent (Point A). Furthermore, the simulated ETF test completed at Veolia Labs (Bench Test) used untreated effluent concentrations that are also higher than current concentrations in untreated effluent (Point A). These results of the simulation showed that the treatment system could produce treated effluent that meets design specifications, as the treated concentrations were primarily below the design specification concentrations.

2.4 Treated Effluent Characterization

Submit a complete physical and chemical characterization of NPNS's expected effluent following treatment by the proposed technology. To assess the efficacy of the proposed treatment technology, the following must be included:

- *Data from laboratory trials on NPNS's raw wastewater that were conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018;*
- *Modelling results using the raw wastewater parameters and quality;*
- *A comparison of the effluent characterization results from the laboratory trials and modelling work, against appropriate regulations and/or guidelines.*

In addition to Veolia's testing to the standard pulp and paper parameters for the bench scale testing, the effluent characterization at Point C was used as a surrogate for the proposed treated effluent characterization. A comparison of the untreated (Point A) and treated (Point C) effluent components against published effluent composition data from other Canadian jurisdictions (Table 2.4-1) indicates that the mill's effluent is similar to effluent from other bleached kraft mills in Canada operating either an ASB or AST system. Based on Veolia's anticipated performance of the proposed ETF, it is expected that the proposed replacement ETF will provide performance that is comparable to other mills. As such, since the current and proposed ETFs are anticipated to have comparable performance, the data collected from Point C can be used to accurately represent what the effluent from the replacement ETF would resemble.

2.4.1 Data from Laboratory Trials on NPNS's Raw Wastewater That Were Conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018

The selected process for the replacement ETF is the Biological Activated Sludge™ process (BAS™) provided by AnoxKaldnes™ (a division of Veolia Water Technology). The BAS™ process was chosen for this project because of its flexibility and advantages in process design compared to other technologies, as well as its extensive reference list in the pulp and paper industry. The system is also extensively used in municipal wastewater treatment applications. There are over 800 municipal and industrial BAS™ systems installed globally. Similar system configurations are currently in operation at 52 pulp and paper facilities worldwide, including over 20 chemical pulp mills (60–75% of all the biological effluent treatment plants in the pulp and paper industry use AS systems).

The MBBR system is designed to remove roughly 40% of the easily or readily biodegradable soluble COD present in the untreated effluent and to provide 2.2 hours of retention time. The AST stage is designed for a solids retention time of 7 days, the duration that Activated Sludge solids (bacteria) remain in the system. The AST stage is expected to remove up to 30% of the soluble COD.

The BAS process is designed for a soluble COD removal efficiency of up to 70% overall. The biodegradability of effluents varies depending on the mill processes, so a lab trial was undertaken to determine the fraction of soluble COD in NPNS effluent, from which the process performance was finalized.

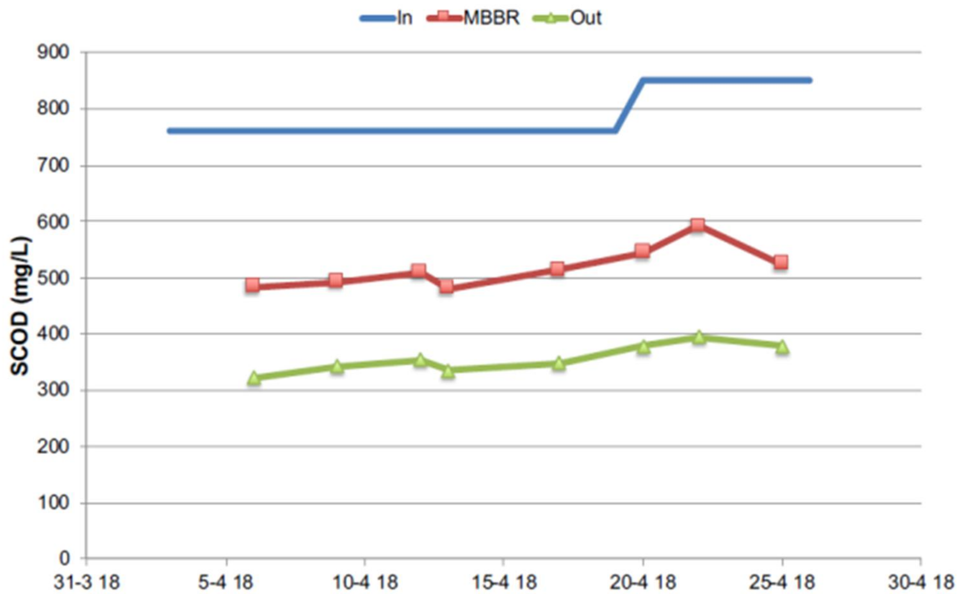
2.4.2 VEOLIA/ANOXKALDNES Lab Trial – Lund, Sweden

The lab trial to determine the biological treatability of NPNS untreated effluent was conducted at the Veolia/AnoxKaldnes facility in Lund, Sweden in May 2018. The lab trial, which was seeded with active biomass or microorganisms from a nearby Swedish kraft pulp mill, ran continuously over a three week period, allowing time to conduct a sensitivity analysis to ensure the proposed treatment technology.

To evaluate the efficacy of the proposed ETF, key indicator parameters were measured during the benchmark test. Of particular importance to ETF efficacy, chemical oxygen demand is a key indicator that is monitored to ensure protection of the receiving water body. Chemical oxygen demand (COD) is a measurement of the oxygen required to oxidize soluble and particulate (solids) organic matter in water. COD is made up of two sub-types: particulate chemical oxygen demand (pCOD) and soluble chemical oxygen demand (sCOD). Many organic compounds, including colour compounds and fibres, which are not easily biodegradable, along with any inorganic chemicals will show up as pCOD. The soluble sCOD is a more representative way to assess the effect of effluent on a receiving environment. This filtered, or soluble, sCOD has been found to be a better representation of the actual biochemical oxygen demand of the wastewater than the unfiltered or total test result. sCOD is a more accurate representation of the expected or actual performance of a biological wastewater treatment system. Total COD is the typical industry measurement in Canada, referred to as tCOD in the lab report, which is a combination of the biodegradable sCOD fraction and the not easily biodegradable pCOD. The focus of the laboratory trial was the removal of sCOD at different flow rates and loadings.

During the Bench Test, flow rate and volume of effluent were varied to determine how successful the ETF was at reducing the amount of sCOD in the effluent. The results showed that, on average, sCOD could be reduced by 55% through the treatment process regardless of flow rate or solids loading. Veolia stated that the reduction of sCOD by the ETF is the maximum reduction that an ETF process can achieve, and that this maximum reduction was achieved during multiple tests (see Veolia Report in Appendix 2.4). A reduction of 55% sCOD is common for kraft mill effluent without oxygen delignification. To achieve a reduction of more than 55%, some form of extended delignification would be required in the pulping stage, such as oxygen delignification. NPNS has plans to add oxygen delignification after the completion of the ETF (further details on adding the oxygen delignification are given in Addendum 1.0). A very low residual BOD_5 of less than 3 mg/L for treated effluent on the last day of the trial further verified that the maximum biodegradation of the organic content had been reached. Trial runs included simulating significantly higher TSS loading in the untreated effluent and a higher effluent flow of 90,000 m^3/day.

Figure 2.4-1: Results of the sCOD Removals during the Laboratory Tests



Another component of the experimental work was dedicated to nutrients present in untreated and treated effluent. Results show that there is considerable excess of phosphorus in the untreated effluent without nutrient addition, and that a large part of it remains in soluble form after biological treatment. There is also a considerable fraction (roughly 40%) of the nitrogen in the untreated effluent that is inert, roughly 40% and that will move through the treatment process unchanged. Veolia has concluded that the expected treated effluent quality as outlined in the KSH Design Criteria of ≤0.5 mg/L for phosphorus and ≤3.0 mg/L nitrogen are likely unattainable. Therefore, higher design concentrations were carried through to the receiving water studies (RWS).

2.4.3 Modelling Results Using the Raw Wastewater Parameters and Quality

KSH performed a statistical analysis of a full year of NPNS untreated effluent quality data from the TME (total mill effluent or Point A) for the calendar year 2016 in order to develop design specifications for the new replacement ETF. The design specifications are provided in Appendix 2.4. The analyses were performed to provide the average, median, standard deviation, and 90% percentile confidence level for flow, BOD, TSS and COD. All data were presented to potential technology providers to allow them to provide a design that would provide appropriate treatment while understanding the variation in quality. Design and peak values were developed for the data set. As concentrations of parameters vary by effluent flow and/or pulp production rate, ranges based on the highest load divided by lowest flow and lowest load divided by highest flow were developed. These wide ranges provide an added safety factor in the ETF design. The full physical and chemical untreated and treated effluent characterization was undertaken then updated on a more up to date annual data set for 2018. Table 2.4-1 below presents the data for comparison purposes for those parameters that are of interest to designers of a new ETF system.

Table 2.4-1: Time Average Design Specifications versus 2018 Effluent Characterization (KSH, 2019)

Point A – Untreated Effluent	Production (ADt/d)	Flow (m^3/day)	TSS (mg/L)	BOD (mg/L)	Colour (TCU)	AOX (mg/L)	COD (mg/L)	P (mg/L)	N (mg/L)
Time Average Design Specifications	802	64,150	325	200	860	6.0	875	1.6	2.3
2018 Full Effluent Characterization	777	63,582	365	209	735	1.2	723	1.5	4.7

2.4.4 A Comparison of the Effluent Characterization Results from the Laboratory Trials and Modelling Work, Against Appropriate Regulations and/or Guidelines

The effluent characterization results from the laboratory trials and modelling work as compared to Canadian regulatory limits or guidelines are provided in Table 2.4-2 below.

Table 2.4-2: Calculated Regulatory Limits in Canadian Jurisdictions vs. Veolia Expected Performance

	BOD				TSS			
	Daily Max		Monthly Avg		Daily Max		Monthly Avg	
	kg/t	kg/day	kg/t	kg/day	kg/t	kg/day	kg/t	kg/day
Canada								
PPER (1992 current)	12.5	11,731	7.5	7,037	18.75	17,597	11.25	10,558
PPER (2019 first draft)[1]	4.5	4,223	2.6	2,440	6.3	5,913	3.75	3,519
Québec (existing mills)	7.1	6,663	4.5	4,223	7.1	6,663	4.5	4,223
Ontario	10.0	9,385	5.0	4,693	13.4	12,576	7.9	7,414
British Columbia	7.5	7,039	7.5	7,039	18.75	17,597	11.25	10,558
Alberta (existing mills)	5.0	4,4693	2.5	2,346	8.0	7,508	4.0	3,754
New Brunswick	4.3-13.4	11,731[a]	2.7-8.0	7,039[a]	18.75	17,597	11.25	10,558
Nova Scotia	12.5	11,731	7.5	7,039	18.75	17,597	11.25	10,558
Manitoba	10-32	11,731[a]	10-32	7,039[a]	5.0	4,693	5.0	4,693
Newfoundland	12.5	11,731	7.5	7,039	18.75	17,597	11.25	10,558
NPNS								
Veolia ETF Performance	----	----	2.0	1,875	----	----	2.0	1,875

Notes:
1. The values shown are speculative and are based on discussions between ECCC and Industry representatives
a. Calculated at Canadian limit as discharge limits in this province are permit-specific

Regulatory Review of Other Jurisdictions

The replacement ETF was designed using BATEA (Best Available Technology Economically Achievable) principles and by review of other Canadian jurisdictions where mills of similar age and design operates. The Province of Québec offers some of the most applicable regulations in Canada and differentiates between new and existing mills. With the limits in Québec being more stringent than the current Federal PPER limits, they were used as the starting point for the replacement ETF design in 2016. The new ETF system capability was designed with a margin of safety to ensure that NPNS can consistently operate below the monthly and daily regulatory limits.

Since the ETF project commenced, Environment and Climate Change Canada (ECCC) announced their intention to modernize the PPER. The first draft of the regulations was issued in May 2019.

The expected ETF effluent quality, based on Veolia performance expectations, was compared with the current PPER, the first draft of the updated PPER, and the regulations in other Canadian jurisdictions.

The results summarized in Table 2.4-3 demonstrate that the proposed replacement ETF would not only continue to meet the existing PPER limits and be in compliance in every Canadian province, but would also meet the benchmarks from the first draft of the 2019 PPER regulations.

Receiving Water Study (RWS) Effluent Loading

The 2018 RWS for the Caribou Harbour outfall presented daily maximum effluent water quality expressed on a concentration basis. Based on a peak flow of 85,000 m^3/day, contaminant loadings in kg/day can be calculated. The RWS, with far-field modelling conducted over a period of one-month, assumes that the maximum daily effluent quality occurs every day of that month; therefore, it can be thought of as a monthly average with peak flow of 85,000 m^3/day occurring every day.

A comparison of NPNS's current treated effluent loadings at Point C and the proposed ETF's expected performance run from Veolia, was conducted against the pollutant loadings that were brought forward to the RWS (Table 2.4-3). For all parameters presented below, the loadings brought forward to the RWS are greater than both current and future expected effluent quality and hence conservative.

It is noted that actual operating parameters in the new replacement ETF are expected to be below the maximum performance run values from Veolia.

Table 2.4-3: Effluent Loadings Comparison

	2018 Point C Treated Effluent Loading (kg/day)[1]	Veolia Expected Loading (kg/day)[2]	RWS Loading (kg/day)
BOD	1,526	≤ 1,875	4,080
TSS	1,717	≤ 1,875	4,080
COD	39,521	≤ 37,500	61,625
AOX	87	≤ 225	663
Nitrogen	299	≤ 450	510
Phosphorus	95	95	128

Notes:

1. Based on annual average production rate of 777 ADt/d.
2. Based on Reference Production Rate (RPR) of 938.5 ADt/d.

2.5 Changes to Pipeline

Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads, excavation, blasting, disposal at sea, and others where applicable).

Summary

Design of the marine pipeline has evolved since the route into Caribou Harbour was selected. New information has been collected since the submission of the EARD including bathymetry (elevations of the ocean floor), soil and rock conditions, and analysis of fish habitat that has allowed design and construction decisions to be made. Considerations for design have included available staging sites for the approximate 4.0 km Caribou Harbour marine pipeline section, ballasting and weighting for pipeline trench placement and stability, and burial for protection from vessel traffic and ice scour. Appendix 2.5 provides the details of the current proposed construction. The main changes to the pipeline construction from the EARD to the current proposed design are summarized in the Table 2.5-1.

Table 2.5-1: Summary of changes to construction of the pipeline between EARD and Focus Report

Pipeline Construction Component	EARD	Current Design	Rationale for Change
Length (marine only)	Approximately 3.9 km in Caribou Harbour.	Approximately 4.0 km in Caribou Harbour and approximately 1.5 km in Pictou Harbour adjacent to the causeway.	Detailed surveys had not yet been completed in January 2019. Pipeline alignment relocated from shoulder of causeway to adjacent marine environment following EARD submission.
Pipeline Assembly	The pressure test (hydrostatic testing of pipeline section following pipe fusion process) can be conducted with the pipe floating in the lagoon as long as both ends are supported onshore or on a barge.	The pressure test (hydrostatic testing of pipeline section following pipe fusion process) can be conducted on-land or on water, on each flange-capped section of staged pipeline.	N/A. Additional assembly options presented.
Dredge Method Selection	Prior to completion of marine geotechnical surveys, estimate of excavated volume of more than 13,500 cubic metres of soil per kilometre.	Following completion of marine geotechnical surveys and determination of ice scour on route, estimate of excavated volume of more than 20,000 cubic metres of soil per kilometre.	September 2019 report considers details from the completed marine geotechnical survey.

Pipeline Construction Component	EARD	Current Design	Rationale for Change
Excavation	Clamshell excavator as the primary excavation method. Dredge spoils will be raised out of the trench and side-casted adjacent to the trench (pending permitting/ approvals). In deeper waters, or for other reasons, the hydraulic dredging and trenching technique known as Cutting Suction Dredging (CSD) may be used.	Clamshell excavators, backhoe excavators, or a suction based dredge (CSD) as the primary excavation method, or combinations thereof. Dredge spoils considered in the geotechnical assessment.	September 2019 report considers details from the completed marine geotechnical survey.
Excavation	Estimated excavation rate of 300 to 500 cubic metres per hour (assumes cutting suction dredge method); the anticipated production schedule would be 3-4 days per kilometre.	Estimated excavation rate of 60-120 cubic metres per hour (assume clamshell bucket method); the anticipated production schedule would be at least 21 days per kilometre.	January 2019 report assumes CSD trenching method. September 2019 report assumes clamshell bucket excavation method.
Staging	No equipment or process details provided.	Equipment will be needed to capture and pull the floating pipeline end into position. This is usually performed by a bulldozer or anchored winch. An onshore staging site or shoreline access would be desirable for contractor crew and small equipment loading and offloading.	Contractor to determine based on Final Detailed Engineering Design.

Marine Pipeline Construction Description

Makai Ocean Engineering, Inc. has completed a preliminary study for the new marine pipeline construction. Appendix 2.5 provides details of the likely construction methods and design features of the pipeline, based on the available data and standard practices for marine pipelines. The marine portions of the pipeline include an approximately 1.5 km long segment in Pictou Harbour adjacent to the causeway heading north from NPNS property, prior to a terrestrial segment of the pipeline, which extends to Caribou Harbour. The final leg of the proposed pipeline is approximately 4.0 km of marine pipeline, extending out from the Caribou Harbour ferry terminal area. The entire length will consist of 36 inch (900 mm) diameter High-Density Polyethylene (HDPE). The proposed pipeline will be weighted down with concrete, buried along the length of the marine route to the west of the ferry channel, and end offshore at a discharge diffuser in approximately 20 m of water depth.

Caribou Harbour, and the nearby section of the Northumberland Strait, is susceptible to ice scour, predominately due to ice floes. To protect the proposed pipeline from damage due to impact or bearing pressure, the pipeline will be buried to a depth of up to 3 m. Burying the pipeline below the potential scour impact is the most effective measure to protect pipelines from ice damage. Given the sandy-silt and light gravel soil type of the sea bottom along much of the pipeline route, the planned soil cover of up to 2 m over the pipeline is expected to provide protection. During the survey completed by Canadian Seabed Research (CSR), no evidence of ice scour was found at the planned location of the diffuser port, located outside of Caribou Harbour in 20 m water depth. CSR concluded that given the water depth, the shelter provided by Caribou Island and the lack of any scour indicators observed, an ice strike at this location appears unlikely.

Given the water depth and surveyed soil type, the recommended method of excavating the pipeline trench is mechanical means, specifically clamshell excavator, cutter-suction dredge, and long-reach backhoe excavator types. The exact method used for dredging will be determined by the selected marine contractor based on schedules, costs, and available equipment resources. The marine portions of the HDPE pipe will be constructed of extruded HDPE pipe segments. Longer segments of the HDPE pipes will be staged with concrete ballast, most likely from NPNS site into Pictou Harbour where the pipe can then be floated and towed to Caribou or the Pictou Causeway. When ready, the pipeline will be gradually flooded along its length where it will settle into the excavated trench. Once placed, the trench will be filled to provide soil coverage to existing grade.

The 2019 geotechnical survey indicates surficial sediment layers of sand, silt, and gravely sand. Layers of glacial till, and possibly some section of bedrock, may exist several metres below these surficial sand layers. The route's shallow water depth and trench height is expected to allow for these layers, if they exist, to be broken up by mechanical means (e.g. ripper, hammer, clamshell digger). The need for blasting is considered very unlikely. It is anticipated that spoils from the excavation will be repurposed as fill to cover over the trenched pipeline once placed. Excess spoils may be require disposal and will be subject to regulatory approval and permitting.

3.0 FACILITY DESIGN, CONSTRUCTION AND OPERATION AND MAINTENANCE

3.1 Treatment Technology Specifications

Submit treatment technology specifications (e.g., optimal performance range of the technology) and an assessment of the efficacy of the proposed treatment technology for use at the NPNS facility, to the satisfaction of NSE. For example, peak effluent temperature is proposed to be above the generally accepted range of temperatures to achieve optimal biological treatment. Explain how the proposed higher than optimal treatment temperature would affect the treatment performance.

As previously described in Section 2.4 above, the efficacy of the proposed treatment technology (Design Specifications Appendix 2.4) has been compared to the results of the Bench Test completed in Sweden (raw effluent from NPNS run through a simulated treatment plant). The results indicated that the monthly averages in BOD and TSS from the Bench Test are below the PPER requirements; therefor, the new ETF will be able to provide adequate treatment. The Veolia Performance versus PPER requirements as identified in Table 3.1-1 is reiterated below:

Table 3.1-1: Treatment Performance from the Bench Test

Tests and Guidelines	BOD Monthly Average	TSS Monthly Average
	kg/day	kg/day
Veolia/AnoxKaldnes™ BAS™	1,875	1,875
PPER (Current)	7,039	10,558

Notes:
BOD = Biochemical Oxygen Demand; TSS = Total Suspended Solids; BAS = Biological Activated Sludge ™ ;
PPER = Pulp and Paper Effluent Regulations (under the Fisheries Act)

The following provides further evidence that the specifications for the clarifiers will meet, and in fact exceed the design specifications.

Treatment Performance – Settling Time

The replacement ETF includes a primary clarifier (56 m diameter concrete circular tank that has a liquid depth of 5.5 m). The average flow rate through the clarifier from the KSH design specification is 65,000 m^3/day. This translates into a settling time (i.e., the available time for solids to sink to the bottom) of about 5.7 hours. The design flow rate through the unit from the KSH design specification is 85,000 m^3/day, which provides a settling time of about 4.3 hours. The typical design settling times of 2.5 hours for average flow and 1.5 hours for design flow is exceeded by replacement ETF.

The effluent leaving the AST process will be pumped and split evenly between two 56 m diameter concrete circular tanks (i.e., secondary clarifiers) designed for a 6.2 m liquid level. The average flow rate through each unit from the KSH design specification is 32,500 m^3/day. This translates into a settling time of about 11.3 hours. The design flow rate through each unit from the KSH design specification is 42,500 m^3/day. This means it has a settling time of about 8.6 hours. The design specification for the secondary clarifier is based on the rate (overflow rate) that the effluent overflows the edges (weir). The design criteria for overflow rates are between 16 and 28 m^3/m^2/day for average flow and between 40 and 64 m^3/m^2/day for peak flow. The actual design for the replacement ETF is more conservative than these criteria as it has an overflow rate of 13.2 m^3/m^2/day for average flow and 17.3 m^3/m^2/day for peak flow. Solids removal efficiency at the secondary clarifiers is expected to be around 99%.

Both primary and secondary clarifiers are very conservatively designed compared to design recommendation ranges.

Treatment Performance Temperatures

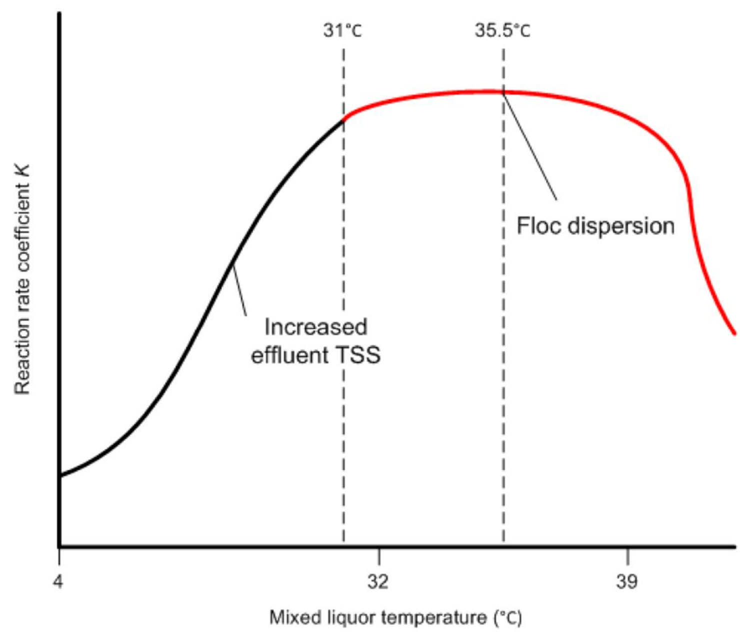
Temperature control of the effluent prior to biological treatment is essential in an AST system. The proposed effluent cooling system for NPNS' new replacement ETF will use cooling towers in a closed-loop cooling system design (shell-and-tube heat exchangers). The overall effluent cooling system has been sized at maximum effluent flow and temperature in summer conditions, when effluent and raw water temperatures are at their highest and when evaporative cooling in the cooling towers is limited because of the prevailing weather conditions (i.e., high temperatures and humidity). The modular design of the system, with multiple heat exchangers and cooling tower units, allows the mill to shut down individual units in order to limit effluent temperature fluctuations.

The KSH design specifications indicate a design temperature range after cooling of 28-37°C. Temperature will be controlled by varying raw water flow to the cooling towers to achieve the desired operating temperature set point, most likely set at or near 35°C in the summer and likely slightly less in the winter. A review of other Paper Excellence mills confirms the operating ranges for the biological treatment stage chosen, by both KSH and Veolia, for this project are appropriate. Howe Sound Pulp and Paper operates their ETF at a maximum of 37.0 - 38.5°C and the Port Alberni mill operates at a maximum of 37 - 38°C in summer. AST facilities operate well in these ranges.

A biological treatment system contains many microorganisms that provide treatment. The types of organisms working change because of the constantly changing composition and quality of the effluent. As the temperature changes in the effluent, one group of microorganisms will slow down, even die off, and another group will perform the treatment needs. Variations in temperature affect all biological processes. In the mesophilic (moderate temperature) range, the rate of the biological reaction will increase with temperature to a maximum value around 35.5 °C for most aerobic effluent systems. Temperatures above 39°C will result in a decreased oxidation rate for mesophilic organisms as can be seen in Figure 3.1-1 below. Therefore, biological oxidation rate is still high at the design temperatures assigned.

Figure 3.1-1: Effect of Temperature on Biological Oxidation Rate Constant K

Source: Harold B. Gotaas, *Sewage Works Journal* Vol. 20, No. 3 (May, 1948), pp. 441-477



With increasing effluent temperature, bacterial activity increases. The maximum acceptable operating temperature for typical AS systems is limited to about 39°C, which corresponds to the maximum temperature for the growth of mesophilic organisms.

3.2 Effluent Flow Data

Provide effluent flow data to support the proposed peak treatment capacity of 85,000 m^3 maximum flow of effluent per day. At a minimum, data from 2017 and 2018 is required. Provide flow data for Point A, clarify source of the effluent flow volumes given in the EARD, and provide other relevant data and information to support the proposed treatment system design. If the 85,000 m^3 cannot be justified based on historical data, identify water reduction projects, or re-evaluate the treatment system design and update the receiving water study accordingly.

Summary

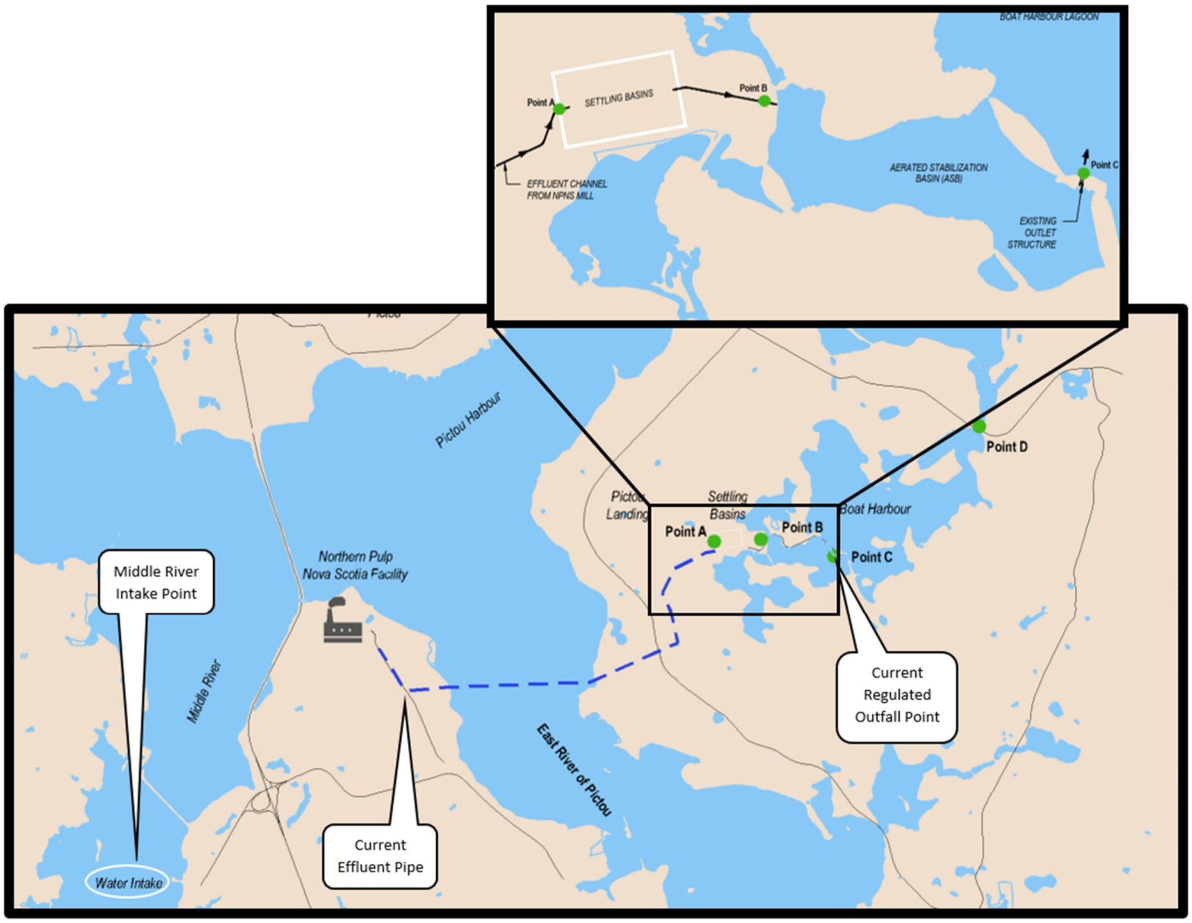
The basis of design for the new replacement ETF and associated effluent outfall was a design effluent flowrate of 85,000 m^3/day. Three years of operating data confirm that 85,000 m^3/day was exceeded only once in three years (87,655 m^3/day one day in 2016). More than 90% of the time, the daily average effluent flow is between 55,000 – 75,000 m^3/day. A design of 85,000 m^3/day is therefore appropriate and well supported by the operating data of the last three years.

Non-contact cooling water makes up a considerable portion of the total mill effluent (TME) flow. Cooling towers will be installed to recycle clean water for reuse within the mill during the summer months. New cooling towers are expected to reduce the peak summer effluent flow at the mill by approximately 5,000 m^3/day below current levels, making the design flow even more conservative.

Figure 3.2-1 shows where Point A, Point B, Point C, and Point D are located at the BHETF.

- Point A is untreated effluent prior to where any treatment starts;
- Point B is after the primary settling basins and before the aeration basin;
- Point C is where the treated effluent leaves the operating BHETF and enters the Boat Harbour Basin (Current Regulated Outfall Point with ECCC);and
- Point D is where treated effluent flows over a dam and discharges into the Northumberland Strait. (Historical Outfall Point with ECCC until 2009).

Figure 3.2-1: Location of Select Point spots across NPNS property



Evaluation of Current Effluent Flow at NPNS

As stated in the EARD, 85,000 m^3/day is the highest daily average flow that is expected for the new replacement ETF, and was used as the basis of design for the new replacement ETF and associated effluent outfall. This proposed peak treatment capacity of 85,000 m^3/day was determined by review of the actual operating data from the NPNS mill for effluent flow at Point C, the mill's current regulated outfall location at the BHETF. The flow measurements at Point C were used because the measurement equipment at Point C is the most accurate and reliable. Point A flow data would have been used for the design review if the flow meter at that location possessed the accuracy required for the evaluation. The flow measurement at Point A, used only to assist operations at the mill, is less accurate than the regulatory flow measurement (i.e., Parshall Flume) used at Point C.

In the absence of accurate Point A data, a verification review of raw water flow from Middle River in to the mill was undertaken to confirm the accuracy of the Point C data. The relationship between incoming raw water and effluent flow is well known at NPNS. The effluent flow is roughly 10% lower than the raw water flow due to water vapour lost through four wet scrubbers (i.e., air pollution control devices) used at the mill to remove particulate matter in the exhaust streams (Figure 3.2-2). Evaluation of flow data for 2016, 2017, and 2018 as outlined in Appendix 3.2 confirmed the expected correlation or relationship between raw water and effluent flow.

Figure 3.2-2: Water Loss within the NPNS Mill

The average raw water used for the inflow of water from Middle River was 72,600 m^3/day based on the flow meter data from January 2016 to December 2018. The average flow at Point C for the treated effluent flow rate for the same period was 63,500 m^3/day. The difference of 9,100 m^3/day represents the average flow of water lost to evaporation during that period (an approximate 10% loss).

Appendix 3.2 presents the statistical analysis performed on the effluent flow data. Review of the data indicates that the daily average design flow of 85,000 m^3/day was exceeded once in 2016, and not at all in 2017 or 2018. The data also indicates that more than 90% of the time, the daily average effluent flow is therefore between 55,000 – 75,000 m^3/day. A design of 85,000 m3/day is appropriate and well supported by the operating data of the last three years.

Secondary treatment systems are typically designed based on a daily maximum flow. It is important to note that although the replacement ETF has been designed for 85,000 m^3/day, it does not mean that the system is "broken" or unable to effectively treat effluent for shorter-term periods of higher flow. As outlined in Section 2.4, Veolia/AnoxKaldnes trials undertaken in Sweden indicate that the system is well designed and can effectively treat effluent flow of 90,000 m^3/day without compromising organic removal efficiency. Components such as clarifiers, aeration basins, piping and pumps are always designed for peak hourly flows that are significantly higher than the daily average design flow.

Non-contact cooling water makes up a considerable portion of the TME flow. As outlined in Addendum 1, cooling towers will be installed as an in-mill improvement to recycle non-contact, clean cooling water for reuse within the mill processes during the summer months. The goal is to reduce the peak summer effluent flow at the mill by approximately 5,000 m^3/day.

3.3 Effluent Discharge Parameters

Effluent discharge parameters must be updated (where necessary) based upon the results of the effluent characterization in Section 2.4 and relevant additional studies. Refer also to Addendum item 2.0

Addendum 2.0

- *With respect to the effluent discharge parameters: Explain why the total nitrogen parameter has changed to 6 mg/L (daily maximum) from the 3 mg/L (proposed in the August 11, 2017 RWS);*
- *Provide data to support assertions that COD can be reduced to the proposed limit.*

Summary

Effluent characterization was undertaken to confirm the model parameters in the RWS and to identify contaminants of potential concern (COPCs) in the effluent. Total Dissolved Solids (TDS) was the only parameter updated because of the evaluation; however, cadmium, total dioxins and furans, phenanthrene, total resin acids, total fatty acids, and total pulp and paper phenols were also identified as COPCs to be carried forward in the updated RWS.

A review of the model parameters and their levels for the RWS, compared to current wastewater operations or future replacement ETF expectations, prove to be conservative. The updated RWS, presented in Section 4.2 herein, simulates the distribution of far- and near-field effluent from the proposed outfall location near Caribou Harbour based on the updated list of parameters.

Nitrogen Summary from Addendum 2.0

Nitrogen (TN) in the effluent can exist in various forms, some that are available to the organisms (primarily inorganic nitrogen) during the treatment process and others that are not available (inert). Inert nitrogen will remain in the treated effluent, unchanged by the treatment process.

Analyses of nitrogen fractions in untreated effluent, undertaken by Veolia at the Lund Facility in May 2018, concluded that very little inorganic nitrogen was available. This confirms that additional inorganic nitrogen must be added as a nutrient to maintain optimum biological removal efficiency in the new replacement ETF.

Further analyses of the treated effluent indicated that roughly 2 mg/L was determined to be inert. A discharge level of approximately 5 mg/L TN was achieved in the lab trials of which 40% (2 mg/L) was inert. As a result of the lab trial conducted by Veolia at the Lund Facility, the concentration of TN in treated effluent in the 2018 RWS was increased from 3 mg/L to 6 mg/L.

COD Summary from Addendum 2.0 (Untreated Effluent)

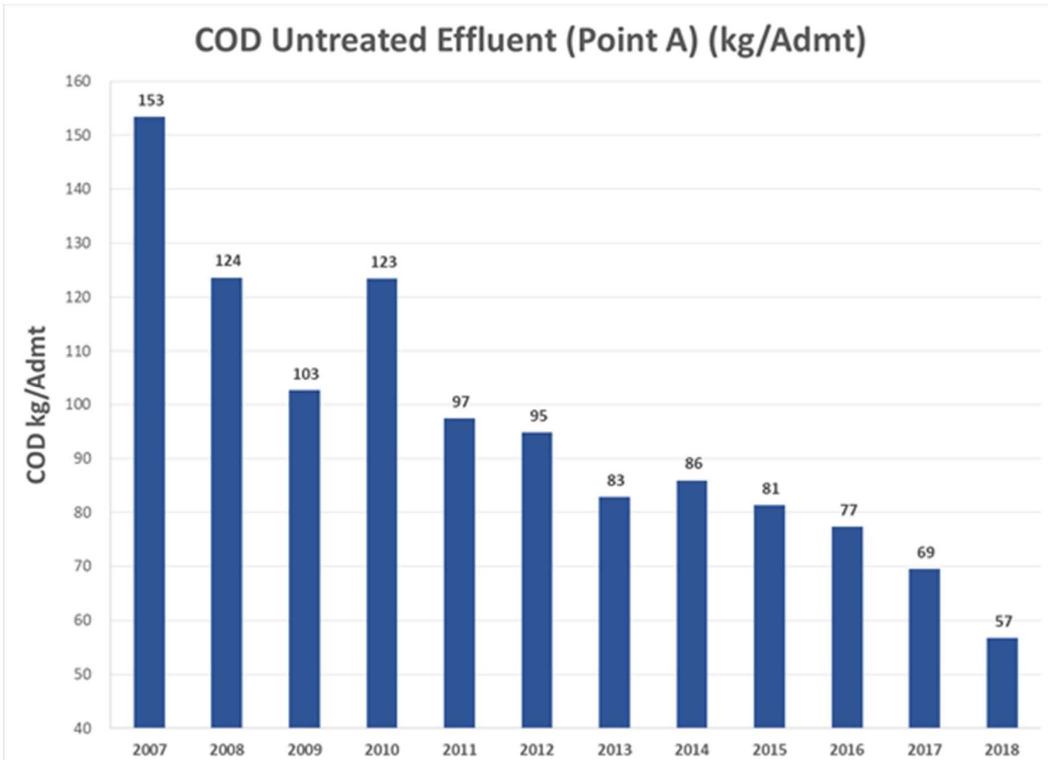
A study to identify all sources contributing to COD in untreated mill effluent was undertaken in 2016. The report outlines the significant improvements that have been made over the last decade through the implementation of many projects and initiatives, including:

1. Brown Stock Screen Room Closure and Washer Upgrades – 2011
2. Black Liquor Emergency Storage Tank – 2011
3. Black Liquor Evaporator Plant Upgrade – 2012
4. Indirect Condenser and Ejector Set for Evaporator Plant – 2016
5. Additional sewer measurements (conductivity and pH probes) – 2017
6. Modification to Recausticizing Area Sewer System - 2018
7. Improved shutdown and start-up management procedures - ongoing

8. Continuous Improvement Activities – ongoing

Figure 3.3-1, updated to 2018, shows the significant improvements in COD resulting from these projects and initiatives.

Figure 3.3-1: COD Improvements in Untreated Effluent



Treated Effluent Discharge Quality

The proposed replacement ETF will accept an estimated annual average of 62,000 m^3/day (85,000 m^3/day peak flow) of raw untreated effluent from the bleached kraft pulp process at NPNS and will discharge the treated effluent into Northumberland Strait. The levels of parameters within the untreated effluent entering the ETF are reduced during multiple treatment processes that occur within the ETF. The treated effluent that is produced from the replacement ETF process is then discharged with parameter levels that are much lower than the untreated effluent.

As the replacement ETF has not yet been constructed, the treated parameters and their levels were predicted. Table 3.3-1 shows the effluent discharge concentrations that are expected to be present in the treated effluent coming out of the new replacement ETF.

These parameters were then carried through to the updated RWS and used as input values to the models. The concentration values are compared to the treated effluent quality from the 2018 RWS outlined in the EARD. The updated RWS, based on inputs from the table, is presented in Section 4.2 of this Focus Report.

Items in bold italics were either updated because of effluent characterization work presented in Section 2.3 and 2.4 or added as a COPC outlined in Section 9.2 in this Focus Report.

AOX (Adsorbable Organic Halogens)

The AOX loading used in the RWS is conservative and remains unchanged. AOX of 7.8 mg/L at the design flow of 85,000 m^3/day equates to 663 kg/day in the RWS, while the Veolia expectation is ≤ 225 kg/day and the 2018 BHETF annual average discharge was 95 kg/day.

TN (Total Nitrogen)

The TN loading used in the RWS is conservative and remains unchanged. TN of 6.0 mg/L at the design flow of 85,000 m^3/day equates to 510 kg/day in the RWS, while the Veolia analysis predicts ≤ 450 kg/day and the 2018 BHETF annual average discharge was 299 kg/day.

Total Phosphorus

The TP loading used in the RWS is conservative and remains unchanged. TP of 1.5 mg/L at the design flow of 85,000 m^3/day equates to 128 kg/day in the RWS, while Veolia predicts TP to remain unchanged from the 2018 BHETF annual average discharge of 95 kg/day.

Colour

The colour loading used in the RWS of 750 total colour units (TCU) is conservative and remains unchanged. Colour is an aesthetic parameter, and generally not regulated or guaranteed. Colour loading most closely follows COD loading as most of the colour is derived from lignin in the trees. In 2018 at the current treatment plant, colour at Point A was 723 TCU and 983 TCU at Point C. Aerobic stabilization basin systems, such as the current one, typically see colour increases during treatment due to long retention times of solids in the primary sedimentation basin. In the future, with the proposed AST process and expected reductions in COD, treated effluent will have less colour than today at Point A.

COD (Chemical Oxygen Demand)

The COD loading used in the RWS is conservative and remains unchanged. COD at 725 mg/L at the design flow of 85,000 m^3/day equates to 61,625 kg/day in the RWS, while the Veolia guarantee for COD is ≤ 37,500 kg/day and the 2018 BHETF annual average discharge was 39,521 kg/day.

BOD_5 (Biochemical Oxygen Demand)

The BOD loading used in the RWS is conservative and remains unchanged. BOD_5 at 48 mg/L at the design flow of 85,000 m^3/day equates to 4,080 kg/day in the RWS, while the Veolia guarantee for BOD is ≤ 1,875 kg/day and the 2018 BHETF annual average discharge was 1,526 kg/day.

TSS (Total Suspended Solids)

The TSS loading used in the RWS is conservative and remains unchanged. TSS at 48 mg/L at the design flow of 85,000 m^3/day equates to 4,080 kg/day, while the Veolia guarantee for TSS is ≤ 1,875 kg/day and the 2018 BHETF annual average discharge was 1,717 kg/day.

DO (Dissolved Oxygen), pH, and Temperature

These three parameters are a result of the treatment process chosen and remain unchanged in the RWS.

TDS (Total Dissolved Solids)

TDS was reduced from 4,000 mg/L (4 g/L) in the 2018 RWS to 2,000 mg/L (2 g/L) for the updated RWS based on effluent characterization testing outlined in Section 2.3. TDS at 2,000 mg/L is still very conservative as the average of the testing undertaken was 1,033 mg/L.

Additional Parameters Added to the Model

Cadmium, total dioxins and furans, phenanthrene, total resin acids, total fatty acids, and total P&P phenols were all added to the parameter list to be carried forward in the updated RWS based on feedback from relevant stakeholders to alleviate concerns of the potential impact.

Table 3.3-1: Summary of Parameters Present in Treated Effluent and Modelled in the RWS

	Units	2018 RWS	Updated RWS
AOX	mg/L	7.8	7.8
Total Nitrogen	mg/L	6	6
Total Phosphorus	mg/L	1.5	1.5
Colour	TCU	750	750
Chemical Oxygen Demand	mg/L	725	725
Biochemical Oxygen Demand	mg/L	48	48
Total Suspended Solids	mg/L	48	48
Dissolved Oxygen	mg/L	1.5	1.5
pH	-	7 – 8.5	7 - 8.5
Temp	°C	25 (winter) 37 (summer)	25 (winter) 37 (summer)
Total Dissolved Solids	g/L	4.0	*2.0*
Cadmium	µg/L	---	*1.03*
Total Dioxins & Furans	pg/L	---	*3.675*
Phenanthrene (PAH)	µg/L	---	*0.044*
Total Resin Acids	mg/L	---	*0.57*
Total Fatty Acids	mg/L	---	*0.335*
Total P&P Phenols	µg/L	---	*6.13*

Notes:
Parameters in bold were added to the 2019 RWS analysis based on the revised chemicals of potential concern (COPC).

The updated RWS in Section 4.2 of this report uses the MIKE 21 and CORMIX models to simulate the distribution of far- and near-field effluent from the proposed outfall location near Caribou Harbour based on the updated parameter list.

3.4 Spill Basin

Provide the following information regarding the spill basin:

KSH Consulting completed the spill basin design in 2018/2019 as part of the design of the ETF.

Spill basins offer a measure of protection for the treatment biology in an AST by avoiding upsets that could negatively affect them. The effluent entering the ETF is continuously monitored for flow, pH, temperature, and conductivity. In cases where the effluent is out of a normal range, or during an emergency such as a power outage, effluent will be diverted to the spill basin. The sizing of the spill basin, to hold 10 – 13 hours of effluent, is in line with others across the country.

Maintaining an empty spill basin is a priority to ensure it is available in the event of an emergency. Materials in the spill basin can either be returned to the ETF or removed from the system. Continuous monitoring of level, as well as standard operating procedures, will ensure there is not a release to the environment. Steps will be taken, up to and including slowing or stopping pulp production, to manage upset conditions in a manner that does not see untreated effluent released from the mill site. The mill will not continue normal operation if there is a risk of overflow to the environment.

3.4.1 Spill Basin Design

Submit information to assess the sizing and appropriateness of the design of the spill basin. The EARD indicates a retention time of 10-13 hours at a design capacity of 35,000 m^3. The basis of this design has not been provided. If flows exceed 85,000 m^3 per day on a consistent basis (e.g., during summer months), confirm that there will be sufficient recovery time in the treatment system to empty the basin before the additional volume is required;

Spill basins offer a measure of protection for the treatment biology in an AST by avoiding upsets that could negatively affect them. Effluent determined to be out of normal range can be diverted to the spill basin. A spill basin is not a regulatory requirement and some Canadian pulp and paper mills with ASTs effectively manage system upsets and discharge effluent well within regulatory requirements without the use of a spill basin. NPNS has made the decision to include one because it is considered a best practice in the design of an ETF. Figure 3.4-1 shows a three-dimensional rendering of the spill basin as designed for the ETF.

Figure 3.4-1: Three Dimension Rendering of the Spill Basin

Note: Humans are not to scale.

Retention time is important to consider when designing the size of the spill basin. Retention time is defined as the amount of time that it would take to fill an empty basin with untreated effluent coming from the mill. Retention time can be thought of as the amount of time it would take to fill a bathtub with water. The new spill basin at NPNS is sized to hold 35,000 m^3 of raw effluent. It will take 10 hours to fill the spill basin if the effluent flow rate is 85,000 m^3/ day (the KSH design maximum daily flow rate). Based on 62,000 m^3/day (the KSH design average daily flow rate), it would take 13 hours to fill the new spill basin. The sizing of the proposed spill basin is in line with other mills across the country that have spill basins.

Even though the ETF is designed to treat 85,000 m^3/day of effluent, the ETF will not operate at that flow for an extended period of time. A review of the operating data indicates that the mill's three-year average summer effluent flow (July and August) is 70,000 – 75,000 m^3/day. The summer is typically the time when flow is the highest as explained in Appendix 3.2. As the new replacement ETF is designed to treat at least

85,000 m^3/day, the mill will be able to empty the spill basin even during the summer months. There will be at least 10,000 m^3/day (i.e., 85,000 m3/day minus- 75,000 m3/day) of the available capacity to process additional effluent. If the spill basin is full, it will typically take less than 3.5 days to empty it at the highest summer flow rates. Emptying it at any other time of the year would take less time.

Non-contact cooling water makes up a considerable portion of the TME flow. As outlined in Addendum 1, cooling towers will be installed as an in-mill improvement to recycle non-contact, clean cooling water for reuse within the mill processes during the summer months. The goal is to reduce the peak summer effluent flow at the mill by approximately 5,000 m^3/day. This will provide additional “room” in the spill basin for both increasing retention time as well as reducing the time it takes to empty the spill basin when it is full.

Design and sizing details of the spill basin are provided in Appendix 3.4.

3.4.2 Spill Basin Overflow

Explain where the overflow will be directed in the event of unforeseen scenarios (e.g., power outage).

As outlined in Appendix 3.4, untreated effluent may go to the spill basin for the following reasons:

- The effluent is out of range for monitored parameters;
- Winter recirculation for freeze protection;
- The mill operators make the decision to shut down the effluent pumps feeding the ETF; or,
- There is a system failure (e.g., loss of power).

The system will be designed to circulate a small stream of effluent through the spill basin and back to the ETF in the winter months, regardless of effluent quality. Warm effluent will prevent freezing of the spill basin pipelines and pumps. Recirculation is a safety measure, in addition to heat tracing and insulation, which will ensure the availability of the spill basin during the winter.

Although the effluent can be diverted to the spill basin, the spill basin in normal conditions will never be full. The ETF operators have level controls to monitor how much is in the basin. Effluent in the basin will be reintroduced to the ETF process as soon as the reason for the diversion has been corrected (e.g., when the power in the mill comes back on, or when quality of the effluent is improved). Effluent in the spill basin will be reintroduced to the ETF treatment process through pumps that have variable speeds to control the return effluent flow rate. Alternatively, operators will have the option to remove the materials in the basin, via tanker truck, and either dispose of the materials off-site at an approved facility or re-introduce them into the mill process following evaluation of testing undertaken to determine the quality.

The mill has operated the forebay, TME pumping station, and ash pond since the inception of the mill in 1967 in a similar way to what is proposed for the future spill basin operations. The forebay and its overflow to the ash pond have been sized and operated in a manner to contain effluent in the event of a power outage or unexpected shutdown of the mill or TME pumping system, and have been in operation for many years.

In the event of a power outage, the Middle River raw water pumping station, which feeds the mill and its processes, will also shut down. The raw water pumps are electrically fed from NPNS's power supply, meaning all the mill pumps and the Middle River raw water pumps stop at the same time with loss of power. This effectively prevents raw water from flowing to the mill during a power outage.

The current operating strategy at the TME and the power supply at the Middle River pumping station will not change in the future. Therefore, the addition of a spill basin effectively adds additional "space" for holding untreated effluent on the mill site in the event of an emergency.

The mill has been in operation for many years and there are already many active emergency procedures. For example, to address a potential effluent release to the environment, there is an emergency water reduction plan already in place. Standard operating procedures will be updated to include the new replacement ETF during commissioning, but the general operating philosophy remains unchanged. Steps will be taken, up to and including slowing or stopping pulp production, to manage upsets in a manner that does not see untreated effluent entering Pictou Harbour from the mill site. The mill will not continue normal operation if there is a risk of overflow to the environment.

3.5 Effluent Pipeline Leak Detection

Provide viable options including the selected option for leak detection technologies and inspection methodologies, with specific consideration to any portion of the pipeline located in the Town of Pictou's water supply protection area;

3.5.1 Effluent Pipeline Design

The overland pipeline system from Pictou to Caribou is being designed by Wood Environment & Infrastructure Solutions. Wood has provided a Construction Methodology and Design Report that can be found in Appendix 2.1.

The entire pipeline system will be installed using High-Density Polyethylene (HDPE) pipe manufactured in resin designation PE4710. PE4710 resin was introduced to the marketplace in 2005 and represents an improvement in hydrostatic design stress and superior resistance to slow crack growth compared to previous resins, as a result slow crack growth is uncommon. HDPE materials are resistant to attack from many chemicals and are compatible with pulp mill effluents operating up to temperatures as high as 60°C.

Preliminary hydraulic calculations, performed by the pipeline designer, concluded that SDR 17 900 mm (36 inch) diameter pipe with a wall thickness of 53.8 mm (2.118 inches) is the correct choice providing a safety factor of 2.1 times normal operating pressure. The expected operating pressure in the pipeline is roughly between 45 - 70 psi (g) at the pump discharge at the new effluent treatment centre. Due to pressure losses and elevation changes, the pressure changes along the length of the pipeline and becomes slightly negative (under vacuum) at the highest point in the pipeline roughly 1,300 m south of the Caribou Ferry Terminal where a vacuum break valve will be installed. From that point, effluent will flow by gravity the rest of the way to the marine outfall.

Construction Phase

It is expected that the vast majority of the land-based portion of the effluent pipeline, including the short section on NPNS property, will utilize trench and bury methodology for effluent line installation. It is anticipated that both wetland compensation and watercourse alteration permits will be required for construction.

Close construction monitoring will ensure that the pipes are properly joined and placed in the pipe trenches. Pipe placement is accomplished with quality pipe bedding material placed and compacted in the trench bottom in accordance with the engineering design. After the pipe is laid in the trench, embedment material is placed around the pipeline and compacted. The reuse of excavated soils for pipe backfill above the bedding materials will be considered where appropriate.

Pipe Jacking (sometimes also referred to as micro tunnelling) is a trenchless technique that will likely be used at road crossings due to the size of the pipe and the distance at the crossings. It involves the installation of carrier pipe via powerful hydraulic jacks that push the specially designed pipe through the ground behind a steerable cutting head. The carrier pipe placed via this method would be maintained and the High-Density Polyethylene (HPDE) pipe would be placed inside of it.

The onshore (land-based) pipeline will be connected to the offshore (or marine) pipeline at three different locations. These are: as the pipeline enters and exits Pictou Harbour and as the pipeline enters Caribour Harbour. The connections are often made with "spool pipe segments" between the onshore and offshore segments. In this method, divers generally assemble a template between two flanges and then construct a spool piece that exactly matches the template. The spool pieces will be constructed out of HDPE pipe and installed by a skilled fusion technician. In some instances it is possible to fuse the connections: the decision to flange or fuse the connections will rest with the installation contractor. It is anticipated that the rest of the pipeline will be fusion welded (seamless).

Once the installation of the effluent pipeline is complete, the effluent pipeline corridor will be restored to finished contours and vegetated appropriately. Required signage notifying the public of the presence of the effluent pipeline will be posted in accordance with Provincial regulations.

Operation and Maintenance Phase

Engineering safety factors will be applied to the design to provide an operational buffer that addresses the potential for operational conditions beyond those stated in the process design. System automation and control are designed to allow the effluent pipeline to operate with the ETF as a fully automatic system with information being gathered and transmitted to the ETF control system.

The operation of the pipeline will be monitored on an ongoing basis with the following status information sent to the ETF control system:

- Pump discharge pressure at the main pump station;
- Effluent pipeline flow rate; and
- Operating temperature in the pipeline.

A leak detection system as described below will be installed with the effluent pipeline to monitor for potential leaks in the overland portion of the route between Pictou and Caribou, in the unlikely event that one occurs. Leak Detection Programs (LDP) for liquid pipeline systems generally fall into two categories, internal or external.

Examples of external leak detection systems include:

- Visual checks including aerial inspections and video surveillance;
- Sound monitoring; or
- Fibre optic cable systems sensing temperature, pipe strain or other operational signs.

Internal systems for leak detection include:

- Operational systems checks;
- Metering for volume flow, pressure loss, and flow/mass balancing; and
- Automated Computational Methods such as statistical models and/or real time transient modelling (RTTM).

Automated Computational Methods use measured system parameters such as flow, pressure, and temperature as inputs to determine unusual pipeline operation, and assess the results to determine the presence and approximate location of a leak. The leak detection system alerts the pipeline control system accordingly for operator action. LDP's utilizing fibre optic systems, line balance metering, or, RTTM methods generally provide the highest level of sensitivity. These systems have been deployed on water systems as well as liquid petroleum systems in steel and other materials including HDPE and selected systems have demonstrated success in detecting leaks as small as 60 L/hr. The leak detection system installed at NPNS between Pictou and Caribou will fall into one of these three categories. Final selection will be made during the detailed design phase. Automated leak detection will not be installed in the rest of the fused HDPE pipeline outside of this land-based section.

The pipeline system will be designed to operate and be controlled with the following capabilities:

- Initiate an alarm when an unusual operating condition is detected including high pressure, low flow, high flow and high temperature; and
- Initiate an alarm if a leak is detected.

3.5.2 Pipeline Protection

Provide viable options including the selected option for the enhanced pipeline protection, such as trench lining and justify how the chosen option is an adequate option for secondary containment. Be sure to address any potential changes in flow regimes, especially within the Town of Pictou's water supply protection area, due to the installation of the pipeline and secondary containment. If different options are provided for different areas of the proposed realigned pipeline route, the locations for each option must be identified.

Town of Pictou's Water Supply Protection Area

The proposed effluent pipeline route runs adjacent to Highway 106 on its east side and will pass through the Town of Pictou and its source water protection area. Of the 13 wells located in these areas, all except one well are located in excess of 900 m away from the pipeline route. NPNS obtained Light Detection and Ranging (LiDAR) survey data from the Province of Nova Scotia and overlaid it on the map of the Town of Pictou's source water protection area. The data contained elevation information that was accurate within +/- 15 cm and was used to delineate Surface Flow Accumulation areas around the proposed pipeline location. This information was used to understand the likely paths of surface water movement and determine collection points, called flow accumulation points, based on topography or the lay of the land. Figure 3.5-1 indicates that surface runoff from a potential breach of the pipeline will flow away from the Pictou Wellfields in all of the identified Surface Flow Accumulation areas.

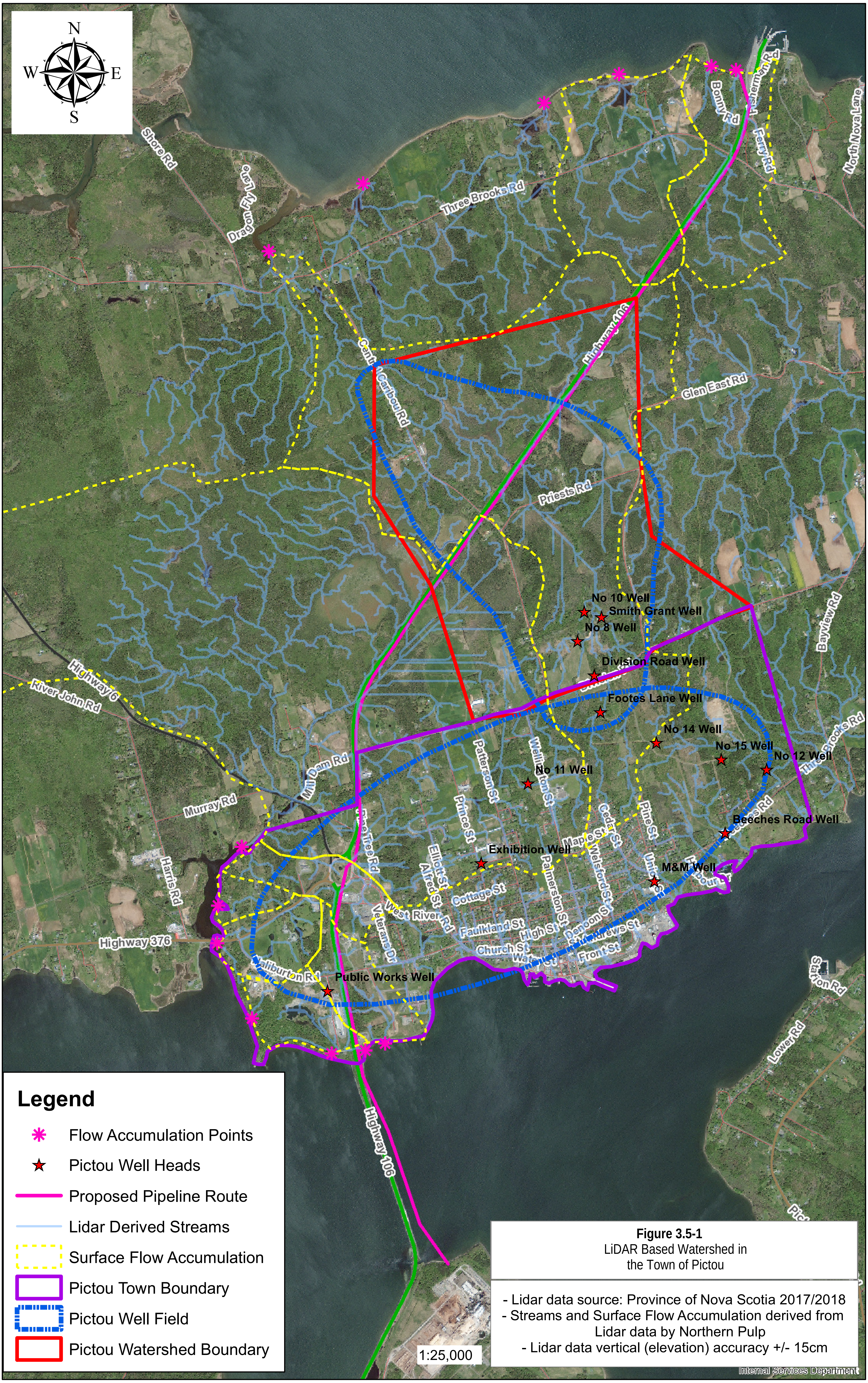


Figure 3.5-1
LiDAR Based Watershed in the Town of Pictou

Treated effluent was characterized and compared to Canadian Drinking Water Quality Guidelines for the HHR in Appendix 9.2 of this Focus Report.

There were three options explored to minimize the risk of a leak affecting the Town of Pictou's water supply. The first option involved clay lining the bottom of the trench where the pipe would be placed. This was ruled out by the pipeline designer because the bottom profile of the pipe is not flat. This type of containment would only work if the pipeline was level or sloped in a single direction only. If the elevation is changing, the effluent could pool or collect at low spots in the event of a leak.

The second option explored was one where a pipe is placed within a pipe (double-walled). This type of containment system for a pipeline generally involves the installation of the primary pipeline inside a secondary containment pipe. An air gap is provided by installing spacer rings or pads on the primary line as it is pulled through the secondary containment pipe. A leak would be contained in the containment space between the pipes. Double-walled installations make the pipeline diameter considerably larger and are not common for treated effluent pipeline applications. The pipeline designer concluded that double-wall secondary containment is unnecessary since a properly designed, specified, installed, and tested/commissioned pipeline will result in a leak-free system over its design lifetime.

The third option explored was to minimize risk through engineering design. The pipeline designer concluded that SDR 17 900 mm (36 inch) diameter pipe with a wall thickness of 53.8 mm (2.118 inches) is the correct choice for this pipeline. To increase the safety factor of the design, a pipe with an increased wall thickness could be used. Using a pipeline constructed from nominal 900 mm (36-inch) diameter SDR 13.5 pipe with a wall thickness of 67.7 mm (2.667 inches) was proposed as an additional measure, which increases the diameter of the pipeline, by approximately 0.5 inches. The benefit resulting from increasing the wall thickness of the pipeline is increased maximum allowable operating pressure including greater resistance to surge pressures and increased fatigue resistance.

The design and material selection for this pipeline are conservative and the likelihood of a leak occurring after the proper installation and commissioning of the line is extremely low. A properly designed, specified, installed, and tested/commissioned pipeline will result in a leak-free system over its design lifetime. The design and material selection for this pipeline are very robust and resistant to catastrophic failure and leak propagation. Therefore, after proper installation, testing and commissioning, the effluent pipeline should be leak-free over its design lifetime. However, in consideration of the concerns raised regarding the water supply and recognizing the presence of municipal and residential water wells in the area of the pipeline corridor, the pipeline material specification will be increased to 900 mm (36 inch) SDR 13.5, providing a heavier wall thickness and increased factor of safety for the entire portion of the land-based pipeline between Pictou and Caribou. The thicker-walled pipe increases the design safety factor over operating pressures.

This, coupled with a modern leak detection system using advanced detection technologies that can detect very small leaks as discussed in Section 3.5.1, provides a robust system design that can be operated with confidence.

3.6 Dangerous Goods

Clarify where the potential releases of waste dangerous goods at the project site will be directed for treatment and/or disposal. It is important to note that the new treatment facility is not proposed to treat waste dangerous goods based on the information provided in the EARD and requirements of NSE.

On June 25, 2018, NPNS submitted Revision 2 of the "Secondary Containment and Spill Management Study" report, completed by KSH Solutions. The conclusions from this report were accepted by NSE on August 12, 2018 as evidence that NPNS has completed their obligations (pertaining to Condition 14 n) and 14 r) of Approval 2011-076657-A0). The conclusions reached in the "Secondary Containment and Spill Management Study" report are summarized below in Table 3.6-1; however, more details relating to the report can be found in Appendix 3.6. A key point is that the new replacement ETF is not proposed to treat waste dangerous goods on-site. The recommendations provided in the NPNS submitted Revision 2 of the "Secondary Containment and Spill Management Study" report would be implemented in the final design of the treatment plant.

Table 3.6-1: Summary of Secondary Containment and Spill Management Study

Dangerous Good	Options For Treatment And/or Disposal If Potential Release	Recommendations For Upgrades In Response To New Effluent Treatment Plant
Chemical Storage Tanks	Select chemical storage tanks are equipped with secondary containment.	· Construct new sulphuric acid tank with secondary containment in Chemical Storage Area. · Add Vapour suppression system and secondary containment in Chemical Storage Area.
Process Tanks	Sufficient procedures in place for spills from process tanks.	New spill basin added next to untreated effluent lift station, and integrated into existing emergency response procedures.
Rail Car Unloading	Confirmed there is proper paving and sloping of current rail unloading areas.	None required.
Non-compatible Dangerous Goods	New spill basin will collect the non-compatible dangerous goods, which will then pump the content of the spill basin into tanker trucks to process the spilled material in a licensed, off-site facility. Diversion system is illustrated in Drawing #200-0-3011_Rev_B in Appendix 3.6.	New spill basin added next to untreated effluent lift station, and integrated into existing emergency response procedures.

A standard operating procedure (SOP) is a set of written instructions that describes in detail how to safely perform work involving hazardous materials, hazardous equipment, or hazardous operations to prevent incidents. The mill has been in operation for many years with multiple active emergency and operating procedures. Employees are trained, as part of the mill's Emergency Response Team, to respond to emergencies related to dangerous goods or waste dangerous goods.

The mill facility is designed and laid out so that in the event of a rupture or failure of any large dangerous goods vessel or dangerous goods storage tank, the lost material will be contained in a containment area (if the tank is equipped with one) or the lost material will be contained in a dyke. If these secondary containment areas are breached, the material will be directed, via the mill sewer system and effluent sewer lines, to the new spill basin. Online instrumentation on the internal sewers and within the new ETF will alert operators of an issue and valves will be operated to divert the flow into the new spill basin.

If the spill basin contains effluent and potential contents from a storage tank spill are added (which only occurs if both the primary and secondary containment fails), SOPs will be developed and/or updated to ensure the combined contents in the spill basin are compatible with the treatment system before the decision to return the contents of the spill basin to the ETF system is made. In the event that the combined contents of the spill basin are not compatible with the design of the replacement ETF, provisions have been made in the design to pump the content of the spill basin into tanker trucks and dispose of the spilled material at an approved dangerous goods disposal, off-site facility. This diversion system is illustrated in Drawing #200-0-3011_Rev_D of Appendix 3.4.

As part of an existing SOP, the mill has installed pH and conductivity probes on the individual sewers in the mill that will alarm the operators of any chemical leaks or off-specification effluent. The individual chemical tanks also have high level and high-high level alarms, along with rate of change alarms that will alert an operator of a potential leak. In addition, for each dangerous good used on-site, an emergency response plan has been developed following the *Canadian Environmental Protection Act* (CEPA) Environmental Emergency Regulations (E2) to address a potential effluent release to the environment. These procedures will be updated to include the new replacement ETF. Steps will be taken, up to and including slowing or stopping pulp production if required, to prevent any releases of dangerous goods to the effluent treatment system or the environment.

Although the effluent can be diverted to the spill basin, the spill basin in normal conditions will never be full. The mill operators on duty have level controls to monitor how full the basin is. Refer to Section 3.4 that explains in detail the sizing and appropriateness of the design of the spill basin.

4.0 MARINE WATER AND MARINE SEDIMENT

4.1 Baseline Marine Studies

Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.

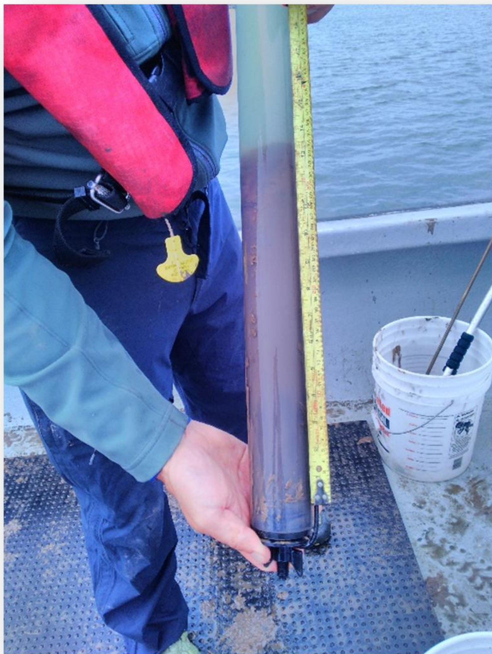
Baseline studies are completed in order to understand the potential for impacts and to enable a comparison of future conditions against the current (baseline) conditions, if so desired in the future. As identified above, the new outfall will require installation in marine settings in both Pictou and Caribou Harbours.

Marine Water Quality

Seawater sampling of selected analytical chemical compounds from Caribou Harbour and the Northumberland Strait was undertaken on behalf of NPNS by Stantec Consulting Ltd. on May 24 and 25, 2019. The purpose of the sampling was to build a baseline database of seawater composition in and around NPNS's proposed effluent outfall for the replacement ETF.

Six samples were collected at varying depths and tide cycles using 10 L Niskin bottle water sampler manufactured by General Oceanics to take a grab water sample (Figure 4.1-1). The Niskin bottle is a non-metallic, free-flushing sampler recommended for general-purpose water sampling and activated by a messenger when sampling at various depths. Caribou Harbour water samples were taken near the proposed location of the diffuser outfall to provide more accurate background water quality for the updated RWS. Caribou samples were analyzed for the same full suite of parameters as the effluent (as described in Section 2.3). The data provides a characterization of the baseline or background water quality to be carried through to the updated RWS.

Figure 4.1-1: Sediment Sampling Tools and Field Staff (Stantec, 2019)



The locations sampled, the timing and conditions are described in Table 4.1-1.

Table 4.1-1: Sediment Sample Locations and Descriptions

Sample ID on COC	Date/Time	Location	Tide	Depth
Caribou Sea Water CH-BOF 1-1	05/24/2019 – 13:30	Outfall	Flooding	Surface (0.5m)
Caribou Sea Water CH-BOF 1-2	05/24/2019 – 13:00	Outfall	Flooding	Bottom (20m)
Caribou Sea Water CH-B 2-1	05/24/2019 – 18:15	Outfall	Ebbing	Surface (0.5m)
Caribou Sea Water CH-B 2-2	05/24/2019 – 18:15	Outfall	Ebbing	Bottom (21m)
Caribou Sea Water 1	05/24/2019 – 17:00	Caribou Harbour	Ebbing	Surface (0.5m)
Caribou Sea Water 2	05/24/2019 – 16:30	Caribou Harbour	Ebbing	Bottom (3m)

The parameters tested at each location included:

- General Chemistry and Physical Parameters;

- Anions and Nutrients;
- Oxygen Demand;
- Adsorbable Organic Halides (AOX);
- Dioxins and Furans;
- Organic Halogens;
- Metals;
- Petroleum Hydrocarbons (PHCs);
- Phenols;
- Polychlorinated Biphenyls (PCBs);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Glycols;
- Volatile Organic Compounds (VOCs);
- Semi-volatile Organic Compounds (SVOCs);
- Fatty Acids; and,
- Resin Acids.

Full analytical results can be found in Appendix 2.3.

Table 4.1-2 presents the Caribou Harbour background water quality sampled as described above and the results were used in the updated model. Items in bold, italics were updated or added because of the 2019 sampling program. Cadmium, total dioxins and furans, phenanthrene, total resin acids, total fatty acids, and total P&P phenols are also carried through to the updated RWS for comparison of effluent and background water quality. Detailed laboratory results are provided in Stantec's report, appended in Appendix 4.1 of this report.

Table 4.1-2: Background Water Quality at Caribou Harbour used in RWS

Parameter	Unit	Background Water Quality used in RWS
AOX	mg/L	n/a
Total Nitrogen (TN)	mg/L	0.17
Total Phosphorus (TP)	mg/L	0.5
Colour	TCU	4.5
Chemical Oxygen Demand (COD)	mg/L	n/a
Biochemical Oxygen Demand (BOD)	mg/L	2.5
Total Suspended Solids (TSS)	mg/L	2.5

Parameter	Unit	Background Water Quality used in RWS
Dissolved Oxygen (DO)	mg/L	9.7[a]
pH	-	7.8[a]
Temperature (Summer)	°C	16.8
Temperature (Winter)	°C	1
Salinity	psu	30[b]
Cadmium	µg/L	0.084
Total Dioxins & Furans	pg/L	3.213
Phenanthrene (PAH)	µg/L	0.01
Total Resin Acids	mg/L	0.06
Total Fatty Acids	mg/L	0.07
Total P&P Phenols	µg/L	5.0

Notes:

a. Result shown is a field measurements
b. Result shown is from Caribou Harbour May 24/25 2019

C = Celsius; mg/L = milligrams per litre; TCU = Total Colour Units; g/L = grams per litre; µg/L = micrograms per litre; pg/ L = pictograms per litre; psu = practical salinity units.

Temperature profiles in the marine environment were also completed along the proposed pipeline corridor during the sampling period. The locations of the temperature profiles are shown in Figure 4.1-2, and results are presented in Figure 4.1-3.

Figure 4.1-2: Temperature Profile Locations

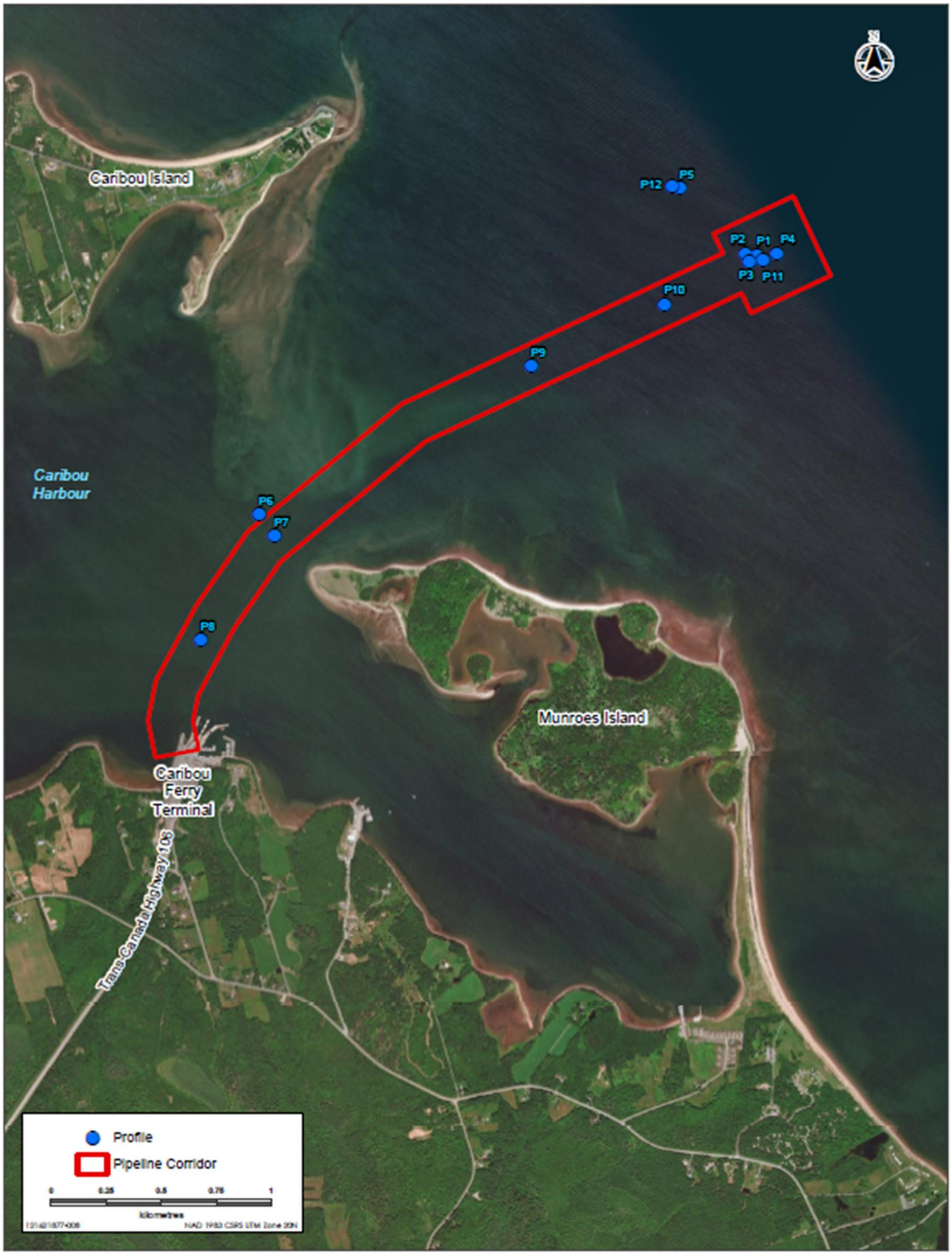
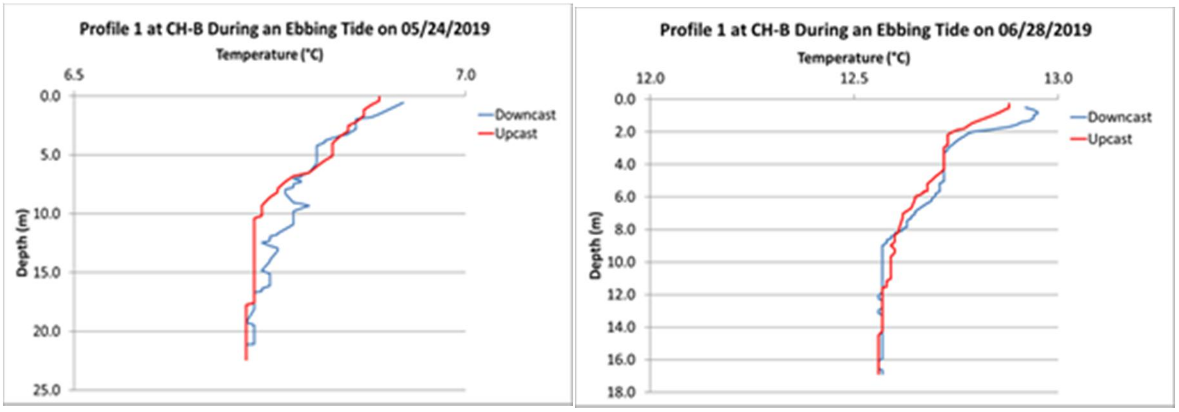


Figure 4.1-3: Temperature Profiles Along the Effluent Pipeline Corridor



Sediment Baseline Study

In order to assess the marine sediment, Stantec conducted a 2019 sampling program of existing marine sediment/silt at both locations along the proposed marine pipeline route, which included 44 samples. Stantec compared the results to the ECCC criteria for disposal of dredging material at sea, in case there is a possibility that sediment will be disposed of at sea. The results indicated select exceedances of the CCME's interim sediment quality guideline (ISQGs). At this time, the construction method described in Section 3.0 assumes that sediment will preferably be placed back on the seafloor. However, if during construction it is decided the sediment would best be disposed of at sea, NPNS will apply to ECCC for approval to dispose of the dredging material at sea. The quantity of sediment to be dredged will be better known once final design is complete.

Stantec completed a baseline study of the sediment in Northumberland Strait/ Caribou Harbour and Pictou Harbour. The locations where samples were collected along the proposed realigned pipeline route are presented in Figure 4.1-4 (Caribou Harbour Sample Locations) and Figure 4.1-5 (Pictou Harbour Sample Locations). Forty-four sediment samples were taken at 25 unique locations along the proposed effluent pipeline route (i.e., 20 unique locations in Caribou Harbour, and five unique locations in Pictou Harbour). Sometimes, more than one sediment sample was collected at the unique sample location, reflecting different depths. By collecting more than one sediment sample at the same location, the results can show if there is a difference between the sediment make up, depending on how deep the sediment is. The sediment samples collected were submitted to Bureau Veritas Laboratory for analysis, which is an independent laboratory that is regulated and qualified to complete the analysis. The results of the sediment analysis from the laboratory are important for several reasons:

- To determine the geological makeup of the sediment;
- The results give an indication of what chemicals are present in the sediment currently. These results will help to determine where the sediment can be placed, if a future decision made during construction decides the sediment should be moved. This process is called sediment disposal, and is regulated through disposal at sea permitting applications with ECCC; and,
- The chemical results will be shared with EcoMetrix and reported in their Human Health Risk Assessment (HHRA).

The sediment analyses from the lab are summarized below for each harbour. Detailed laboratory results and screening tables are provided in Stantec's report, appended in Appendix 4.1 of this report.

Figure 4.1-4: Sediment Sample Locations in Caribou Harbour/Northumberland Strait (Stantec, 2019)

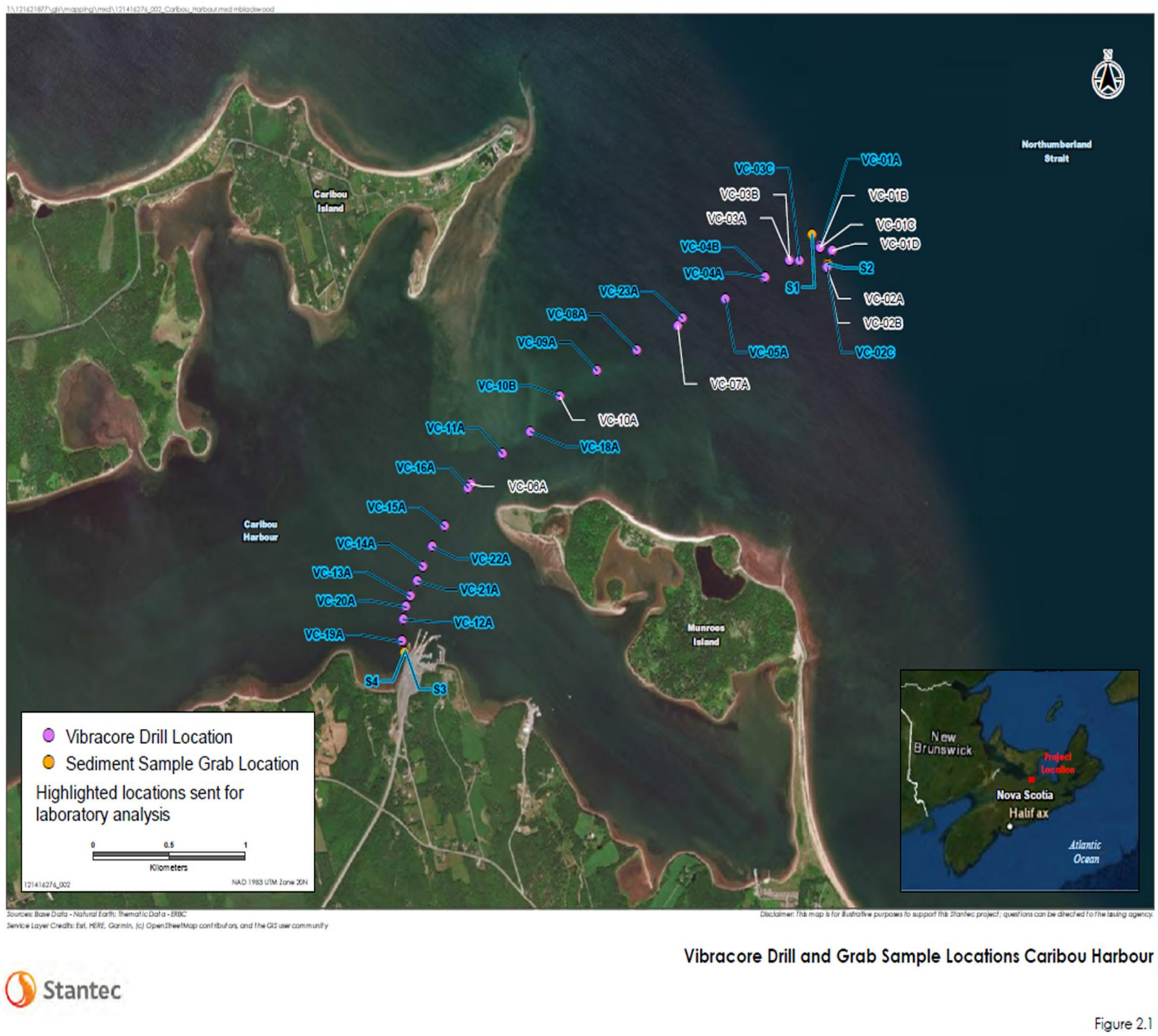


Figure 4.1-5: Sediment Sample Locations in Pictou Harbour (Stantec, 2019)

Figure 4.1-6 shows the geological makeup of sediment found in Northumberland Strait, Caribou Harbour, and Pictou Harbour. A summary of baseline results found in marine sediment is provided in Table 4.1-3.

Figure 4.1-6: Grain size distribution found in sediment samples

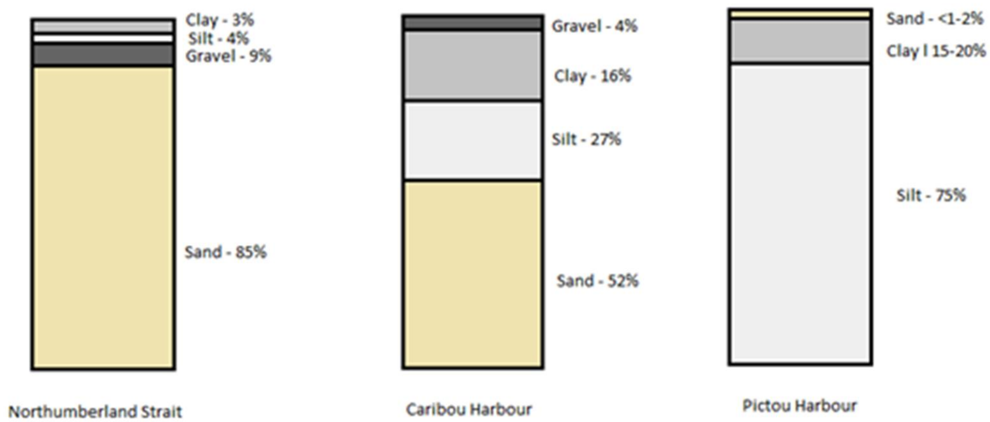


Table 4.1-3: Summary of Baseline Results found in Marine Sediment

Objective	Northumberland Strait / Caribou Harbour Results	Pictou Harbour Results
Grain Size	The sediment in Caribou Harbour is mostly sand in the middle of harbour and becomes more dirt like (silty which is fine grained) closer to the shoreline.	The sediment in Pictou Harbour is mostly made up a dirt (silt) and clay (which is very fine grained), and little sand.
Chemical Parameters	· Total organic carbon (TOC) concentrations ranged from below detection (<0.5 g/kg) to 23 g/kg; · PAH concentrations were below CEPA Disposal at Sea sediment screening criteria and CCME Sediment Quality Guidelines – Probable Effects Levels for Marine environments in all samples collected; · Arsenic concentrations exceeded the CCME ISQG benchmark of 7.24 mg/kg at several sampling locations and sediment depths ranging from 7.3 mg/kg to 12 mg/kg). Exceedances for this parameter were generally localized to the area between the Caribou Harbour Ferry Terminal and Munro's Island and concentrations remained below the CCME Probable Effects Level (PEL). The PEL is defined as the level above which adverse biological effects ae usually or always observed; · Copper exceeded the CCME ISQG of 18.7	· TOC ranged from 4.7 g/kg to 69 g/kg; · Total PAH concentration exceeded the CEPA Disposal at Sea Screening Criteria at VC-50C-1, which was the sample taken near the southern portion of the Pictou Causeway and represented a depth of the upper 0.2 m of substrate at that location; · 2-Methylnaphthalene (1.8 mg/kg), acenaphthene (0.69 mg/kg), fluorene (0.36 mg/kg), and naphthalene (6.8 mg/kg) each exceeded the Canadian Sediment Quality Guidelines (CSQG) PEL (0.201, 0.0889, 0.144 and 0.391 mg/kg, respectfully) at VC-50C-1; · 2-Methylnaphthalene, fluoranthene, fluorene, naphthalene, phenanthrene and pyrene all

Objective	Northumberland Strait / Caribou Harbour Results	Pictou Harbour Results
	mg/kg in two samples collected within along the proposed pipeline at VC-12-2 (41 mg/kg) and VC-16-3 (19 mg/kg) (z), but did not exceed the PEL at any location; · PCBs remained below detection in most instances and in all cases, concentrations were well below the Marine ISQG PELs; and · Two chlorinated dioxin compounds (1,2,3,4,6,7,8-Hepta CDD and 1,2,3,4,6,7,8-Hepta CDF) exceeded the CCME ISQG benchmark (0.85 pg/g both compounds) at VC16-1 which was located just west of Munro's Island. However, neither compound had concentrations exceeding the CCME PEL.	had concentrations that exceeded their respective CSQG PELs at VC-50C at multiple depth strata; · Only one sample (0.64 mg/kg at VC-53-3) exceeded the sediment screening criteria for cadmium (0.60 mg/kg) under the CEPA Disposal at Sea Regulations; · Arsenic concentrations in samples taken at all locations and associated depths along the proposed pipeline corridor exceeded the CSQG Marine PEL (7.24 mg/kg) and ranged from 8.3 mg/kg to 12 mg/kg; · Copper marginally exceeded the CSQG Marine PEL (18.7 mg/kg) at a number of locations both near substrate surface (0 to 0.5 m) as well as at greater depths (2 to 3 m). Concentrations ranged from 19 to 21 mg/kg;

Objective	Northumberland Strait / Caribou Harbour Results	Pictou Harbour Results
		· Lead marginally exceeded the CSQG Marine PEL (30.2 mg/kg) at VC-50C-1 (33 mg/kg) and VC-50C-3 (33 mg/kg), which was the sample taken near the southern portion of the Pictou Causeway and represented depths of 0 to 0.2 m and 1.2 to 2.2 m, respectively.

As stated in Stantec's report, some of the sediment samples will be used in the HHRA. Risk assessment results are provided in Section 9.2 Human Health Report.

4.2 Receiving Water Study

Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou Harbour must be applied to this study. Refer also to Addendum 3.0.

Summary

An updated Receiving Water Study was completed by Stantec Consulting Ltd. in 2019 for the proposed Caribou Harbou outfall location.

A receiving water study (RWS), to simulate the fate and transport of effluent in the receiving environment, required two types of simulation models to simulate dispersion behaviour in the Northumberland Strait: one in the far-field and the other in the near-field area around a diffused outfall. First, a two-dimensional (2D) software model was used for marine modelling to simulate far-field effluent dispersion and flow patterns and to provide indications of the potential cumulative effects on sensitive marine habitats. Second, a three-dimensional (3D) model considered the design of the diffuser (number of ports, port spacing, port height, and jet-like discharge velocity) and predicted how effluent disperses in the immediate area of the diffuser, often referred to as the "mixing zone". The diffuser and outfall location, and surrounding bathymetry, are shown in Figure 4.2-1.

The specific objectives of the updated RWS were to:

- Conduct far-field hydrodynamic modelling to model regional and local effluent dispersion characteristics and evaluate the potential for cumulative effects;
- To conduct near-field modelling to confirm the outfall diffuser design is appropriate in modelling how the treated effluent will mix with the water at the outfall in the Northumberland Strait; and
- To assess the impact of various operating scenarios, including winter ice cover, to prove the model is conservative and protective of the environment at all times.

Far-Field Modelling

The two-dimensional (2D) software model applied was the MIKE21 Coupled Model developed by the Danish Hydraulic Institute, a widely accepted industry standard model (https://www.mikepoweredbydhi.com/products/mike-21).

Dilution in the far-field is determined in large part by complex ocean currents, tides, wind, bathymetry, and waves. The study area included in the far-field model comprises an area 58.8 km x 42.5 km.

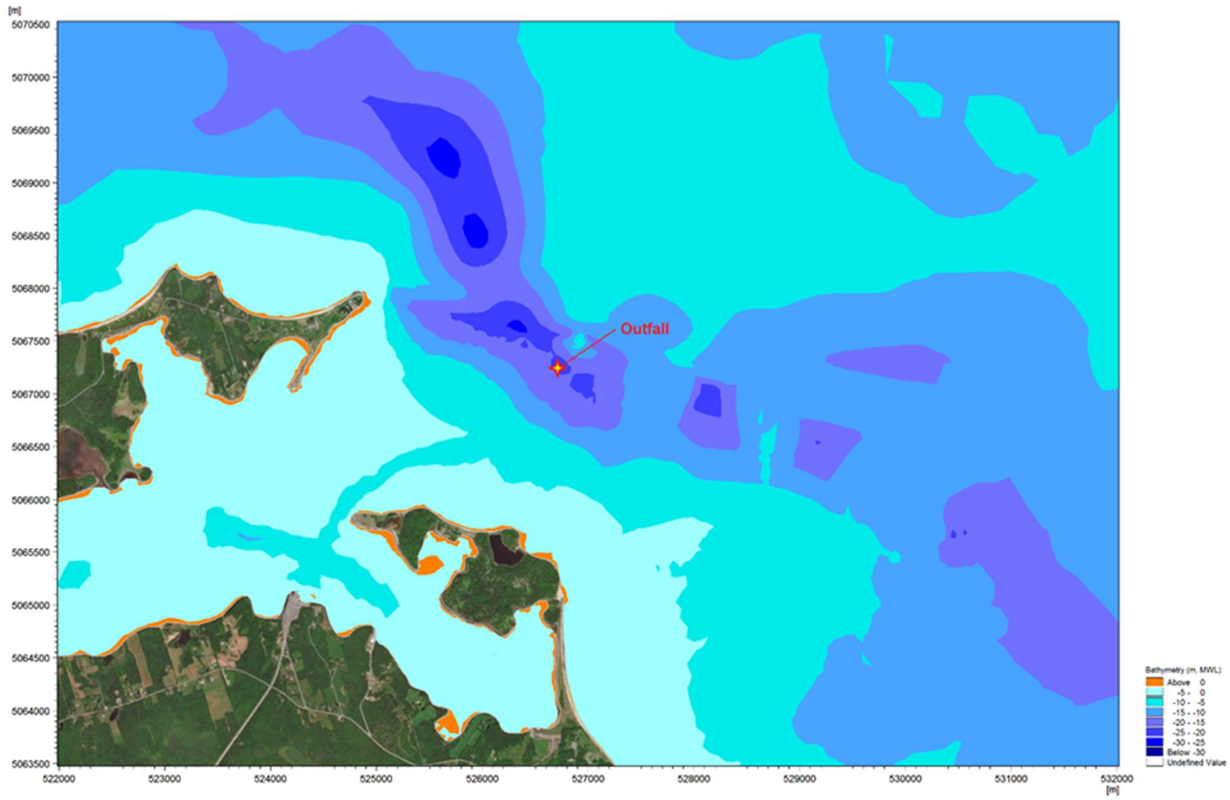
Different computational modules can be incorporated into the model. The modules used in this RWS include:

- Hydrodynamic Module (HD) – the basic component of the model that takes into account parameters such as bathymetry and interactions with currents;
- Temperature and Salinity Module (TS) – incorporates temperature and salinity and density gradients that create buoyancy;
- Particle Tracking Module (PT) – simulates fate and transport of dissolved and suspended particles; and,
- Spectral Wind-Wave Module (SW) – simulates wind-generated waves and swells and wave-current interactions and considers heat transfer at the water-air interface.

The HD, TS, and PT modules were all incorporated into the 2018 RWS. The SW module was added to the updated RWS to model the effect of wind and waves that generate non-tidal wind driven currents. The SW module also makes it possible to approximate the effect of winter ice coverage by imposing friction at the ice-water interface that may impede flow under the ice.

The 2D model is conservative as it only considers the effluent entering the marine environment at one point, which does not take advantage of the geometry and jet velocity benefits of the diffuser outfall. A discharge effluent concentration in the far-field is arbitrary because dilution factors are just ratios between the effluent and the background receiving water. A concentration of 100 mg/L was chosen for simplicity and ease of understanding calculations and figures presented. It does not represent any particular effluent parameter. Figure 4.1-1 from the updated RWS shows the location of the proposed outfall outside of Caribou Harbour at 20 m water depth.

Figure 4.2-1: Outfall Location and Bathymetry in the Study Area



Far-field Model Data Sources and Calibration

A spring 2019 field study was undertaken to gather calibration data closer to the Caribou outfall location. As part of the field survey programs conducted in May and June 2019, two water level gauges were deployed at Skinner Cove and Arisag. One bottom-mounted Acoustic Doppler Current Profiler (ADCP) was deployed in the vicinity of the outfall to measure water level, current, waves and water temperature. Marine water quality data was also collected near the outfall.

The hydrodynamic model, coupled with the wave module, comprises the integrated effects of tidal circulation, wind, air temperature, and water temperature and salinity. Good agreement was achieved between the simulated and measured parameters.

Stratification, or variation from the top to the bottom, of the water column was assessed during both flood and ebb tides to confirm that a 2D model was appropriate in the far-field. If stratification is present it could interfere with the plume dispersion characteristics. Vertical profile measurements for velocity, temperature, and salinity are all weakly stratified, or conversely, well mixed. The differences through the water column were small enough to conclude that 2D far-field modelling is appropriate. Since background water is highly homogeneous, trapping of effluent layers is unlikely to occur.

Of particular note, higher salinity and lower variation, < 0.5 parts per thousand (ppt), were observed suggesting less influence from river inflows near the outfall that could lead to density or temperature stratification. It can also be concluded (2019 RWS Table 16 and standard salinity tables) that effluent is always of lower density than ambient receiving waters, ensuring plume buoyancy in all seasons.

Near-Field Modelling

The three-dimensional (3D) software model used was CORMIX Version 11 (Cornell Mixing Zone Expert System), which is a U.S. EPA-supported mixing zone model used for assessment of regulatory mixing zones resulting from continuous source discharges. The system emphasizes the role of boundary interaction to predict steady-state mixing behaviour and plume geometry (https://www.cormix.info). A mixing zone for this study was defined as per the Canadian Council of Ministers of the Environment (CCME, 2003) as "*an area contiguous with a point source (effluent) where the effluent mixes with ambient water and where concentrations of some substances may not comply with Water Quality Guidelines or objectives*". The 3D modelling aimed to confirm that the ambient water quality concentrations or the established Water Quality Guidelines (WCG) are met at the edge of the mixing zone. A mixing zone of 100 metres was applied to this study, which is a standard mixing zone distance accepted by CCME (CCME 2009).

As is standard practice, the far-field predictions of currents, temperature and salinity, as well as both tidal and wind-generated currents, provide data to the CORMIX model.

The scale of the near-field modelling is several metres to about 200 metres, which allows for detailed prediction of the effluent plume which takes the diffuser design (e.g., number of ports, port spacing and height, jet-flow valves) into consideration. As outlined in the 2018 RWS, the diffuser will be 3-port, spaced 50 m apart at a height of 1 m above the bottom of the seabed.

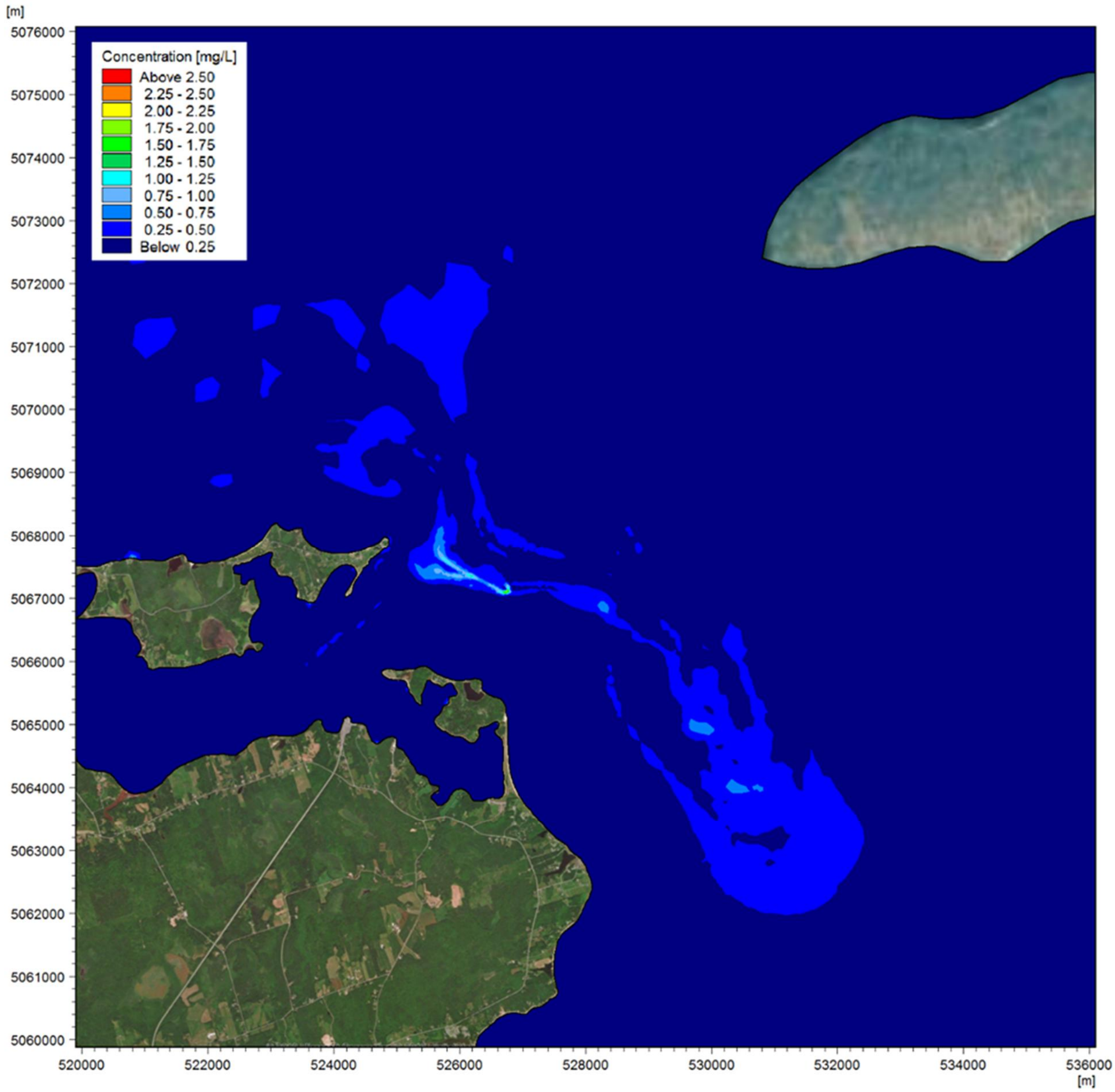
Strong turbulence from the diffuser ports occurs due to jet-like velocity flow from the ports over the first metres of the plume. Effluent ports are designed with flexible "duckbill" style valves, like the one shown in Figure 4.2-2 below, that open and close with changing flow to ensure strong turbulence leaving the diffuser. They are designed to ensure the effluent enters the receiving water environment with jet-velocities of at least 3 m/s to promote good mixing at the beginning of the mixing zone, similar to putting a garden hose nozzle in a pool of water. In addition to the diffuser design and geometry, the quality of both the effluent and the ambient water are important considerations in the near-field model.

Figure 4.2-2: Example of Effluent Port on the Diffuser

Far-Field Modelling Results

The 2D modelling is run over a full tidal cycle of 30 days to determine dilution ratios and effluent concentrations at different tidal conditions and to determine if effluent will have a tendency to "build up" anywhere in the model area. The 2D modelling can be found in Appendix 4.2, Stantec 2019 RWS. Both summer and winter (ice-covered) models were developed. As the mixing conditions are very favourable and effluent concentrations are quickly diluted to less than 1 mg/L (from the 100 mg/L arbitrary start point), the fate and transport of the plume is hard to see unless the figures are reduced to a much smaller scale. A maximum scale of 2.5 mg/L was chosen below. As such, the figures below are not directly comparable to standard 100 mg/L figures shown in the Stantec 2018 RWS. Figure 4.2-3 represents the summer case where the wind and waves are modelled at the water surface (July 2019), while Figure 4.2-4 presents the winter ice-covered model with no wind and wave effects (February 2019). Similar dilution ratios are achieved as indicated in Tables 4.2-1 and 4.2-2 in either scenario. In both summer and winter, flood tides are predominantly northwest and ebb tides are predominantly southeast. Build up is not occurring in the harbours; in other words, no entrainment was observed.

Figure 4.2-3: Simulated Effluent Concentration by End of One-Month Simulation Period in July



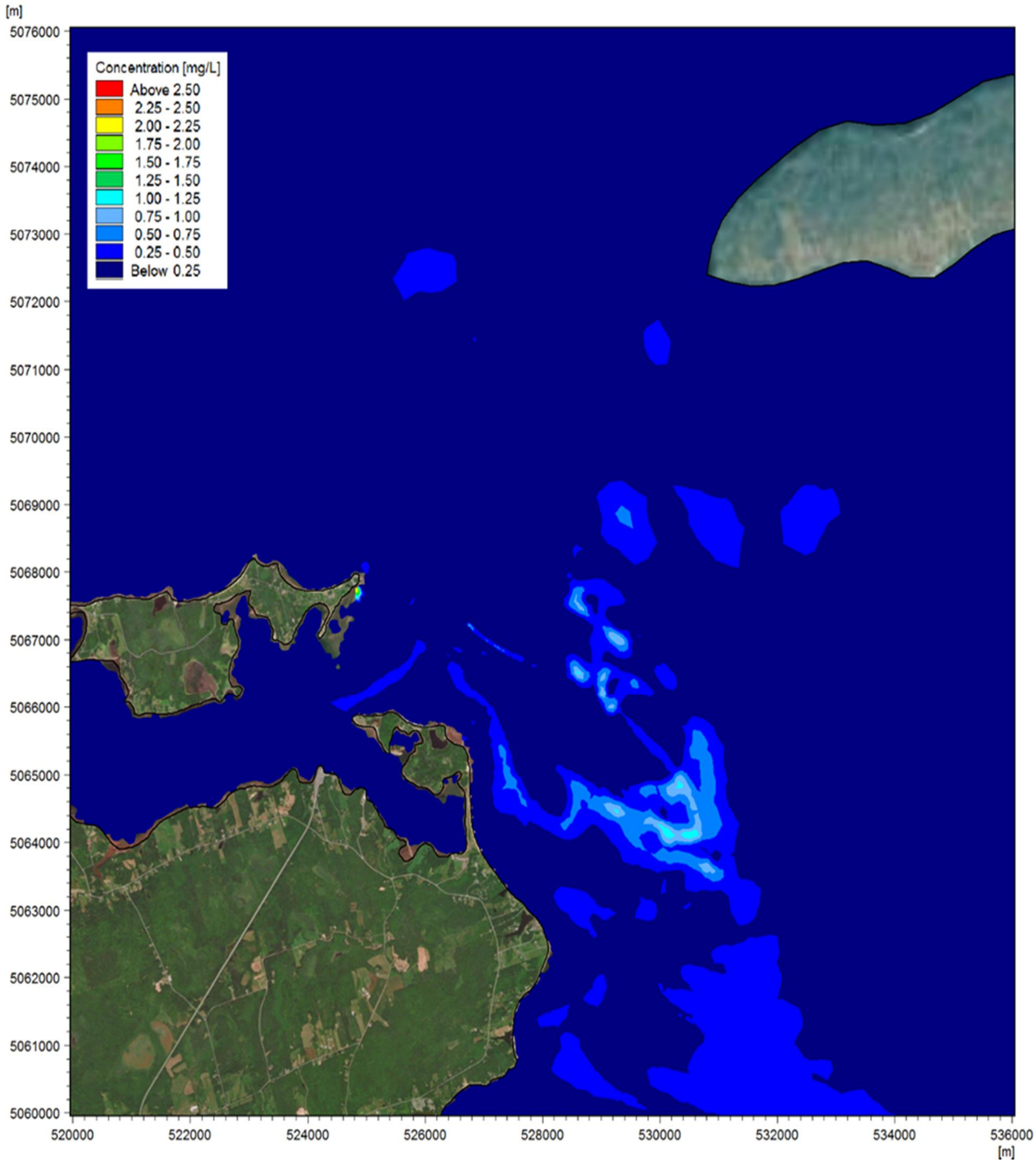
Note: concentrations in effluent arbitrarily set at 100 mg/L and assuming no particle degradation over the simulation period) using lower concentration of 2.5 mg/L for the upper bound in the Figure legend.

Table 4.2-1: Mean Effluent Concentration and Dilution at 100 m Radius of Outfall Discharge[1] in July

Observation Location	Mean Concentration (mg/L)	Mean Dilution (Non-dimensional)
100 m North (N)	0.127	787
100 m Northeast (NE)	0.127	787
100 m East (E)	0.129	775
100 m Southeast (SE)	0.227	441
100 m South (S)	0.164	610
100 m Southwest (SW)	0.162	617
100 m West (W)	0.173	578
100 m Northwest (NW)	0.203	493

NOTE:
1 Effluent concentration at outfall discharge is arbitrarily assumed as 100 mg/L

Figure 4.2-4: Simulated Effluent Concentration by End of One-month Simulation Period in February



Note: Concentration in effluent arbitrarily set at 100 mg/L and assuming no particle degradation over the simulation period) using lower concentration of 2.5 mg/L for the upper bound in the figure legend.

Table 4.2-2: Mean Effluent Concentration and Dilution at 100 m Radius of Outfall Discharge[1] in February

Observation Location	Mean Concentration (mg/L)	Mean Dilution (non-dimensional)
100 m North (N)	0.171	585
100 m Northeast (NE)	0.173	578
100 m East (E)	0.179	559
100 m Southeast (SE)	0.297	337
100 m South (S)	0.191	524
100 m Southwest (SW)	0.188	532
100 m West (W)	0.231	433
100 m Northwest (NW)	0.251	398

NOTE:
1 Effluent concentration at outfall discharge is arbitrarily assumed as 100 mg/L

Near-Field Modelling Results

Background water quality and effluent quality were updated in the 2019 RWS, as outlined in Table 14 and 15 in the 2019 RWS Report. Expected daily maximum water quality characteristics of the treated effluent were provided by KSH (2016) and summarized in Table 15 Scenario A and remain unchanged from Stantec 2018 except for total dissolved solids (refer to Table 11, in Appendix 4.2) and additional parameters that were added to the model.

Two additional runs and assessment of assimilative capacity of the receiving water were added to the 2019 RWS. Effluent quality for Scenario B and C were provided by NPNS. Effluent quality in both Scenarios B and C are based on the May 2019 draft *Pulp and Paper Effluent Regulations* (PPER) limits applied to NPNS current Reference Production Rate (RPR) as defined by Environment and Climate Change Canada (ECCC). The draft PPER are mass-based limits. Scenario B applies the regulated limits at 85,000 m^3/day flow while Scenario C applies the regulated limits at 50,000 m^3/day

Table 4.2-3: Background Water Quality

Parameter	Unit	Average Value
Adsorbable Organic Halides (AOX)	mg/L	n/a
Total Nitrogen (TN)	mg/L	0.17
Total Phosphorus (TP)	mg/L	0.5
Colour	TCU	4.5
Chemical Oxygen Demand (COD)	mg/L	n/a
Biochemical Oxygen Demand (BOD_5)	mg/L	2.5 [1]
Total Suspended Solids (TSS)	mg/L	2.5
Dissolved Oxygen (DO)	mg/L	9.7
pH	-	7.8
Temperature (summer)	°C	16.8
Temperature (winter)	°C	1
Salinity	g/L	30
Cadmium	µg/L	0.084
Total Dioxins & Furans	pg/L	3.213
Phenanthrene (PAH)	µg/L	0.01
Total Resin Acids	mg/L	0.06
Total Fatty Acids	mg/L	0.07
Total Pulp and Paper Phenols	µg/L	5[1]

[1] Non-detect; a ½ of the reportable detection limit of 5 mg/L was used
n/a – not applicable to marine test

Table 4.2-4: Daily Maximum Effluent Water Quality

Parameter	Unit	Daily Maximum Effluent Water Quality (2018 Stantec) Scenario A (Average Velocity)	Draft PPER Limits (High Flow and Low Concentration)[1] Scenario B (Slack Velocity)	Draft PPER Limits (Low Flow and High Concentration)[1] Scenario C (Slack Velocity)
AOX	mg/L	7.8	7.8	7.8
TN	mg/L	6.0	15.0	15.0
TP	mg/L	1.5	1.5	1.5
Colour	TCU	750	750	750
COD	mg/L	725	497	845
BOD_5	mg/L	48	29	49
TSS	mg/L	48	42	71
DO	mg/L	>1.5	>1.5	>1.5
pH	-	7.7 (range 7.0-8.5)	7.7 (range 7.0-8.5)	7.7 (range 7.0-8.5)
Temperature	°C	25 (winter), 37 (summer)	25 (winter), 35 (summer)	25 (winter), 35 (summer)
TDS or Salinity	g/L	2	2	2
Cadmium	µg/L	1.03	1.03	1.03
Total Dioxins & Furans	pg/L	3.675	3.675	3.675
Phenanthrene (PAH)	µg/L	0.044	0.044	0.044
Total Resin Acids	mg/L	0.57	0.57	0.57
Total Fatty Acids	mg/L	0.335	0.335	0.335
Total P&P Phenols	µg/L	6.13	6.13	6.13

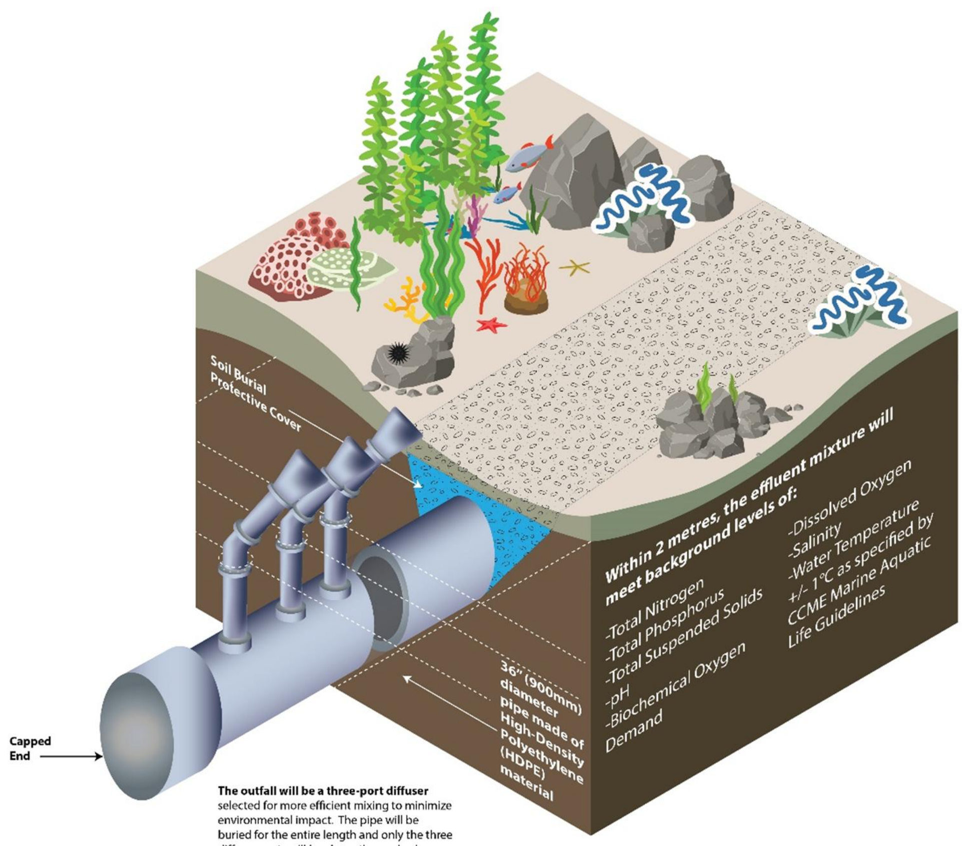
Notes:
[1] RPR 938.5 Adt/y

Dilution ratios for all three scenarios, found in Table 4.2-5 and summarized in Figure 4.2-5, are higher with the updated model than the 2018 RWS. Dilution ratios for both studies are shown for comparative purposes. Scenario A most closely matching the 2018 RWS, indicates that dilution ratios are more than three times higher than predicted in the 2018 RWS.

Table 4.2-5: Effluent Dilution Ratios for the CH-B Outfall Location with a Three-Port Diffuser

Scenario	Distance from Diffuser and Dilution Ratio						
	2 m	5 m	10 m	20 m	50 m	100 m	200 m
Scenario A	113.5	178.6	251.6	353.8	407.5	427.2	454.3
Scenario B	33.0	51.4	71.8	100.1	129.9	145.7	164.1
Scenario C	50.1	78.3	109.6	152.8	195.6	219.0	247.9
2018 RWS	32.4	50.5	70.8	99.1	128.3	144.1	159.8

Figure 4.2-5 Graphical representation of RWS results at Diffuser Location



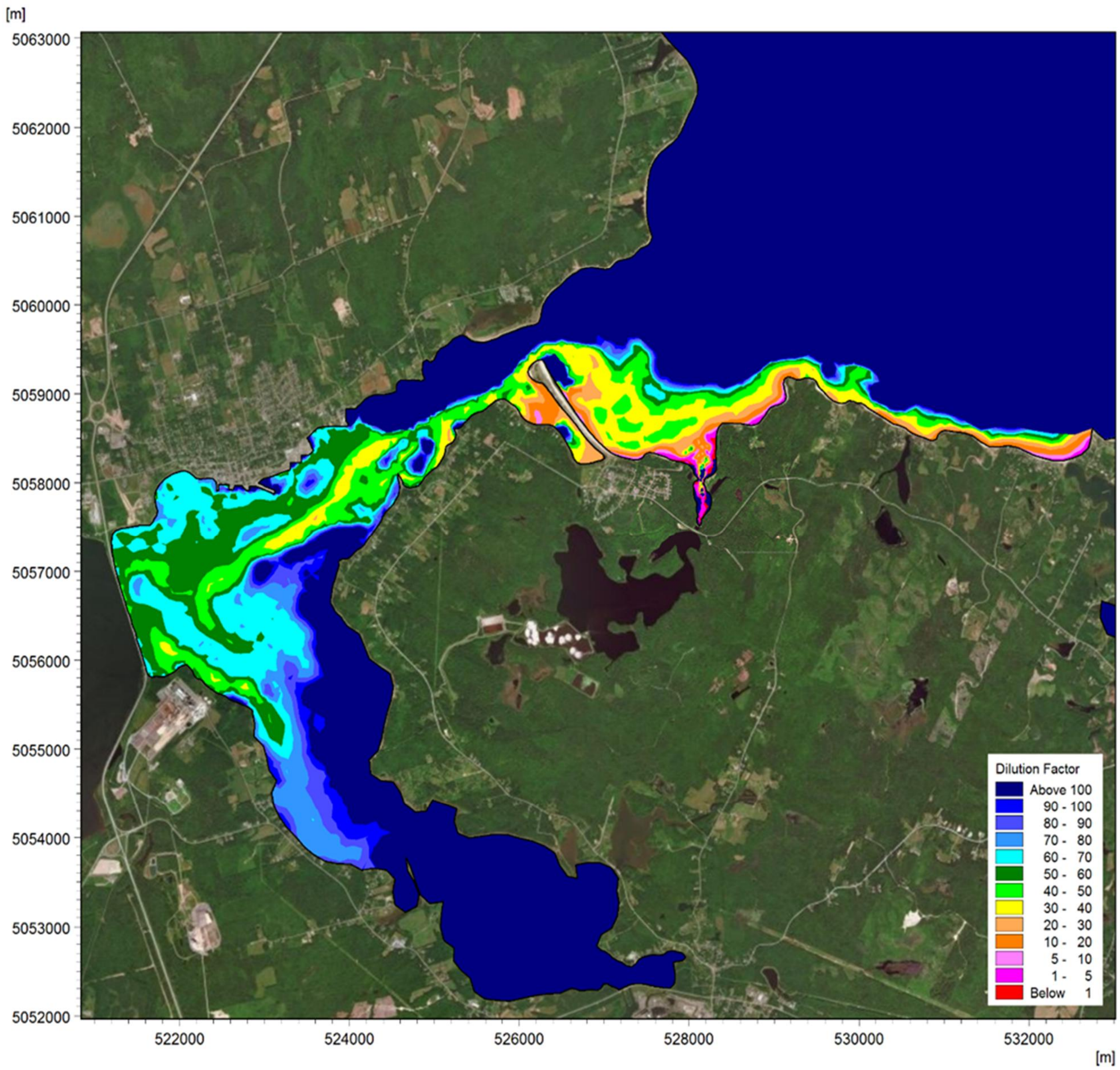
Far-Field Modelling at Boat Harbour Dam – Existing Conditions

In the original 2017 receiving water study and carried through to 2018 and 2019 studies, for modelling purposes, a future scenario for Boat Harbour with tidal influence was incorporated into the model. In this future scenario, Boat Harbour was assumed connected to Pictou Road area of the Northumberland Strait through a navigation channel as proposed by Jacques Whitford Environment Limited (JWEL 2005, Stantec 2017).

In 2017, to further understand effluent dispersion characteristics and their corresponding potential environmental effects, Stantec ran a 2D far-field model for existing conditions with effluent entering the Northumberland Strait flowing over a dam structure at the exit of the Boat Harbour Basin as it does today. In other words, the Boat Harbour Basin was not considered tidal. A memo detailing the model run is provided in Appendix 4.2.

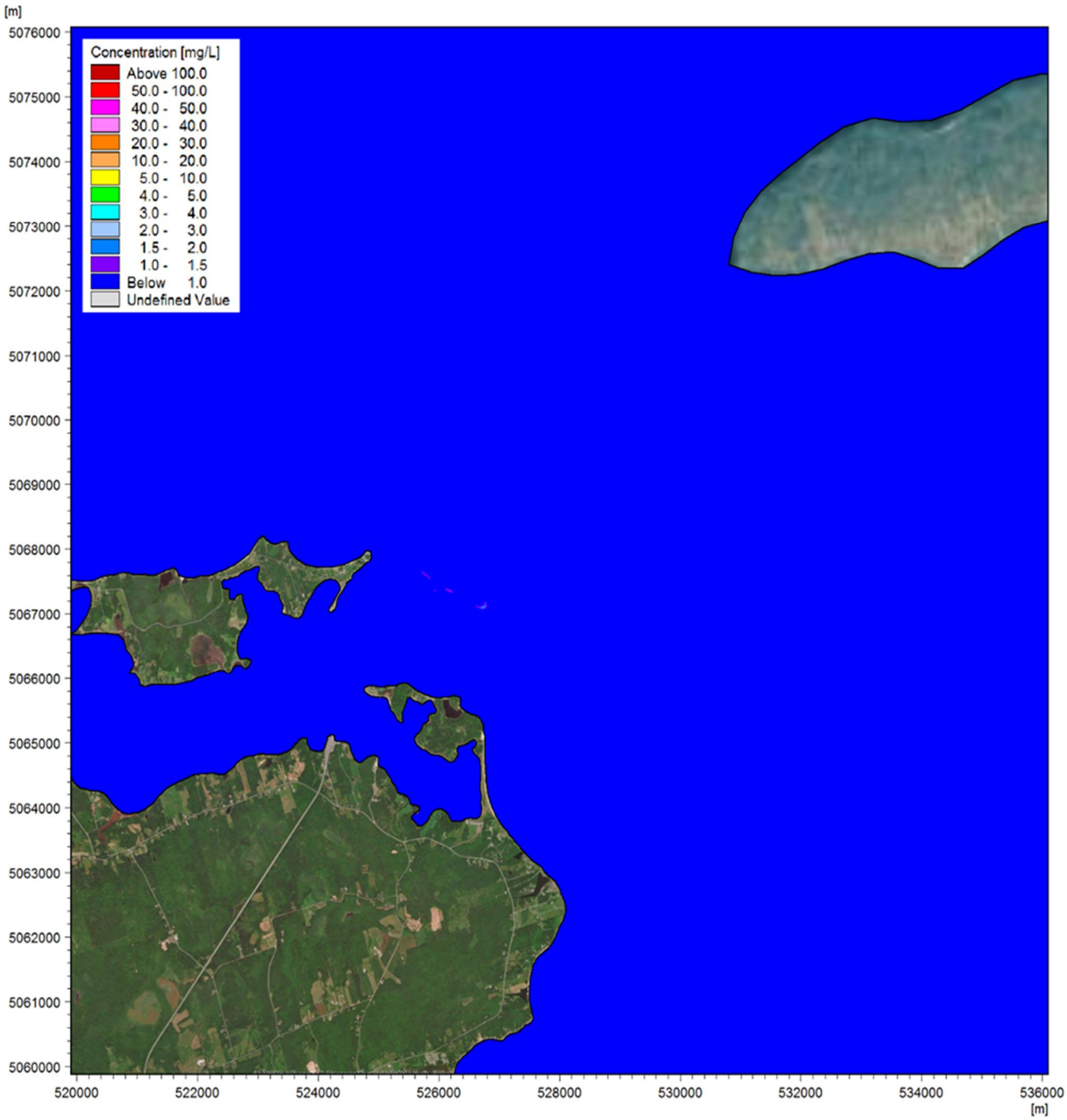
The modelling results indicate that the potential effluent impact on the surrounding environment of Pictou Road estuary is higher than the modelled discharge of the current outfall location at CH-B near Caribou. The cumulative effects at the end of the one-month run (July 2016) indicate that the highest dilution factor achieved in the channel and in the Pictou Road estuary of the Northumberland Strait is 10, which is considered low and insufficient for effluent mixing with ambient water. The outfall at Caribou provides considerably improved mixing and dilution as compared to the current outfall. Results of the 2D modelling are shown below for comparative purposes.

Figure 4.2-6: Spatial Distribution of Simulated Effluent Dilution Factor at the End of a One-Month Simulation Period July 2016



Note: The figure assume no particle degradation over the simulation period)

Figure 4.2-7 Simulated Effluent Concentration by End of One-month Simulation Period in July 2019



Note: Concentration in effluent arbitrarily set at 100 mg/L and assuming no particle degradation over the simulation period)

4.3 Sediment Transport Modelling

Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near-field and far-field model areas. This should include chemical and physical characterization of the solids proposed to be discharged by NPNS as well as a discussion of how these solids will interact with the marine sediments and what the potential impact will be on the marine environment as a result.

In 2019, Stantec conducted sedimentation modelling to characterize the potential sediment transport distances for the effluent sediments resulting from the proposed replacement ETF. In an attempt to determine the sedimentation characteristics of the effluent sediments resulting from the proposed ETF, data from the Howe Sound and Crofton kraft mills were applied as surrogates for the proposed NPNS ETF, as the effluent generated by both mills is treated using AST systems.

Sediment transport is the movement of solid particles within a water column caused by the combination of gravity in a vertical direction and by currents in a horizontal direction. Sediment transport can be estimated by the settling velocities of the solid (i.e., sediment) particles and the current velocities.

The treated effluent sediments from the Howe Sound and Crofton mills consist primarily of fine particles (Table 4.3-1); however, samples collected from the Northumberland Strait indicate that the sediment in the outfall area are defined as medium to coarse sand. These results indicate that finer material is scarce in the proposed outfall area, and the treated effluent sediments are not anticipated to settle in the area of the proposed outfall location due to the relatively high current speeds identified in the area.

Table 4.3-1: Sediment Properties of Treated Effluent Applied in the Sediment Transport Modelling (Stantec, 2019)

Sediment Sample Location	Grain Size	
	D_{50} (µm)	D_{90}(µm)
Howe Sound Mill	15.3	58.8
Crofton Mill	12.6	74.6

Notes:
D_{50} = 50% of the sample's mass is comprised of smaller particles; 50% are coarser.
D_{90} = 90% of the sample's mass is comprised of finer particles; 10% are coarser.

Stantec's modelling of the anticipated transport distances for the effluent sediment particles resulting from the proposed replacement ETF are summarized in Table 4.3-2.

Table 4.3-2: Estimated Transport Distance of Effluent Sediment Particles (Stantec, 2019)

Effluent Sample Location	Particle Size (µm)	Settling Velocity (cm/s)	Suspension Time (hour)		Transport Distance for Current Speed 0.08 m/s (km)		Transport Distance for Current Speed 0.35 m/s (km)	
			1 m above bed	5 m above bed	1 m above bed	5 m above bed	1 m above bed	5 m above bed
Howe Sound Mill	D_{90}=58.8	0.0052	5.3	26.6	1.5	7.7	6.8	34.0
	D_{50}=15.3	0.0004	78.7	393.2	22.7	113.3	100.5	502.
Crofton Mill	D_{90}=74.6	0.0084	3.3	16.5	1.0	4.8	4.2	21.1
	D_{50}=12.6	0.0002	116.0	579.8	33.4	167.0	148.2	741.0

Stantec concluded that based on their conservative modelling assumptions for similar quality of treated effluent, it is unlikely that effluent sediment resulting from the proposed replacement ETF and its associated proposed outfall location will build up in either the near- or far-field. Therefore, impacts associated with sediment transport and deposition that may be detrimental to aquatic life are not anticipated.

Further details of the estimated sediment transport dispersion associated with NPNS's proposed replacement ETF are available in the Stantec memorandum titled "*Estimate of Sediment Transport of the NP's Treated Effluent*" and dated, September 25, 2019.

Summary

An estimation of sediment transport in the area near the proposed outfall was based on measured and calculated values for particle movement as well as information derived from other mills (Howe Sound Pulp and Paper and Crofton Mill) operating AST systems. Treated effluent will contain a small amount of total suspended solids (TSS) which are largely organic in nature. The results concluded that the particles are very fine colloidal material of low density, with a diameter less than a grain of sand.

The movement of these particles was modelled considering both settling velocity (gravity) and movement due to ocean currents. Particles closest to the diffuser during the 1-hour slack tide period (when the direction of the tide reverses) were considered most conservative. Particles discharged one metre from the seabed at slack tide are likely to travel 1 km before settling.

Sediment Transport investigations by CSR GeoSurveys concluded that currents are strong in the areas around the proposed diffuser location, and the sediments near the proposed location of the outfall consist of sand and gravel and are therefore unlikely to be entrained in the effluent plume.

Sediment transport modelling, strong ocean bottom currents and the organic nature of the particles make sediment deposition in the near- and far-field extremely unlikely.

Chemical and Physical Characterization of Sediment Solids

The proposed replacement ETF discharge will contain a small amount of suspended solids referred to as total suspended solids (TSS). The solids from any biological treatment process, whether municipal or industrial, are primarily naturally occurring biological bacteria that have not settled in the secondary clarifier and instead leave with the treated effluent. It is well known that secondary treatment solids are significantly organic in nature . Detailed chemical analyses of total effluent samples, including both the liquid and solids portions, can be found in Section 2.3 of this Focus Report.

The solid particles are primarily biological in nature with a high degree of hydration; in other words, a density close to that of water. Their low density makes settling very difficult.

The suspended solids, often referred to as "sediment", can be physically characterized by particle size analysis (PSA). PSA was completed on samples of effluent solids from two Paper Excellence mills in British Columbia: Howe Sound Pulp and Paper and Crofton Mill. Both mills operate AST treatment systems with bacteria of similar types and sizes that can be expected from the proposed replacement ETF at NPNS. The results, included in Appendix 4.3, indicate that a significant percentage of the particles are very fine colloidal-type material, with greater than 90% of the particles smaller than 75 µm (0.003 inches) in diameter (for comparison, human hair is between 50-70 µm). Both their low density and their small size prevented these particles from settling out in the secondary clarifiers after more than 11 hours in that calm environment.

For comparative purposes, background Caribou seawater samples were also tested for PSA. A significant percentage of the particles are very fine colloidal-type material with greater than 90% of the particles smaller than 40 µm (0.002 inches) in diameter.

As the natural seawater samples contain particles that are even smaller than effluent particles, it is unlikely that they will settle or interact with the effluent plume in any way that would influence settling or entrainment.

Sediment Transport

Treated effluent diffusers are designed to provide jet-like velocity greater than 4 m/s leaving the diffuser ports. When the strong turbulence of the jets begin to weaken, other forces (such as temperature and density differences) continue to disperse the effluent plume. When both turbulence and buoyancy reach equilibrium with the background, particles in the effluent will rise or settle based on other factors related to the particles themselves and the background receiving water.

Sediment transport refers to the movement of solid particles in a water column driven by gravity in the vertical direction and by ocean currents in the horizontal direction. Both the particle settling velocity and the ocean current velocities are important considerations in determining where solids released at the diffusers will go.

The physical size and density of the particles is important to determine if sediments in treated effluent could have a tendency to accumulate or “build up” at the diffuser location.

First, the settling velocity of the particles must be calculated. From the settling velocity, the amount of time that particles will be suspended in the water column is then calculated. This is the amount of time that it will take the particles to settle directly on the seafloor without any ocean currents or wind-induced waves interfering with settling (i.e., no horizontal movement).

Second, the transport distance must be calculated considering the ocean currents. This is the distance from the outfall that the particle is expected to travel while suspended in the water column due to horizontal currents acting on the particle. The location of the particle in relation to the height of the water column is an important factor to consider. Transport distances were calculated for both the mean water velocity as well as the slack tide velocity that was measured near the proposed outfall location and all calculations are presented in Appendix 4.3.

In conclusion, particles have a significant settling time or travel distance for the solids in effluent from both Howe Sound Pulp and Paper and Crofton Mill over the range of velocities applied. The worst case settling conditions would be represented by:

- The mill with the smallest particle size (Howe Sound Pulp and Paper);
- The lowest ocean velocity (1-hr average around slack tide); and
- The lowest height in the water column (1 metre or diffuser port height).

For the worst case condition, 90% of the TSS particles dropping from the diffuser port are expected to transport and deposit 4.8 km away from the outfall location and not settle near the diffuser.

Interaction with Marine Sediments and Impact on the Marine Environment in the Near-Field

Sediment transport investigations were undertaken by CSR GeoSurveys Ltd. as part of the marine survey work outlined in Section 2.2 of this Focus Report. CSR identified three areas exhibiting sediment transport features, occurring in non-cohesive sand, in the Caribou survey corridor. Sediment transport features are current or wave induced bedforms evident on the sea bottom. These bedforms are created by the agitation of loose sediment (predominately sand) by the action of waves or currents acting on the seabed. Two of the three features were found near the outfall location (CSR Figure 5.3.7): one 75 m north and the other 160 m southwest of the proposed location of the outfall. Based on measurements of the megaripples and sand waves approaching 0.5 m depth, it was concluded that these features were likely formed by currents with near bed-flow (bottom) velocities in the range of 0.4-1.0 m/s.

To update the receiving water study, Stantec deployed an ADCP unit moored on the seabed about 490 m northwest of the proposed outfall location for a one-month period in spring 2019. The unit measured currents throughout the height of the water column and recorded a maximum current of 0.86 m/s and an average current of 0.26 m/s at 2.1 m above the seabed. The ADCP unit confirms CSR's prediction that currents strong enough to cause sand ripples and megaripples are occurring in areas surrounding the proposed location of the diffuser.

No sediment transport features were observed in the immediate vicinity of the proposed outfall area which, CSR concluded, may indicate an increase in gravel within the surficial sediments at this location. Given this, and the 1 m height of diffuser ports above the seafloor, interactions of effluent sediments with marine sediments is expected to be minimal, and entrainment of benthic sediment into the effluent plume is extremely unlikely.

Sediment transport modelling and the presence of sediment transport features near the outfall support the conclusion that effluent sedimentation is not likely to occur in the proposed diffuser area. Therefore, effluent sediment will not have a significant impact on the marine benthic environment.

Interaction with Marine Sediments and Impact on the Marine Environment in the Far-Field

As indicated above, effluent particles are not readily settleable and are likely to travel significant distances far from the diffuser. Total suspended solid particles are largely organic and biodegradable. They are a food source for other marine organisms and as such are not expected to build up and deposit in areas away from the diffuser.

5.0 FRESHWATER RESOURCES

5.1 Wetland Baseline Study

Complete a wetland baseline survey along the proposed realigned effluent pipeline route (if wetlands are expected to be altered).

Dillon Consulting Limited completed a wetland baseline survey in the spring of 2019 for wetlands identified within the right of way of Highway 106 corresponding to the planned pipeline alignment.

Wetlands are areas that are typically flooded or saturated with water for some periods of time in most years. While some wetlands are flooded year-round, others may dry up for periods of the year. These areas support different types of water life including 'water-loving' (hydrophytic) plants and animals such as amphibians, fish, insects and birds. Wetlands often support plant and animal communities that are very diverse and contribute to the environment. Many species rely on them for their habitat. Wetlands also may provide important functions including controlling flood waters and improving water quality. The Figure 5.1-1 examples of the wetland types observed along the proposed realigned effluent pipeline route.

Figure 5.1-1: Summary of different types of wetlands

a) Swamp

b) Wet Meadow

c) Floodplain

d) Marsh/ Fen/Bog

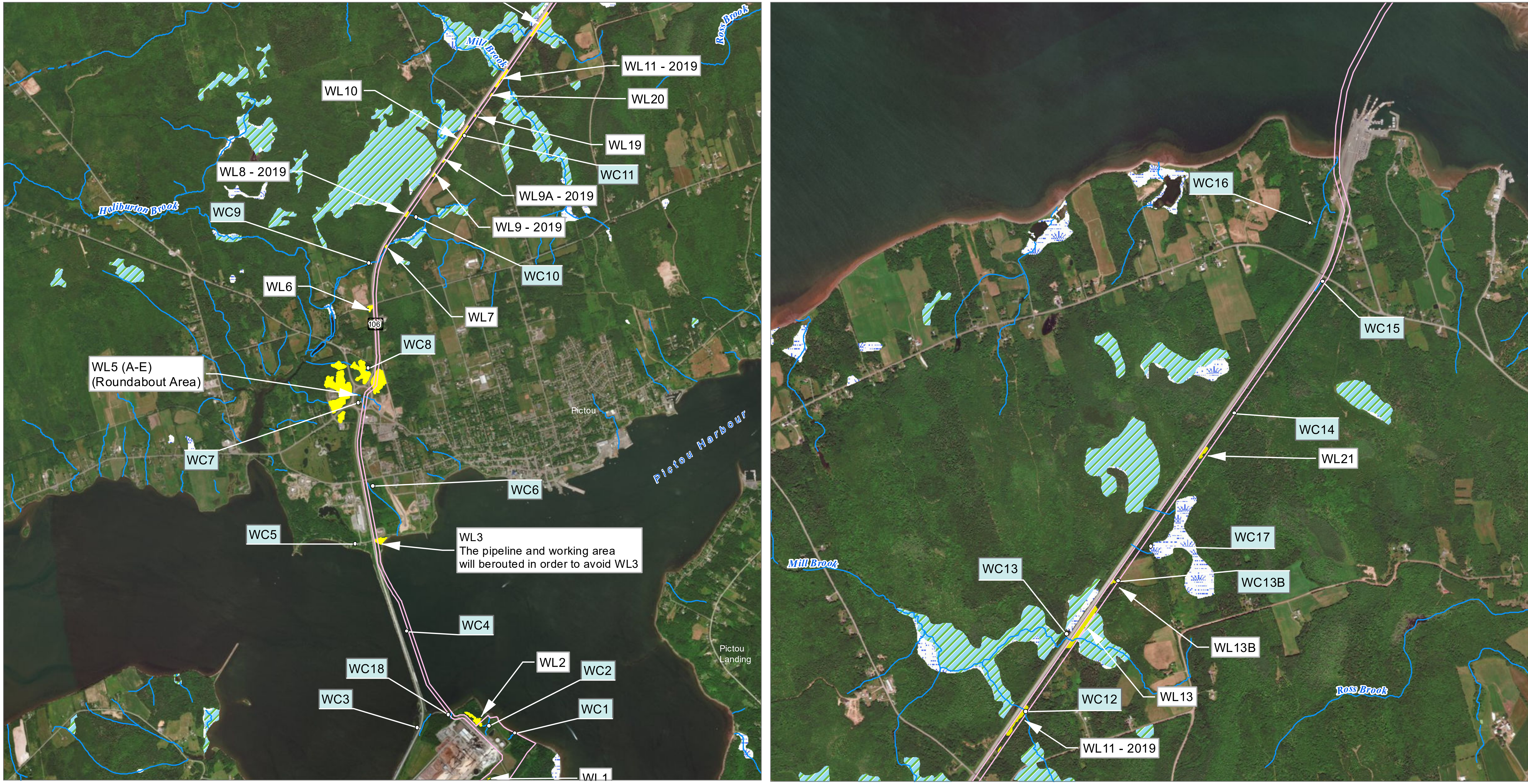
e) Salt Marsh

A baseline wetland survey program was conducted along the proposed realigned pipeline route. Wetlands that occur within the proposed project route were identified, surveyed and had their functions assessed.

A total of 19 wetlands were documented within the realigned pipeline route. These wetlands include swamps, wet meadows, floodplains, marshes, and a salt marsh. The most important functions of the wetlands assessed were:

- Stream flow support (wetlands that contribute water to streams, especially during the driest part of the growing season; this is important for fish and many other aquatic animals).
- Waterbird feeding habitat (wetlands help waterbirds that migrate or spend their winters here).
- Public use and recognition (wetlands that support recreation and/or protect public investments).

Figure 5.1-2 (below) shows the location of wetlands and other aquatic features identified in the ETF area and along the realigned pipeline route. More information on wetland survey methods, the wetlands identified and the assessments can be found in Appendix 5.1.



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Wetlands along the Proposed Project
Figure 5.1-2

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Approximate Project Footprint Area*	NS Topographic Database Wetland	WL# Wetland ID
Wetland Delineated in the Field	NSDNR Database Wetland	WC# Watercourse ID
Watercourse		

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pulp Nova Scotia, NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 500 1,000 2,000 Meters

N W E S

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-09-26

5.2 Monitoring Methodologies

Provide monitoring methodologies for areas with significant risk of pipeline leaks or spills (e.g., two areas where the pipeline crosses the Source Water Protection Delineated Boundary for the Town of Pictou wellfields; below water table; important wetlands; watercourse crossings; etc.).

Leak detection technologies and inspection methodologies are addressed in other sections of this report.

The route proposed for the new treated effluent pipeline will go through the Town of Pictou and its watershed area. Recognizing the presence of municipal and residential water wells, as well as important wetlands and watercourses in the area of the pipeline corridor, the pipeline material specification has been increased to 900mm (36 inch) SDR 13.5, providing a heavier wall thickness and increased factor of safety for this overland pipeline section from Pictou to Caribou. This, coupled with a leak detection system using advanced detection technologies, provides robust protection against any leaks and early detection in the very unlikely event that one occurs.

A surface water monitoring program will be developed and maintained over the life of the project in accordance with the requirements stipulated by NSE through an IA requirement for the entire land-based portion of the pipeline. Parameters analyzed from each of the monitoring station locations will be in accordance to the requirements of NSE. A baseline surface water monitoring program is currently underway and will be completed prior to project commencement in order to satisfy future IA requirements. It is noted that there is connectivity between the majority of wetlands and surface water features within and adjacent to the project footprint area. These surface water features are included in the surface water monitoring program.

During the construction phase, additional monitoring required to achieve environmental compliance will be outlined in the EPP. The Construction Monitoring Program will be developed in consultation with NSE and will include monitoring of surface water (pH and TSS) during storm events and groundwater levels during construction.

The existing network of monitoring wells associated with the NPNS monitoring program has been and will continue to be used to monitor groundwater (elevations and quality) at the NPNS property before and after the ETF is constructed. NPNS will develop a surface water monitoring program to monitor runoff within the pipeline footprint both during and subsequent to construction in areas where surface water can infiltrate to groundwater. As part of this program the frequency of monitoring and parameters to be assessed will be identified in consultation with NSE, particularly with respect to surface waters that could infiltrate to groundwater within the municipal groundwater watershed areas identified within the Source Water Protection Plan (SWPP) and more populated residential neighbourhoods along the pipeline footprint.

In the spring and summer of 2019, considerable work was completed to confirm the locations and sensitivities of wetlands located within the proposed realigned treated effluent pipeline footprint. It is anticipated that wetland compensation will be required for proposed wetland alterations. Future monitoring will be conducted to assess the success of wetland compensation for the proposed wetland alterations. In addition, the degree of disturbance in wetlands adjacent to the proposed project footprint area will be assessed prior to and subsequent to construction activities. The condition of the disturbed portions of wetlands will be compared to the conditions of any undisturbed portions of the same wetlands located adjacent to the pipeline footprint. Criteria assessed will be a comparison of grade, substrate composition, surface water presences/absence, water quality, and hydrophytic vegetation re-establishment to those observed on adjacent undisturbed wetland portions. The results of this comparison will be used to measure the effectiveness and efficiency of mitigation measures and to assist in the determination and maintenance of wetland function.

6.0 AIR QUALITY

6.1 Revised Air Contaminants

Provide a revised inventory of all potential air contaminants to be emitted from the proposed project, including but not limited to, speciated volatile organic compounds, semi-volatile organic compounds, reduced sulphur compounds, polyaromatic hydrocarbons and metals.

An additional air quality study entitled "Expanded Air Dispersion Modelling Study" was conducted by Stantec Consulting Ltd. (Stantec 2019, dated September 27, 2019), which is attached to this Focus Report as Appendix 6.2 (*Appendix 6.1 was answered in the same report as Appendix 6.2*). The study consisted of an analysis to develop a revised emissions inventory from a variety of sources and methods and to conduct subsequent dispersion modelling of the revised emissions inventory. The air contaminants considered in the development of the revised inventory included criteria air contaminants (CACs), metals, PAHs, volatile organic compounds (VOCs), reduced sulphur compounds, dioxins and furans and terpenes.

As stated in the Stantec report (2019):

> "*The considered list was refined using published literature focused on the pulp and paper industry...Of the refined contaminant list, those included in the revised inventory, and therefore assessed through modelling, were based on-site-specific data, data obtained from kraft mills with similar operations (e.g. AST ETF and co-combustion of biosludge and biomass), and published literature specific to the project operations...The air contaminants of interest that were assessed in this expanded modelling study were those identified to be potentially emitted specifically from the project (i.e. the proposed ETF and/or from the co-combustion of biomass with a mixture of biosludge in the biomass boiler). If other mill sources are also expected to emit the identified air contaminants of interest, they were included in the assessment*."

The revised inventory list can be found in Appendix A of the Stantec Expanded Air Dispersion Modelling Study report attached as Appendix 6.2 of this Focus Report.

6.2 Updated Air Dispersion Model

Update the air dispersion modelling for the pulp mill facility for all potential air contaminants of concern related to the Project.

Stantec was retained by NPNS to conduct an air dispersion modelling study to support the EA for the replacement ETF. The original air dispersion modelling study focused on criteria air contaminants (CACs) regulated by the Government of Nova Scotia under its *Air Quality Regulations* and those included in the Facility's Industrial Approval (2011-076657-A01). The updated air dispersion modelling study was conducted entitled "Expanded Air Dispersion Modelling Study" (Stantec 2019), which incorporated the expanded emissions inventory developed (see Appendix 6.2).

The expanded dispersion modelling assessment was conducted with the objective of assessing the project's potential effects on ground-level concentrations (GLCs) for air contaminants of interest to the project. The air contaminants considered in the development of the revised inventory for the project included CACs, metals, PAHs, VOCs, reduced sulphur compounds, dioxins and furans and terpenes, as per Section 6.1 of the Terms of Reference for the Focus Report and through further communication with NSE. The considered list was refined using published literature focused on the pulp and paper industry.

The air contaminants of interest that were assessed in this expanded modelling study were those identified to be potentially emitted specifically from the project (i.e., the proposed ETF and/or from the co-combustion of biomass fuel with a mixture of biosludge in the biomass boiler). If other mill sources are also expected to emit the identified air contaminants of interest, they were included in the assessment.

Dispersion modelling was performed using the AERMOD dispersion modelling system. The receptor grid used for the dispersion modelling consisted of a 30 km by 30 km grid surrounding the mill. The model included ten discrete receptors representing nearby residential areas.

The maximum predicted GLCs of ammonia, chloroform, TRS, and hexavalent chromium were above applicable ambient air quality criteria during the predicted operation of the project (though none of these contaminants are currently regulated under the *Air*

Quality Regulations). All remaining contaminants were below applicable ambient air quality criteria.

The ambient air quality criteria, to which predicted GLCs were compared, included: the Nova Scotia *Air Quality Regulations* for carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), total suspended particulate (TSP), and hydrogen sulphide (H_2S); the 2020 Canadian Ambient Air Quality Standard for fine particulate matter ($PM_{2.5}$); and the Ontario Reg. 419/05 criteria for the remaining contaminants (in the absence of specific guidelines or standards for these parameters. Only contaminants that were compared against O. Reg. 419/05 (which have no force of law in Nova Scotia and are simply used here for comparison purposes) were found to have predicted GLCs above the respective criteria.

A frequency analysis was performed to estimate the frequency for which the predicted concentrations exceeded ambient air quality criteria for each contaminant, at each of the discrete receptor locations. The results are presented in Table 7.1 of the Stantec report. Of the contaminants that were being compared to a health-based standard, the exceedances occurred at discrete receptors less than 1% of the time. TRS exceeded the odour based 10-minute limit more frequently. Emission rates were based on a combination of site-specific data, data from alternative kraft pulp mills, and published emission estimation methods, and as such, emissions are expected to be conservative and maximum predicted GLCs may be overestimated.

Once the replacement ETF is operational, source emissions testing with follow-up air dispersion modelling and/or ambient air monitoring of selected contaminants of interest will be conducted to evaluate compliance with the applicable ambient air quality criteria. This is further discussed in the Updated Air Monitoring Plan in Section 6.3.

With respect to possible TRS exceedances, the new replacement ETF is being designed to reduce odours from the secondary effluent system. As described in the "Expanded Air Dispersion Modelling Study" (Stantec 2019), the TRS emissions from the replacement ETF noted in the report are most likely an overestimation. Experience at other kraft pulp mills confirms that air can be used as a source of oxygen (via coarse bubble diffusers in the bottom of the basins for the proposed ETF) and the aerobic nature of that design allows the full destruction of TRS within the ETF and without release of TRS odours that were present in the untreated effluent.

Kraft mills produce hot effluent that must be cooled because the living biology of an ETF that uses biological treatment depends on a specific range of effluent temperature to ensure the biomass remains healthy and active and able to consume the dissolved wood-based organics that occur in pulp mill effluents. The standard industry practice uses direct-contact cooling systems to bring the temperature to the optimum range for the biology. NPNS has opted to install a more elaborate indirect-cooling system designed to eliminate the potential of odourous emissions from this stage in the process. Retaining the odour within the untreated effluent until the effluent enters the ETF ensures that odour is not discharged to ambient air and ensures that the chemicals that generate the odour are oxidized and treated within the ETF.

The biosludge that needs to be combusted in the biomass boiler is a result of the generated by the ETF due to the biological activity. The most common practice in the Canadian pulp and paper industry is to mix waste biosludge with wood waste (hog fuel) and generate steam and energy from combustion in power boilers, thereby avoiding the need to dispose of this sludge in a landfill where it would generate odours. NPNS will also combust the biosludge in order to maintain the desired inventory of biomass within the aeration basins and secondary clarifiers.

The operation the secondary clarifiers provides a means of separating the “bugs” from the treated effluent and provides settling time to thicken the biosludge. The thicker the biosludge as it leaves the secondary clarifier, the less water that must then be removed to allow the biosludge to be combusted. The consistency of this biosludge is typically about 2% solids. Prior to mixing with biomass, the biosludge is dewatered using dewatering equipment to squeeze out the water.

The mill will use solids removed from the primary clarifier to enhance dewatering of the biosludge generated within the ETF. The reject fibre and other coarse solids that separate from untreated effluent within the primary clarifier help within the dewatering process. The material feeding the biomass boiler will be a mixture of primary solids (wood waste mostly) from the primary clarifier and biosludge (mostly bug bodies) from secondary effluent treatment.

Part of the air modelling has been conducted to assess the impact of mixing biosludge with biomass and combusting the mixture within the biomass boiler. References to other pulp and paper operations have confirmed that there are no specific emission issues that are created when biosludge is mixed with biomass. Ongoing stack testing at NPNS, after the new secondary effluent treatment is running, will confirm what has been observed at other pulp and paper facilities – that the addition of biosludge at the ratios anticipated will not affect air contaminant emissions from the biomass boiler. Most combustion by-products from biosludge combustion are the same combustion by-products as biomass combustion. A lot of the contaminants (including some metals) are recovered in the fly ash that is generated from the combustion process. This fly ash is recovered from the process and landfilled in an approved landfill on-site.

6.3 Updated Air Monitoring Plan

Complete an updated ambient air monitoring plan for the Project site based on the air dispersion modelling results. This plan must include the potential air contaminants to be monitored and proposed air monitoring location(s).

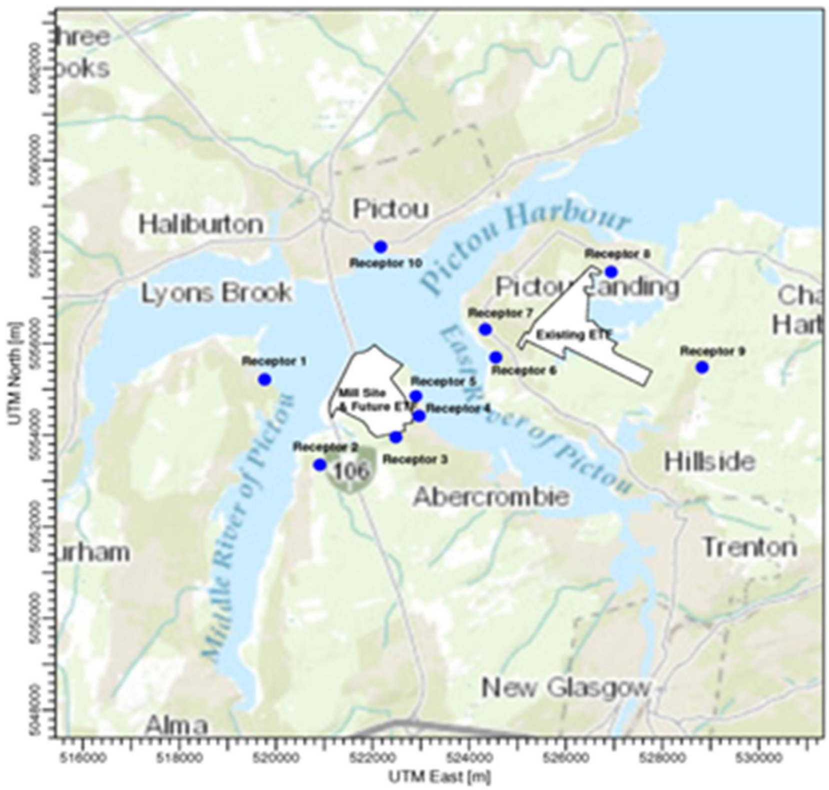
As outlined in the Terms of Reference for the Preparation of the Focus Report, a complete updated ambient air monitoring plan was to be developed for the project site based on the air dispersion modelling results. The plan had to include the potential air contaminants to be monitored and proposed monitoring sites.

This Monitoring plan was developed based on the results of the revised air modelling study completed by Stantec for the Focus Report. The purposes of the ambient monitoring program will be to:

1. Update the ambient monitoring program in light of the proposed project;
2. Monitor ambient air quality in the region surrounding the project to measure GLCs of select air contaminants associated with the project;
3. Monitor concentration levels of the project's related air contaminants at select locations that are representative of nearby residential areas;
4. Quantify background ambient levels of air contaminants in the area.

In order to complete these goals, NPNS proposes to perform air sampling and testing at some of the receptors locations used in the Expanded Air Dispersion Modelling Study for Replacement ETF prepared by Stantec (2019b). The results from all of the receptors will be used to select a few key locations that would be proposed as potential monitoring stations or portable testing sites. This testing will be performed in order to validate the air dispersion model predictions for the various air contaminants for the project.

Figure 6.3-1: Expanded Air Dispersion Modelling Study for Replacement ETF prepared (Stantec, 2019b)



Based on the "Expanded Air Dispersion Modelling Study" (Stantec 2019), predictions of the following contaminants were chosen to be possibly included in the proposed monitoring program due to the compounds either being present in NPNS' biomass boiler stack testing, present in sludge analyzed from similar kraft pulp mill's with AST treatment, or released from AST facilities as presented in NCASI (2007):

- Carbon Monoxide (CO);
- Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$);
- Metals in total suspended particulate (TSP);
- Nitrogen Oxides (NO_X);
- Sulphur Dioxide (SO_2);
- Total Reduced Sulphur Compounds (TRS);

- Ammonia (NH_3); and
- Select Volatile Organic Compounds (sVOCs).

Further details can be found in the Stantec report that determined the air contaminants of interest. Further details on the parameters will be developed in consultation with NSE.

Measurement programs at monitoring sites will include both continuous and non-continuous monitors conducting testing at select monitoring locations. All equipment will be calibrated to industry standards and all analytical testing will be conducted at accredited third party laboratories. Figure 6.3-2 below shows the Tisch Jo-Vol total particular sample that is currently located in Pictou Landing. Similar models will be used at select monitoring locations.

Figure 6.3-2: Tisch Jo-Vol Total Particulate Sampler at Pictou Landing

The data compiled with be reviewed and subject to quality assurance and quality control procedures, parameters, organized into reports and submitted to the proper government authority to demonstrate the three goals of the Ambient Air Modelling Quality Program listed above are being satisfied.

7.0 FISH AND FISH HABITAT

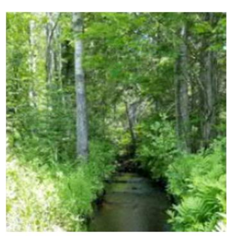
7.1 Freshwater Fish and Fish Habitat Survey

Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.

Baseline surveys are completed at the beginning of a project or prior to project construction. The objective of the baseline survey is to establish the current status of certain environments so the results of the baseline survey can act as a benchmark to measure project success.

A fish habitat baseline survey was completed by biologists from Dillon Consulting Limited in 2019 to identify the freshwater environments along the realigned effluent pipeline route that could provide habitat for fish. The fish habitat baseline condition survey for the freshwater environment was undertaken where freshwater watercourses cross the project area. The survey involved recording and measuring certain characteristics of the watercourses that may or may not make them suitable for fish. For example, some fish rely on streams that are clear, fast-flowing, with rocky bottoms for egg laying; whereas, others may require still water with a lot of plant cover for feeding and avoiding predators. Figure 7.1-1 below shows the different types of fish habitats observed during the study. The physical habitat survey included measuring characteristics including bottom type, plant cover, width, depth, stream character, to name a few.

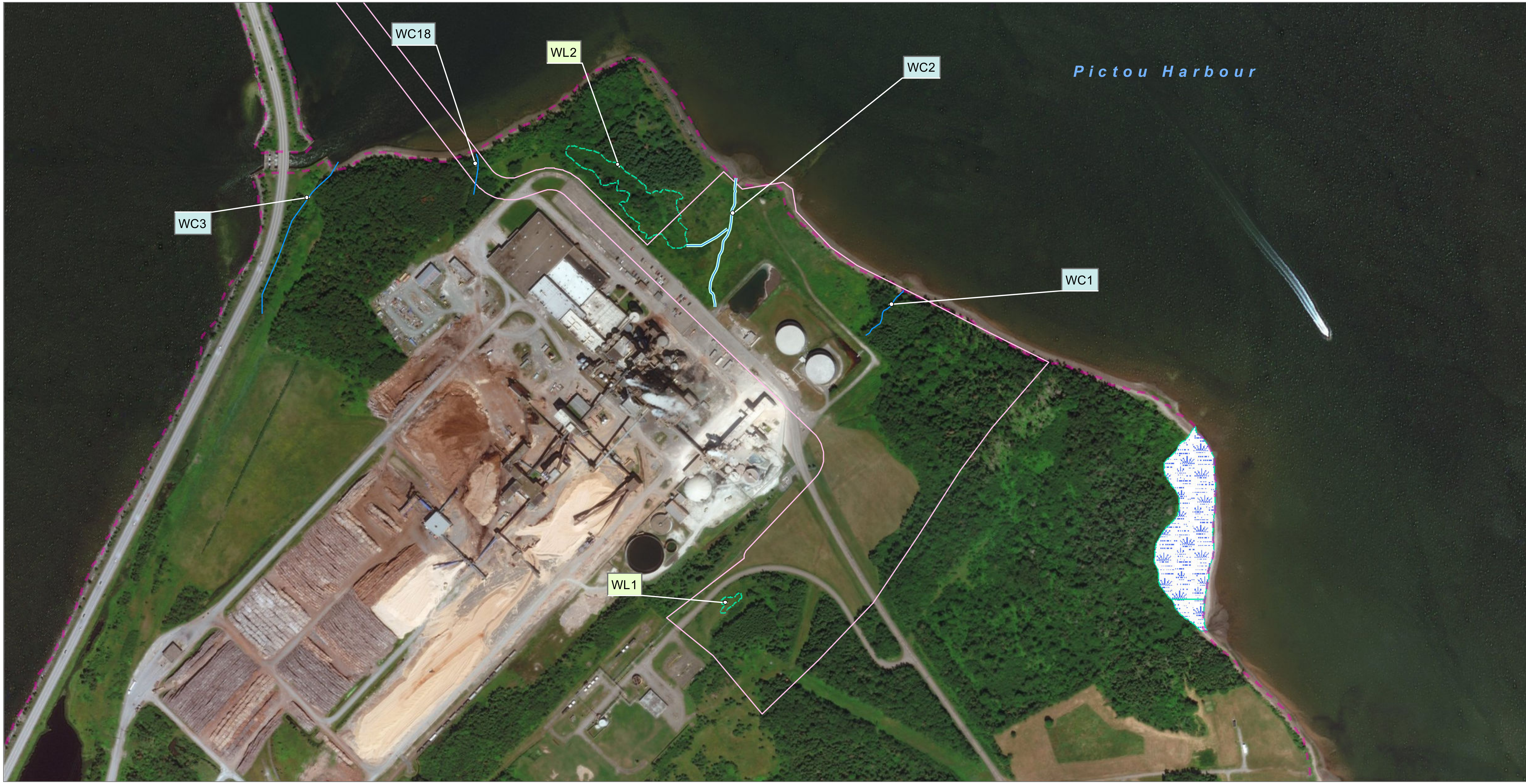
Figure 7.1-1: Photo Summary of fish habitats observed during survey.



Baseline fish surveys were completed to supplement the habitat observations to examine if fish could be captured (and returned to) in the watercourses that intersect the project area. The absence of fish in capture efforts did not necessarily mean the watercourse is not fish habitat; only that fish were not present during the survey. The fishing methods used were chosen based on the physical characteristics of individual watercourses and known fish species previously identified in the area (using available DFO/provincial fisheries data and professional judgment on habitat suitability). The presence/absence survey methods involved electro-fishing and minnow trapping and were carried out under conditions authorized by a DFO permit. Figure 7.1-2 shows an example of electro-fishing used in the field.

Figure 7.1-2: Electro-fishing in fish habitats (generic photo)

Figure 7.1-1 and 7.1-2 show the freshwater environments in the proposed replacement ETF area and along realigned effluent pipeline route (note: not all of these watercourses provide suitable habitat for fish). Additionally, tables in Appendix 7.1 provide more details on freshwater environments surveyed, and the types of habitat and fish present (if fish were found in the particular watercourse).



Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Watercourses in the Proposed ETF Area
Figure 7.1-3

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

Approximate Project Footprint Area*

Secondary Watersheds (NSE Watershed Dataset) (SD= Shore Drainage)

WL# Wetland ID

Watercourse

Wetland

WC# Watercourse ID

Watercourse Assessed as Potential Fish Habitat

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia,
NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 50 100 200 Meters

N E S W

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-09-26

Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Watercourses Along the Proposed Realigned Pipeline Route
Figure 7.1- 4

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

	Approximate Project Footprint Area*		Secondary Watersheds (NSE Watershed Dataset) (SD= Shore Drainage)	WL#	Wetland ID
	Watercourse		Wetland	WC#	Watercourse ID
	Watercourse Assessed as Potential Fish Habitat				

DILLON
CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pulp Nova Scotia, NSDNR, GeoNova, NSDNR, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 500 1,000 2,000 Meters

N E S W

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-10-01

7.2 Fish Habitat Baseline Survey

Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.

Baseline surveys are completed at the beginning of a project or prior to project construction. The objective of the baseline survey is to establish the current status of certain environments so the results of the baseline survey can act as a benchmark to measure project success.

Underwater benthic habitat surveys (UBHS) are used by marine scientists for fish habitat baseline surveys in marine environments. They are typically completed using underwater video. For purposes of some project types, survey findings are submitted to DFO for review. An UBHS was conducted from May 3 to 7, 2019 in Caribou Harbour and Pictou Harbour by CSR GeoSurveys Ltd. and Stantec Consulting Ltd. The objectives for completing the UBHS were:

- to identify what habitat types are present;
- to identify what benthic (bottom) communities are present;
- to determine if eelgrass is present; and
- to describe what vegetation species are present.

The area covered by the UBHS was selected based on the proposed marine portions of the realigned treated effluent pipeline route and the diffuser area. Results from earlier studies, including surficial geology analysis and sidescan sonar survey, also helped to define the survey area. The UBHS covered the area along the proposed marine pipeline route in Pictou and Caribou Harbours, and the diffuser area, as shown in Figure 7.2-1.

Once the UBHS video was completed, it was analyzed by a marine scientist from Stantec to evaluate the four UBHS objectives listed above. A summary of the findings of the UBHS are summarized below in Table 7.2-1. More details of the UBHS are presented in Stantec's full UBHS report in Appendix 7.2.

Table 7.2-1: Summary of UBHS Results

Objectives	Pictou Harbour	Caribou Harbour	Diffuser Area
1) Habitat Types Present	Silt and mixed sediment (silty sand, shell hash, and gravel) were the primary habitat types. Silt was most prevalent. Pockets of other substrate were noted including cobble/gravel near the causeway opening.	Different types of habitat were identified: silt, silty sand, sand, and mixed sediment (sand, shell hash, and gravel). Overall, the proposed pipeline corridor is composed primarily of sand. Silty sand transitions to sand toward the mouth of Caribou Harbour until the Northumberland Strait, where the habitat then transitions into mixed sediment near the proposed area of the diffuser.	Mixed sediment (sand, gravel, and shell hash) was the primary habitat observed.
2) Benthic Communities Present	Sea stars (*Asteria forbesi*) and rock crabs (*Cancer irroratus*) were the most common benthic communities found on the silty habitat. Near the Pictou Causeway, blue mussel (*Mytilus edulis*) beds were observed. Holes in the sediment dug by benthic organisms were also commonly observed.	Rock crabs (*Cancer irroratus*) were observed in all habitats at all depths. At greater depths in the sand habitat areas, sand dollars (*Echinarachnius parma*) were abundant and moon snails (*Euspira heros*) were also observed. American oysters were observed in at least one location but it was not possible to determine if they were alive or simply shells.	Rock crabs (*Cancer irroratus*), blue mussels (*Mytilus edulis*), and sand dollars (*Echinarachnius parma*) were observed in the area. Low benthic diversity observed.
3) Eelgrass Presence	None observed.	Eelgrass and eelgrass beds were present and thickest along the shore line of Caribou Harbour.	None observed.
4) Vegetation Present	Identification of large plants (visible to the naked eye) was difficult as they were covered in silt. Species included *Cystoseira*, *Chorda*, *Fucus*, *Laminaria* and *Ascophyllum* in low densities near shore and even sparser elsewhere.	In shallow silty sand areas, eelgrass was the primary vegetation observed. At deeper depths, there was less eelgrass present.	Algae species were observed (*Laminaria* sp., *Rhodophyta* sp., and *Cladophora* sp.).

Figure 7.2-1: Sample locations for underwater benthic survey along pipeline route (Stantec, 2019c)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Underwater Benthic Habitat Survey Area in Caribou Harbour and Pictou Harbour

Stantec
NORTHERN PULP

Figure 1

7.3 Impact Assessment for Marine Fish

Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.

Summary of Section 7.3

The goal of an impact assessment is to evaluate the positive or negative consequences of a plan, policy, program, or project prior to moving forward with the proposed action. This section assessed the potential physical effects on marine fish and fish habitat that may occur as a result of pre-construction, construction, and operation and maintenance activities implemented during the project. The assessment methodology to assess this work was developed in consultation with relevant Federal and Provincial governments. Additional field work was conducted to update baseline data within the project area, as indicated below:

- marine water quality (see Sections 4.1 and 4.2);
- sediment quality (see Sections 4.2 and 4.3);
- benthic (bottom organisms) (see Sections 4.1, 7.1 and 7.2);
- plankton (small drifting organisms) (see Sections 4.1, 7.1 and 7.2);
- identification of marine fish species (see Sections 7.1 and 7.2); and
- Identification of fish habitat (see Sections 4.1, 4.2, 7.1 and 7.2).

Potential impacts to important fisheries of commercial, recreational, and Aboriginal (subsequently referred to as 'Indigenous') value within the project area were also evaluated. The fisheries that were evaluated included: the American lobster, Atlantic mackerel, Atlantic herring, plaice, winter flounder, sea scallop, rock crab, and seaweed species.

In order to review potential impacts to water quality, multiple studies were reviewed and analyzed as a whole. The key topics and studies that were reviewed in regards to the marine environment include:

- Marine Water Data (described in detail in Section 2.4 and Section 4.1); and
- Results of the RWS (described in detail in Section 4.2).

Based on testing, modelling and the incorporation of mitigation activities, no significant residual impacts to marine water quality are expected to arise on any fisheries or fish habitat as a result of this project. To confirm these predictions, NPNS will continue with a federally-regulated Environmental Effects Monitoring (EEM) program and additional EA Follow-up monitoring. These activities under EEM will include confirmation of the 1% dilution zone, conducting standardized sublethal toxicity testing of effluent and biological monitoring studies in the aquatic receiving environment to determine if the mill is having effects on fish, fish habitat, or the use of fisheries resources. Future studies could include toxicity testing, specifically on larval lobster and herring eggs to evaluate sublethal effects on these species. Phytoplankton (small plant-based drifting organisms), zooplankton (small animal based drifting organisms), and benthic invertebrate community assessments could also be conducted alongside ongoing water quality analysis. To develop the EA Follow-up monitoring program, NPNS will consult with relevant stakeholders on continuing tissue chemistry investigation.

After reviewing the results of these studies, it was determined that beyond a zone of <5 m from the diffuser, water parameters match marine baseline data in the Northumberland Strait, limiting exposure to marine organisms. Additionally, with the orientation of the diffuser pipes, treated effluent will be discharged away from the ground, minimizing contact with benthic environment.

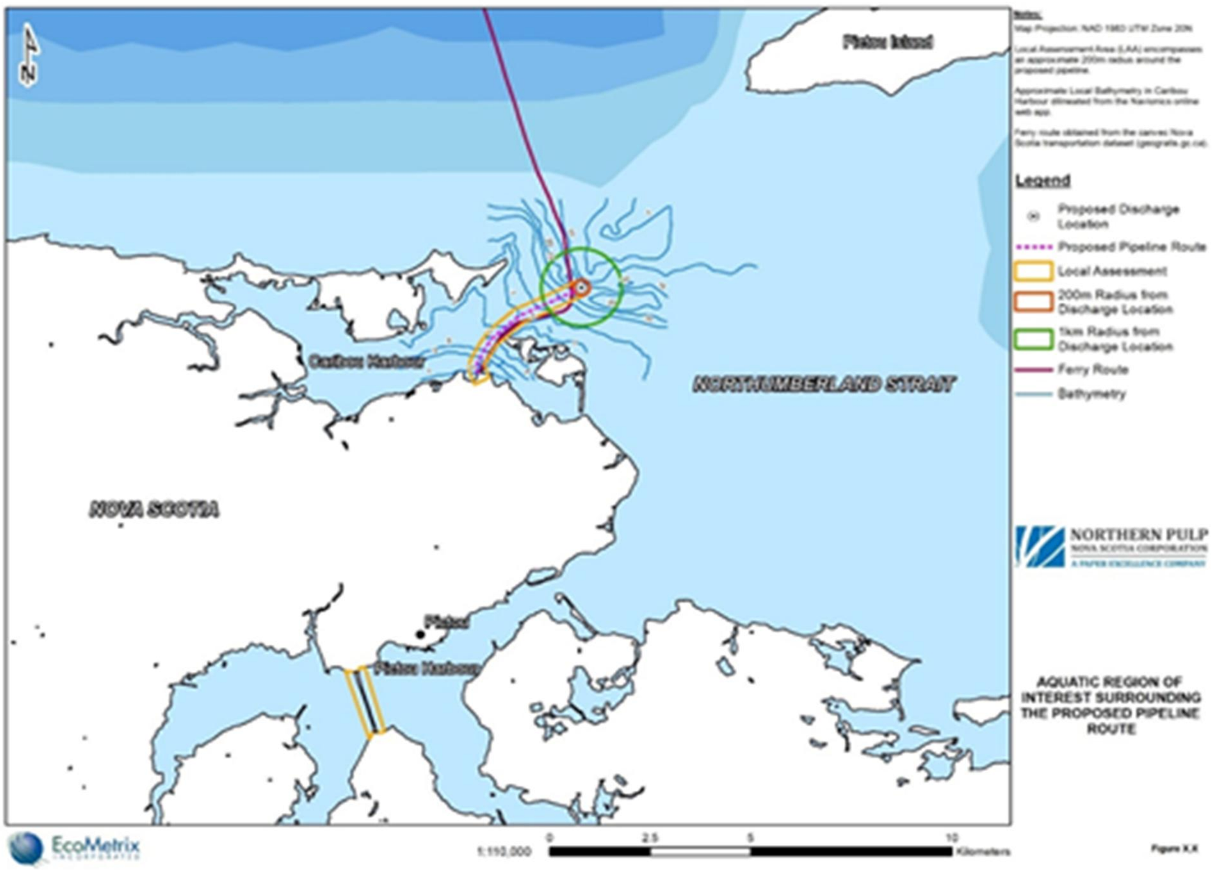
Detailed Summary

The goal of an impact assessment is to evaluate the positive or negative consequences of a plan, policy, program and project prior to moving forward with the proposed action. This section assessed the potential physical effects on marine fish and fish habitat that may occur as a result of pre-construction, construction, operation and maintenance, and operational activities implemented during the project. This encompasses the area where the proposed replacement ETF, realigned treated effluent pipeline, and diffuser will cross. These regions were considered in two distinct marine areas (Figure 7.3-1):

Marine Regional Assessment Area (RAA) – The area inclusive of Pictou Harbour, Caribou Harbour, and the south-eastern portion of the Northumberland Strait adjacent to the Marine Local Assessment Area.

Marine Local Assessment Area (LAA) – The area surrounding the pipeline footprint (within 200 m on either side of the pipeline) and the effluent diffuser area (within a 200 m radius around the effluent discharge point). This includes the marine environment surrounding the pipeline footprint around the diffuser within the area that is predicted to be exposed to relative effluent concentrations over 1%.

Figure 7.3-1: Marine Regional and Local Assessment Areas as defined by EcoMetrix



Study of the Existing Environment – Baseline Understanding

Prior to determining the potential effects of the project on the marine aquatic environment, there needs to be a greater understanding of the existing environment. This assessment focused on the marine aquatic environment and marine resources that are specific to the commercial, recreational, and Indigenous fisheries around the project area. Data was drawn from historical data within the region of the project in addition to new data collected specifically to address the concerns raised from the EARD (2019).

This data supports the project assessment and design in addition to providing critical background data.

Water Quality

Water quality was examined within the LAA over two seasons (October 2018 and May/June 2019) and at varying depths and tide cycles. In total, 22 samples were collected, eight from Caribou Harbour along the proposed pipeline route and 14 within the effluent mixing zone. Over 300 water quality parameters were analyzed from the water samples collected and these results were compared to the CCME Marine Water Quality Guidelines for the Protection of Aquatic Life. Where CCME standards were not available, guidelines developed by the USEPA for the states of Maine and New Hampshire were used.

The analysis of all these pre-project samples showed that the large majority of concentrations were below the detection limits of the test in all samples. Where detectable limits were reported, none of the values exceeded the CCME or USEPA guidelines. When comparing the samples from the pipeline corridor to the diffuser area the results were generally the same but for a few parameters where the pipeline corridor showed higher concentrations than the diffuser location.

Sediment Quality

Marine sediments were collected in April/May 2019 by Stantec along the pipeline corridor and the area surrounding the diffuser location and have previously been described in detail in Section 4.1 above. Sediments composition was determined in addition to key parameters such as TOC, PAHs, metals, and polychlorinated biphenyls (PCB).

Marine Benthos

Marine invertebrates are a diverse group of spineless organisms that live throughout the ocean. A subgroup of marine invertebrates that live in or on the sediment of the seafloor are referred to as benthic invertebrates.

Data for the evaluation of the benthic community were compiled from various ongoing studies on the Gulf of St. Lawrence, Northumberland Strait, and Caribou Harbour as a part of NPNS's EEM program for the last 20 years. Consistently over the years, the same benthic invertebrates have been found, including: polychaete worms, amphipods (scavenging “scuds” or “side swimmers”), bivalves (clams, oysters, cockles, mussels, scallops), gastropods (snails and slugs), decapod crustaceans (lobsters and crabs), and echinoderms (sand dollars, starfish, sea urchins and sea cucumbers).

Although the current evaluation provides a comprehensive picture of the benthic community, to further understand the benthic community in the LAA, future field work will be conducted in the area of the effluent diffuser in the fall of 2019 to supplement the existing database.

Plankton

Plankton are defined as organisms that spend a portion of their lives suspended in the water column, free floating with limited mobility and largely dependent on the movement of surrounding water for mass movement. Plankton play a crucial role in the aquatic food chain. Zooplankton are a subgroup of plankton and feed on plants, bacteria, detritus, and other zooplankton.

Previous studies in the area of Shediac Bay and for the Confederation Bridge project shed some light on the potential zooplankton of the study area. Nearshore zooplankton from these studies show a large abundance of copepods. Open water findings within the Strait outside the RAA indicate a dominance of coastal, warm water calanoid copepods, larval molluscs and pteropods (free swimming sea snails and slugs).

Further studies in the area of the proposed diffuser location have begun in the summer of 2019, with additional studies to be scheduled prior to any construction activities. These studies aim to provide a baseline of phytoplankton and zooplankton presence, diversity and relative abundance.

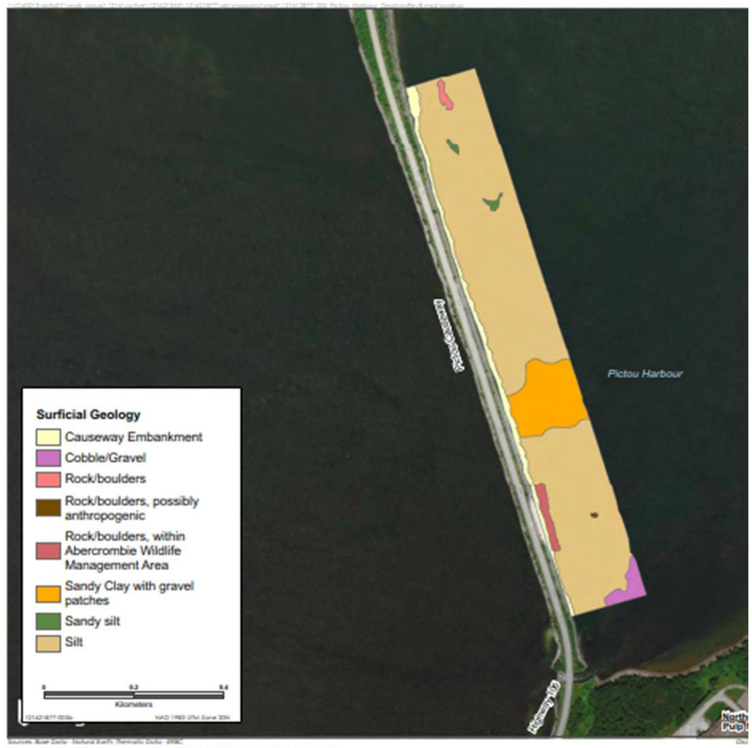
Distribution of Marine Fish and Fish Habitat in Study Area

An Underwater Benthic Habitat Survey (UBHS) was conducted along the proposed pipeline route (Figure 7.3-2). This was achieved by sidescan sonar and underwater video (previous described in detail in Section 4.1, and by Stantec in Appendix 4.1). Water depths along the majority of the pipeline vary between 2 to 7 m, with the proposed diffuser locations at 19 m. The sea bottom transitions from fine material (silt, sandy-silt, and clayey silt) to larger material and then back to silty sand again. In both the

Northumberland Strait/Caribou Harbour and Pictou Harbour sections of the survey, marine invertebrates and marine fin-fish species sightings were rare and were not found in any abundance. The vegetation in Caribou Harbour was predominately eel grass in the shallow area, especially where the ground was made up of finer particle material. Along the Pictou Causeway, the vegetation is sparse, made up of brown algae species. As water depths increase the vegetation decreases and within the area of the proposed diffuser, a dominance of sand with some gravel and shell hash can be seen.

Figure 7.3-2: Underwater Benthic Habitat Survey Area (Stantec, 2019)

Pictou Harbour



Northumberland Strait and Caribou Harbour

Fish distribution and abundance in the area were examined based on historical studies and the 2019 UBHS. Marine fin-fish within the RAA and LAA were categorized by likelihood of appearance and by their Species at Risk (SAR) or Species of Conservation Concern (SOCC) status and importance in the Commercial, Recreational, or Indigenous fishery. Of the 48 potential fin-fish species in the RAA, none were identified as SAR. The fish observed in the area were also categorized using Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designations; and the results were as follows for the RAA:

- Endangered: 4 species (i.e., white hake, winter skate, Atlantic bluefin tuna, and Atlantic cod);
- Threatened: 2 species (American eel, Atlantic striped bass); and,
- Special Concern: 1 species (Atlantic salmon).

Commercial, Recreational and Indigenous Fisheries Resources and Use in the Study Area

The potential for project contact of the significant CRA fisheries are outlined as follows:

Lobster - American lobster makes up the largest proportion of the CRA fishery in Caribou Harbour and Pictou Harbour, with all life cycle stages represented within this area. American lobster active harvesting areas and buoy location clusters are presented in Figures 7.3-3 and 7.4-4 below. The proposed treated effluent pipeline traverses the Scallop Buffer Zone, SFA 24, set in place in order to protect lobster nursery habitat. The placement of the pipeline outfall diffuser was chosen so as to minimize the impact in active fishing areas. The proposed outfall lies within the intersection of the marine ferry lines to Prince Edward Island (PEI) and Pictou Island.

Figure 7.3-3: Northumberland Strait Lobster Buoy Locations

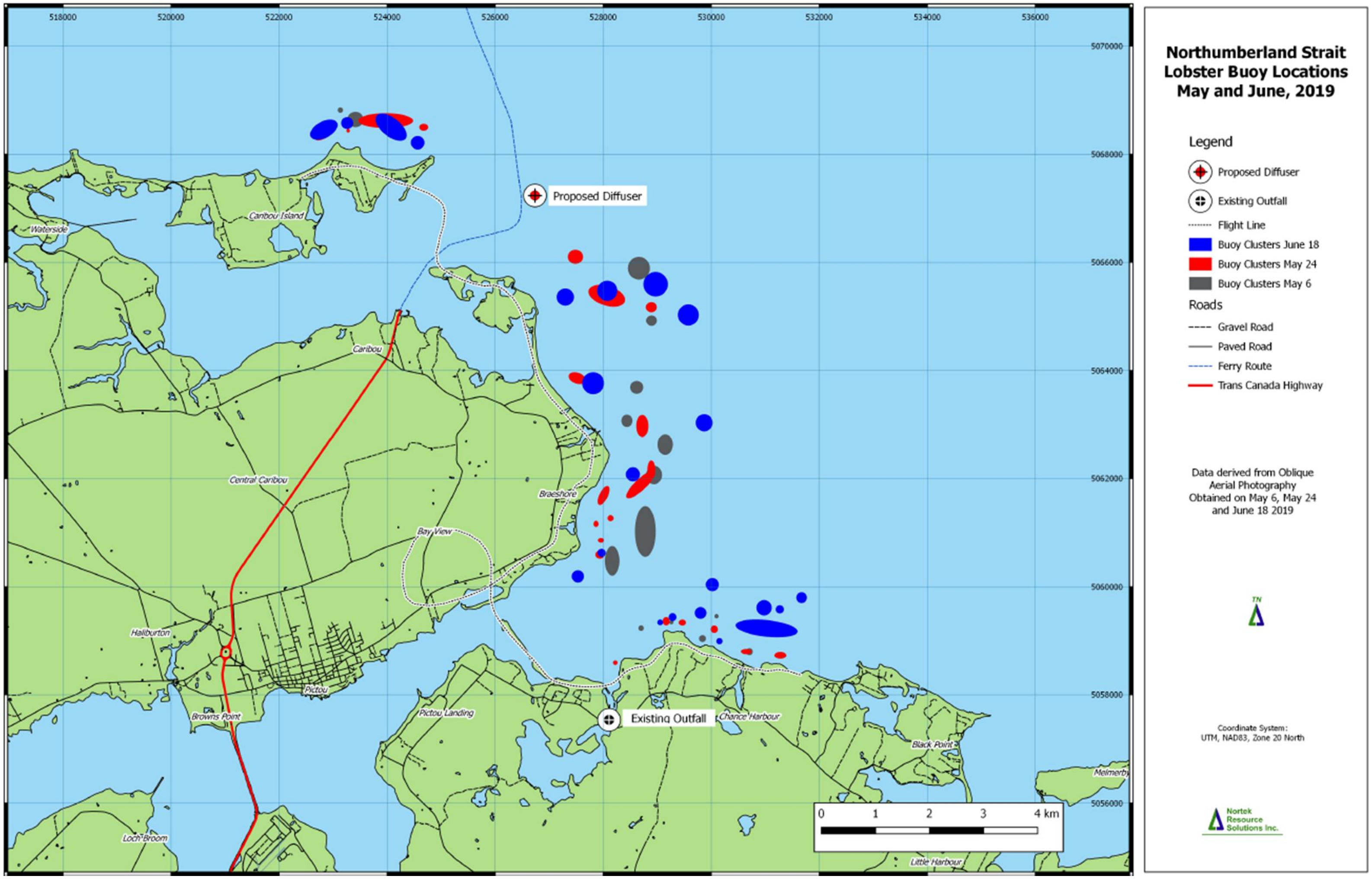
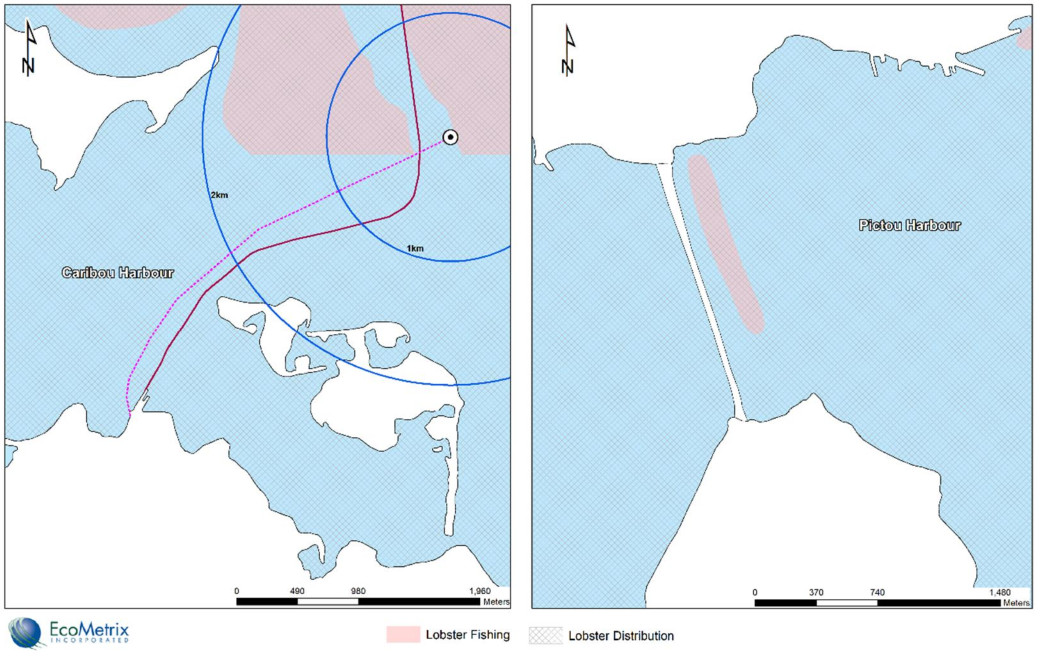
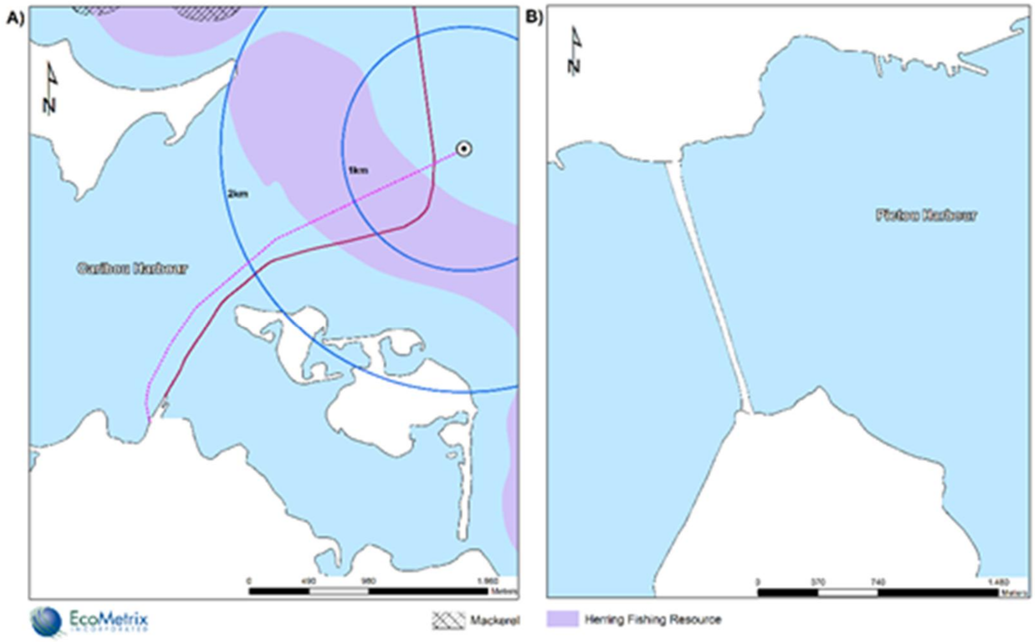


Figure 7.3-4: Lobster Distribution and Harvest Areas in the LAA



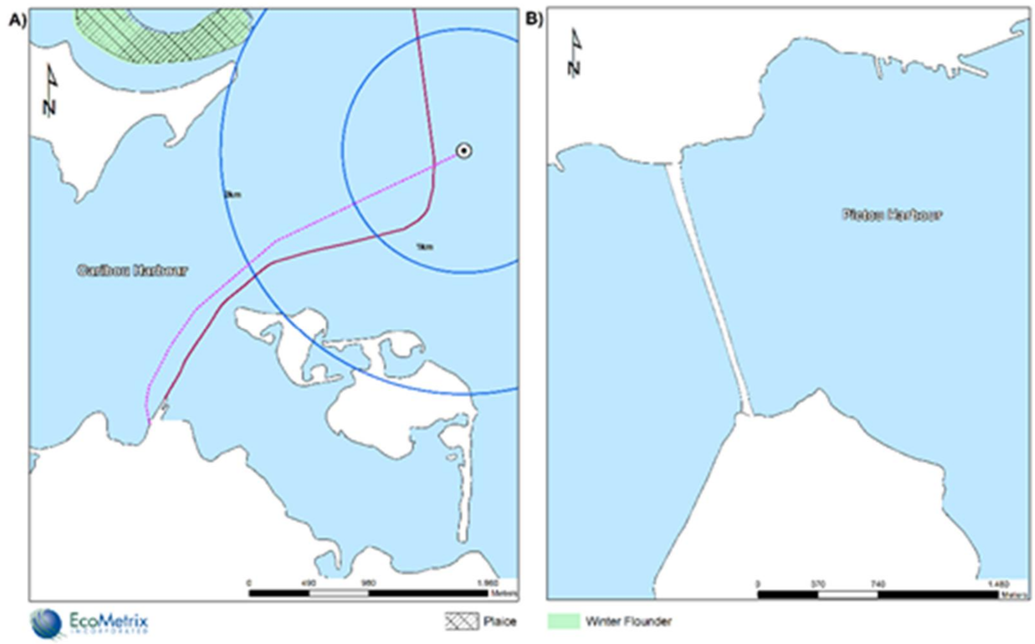
Mackerel and Herring – Atlantic mackerel and Atlantic herring are found in the Outer Caribou Harbour/Northumberland Strait (Figure 7.3-5) at depths of 10 m and greater. The nearest mackerel harvest area is well outside the proposed pipeline footprint and more than 2 km northwest of the proposed diffuser location; however, the proposed pipeline route will interact with the herring fishery.

Figure 7.3-5: Atlantic Mackerel and Atlantic Herring Distribution and Harvest Areas



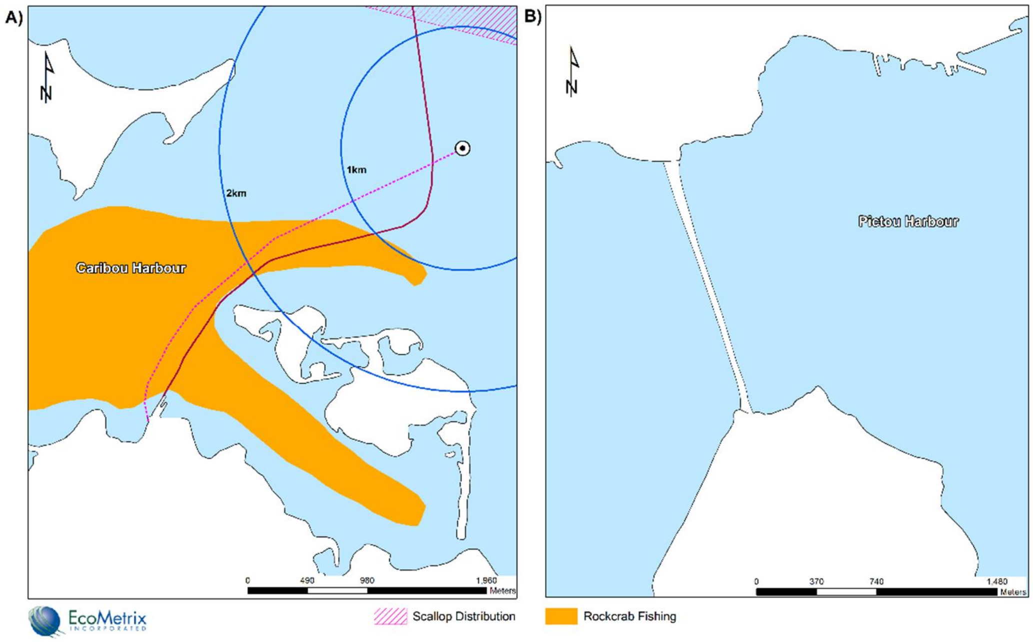
Plaice and Winter Flounder - Atlantic plaice and winter flounder are concentrated outside of the proposed project LAA and 2 km beyond the proposed diffuser location (Figure 7.3-6).

Figure 7.3-6: Atlantic Plaice and Winter Flounder Distribution and Harvest Areas



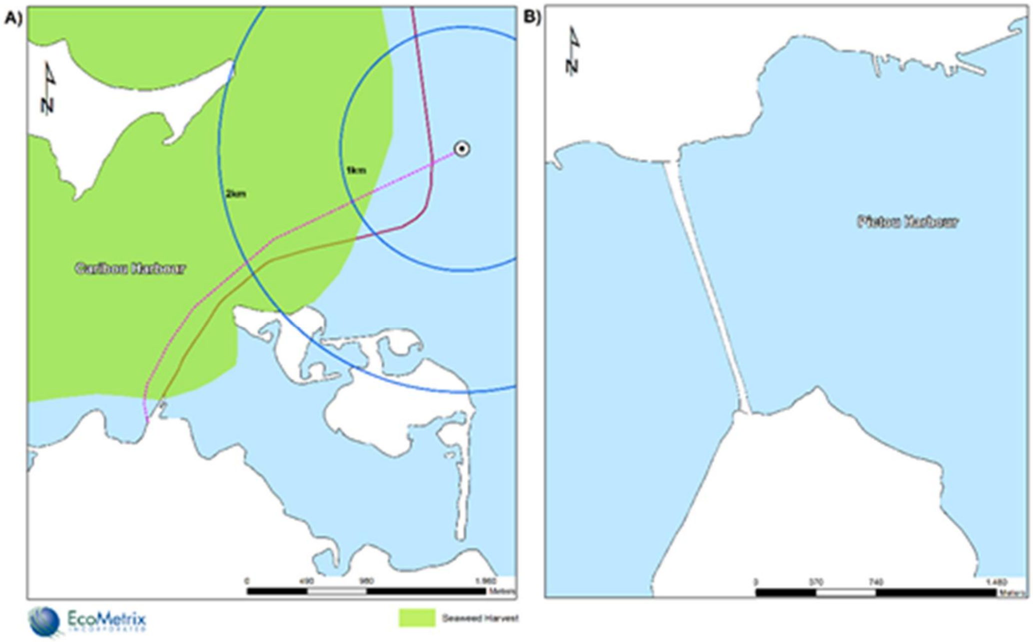
Scallop and Rock Crab – The Scallop Buffer Zone SFA 24 has been in place since 2014, and was established to protect juvenile American lobster nurseries. The proposed pipeline will cross through SFA 24 in Caribou Harbour near Jessie's Cove. The diffuser is outside SFA 24 and not within an area known to be used for scallop harvesting (Figure 7.3-7). Rock crab is one of the most important species harvested in the LAA by commercial and Indigenous fishers. The proposed project will interact with the Rock Crab resource along the proposed pipeline corridor (Figure 7.3-7) but not at depths greater than 10 m or near the diffuser location.

Figure 7.3-7: Scallop and Rock Crab Distribution and Harvest Areas



Seaweed – Harvest of seaweed species has historically been of Irish Moss, brown algae or "Rockweed", and dulse. Recent aquaculture of these species along with the traditional harvest fall into the area identified as having direct interaction with the pipeline route yet is greater than 500 m from the diffuser location (Figure 7.3-8).

Figure 7.3-8: Seaweed Harvest Areas



Effects Assessment and Mitigation

With baseline data established the focus shifts to determining and assessing the potential impacts of the project. Outlining the "who, what, where, when and how" of the project defines the scope assessment.

Who – Valued Ecosystem Components (VEC)

A Valued Ecosystem Component is defined as:

> "an environmental element of an ecosystem that is identified as having scientific, ecological, social, cultural, economic, historical, archaeological or aesthetic importance. The value of an ecosystem component may be determined on the basis of cultural ideals or scientific concern."

Essentially a VEC is a component of the environment that has value and can be measured. VECs are used to measure the potential effects of a project on the environment. In this assessment the main VEC is the "Marine Fish and Fish Habitat". While this is a broad sweeping statement, the VEC in this case looks at the classes of: marine fin-fish, marine shellfish, plankton, benthic invertebrates, marine vegetation, and marine fish habitat. Evaluation is done on how each of these classes, which are further broken down into groups and then key indicators (individual species or components), is represented and can be affected by the proposed project.

Where and When – Spatial and Temporal Boundaries

As previously described, the scope of the assessment needs to be clearly defined spatially and in this case the RAA and LAA make up that scope. Temporally, the project can be defined in different phases: Construction and Commissioning, Operation and Maintenance, and Decommissioning. It is expected that the construction and commissioning phase is to occur over 21 months with 1 to 3 months for commissioning. Operation and maintenance phase involves the discharge of treated effluent into the marine environment, starting after construction and commissioning and going on for several decades. Ongoing maintenance and repair will occur during this timeframe with regular inspections. The decommissioning phase will occur when the project has come to the end of its useful service life or the end of the NPNS facility.

What – Project-Environment Interactions

The marine fish and fish habitat can be directly or indirectly impacted by activities and components of the project during all phases described above. With the focus of the Impact Assessment being the direct mortality of fish and/or harmful alteration, disruption, or destruction of fish habitat (HADD), potential changes to the marine environment can ultimately impact the success of fish species and habitat throughout their life cycle. This interaction with the environment can be a physical interaction or an emission related interaction.

Potential Effects from Physical Interactions

During the construction phase, marine fish may be impacted through the direct placement of the in water infrastructure. Sessile or slow moving fish and invertebrates would be most at risk.

Excavation, installation and back filling portions of construction could change the sea floor – particle size and distribution, fish cover, water and sediment quality or changes to acoustic quality – which may impact marine invertebrates, fish species, and fish habitat.

Changes in the sediment quality from dredging activities may cause increased TSS and increase sedimentation in other areas which can impact life stages of all marine life in the area.

Other physical interactions include acoustic disturbances from vessel noise, trenching, piping, backfilling, and potentially blasting if required.

These same construction interactions may also occur during the operation and maintenance of the project, albeit at a smaller scale than the initial project construction.

6.3.2 Potential Effects from Project – Related Releases

For this assessment, the treated effluent from the replacement ETF will be considered to be consistent to the effluent currently discharged at Boat Harbour today, which is comparable to bleached Kraft mills in Canada and abroad. Like the current discharge, the future discharge will meet all provincial and federal discharge quality limits.

To investigate how treated effluent could impact the environment from the proposed diffuser location into Caribou Harbour/Northumberland Strait, an assessment of COPCs in the future treated effluent was conducted (detailed results are provided in Appendix 7.3). Current treated effluent was analyzed for an extensive list of parameters. To focus on COPCs, the maximum effluent concentrations of these parameters found from the analyses were compared to the median background concentrations in the receiving water (Caribou Harbour). If the parameter was found to be greater than background, then the maximum effluent concentration was evaluated against CCME Canadian Water Quality Guidelines (CWQG) for the Protection of Marine Aquatic life (Table 7.3-1). If the parameter was found to be greater than the CWQG, then it was classified as a COPC for the assessment. Finally, through 3D modelling by Stantec (2019) in the RWS Report (discussed in detail in Section 4.2), the distance to reach background concentrations from the outfall diffuser was determined for each COPC (Table 7.3-1). Scenario B was the most conservative assessment completed by Stantec. In Scenario B, the modelling looked at summer conditions, which is when the lowest mixing occurs due to low tidal current (slack) velocities and conditions persist for longer period of time as they are not covered by ice. More specific details of RWS Scenario results can be found in Appendix 4.2.

Table 7.3-1: Marine Water Quality COPCs and Estimated Dilution

Parameters	Units	Guidelines	Concentrations			Based on dilution ratios from Worst Case Scenario (Scenario B, RWS)		
		CWQG (Marine)	2018	2019	Point C (Maximum)	5 m	100 m	Distance from Diffuser Ambient conditions are reached
Effluent Flow	m^3/s	-	-	-	0.984	-	-	-
Adsorbable Organic Halides (AOX)	mg/L	-	n/a	n/a	7.8	0.15	0.05	n/a
Total Nitrogen (TN)	mg/L	-	0.24	0.17	15	0.46	0.17	< 20 m
Total Phosphorus (TP)	mg/L	-	0.35	0.5	1.5	0.52	0.5	< 2 m
Colour	TCU	-	10.8	4.5	750	19	5.1	< 200 m
Chemical Oxygen Demand (COD)	mg/L	-	n/a	n/a	497	9.7	3.4	n/a
Biochemical Oxygen Demand (BOD5)	mg/L	-	n/a	2.5	29	3.02	2.5	< 2 m
Total Suspended Solids (TSS)	mg/L	5[a]	8.5	2.5	42	3.3	2.5	< 2 m
Dissolved Oxygen (DO)	mg/L	> 8.0[b]	7.2	9.7	1.5	9.5	9.7	< 2 m
pH	-	7.0–8.7[c]	8	7.8	7.7	7.8	7.8	< 2 m
Temperature (summer)	°C	Narrative[1]	17.6	16.8	35	17.2	16.8	< 2 m
Temperature (winter)	°C	Narrative[2]	0	1	35	1.5	1	< 2 m
Salinity	g/L	Narrative[3]	28	30	2	29.5	30	< 2 m
Aluminum	µg/L	NG	-	50	2330	50	50	< 2 m
Barium	µg/L	NG	-	10	450	10	10	< 2 m
Cadmium	µg/L	0.12	n/a	0.084	1.03	0.1	0.084	< 2 m
Copper	µg/L	NG	-	5	7.5	5	5	< 2 m
Iron	µg/L	NG	-	500	718	≤ 500	≤ 500	< 2 m
Manganese	µg/L	NG	-	20	2800	54	19	≈ 50 m
Mercury	µg/L	0.016	-	0	0.028	0.028	0.028	< 2 m

Parameters	Units	Guidelines	Concentrations			Based on dilution ratios from Worst Case Scenario (Scenario B, RWS)		
Zinc	µg/L	-	-	50	160	50	50	< 2m
Total Dioxins & Furans	pg/L	-	n/a	3.213	3.675	3.22	3.213	< 2 m
Phenanthrene (PAH)	µg/L	-	n/a	0.01	0.044	0.01	0.01	< 2 m
Total Resin Acids	mg/L	-	n/a	0.06	0.57	0.07	0.06	< 2 m
Total Fatty Acids	mg/L	-	n/a	0.07	0.335	0.08	0.07	< 2 m
Total P&P Phenols	µg/L	-	n/a	5	6.13	5.03	5	< 2 m

Notes:

NG = No Guidelines, n/a = not applicable, “-“indicates parameter not analyzed.

Mixing zone results – parameter concentrations (Stantec 2019c)

Effluent Flow 85,000 m3/day or 0.984 m3/s

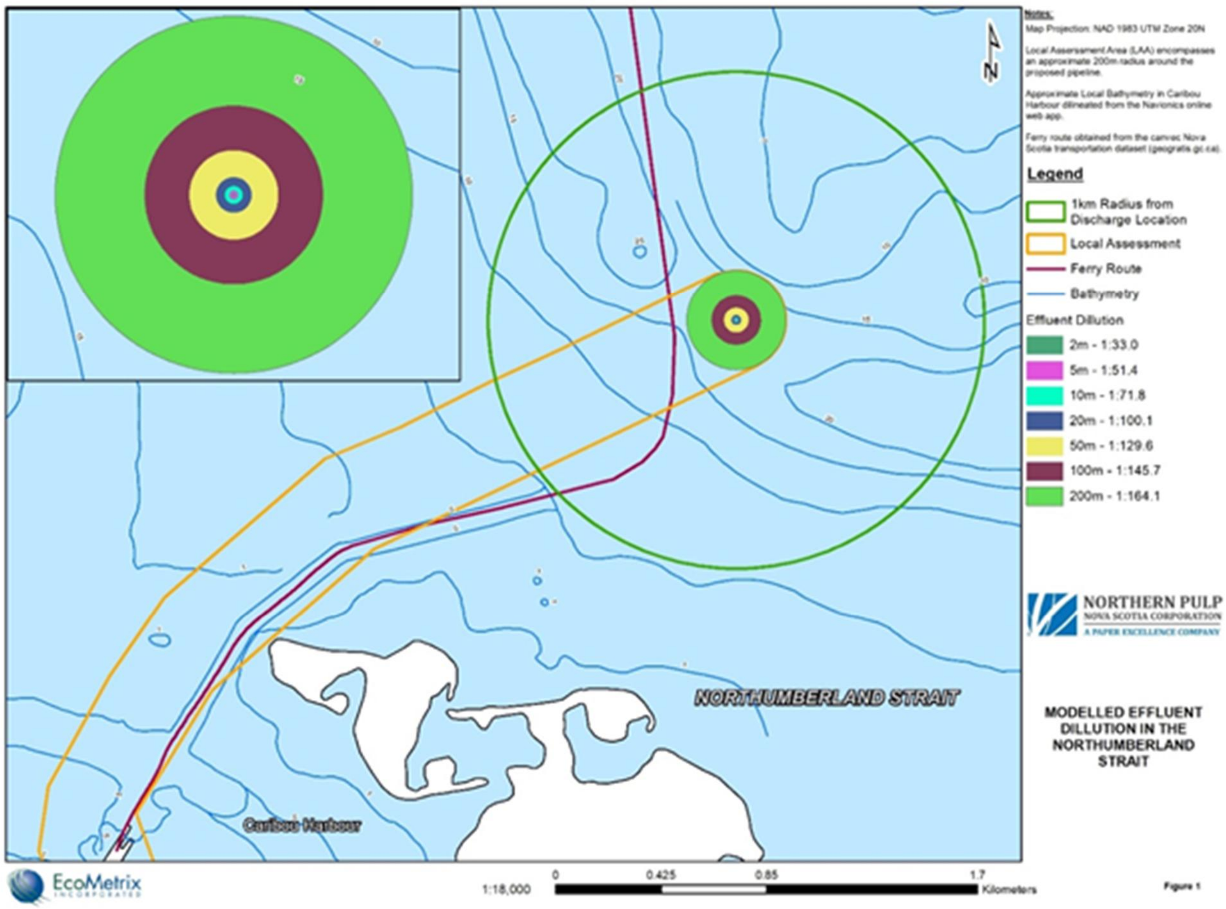
Cormix Model “Run B” - July 2019 Daily Average of Lowest Hourly Velocities (Ambient Velocity at Tidal Conditions, m/s - Max=0.85, Average=0.41)

Calculated using estimated dilution ratios as provided for a representative parameter with 100 mg/L concentration in effluent (Stantec 2019c)

a. Narrative - clear flow - Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d)
b. Narrative - The recommended minimum concentration of DO in marine and estuarine waters is 8.0 mg/L

1. Narrative - The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.
2. Narrative – Interim Guideline - Human activities should not cause changes in ambient temperature of marine and estuarine water to exceed ±1°C at any time, location, or depth. The natural temperature cycle characteristic of the site should not be altered in amplitude of frequency by human activities. The maximum rate of any human-induced temperature change should not exceed 0.5 °C per hour.
3. Narrative – Interim Guideline - Human activities should not cause the salinity (expressed as parts per thousand [‰]) of marine and estuarine waters to fluctuate by more than 10% of the natural level expected at that time and depth.

Figure 7.3-6: Modelled Effluent Dilution in the Northumberland Strait



From the modelling and water quality testing, the majority of COPCs will be at background conditions within less than 5 m of the diffuser outfall. The modelling also indicates the vertical mixing of the effluent plume will counteract immediate interaction with the benthic environment of the receiving environment.

How – Identification of Residual Effects and Mitigation

Residual effects are defined as the non-trivial effects identified through effects assessment where no effective mitigation measures are available or for which mitigation or compensation does not largely or entirely remove the identified effect. Further to identifying a residual effect, the significance of a residual effect is integral to the EA process. How large is this effect? Over what geographic area, duration, and frequency is this effect expected to occur? Is the effect reversible and what is the likelihood of the effect even occurring? Finally, in what does this residual effect mean to the public, the community, government, and Indigenous peoples?

Based on these questions each residual effect was evaluated for significance and determined to not likely be of significance if:

- It is of low magnitude and/or geographic extent; or
- Of short-term duration including residual effects (i.e., the effect itself is of short-term duration); or
- Is likely to occur very infrequently (or not at all) with little potential for long-lasting effects.

From this criteria, each VEC group indicator was evaluated from all different aspects of the project. Ultimately, no significant residual effects were identified. Given the complexity of this assessment, please refer to Table 4-6 in Appendix 7.3 for a detailed explanation of a complete residual effects evaluations. A summary of Table 4-6 from EcoMetrix's report is provided below in Table 7.3-1, and summarizes the key indicator species, potential effects, proposed mitigation measures, and overall residual and significance.

Stakeholder consideration input has identified three key indicator species that warrant further investigation due to their importance in commercial and Indigenous harvests occurring within the LAA: American lobster, rock crab, and Atlantic herring. Each of these fish species spends some part or all of its life cycle within the RAA and LAA. However, with the modelling, mitigative design and following the criteria of evaluation, the exposure of these species whether in adult, juvenile or larval form, will be very short in duration and impact a very small proportion of the overall population.

That being said, further environmental monitoring will be undertaken to confirm the performance of mitigative design and confirmation of lack of significant residual effect.

Table 7.3-2 Summary of Marine Impacts, Mitigation Measures, and Overall Significance

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
Marine Fin-Fish (Benthic Species)				
Winter Flounder, Atlantic Plaice, White Hake (SOCC), Winter Skate (SOCC)	Physical – disturbance to benthic habitat due to the staging, excavation, pipe placement, and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation, and potential change to sediment quality.	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning) • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An Erosion and Sediment Control Plan (ESCP) will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable • Displaced substrate will be recovered to bury portions of the pipeline, wherever practical. • Provision of habitat offsetting, if required.	With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation the use of excavated materials to back-fill trenching (i.e. replace fish habitat), or habitat offsetting if required, the ecological function of the benthic marine environment will be maintained.	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
	Acoustic – potential increase in sound and vibration during construction.	• Marine blasting, if required, will be conducted in accordance with *DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998). • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning)	With implementation of mitigation measures as proposed, including use of timing windows and meeting the requirements of DFO Guidelines the function of the benthic marine environment will be maintained	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Marine Fin-Fish (Migratory Species)				
Atlantic Herring, Atlantic Mackerel, Atlantic Cod, Rainbow Smelt, Atlantic Salmon, Atlantic Striped Bass,	Physical – disturbance to benthic habitat due to the staging, excavation, pipe placement, and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation, and potential	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. spawning) • Work during the construction phase will be	With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation water quality effects minimized. Mackerel harvest areas are generally located outside the RAA	Overall effects are considered to be generally minor, localized and generally reversible

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
American Eel, Atlantic Bluefin Tuna	change to water quality.	scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable • Provision of habitat offsetting, if required.	Herring harvest areas will be directly affected by the pipeline in outer Caribou Harbour and Northumberland Strait	Not Significant
	Acoustic – potential increase in sound and vibration during construction.	• Marine blasting, if required, will be conducted in accordance with *DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters* (Wright and Hopky 1998). • Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages (i.e. migratory period when plentiful in harvest areas)	With implementation of mitigation measures as proposed, including use of timing windows and meeting the requirements of DFO Guidelines the function of the migratory marine environment will be maintained	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life.	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Marine Shellfish (Crustacean)				
Rock Crab	Physical – disturbance to benthic habitat due to the staging, excavation, pipe placement, and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation, and potential change to sediment quality.	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable	Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, yet not at greater depths > 10 m or near the diffuser location. With implementation of mitigation and through offsetting as required, Rock Crab productivity will be maintained	Overall effects are considered to be generally minor, localized and generally reversible

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
		• Provision of habitat offsetting, if required.		Not Significant
	Water Quality – changes to water quality including salinity due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Rock Crab is fished within Caribou Harbour along a majority of the proposed pipeline corridor, yet not at greater depths > 10 m or in the vicinity of the diffuser location therefore no interaction is expected	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Marine Shellfish (Crustacean)				
American Lobster	Physical – disturbance to benthic habitat due to the staging, excavation, pipe placement, and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation, and potential change to sediment quality.	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable • Provision of habitat offsetting, if required.	The Lobster resource and its habitat extent throughout Caribou Harbour and Pictou Harbour and will be directly impacted by the project. However, the areas of Lobster harvest are generally located outside of the LAA. The LAA represents a small proportion of the area with suitable Lobster habitat With implementation of mitigation and through offsetting as required, Lobster productivity will be maintained in the RAA.	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Lobster outfall location	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life. The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment and adult Lobster	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Marine Shellfish (Shellfish)				
Sea Scallop, Soft-Shell, Bar, Razor Clams, Blue Mussel, Oyster, Quahaug	Physical – direct mortality, disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical.	With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential compensation through No Net Loss Plans and/or equivalent offsetting resource productivity will be maintained.	Overall effects are considered to be generally minor, localized and not reversible with respect to the potential loss of shellfish along the corridor and diffuser area and may require compensation (provision of offsetting may be required).

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
		• An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable • Provision of habitat offsetting, if required.		Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Shellfish	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life. The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Plankton (Phyto - & Zooplankton)				
Plankton Diversity and Abundance	Physical – disturbance to benthic habitat due to the staging, excavation, pipe placement, and material backfilling, causing changes to water quality due to increased sedimentation.	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable	With implementation of mitigation measures as proposed, including use of timing windows and consistent monitoring of turbidity and sedimentation, minimized effects to water quality will be realized.	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Benthic Invertebrates				
Benthic Invertebrate Community (abundance, diversity, richness)	Physical – direct mortality, disturbance to benthic habitat due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid	With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential. Re-use of sediment to backfill trench and therefore potential for recolonization within local environment	Overall effects are considered to be generally minor, localized and generally reversible

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
		periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.		Not Significant
	Water Quality – changes to water quality due the discharge of treated effluent to the Strait at the diffuser including reduced salinity and increased water temperature which may influence reproduction, survival and growth of larval and adult Shellfish	• During operation, effluent will be treated to comply with all applicable regulatory requirements for effluent discharge quality. This includes compliance with federal and provincial permit requirements and regulatory requirements such as PPER.	Meeting industry design standards for effluent treatment and design of the effluent diffuser to maximize dilution of effluent in the marine environment, effects will ensure that any changes to water quality in the receiving environment are minimized to a small area (within 5 m of the outfall) at which water quality will meet background or CCME guidelines for the protection of aquatic life. The vertical mixing at the diffuser due to differences in effluent density (i.e. temperature and salinity) will negate interactions of the effluent with the benthic environment	Overall effects are considered to be generally minor, localized and generally reversible Not Significant
Marine Vegetation (Seaweed				
Seaweed	Physical – direct removal, disturbance of vegetation due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality	• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.	Previous studies have not identified abundant seaweed beds along the proposed pipeline corridor or near the diffuser. Any loss of vegetation would be minor in the context of the RAA. Therefore, no residual effect is expected.	Overall effects are considered generally minor, as the effected vegetation will be specific to a small area within the context of the RAA. Not significant
Marine Fish Habitat (vegetation / Cover)				
Eel Grass Beds	Physical – direct removal, disturbance of highly important habitat type for multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling, potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality	• Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Avoid direct removal of eel grass beds where feasible along corridor • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.	Long-term, reversible or largely reversible loss of sensitive fish habitat, which concentrates numerous species	Overall effects are considered generally minor, as the effected vegetation will be specific to a small area within the context of the RAA.

Indicator(s)	Potential Effect	Proposed Mitigation	Residual Effect	Overall Significance
		• Provision of habitat offsetting, if required		Not significant
Marine Fish Habitat (Substrates/ Cover)				
Cobble/rock, Sand / Silt / Gravel	Physical – direct removal, disturbance of existing substrates utilized by multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling, Potential habitat overprinting associated with land-marine pipeline connection, increased sedimentation and potential change to sediment quality	• Work will be staged and incorporate fisheries timing windows to avoid sensitive life stages • Work during the construction phase will be scheduled to the extent practical to avoid periods of adverse weather or spring tides to reduce turbidity and sedimentation. • Duration of in-water work will be managed to the shortest time that is practical. • An ESCP will be developed for the site that reduces the risk of sedimentation to the marine environment and additional mitigation measures identified as applicable.	With implementation of mitigation measures, as proposed including those to reduce turbidity and sedimentation and potential. Re-use of existing sediment and rock to backfill trench and therefore potential for recolonization within local environment	Overall effects are considered to be generally minor, localized and generally reversible
		• Provision of habitat offsetting, if required		Not Significant

7.4 Updated Environmental Effects Monitoring Program

Submit an updated Environmental Effects Monitoring (EEM) program based on the results of various relevant baseline studies and an updated receiving water study. Refer also to Addendum item 4.0.

EEM is a science based performance measurement tool used to evaluate the adequacy of effluent regulations in protecting environmental resources. The Government of Canada states that EEM studies are conducted by industries to identify potential effects caused by effluents on fish habitat, fish, and usability of fisheries resources (https://www.canada.ca/en/environment-climate-change/services/managing-pollution/environmental-effects-monitoring.html).

The federal department of ECCC develops Technical Guidance for EEM to assist mills on how to fulfill the regulatory requirements for EEM. The guidance includes methodologies on how to carry out EEM studies and requires studies to be conducted on a regular basis (typically on a cycle of once every three years). The EEM guidance documents will continue to be adhered to, and consultation with ECCC and other relevant parties will continue, as has been conducted during previous EEM cycles.

EcoMetrix Incorporated has been retained by NPNS to implement the last number of cycles for the federal EEM program at its mill. There have been eight cycles completed to date related to the existing BHETF.

The proposed EEM investigations related to the NPNS Caribou Harbour outfall relocation was provided by EcoMetrix Incorporated as part of the original EARD (Appendix G of the EARD)(EcoMetrix, 2018a) and remains relatively unchanged based on the various baseline studies and the updated RWS. As noted in EARD EcoMetrix EEM report, the Federal PPER (SOR/92-269) impose various requirements on pulp and paper mills, including, for example:

- installing, maintaining and calibrating monitoring equipment, and keeping records of that equipment;
- monitoring effluent;
- submitting monthly reports containing effluent monitoring results and production information;

- notifying an inspector of a test result that indicates a failure or non-compliance with the Regulations;
- submitting identifying information;
- preparing, and updating annually, a remedial plan describing the measures to be taken by the operator to eliminate all unauthorized deposits of deleterious substances in the case where effluent fails an acute lethality test;
- preparing an emergency response plan and making it readily available on-site to persons who are to implement the plan;
- providing information related to the Reference Production Rate (RPR);
- submitting information on outfall structures and depositing effluent only through those outfall structures;
- complying with requirements for EEM studies;
- keeping records available for inspection;
- requesting an authorization to combine effluents; and
- providing written reports and additional sampling for the deposit of a deleterious substance in water frequented by fish that is not authorized under the *Fisheries Act*, which results or may result in detriment to fish, fish habitat or the use of fish by humans.

The amended PPER (2018) also prescribed effluent discharge quality criteria that limit the discharge of TSS, BOD and the acute lethality of effluent. In addition, the amended PPER (2018) prescribed that all mills were required to participate in an EEM program.

The EEM program studies are designed to detect and measure changes in aquatic ecosystems into which treated mill effluents are released (i.e., "receiving environments"). The pulp and paper EEM program is an iterative system of monitoring and interpretation phases that is used to help assess the effectiveness of environmental management measures, by evaluating the effects of effluents on fish, fish habitat, benthic communities, and the use of fisheries resources by humans. The EEM program goes beyond end-of-pipe measurement of chemicals in effluent, to examine the effectiveness of environmental protection measures directly in aquatic ecosystems. Long-term effects are assessed using regular cyclical monitoring and interpretation phases designed to assess and investigate the impacts using repeat parameters and locations. In this way, both a spatial characterization of potential effects and a record through time to assess changes in receiving environments are obtained. EEM studies consist of:

- Sublethal toxicity testing of effluent to monitor effluent quality (PPER section [s.] 29); and
- Biological monitoring studies in the aquatic receiving environment to determine if mill effluent is having an effect on fish, fish habitat or the use of fisheries resources (PPER s. 30).

Within the regulations, there are provisions for the removal of the requirements for specific study components of the EEM program based on the dilution of effluent to <1% of that initially discharge. If the mill demonstrates that the effluent concentration is <1% at a distance of 250 m, then the EEM does not require a fish community study component. Likewise, if the mill demonstrates that the effluent concentration is <1% at 100 m from the discharge, then a benthic invertebrate community study is not required. At present, the three-dimensional (3D) modelling of the area in the local study area as part of the updated RWS indicates that dilution to less <1% effluent will occur at approximately 20 m from the discharge location (Stantec, 2019).

The predictions in the most recent RWS indicate there will be no requirement for NPNS to conduct either a fish community or benthic community study near the discharge. These predictions of effluent dilution will need to be confirmed as part of the first EEM study to determine the final components required as part of the EEM. If confirmed, there is no regulatory requirement for any further field investigations as part of the EEM program unless there is a major change in discharge volume. As part of the EEM, the mill will continue to be required to conduct: acute and sublethal toxicity testing, effluent parameter analysis, and reporting, and be subject to the PPER. Although not regulated as part of the PPER, some the fish and benthic component studies are still warranted as part of the EA Follow-up and monitoring program that is described original EARD (EcoMetrix, 2018b) and it is intended that they will be completed by a third party consultant for the current project.

7.5 Contingency Measures

Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shutdown periods.

Controlling untreated effluent temperature within the mill is necessary to optimize microbiological growth in the AST system, which ensures that treatment processes can occur. Additionally, by controlling the temperature within the mill, potential temperature swings in the final treated effluent leaving the replacement ETF are also limited. Effluent temperature is expected to fall within the range of 25-37°C at the outfall location, as discussed in detail in Section 3.1 of the Focus Report, with the lower end of the range primarily attributed to winter heat loss in the system and downstream piping, after the microbiological treatment. These temperature changes are seasonal in nature and occur over the course of several months from summer to winter and again from winter to summer. Further, due to the large volume of water in the effluent treatment system (in the primary clarifier, the treatment reactors, and two secondary clarifiers), any incoming changes in effluent temperature at the front end of the ETF would be dampened and significantly eliminated in the final effluent.

Treated effluent at the diffuser will vary in temperature between 25-37°C over the course of a six-month period. The following contingency measures are in place to mitigate thermal shock:

- Design aspects of the ETF: such as temperature control by plant operators, the large volume of water which dampens temperature swings, and slow seasonal changes (environmental temperature changes slowly over the season), all help to minimize any thermal shock to marine life at the outfall by resulting in temperature changes occur over months, that are not rapid.
- Contingency measures will be part of the SOPs and will cover a wide range of operating scenarios that will eliminate the likelihood of rapid fluctuations in effluent temperature. SOPs will include a wide variety of operating scenarios including production variability, loss of electrical power, and annual maintenance outages and resumption of mill production.

- The engineered outfall (i.e., the diffuser) is designed to eliminate potential thermal impacts to the receiving water, and will meet the CCME Marine Aquatic Life (MAL) guidelines for temperature that were developed to be protective of Canadian receiving environments.

7.5.1 System Temperature and Control

Temperature control of the effluent prior to biological treatment is essential in an AST system, much more so than in an ASB system like the existing BHETF. The proposed effluent cooling system for NPNS's replacement ETF will use cooling towers in a closed-loop cooling system design (with shell-and-tube heat exchangers). The overall effluent cooling system has been sized at maximum effluent flow and temperature in summer conditions, when effluent and raw water temperatures are at their highest and when evaporative cooling in the cooling towers is limited because of the prevailing weather conditions (i.e., higher ambient temperatures and humidity during summer). The modular design of the system, with multiple heat exchangers and cooling tower units, allows the mill to shut down individual units in order to limit effluent temperature fluctuations.

Controlling untreated effluent temperature is necessary to optimize microbiological growth in the AST system. In doing so, it also limits temperature swings in the final treated effluent leaving the ETF. Effluent temperature is expected to fall within the range of 25-37°C at the outfall location, as discussed in detail in Section 3.1 of the Focus Report, with the lower end of the range primarily attributed to winter heat loss in the system and downstream piping after the microbiological treatment. These temperature changes are seasonal in nature and occur over the course of several months from summer to winter, and again from winter to summer. Further, due to the large volume of water in the primary clarifier, the treatment reactors, and two secondary clarifiers within the ETF, any incoming changes in effluent temperature at the front end of the ETF would be dampened and significantly eliminated in the final effluent.

Over the course of day-to-day operations with designed temperature control, the large inherent capacity of effluent in the replacement ETF, and the small zone of influence around the diffuser (See Section 4.2 of the Focus Report), thermal shock to the receiving environment and marine life at the effluent discharge are unlikely to occur.

7.5.2 Operational Procedures

The replacement ETF facility will be controlled by well-trained operators who will rely on SOPs to be developed during the project. SOPs will include a wide variety of operating scenarios including production variability, loss of electrical power, and annual maintenance outages and resumption of mill production.

7.5.2.1 Low Production

During periods of low production, it is most likely that effluent flow and temperature will remain close to normal operating conditions in terms of flow and temperature. Temperature control of the effluent will still occur. There will, however, be less loading entering the treatment system and operators will take action to reduce nutrients and other parameters according to incoming effluent quality. There will be no appreciable change in temperature of final effluent compared to steady day-to-day operation. Low production will not create significant or rapid fluctuations in effluent temperature.

7.5.2.2 Loss of Power

In the event of loss of power, untreated effluent will be diverted to the spill basin, as discussed in Section 3.4 of the Focus Report. It should also be noted that the ETF plant itself will have a dedicated diesel generator back-up power supply to run critical equipment and instrumentation to keep portions of the ETF process operational. The emergency power supply includes one final treated effluent pump. Operators will make the decision to stop the effluent flow according to SOPs for a prolonged outage, or possibly not at all for a short interruption. Changes in effluent flow will be reduced in a stepwise fashion from multiple pumps operating, to one pump operating, then to an orderly full shutdown if deemed necessary. Effluent flow is unlikely to stop suddenly (i.e., for many hours) and will not introduce large or rapid fluctuations in effluent temperature.

7.5.2.3 Annual Maintenance Shutdowns and Resumption of Production

SOPs will be developed specifically addressing annual maintenance shutdowns and start-ups. Annual shutdowns occur in the warmer seasons, usually spring or fall. During annual maintenance shutdowns, the ETF system will typically remain operational to treat any wastewater that might be generated during maintenance operations, and the outfall will remain discharging. Procedures will be in place to keep the ETF system as warm as possible. SOPs will help ascertain the health of the microbiology population to ensure that the system is fully viable. Annual maintenance shutdowns and resumption of production will not induce large or rapid temperature fluctuations in the receiving waters surrounding the outfall.

7.5.3 Engineered Diffuser Outfall

Effluent outfall designs have changed significantly over the years, evolving from open-ended pipes to engineered diffuser ports with multi-port risers and valves designed to provide jet-like turbulence at the ports to promote mixing of the effluent with the background receiving environment. As discussed in Section 4.2 of the Focus Report, jet mixing and buoyancy due to temperature differences are the primary drivers that promote mixing in the near-field RWS model. The diffuser valves are designed to create high velocity at the discharge, and combined with temperature differences between effluent and background waters, ensure buoyancy of the plume over the entire range of effluent temperature, in both summer and winter.

The diffused outfall and mixing zone are discussed in the RWS in Section 4.2 of this Focus Report. Potential thermal impacts of treated effluent on the receiving environment were modelled for both summer and winter effluent temperature in the near-field modelling. In both summer and winter, the outfall is effective in diffusing the temperature effects of effluent. The CCME MAL guideline (<1 °C differential) is met within 2 m of the outfall. Near-field modelling (using the CORMIX model) shows that the warm effluent quickly mixes with ambient water and the effluent temperature exponentially drops within several metres from the diffuser. In fact, at the end of the mixing zone at 100 metres from the outfall, the receiving water is only 0.1°C above background. The zone within which temperature could have an impact on fish is extremely small. Hot or cold zones will not occur in the Northumberland Strait near the outfall whether effluent is flowing or not.

8.0 FLORA AND FAUNA

8.1 Plant Baseline Survey

Complete a plant baseline survey along the proposed realigned effluent pipeline route.

Dillon completed a baseline plant survey along the proposed realigned treated effluent pipeline route. During the survey, plants that were present along the route were identified and recorded by a specialist plant biologist. Table A8.1-1 and Figure 8.1-1 show the habitat types that were identified along the proposed pipeline route. Appendix 8.1 provides more details on the specific types of plants found along realigned treated effluent the pipeline route. Representative photos from the types of plant habitats that were identified along the land-based portion of the realigned pipeline route are shown below:


Wooded/Forested


Developed


Agricultural Fields


Wetlands


Road Corridor/Ditch


Marine/Coastal

Tables A8.1-1 and A8.1-2 in Appendix 8.1 provide lists of all the plants identified in the baseline plant survey. Most of the plant species identified during field surveys have secure populations (common, widespread, and abundant) within the Province of Nova Scotia, or are exotic species (i.e., not native to the Province). Appendix 8.1 also provides information on priority plants observed during the field surveys. Priority plants are plants that are listed under the *Species at Risk Act* (SARA), the Nova Scotia *Endangered Species Act* (NS ESA), or have rankings of S1 (extremely rare in the Province) to S3 (uncommon in the Province) by the Atlantic Canada Conservation Data Centre (AC CDC). During the plant surveys, three rare lichen species and two mosses (one ranked S1 for extremely rare and one ranked S3 for uncommon) were identified. Details on the five priority species observed during the field surveys are presented in Appendix 8.1; Section 8.1.5.

Northern Pulp Nova Scotia Corporation
Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Approximate Project Footprint Area*	Cut Over (Varying Stages of Regeneration)	Wetland	Developed
Approximate Diffuser Location	Old Field/Pasture	Open Water	Dunes/Cliffs
Wooded	Agriculture	Beach	

Habitats Along the Proposed Pipeline
Figure 8.1-1

NORTHERN PULP NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pulp Nova Scotia, GeoNova, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

*Precise Project Footprint to be determined following completion of detailed design

0 250 500 1,000 Meters

PROJECT: 17-6461

Date: 2019-09-26

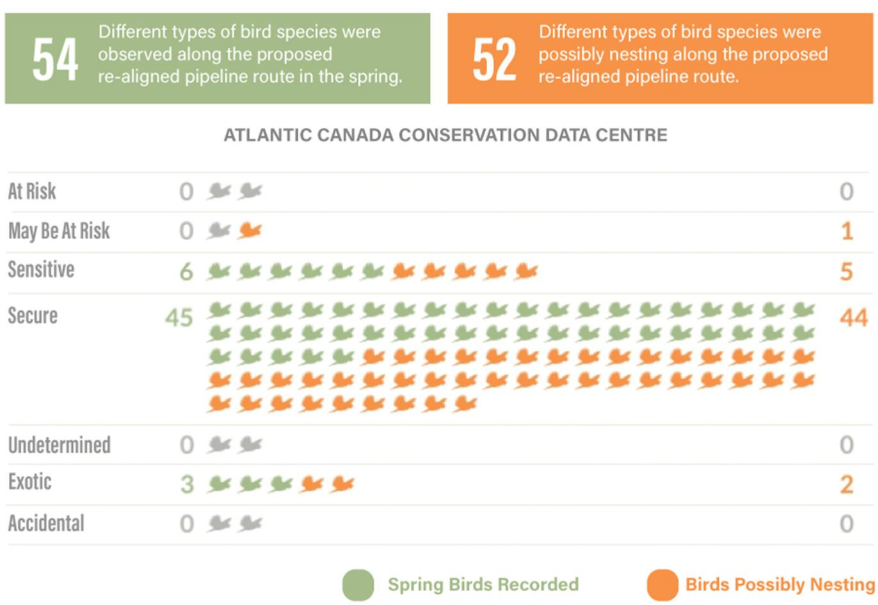
8.2 Migratory Bird Survey

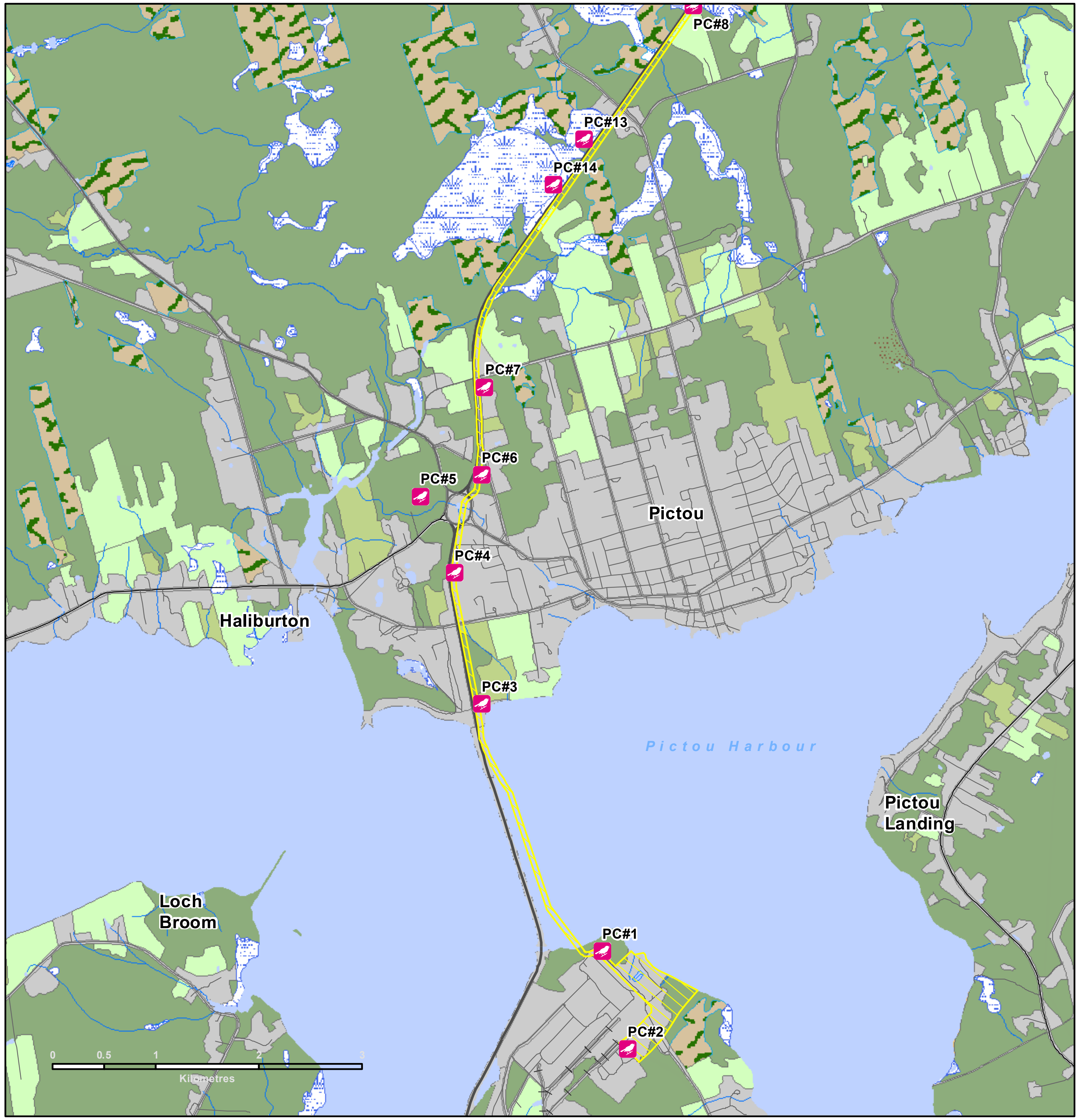
Complete a migratory bird survey along the realigned pipeline route.

Dillon completed a migratory bird survey program along the proposed realigned effluent pipeline route. During the survey, migratory birds that were spotted potentially nesting or migrating through during the spring along the route were identified by species and number of individuals, which were recorded by biologists. Figure A8.2-1 from Appendix 8.2 shows the location of the bird surveys that were completed. Appendix 8.2 provides more details on the specific types of migratory birds found along the pipeline route.

Potential priority birds were reviewed in the EARD. In general, the potential priority bird species remain the same for the revised project route as they were for the original pipeline route assessed in the EARD. The 2019 migratory bird survey program did not identify any additional potential habitat for priority birds (beyond those listed in the EARD). The proposed realigned treated effluent pipeline route is within an area that was previously, and continues to be, a highly disturbed habitat (due to construction, maintenance and noise from roadways, commercial areas, and agricultural activities). Figure 8.2-1 below summaries one of the population status systems used to in the migratory birds Appendix 8.2.

Figure 8.2-1: Summary of Migratory Birds Observed and Their ACCDC Status





Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment- Focus report

Bird Point Count Locations
Figure 8.2-2

Bird Survey Point Count Locations	Cut Over (Varying Stages of Regeneration)	Developed	Dunes/Cliffs
Approximate Project Footprint Area*	Old Field/Pasture	Open Water	Beach
Wooded	Agriculture	Wetland	

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-09-26

8.3 Bird Baseline Survey

Complete a bird baseline survey for Common Nighthawk, Double-crested Cormorants, owls, and raptors and raptor nests, for the entire project area which includes the realigned pipeline route.

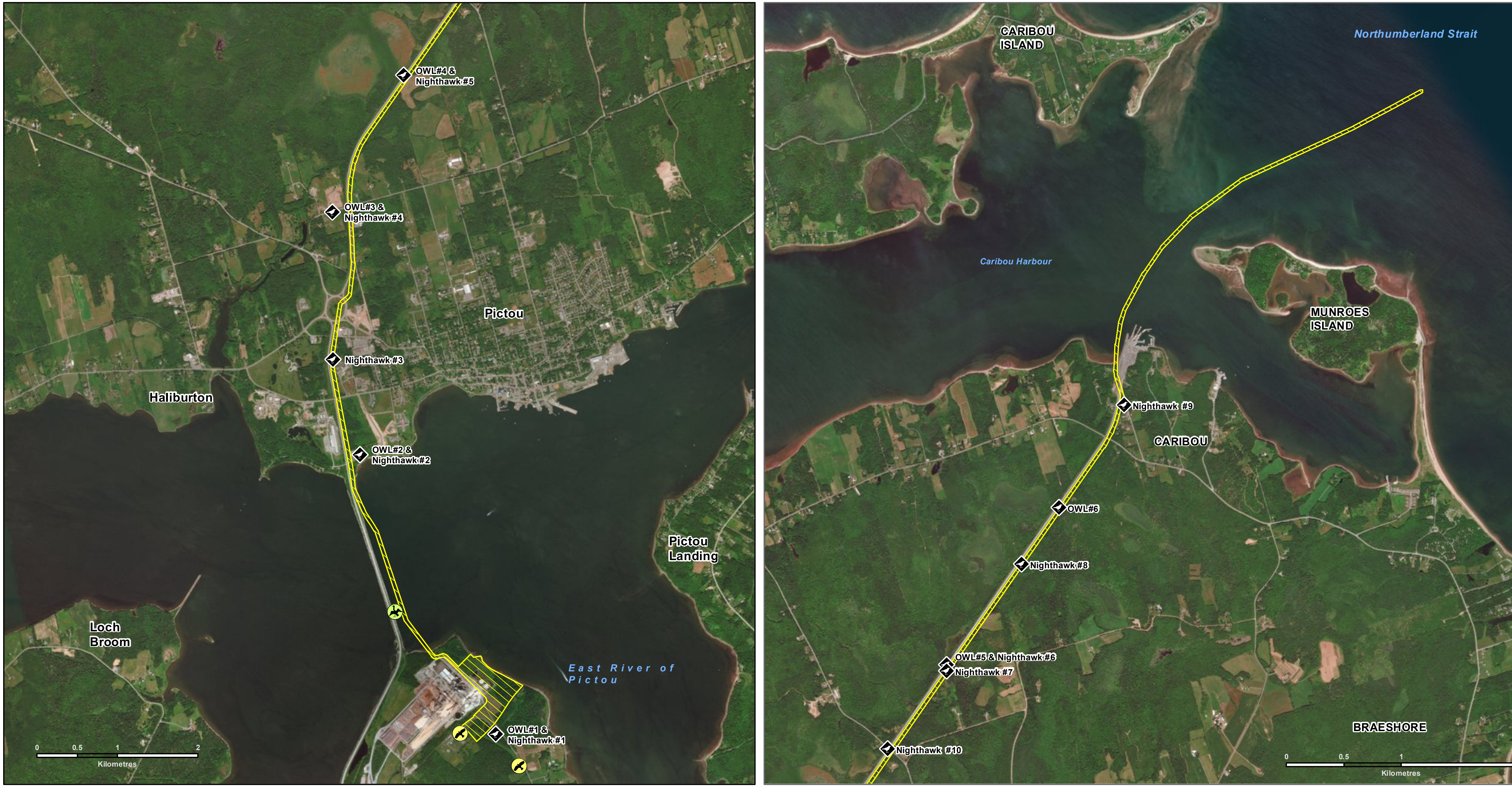
Dillon completed a baseline bird survey along the proposed project area including the realigned treated effluent pipeline route for Common Nighthawk, Double-crested Cormorants, owls, raptors, and raptor nests. During the survey, birds or nests that were spotted along the route were identified and recorded by specialist biologists. Figure A8.3-1 shows Common Nighthawk, Double-crested Cormorant, owl, and raptor survey locations along the proposed realigned pipeline route. Appendix 8.3 provides more details on the survey methods and types of birds found along the pipeline route.

Table 8.3-1 below summarizes the baseline bird survey for the individual species and species groups listed above.

Table 8.3-1: Summary of Baseline Bird Survey Results

Bird	# Birds Counted	Location ID (See Figure A8.3-1)
Common Nighthawk	1 2	Nighthawk #3 Nighthawk #5
Double-crested Cormorant	1245	Double-crested Cormorant Colony
Owls	2 1 2	Owl #3 (Barred Owl) Owl #5 (Great Horned Owl) Owl #6 (American Woodcock)
Raptor Nests	2	Osprey Nests

Photo: Double-crested Cormorant Colony Located on the East Side of the Highway 106 Causeway (Taken June 10, 2019)



Nocturnal Bird Point Count Locations

Project Footprint Area*

Active Osprey Nests

Double-crested Cormorant Colony

Northern Pulp Nova Scotia Corporation

Replacement Effluent Treatment Facility
Environmental Assessment - Focus Report

Nighhawk,Owl, Double-crested Cormorant and Raptor Survey Locations
Figure 8.3-1

NORTHERN PULP
NOVA SCOTIA CORPORATION
A PAPER EXCELLENCE COMPANY

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Northern Pup Nova Scotia, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: SLD
MAP PROJECTION: NAD 1983 UTM Zone 20N

*Precise Project Footprint to be determined following completion of detailed design

PROJECT: 17-6461

Date: 2019-10-01

8.4 Herptile Survey

Complete a herptile survey for the Project area which includes the realigned pipeline route.

Dillon completed a baseline herptile survey along the proposed realigned treated effluent pipeline route. Herptile is a word for a reptile (such as snakes and turtles) or amphibian (such as frogs). During the survey, herptiles and their habitat that were present along the route were identified and recorded by biologists. Figure 8.3-1 summarizes the types of herptiles and habitat that were identified along the proposed realigned pipeline route. Appendix 8.4 provides more details on the survey methods and types of herptiles and herptile habitat found along the pipeline route.

Table 8.4-1: Categories of Herptiles Identified Along the Proposed Realigned Pipeline Route

Herptiles	Photo	Summary
Snakes		The only snake species observed was the common garter snake. Snakes were found in four wetlands and within ditches near Highway 106.
Frogs		In total, five frog species were observed during herptile surveys conducted in 2019: • American Bullfrog • Green Frog • Northern Leopard Frog • Spring Peeper • Wood Frog During the earlier surveys (May and June 2019), amphibian eggs and tadpoles were observed in several wetlands with ponded water, as well as the relatively stagnant, backchannels of some watercourses.
Turtles		No turtles were observed in 2019; however, observations of potential turtle habitat (i.e., nesting, foraging, overwintering) which includes freshwater bodies with high plant cover; as well as roadsides and fields near freshwater sources were observed.

Note: Species observed have secure populations in Nova Scotia

9.0 HUMAN HEALTH

9.1 Baseline Study Marine Survey

Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.

EcoMetrix has initiated the HHRA and it is currently ongoing; however, its completion is not anticipated until spring of 2020.

As a component of the Human Health Risk Assessment (HHRA), baseline tissue analysis (initial round - June to July 2019) has been completed by Ecometrix Incorporated for representative key marine species important for commercial, recreational and Aboriginal fisheries. Samples were collected in the vicinity of the proposed outfall discharge from the project and included:

- American lobster;
- Rock crab; and
- Quahogs (a shellfish species).

Fish and shellfish specimens were collected for tissue analysis with the assistance of members of the local First Nations based on availability and potential to be consumed.

Fish and shellfish tissue that are likely to be consumed by humans were analyzed by an independent accredited laboratory for:

- Total phenols;
- Total metals contents;
- Low level and methyl mercury;
- PAHs;
- Lipids; and
- Dioxins and Furans.

Appendix 9.1 provides the laboratory results of the analyzed tissue sample and additional information on the relevance of the analyzed parameters is provided in Appendices 2.3, 2.4, and 3.3.

A highlighted result is that arsenic levels in the majority of samples analyzed exceeded the Canadian Food Inspection Agency (CFIA) edible guideline. However, Health Canada has acknowledged that the form of arsenic rather than the absolute concentration is the main contributor to potential human health risks associated with the consumption of food (e.g., fish tissue) containing arsenic. Organic forms of arsenic that comprise the majority of the arsenic concentrations in fish and shellfish are recognized to pose a lower potential for adverse effects to human health compared to inorganic arsenic. Despite the exceedance of the guideline, the elevated levels of arsenic currently reported are anticipated to pose a negligible potential for adverse effects to human health.

EcoMetrix plans on conducting up to two additional rounds of tissue collection prior to beginning construction targeting additional shellfish (scallop, blue mussel and oyster), and locally relevant fish (such as Atlantic striped bass, Atlantic mackerel and Atlantic herring).

9.2 Human Health Risk Assessment

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 analysis must inform the identification of contaminants of concern and updating of the RWS.

9.2.1 Summary

Part of the replacement ETF project involves the preparation of a HHRA to estimate the potential health risks to people associated with the release of contaminants into local air and the seawater in the vicinity of the effluent discharge point. HHRAs estimate the potential for adverse effects to human health by using measured or estimated concentrations of contaminants of potential concern (COPCs) in areas and media where people can come in contact with the COPCs. HHRAs quantify a predicted exposure against standards of recognized safe levels. If there is no possible pathway of exposure to a chemical, regardless of how toxic it might be within a given medium, there is no potential for the development of adverse human health effects from that chemical.

EcoMetrix will be studying air impacts within an approximate 8 km radius around the NPNS facility and within a 5 km radius around the proposed location of the effluent diffuser, which is considered standard practice. EcoMetrix have already completed their identification of COPCs from a list of over 300 COPCs. The potential concentrations of between 37 and 44 COPCs will be modelled in air and seawater to assess their potential for adverse effects to human health via their applicable exposure pathways. First Nations, the local population, and commercial fishermen's exposure will be assessed by examining the following exposure pathways:

- Outdoor/Indoor air inhalation;
- Seafood ingestion;
- Skin contact with seawater and ocean sediments;
- Incidental ingestion of sediments; and
- Incidental ingestion of suspended sediment in surface water.

9.2.2 Requirement for a HHRA from the Government

NSE directed NPNS on April 23, 2019 to ...

> "*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 analysis must inform the identification of contaminants of concern and updating of the RWS*."

9.2.3 What Is an HHRA?

An HHRA is a tool which is used by health and environmental experts to estimate the nature and probability of negative health effects in humans who may be exposed to contaminants in their local receiving environment. This typically includes exposure through local air quality, drinking water, food sources and any other identified unique paths. An HHRA is undertaken in several steps:

1. Determine what emission or discharge sources will be included in the scope of the study and what size the local study area should be.
2. Determine ways in which humans can be exposed to COPC from those sources in the study area.
3. Determine actual COPCs leaving those sources.
4. Determine locations of human populations within the local study area.
5. Measure or estimate the level of concentration of all COPCs across the study area.
6. Assess the level of human exposure to all COPCs as a combination of both levels of concentration and duration of exposure and compare those figures to established standards of recognized safe levels of exposure.

9.2.4 Who Is Doing the HHRA?

EcoMetrix has been hired by NPNS to complete the HHRA as part of the requirements of the project. EcoMetrix's licensed professional engineers and health experts are using air dispersion models that have been developed for the project by Stantec as well as effluent dilution models that have been developed by Stantec.

9.2.5 Scope and Area of Focus

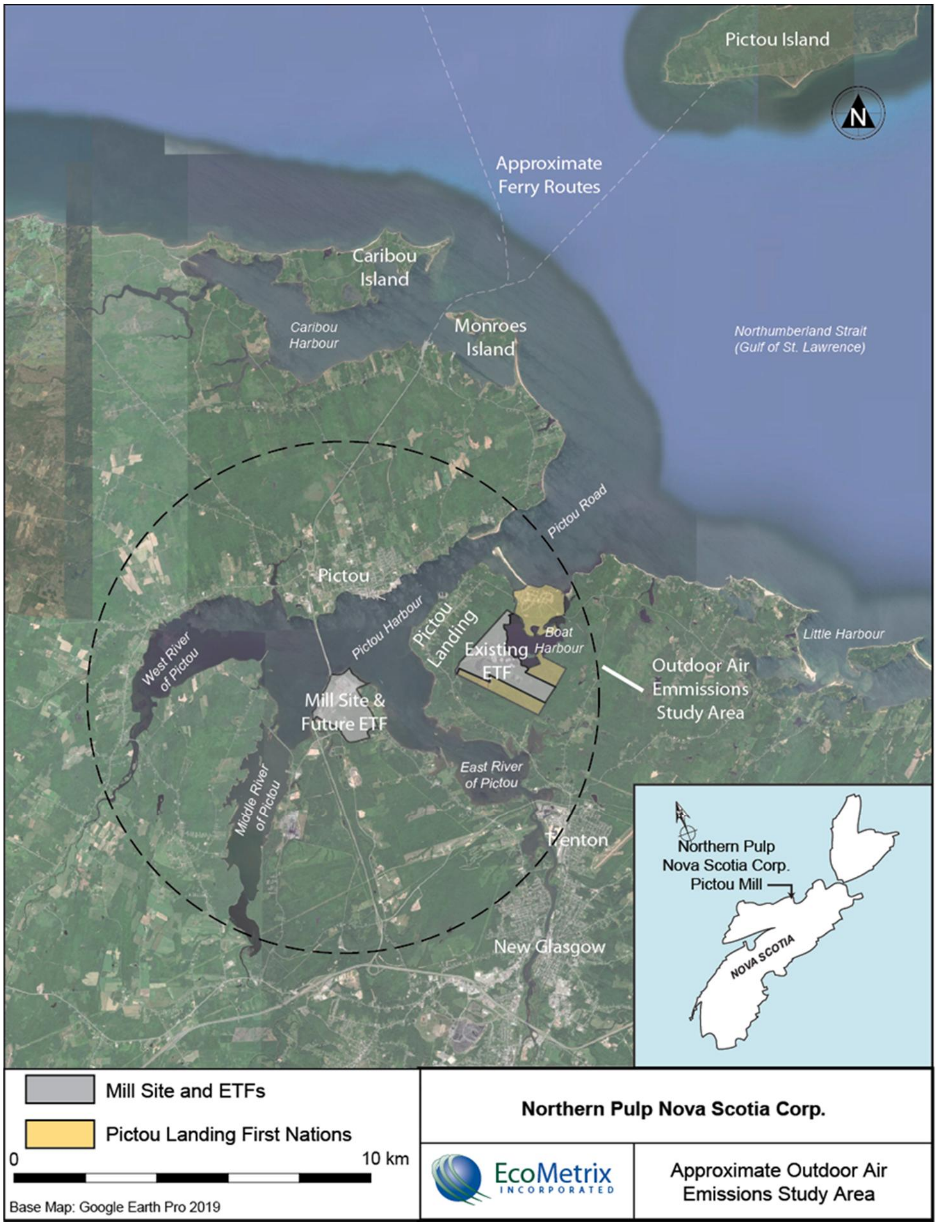
This HHRA will follow a standard risk assessment approach as defined in the Detailed Quantitative Risk Assessment guidance from Health Canada. The objective of the HHRA will be to characterize and evaluate potential health risks to human receptors from exposure to emissions from the new replacement ETF. This includes exposure from the air emissions from the burning of sludge in the power boiler and effluent discharge into the Northumberland Strait.

For the air emissions exposure pathway, only outdoor air inhalation by humans within the future dispersion area of the boilers and the replacement ETF will be considered as indoor air quality is not significantly impacted. For the future effluent discharge exposure pathway, an approach will be taken to consider exposure from all relevant environment components like as water, sediment, and sea food ingestion.

9.2.5.1 Air Emissions Study Area for the HHRA

An air dispersion model has been completed to support the Focus Report. This model will be relied upon for the HHRA to define the areas potentially affected by air emissions from the new treatment plant. In general, the Air Emissions Study Area will have a boundary surrounding the mill where the air emissions are indistinguishable from background air quality. This area is the shape of a circle and has an approximate radius of 8 km around the mill.

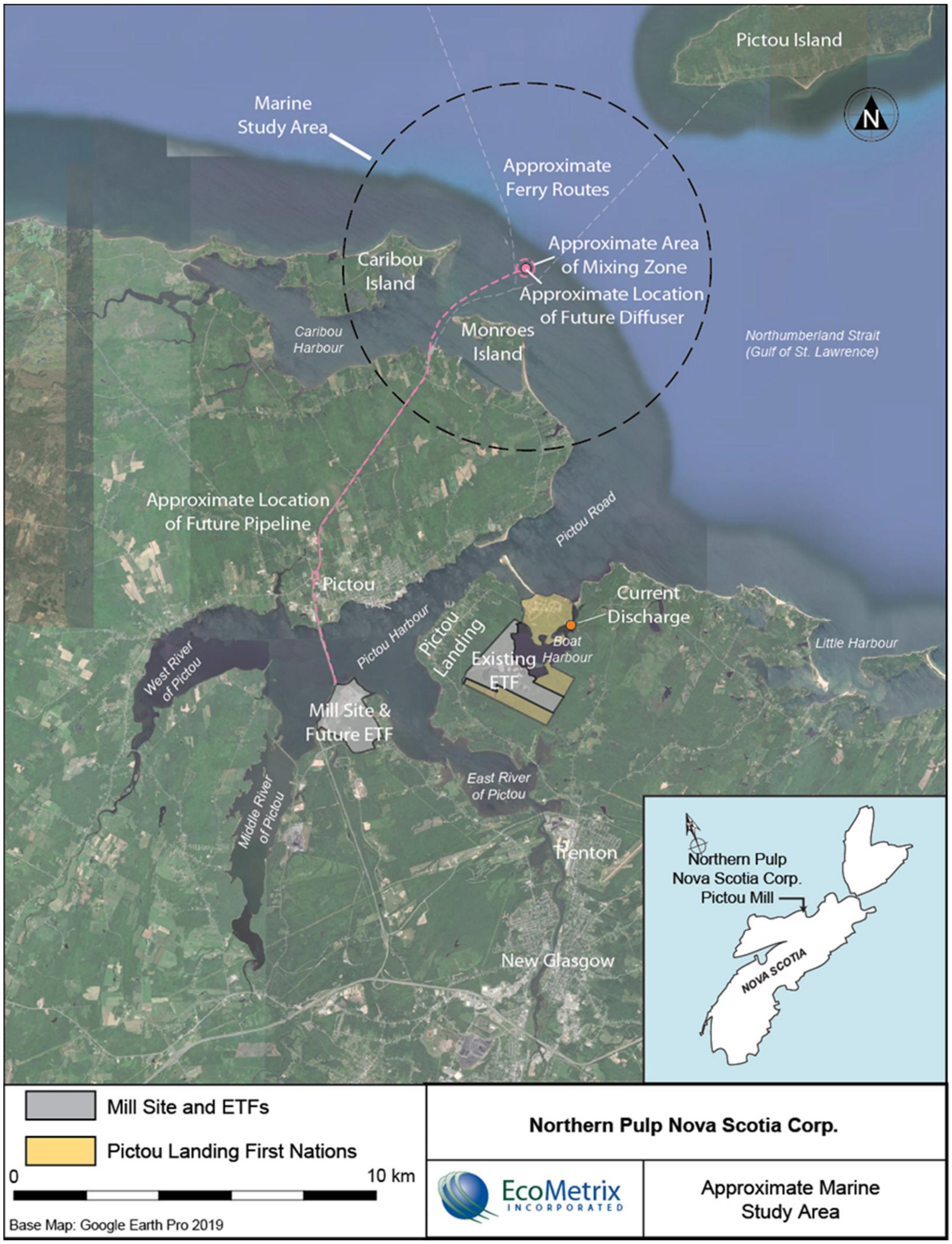
Figure 9.2-1: Approximate Outdoor Air Emissions Study Area



9.2.5.2 Effluent Discharge Study Area for the HHRA

The HHRA will consider a Marine Study Area of a 5 km radius around the future diffuser. This Marine Study Area is conservative as the potential exposure to effluent parameters above background levels are likely only within 2% of this area. The water depth is approximately 20 m at the diffuser and it is anticipated that the effluent will not come into contact with sediment within the mixing zone.

Figure 9.2-2: Approximate Marine Study Area



9.2.6 Identifying HHRA Contaminants of Potential Concern

There are two sources of contaminants of potential concern that will be considered:

7. Atmospheric emissions from the mill due to use of biosludge from the future ETF as fuel for the biomass boiler, as well as fugitive emissions from the new ETF.
8. Marine discharge comprised of treated effluent released to the Northumberland Strait offshore of Caribou Point through an engineered diffuser.

9.2.7 Air Contaminants

EcoMetrix conducted a screening process to identify airborne COPC in the air emissions from the project. 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 identified by Stantec in their air dispersion modelling study. Fifty-seven of these parameters were identified in the screening process as deeming further study. All of these parameters either exceeded background outdoor air quality concentrations or did not have background outdoor air quality concentrations available. When compared to air quality criteria, nine parameters exceeded air quality criteria and became air emission COPCs for the project (Table 9.2-1). Criteria are still under consideration for seven 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 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, 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.

Table 9.2-1: COPCs Identified in Air

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

9.2.8 Effluent Contaminants

KSH Consulting reported that the current treated effluent is a reasonable example of the future treated effluent and that the current treated effluent is also comparable to other pulp mills' effluent. Further they said that the future ETF is expected to have similar performance to other pulp and paper mills' treatment systems in Canada. The effluent will be diluted quickly within the receiving water and marine life or humans will be exposed to much lower concentrations than the values to be used for screening and ultimately the HHRA.

EcoMetrix conducted a screening process to identify waterborne COPCs in the future treated effluent. Parameters analyzed in current effluent samples collected from the current ETF were used as the initial list of candidate parameters.

For the seafood ingestion 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 estimated. The screening process for seafood ingestion is protective of fish and shell fish ingestion. According to the commercial harvest areas, 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 conducting a food intake survey, and 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.

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 guidelines was considered to have potential for tainting of seafood and was retained as a contaminant of potential concern to be assessed in the HHRA with respect to tainting.

The initial parameter list included over 300 parameters based on samples provided by NPNS to an independent, third party laboratory. Parameters that are not of human toxicological concern were removed. Overall, parameters were considered waterborne COPCs if:

1. They had concentrations greater than the median background concentration based on samples from the proposed diffuser area; and
2. The maximum effluent concentration exceeded water guidelines for seafood ingestion or recreational use or seafood tainting.

A summary of effluent COPCs that will be used in the HHRA is shown below in Table 9.2-2.

Table 9.2-2: Summary of COPCs carried through in 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	N/A	No
1,2,3,7,8,-Penta CDD	Yes	N/A	No
1,2,3,4,7,8-Hexa CDD	Yes	N/A	No
1,2,3,6,7,8 Hexa CDD	Yes	N/A	No
1,2,3,7,8,9-Hexa CDD	Yes	N/A	No
1,2,3,4,6,7,8,-Hepta CDD	Yes	N/A	No
2,3,7,8-Tetra CDF	Yes	N/A	No
1,2,3,7,8-Penta CDF	Yes	N/A	No
2,3,4,7,8-Penta CDF	Yes	N/A	No
1,2,3,4,7,8,-Hexa CDF	Yes	N/A	No
1,2,3,6,7,8- Hexa CDF	Yes	N/A	No
2,3,4,6,7,8-Hexa CDF	Yes	N/A	No
1,2,3,7,8,9-Hexa CDF	Yes	N/A	No
1,2,3,4,7,8,9,-Hepta CDF	Yes	N/A	No
Polycyclic Aromatic Hydrocarbons			
Phenanthrene	Yes	No	No
Volatile Organics			
Ethylene Dibromide	No	Yes	No
Phenols			
Catechol	No	No	Yes
2-Cholrophenol	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

9.2.9 Locations of Human Populations for the HHRA

A conservative approach has been taken in the selection of human receptors to ensure that the key receptors with the highest frequency and duration of exposure will be included in the HHRA. These groups include First Nations communities, residents, and commercial fisheries workers. Communities include Pictou Landing directly east of NPNS, adjacent to Boat Harbour and across the inlet in the Town of Pictou.

The general population are assumed to participate in seafood consumption and in recreational activities such going to the beach, swimming and fishing in the Marine Study Area. They also live within the Air Emissions Study Area. Since toddlers are the most sensitive age group due to their exposure characteristics, they will be used to evaluate risks to the public exposed to non-carcinogenic COPCs. A lifetime, composite human receptor will be used to evaluate risk for all residents exposed to carcinogenic COPCs.

Commercial fisheries workers 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.

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 exposures (shown above) have far higher exposure frequency and duration than the recreational user.

The characteristics of each of the critical human receptors, apart from the food ingestion rates, will be obtained from Health Canada. The food ingestion rates for the HHRA will be derived using data collected from a food survey, created specifically for this project.

9.2.10 Human Exposure to Contaminants

The sources of COPCs in this HHRA include the 1) atmospheric emissions from burning ETF sludge in the power boiler at the mill and fugitive emissions of odour from the ETF, and 2) the marine discharge of treated effluent from the diffuser near Caribou Point.

The exposure pathways for air emissions include the inhalation of outdoor air which will be quantitatively assessed for the HHRA. The modelling of air emissions releases into the local air is currently being updated and concentrations for all locations relevant to human receptors will be evaluated in the HHRA against background levels and air quality criteria. Exposure locations include a theoretical home directly adjacent to the mill, a representative home within the Air Emissions Study Area, a home at Pictou Landing, and a home outside the area of mill influence.

The complete exposure pathways for contaminants in the effluent include:

1. Incidental ingestion of effluent and skin contact with water;
2. Incidental ingestion of effluent and skin contact with ocean sediments; and
3. Ingestion of seafoods that have accumulated contaminants from ocean water, ocean sediments or prey that those seafoods consumed.

Human exposure locations will include:

1. Beach areas along the shoreline of the Marine Study Area; and
2. Harvest areas within the Marine Study Area.

Modelling of effluent mixing into Northumberland Strait was undertaken to estimate contaminant concentrations in seawater at the receptor exposure and seafood harvest locations (Stantec, 2019). Uptake of contaminants into seafood will be estimated using water-based bioaccumulation factors.

Drinking groundwater is considered an incomplete pathway for the HHRA because there is no contact between the treated effluent and groundwater. There is potential for ocean intrusion into wells that are close to shore, but residents would likely stop drinking their groundwater due to taste from the salt and would therefore have minimal exposure. There will be spill contingency plans in place to immediately stop and clean up any spill caused by ruptured pipelines or leaks along the pipeline corridor. Therefore, the potential for any spilled effluent to have contact with groundwater used for drinking is small. For these reasons, the drinking of groundwater pathway is considered incomplete.

9.2.11 HHRA Reporting

The report will outline the identified COPCs, the predicted environmental concentrations and human exposure frequencies of those substances, and any predicted health impacts on the local population using established exposure limits.

10.0 ARCHAEOLOGY

10.1 Marine Archaeological Resource Impact Assessment

Complete an Archaeological Resource Impact Assessment for the marine environment related to the Project.

An Archaeological Resource Impact Assessment (ARIA) for the marine environment was undertaken in the spring and summer of 2019 by Stantec Consulting Ltd. (Stantec) on behalf of NPNS.

The ARIA for the marine environment consisted of four primary elements to gather information to assist in determining if archaeological resources may be present and/or affected by the proposed project. These four elements were:

- A review of historic and archaeological literature;
- A review of underwater video and marine geophysical data. Marine geophysical data included sidescan sonar and marine magnetic surveys, and sediment samples from the seafloor obtained through sediment core sampling. The sidescan sonar and marine magnetic surveys are physical scans of the seafloor that generate specialized imagery through the emission and detection of sound (for sidescan sonar) or magnetic fields (for magnetic surveys) that identify changes or differences in some of the features on the seafloor compared to other areas. This data can provide signs of the potential presence of archaeological or cultural resources;
- A review of coastal landforms and past sea level elevations to identify submerged landscapes which may contain sites of potential archaeological significance. Sediment core samples provide additional information in determining the potential presence of submerged landscapes; and
- Recommendations to avoid and/or mitigate areas that may contain archaeological or cultural resources.

The study area for the marine ARIA included two locations along the marine portion of the proposed realigned effluent pipeline route, as shown in Figures 10.1-1 and 10.1-2:

- The toe of Pictou Causeway within Pictou Harbour (i.e., the east side of the causeway); and

- Caribou Harbour between the shoreline adjacent to the ferry terminal property and the site of the diffuser at the end of the pipeline.

A series of sediment core samples were taken along transects in both the Pictou Harbour and Caribou Harbour study areas (Figures 10.1-1 and 10.1-2, respectively). No direct evidence (e.g. chipped lithics, stone tools, charcoal, or plant or animal matter) of archaeological resources were found in the core samples. However, one sediment core sample (VC-02C) at the far eastern edge of the Caribou Harbour Study Area may contain evidence (i.e., an obvious change in sediment type) that indicates the presence of a preserved landscape.

Figure 10.1-1: Sediment Sample Locations in Pictou Harbour

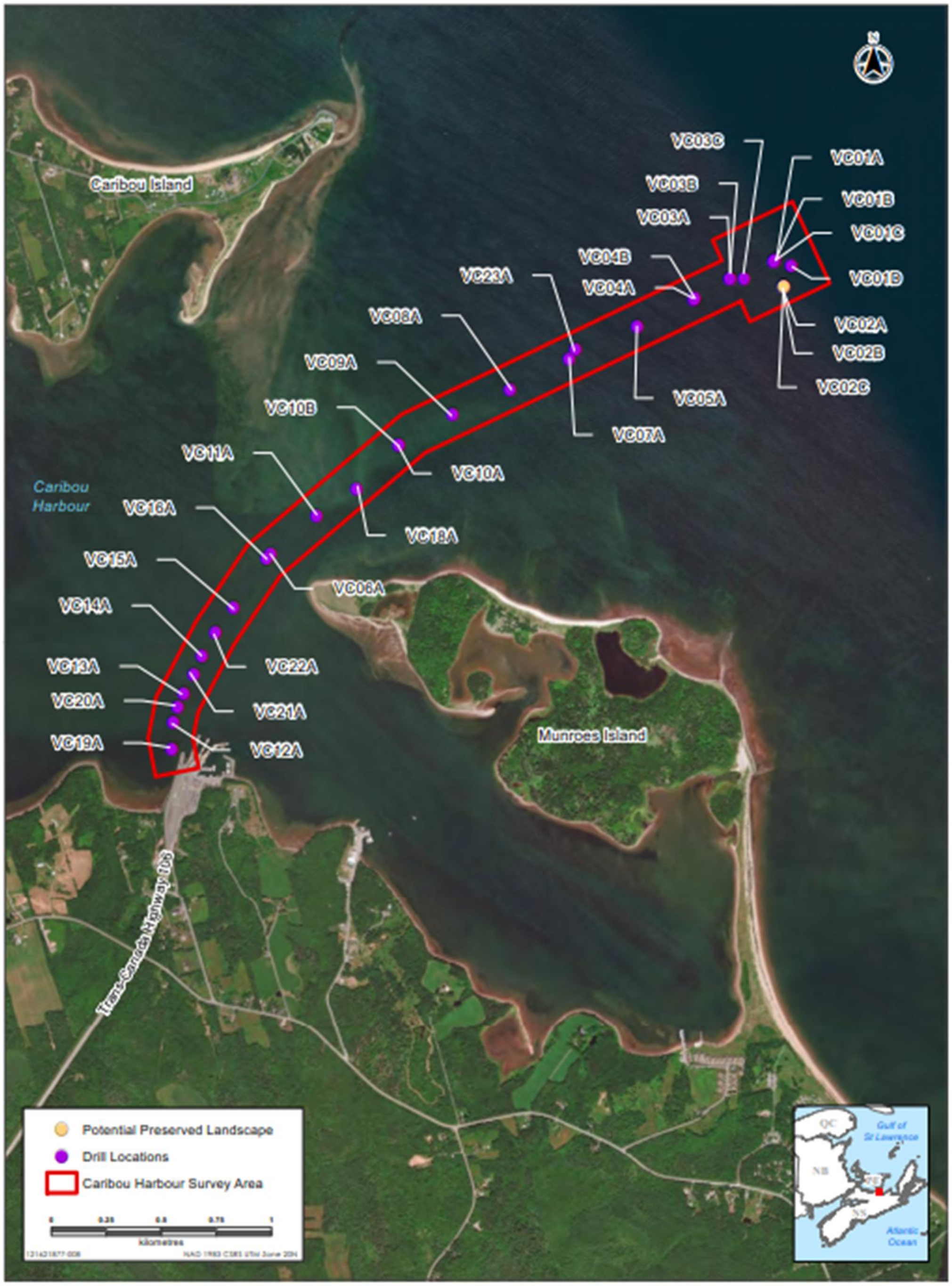
Vibracore Drill Locations – Pictou Harbour

Stantec

NORTHERN PULP

Figure 10.1-1

Figure 10.1-2: Sediment Sample Locations in Caribou Harbour



Vibracore Drill Locations – Caribou Harbour

Stantec

NORTHERN PULP

Figure 10.1-2

The marine geophysical (sidescan sonar and marine magnetic) surveys revealed 43 sidescan sonar and 31 magnetic features in the Pictou Harbour Study Area, while seven sidescan and seven magnetic features were identified in the Caribou Harbour Study Area, which could indicate potential areas of archaeological interest.

In the Pictou Harbour Study Area, the archaeological review of the geophysical data revealed that one of the identified features retained potential to be an archaeological resource. The feature was identified along the eastern edge of the Pictou Harbour Study Area and presented as a rectangular, wooden feature.

In the Caribou Harbour Study Area, the archaeological review of the geophysical data revealed that two of the identified features retain potential to be archaeological resources. The two features identified present as circular and linear rock formations. These features could possibly represent pre-contact archaeological resources associated with hunting structures. In addition, these features were identified at the same depth of, and in vicinity to, sediment core sample VC-02C (described above), thus placing the potential features within the same time period as the possible preserved landscape. Both features were identified outside the proposed Caribou Harbour Study Area.

The following recommendations were provided by Stantec following the marine ARIA:

1. Stantec considers the sediment core sample feature VC-02C to be avoidable during construction, given that it is at the far eastern edge of the study area. If avoidance of this feature is not possible due to project design or construction, archaeological monitoring during construction is recommended to ensure any additional deposits are not disturbed. If archaeological monitoring is not a practical option, further marine archaeological assessment may be required.
2. For the one possible archaeological resource identified in the Pictou Harbour Study Area, avoidance of the feature is recommended in conjunction with a 20 m buffer zone. If avoidance of the feature and its associated buffer zone is not possible, further marine archaeological assessment may be required.
3. For the two possible archaeological resources identified in the Caribou Harbour Study Area, avoidance of the two features is recommended in conjunction with a 20 m buffer zone. Both features were identified outside the proposed Caribou Harbour Study Area and should not be affected by the work as proposed. If work extends beyond the study area and avoidance of the features and their

associated buffer zones is not possible, further marine archaeological assessment may be required.

4. If submerged cultural resources or potential submerged cultural resources are identified during pre-inspection or construction of the proposed project, then all work should stop in the vicinity of the resource, and the Nova Scotia Department of Communities, Culture and Heritage Special Places Branch and a marine archaeologist should be contacted.

Stantec's report on the marine ARIA was provided to the Nova Scotia Department of Communities, Culture and Heritage Special Places Branch for review. The Special Places Branch accepted the findings and recommendations of the report.

The complete marine ARIA is provided in Appendix 10.1.

10.2 Land-Based Archaeological Investigation

Complete shovel testing for areas in the terrestrial environment that are identified to have elevated or medium potential of archaeological resources, to confirm the presence or absence of these resources.

A shovel testing program in the terrestrial environment along the proposed realigned effluent pipeline route was undertaken in June and July 2019 by professional archaeologists from the Cultural Resource Management (CRM) Group Inc. on behalf of NPNS. A shovel testing program is a systematic subsurface investigation of the underlying surface soils that is conducted by manually excavating test pits of a defined size and depth (typically 50 cm by 50 cm by 50 cm deep, or until glacial till is encountered) using a shovel, followed by screening of the soils using 63.5 mm (¼ inch) screens, to determine if they contain artifacts or other archaeologically or culturally significant materials. Figure 10.2-1 displays some images that show the shovel testing program conducted for this project.

Figure 10.2-1: Shovel Testing Program

Prior to conducting the shovel test program, archaeologists conducted a visual inspection of two areas of the proposed realigned pipeline route that had become more defined since submission of the EARD. These two locations, one near Caribou and the other surrounding the Pictou roundabout, were determined to exhibit a low potential for encountering Mi'kmaq or European-Canadian archaeological or cultural resources due to heavy disturbance, low, wet ground conditions, and a lack of historic evidence of land use.

Shovel testing was therefore focused on the areas surrounding the NPNS plant that had been identified in the EARD as having a medium or high potential for encountering archaeological or cultural resources. A medium to high potential for archaeological or cultural resources had been assigned to these areas due to the proximity of two previously encountered archaeological sites as well as their proximity to the shoreline.

Based on the results of the shovel testing and a review of historic aerial photos, it was determined that the project footprint area had been cleared of all trees and stripped of topsoil. As a result, CRM Group considers the project footprint area to exhibit a low potential for encountering cultural resources.

The following recommendations were provided by CRM Group following the shovel testing program:

1. Based on the background research undertaken and the results of the site visit and characterization, it is recommended that the parking turnaround and Pictou roundabout study areas along the realigned treated effluent pipeline route further Archaeological Investigation is not required.
2. Based on the background research and the results of the shovel testing program, it is recommended that the outfall alignment on Abercrombie Point, as it is currently defined in the report, does not require any further subsurface investigation.
3. Based on the close proximity to existing archaeological sites, it is recommended that an archaeological monitor be present during the excavation of the pipeline alignment on Abercrombie Point.
4. In the event that the alignment associated with the effluent outflow route is changed or expanded beyond the area assessed during the shovel testing program, it is recommended that an archaeological assessment be undertaken to address the new alignment.
5. In the unlikely event that human remains or intact archaeological deposits are encountered during activities associated with the project, all work in the associated area(s) must be halted and immediate contact made with the Coordinator of Special Places (Sean Weseloh McKeane: 902-424-6475). If human remains are encountered, immediate contact should also be made with the Assembly of Nova Scotia Mi'kmaq Chiefs via the Kwilmu'kw Maw-klusuaqn Negotiation Office (Heather MacLeod-Leslie: 902-843-3880), in addition to the RCMP.

CRM Group's report on the shovel testing program was provided to the Nova Scotia Department of Communities, Culture and Heritage Special Places Branch for review. The Special Places Branch accepted the findings and recommendations of the report.

Due to the fact that cultural resources were found in the archaeological survey, it was suggested by Special Places that the detailed survey results not be provided herein. (Pers. Comm. C. Cottreau-Robbins, September 2019).

11.0 INDIGENOUS PEOPLE'S USE OF LAND AND RESOURCES

11.1 Mi'kmaq Ecological Knowledge Study

Complete a Mi'kmaq Ecological Knowledge Study (MEKS) for the Project.

In 2007, the Assembly of Mi'kmaq Chiefs developed a Protocol for guiding the development and preparation of Mi'kmaq Ecological Knowledge Studies. The definition of Mi'kmaq Ecological Knowledge based on the Protocol is:

> "...*the collection and adaptation of knowledge that Mi'kmaq people have with all components of the natural environment and the interrelationships that exist between all life forms from a unique historical, cultural and spiritual perspective*".[1]

The MEKS report is a documentation of ecological information regarding Mi'kmaq use of specific land, water and resource use as identified by participants interviewed as part of the study.

A MEKS was completed between May and July 2019 and complements the previous study completed in July 2018 by Membertou Geomatics Solutions on behalf of NPNS. Throughout the MEKS, 48 interviewees contributed to the MEKS, identifying areas where activities were undertaken by themselves or where they had knowledge of traditional activities carried out by other Mi'kmaq individuals. This information was then transcribed into a geographic information system (GIS) dataset.

The findings were divided geographically into the project site (i.e., within 50 m of the proposed project) and the study area (i.e., within 5 km of the proposed project).Based on the information gathered, it was determined that the project site was used by the Mi'kmaq in the historic past (i.e. prior to 25 years ago) as well as the recent past (i.e.11 - 25 years ago).

[1] Assembly of Mi'kmaq Chiefs. 2007. Mi'kmaq Ecological Knowledge Study Protocol.

Primary uses within the project site identified by interviewees include fishing, hunting, gathering food and culturally significant plants, and use of culturally significant and recreation areas. The traditional uses identified in the study area are similar to those identified in the project site, but the number of locations where uses were identified is substantially higher given the larger area considered.

A review of the MEKS shows that there is some limited harvesting of plants and medicines in the study area that may be affected by the project. However, these plants and medicines are readily available at many other locations in close proximity to the community. With respect to the plants and medicines in the pipeline route, excavation activities will render the availability of some plants and medicines directly where construction activities will take place, but then after the pipeline is buried and the plants will likely regrow in these areas within one or two growing seasons, re-establishing their potential use. As well, given the location of the pipeline within the Highway 106 ROW, there could be no hunting activities in these areas due to hunting safety legislation. Fish habitat will be addressed as required under regulatory authorizations to offset effects to fish or fish habitat.

Every effort will be taken to avoid impacts and, where not possible, these impacts will be minimized and mitigated.

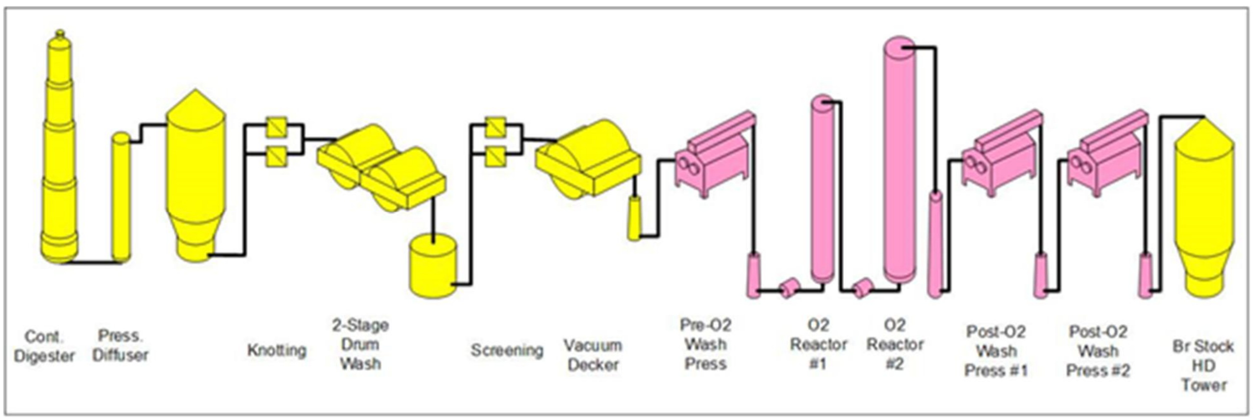
Addendums

Addendum 1 - Focus Report Tasks Description

Provide information regarding whether and when new technology and equipment will be installed at the NPNS pulp mill to improve the effluent quality, including but not limited to the following:

A.1.a) Will O2 Delignification be installed at NPNS pulp mill?

Two-stage Oxygen (O_2) Delignification technology will be incorporated into the pulp making process at NPNS. The system, which consists of oxygen reactors and wash presses, will be installed after the brown stock washing stage and before the existing bleaching stages. The system uses oxygen gas to react with residual lignin that remains in the pulp after brown stock washing. The lignin removed in this new stage will result in the use of less bleaching chemicals to whiten the pulp in the existing bleach plant. It is a significant and well-proven process for elemental chlorine free (ECF) pulp and as such it is often referred to as the first stage of bleaching (oxygen bleaching).



Yellow: Existing Equipment. Pink: Future Oxygen Delignification Equipment

The following is a list of environmental benefits of Oxygen Delignification:

- Reduces chlorine dioxide bleaching chemicals by 30 – 40% - corresponding reduction in effluent organic loading and chlorinated compounds:
- Reduces effluent colour;
- Reduces wood losses;
- Increases recovery of lignin to the liquor cycle – reduction in carbon footprint;

- Reduces energy consumption by reducing aeration requirements in the new ETF – reduction in carbon footprint; and
- Reduces nutrient addition in the new replacement ETF.

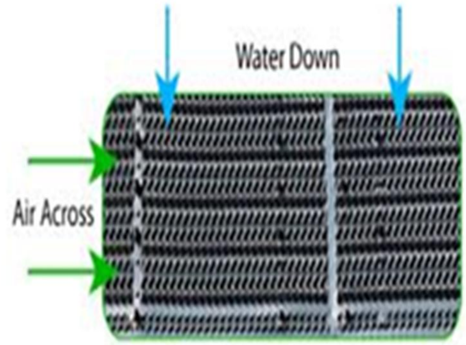
The Oxygen Delignification project has been studied at NPNS. In 2017, NPNS conducted a preliminary engineering study to determine how the project would be integrated into the existing mill processes and developed a high level cost estimate of the project. As outlined in Section 2.4, the future Oxygen Delignification system was considered in the design of the replacement ETF and will be managed as a separate project to be undertaken after the replacement ETF project is completed. This project is a significant capital expenditure, an implementation schedule has not been determined at this time.

A.1.b) What other technology and equipment will be installed at the NPNS pulp mill?

Non-contact cooling water makes up a considerable portion of the TME flow. Cooling towers will be installed as an in-mill improvement to recycle non-contact, clean cooling water for reuse within the mill processes during the summer months. Reducing cooling water will in turn reduce the effluent flow. The goal is to reduce the peak summer water flow at the mill by approximately 5,000 m^3/day. This water reduction will help to even out seasonal variation in effluent flow.

Note that these cooling towers are in addition to the effluent cooling towers that will operate year-round at the new replacement ETF. As is industry standard, direct-contact cooling towers will be used. Cooling towers use evaporation to achieve heat transfer. In this case, the evaporative medium is recycled raw water. The operation of the cooling towers will result in additional evaporative water losses at the mill. Care will be taken the ensure that the cooling towers stay clean and free of naturally occurring legionella bacteria by employing biocides if and when necessary. The fresh water cooling towers will be installed in conjunction with the replacement ETF project.

Figure A.4.1 A cooling tower and a schematic of the cooling process within the towers



Within the cooling towers, fresh water trickles down the medium, as air is blown across. As such, cooling occurs through evaporation.

A.1.c) How will each proposed new technology and/or equipment to improve the effluent quality?

The improvement expected from Oxygen Delignification relates to the bleach plant portion of the effluent due to the reduction in chlorine dioxide usage. Lower BOD, COD, AOX and colour in the bleach plant effluent are expected benefits of the project due to a reduction in chlorinated organic compounds. Pollutant loadings in total mill untreated effluent are primarily, but not entirely, a result of bleach plant effluent. At NPNS, bleach plant effluent represents roughly 75% of the total untreated effluent load which is very typical when compared to industry standards for a mill with conventional bleaching without Oxygen Delignification. The KSH Design Specification No: 10-1113-A000-09400 (third case - After O_2 Delig.) presented in Section 2.4 summarizes the impact of the improved bleach effluent fraction on the overall untreated or influent effluent quality before treatment.

Fresh water cooling towers installed to allow recycle of non-contact cooling water will reduce peak summer effluent flow by approximately 5,000 m^3/day. The reduction of peak effluent flow will help to reduce seasonal variations in flow through the replacement ETF.

Addendum 2.0 Effluent Discharge Parameters

a) Explain why the total nitrogen parameter has changed to 6 mg/L (daily maximum) from the 3 mg/L (proposed in the August 11, 2017 receiving water study).

Nitrogen (N) in the effluent can exist in various forms, some that are available to the organisms during the treatment process and others that are not available (inert). The large majority of inorganic nitrogen is available, while organic nitrogen may or may not be available depending on the structure and degree of degradation of the organic nitrogen-containing molecules. The sum of inorganic nitrogen and degraded organic nitrogen is what is available to the treatment process.

During the laboratory-scale Veolia/AnoxKaldnes treatability study, analyses of nitrogen fractions in the untreated effluent showed that almost all nitrogen was present in organic forms, with very little available inorganic nitrogen. As was expected, this confirms that additional nitrogen must be added as a nutrient to maintain optimum biological removal efficiency.

Further analyses of the treated effluent indicated that roughly 2 mg/L was determined to not be available during treatment and remains as an inert soluble nitrogen fraction after treatment. The total nitrogen (TN) in the treated effluent discharge will then be made up of this inert nitrogen plus any excess available nigrogen nutrient dosage plus nitrogen present in outgoing TSS.

With very well settled outgoing treated effluent samples, a discharge level around 5 mg/L TN was achieved in the tests. This is a better result than what can be achieved in practice as lab settling of solids is more efficient than what is typically achieved in the field.

To account for the inert nitrogen present, the high lab efficiency and typical nutrient dosing residuals, it was recommended that a concentration of 3 mg/L was not unlikely achievable and 6 mg/L should be carried forward to the RWS.

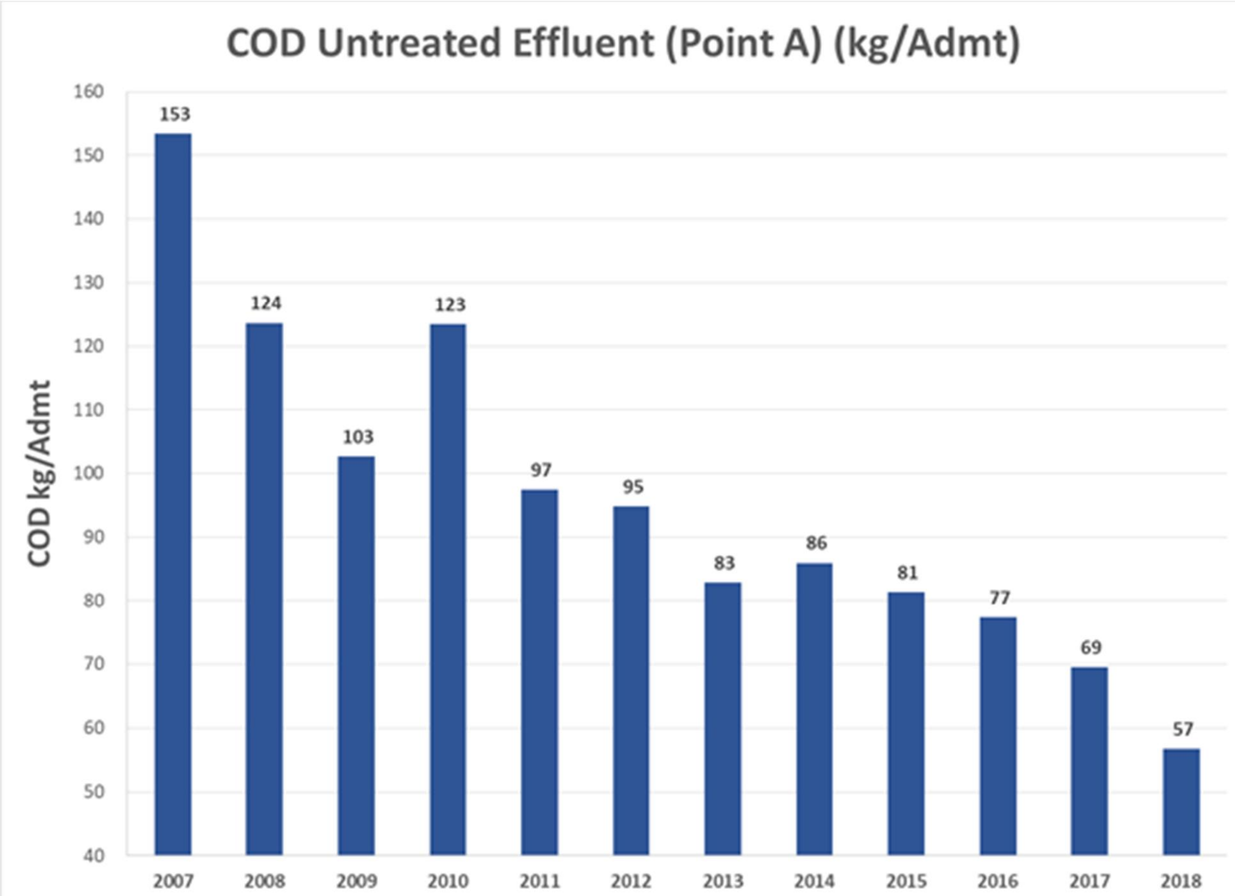
b) Provide data to support assertions that chemical oxygen demand (COD) can be reduced to the proposed limit.

As a condition of NPNS's Industrial Approval, a study was undertaken to identify all sources of COD contributing to mill effluent and develop a plan to achieve reductions of

COD in untreated effluent (at Point A) over the term of the Industrial Approval. The COD study, attached as Appendix 3, was completed in December of 2016. The report outlines the significant improvements that have been made since 2007, the year used to benchmarked NPNS untreated effluent quality against other Canadian mills (AMEC, Boat Harbour Return to Tidal Re-evaluation, April 2010). Figure A.2-1 has been updated to include recent mill data. NPNS has made significant continuous improvements in untreated effluent quality realized in part by in-mill improvements undertaken by Paper Excellence Canada since it purchased the mill in 2011:

1. Brownstock Screen Room Closure and Washer Upgrades – 2011;
2. Black Liquor Emergency Storage Tank – 2011;
3. Black Liquor Evaporator Plant Upgrade – 2012;
4. Indirect condenser and Ejector Set for Evaporator Plant – 2016;
5. Additional sewer measurements (conductivity and pH probes) – 2017;
6. Modification to Recaust Area Sewer System – 2018;
7. Improved shutdown and start-up management procedures – ongoing; and
8. Continuous Improvement Activities – ongoing.

Figure A2-1: Evolution of Untreated Effluent COD (at Point A), 2007 - 2018



A benchmark COD of 1,900 mg/L was set for the duration of the Industrial Approval (IA). The intention of this IA condition was to drive continuous improvement in black liquor losses at NPNS. The implementation plan that was developed, in conjunction with NSE, requires NPNS to test COD of untreated effluent daily and report incidents that are more than double the benchmark value (indicating that an incident outside of normal operations has occurred). Incidents are individually investigated at NPNS to determine what appropriate corrective actions will be implemented. It is important to note that NPNS has never diverted effluent flow to the spill pond at the BHETF related to these incidents. Effluent on these occasions was treated normally running through the BHETF. As the BHETF provides effective treatment even during upset conditions, none of the events have led to a reportable environmental exceedance of treated effluent discharging from the BHETF.

Condition 6 (e) iii) of the Industrial Approval outlines that NPNS must achieve a 50% reduction in untreated effluent COD, based on the benchmark, by the end of the IA term (January 2020). In other words, NPNS should operate below 950 mg/L by January, 2020. The annual average COD for untreated effluent in 2018 was 723 mg/L (measured as total COD) thus proving that the reduction is being met. NPNS will continue to report and investigate incidents that are more than two times the 1,900 mg/L benchmark as it has done since the implementation of the IA.

Effluent quality metrics based on concentration will need to be re-evaluated after in-mill cooling towers are installed in the future as mill water reduction will increase the concentration of untreated effluent without increasing the amount of pollutants that the effluent contains.

Addendum 3.0 – Receiving Water Study

With respect to the updating of the Receiving Water Study:

- *Provide a response to questions and comments on the receiving water study (not already outlined in this document) from Environment and Climate Change Canada's EARD review submission dated March 18, 2019, and update the receiving water study as applicable;*
- *Explain how the initial mixing and dispersal of the plume was taken into account when simulating far-field extent and concentrations of effluent in Section 3 of Appendix E1 of EARD. It appears that the far-field model simulations were run before the near-field model. One could expect that the behaviour of the plume further afield depends a large extent on how it behaved at the diffuser, i.e. how quickly it mixed and spread and rose to the surface;*
- *Confirm dilution ratios and distances required to achieve background level for water quality parameters in Appendix E1 of the EARD, as the dilution ratios and distances may be overestimated;*
- *Explain if the salinity and temperature differential between the effluent and the receiving waters has been accounted for in the model. When the buoyancy differential between the effluent and receiving waters are greater in winter, it results in a faster rising plume. This can potentially affect the visibility of the effluent in the receiving environment. Has this been accounted for in the model? Also provide results for winter conditions;*

- *Explain if re-entrainment of effluent and sediment at the diffuser location was accounted for in the one-hour period surrounding slack tide. Support this explanation with model results using a smaller time step (30 minutes) if necessary.*

The response for Addendum 3 has been provided by Stantec and is found in Appendix A-3.

Addendum 4.0 - Updates to EEM Program

It is important to note that the following field study and monitoring are likely to be required as part of an EEM program regulated under the Pulp and Paper Effluent Regulations for the Project if it is approved:

A.4.a) Field delineation of treated effluent plume to confirm the prediction from the receiving water study;

A detailed study plan for the in-field plume delineation will be developed prior to implementing the field work and would be provided to ECCC, as well as other interested parties as may be appropriate. Plume delineation is a study to determine the behaviour of effluent that is discharged to the environment. In the study the behaviour and spatial extent of the effluent in the environment is assessed. The overall approach to the in-field plume delineation study is described in brief as follows. A conservative tracer (Rhodamine WT, a fluorescent dye that is not harmful to the aquatic environment) will be injected into the effluent at the replacement ETF and tracked in the Northumberland Strait. Concentrations of dye will be measured in real time by measuring fluorescence in the water at the surface and in vertical profiles. The tracking of the dye would extend outwards from the diffuser location until such time as the 1,000:1 dilution limit is determined. The dye would be injected continuously over a sufficient time period (several tidal cycles) to establish an equilibrium concentration in the receiving water.

Along with the fluorescence measurements a variety of other information will be collected regarding effluent discharge rates, tidal, and current conditions, water temperature and salinity, and wind direction and speed so that the fluorescence data can provide an overall spatial perspective on effluent dispersion in the Strait under that specific set of conditions.

Subsequent to the field study, some additional numerical modelling may also be conducted. This modelling would provide the means by which the plume measurements could be extrapolated to simulate effluent dispersion over a wider range of environmental conditions than those encountered during the field survey to ensure that the full extent of the mill's effluent plume has been established.

At present, the 3D modelling of the area in the local study area as part of the updated RWS indicates that dilution to less <1% effluent will occur at approximately 20 m from the discharge (Stantec, 2019).

A.4.b) Monitoring of marine water quality and marine sediment quality;

Water samples for the characterization of water quality parameters will be collected. This includes parameters such as TOC, dissolved organic carbon (DOC), total Kjeldahl nitrogen (TKN), and colour. Comparison of data for these parameters for areas where effluent is present and where it is not present will provide useful information for the planning of the EEM biological monitoring programs.

Water samples will be collected for the measurement of:

- dissolved oxygen levels;
- temperature;
- salinity;
- colour;
- pH;
- TSS;
- turbidity;
- DOC;
- TOC;
- TKN;
- TP;
- TN;
- metal scan;
- low level mercury;
- resin fatty acids;
- BOD_5;
- dioxins;
- furans;
- total phenols; and

- AOX.

Supporting environment data will also be collected to help interpret any patterns that may be identified in the benthic data. This will include sediment samples that will be characterized for:

- total phenols;
- grain size;
- TOC;
- total sulphides;
- pH; and
- the carbon to nitrogen ratio.

A.4.c) Sublethal toxicity testing and chemistry testing of the treated effluent

As part of the EEM, the mill will continue to be required to conduct acute and sublethal toxicity testing, effluent parameter analysis, and reporting, and be subject to the effluent regulations. The EEM program includes provision for biological monitoring via laboratory-based sublethal effluent toxicity testing. The mill will complete routine testing as prescribed in the PPER. Laboratory sublethal toxicity testing requirements are described in Schedule IV, Part 2(3) of the PPER as follows:

> "*(3) In the case of effluent that is deposited into marine or estuarine waters, sublethal toxicity tests shall be conducted by using the following test methodologies, as amended from time to time, as applicable to each species:*
>
> *(a) in the case of an invertebrate species, Biological Test Method: Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars) (Report EPS 1/RM/27), December 1992, published by the federal Department of the Environment; and*
>
> *(b) in the case of algal species, one of the following test methodologies, as applicable, namely,*
>
> > *(i) Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (Third Edition) (Reference Method EPA/821/R/02–014), October 2002, published by the U.S. Environmental Protection Agency, or*

(ii) Short-term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Waters to West Coast Marine and Estuarine Organisms (First Edition) (Reference Method EPA/600/R-95-136), August 1995, published by the U.S. Environmental Protection Agency."

Laboratory tests are conducted twice annually to assess the potential influence of mill effluent exposure on sea urchin fertilization, as well as, the growth of the alga *Champia parvula*. These data are used to assess effluent quality and also to assist in the interpretation of biological field survey data.

A.4.d) Biological monitoring studies including benthic invertebrate community study, fish population study, and dioxin and furan levels in fish as applicable.

The NPNS mill has completed the required testing on mill effluent treated at the BHETF and will continue testing on treated effluent generated at the proposed replacement ETF.

According to the most recent information concerning predicted effluent mixing in the Northumberland Strait (Stantec, 2019), effluent concentrations are predicted to be less than 1% within metres (generally less than 2 m) of the discharge structure. In consideration of Schedule IV, Part 3 of the PPER, it is apparent that neither in-field fish nor benthic surveys will be required with the new discharge configuration. These predictions of effluent dilution will need to be confirmed as part of the first EEM study to determine the final components required as part of the EEM. If confirmed, there is no regulatory requirement for any further field investigations as part of the EEM program unless there is a major change in discharge volume.

Requirements for in-field Requirements for in-field biological monitoring studies are described in Schedule IV, Part 3 of the PPER as follows:

"(a) a study respecting the fish population, if the concentration of effluent in the exposure area is greater than 1% in the area located within 250 m of a point of deposit of the effluent in water;

(b) a study respecting fish tissue if

(i) since the submission of the most recent interpretive report, the effluent contained a measurable concentration of 2,3,7,8-TCDD or of 2,3,7,8-TCDF,

within the meaning of the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations, or

(ii) an effect on fish tissue was reported in the most recent interpretive report; and

(c) a study respecting the benthic invertebrate community, if the concentration of effluent in the exposure area is greater than 1% in the area located within 100 m of a point of deposit of the effluent in water."

Although not regulated as part of the PPER, some fish and benthic component studies are still warranted as part of the *EA Follow-up monitoring program* described in the original EARD submission.

Dioxin and furan testing in fish or shellfish tissues for EEM is not likely to be required by the PPER based on current and predicted future levels of these constituents in-mill effluent. Annual testing of treated effluent for dioxins and furans in the future treated effluent will continue to be performed as per the requirements set out in the *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations.*

References

Assembly of Mi'kmaq Chiefs. 2014. Mi'kmaq Ecological Knowledge Study Protocol, Second Edition.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian National Ambient Air Quality Objectives: Process and Status. In: Canadian Environmental Quality Guidelines, 1999, Winnipeg.

CCME (Canadian Council of Ministers of the Environment). 2018. Canadian water quality guidelines for the protection of aquatic life. Canadian Council of Ministers of the Environment, Winnipeg. http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/

Canadian Seabed Research Ltd., December 2014. Lake Erie Connector – Cable Route Desktop Assessment. Contract report prepared by Canadian Seabed Research for ITC Holdings, CSR Report # 1408-2.

CSR GeoSurveys Limited. August 2019. Geophysical &Geotechnical Survey Report: Pictou Harbour and Caribou Harbour Proposed Pipeline Corridors. Contract report prepared by CSR GeoSurveys Limted for Northern Pulp Nova Scotia Corporation Ltd. CSR Report #1806-1.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018. Canadian Wildlife Species at Risk. http://www.cosewic.gc.ca.

Det Norske Veritas AS. 2013. Submarine Pipeline Systems Offshore Standard DNV-OS-F10, October 2013.

Ecometrix. 2013. EEM Cycle 6 Interpretive Report for the Northern Pulp Nova Scotia Corp. Facility near Pictou, Nova Scotia. Prepared for: Northern Pulp Nova Scotia Corp. Prepared by: Ecometrix Inc. Ref. 12-1942. March 2013.

EcoMetrix. 2018. Follow-up Studies Associated with the Environmental Assessment Process for the New Treated Effluent Discharge Configuration at the Northern Pulp Nova Scotia Corporation Mill. Prepared for Northern Pulp Nova Scotia Corporation, August 2018.

EcoMetrix. 2019. Human Health Risk Asessement Problem Formulation for the Northern Pulp Nova Scotia Cormporation Replacement Effluent Treatment Facility Project. Prepared for Northern Pulp Nova Scotia Corporation, September 23, 2019.

KSH Consulting. 2019. Task 2.3: Raw and Treated Effluent Characterization. Prepared for Northern Pulp Nova Scotia Corporation. September 17, 2019.

KSH Consulting. 2019. Task 2.4: Expected Effluent Quality Following Treatment by the Proposed Technology. Prepared for Northern Pulp Nova Scotia Corporation. September 18,2019.

KSH Consulting. 2019. Task 3.1: Treatment Technology Details. Prepared for Northern Pulp Nova Scotia Corporation. September 18, 2019.

KSH Consulting. 2019. Focus Report Task 3.2: Effluent Treatment Plant Replacement: Flowrate Data Analysis. Prepared for Northern Pulp Nova Scotia Corporation. June 6, 2019.

KSH Consulting. 2019. Task 3.4: Effluent Spill Basin.: Prepared for Northern Pulp Nova Scotia Corporation. September 18, 2019.

KSH Consulting. 2019. Task 3.6: Potential Releases of Waste Dangerous Goods.: Prepared for Northern Pulp Nova Scotia Corporation. September 18, 2019.

MECP (Ontario Ministry of Environment, Conservation, and Parks). 2019. Ontario's Ambient Air Quality Criteria – Sorted by Contaminant Name. https://www.ontario.ca/page/ontarios-ambient-air-quality-criteria-sorted-contaminant-name#fn8. Published December 8, 2016 and updated April 30, 2019.

Mi'kmaq of Nova Scotia, Her Magesty the Queen in Right of Nova Scotia, Her Magesty the Queen in Right of Canada. 2007. "Made-In-Nova Scotia Process": Mi'kmaq - Nova Scotia - Canada Framework Agreement. Membertou, Nova Scotia, Febrary 23 2007.

Nova Scotia Environment. 2005. Air Quality Regulations (amendded 2017).Accessed September 2019. https://novascotia.ca/just/regulations/regs/envairqt.htm

Nova Scotia Department of Environment (NSDOE now NSE). 1994-95. Environment Act (amended 2017). Accessed September 2019 http://nslegislature.ca/legc/statutes/environment.pdf.

NSESANS ESA (Nova Scotia Endangered Species Act). 2010. Endangered Species Act, SNS 1998, c. 11. Amended 2010, c. 2, s. 99.

Nova Scotia Property Online. Accessed September 2019.t https://linns.gov.ns.ca.

Pulp and Paper Effluent Regulations. SOR/92-269. Current to March 26, 2018. Last amended on June 29, 2012. http://laws-lois.justice.gc.ca.

Species At Risk Public Registry (SARA) 2012. http://www.sararegistry.gc.ca/sar/index/default_e.cfm. Accessed September 2019.

Stantec. 2019. Final Report - Marine Sediment Samping Program: Caribou Harbour and Pictou Harbour. Prepared by Stantec Consulting Ltd. for Northern Pulp Nova Scotia Corporation. September 2019.

Stantec. 2019. Northern Pulp Effluent Treatment Facility Replacement Project: Updated Receiving Water Study, Caribou, Nova Scotia . Prepared by Stantec Consulting Ltd. for Northern Pulp Nova Scotia Corporation. September 2019.

Stantec. 2019. Estimate of Sediment Transport of the NPNS Treated Effluent. Memorandum, September 25, 2019.

Stantec. 2019. Expanded Air Dispersion Modelling Study - Replacement Effluent Treatment Facility. Prepared by Stantec Consulting Ltd. for Northern Pulp Nova Scotia Corporation. September 2019.

Stantec. 2019. Underwater Benthic Habitat Survey of Caribou Harbour and Pictou Harbour Pipeline Corridors: Final Report. Prepared by Stantec Consulting Ltd. for CSR GeoSurveys Ltd. for submission to Northern Pulp Nova Scotia Corporation. September 2019.

Stantec. 2019. Marine Archaeological ResourceImpact Assessment: Northern PulpReplacement Effluent Treatment Facility. Prepared by Stantec Consulting Ltd. for Northern Pulp Nova Scotia Corporation. September 2019.

Town of Pictou. 2017. Pictou/Caribou Source Water Protection Plan and Well Field Map

Veolia Water Technologies AB. 2018. A Study on the Biological Treatability of Effluent from Northern Pulp. Lund, Sweden, May 17, 2018.

Wood Environment & Infrastructure Solutions. 2019. Construction Methodolgy and Design Report: Effluent Line (Overland Portion) Detailed Design. September 25, 2019.