REGISTRATION DOCUMENT

by Nova Scotia Power Incorporated

in support of

REGISTRATION of TUFTS COVE 6 WASTE HEAT RECOVERY PROJECT

Under the Nova Scotia Environment Act

March 3, 2009

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PAGE

FIGURES

TABLES

LIST OF ACRONYMS

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
BIO	Bedford Institute of Oceanography
Bop	Balance of plant (system)
BTEX	benzene, toluene, ethylbenzene, and xylene
CCME	Canadian Council of the Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
CEMS	Continuous Emission Monitoring System
CEPA	Canadian Environmental Protection Act
CO_2	carbon dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CTs	combustion turbines
dBA	decibels
DFO	Department of Fisheries and Oceans Canada
CWS	Canadian Wildlife Service
DSM	Demand Side Management
EA	environmental assessment
EC	Environment Canada
ECCs	environmental components of concern
ECM	Environmental Compliance Monitoring
EEM	Environmental Effects Monitoring
EMPs	Environmental Management Plans
EPA	Environmental Protection Agency
EPPs	Environmental Protection Plans
ERP	Emergency Response Plan
FA	Federal Authorities
HADD	Harmful Alteration, Disruption or Destruction
HCP	Habitat Compensation Plan
HRM	Halifax Regional Municipality
GHG	greenhouse gases
GLCs	Ground Level Concentrations
HRSG	Heat Recovery Steam Generator
HRM	Halifax Regional Municipality
ISCST	Industrial Source Complex – Short Term
ISQG	Interim Sediment Quality Guidelines
MBBA	Maritime Breeding Bird Atlas
MBCA	Migratory Birds Convention Act
MOE	Minister of Environment
MW	megawatts
NAFO	Northwest Atlantic Fisheries Organization
NO_X	nitrogen oxide
NPA	National Program of Action
NRCAN	Natural Resources Canada
NSAQR	Nova Scotia Air Quality Regulations
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSEA	Nova Scotia Environment Act
NSESA	Nova Scotia Endangered Species Act
NSPI	Nova Scotia Power Incorporated

NSWA	Nova Scotia Wildlife Act
NWPA	Navigable Waters Protection Act
PAHs	polycyclic aromatic hydrocarbons
PPhM	parts per hundred million
RA	Responsible Authority
SAR	species at risk
SARA	Species at Risk Act
TC	Transport Canada
TPH	total petroleum hydrocarbons
TSS	total suspended solids
UARB	Utility and Review Board (Canada)
VECs	Valued Environmental Components
VOCs	volatile organic compounds
WHRP	Waste Heat Recovery Project
WHMIS	Workplace Hazardous Material Information System

1 INTRODUCTION

1.1 The Proponent

Nova Scotia Power Inc. (NSPI) is the primary operating subsidiary of Emera Inc., a diversified energy company, based in Halifax, Nova Scotia, that provides 97% of the electrical generation, transmission and distribution in the province and serves 460,000 residential, commercial and industrial customers. Currently, NSPI operates 5 thermal generating stations across Nova Scotia. Tufts Cove Generating Station, located on the eastern shore of Halifax Harbour in the North End of Dartmouth, utilizes a combination of oil and natural gas to produce energy.

1.2 Project Overview

In 2004, NSPI submitted an Environmental Assessment (EA) Registration Document for the proposed Tufts Cove #5 Combustion Turbine Project. Under the Terms & Conditions listed in the Approval for the Project, NSPI was required to convert the plant to a combined cycle operation within three years of exceeding a 20% capacity factor, subject to Utility and Review Board (UARB) and other required regulatory approvals. The Waste Heat Recovery Project (WHRP) was approved by the Utility Review Board in 2007.

This proposed upgrade involves the addition of a 50 megawatt (MW) Heat Recovery Steam Generator (HRSG) that uses waste heat from existing Tufts Cove Units 4 and 5 to create an additional 25 MW through combined cycle operation. An additional 25 MW will come from supplemental duct-firing using natural gas. The new system will be made up of two boilers and a condensing steam turbine generator.

1.3 Regulatory Overview

NSPI contacted Nova Scotia Environment (NSE) and on January 6, 2009 received formal confirmation the proposed Tufts Cove 6 project would be designated as Class 1 for EA review, on the basis that it is a modification or extension of an existing facility with minimal potential impacts. NSPI has also had some technical discussions with Nova Scotia Environment (NSE) representatives, incorporating appropriate information into this registration package to address the main topics of concern.

The marine portion of the project includes an infill of the Halifax Harbour and a cooling water intake structure. In discussions with the Department of Fisheries and Oceans (DFO) it has been confirmed both the infill activity and construction of the cooling water structure will need to be authorized under the Fisheries Act and therefore also trigger an environmental assessment under the Canadian Environmental Assessment Act. Additionally, discussions with the Navigable Water Protection Agency have confirmed both the proposed infill and cooling water structure may require authorizations under the Navigable Waters Protection Act (NWPA). NSPI currently has two NWPA authorizations for the Tufts Cove site, including the 1963 Authorization for the original infill and the 1978 authorization for the coal pier.

NSPI will register this project on March 3, 2009. Following a period of notification and public comment, a decision by the Nova Scotia Minister of Environment (MOE) is required within 50 days. Subject to EA approval, NSPI will also obtain a construction approval for the project and will then negotiate an amendment to the Industrial Operating Approval for the Tufts Cove Generating Station.

The construction methods will not involve blasting or the use of explosives. As well, the facility will not manufacture, store, or use explosives during operation. There are also no requirements for radio apparatus to be located on the site, or radio towers or masts to be erected.

Following the EA process, and pending approval, construction and operating approvals will be required for the land-based structure from the provincial regulator, NSE, under the Nova Scotia Environment Act (NSEA) (Activities Designation and Approvals Procedure Regulations).

1.4 Organization Of The Report

This Report includes the detailed project description and environmental information supporting that Registration. This document is organized in the following manner so as to meet all of the requirements of a registration document:

Section 1: Introduction – introduces the Project and provides a brief background about NSPI.

Section 2: Project Description – describes the nature of the Project including the major components, past and current land use of the site, purpose and need of the Project, construction and operation schedules, decommissioning, applicable environmental legislation, and required environmental approvals.

Section 3: Environmental Assessment Process - describes the provincial considerations of the EA process.

Section 4: Public Consultation Program – summarizes the public consultation activities, including issues raised and corresponding responses.

Section 5: Biophysical Environment – describes the current environmental conditions of the area and identifies the valued ecosystem components.

Section 6: Socioeconomic Considerations – describes the relevant socioeconomic issues related to the project.

Section 7: Environmental Studies – provides a summary of the studies completed for air quality, cooling water, marine benthic and sediment surveys, and noise for the site.

Section 8: Valued Ecosystem Components – lists the valued ecosystem components and provides rationale for the selection.

Section 9: Effects Assessment Methodology – describes the methodology used for the Effects Assessment.

Section 10: Effects Assessment – presents the methodology of the effects assessment and an effects assessment of the previously identified valued ecosystem components.

Section 11: Synthesis – summarizes the key environmental components of the project (including any proposed mitigation) and reinforces the beneficial nature of this proposed undertaking.

Section 12: References – provides a list of references for the Project Report.

2 PROJECT DESCRIPTION

2.1 Nature of the Project

NSPI currently operates two LM6000 PC E-Sprint gas turbine generators located at Tufts Cove, Nova Scotia. These gas turbines (Tufts Cove 4 and 5) are operated in simple cycle mode. Simple cycle is the most basic operating cycle for gas turbines. In simple-cycle mode ambient air is drawn in and compressed, directed into a combustion chamber where fuel is introduced, ignited and burned. The hot gases from the combustion spin the turbine, and the connected electrical generator, before being exhausted to the atmosphere. Figure 1 provides an illustration of the simple cycle process

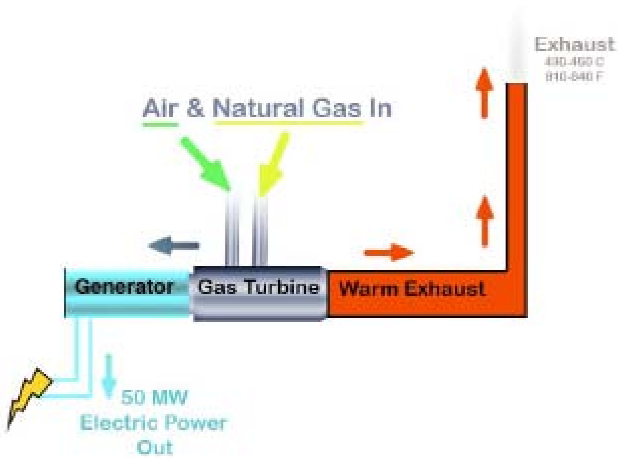

Figure 1 Simple Cycle Process

NSPI is working to upgrade these units by installing two heat recovery boilers, a single condensing steam turbine generator (Tufts Cove 6) and associated balance of plant to create a combined cycle generating station (the Project).

Combined cycle operation involves recovering waste heat in the gas turbine exhaust. A HRSG is a boiler designed to use the heat in the exhaust to produce steam. The steam is then used to power a steam turbine and generator. The use of the waste heat represents a substantial improvement to cycle efficiency. The switch to LM6000 combined cycle operation would deliver efficiency levels of 43-46 percent as opposed to the current efficiency factor of 36 percent. Conversion of Tufts Cove Units 4 and 5 to a combined cycle operation would result in the most efficient thermal generating station in NSPI's fleet, while also adding 25 MW of capacity with no additional fuel cost or emissions to the NSPI generation portfolio.

The total project capacity is 50 MW; 25 MW of generation are produced from the waste heat of the two existing combustion turbines, Units 4 and 5, and an additional 25 MW is achieved through supplemental duct-firing. Duct firing consists of the installation of natural gas fired burners in the ductwork upstream of the HRSG. The additional heat provided by the duct burners can allow even more steam to be produced in the HRSG, thereby leading to increased steam flow in the steam turbine and ultimately, an increase in generator output. Figure 2 provides an illustration of the combined cycle process with supplemental duct firing.

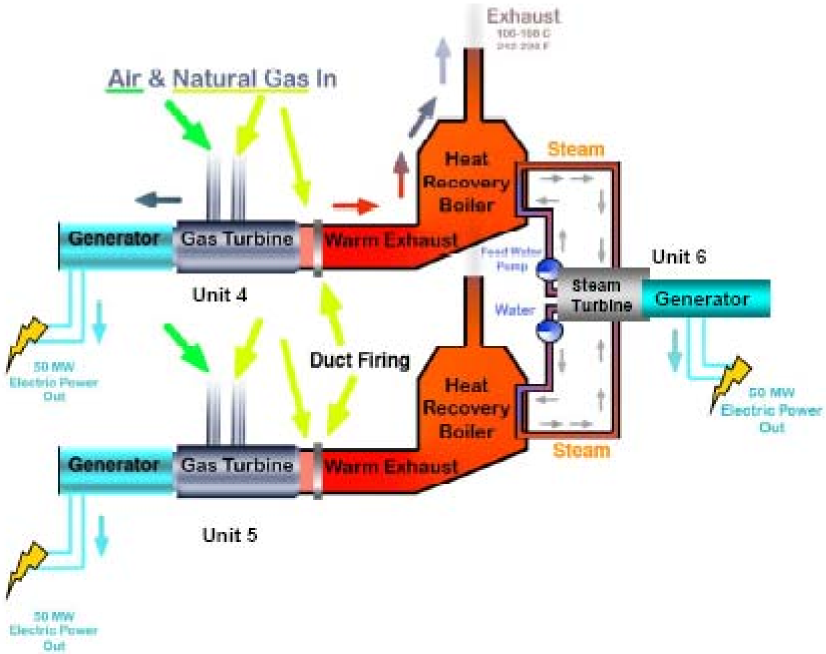

Figure 2 Combined Cycle Process with Supplemental Duct Firing

The increase in gas-fired generation will facilitate the expansion of NSPI's renewable generation portfolio by increasing the Company's ability to accommodate additions of intermittent supply sources (e.g. wind power) as well as providing fast-response backup generation. The project also facilitates the development of Demand Side Management (DSM) programs as the addition of 50 MW of capacity will delay the need for a much larger-scale generating facility. Increased gas-fired generation will contribute positively to NSPI's operating and fuel flexibility and security of supply through increased reserve margins, access to lower-emission energy, reliability of service and consumption of an indigenous fuel source.

In addition to the above, this project complies with the requirement stipulated in the environmental permit for Tufts Cove 5 whereby NSPI is required to seek regulatory approval for a combined cycle plant once the Tufts Cove 5 annual capacity factor exceeds 20 percent. This figure was achieved in 2005.

Figure 3 shows an exterior illustration of the 50 MW HRSG and its relationship to the existing five units: Tufts Cove 1 (100 MW), Tufts Cove 2 (100 MW), Tufts Cove 3 (150 MW), Tufts Cove 4 (47.3 MW) and Tufts Cove 5 (47.3 MW).

Figure 3 Sketch of Tufts Cove Generating Station – showing existing CT Units 4 and 5 and proposed TUC 6 powerhouse adjacent to powerhouse for Units 1-3

2.2 Purpose and Need of the Project

The increase in gas-fired generation will facilitate the expansion of NSPI's renewable generation portfolio by increasing the Company's ability to accommodate additions of intermittent supply sources (e.g. wind power) as well as providing fast-response backup generation. The project also facilitates the development of Demand Side Management (DSM) programs by delaying the need for a much larger-scale generating facility. Increased gas-fired generation will contribute positively to NSPI's operating and fuel flexibility and security of supply through increased reserve margins, access to lower-emission energy, reliability of service and consumption of an indigenous fuel source. In the initial operational years, the capacity factor will be variable. The equipment and systems are designed for continuous base load operation and capable of operating in two shift mode on a regular basis. The plant is expected to operate 5000 hours per year and the design allows for any combination of overnight, weekend and extended cycles with up to 300 starts per year. The turbines' load can be ramped up as quickly as in the present simple cycle mode, unrestricted by downstream components including the boilers and steam turbine. Tufts Cove 6 also provides the option of running one or both Units 4 and 5 in simple cycle mode.

The proposed project complies with the Terms and Conditions of the Environmental Assessment Approval for Tufts Cove 5, specifically section 2.1 which states:

> *"The Proponent will be required to convert Tufts Cove #5 to a combined cycle operation, subject to Nova Scotia Utility and Review Board and other regulatory approvals, within three years if the plant exceeds a 20% capacity factor measured on an annual basis."*

Tufts Cove #5 exceeded the 20% capacity factor in 2005.

2.3 Past and Present Land Use

The existing Tufts Cove Generating Station is located along 1000 m of shoreline in Dartmouth, Nova Scotia, between the two bridges spanning Halifax Harbour (Figure 4). The Station is bounded by Canadian Forces Base Shannon Park to the North, Halifax Harbour to the west and residential/commercial development to the East and South. The coordinates of the site are:

Latitude N 44° 40’ 29.77”
Longitude W 63° 35’ 47.70”
UTM N 4947014 E 452715

Figure 4 Tufts Cove Generating Station – Dartmouth, NS (Google Earth, 2009)

The site is accessed by secondary paved roads, and the major trunk Highway 118. The Halifax Regional Airport is located 35 kilometres from the site.

Maps and drawings showing the location of the site can be found in Appendix A. Relevant property information and proof of land ownership is provided in Appendix B with the inclusion of a site drawing and a list of all property deeds and water lot leases associated with the Tufts Cove Power Generation Station.

In December 2008, Cultural Resource Management (CRM) Group completed a historical review of the south end of the Tufts Cove Generating Station site. Eighteenth century maps of Halifax Harbour made after the founding of Halifax in 1749 accurately show Tufts Cove to be a significant inlet located immediately southeast of the harbour narrows. Residence at Tufts Cove would have provided settlers with immediate access to an array of terrestrial, fluvial, estuarine and marine resources; therefore Tufts Cove was likely settled periodically in Precontact times.

However, considering the stoniness and unevenness of the ground, the small size of the brooks that flowed into the cove and its periodic exposure to southwest gales, the cove would not have been the preferred campsite on the harbour.

The earliest known record of Mi'kmaq habitation at Tufts Cove is a 1791 watercolor painting that depicts a group of at least twenty individuals at a shoreline encampment. Subsequent sketches and paintings show similar scenes and suggest that the community extended northward from the study area toward the head of Tufts Cove.

By the late nineteenth century, the Mi'kmaq population in the area had shifted slightly southward along the shore, to the present alignment of Nivens Avenue. When the Halifax Explosion occurred in December 1917, almost directly across the harbour from Tufts Cove, the shock wave and tidal surge destroyed buildings all around the cove. Survivors of the Mi'kmaq community moved to other Mi'kmaq communities at Shubenacadie and in Cape Breton. According to a local historian, the Mi'kmaq are not known to have established a cemetery at Tufts Cove. Records indicate that Mi'kmaq residents at Tufts Cove buried their dead at Catholic cemeteries in Dartmouth, established first in 1829. It is also believed that some Tufts Cove residents may have been buried at Shubenacadie.

Sometime before 1808, a bark mill and tannery was established on the south side of the harbour shore north of Grove Street, approximately 330 meters south of the study area. Known as the Rockland Tannery, it remained in operation until the mid-1800s. In 1867, the Turtle Grove Brewery was established on the site of the former Rockland Tannery, and was later known as the Army & Navy Brewery.

Following the Halifax Explosion, the study area appears to have remained vacant until work began on the Tufts Cove Generating Station. (CRM, 2008)

Unit 1 was commissioned in 1965, with a dual-fuel capability to burn coal and oil. In 1972, Unit 1 was modified to fire oil only and Unit 2 was commissioned. Unit 3 was added in 1976. Over time the following improvements have been made:

- Docking facility in 1976;
- Storage tank in 1977;
- Magnesium Hydroxide injection system in 1986;
- Wastewater treatment facility in 1993;
- Electrostatic precipitator for Unit 2 in 1994-1995;
- Modification to allow the burning of natural gas in Units 1, 2 and 3 in 1999-2000; and
- Electrostatic precipitators for Units 1 and 3 2000-2006.

In 2003, Unit 4 was commissioned, followed by Unit 5 in 2004.

The existing station has a nameplate capacity of approximately 445 MW. Units 1 to 3 can be fired on either No. 6 oil (Bunker "C") or natural gas, or a combination of those two fuels. Units 4 and 5 are solely fired on natural gas. The station is bounded by CFB Shannon Park to the North, and residential/commercial development to the East and South (Figure 5).

Figure 5 Tufts Cove Generating Station – March 1965

2.4 Project Schedule

The construction of the unit will begin as soon as EA and construction approvals are received. NSPI expects to commence mobilizing by late April with construction starting in early May 2009. Initial construction will involve ground breaking and Harbour infilling. The planned in-service date is November 2010 and the Project has been designed for a 20-30 year operating life. The decommissioning phase of this project has not been scheduled or planned. When the decommissioning phase takes place all relevant regulations and requirements will be met. Since much of the system is delivered to the site in pre-assembled components, some of the on-site construction is more straightforward when compared with historical generation facility construction. There is a need, however, for preparation of building foundations and assembly of other civil structures, and considerable effort is required for assembly of components. Time is being scheduled for the commissioning of each system of the Tufts Cove (TUC) 6 project. Currently there are no foreseen requirements for off-site land use in the construction or operation phases of this project.

2.5 Major Project Components/Activities

The following sections describe the various components and activities associated with the proposed project. Drawing No. 8560003 in Appendix A depicts the major components of the proposed project in a plan view format and Drawing No. 85600004 depicts the details of the harbour infill and circulating water intake.

2.5.1 Land-based Structures

Land-based structures that fall within the operational scope of Tufts Cove 6 include the following:

- Two heat recovery boilers complete with natural gas duct burners;
- Two stacks approximately 30 m in height;
- A 50 MW steam turbine generator with sea water condenser;
- Turbine generator building;
- Circulating water system;
- Balance of plant (BOP) systems;
- Low pressure gas line;
- Control system; and
- Substation transformer/switchgear.

General site preparation will include a modest amount of excavation to prepare building foundations.

2.5.2 Marine-based Structures

Marine structures associated with Tufts Cove 6 include the cooling water intake and outfall structures. Although the footprint for the new components will be largely within the existing plant site, an additional infill of 2520m^2 in the Harbour adjacent to the site is required to create space to accommodate construction and for post-construction access around the site (Drawing 8560003 in Appendix A). The proposed cooling water intake structure will have a footprint of 400m^2 (Drawing 8560003 in Appendix A), bringing the total infill to 2920m^2. Neither the infill nor the cooling water intake will extend beyond the water lot currently owned by NSPI.

Tufts Cove 6 will require a supply of natural gas for the supplemental duct-firing. Piping will be installed to connect the new system to the existing natural gas supply for Units 4 and 5. A short pipe will run from the compressor building to the boiler ductwork.

2.5.3 Water Usage

The main water requirement for operation is associated with the cooling water system. It is estimated that a maximum of approximately 3.0 m^3 of water per second will be pumped from the Halifax Harbour to the system. An auxiliary cooling water system will use sea water heat exchangers at an estimated volume of 0.3 m^3 of water per second. City water will also be used for such activities as flushing the heat exchangers, floor washing, lavatory facilities, and other domestic purposes. Conservation and efficient use of water will be incorporated into the operation of the facility. The results of cooling water studies conducted to support the project are discussed in greater detail in Section 7.2 of this report.

2.5.4 Cooling Water Intake

As a requirement under section 30 of the Fisheries Act, NSPI is obligated to screen or guard against fish passage into the cooling water intake structure. Entrained fish are not a common occurrence at the existing Tufts Cove plant however, NSPI conducted a thorough review of the available and proven technologies currently employed for fish screening in cooling water intake structures. The favoured design as depicted in Drawing #85600003 and #85600004 in Appendix A, was developed by AMEC as a two stage system commonly utilized by power production facilities in North America. It consists of a coarse box screen at the intake end-of-pipe and a finer wedge wire “V” shaped screen system located in the cooling water pump house.

The system consists of two 1.59 m outer diameter (OD) high density polyethylene (HDPE) intake pipes running approximately 41 m from the sheet pile wall (See Drawing #85600003 in Appendix A) in a westerly direction to a coarse box screen structure. These will be non-pressure pipes and will use the head of the water above to push the water through the pipes. At this distance from the wall, the water temperature at the intake depth (approximately 5 m depth) will sufficiently meet operating requirements for the condenser. The outermost guard or box screen at the intake will consist of 0.1 m^2 mesh openings. The objective of the coarse screen is to prevent the entrainment and impingement of divers, debris and larger fish and also to maintain a maximum flow velocity at the screen face of 0.15 m/s, as required by Environment Canada’s Code of Practice for Steam Electric Power Generation. The type of screen material has yet to be determined but will be selected based on anti-corrosion properties as well as prevention of mussel and seaweed attachment. It is known that small fish will likely be entrained into the system but will be directed or induced back to the harbour via a fish passage pipe in the pumping structure.

The innermost fish passage guard is contained within the cooling water pump structure and will consist of two main forebays with wedge wire “V” shaped screens. These screens will be sized to provide a surface area to maintain a flow velocity of 0.15 m/s at the lowest tide while factoring a 50% reduction in surface area due to fouling. These screens will be able to be lifted to the surface to be periodically cleaned. At the apex of the "V" there will be a fish bypass pipe opening approximately 500 mm in diameter that will use an eductor system which will induce flow in the pipe to carry fish back to the harbour. The motive force of this system is a supply of water from a pump which is discharged into the eductor pipe. The fish will not go through an impeller. This type of intake system provides a simple form of maintenance over the long term while achieving fish protection and low flow velocities.

NSPI thoroughly researched a second alternative design for the cooling water intake design, specifically a custom made wedge wire screen at the cooling water pipe intake that would eliminate any need for secondary screening in the pump house. The main benefit of these wedge wire intake screens is the reduction of fish entrainment when properly operating. Several leading North American wedge wire or Vee-Wire manufacturers and distributors were contacted and technical product information reviewed. The wedge wire intake screen technology is being used extensively in various industrial freshwater applications throughout North America. It is also reportedly being used for power production cooling water intake applications in the Great Lakes and other locations throughout the US. However, according to research and discussions with manufacturers and fish passage consultants, it appears the screens are not widely used in saltwater environments and there lacks conclusive anti-fouling performance evidence for seawater applications. The few marine power generation applications on the East Coast of the US that use passive intake screens reportedly require intensive maintenance programs. This option was ultimately not pursued because of performance uncertainty in a comparable marine environment. The inherent risk associated with a product that is not proven in an environment or application similar to Tufts Cove is considered too great.

The two staged AMEC designed system described above will entrain some small fish however, the eductor system combined with the use of the wedge wire "V" shaped screens will effectively promote fish passage and minimize fish mortality. Long term bio-fouling maintenance was also an important design criteria and the AMEC system was designed to minimize long term operating maintenance. The coarse outer box screen at the intake will be equipped with lifting components enabling it to be easily lifted to surface, cleaned and dropped back in place. With the innermost screens in the pump house, the pump chambers will be designed such that each chamber can be easily isolated allowing for maintenance to the screens in the adjacent chamber. From a fish protection and maintenance of screen bio-fouling perspective, the AMEC design appears to be the most effective.

2.5.5 Cooling Water Discharge

After circulating once through the cooling condensers, cooling water will be discharged back into the Halifax Harbour marine environment via a 1.35 m OD outfall pipe located on the south side of the new construction and infill area.

AMEC conducted cooling water studies in 2006 and 2007 in order to determine any incremental increases in background harbour temperatures resulting from the addition of cooling water discharge from Tufts Cove 6 (AMEC, 2008). The cooling water modelling was completed with input criteria requiring that the temperature of the discharge plume meet the guidelines stated in the *Environmental Codes of Practice for Steam Electric Power Generation* (1985)(Steam Codes) issued by Environment Canada, specifically:

> "4.1.1.14 Thermal plume zones.
> RECOMMENDATION R114. Unless it is demonstrated that a greater area of influence is no more detrimental environmentally, the thermal plume (as defined by the 1^{o}C isotherm) from a generating station should not, when combined with thermal plumes from other sources, cause the combined area occupied:
>
> i) within the 50 km segment of nearshore zone on which the station is centred, to be greater than 10 percent of the total nearshore zone surface area for that segment in all water body types except rivers;…
>
> Rationale. The recommendation protects the majority of the nearshore zones in large and small fresh water bodies, in saltwater bodies and in rivers. It ensures that the nearshore zones remain available for normal biological productivity, unaffected by heated discharges, and that the free movement of fish is not seriously inhibited."

Additionally, the Steam Codes include Design Opportunities to minimize the impact of thermal plume zones, one of which is that "a smaller plant may be selected with once-through cooling", which is the case with the proposed project.

The plant will be designed to meet these guidelines. Results from the AMEC study predict the incremental temperature increase of receiving water resulting from the discharge of Tufts Cove 6 cooling water may very from approximately 0.75°C within 20 to 30 m of the cooling water outfall, to less than 0.5°C at 50 m from the outfall, to less than 0.25°C at 200 m from the outfall.

Based on the results of the study, the minimal temperature increase is not expected to have any detrimental effects on the marine environment.

Alternative cooling water discharge options for this application are not feasible considering the existing conditions, limitations with the existing plant site, and the fact that predicted discharge plume temperatures in the receiving environment are well within the guidelines stipulated by the *Environmental Codes of Practice for Steam Electric Power Generation* (1985).

2.5.6 Construction Materials/Services

Construction activities for the project will commence with the extension of the shoreline by approximately 2520 m^2 of offshore infilling. Dredging of seabed materials will be required for the Cooling Water Intake system trench to achieve the desired depths. A recent offshore geotechnical program conducted in January, 2009 indicated that the material in the vicinity of the proposed cooling water trench consisted primarily of large cobbles and boulders. There was very little sediment in this area which is likely a result of abrasive washing from current and tidal action. Dredged sediment spoils, if encountered, will be stockpiled, screened and sampled on NSPI property. Stockpiled material will be placed in designated storage areas with runoff control. All sediment that exceeds the applicable Canadian Council of the Ministers of the Environment (CCME) and the Atlantic Tier I risk-based screening level guidelines will be disposed of at a licensed off-site soil disposal facility.

The material used to infill the shoreline will consist of approximately 7872 m^3 of fill and stone. The fill material used inside and behind the caissons consists of clean rock with no sediment. The characteristics of the infill material for the sloped area nearest the railway are shown in detail 2 of Drawing 85600004 in Appendix A. In general, the infill profile of the sloped area will consist of layered Type 3 engineered fill overlain by Type 4 engineered fill and Type 2 gravel. The slope will be protected from erosion and storm surge by 1.5 m of core and armour stone.

The materials required for the construction of this project will be those typical of similar structures, such as structural steel, concrete, fill, and other fabrication materials.

Equipment will be brought to the site by rail or barge via the Halifax Harbour. Industrial and construction services are readily available locally. There is a possibility that the Steam Turbine Generator will be transported to the site via barge. Should this occur, the Transport Canada (TC) Guidelines for the Control of Ballast Water Discharge from Ships in Water Under Canadian Jurisdiction will be followed and would address an ongoing concern regarding the impact of invasive species to Canadian waterways via exchange of ballast water from international vessels. It is not expected that the construction of Tufts Cove 6 would significantly increase ship traffic to the Harbour.

Energy requirements for construction will be met via electricity supplied by the existing site services or portable generators. Energy requirements for operation will be met via natural gas burned in the combustion turbines (Tufts Cove 4 and 5) or supplemental duct burners. Natural gas will be piped to the boiler ductwork from the compressor building through a piping connection with the existing natural gas supply on site.

The facility will not be using any toxic or hazardous materials in the construction or operation apart from fuels, lubricants, and some chemicals. However, there is potential for release of these materials and proper handling and storing procedures will be put in place to minimize the potential for spills. As well, contingency plans will be developed to respond to accidental spills of these substances, in the rare event that they do occur. Areas where these materials are used or handled will conform to all relevant regulations such as the provincial Dangerous Goods Management, Petroleum Management, Workplace Hazardous Material Information System (WHMIS), and Emergency Spill Regulations. In addition, the site will conform to the Federal Transportation of Dangerous Goods Act and Regulations and the Fisheries Act and Regulations.

2.5.7 Impacted Soils

Special attention will be given to the existing industrial site in regards to the management of impacted areas that might be disturbed by construction. Such management is part of standard practice for Nova Scotia Power and, typically, the company will engage professional expertise to work with the personnel from the company and the regulators to ensure that the requirements established for management of impacted materials are met. The impacts that exist on the power plant property have occurred due the presence of petroleum hydrocarbons and metals. The research conducted during the commissioning of Units 4 and 5, as well as the preliminary work completed for Unit 6, has provided information that indicates that there are relatively low levels of hydrocarbon and metals contamination in the South Yard.

A geotechnical investigation of the proposed location for Tufts Cove 6 was conducted in September, 2007. Representative soil and bedrock samples were collected from five boreholes and select samples were analyzed for the following contaminants:

- benzene, toluene, ethylbenzene, and xylene (BTEX);
- total petroleum hydrocarbons (TPH);
- metals; and
- polycyclic aromatic hydrocarbons (PAHs).

Analytical results indicate some soils have environmental impacts typical of operation of a coal and oil-fired power plant. Material excavated during construction activities will be placed in designated storage areas with runoff control. Representative samples will be collected and analyzed for BTEX/TPH, metals and PAHs. Soil that meets Atlantic Tier I risk-based screening levels and Canadian Council of the Ministers of the Environment (CCME) soil quality guidelines will be re-used on site. Soils that exceed guidelines will be sent for off-site disposal at a licensed facility.

2.6 Environmental Management Plan

A Construction Plan will be developed and submitted for regulatory approval as part of the NSE Construction Approval process. The plan will be consistent with the elements of a site specific Environmental Management Plan (EMP), currently under development, NSPI’s standard practices, as well as applicable regulations and guidelines. The plan will address the following requirements, as necessary:

- Disposal of hazardous and non hazardous waste from the site;
- Recycling and reuse of material(s) where practicable;
- Prevention, mitigation, and remediation of environmental releases;
- Transportation of materials;
- Proper vehicle and equipment cleaning, refuelling and maintenance;
- Procedures for managing the excavation of materials, under all circumstances and conditions; and
- Sedimentation and control measures.

The discussion of the adequacy of the EMP will occur with activity required to obtain approval for the actual construction and installation of the HRSG.

2.7 Waste Disposal

The primary waste associated with the proposed operation of Tufts Cove 6 is wastewater from condensate polisher regeneration. The wastewater will be transferred to the existing wastewater treatment plant for treatment prior to discharge. Water quality of the discharge will be monitored regularly to ensure that waters leaving site meet the terms and conditions specified in the Operating Approval.

Other wastes may include regular garbage, recyclable materials, compostable materials, construction debris, and waste petroleum/chemical products. Regular garbage, recyclables, and compostables will be disposed of as per municipal regulations. Disposal of petroleum and chemical waste will occur as per the regulations laid out under NSE.

Domestic Sewage discharge will remain tied into the Halifax Regional Municipality sewage system during both construction and plant operations. The existing control building is serviced by a sanitary sewage holding tank. With the completion of the Halifax Harbour clean up project, a trunk sewer is now located at the southeast corner of the project site. The tank will be replaced with a sewage lift station with dual grinder pumps in a manhole structure with control panel and a small diameter PVC force main sized to handle current flow. The force main will be installed to discharge to the HRM collector sewer.

2.8 Decommissioning

This proposed Unit will be constructed and operated in a manner that minimizes environmental impacts, thereby facilitating standard decommissioning activities at the end of the operating life. The modular nature of construction and the absence of fuel storage and associated combustion waste management facilities, reduce potential decommissioning activities. In any case, NSPI will carry out future decommissioning in a manner consistent with the standards and requirements of the day.

3 ENVIRONMENTAL ASSESSMENT PROCESS

NSPI inquired about, and received, formal confirmation that this proposed TUC 6 project would be designated as Class 1 for Environmental Assessment (EA) review, on the basis that it is a modification or extension of an existing facility.

Pursuant to the EA Regulations the Minister has authority to consider changes to a project, a “modification” of an undertaking and require an environmental assessment.

NSPI registered this proposed project on March 3, 2009. Following a period of notification and public comment, a decision by the Minister of Environment and Labour is required within 50 days of registration.

Subject to EA approval, NSPI will also obtain a construction approval for the project and will then negotiate an amendment to the Industrial Operating Approval for the Tufts Cove Generating Station.

3.1 Federal Considerations

NSPI is currently engaged in discussions with the Federal Department of Fisheries and Oceans (DFO) and Transport Canada Navigable Waters Division over authorizations required pursuant to the *Fisheries Act* and *Navigable Waters Protection Act* respectively.

4 PUBLIC CONSULTATION

Public consultation is a very critical component of the Provincial EA process.

4.1 Environmental Assessment Requirements

The Provincial EA process has specific requirement opportunities for public consultation. They are listed below:

1. Registration: Registration documents placed at public places (e.g. NSE office) for viewing. Members of the public have opportunity to provide comment before decisions are made by regulatory agencies.

2. Advertising Notices: These notices must be placed in newspapers with provincial and local circulation advising the public that a project has been registered and that documents are available for viewing at select locations.

3. Internet: The registration document must be placed on the NSE EA website for electronic access.

The result of this process is a project that has been thoroughly vetted by the public and regulatory officials.

Preliminary consultation took place during an Open House held on November 6, 2008 from 3:00 pm to 8:00 pm at the Tufts Cove Generating Station. The purpose of this Open House was to provide the public with an opportunity to view information on the proposed HRSG and share comments and views based on the proposed project. Information presented included a panel display containing information on the history of the generating station, project components, the EA process, marine and land based environmental issues, an artist's rendering of the completed project and various photos of the plant. A video segment providing information on areas of interest at the generating station and the plants placement in the community was also produced specifically for this project. Attendees were also encouraged to take an information sheet highlighting details of the project with them. Contact information was provided on the take-away document for further comments or questions.

Notices informing the public of the Open House were placed in the Chronicle Herald and Metro newspapers. Various representatives from NSPI were available at the Open House to answer questions regarding the project. Approximately 20 people attended the event representing various organizations and groups such as the Nova Scotia Boilermakers Union, Nova Scotia Community College, other industry representatives, and local residents.

Consultation also included one-on-one sessions with local municipal officials to ensure that community leaders had up to date information on the project. They were provided with a direct opportunity to discuss the project with company representatives.

The project was also submitted by NSPI as part of the Integrated Resource Plan submitted to the UARB in 2007. Through the course of the consultation the IRP was subject to review by a number of stakeholders in the context of future generation and was considered to be a viable part of the generation mix.

While some questions were raised during these meetings, no significant environmental concerns were voiced. In most cases questions were of a general nature, directed at the scope of the project, what it involved, when it would be done, etc. A few individuals had understood this project would be providing district heating to the surrounding neighbourhood, which is not the case. The issue of noise in relation to existing conditions was also raised. Generally speaking, most stakeholders were supportive of the project and saw it as a positive development. NSPI will continue to liaise on all issues related to this project as they arise.

The Class 1 Registration process also provides a formal opportunity for the general public to review registration materials and provide comments to NSE.

5 BIOPHYSICAL ENVIRONMENT

Information for this biophysical survey was collected for the general area of Halifax Harbour.

5.1 General

Under the classification system for theme regions in Nova Scotia, this area is part of the Atlantic Coast Region (#800) and is designated as the Eastern Beaches Sub-Region/Landscape (#833) characterized by an indented submerged coastline with headlands, long inlets, and drumlin islands (Davis and Browne 1996b; NSDNR, 2005).

Halifax Harbour is a major inlet of the North Atlantic Ocean within the province of Nova Scotia, approximately midway along the south-eastern provincial coast. It extends inland for over 28 km to the northwest and is composed of outer and inner divisions; two projecting arms, the Northwest Arm and Eastern Passage; and a very deep and large bowl-shaped basin at its head, Bedford Basin (NRCAN, 2007). The Harbour has four islands from north to south: Georges, McNabs, Lawlor, and Devils. The Sackville River is the major river that enters the north end of the Harbour in Bedford Bay (NRCAN, 2007).

Generally the Harbour remains ice-free throughout the winter season and as such, it is a major terminal for trade throughout North America. The Harbour is the destination of large bulk carriers on a regular basis, as it is the first inbound and last outbound port of call in eastern North America with trans-continental rail connections. Cape, Panamax, and post-Panamax size vessels visit the port on a regular basis to utilize container facilities and other shipping docks, such as loading and offloading facilities for gypsum, automobiles, and petroleum products. The Royal Canadian Navy - Maritime Command maintains a large base, housing the Atlantic fleet Maritime Forces Atlantic, along the western side of the Narrows, as well as an ammunition depot on the north-eastern shore of Bedford Basin. The harbour is used not only for industrial and military vessels, but also for pleasure boating and there are several marinas on the harbour.

Overall Halifax Harbour is relatively shallow (20 metres) in the Inner Harbour and the Narrows, opening up into the deep waters of the Bedford Basin (70 metres). The Harbour generally behaves as an estuary, with fresh water from the Sackville River and other minor sources mixing with surface sea water to create a two-layered flow system with vertical mixing taking place at the interface between freshwater surface flows and saltier, heavier water flows along the bottom. Currents are strongest in the Narrows, especially in the bottom layer (0.08-0.22 km/h), and off Sandwich Point (Government of Canada and Government of Nova Scotia, 1993). Tufts Cove is a part of the HRM and is located in the Narrows where flow of sub-surface water is to the southwest (NSPI, 2008).

5.2 Atmospheric Environment

The ocean is the dominant influence on the climate of Halifax Harbour which experiences an average annual temperature of 6.5^{o}C (NSDNR, 2005). The main features of the climate include moderated seasonal and daily temperatures, high precipitation and humidity, strong winds, fog, and salt spray (Davis and Browne, 1996b). The warmth of the Gulf Stream, especially from August through October maintains a prolonged fall while cool summer seas stabilize overriding air masses, creating cool summers and suppressing local storm development (Davis and Browne, 1996b). In addition, the merging of contrasting ocean currents - warm Gulf Stream and the cold Labrador Current - produces a great deal of sea fog that often moves far inland (EC, 2006). Winter temperatures are moderate along the coast and the most significant aspect of winter is the marked day-to-day variation caused by the alternation of Arctic and maritime air (EC, 2004 and 2006).

The Halifax coastal area experiences 1500 mm of rain per year (Davis and Browne, 1996b; EC, 2004 and 2006). Halifax Harbour has an average precipitation for May to September of 100 mm, compared with 124 mm for the balance of the year (NSDNR, 2005). Precipitation is slightly greater in the late fall and early winter because of the more frequent and intense storm activity (EC, 2006). Snowfall is relatively light near the Halifax shore and average annual snowfall is around 190 cm, with accumulations varying greatly from year to year (NSDNR, 2005). The snowcover season (the period when there is at least 2.5 cm of snow on the ground) varies considerably in this area with a duration extending from about 110 days a year (EC, 2006).

The period from mid-spring to early summer is the foggiest time and average fog has been measured at about 101 days at Shearwater, on the Dartmouth side of the Harbour, although on most days fog persists for less than 12 hours (Davis and Browne, 1996b; EC, 2006). Average hours of sunshine are about 209 hours between May and September, and 129 hours from October to April (NSDNR, 2005), with August as the sunniest month (EC, 2006). Sunless days (days with less than 5 minutes of bright sunshine) amount to between 75 and 90 a year in this area (Halifax area), with a marked seasonal high from November to February (EC, 2006).

Storms frequently pass close to the coast of the province and cross the southern part of Newfoundland, producing highly changeable and generally stormy weather. Winter storm (nor'easters) create winds that can exceed 150 km/h, and peak wave heights that can be as high as 14 m, causing storm surges of more than a meter at high tide (EC, 2006). Other conditions associated with these storms include freezing spray, reduced visibility in snow, rain, or fog, and increased wind chill, especially in the storm's wake (Davis and Browne, 1996a). Other severe storm activity includes hurricanes or remnants of hurricanes, and tropical storms in late summer and fall, and ice storms and blizzards in winter. Thunderstorms occur on about 10 days of the year, and although tornadoes have been recorded, these events are rare (EC, 2006).

5.3 Geology and Soils

Bedrock is dominated by greywacke, with bands of slate, folded parallel to the coastline which is divided into headlands separated by long inlets most of which are drowned river estuaries and do not appear to be fault-controlled (Davis and Browne 1996b).

The important factors that influence soil development in this region are the high precipitation and shorter winters, which result in strong leaching action over a greater part of the year, resistant igneous or metamorphic bedrock, low relief, and slow decomposition of leaf and needle litter (Davis and Browne 1996a). Well-drained Halifax gravely sandy loams derived from quartzite cover much of this region. Finer textured Hantsport soils (imperfectly drained, sandy clay loam) which have developed from carboniferous parent materials are found around the

Halifax peninsula, which is underlain by slate except in the extreme north end, which has mostly Bridgewater soils (Davis and Browne, 1996b)

The soils in the general area of the proposed location of Tufts Cove 6 consist of fill material overlying native till and quartzite bedrock (NSPI, 2008). The fill material was generally sandy gravel, with cobbles and boulders and the native material consists predominantly of sandy gravel (NSPI, 2008).

5.4 Marine Sediment Quality and Chemistry

Extensive studies of the geochemistry of contaminated surface sediments in Halifax Harbour have contributed significantly to the understanding of the distribution and movements of toxic metals and other contaminants. Due to the heavy concentrations of metals and organics in the sediments, Halifax Harbour ranks as one of the most contaminated marine harbours in the industrialized world (Environmental Assessment Review Panel, 1993; Jacques Whitford, 2001; NPA, 2008).

The distribution of sediments reflects water current patterns and strengths. Sediment thickness on the Harbour bottom varies from a few centimetres to more than 20 m and ranges from fine clays to sand and gravel and, in some areas, bare bedrock (Environmental Assessment Review Panel, 1993). Finer particles can be re-suspended and deposited many times before coming to a final resting place. The outer portion of the Inner Harbour and the channel off Eastern Passage are characterized by sediments undergoing slow chemical changes equivalent to rotting compost (Environmental Assessment Review Panel, 1993). Approximately 95% of the heavy metal contaminants found in the sediments are believed to have arrived there attached to or bound in particulates (Environmental Assessment Review Panel, 1993). Metals dissolved in the water column make relatively small contributions to the sediments, with the exception of zinc, lead, manganese and mercury, which are removed from the sea water by the sediments (Environmental Assessment Review Panel, 1993).

In 2007, Jacques Whitford Environment Ltd. was contracted to conduct a marine habitat assessment of the area adjacent to the Tufts Cove site. As part of the assessment, sediment samples were collected and analyzed for PAHs, TPH, BTEX, and metals. The sediment samples showed evidence of environmental impact. These levels are consistent with concentrations found in the inner Halifax Harbour region.

5.4.1 Marine Flora

In salt marshes cord grass (*Spartina alterniflora*) dominates in the low marsh and salt-meadow cord grass (*Spartina patens*) at higher levels (Davis and Browne, 1996a). Various marine fungi may be associated with and result in the decomposition of *Spartina* (Davis and Browne, 1996a). Seaweeds are common throughout the Harbour (HRM, 1996).

5.4.2 Marine Fauna

Marine fauna is mostly cold-water boreal in character but is not homogenous along the coast of the sub-region. Sheltered inlets and pockets of warmer water support many species with a more southerly distribution (Davis and Browne, 1996b). Periodic incursions of warmer slope water bring in warm-water fish and invertebrates in the summer (Davis and Browne, 1996b).

5.4.3 Benthic Habitat and Benthos

The structure of benthic communities is determined largely by the quality and quantity of benthic substrate, a significant component of marine habitat, in combination with turbidity, depth, temperature, salinity and nutrient level. In Nova Scotia, benthic habitats are largely influenced by cold water (Davis and Browne, 1996a).

The Halifax Harbour undergoes annual marine biological cycles typical of North Atlantic temperate coastal waters and in general, the habitats reflect conditions typically found in estuaries with rocky shorelines and soft muddy depositional areas (Belford, 2000). The sandy areas of the outer Harbour reflect the exposure to wind and wave action and the middle and outer Harbour areas appear to support a benthic environment typical for coastal Nova Scotian waters (Belford, 2000). The benthic community of the more inner areas of the Harbour however is dominated by marine worms (polychaetes) (HRM, 1996). Typical debris items throughout the Harbour consist of tires, timber, bottles, cans, barrels, waste metal, broken lobster traps, paper and plastics, and the occasional shipwreck (Belford, 2000).

A benthic dive survey at Tufts Cove, conducted by Connors Diving Services Limited and Jacques Whitford (2008), was completed on October 29, 2007. This survey examined the seafloor of the Harbour area nearest the Tufts Cove Station and results showed that the seafloor was comprised mainly of soft sediments, subject to high organic loading from the storm water outflow, and low species biodiversity (Figure 6). The distant seafloor transects exhibited hard substrate such as cobbles and boulders embedded in sandy sediments that create a habitat suitable for numerous large crustaceans and fin fish. Marine flora was very limited and little was observed. There did not appear to be any sensitive areas in the immediate vicinity. Additional information on the results of this study is provided in Section 7.3.

Figure 6 Seafloor nearest Tufts Cove

5.4.4 Plankton and Marine Invertebrates

Phytoplankton and seaweeds constitute the base of the marine food chain. Annual cycles of zooplankton abundance are closely tied to those of the phytoplankton, as are distributions and migrations of plankton-eating fish such as mackerel (*Scomber scombrus*) and herring (*Clupea harengus*) (Environmental Assessment Review Panel, 1993).

For Halifax Harbour, in the winter, wind-driven mixing of the water column and low light conditions suppress the growth of phytoplankton (microscopic plants). The return of light and more stable conditions in late winter give rise to the spring phytoplankton bloom, which begins in March, and continues until the supplies of nutrients, notably nitrogen, are consumed (Davis and Browne, 1996a). After nutrients are depleted, phytoplankton populations substantially decrease in number and the species composition changes (Davis and Browne, 1996a). Phytoplankton growth continues throughout the summer and fall months, but numbers and species composition continue to be influenced by nutrient limitation. With the onset of fall and winter storms and low light, the population returns to winter conditions, allowing nutrient supplies to build up (Davis and Browne, 1996a). Phytoplankton production is high in Halifax Harbour (HRM, 1996) and populations are likely to be higher in the areas of sheltered waters (Environmental Assessment Review Panel, 1993).

Marine invertebrate species may include amphipods (*Gammarus* sp.) and isopods (*Idotea* sp.), various bivalve molluscs such as the soft-shell clam (*Mya arenaria*), fingernail clam (unknown species), blue mussel (*Mytilus edu*lis) and ribbed mussel (*Modiola* sp.), and several gastropod species, including periwinkles, spire snail (*Planorbis sp.*), and the Eastern mud snail (unknown species).

5.4.5 Fish

Most resident fish in any estuary are associated with interfaces/substrates, most notably with vegetation such as attached macrophytes (aquatic plants) (Hebda and Gilhen, 2000).

Table 1 provides a list of marine species that have been identified within the Harbour from 1980 to 2000.

Table 1 Marine Fish Recorded from Halifax Harbour (1980-2000)

Common Name	**Scientific Name**	**Location Reported/Caught[1]**	**Status[2]**
Thresher shark	*Alopias vulpinus*	Off Cow Bay	SV
Barndoor skate	*Raja laevis*	Present in estuarine area	M
Tarpon	*Megalops atlanticus*	Present in estuarine area	SV
Atlantic herring		Commercial species	M
American shad	*Alosa sapidissima*	Present in estuarine area	M
Atlantic menhaden	*Brevoortia tyrannus*	Present in estuarine area	SV
Round herring	*Etrumeus teres*	Present in estuarine area	SV
Capelin	*Mallotus villosus*	Present in estuarine area	M

Common Name	Scientific Name	Location Reported/Caught[1]	Status[2]
Atlantic salmon	*Salmo salar*	Present within the watershed	R/M
Brook trout	*Salvelinus fontinalis*	Present within the watershed	R
Atlantic cod	*Gadus morhua*	Near Halifax	R
Haddock	*Melanogrammus aeglefinus*	Present in estuarine area	R
Atlantic tomcod	*Microgadus tomcod*	Present in estuarine area	R
Pollock	*Pollachius virens*	North West Arm	R
Deepsea angler	*Ceratia holboelli*	Off Halifax	V
Spotfin flyingfish	*Cypselurus furcatus*	Present in estuarine area	SV
Banded killifish	*Fundulus diaphanus*	Present in estuarine area	R
Mummichog	*Fundulus herteroclitus*	Present in estuarine area	R
Buckler dory	*Zenopsis conchifera*	Present in estuarine area	SV
Blackspotted stickleback	*Gasterosteus wheatlandi*	Present in estuarine area	R
Ninespine stickleback	*Pungitius pungitius*	Present in estuarine area	R
Flying gunnel	*Dactylopterus volitans*	Present in estuarine area	SV
Grubby	*Myoxocephalus aeneus*	Present in estuarine area	R
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	Present in estuarine area	R
Atlantic spiny lumpsucker	*Eumicrotremus spinosus*	Off Halifax Harbour	NV
Atlantic seasnail	*Liparis atlanticus*	Present in estuarine area	R
Striped seasnail	*Liparis liparis*	Present in estuarine area	R
Striped bass	*Morone saxatilis*	Present in estuarine area	R
Bluefish	*Ponatomus saltatrix*	Present in estuarine area	SV
Remora	*Remora remora*	Prospect	SV
Crevalle jack	*Caranx hippos*	Present in estuarine area	SV
Redtail scad	*Decapterus tabl*	Present in estuarine area	SV
Wreckfish	*Polyprion americanus*	Present in estuarine area	SV

Common Name	Scientific Name	Location Reported/Caught[1]	Status[2]
Spotfin butterflyfish	*Chaetodon ocellatus*	Present in estuarine area	SV
White mullet	*Mugil carema*	Present in estuarine area	SV
Wolf eelpout	*Lycenchelys verrilli*	Present in estuarine area	NV
Rock gunnel	*Pholis gunnellus*	Present in estuarine area	R
Atlantic wolffish	*Anarhichas lupus*	Present in estuarine area	R
Atlantic mackeral	*Scomber scombrus*	Commercial species	R
Bluefin tuna	*Thunnus thynnus*	Present in estuarine area	M
Swordfish	*Xiphias gladius*	Present in estuarine area	M
Butterfish	*Peprilus triacanthus*	Present in estuarine area	M

Source: Hebda and Gilhen, 2000, from the Nova Scotia Museum of Natural History archives.

[1] Species noted as present in estuarine areas have been reported from adjacent estuaries and are likely present in the study area. Species noted as present in the watershed are found in freshwaters, but are anadromous and will therefore pass through the study area. Commercial species in the area are those for which there is a commercial harvest in the Harbour.

[2] Species may be year-round residents, occasional northern visitors at the south end of their normal range (NV), occasional southern visitors at the northern end of their normal range (SV), or migrants (M) which include diadromous fish as well as regularly occurring species.

Marshes are often nurseries for juveniles of commercially important fish species. Killifish, sticklebacks, silversides (*Menidia menidia*) and American eel (*Anguilla rostrata*) are often common in pannes (where water pools on the surface of the marsh), and many of these species, as well as juveniles of local fish species, including flounder (*Paralichthys* sp.), can be found in waters of the salt marsh. Gasperau (alewife) (*Alosa pseudoharengus*) also pass through the Harbour on the way to rivers (Mann, 2000).

Marine Mammals

Seals and whales are present in the Harbour year round; their abundance being quite variable as due to various migratory patterns of both themselves and their prey (Mann, 2000). The following marine mammals are/have been known to utilize the Harbour waters: Atlantic harbour porpoise (*Phocoena phocoena*), Atlantic white-sided dolphin (*Lafnorhynchus acutus*), white-beaked dolphin (*Lafnorhynchus albirostris*), grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina*) (Environmental Assessment Review Panel, 1993; Davis and Browne, 1996b; HRM, 1996; Mann, 2000; HRM, 2007). There have also been occurrences of North Atlantic right whale (*Eubalaena glacialis*), fin whale (*Balaenoptera physalus*), and minke whale (*Balaenoptera acuterostrata*) (Environmental Assessment Review Panel, 1993; Davis and Browne, 1996b; HRM, 1996; Mann, 2000; HRM, 2007).

Other Fauna

There have been incidents of leatherback turtles (*Dermochelys coriacea*) in the area (HRM, 1996).

5.5 Terrestrial Environment

The major terrestrial ecosystem types found within this sub-region/landscape include well to imperfectly drained red, black, and white spruce-balsam fir, undulating terrain and well drained tolerant hardwood-red spruce drumlins (NSDNR, 2005).

5.5.1 Terrestrial Flora

The forests of the Atlantic Coast Region are defined by a Spruce-Fir Coast Zone that develops under the major influences of marine climatic conditions (late springs, cool summers, frequent fog, and strong winds), generally poor soils, and extensive disturbances by fire and cutting (Loucks, 1962; Davis and Browne, 1996b). The cool, wet, acidic conditions favour conifers, whereas deciduous trees are usually restricted to higher, better-drained sites that are sheltered from coastal winds (Davis and Browne, 1996b). On headlands and exposed ridges, trees are usually severely stunted and due to continuous high winds that increase transpiration, trees may actually become desiccated in spite of high rainfall (Davis and Browne, 1996b). White spruce (*Picea glauca*), which has a high tolerance to wind and salt spray, is the characteristic species in this region.

Barrens or semi-barrens are common, supporting mostly low, ericaceous (heath) vegetation and sphagnum bogs are also common in depressions (Davis and Browne, 1996b). A narrow ban of coastal barrens is found between the spray zone and the coastal fir-spruce forest in this area, and consists of a mixture of stunted white spruce, creeping juniper (*Juniperus horizontalis*), common juniper (*Juniperus commmunis*), and various ericaceous shrubs including fox berry (*Vaccinium vitis-idaea*) and low bush blueberry (*Vaccinium angustifolium*) (Jacques Whitford, 2001).

On old farmlands and drumlins, pure stands of white spruce are common (Davis and Browne, 1996b). Salt-marsh and sand-dune plant communities and large beds of eelgrass (*Zostera* sp.) are common along the shore (Davis and Browne, 1996b).

5.5.2 Terrestrial Fauna – Fish

Freshwater fish include white sucker (*Catostomus commersoni*), common shiner (*Luxilus cornutus*), stickleback, perch, banded killifish, and brook trout. As mentioned previously, there are also many species of diadromous/anadromous species (eg. Atlantic salmon and gaserpereau) (refer to the Marine Fish section (Section 5.5.4)).

5.5.3 Terrestrial Fauna – Mammals

The climate has the least persistent winter snow cover of any area in the province creating severe microclimatic stress for small mammals during cold snaps thereby restricting the ability of some species to inhabit the area (i.e. deer mouse) (Davis and Browne, 1996b).

Common mammalian species in this area are listed in Table 2.

Table 2 Mammalian Species for Halifax Harbour and Surrounding Area

Common Name	Scientific Name
White-tailed deer	*Odocoileus virginianus*
Mink	*Mustela vison*
Masked shrew	*Sorex cinereus*
Snowshoe hare	*Lepus americanus*
Red squirrel	*Tamiasciurus vulgaris*
Meadow vole	*Microtus pennsylvannicus*
Muskrat	*Ondatra zibethicus*
Meadow-jumping mouse	*Zapus hudsonius*
Red fox	*Vulpes vulpes*
Raccoon	*Procyon lotor*
River otter	*Lutra canadensis*
Moose	*Alces alces*
Black bear	*Ursus americanus*
Bobcat	*Lynx rufus*
Little brown bat	*Myotis lucifugus*
Northern long-eared bat	*Myotis septentrionalis*
Coyote	*Canis latrans*

5.5.4 Terrestrial Fauna – Other Fauna

Terrestrial reptiles include the maritime garter snake (*Thamnophis sirtalis*), eastern smooth green snake (*Virginia valeriae*), and northern redbelly snake (*Storeria occipitomaculata occipitomaculata*).

Amphibians include the eastern American toad (*Bufus americanus*), northern spring peeper (*Pseudacris crucifer*), and eastern red-backed salamander (*Plethodon cinereus*).

5.5.5 Terrestrial Fauna – Avifauna

A good variety and abundance of avian species are known to inhabit the Harbour area, the most common being the herring gull (*Larus argentatus*) (HRM, 1996; Mann, 2000). Most of these species are usually quite large, and are at or near the top of the coastal marine food chain inhabiting the air-sea interface above shallow coastal water (Davis and Browne, 1996a; Lock, 2000). Water bird fauna is constantly changing, having fewest species present in summertime when most species have withdrawn to breed (Lock, 2000). During spring and fall migrations the species composition is constantly changing as birds move through the area and it is only during the winter months that a stable population of birds establishes itself, from December to March (Lock, 2000).

It is important to note that this sub-region's characteristic inlets provide migration and overwintering habitat for numerous waterfowl (Davis and Browne, 1996b). In spring, particularly mid-March to mid-April, this region is a stopover for several thousand black ducks (*Anas rubripes*), that breed in the coastal barrier beach, estuary, and coastal marsh habitats, and Canada goose (*Branta canadensis*). The numbers peak again in October. Other overwintering birds include common goldeneye (*Bucephala clangula*), which occurs in moderate numbers, and an occasional scaup (*Aythya* sp.) (Davis and Browne, 1996b). Great blue heron and osprey nest on McNabs Island, piping plovers (*Charadrius melodus*) nest further down the shore at Clam Bay and Lawrencetown, and possibly McNabs Island, and the area also provides feeding areas and some scattered nesting habitat for the bald eagle (*Haliaeetus leucocephalus*) (Environmental Assessment Review Panel, 1993; Davis and Browne, 1996b).

The Canadian Wildlife Service (CWS) surveys coastal water birds for areas of coastline of varying length. Results for the 2000 survey show that waterfowl are extremely abundant with close to ten thousand ducks in winter residence, overall, a mean density of close to 10 birds per km (Table 3) (Lock, 2000). Other species reported include cormorants (*Phalacrocorax carbo*), grebes (various), loons (*Gavia immer*), and bald eagles (HRM, 1996). Results from a Christmas Bird Counts (CBC) made on MacNab's Island in 1997 also reveal that a remarkably rich seabird community winters in Halifax Harbour (Table 4) (Lock, 2000). The results of these surveys are summarized in Tables 3 and 4, respectively.

Table 3 Summary of Duck Species Recorded during CWS surveys (2000) for Halifax Harbour

Survey Block No.	Dabbling Ducks	Bay Ducks	Sea Ducks	Total Ducks	No. Surveys	No. Ducks/Survey	km of Coast	Density of Ducks/km
197	1923	193	7814	9930	11	902.7	93.62	9.6
198	19	9	0	28	1	28	41.03	0.7

Of the 15 species identified by CWS for McNabs Island (Table 4), 10 are also identified within the Maritime Breeding Bird Atlas (MBBA) Regional Checklist (MBBA, 2008) for this region (Region #20) which extends from Chebucto to Musquodoboit.

Table 4 Summary of Avian Species for McNabs Island CBC (1997)

Common Name	Scientific Name	Number	MBBA Regional Checklist (Region #20)
Common loon	*Gavia immer*	*2*	Y
Red-necked grebe	*Podiceps grisgena*	*2*	N
Great blue heron	*Ardea Herodias*	*1*	Y
Oldsquaw	*Clangula hyemalis)*	*35*	N
Common Goldeneye	*Bucephala clangula*	*30*	Y
Bufflehead	*Bucephala albeola*	*13*	N
Common eider	*Somateria mollissima*	*306*	Y
Greater scaup	*Aythya marila*	*40*	Y
Red-breasted merganser	*Mergus serrator*	*41*	Y
Black duck	*Anas rubripes*	*68*	Y
Gadwall	*Anas strepera*	*1*	N
Herring gull	*Larus argentatus*	*88*	Y
Iceland gull	*Larus glaucoides*	*17*	N
Great black-backed gull	*Larus marinus*	*26*	Y
Ring billed gull	*Larus delawarensis*	*12*	Y

Source: Lock, 2000

Two further surveys, completed in 1999 (May and June) by Jacques Whitford (1999) at Herring Cove, resulted in the identification of thirty-eight (38) species including two raptor species (Table 5).

Of the 38 species identified (Table 5), all species are also identified within the MBBA Regional Checklist (MBBA, 2008) for this region (Region #20).

Table 5   Bird Species Recorded for Herring Cove (1999)

Common Name	Scientific Name	Breeding Status[1]	MBBA Regional Checklist (Region #20)
Common loon	*Gavia immer*	Ne	Y
Great cormorant	*Phalacrocorax carbo*	Ne	Y

Common Name	**Scientific Name**	**Breeding Status[1]**	**MBBA Regional Checklist (Region #20)**
Double-crested cormorant	*Phalacrocorax auritus*	Ne	Y
Sharp-shinned hawk	*Accipiter striatus*	Ne	Y
Merlin	*Falco columbarius*	Ne	Y
Ruffed grouse	*Bonasa umbellus*	Ne	Y
Great black-backed gull	*Larus marinus*	Ne	Y
Herring gull	*Larus argentatus*	Ne	Y
Rock dove (Rock pigeon)	*Columba livia*	Fo	Y
Ruby-throated hummingbird	*Archilochus colubris*	Pr	Y
Northern flicker	*Colaptes aureus*	Pr	Y
Tree swallow	*Tachycineta bicolour*	Ne	Y
Blue jay	*Cyanocitta cristata*	Cf	Y
Common raven	*Corvus corax*	Fo	Y
American crow	*Corvus brachyrhynchos*	Fo	Y
Black-capped chickadee	*Parus atricapillus*	Cf	Y
Boreal chickadee	*Parus hudsonicus*	Ne	Y
Red-breasted nuthatch	*Sitta Canadensis*	Cf	Y
Brown creeper	*Certhia Americana*	Ne	Y
Winter wren	*Troglodytes troglodytes*	Ne	Y
American robin	*Turdus migratorius*	Po	Y
Hermit thrush	*Catharus guttatus*	Ne	Y
Golden-crowned kinglet	*Regulus satrapa*	Cf	Y
Ruby-crowned kinglet	*Regulus calendula*	Po	Y
Cedar waxwing	*Bombycilla cedrorum*	Ne	Y
European starling	*Sturnus vulgaris*	Ne	Y
Blue-headed vireo	*Vireo solitarius*	Po	Y

Common Name	Scientific Name	Breeding Status[1]	MBBA Regional Checklist (Region #20)
Red-eyed vireo	*Vireo olivaceus*	Po	Y
Black-and-white warbler	*Mniotilta varia*	Po	Y
Parula warbler	*Parula americana*	Po	Y
Magnolia warbler	*Dendroica magnolia*	Po	Y
Yellow-rumped warbler	*Dendroica coronata*	Pr	Y
Black-throated green warbler	*Dendroica virens*	Po	Y
Ovenbird	*Seiurus aurocapillus*	Ne	Y
Common yellowthroat	*Geothlypis thrchas*	Po	Y
Common grackle	*Quiscalus quiscula*	Ne	Y
Evening grosbeak	*Coccothraustes vespertina*	Fo	Y
Purple finch	*Capodacus purpureus*	Ne	Y
Pine siskin	*Carduelis pinus*	Ne	Y
American goldfinch	*Carduelis tristis*	Fo	Y
Red crossbill	*Loxia curvirostra*	Fo	Y
White-winged crossbill	*Loxia leucoptera*	Fo	Y
Dark-eyed junco	*Junco hyemalis*	Cf	Y
White-throated sparrow	*Zonotrichia albicollis*	Pr	Y
Song sparrow	*Melospiza melodia*	Po	Y

Source: Jacques Whitford, 1999a.
[1]Cf: confirmed breeder Po: possible breeder Fo: Observed flying over study area
Pr: probable breeder Ne: no evidence of breeding activity

Of the species noted in Table 5, the most abundant (in descending order of abundance) were black-throated green warbler, golden-crowned kinglet, black-capped chickadee, magnolia warbler, yellow-rumped warbler, and dark-eyed junco (Jacques Whitford, 1999a).

The merlin is considered to be a rare breeding species in Nova Scotia (Scott, 1994) but is frequently observed during migration as was noted during the survey (Jacques Whitford, 1999a).

Of the species recorded during the Jacques Whitford survey, 5 species were confirmed breeders, 4 were considered probably breeders and a further 10 species as possible breeders (Table 5).

None of the species recorded during the breeding season survey are considered to be rare in Nova Scotia (Scott, 1994) or Canada (COSEWIC, 2008). Additional information about species at risk/species of conservation concern is provided below.

It should be noted that the variety of habitats on McNabs Island and the proximity to the Atlantic coast contribute to the rich avifauna in the Halifax Harbour. McNabs and Lawlor Islands also provide nesting and roosting opportunities for birds seen in Halifax and Dartmouth parks. NSDNR (2005) reported a total of 206 species as being sighted on and around McNabs and Lawlor Islands, including 82 species for which there is evidence of breeding. Most notable on the Islands is the nesting of great blue heron and osprey, the latter representing one of the highest concentrations in eastern North America (NSDNR, 2005).

5.6 Species at Risk

A search of the Species at Risk (SAR) website for listed species in the HRM revealed that in 2005 (May) there were a total of 7 species at risk including: 3 birds, 1 reptile, 1 mammal, and 1 lichen (SAR, 2005). Due to the lack of recent information, this search was supplemented by an index search on the Public Registry under the *Species at Risk Act* (SARA) website (SARA, 2008) for SAR in Nova Scotia. Those species considered not within a 10 km range of Tufts Cove, listed as “extinct”, and/or considered to be “not at risk” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), were removed. The search identified 13 species, including sub-species that have the potential to occur. Two additional species: blue whale (*Balaenoptera musculus*) and North Atlantic right whale were removed due to the fact that they would not be found any further inland than the outer reaches of the Harbour. The final list is provided in Table 6 along with status. Nova Scotia General Status Rankings and status of listed species under the Nova Scotia Endangered Species Act (NSESA) (where applicable) are also included. Descriptions of the status/ranking categories are provided in Appendix C.

Table 6 Species at Risk with Potential to Occur in Halifax Harbour

Common Name	Scientific Name	Population	COSEWIC Status[1]	SARA Status[2]	NS General Status Rankings	NSESA Status
American Eel	*Anguilla rostrata*		Special Concern	No Status	Green	N/A
Barrow's Goldeneye	*Bucephala islandica*	Eastern population	Special Concern	Special Concern	Yellow	N/A
Chimney Swift	*Chaetura pelagica*		Threatened	No Status	Yellow	Endangered
Common Nighthawk	*Chordeiles minor*		Threatened	No Status	Yellow	Threatened
Harlequin Duck	*Histrionicus histrionicus*	Eastern population	Special Concern	Special Concern	Yellow	Endangered
Monarch	*Danaus plexippus*		Special Concern	Special Concern	Yellow	N/A
Olive-sided Flycatcher	*Contopus cooperi*		Threatened	No Status	Yellow	N/A
Peregrine Falcon	*Falco peregrinus*		Non-active	Threatened	Red[3]	Vulnerable

Common Name	Scientific Name	Population	COSEWIC Status[1]	SARA Status[2]	NS General Status Rankings	NSESA Status
(anatum subspecies)	*anatum*					
Piping Plover (melodus subspecies)	*Charadrius melodus melodus*		Endangered	Endangered	Red	Endangered
Roseate Tern	*Sterna dougallii*		Endangered	Endangered	Red	Endangered
Rusty Blackbird	*Euphagus carolinus*		Special Concern	No Status	Yellow	N/A
Short-eared Owl	*Asio flammeus*		Special Concern	Special Concern	Yellow	N/A
Wood Turtle	*Glyptemys insculpta*		Threatened	Special Concern	Yellow	Vulnerable

[1] COSEWIC, 2008

[2] SARA, 2008

[3] Subspecies not distinguished

All species listed from the HRM list (2005) (SAR, 2005) are included in Table 6 except for the following three species:

1. Ipswich sparrow (*Passerculus sandwichensis princes*): In 2005, this species was considered Special Concern nationally, and Endangered on a provincial level (SAR, 2005). However, no current information is available from SARA or COSEWIC.
2. Moose (Mainland Population) (*Alces alces americana*): This species is only listed provincially under NSESA (Endangered).
3. Boreal felt lichen (*Erioderma pedicullatum*): Although included in the HRM area (SAR, 2005) this species is found more than 10 km from Tufts Cove.

Several rare bird species have been noted on McNabs Island as reported by NSDNR (2005). Most of these were outside normal ranges and are not rare where they normally occur (e.g., ivory gull (*Pagophila eburnea*), southern heron (species unknown[1]), whippoor-will (*Caprimulgus vociferus*)) and several other endangered species sighted were either vagrants with one sighting each (loggerhead shrike (*Lanius ludovicianus*), Coopers hawk (*Accipiter cooperii*)) or such widely ranging residents or migrants (harlequin duck (*Histrionicus histrionicus*), peregrine falcon (*Falco peregrinus*), and roseate tern (*Sterna hirundo*)) that the occurrence on the Island was probably not important for maintenance of those populations. The piping plover is the only endangered species (SARA, 2008 and b; COSEWIC, 2008; NSDNR, 2005) that may have bred on the Island. Willison et. al., (1996) reported that during the 1991 breeding season, piping plover were found several times on beaches at the southern end of the Island and were classed as probable breeders. However, in a 1996 survey, no piping plover were reported from McNabs Island (NSDNR, 2005). Despite a lack of conclusive proof that piping plover have bred on McNabs Island in recent years, the bird's presence on the Island and the existence of suitable breeding habitat offer hope that breeding could occur.

[1] Reference is only to a "southern heron" but is most likely to be referring to the green heron (*Butorides virescens*).

6 SOCIOECONOMIC CONSIDERATIONS

6.1 Commercial Fisheries

Commercial fishing is carried out by some seasonal lobster, herring, haddock, mackerel and cod fishermen where, in 1996 it was reported by HRM (1996), up to 100 people are employed in these activities. Lobsters are fished extensively, especially around McNabs Island and seaward from there. There is limited fishing in the Northwest Arm and Bedford Basin. Clams and mussels are abundant throughout the Harbour, but are closed to harvesting on account of faecal coliform contamination (Mann, 2000).

6.1.1 Licensing and Landings

Halifax Harbour falls within the boundary of the Northwest Atlantic Fisheries Organization (NAFO) division 4W (NAFO, 2008). Within this division both cod and haddock continue to be under direct moratorium, from 1993 for cod and 1994 for haddock, for directed fisheries (NAFO, 2008). Both species are currently harvested on a limited basis under strict by-catch provisions of other directed groundfish fisheries. All commercial fisheries are regulated through the issuance of commercial licenses by DFO and various methods are utilized to control the amount of harvesting that takes place (i.e. defined areas, quotas, trip limits, by-catch quotas etc.) (DFO, 2008).

6.1.2 Lobster and Finfish Fishery

There is a valuable catch of lobster and finfish in the Harbour. For lobsters, northward from McNabs Island only 2-3 fishermen work, but southward nearly 60 work. Finfish effort increases southward and is very seasonal (Ducharme, 1989).

The season for Lobster Fishing Area 33, which includes Halifax Harbour, is active between the last Monday in November and May 31 (NAFO, 2008). The waters offshore of Eastern Passage are utilized for light lobster fishing and extend from Lawlor Island to past the Canadian Coast Guard Base (Figure 7). Heavy lobster fishing takes place off the lower ends of both Lawlor and McNabs Islands and includes some areas on the western shores of McNabs Island (Figure 7). Although the majority of lobster fishing activity within the Harbour occurs south of the Halterm Container terminals and the Imperial Oil Refinery, the areas of greatest activity continue to be the western shores of the Harbour, south of Ferguson’s Cove, and the area south of McNabs Island, known as the Thrumcap Shoal (Figure 7) (Jacques Whitford, 1999b).

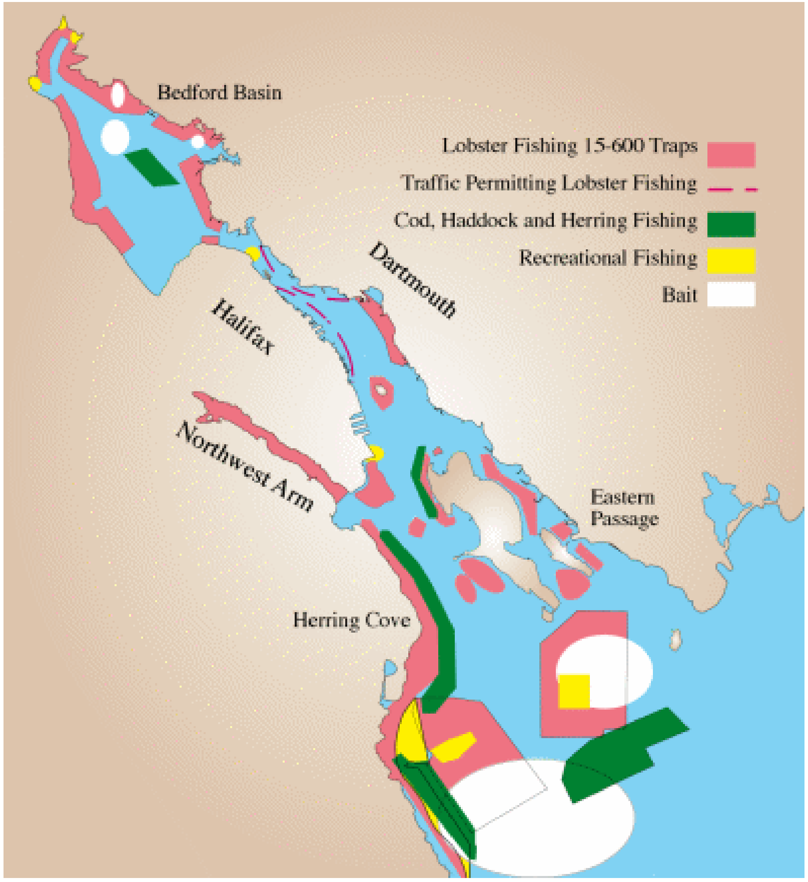

Figure 7 Areas of fishing activity in Halifax Harbour based on information from 1991, 1993, and 1999 (Source: Ross, 2002)

6.1.3 Pelagic Fishery

Herring and mackerel are the two principle pelagic species that are fished regularly in Halifax Harbour. Within the Harbour these species are fished primarily as a bait source for the groundfish and lobster fisheries and to a lesser extent, for human consumption (Jacques Whitford, 1999b). Other pelagic species include gaspereau and, on rare occasions, bluefin tuna (Jacques Whitford, 1999b).

The herring fishery in the Harbour occurs mainly along the outer reaches, south of McNabs Island (and Point Pleasant Park) and runs 12 months of the year, although the species is typically fished according to the timing of the Spring (late February to March/April) and Fall (September) runs along the coast (Jacques Whitford, 1999b). Fishing for herring is typically undertaken using fixed gear (i.e. either drift nets, gill nets or hand lines).

The mackerel season is open from June 1 to December 31, corresponding with the mackerel runs, and is most active in the outer reaches of the Harbour where the mackerel travel along the shoreline in tighter schools (Jacques Whitford, 1999b). This species is harvested using gill nets and hand lines as well as mackerel traps. Recreational fishers, who have no limit, fish mackerel from June to the end of the Labour Day weekend in September, usually in the Herring Cove and Dartmouth areas (Jacques Whitford, 1999b).

Gaspereau are fished, under seasonal licenses, during the spring runs up the Sackville River using gill nets, trap nets, or dip nets at the entrance into the river system (Jacques Whitford, 1999b). This species is usually caught to be utilized as bait fish for the groundfish and lobster fisheries.

Tuna are harvested during the summer months from June to October using either mid-water baited trawl or harpooning techniques close to the coastline. There are no tuna fishing licenses registered for any of the Halifax home ports (Jacques Whitford, 1999b).

6.1.4 Groundfish Fishery

The groundfish fishery in the Halifax Harbour is conducted primarily using hand-lines. As mentioned previously, the directed fishery for both cod and haddock have been under moratorium in the NAFO division 4W, but both species continue to be fished under by-catch provisions for other directed fisheries such as pollock, white hake, and Atlantic halibut, that are fished year round, most actively from spring to mid or late summer, with some specific closures for both spawning and juvenile rearing areas within the 4W division (Jacques Whitford, 1999b; NAFO, 2008).

Groundfish are also fished recreationally within the Harbour from early June to the end of the Labour Day weekend in September, with limits of five fish per day per person, excluding Atlantic halibut (Jacques Whitford, 1999b).

6.1.5 Shellfish Harvesting

All shell fish harvesting including the collection of clams, mussels and oysters is prohibited due to fecal coliform contamination with the boundaries of Halifax Harbour north of the Devil’s Island and Chebucto Head (Jacques Whitford, 1999b).

6.1.6 Fish Holding Facilities

There are four fish holding facilities that utilize the Harbour water as a source for large fish aquariums or for live food storage:

- Clearwater Fine Foods;
- Dalhousie Aquatron;
- Fisherman’s Market; and
- Bedford Institute of Oceanography (BIO).

Three of these facilities are located in the Bedford Basin. The fourth, closest to Eastern Passage, is the Dalhousie Aquatron which is located in the Northwest Arm.

7 ENVIRONMENTAL STUDIES

Various environmental studies have been carried out to date including:

- Air Dispersion Modelling completed on November 24th, 2004 to evaluate potential impacts to ambient air quality;
- Cooling Water Studies completed in 2006 and 2007;
- Marine Benthic Habitat Survey and Sediment Sampling Program completed in 2007; and
- Noise Survey completed in August, 2008.

7.1 Air Quality

The air impacts from Tufts Cove operations were previously evaluated for the Tufts Cove 5 registration document in 2004 (NSPI, 2004). The study consisted of modelling the plume dispersion of stack emissions to predict the downwind concentrations of the air contaminants. The impacts of the combustion turbines (CTs) as well as the CTs with the three thermal units operating were evaluated. In that study, the regulated air contaminant of interest was nitrogen oxide (NO_X). Other contaminants of natural gas combustion are present in very small amounts in the exhaust and were eliminated from concern after consideration of the extent of possible impact. Essentially, the emissions from the burning of a non-sour natural gas in a combustion turbine are extremely low of carbon monoxide, carbon dioxide, other reactive hydrocarbons, and sulphur dioxide and were therefore not modelled.

A more recent study examined the potential air impacts of Tufts Cove 6 in Combined Cycle mode. Similarly to the Tufts Cove 5 study, the relevant air contaminant that was evaluated was NO_X. There are no additional emissions associated with the Combined Cycle mode operation of the CTs as part of the Tufts Cove 6 project since the turbines will be operating the same way with the exception being the waste heat that is recovered and utilized instead of exhausted from the stack. However, the addition of the 25 MW of duct firing means the effects should be re-modelled.

7.1.1 Existing Air Quality – Nitrogen Dioxide

It is important to consider the existing air quality in the area of the modelling study as to consider the cumulative effects of existing sources in addition to the project being evaluated. Ambient data obtained[2] for the studies related to the Tufts Cove Generating Station have been recently discussed with representatives from Nova Scotia Environment (NSE). The average 1-hour Nitrogen Dioxide (NO_2) concentration in ambient air for Downtown Halifax in 2000 and 2006 was 16 and 18 ppb respectively (approx. 32 micrograms/cubic metre ($\mu g/m^3$) average). Sufficient data was not available for the 2001 – 2005 time period. Data for 2007 and 2008 is currently being reviewed and is not available yet. Since the traffic density in the area of Tufts Cove is less than that in Downtown Halifax, it is expected that ambient concentrations in the Tufts Cove area would not be as high. For the purposes of this study, an average "background" value of 32 $\mu g/m^3$ will be used which adds conservatism into the modelling result. *Table 8 shows that the Air Quality Regulations for N.S., establish the limit for this value to be 100 $\mu g/m^3$.*

[2] Pers. Comm. F. E. Di Cesare to J. Morrison by e-mail, 2009 01 06. Annual average 1-h Nitrogen Dioxide Concentrations for Downtown Halifax (2000 & 2006).

7.1.2 *Air Dispersion Modelling*

The initial objective for a typical modelling study is to define the worst-case scenario regarding emission rates, meteorological conditions, and operating parameters, for comparison to desired air quality objectives. If, under such circumstances, the estimated impact does not exceed appropriate criteria, there is no need for more-detailed analysis. If, on the other hand, appropriate criteria were not met, the more-detailed analysis would be necessary to quantify the extent of the impact (within modelling limits) as the basis for mitigation activity. The worst-case modelling exercise can be thought of as a “screening assessment”.

Tufts Cove Units 1 – 3 have the capability to burn both No. 6 Oil (Bunker C) and Natural Gas. It was determined that the worst case emissions scenario occurs when the units are burning No. 6 Oil. Therefore, this scenario was modelled with the logic being that if this scenario meets the guidelines for NO_2, then all other operating scenarios will meet the guidelines. The NO_x emission rate will meet the National Emission Guidelines for Stationary Combustion Turbines (CCME, 1992). A Continuous Emission Monitoring System (CEMS) will be used to monitor the NO_x concentrations within the stack.

The model was supported by an interface provided by Lakes Environmental Software.[3] Meteorological data were obtained from Scotia Weather Services for years 2002 - 2006. The surface data is from Shearwater (Station 71601) and the upper air data from Yarmouth (Station 71603). All five years of data were used in the model assessment to assure that no unique meteorological situation might be missed during the assessment. The wind rose for Shearwater is shown in Figure 8.

[3] Lakes Environmental Software: www.lakes-environmental.com

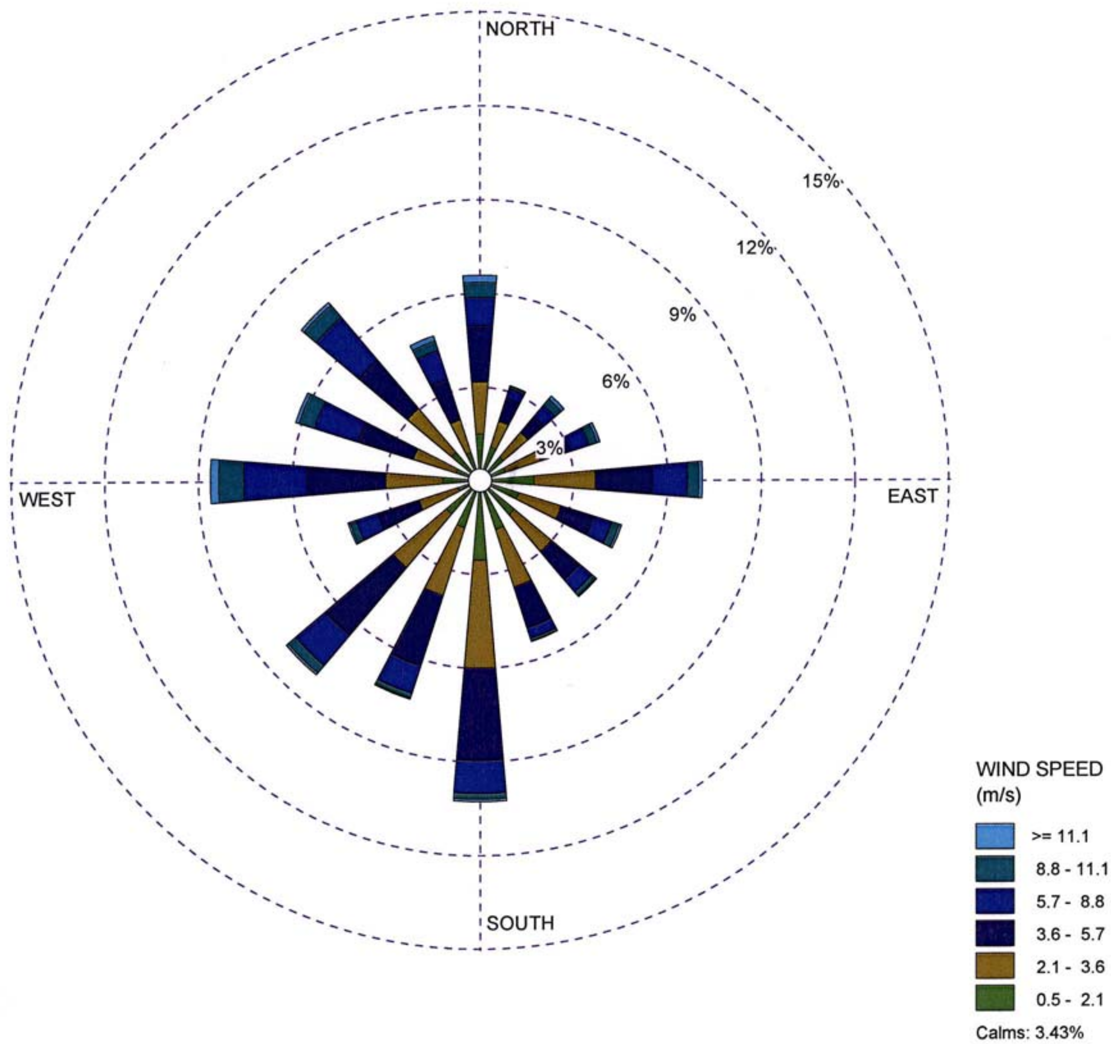

Figure 8 Shearwater Wind Rose

A receptor grid based on polar co-ordinates was used, centred on the existing stack for Unit 2. Ground level concentrations (GLCs) for NO_2 were predicted for each defined grid point within an 8 km radius, using a 16-point compass, with receptors at 0.5 km intervals along each radius. This produced 208 receptor points distributed uniformly over a circle with a radius of 8 km. The general area of coverage is shown in Figure 9.

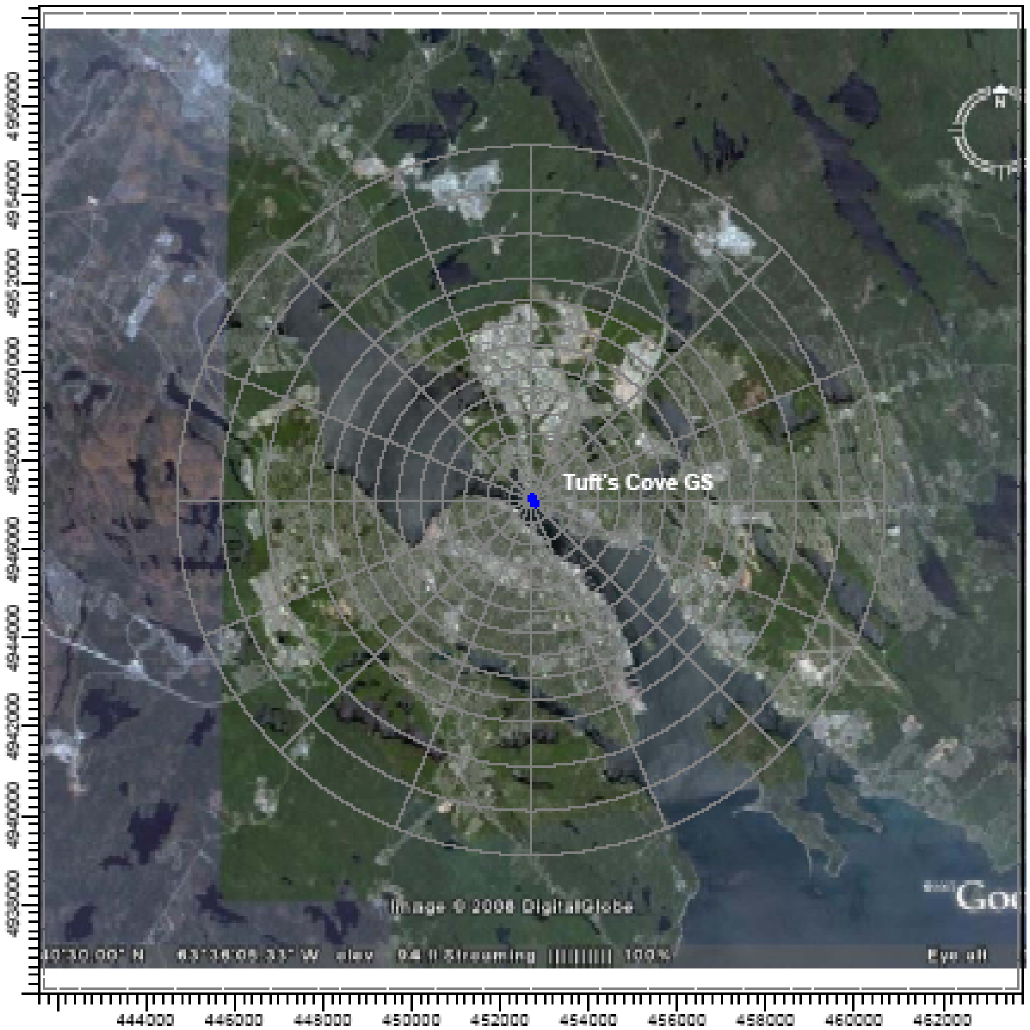

Figure 9 Receptor Grid of Modelling Area

The air quality assessment was completed using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD); the dispersion model recommended for use by the U.S. Environmental Protection Agency (EPA). AERMOD fully replaced the Industrial Source Complex – Short Term (ISCST3) dispersion model as the regulatory model on December 9, 2006 (EPA, 2008). AERMOD is a steady-state Gaussian plume model and was used in this study to estimate GLCs of NO_2 in the region surrounding the Tufts Cove Generating Station. AERMOD was designed to incorporate two fundamental features associated with "downwash" of a plume because of the interference from turbulence of nearby structures.

The following characteristics were used as input for the conservative ("worst-case") modelling approach used in this study to estimate GLCs for NO_2.

Table 7 Attributes for Stacks – Model Input (Conservative Approach)

Attribute	TUC 1	TUC 2	TUC 3	TUC 4 (LM 6000)	TUC 5 (LM 6000)
Base Elevation (m)	2.74	2.74	2.74	2.74	2.74
Stack Height (m)	152.4	152.4	152.4	28.35	28.35
Exit Diameter (m)	2.44	2.44	3.05	3.05	3.05
Stack Gas (K)	439	429	446	373	373
Stack Gas Velocity (m/s)	10.5	11.8	30.3	22.9	22.9
NO_x Emission Rate (g/s)	116.4	48.5	71.1	8.44	8.44[4]

7.1.3 Air Dispersion Modelling Results

The modelling results were compared to the values for ambient NO_2 concentrations in the Nova Scotia Air Quality Regulations (NSAQR), described below in Table 8.

Table 8 Nova Scotia Air Quality Regulations (partial list)

Air Contaminant	Averaging Period	Concentration (μg/m^3)	Concentration (pphm)
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5

The worst-case scenario for the GLCs of NO_2 was established as the basis for analysis of the potential impact of the addition of TUC 6, as noted. Typically, not all of the NO_x emitted from any fossil fuel combustion system will exist as NO_2 in the near-field of the stack. In reality some of the NO_X emissions will exist as NO. For this study, the total NO_x emissions from any of the five TUC units, operating at full load, were assumed to exist at the respective stack top as NO_2. Thus, the predicted GLCs for NO_2 will be significantly conservative[5], in part, because of this assumption.

Table 9 also presents the predicted dispersion modeling results for NO_2. In lieu of specific air dispersion modeling guidance in Nova Scotia, the guidelines from Ontario's MOE 419/05[6] Regulation were applied. This regulation considers the eight highest one hour averages to be "outliers" and discards them using the next highest hour as the maximum. For this study, the worst-case scenario regarding NO_x emissions did not produce exceedances of the relevant air quality criteria. Hence, the GLCs reported below represent the *maximum* potential for impact from NO_x emissions, and these modelled estimates would be expected to be greater than any GLC that might be measured around the station during plant operation.

[4] This rate represents the worst-case operating conditions for the CTs including the duct firing using CCME Guidelines for Stationary Combustion Turbines.
[5] Unless site-specific data are available, the default position is NO_2/NO_x = 0.75. On a short-term basis, the ratio would be lower. (Ref: Appendix W to Part 51 – *Guidelines on Air Quality Models.* 40 CFR 1 (7-1-01 Ed.))
[6] www.ene.gov.on.ca/envision/gp/5165e.pdf

Table 9 Predicted Ground Level Concentrations (GLCs) of NO_2

Maximum 1-hour NO_2 concentration [μg/m³]	134.8
Maximum 1-hour NO_2 concentration including background [μg/m³]	166.8
Distance to maximum 1-hour concentration [km]	0.5
Direction to maximum 1-hour concentration	NE
Exceedances above 1-hour NSAQR	0
Maximum annual NO_2 concentration [μg/m³]	5.45
Distance to maximum annual concentration [km]	1.0
Direction to maximum annual concentration	NNE
Exceedances above annual NSAQR	0
1-hour NSAQR [μg/m³]	**400**
Annual NSAQR [μg/m³]	**100**

The results of these studies indicate the following:

- there were no exceedances of the 1-hour or annual GLCs for NO_2 under this worst-case NO_x emission and transformation scenario;
- potential changes in ground-level concentrations of nitrogen oxides (as NO_2) from worst-case operation of TUC 6 are small, compared to both existing background concentrations and levels specified in the NSAQR; and
- NO_x emissions will meet the existing National Emission Guidelines for Stationary Combustion Turbines.

Figures 10 and 11 show the NO_2 concentration distribution for the 1-hour and annual averaging periods.

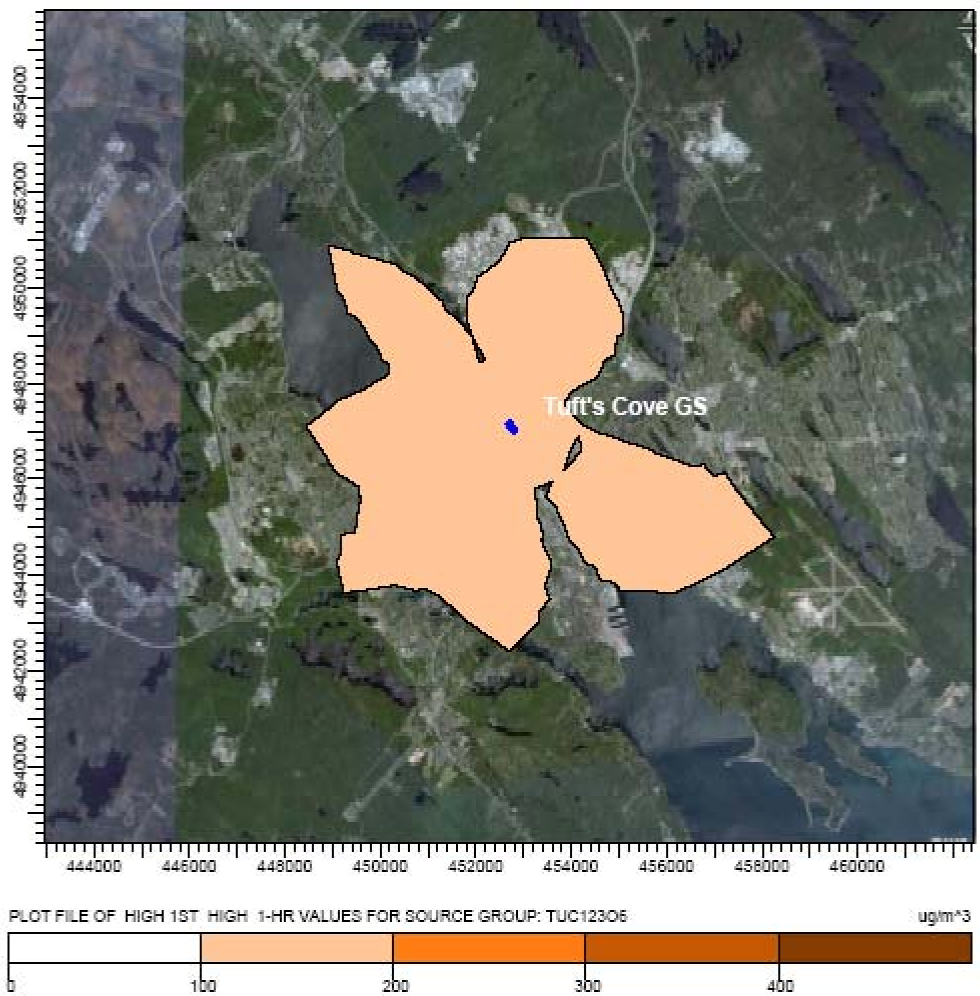

Figure 10 Maximum 1-Hour NO_2 Predictions

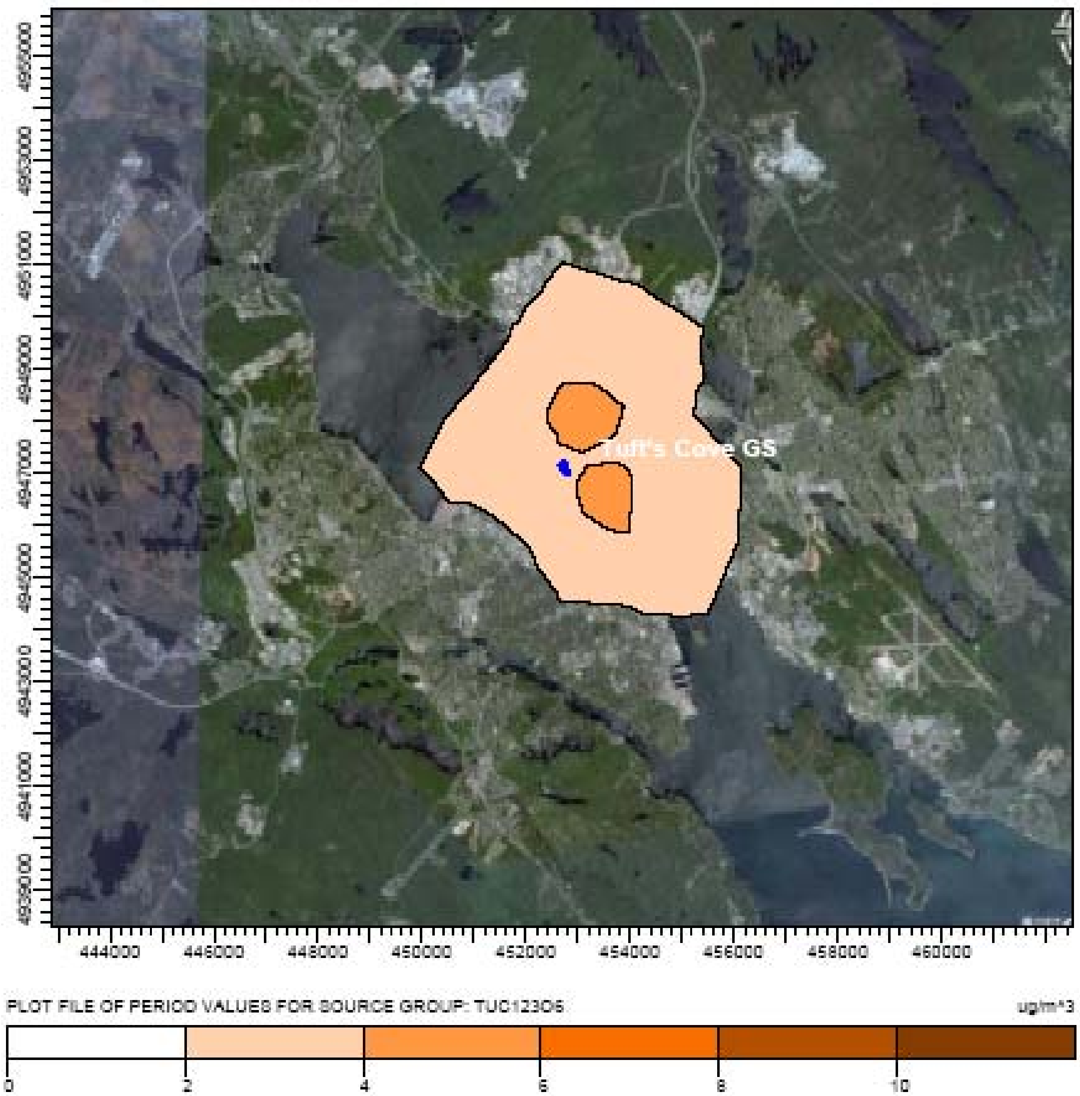

Figure 11 Annual NO_2 Predictions

7.1.4 CO_2 Emissions

For the Tufts Cove 6 project, the 25 MW of electricity from waste heat will not produce additional air emissions. By using the waste heat from Units 4 & 5, it is essentially “free” energy from an emissions perspective. Currently, Units 4 & 5 in simple cycle configuration operate with the highest available efficiency in NSPI's thermal operating fleet and have lower carbon intensity from burning natural gas which has a much lower quantity of CO2 released per unit of energy production than for oil or coal. The additional 25 MW of electricity will be produced from high efficiency, low emission, natural gas duct firing burners. While the firing of these duct burners will produce a relatively small contribution of carbon dioxide emissions, the benefit of the two combined (waste heat and duct firing) results in a lower overall intensity of emissions (i.e. emissions per MWh generated) because of less fuel being consumed with increased generation.

7.2 Cooling Water Studies

As described in Section 2.5.4, new cooling water intake and outfall structures are required for Tufts Cove 6. AMEC Earth and Environmental (AMEC) were contracted to conduct cooling water studies in 2006 and 2007 in order to determine any incremental increases in background harbour temperatures resulting from the addition of cooling water discharge from Tufts Cove 6 (AMEC, 2008). The work included consideration of the cooling water released to Halifax Harbour from Tufts Cove Unit 1, 2, and 3.

Results from the AMEC study predict the incremental temperature increase of receiving water resulting from the discharge of Tufts Cove 6 cooling water may vary from approximately 0.75°C within 20 to 30 m of the cooling water outfall, to less than 0.5°C at 50 m from the outfall, to less than 0.25°C at 200 m from the outfall. Combined with the 1°C increase in background temperature from current operations, the total average far-field thermal excess build-up is predicted to be approximately 1.25°C.

Based on the results of the study, the minimal temperature increase is not expected to have any detrimental effects on the marine environment.

7.3 Marine Benthic Habitat Survey and Sediment Sampling Program

A marine habitat assessment was conducted to survey both benthic habitat and flora/fauna, as well as sample sediments (Jacques Whitford, 2008). The survey consisted of videography, along the length of four 100 m and two 50 m transects. A diver, using underwater digital videography, swam along a pre-laid transect line marked at 5 m intervals to maximize visual inspection of sub tidal habitats. The transect locations were chosen in order to evaluate benthic habitat variation throughout the proposed infilling site as well two reference location sites chosen outside the range of the infilling. Benthic communities were evaluated using captured digital videography techniques. Upon review of the video, marine species were enumerated and identified to species or genus level where possible. Species density was calculated using a species count per estimated area of video coverage. Table 10 presents the species abundance as determined by the number of species per transect.

Table 10 Benthic Macro-fauna Abundance – Halifax Harbour Adjacent to Tuft's Cove Generation Station

Species	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6
Green sea urchin	250	830	1150	430	189	1800
Plumose sea anemone	31	129	48	8	9	146
Northern ceranthid	140	60	212	356	297	133
Seastar	8	4	16	5	139	16
Rock crab	20	--	2	4	--	1

Species	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6
Lobster	--	--	--	--	--	1
Barnacles	--	--	--	--	3	--

Source: Jacques Whitford, 2008

No vegetative communities were noted and, except for one transect, individual vegetative species were not seen (Jacques Whitford, 2008). It was noted that in Transect 6 (0-30 m) benthic flora was observed in the form of algae and sea lettuce (*Ulva lactuca*).

The study concluded that the seafloor nearest Tufts Cove Generating Station is comprised mainly of soft sediments which are subject to high organic loading from the storm water outflow. The seafloor supports low species biodiversity. The distant seafloor transects exhibit hard substrate such as cobbles and boulders embedded in sandy sediments that provided suitable habitat for numerous large crustaceans (*e.g.,* rock crabs) and fin fish (*e.g.,* longhorn sculpin) (Jacques Whitford, 2008).

In order to characterize the sediment chemistry, a total of 16 surface sediment samples were collected from the top 15 cm of the substrate. Six samples were analyzed for the following:

- PAHs;
- TPH;
- Benzene;
- Toluene;
- Ethyl benzene;
- BTEX; and
- metals (including arsenic, cadmium, and lead).

The remaining samples were archived and later analyzed for metals.

In comparison to the 2002 CCME <u>Marine Interim Sediment Quality Guidelines</u> (ISQG), and <u>Soil Quality Guidelines</u>, the marine sediment chemistry data showed some parameters in concentrations above the Guidelines in the study area. Of the sites sampled, seven PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, chrysene, flouranthene, phenanthrene, and pyrene) consistently exceeded guidelines at the sampling location on each transect. These compounds are readily found in emissions from the incomplete combustion of fossil fuels. TPH levels exceeded CCME <u>Soil Quality Guidelines</u> for Industrial land use in all samples. BTEX compounds were non-detect in all samples, except xylene which was detected at one location in concentrations well below CCME <u>Soil Quality Guidelines</u>. Concentrations of copper (Cu), and lead (Pb) also exceeded CCME ISQG at all transect sites. Concentrations of cadmium (Cd) were consistent along all transects; concentrations of Cd exceeded CCMEISQG at locations along four transects. Zinc (Zn) levels exceeded CCME ISQG at all but one sampling location. Concentrations of vanadium (V) exceeded CCME Soil Quality Guidelines at three transect sites. All transects with greater than one sample per length displayed similar results, indicating the uniformity of impacted sediment within the transect length.

The study concluded that the elevated levels of PAHs, metals and TPH within the study area are consistent with concentrations found in the inner Halifax Harbor region (Jacques Whitford, 2008).

Table 11 Marine Sediment Chemistry – Halifax Harbour near Tufts Cove (October 2007)

			Tufts Cove Halifax Harbour																CCME	CCME
Parameter	Units	RDL	T1S	T2S	T2M	T2E	T3S	T3M	T4S	T4M	T4E	T5S	T5SM	T5ME	T5E	T6S	T6M	T6E	Marine Sediment ISQG (2002)	Soil Quality Guidelines for Industrial Use (2004)
Aluminum	mg/kg	1	42000	30000	29000	32000	41000	46000	38000	38000	27000	19000	10000	43000	41000	41000	44000	42000		
Antimony	mg/kg	2	4.5	--	--	--	--	--	--	--	--	--	ND	ND	ND	--	--	ND		
Arsenic	mg/kg	2	11	12	12	5.8	3.8	8	12	18	16	7.6	5	13	10	5.2	7.2	8.2	7.24	12
Barium	mg/kg	5	390	280	250	280	420	350	330	410	240	210	59	290	270	370	410	330		2000
Beryllium	mg/kg	5	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	--	--	ND		
Cadmium	mg/kg	0.15	0.81	1.0	1.1	0.45	0.28	0.49	0.79	0.78	0.85	0.89	0.84	0.79	0.83	0.53	0.43	0.54	0.7	22
Chromium	mg/kg	2	51	45	45	50	61	49	49	53	46	31	24	63	63	50	47	45	52.3	87
Cobalt	mg/kg	1	8.7	6.6	6.8	6.4	5.6	6.5	7.4	7.6	7.2	5.0	4.6	8.1	8	8.0	8.9	8.7		
Copper	mg/kg	2	81	100	100	42	24	54	120	100	110	250	140	140	140	94	49	62	18.7	91
Iron	mg/kg	50	28000	47000	43000	21000	23000	25000	23000	23000	19000	14000	11000	29000	29000	20000	23000	24000		
Lead	mg/kg	0.5	120	74	72	39	57	61	100	130	90	66	45	150	130	190	150	72	30.2	600
Manganese	mg/kg	2	570	350	330	350	540	490	390	350	270	190	140	350	330	370	500	470		
Molybdenum	mg/kg	2	5.2	7.4	7.6	2.6	2.1	3	4.8	4.6	4.6	13	12	6.7	5.1	4.5	3	3.7		
Nickel	mg/kg	2	36	44	44	23	23	31	62	69	5.3	34	19	38	33	71	28	26		50
Selenium	mg/kg	2	--	--	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--		3.9
Strontium	mg/kg	5	94	310	330	95	94	97	140	180	170	410	280	120	160	110	99	93		
Thallium	mg/kg	0.1	0.62	0.37	0.37	0.45	0.43	0.45	0.43	0.41	0.39	0.31	0.26	0.44	0.39	0.41	0.43	0.39		1
Tin	mg/kg	2	14	11	27	72	42	8	14	14	13	7.2	6.6	19	18	19	7.3	10		
Uranium	mg/kg	0.1	2.7	2	1.9	1.9	2	2.1	2.1	2	1.8	2.5	1.8	2.7	2.2	2.3	2.3	2.1		
Vanadium	mg/kg	2	120	160	160	78	64	90	230	270	210	99	68	130	120	260	83	87		130
Zinc	mg/kg	5	290	230	230	180	99	150	260	260	240	210	190	300	270	200	150	190	124	360
Benzene	mg/kg	0.03	--	--			--		--			--				--				5
Toluene	mg/kg	0.03	--	--			--		--			--				--				0.8
Ethylbenzene	mg/kg	0.03	--	--			--		--			--				--				20
Xylenes	mg/kg	0.05	--	--			0.08		--			--				--				20
C_6 - C_{10} (less BTEX)	mg/kg	3	--	--			--		--			--				--				
$>C_{10}$-C_{21} Hydrocarbons	mg/kg	15	99	160			76		390			250				250				
$>C_{21}$-$<C_{32}$ Hydrocarbons	mg/kg	15	260	470			220		990			690				700				
Modified TPH (Tier 1)	mg/kg	20	360	640			300		1400			950				940				10
PAHs																				
1-Methylnaphthalene	mg/kg	0.05	--	0.12			--		0.36			--				0.10				
2-Methylnaphthalene	mg/kg	0.05	--	0.14			--		0.56			--				--				
Acenaphthene	mg/kg	0.05	--	0.35			--		0.55			--				0.16			0.00671	
Acenaphthylene	mg/kg	0.05	--	--			--		--			--				--			0.00587	
Anthracene	mg/kg	0.05	0.15	0.54			--		0.73			0.25				0.82			0.0469	
Benzo(a)anthracene	mg/kg	0.05	0.35	1.3			0.18		1.5			0.50				1.5			0.0748	10
Benzo(a)pyrene	mg/kg	0.05	0.36	1.3			0.19		1.5			0.50				1.3			0.0888	10
Benzo (b) flouranthene	mg/kg	0.05	0.33	1.1			0.19		1.4			0.47				1.1			0.0888	
Benzo (g,h,i) perylene	mg/kg	0.05	0.22	0.7			0.12		0.81			0.30				0.69				
Benzo(k)fluoranthene	mg/kg	0.05	0.34	1.1			0.19		1.4			0.47				1				10
Chrysene	mg/kg	0.05	0.42	1.4			0.22		1.8			0.60				1.7			0.108	
Dibenz(a,h)anthracene	mg/kg	0.05	0.10	0.16			--		0.23			0.22				0.16			0.00622	10
Fluoranthene	mg/kg	0.05	0.74	3.2			0.43		4.2			1.2				3.0			0.113	
Fluorene	mg/kg	0.05	--	0.32			--		0.70			--				0.35			0.0212	
Ideno (1, 2, 3-cd) pyrene	mg/kg	0.05	0.21	1			0.16		0.89			0.37				0.61				10
Naphthalene	mg/kg	0.05	--	0.14			--		0.95			--				--			0.0346	22
Perylene	mg/kg	0.05	0.11	0.4			--		0.47			--				0.34				
Phenanthrene	mg/kg	0.05	0.47	1.7			0.30		3.9			0.74				2.2			0.0867	50
Pyrene	mg/kg	0.05	0.71	2.8			0.44		3.3			1.0				3.2			0.153	100
Total PAHs	mg/kg		4.51	17.77			2.42		25.25			6.62				18.23				

Notes:

-- Below Reportable Detection Limit (RDL)

PAH = polycyclic aromatic hydorcarbons

PCB = polychorinated biphenyls

ISQG = interim sediment quality guideline

Grey Shading Exceeds CCME Marine Sediment ISQG 2002

Bold exceeds CCME Soil Quality Guidelines 2004

7.4 Noise Survey

Noise was a consideration in both the TUC 4 and TUC 5 Environmental Assessment registration documentation. Information was presented on baseline conditions for the area with Units 1, 2, 3 and 4 in operation. This information identified the “compliance points”, against which measurements recorded during operation of both TUC 4 and TUC 5 would be compared. Noise mitigation design measures were outlined and a commitment was made to maintain noise levels (with the addition of TUC 5) to those of the baseline conditions. TUC 6 will comply with the existing sound limits set in the operating approval for TUC5.

Noise mitigative measures were implemented at different stages following the commissioning of TUC 4 and TUC5 projects to continuously reduce off-site noise impacts and meet compliance limits.

Following the installation of Unit 4 in 2004, measures were taken to reduce ambient noise levels with a focus on the south yard. These included: nine acoustical louvres to replace existing Unit 1, 2, and 3 building louvres on the east side of the existing plant; an absorptive barrier to envelope the Unit 2 & 3 transformer area; and acoustic seals to existing equipment doors on the south side of Unit .

As well, many of the significant noise source pieces of equipment were housed within noise-reducing buildings. These included the compressors, the auxiliary skids for lubrication and water injection, and the SPRINT support skids. Extra height on the stacks and the use of additional baffles in the stacks also resulted in noise mitigation. Additional sound insulation was added to various structures and some pieces of equipment were relocated to further reduce noise for nearby residents.

For construction of TUC5, many of the same measures were implemented such as the extra stack height with additional baffles and the significant noise sources being housed within noise-reducing buildings. Following the installation of Unit 5, further testing was completed by ATCO, mostly focused on the anti-icing (AI) system on the LM’s. Results showed the AI system contributed to the sounds levels on site. In 2007, anti-icing silencers were added to the AI system and testing by ATCO showed the silencers resulted in lower noise measurements at receptor sites 10 & 11.

After the installation of TUC 5, sound measurements were collected during operation of Units 1, 2, 3, 4 and 5 to determine the ambient noise levels, as compared to the “compliance limits”. Noise control measures implemented during the plant expansion were shown to be successful in reducing sound levels within regulatory requirements; however operation of the units continued to be restricted because of complaints from nearby residents. In response, NSPI hired ATCO Noise Management to design and build an acoustic noise barrier between the units and the nearby residents. After its completion in 2008, additional measurements were collected to evaluate the barrier’s effectiveness in reducing the noise level in the surrounding residential environment. The most recent set of sound measurements were collected in January, 2009 to both establish the pre-existing local ambient noise levels prior to TUC6 construction and confirm noise level compliance with all five units generating as per the TUC5 Operating Approval. The results are as follows:

Receptor Site	Limit	Measured Level (dB)
7	63	61
9	57	54
10	60	58
11	58	57

Note: measured levels based on combination of data gathered in 2008 and 2009.

Analysis of the measurements shows that the acoustic barrier reduces the sound pressure levels by a minimum of 2.8 decibels (dBA) and by as much as 7.4 dBA at the measurement points in the surrounding area (note that every 3 dBA of reduction equals a halving of the absolute sound pressure). The measurement locations are shown below in Figure 12.

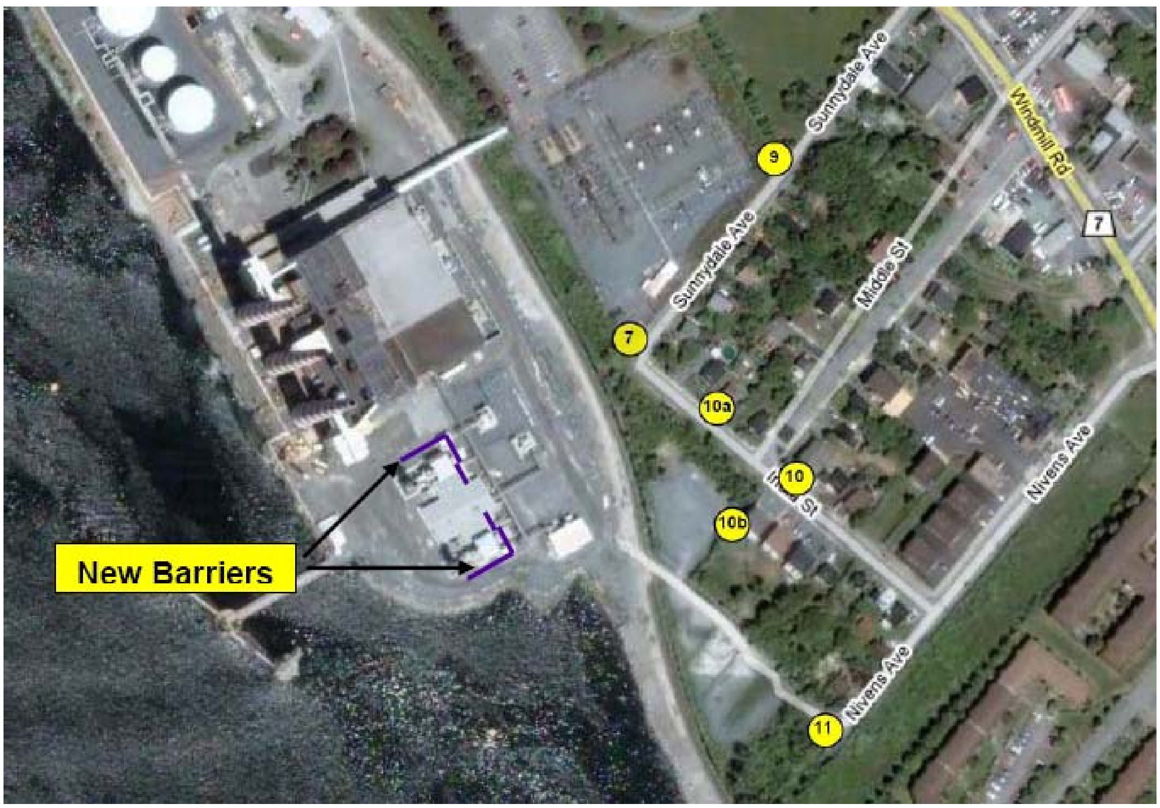

Figure 12 Aerial View of Tufts Cove and Nearby Receptors

8 VALUED ECOSYSTEM COMPONENTS

Valued Ecosystem Components (VECs) are environmental attributes or elements that have scientific, ecological, social, cultural, economic, historical, archaeological or aesthetic importance. VECs are specific to the environmental setting in which a project or activity takes place. In order to be selected there needs to be a reasonable possibility that the VEC will be affected by the proposed Project works and activities. Once identified, the VECs are assessed according to the project activities, existing environmental legislation, potential effects, significance of effects before mitigation, mitigation measures, significance of residual effects, cumulative effects, and follow-up monitoring.

A preliminary set of environmental components of concern (ECCs) were identified, based on issues that had been highlighted through public consultation, and regulatory review. These ECCs were refined through further consultation, agency involvement and the professional judgment of the study team, and are presented in Table 12. Where no meaningful interaction or impact pathway was identified, the issue was deemed not to be relevant to the assessment and scoped out of the analysis (i.e. a non-VEC). Where clear interactions or pathways between ECCs and the Project activities were identified, they became the VECs on which the effects assessment focused.

8.1 Boundaries

Boundaries are established to provide for a meaningful and manageable focus for the assessment and also aid in determining the most effective use of available study resources. The boundaries established in the context of this EA include:

- **Project Boundaries** define the extent of the Project site, both spatially and temporally. The Project site is identical for all VECs and involves the current footprint and boundary of the future proposed Project footprint as described in Section 2. Project spatial boundaries therefore include the:

    - Tufts Cove site on land (NSPI property); and
    - The area to be infilled in Halifax Harbour.

  The temporal project boundaries are set by the Project schedule as established in Section 2.5.

- **Ecological Boundaries** are determined by the spatial and temporal distributions of the biophysical VECs under consideration. Spatial ecological boundaries may be limited to the Project site and adjacent lands, or may extend well beyond the immediate footprints as the distribution and/or movement of an environmental component can be local, regional, national, or international in extent. Such factors as population characteristics and migration patterns are important considerations in determining ecological boundaries, and may influence the extent and distribution of an environmental effect. Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects and any sensitive or critical periods of a VEC's life cycle (*e.g.,* spawning, migration), where applicable.

Ecological spatial and temporal boundaries for this assessment are described for each biophysical VEC in Table 12.

Table 12 Scoping, Pathway Analysis and VEC Identification

Environment/ Resource	Environmental Components of Concern (ECC)	Pathway of Concern/ Project-Component Interaction		Possible Pathways/Project-ECC Interactions	Determined to be a VEC?		Key Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)
		Yes	No		Yes	No	
ATMOSPHERIC ENVIRONMENT	AIR QUALITY – INCLUDING:	X		• Exhaust emissions from on-site operation of heavy equipment (mainly during construction) • Fugitive dust from site preparation and earthwork • Exhaust emissions from ship/barge delivery	X		• Protected by statute / regulation • Public concern
GEOLOGY AND SOILS	SOIL QUALITY		X	• No adverse interaction identified		X	Not included as a VEC
FRESHWATER ENVIRONMENT (INCLUDES COASTAL WETLANDS AND SALT MARSHES)	QUALITY AND QUANTITY		X	• No adverse interaction identified (there are no freshwater environments on the Project site. Potential impacts to off-site freshwater environments are dealt with under surface water resources. There are no wetlands or salt marshes present on the Project site or within close proximity)		X	Not included as a VEC
GROUNDWATER RESOURCES	QUALITY AND QUANTITY		X	• No adverse interaction identified		X	• Not included as a VEC
SURFACE WATER RESOURCES	QUALITY AND QUANTITY		X	• No adverse interaction identified		X	• Not included as a VEC
MARINE ENVIRONMENT	MARINE SEDIMENTS	X		• Sediment removal from dredging could impact marine habitat in both positive and negative ways. This is dealt with under the Marine Habitat VEC.		X	• Not included as a VEC
	MARINE HABITAT	X		• Habitat alteration, disturbance and /or destruction (HADD) as a result of infilling • Increased concentrations of contaminants released to marine waters due to sediment disruption from dredging • Effects from cooling water on in-shore areas • Ballast water discharges at wharf (not considered part	X		• Protected by statute/regulation (*Fisheries Act*, Guidelines for the Control of Ballast Water Discharge from Ships in Water Under Canadian Jurisdiction)

Environment/ Resource	Environmental Components of Concern (ECC)	Pathway of Concern/ Project-Component Interaction		Possible Pathways/Project-ECC Interactions	Determined to be a VEC?		Key Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)
		Yes	No		Yes	No	
				of routine operations)			• Public concern
	Marine Flora		X	• No adverse interaction identified (Although some effects to flora could result (i.e. sediment plumes from dredging could choke out marine plants, and infilling activities could result in loss of marine flora) it is unlikely as very little vegetative species and no vegetative communities exist in the impacted area (refer to Section 7.3))		X	• Not included as a VEC
	Marine Fauna	X		• Effects on fauna as a result of changes to marine habitat (losses and siltation), direct mortalities, and disturbance from activities (i.e. underwater water noise levels)	X		• Protected by statute/regulation (*Fisheries Act*) • Public concern
	Marine Resources (Commercial and Recreational Fisheries)	X		• Effects on commercial/recreational fisheries as a result of disturbance from activities (i.e. lighting, activity, equipment in the water)	X		• Protected by statute/regulation (*Fisheries Act*) • Public concern and livelihood
Terrestrial Environment	**Terrestrial Flora**		X	• No adverse interaction identified		X	• Not included as a VEC
	Terrestrial Fauna including Birds and other Avifauna	X		• Noise effects (disruption; startling) from construction activities (use of heavy equipment, pile driving) • Lighting effects and bird collisions with equipment and structures • Disruption of nesting activities (noise, movement)	X		• Protected by statute/regulation (*Migratory Bird Convention Act* (MBCA), *NS Wildlife Act* (NSWA)) • Public concern
Species At Risk	**Species at Risk and Critical Habitat/Residences**		X	• No adverse interaction identified (Project site is industrial and footprint is relatively small. There is no critical habitat or SAR present.)		X	• Not included as a VEC

Environment/ Resource	Environmental Components of Concern (ECC)	Pathway of Concern/ Project-Component Interaction		Possible Pathways/Project-ECC Interactions	Determined to be a VEC?		Key Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)
		Yes	No		Yes	No	
NOISE	**NOISE LEVELS**	X		• Construction – Elevated noise levels during construction activities and installation of equipment. • Operations - history of operational noise complaints at TUC generation station from operation of TUC1-5. It is expected the addition of TUC6 HRSG unit will decrease low frequency noise levels.	X		• Public Concern
OCEANOGRAPHIC CONDITIONS	**CURRENTS**		X	• No adverse interaction identified. Infill may initially cause change in currents at and near site but all changes will equilibrate over time.		X	• Not included as a VEC
	SEDIMENT TRANSPORT		X	• No adverse interaction identified. Infill area may initially change sediment transport, erosion and deposition at and near site however, all changes will equilibrate over time.		X	• Not included as a VEC

9 EFFECTS ASSESSMENT METHODOLOGY

For each VEC, the potential interactions are investigated and evaluated based on current scientific knowledge with regard to each interaction. The effects are characterized as either “positive” or “adverse.” For adverse effects, mitigation measures are identified and the significance of the predicted environmental effects of the Project are evaluated based on a set of defined environmental effects thresholds of significance (refer to Section 8.1). For positive effects no determination of significance is conducted.

Environmental effects are evaluated for each VEC as either significant or not significant, based on the significance criteria (see below), and summarized in table form.

9.1 Thresholds for Determination of Significance

Section 16(1)(b) of the *Canadian Environmental Assessment Act* (CEAA) requires that the significance of environmental effects be determined. Accepted practice in meeting this requirement involves establishing and applying a threshold for the determination of significance. Residual environmental effects significance thresholds have been established based on information obtained in issues scoping, available information on the status and characteristics of the VEC, and may involve the application of environmental standards, guidelines or objectives, where these are available (e.g., applicable ambient air quality guidelines). Consideration of the carrying capacity, tolerance level, or assimilative capacity of the area or VEC may be helpful, even though it may not be possible to quantify these characteristics.

In general, significant environmental effects on VECs are those <u>adverse effects that are rated high in magnitude and which extend beyond local boundaries, occur frequently or permanently, and are not reversible</u>.

9.2 Evaluation of Significance

The significance evaluation of residual adverse effects for each VEC is based on the criteria as specified by the Agency, including:

Magnitude: the nature and degree of the predicted environmental effect. Rating depends on the nature of the VEC and the potential effect. For biophysical/ecological VECs the rating system is as follows:

Low	Affects a specific group or critical habitat for one generation or less; within natural variation;
Medium	Affects a portion of a population or critical habitat for one or two generations; temporarily outside the range of natural variability; or
High	Affects a whole stock, population or critical habitat (may be due to the loss of an individual(s) in the case of a species at risk) outside the range of natural variability.

Geographic extent: The area over which the particular effect will occur.

Duration/Frequency: How often/how long the effect will occur.

Reversibility: The ability of a VEC to return to an equal, or improved, condition once the disturbance has ended (for example, reclaiming habitat area equal or superior to that lost). Predicted effects are rated as reversible or irreversible, based on previous research and/or experience.

9.3 Follow-up and Monitoring

Section 16(2)(c) of CEAA requires consideration of the need for, and requirements of, any follow-up studies. Follow-up and Environmental Effects Monitoring (EEM) programs provide essential feedback, in particular with respect to:

- predicted Project effects;
- unanticipated effects;
- the necessity and efficacy of Project management strategies; and
- cumulative effects.

Monitoring allows environmental managers to adapt follow-up procedures to the situation and implement an adaptive management approach.

Monitoring may be undertaken for a number of reasons including regulatory or corporate compliance (environmental compliance monitoring (ECM)), evaluation of mitigating measures, and/or commitments to third parties.

Monitoring and follow-up requirements are evaluated for each VEC and are linked to the sensitivity of a VEC to both Project-related and cumulative environmental effects. The likelihood and importance of such effects, as well as the level of confidence associated with the adverse residual effects rating, are also taken into consideration.

10 EFFECTS ASSESSMENT

In discussions with the public and government officials, it should be noted that most people view the construction of Tufts Cove 6 to be a "net-positive" project. Nevertheless, adverse effects may be experienced as the various Project activities occur. This section therefore focuses on the assessment of these adverse effects of the Project.

10.1 Atmospheric Environment

10.1.1 Boundaries

Temporal Boundaries

The temporal boundaries include both construction and operation of the Project. Activities related to decommissioning are expected to remain within the air impacts associated with the construction phase.

Spatial Boundaries

The spatial boundaries include the Project boundaries. Adjacent lands (residential and high use (the Harbour) areas) are taken into consideration with respect to potential receptor locations.

10.1.2 Threshold for Determination of Significance

A significant adverse air quality effect has been determined to represent a condition where regulatory objectives are regularly exceeded.

NSE has established maximum permissible ground level concentrations for ambient air quality in Nova Scotia. All approvals issued by the MOE contain provisions to ensure that the maximum permissible ground level concentrations are not exceeded. Table 13 provides a list of these criteria.

Table 13 Federal and Provincial Ambient Air Quality Criteria

Pollutant	Averaging Time Period	Nova Scotia	Canada			
		Maximum Permissible[1]	Canada-Wide Standards[2] (Pending)	Ambient Air Quality Objectives[3]		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen Dioxide ($\mu g/m^3$)	1 hr	400	-	-	400	1000
	24 hr	-	-	-	200	300
	Annual	100	-	60	100	-
Sulphur Dioxide ($\mu g/m^3$)	1 hr	900	-	450	900	-
	24 hr	300	-	150	300	800
	Annual	60	-	30	60	-
Hydrogen Sulphide ($\mu g/m^3$)	1 hr	42	-	1	15	-
	24 hr	8	-	-	5	-
Total Suspended	24 hr	120	-	-	120	400

Pollutant	Averaging Time Period	Nova Scotia	Canada			
		Maximum Permissible[1]	Canada-Wide Standards[2] (Pending)	Ambient Air Quality Objectives[3]		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Particulate Matter ($\mu g/m^3$)	Annual	70	-	60	70	-
PM_{10} ($\mu g/m^3$)	24 hr	-	-	-	-	-
$PM_{2.5}$ ($\mu g/m^3$)	24 hr	-	30	-	-	-
Carbon Monoxide (mg/m^3)	1 hr	34.6	-	15	35	-
	8 hr	12.7	-	6	15	20

1. Government of Canada, 2004
2. CCME, 2000
3. NSE, 2007

There has been increased focus on greenhouse gas (GHG) emissions since Canada ratified the Kyoto protocol in 2002. This international agreement calls for signatory countries to substantially reduce GHGs beginning in 2010. For NSPI, the main GHG emission is carbon dioxide, coming from fossil fuel generated electric power. The federal government has introduced several frameworks for GHG emission reduction, the latest being the 2008 "Turning the Corner" initiative, which calls for a 20% reduction from 2006 emission levels by 2020. With recent developments in the United States and Europe, some changes to the timing and content of the final federal framework are expected. The Nova Scotia government released its energy strategy, "Toward A Greener Future" in January 2009. The goal is a GHG emission level 10% below 1990 levels by 2020. NSPI is developing a comprehensive plan to achieve appropriate GHG emission reductions. The Tufts Cove 6 project is one component of the plan, delivering cleaner, more efficient electrical energy for Nova Scotia.

10.1.3 Effects

Construction

Construction activities associated with the Project will require the use of internal combustion engines in various cranes, backhoes, dozers, loaders, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, miscellaneous heavy construction equipment, and worker commuting vehicles. The use of ships/barges to deliver Project parts will also be used. These activities will result in emissions of NO_x, SO_2, CO, PM_{10}, $PM_{2.5}$, and volatile organic compounds (VOCs). Additionally, fugitive dust emissions from construction activities such as site preparation, grading and vehicle traffic, will also occur during the construction period. Prior to paving or re-vegetation of disturbed soil areas within the Project site, it is possible that wind erosion of displaced soil may also generate fugitive dust emissions.

The use of equipment during construction activities will result in temporary, short-term emissions of air pollutants that will be restricted to the construction period and will terminate once construction has been completed. These emissions will likely not result in significant adverse impacts to the air quality within the vicinity of the Project. Fugitive dust control measures will be implemented, if required.

Operation

The operation of Tufts Cove 6 will result in a slight increase of combustion emissions due to the additional 25 MW of generation through duct firing. However, from an intensity perspective, emissions per energy output will improve through the utilization of the waste heat from the turbines instead of exhausting the heat from the stacks.

10.1.4 Mitigation

Construction

An EMP will be developed and implemented for the project. Furthermore, site specific Environment Protection Plans (EPPs) will be developed and implemented.

During construction NSPI will incorporate mitigation measures to minimize emissions and fugitive dust associated with construction activities. These measures may include:

- Requiring contractors to meet all provincial air quality regulations and emission standards applicable to the equipment;
- Ensuring that all construction equipment should be properly maintained;
- Applying water or dust suppressants to disturbed areas, as necessary, to reduce vehicle traffic dust;
- Covering open hauling trucks with tarps, as necessary;
- Using paved roads for construction vehicle traffic, wherever practical;
- Limiting vehicle speeds to reduce dust generation; and
- Upon completion of construction activity, stabilize disturbed areas.

10.1.5 Monitoring

Environmental management considerations for the Project include monitoring and maintenance programs such as EEM and ECM. Generally particulate emissions will be managed by responding promptly to any significant particulate emission concerns that occur during construction and by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented (Table 14).

The details of the monitoring programs will be determined in consultation with regulatory agencies and documented in the Project EMP.

10.1.6 Residual Effects

Overall effects on the atmospheric environment during construction and operation are not expected to be significant (Table 14).

Table 14 Atmospheric Environment - Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Emissions of NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs	A	o Require contractors to meet all provincial air quality regulations and emission standards o All construction equipment should be properly maintained	Low	Project site and adjacent areas	Construction Phase	R	Adjacent residential setting and high use area (the Harbour)	NS
Dust emissions from excavation, site preparation, grading and vehicle traffic. Wind erosion of displaced soil may also generate fugitive dust emissions prior to stabilizing.	A	o EMP and EPP o Apply water or dust suppressants o Cover open hauling trucks o Use paved roads o Limit vehicle speeds o Respond promptly to any significant particulate emission o Stabilize disturbed areas	Low	Project site and adjacent areas	Construction Phase	R	Adjacent residential setting and high use area (the Harbour)	NS
Operation								
Decreased plant emissions intensity per MWh generated	P	N/A	Med	Project site and adjacent areas	Operation Phase and possibly long term	N/A	Improvements to atmospheric conditions	N/A

10.2 Marine Habitat

10.2.1 Boundaries

Temporal Boundaries

The temporal boundaries include the construction and operation phase of the Project. Activities related to decommissioning are expected to remain within the impacts associated with the construction phase.

Spatial Boundaries

The spatial boundaries include the marine habitat immediately offshore of the site that will be infilled and the marine habitat immediately adjacent.

10.2.2 Threshold for Determination of Significance

Marine habitat is subject to regulations under the federal *Fisheries Act*. Section 35 (1) of the *Fisheries Act*, states that no one shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD). In addition to this, Section 36 of the *Fisheries Act*, administered by EC, prohibits the introduction of deleterious substances into waters frequented by fish.

A significant adverse effect on marine habitat is defined as one that is likely to cause any one of the following:

- adverse changes to critical habitats;
- further impairment of the ecological functioning of the biotic community;
- mortality or serious injury to species at risk (SAR); and
- increased ecological risk to a level that long term effects to the health of aquatic biota is predicted.

10.2.3 Effects

Construction

Construction activities will have both positive and adverse effects on marine habitat in the immediate area.

Construction activities close to and on shore have the potential to release sediment into the marine environment via run-off.

Adverse effects will also occur on habitat quality and quantity due to the direct removal and loss of habitat. Disturbance of the substrate from dredging activities will decrease habitat quality by re-suspending impacted sediments in the marine environment. This same effect is also possible as a result of propeller wash from ships/barges (that may be delivering equipment and/or Project components) in the area. Removal of sediment (dredging) and infilling activities will result in the direct removal and loss of marine habitat and therefore a negative effect. However, as shown by sediment studies (Section 7.3) the substrate in this area is impacted with compounds (PAHs) readily found in emissions from the incomplete combustion of fossil fuels, as well as metals, and TPH. The removal of sediment from the substrate will therefore create an overall positive effect.

Adverse effects may also occur from the discharge of wastewater and bilge water from ships/ barges (that may be delivering equipment and/or Project components) that may introduce non-native and invasive species into the marine environment.

There will be no blasting in the marine environment, and thus there is no concern over possible effects of this activity.

Operation

There remains a potential to release sediment into the marine environment via run-off during operation.

10.2.4 Mitigation

Construction

An EMP will be developed and implemented for the project. Furthermore, a site specific EPP will also be developed and implemented.

Control of sediment run-off will be covered in the EMP/EPP under an Erosion and Sediment Control Plan, and Stormwater Management Plan. Mitigative measures could include use silt booms and/or silt curtains.

If depths are shallow enough to create concern with respect to propeller wash, vessels may be docked with the assistance of tugs.

To minimize the re-suspension of sediments in the water column during dredging the following measures should be implemented:

- Ensure that the dredge bucket descends to the bottom in manner which reduces the potential re-suspension of sediments as the bucket contacts the bottom;
- Minimize the potential for washing of material from the bucket during ascent by having the operator try to achieve full bucket capacity;
- Control the rate at which the bucket ascends to reduce the potential of winnowing of sediment;
- Empty the bucket after material is unloaded before continuing to dredge;
- Use a rinse tank to remove build-up on the bucket;
- Do not drag the bucket on the bottom for the purposes of leveling;
- If necessary, limit dredging activities to periods during which tidal currents are weakest; and
- Use of silt booms or curtains to contain sediment wherever feasible.

Infilling activities will result in the permanent loss of approximately 2920m^2 of marine habitat. The *Fisheries Act* and relevant policies of the DFO (*Policy for the Management of Fish Habitat*) require that NSPI compensate for these losses/alterations to the satisfaction of DFO and with the objective of achieving a “no net loss” of fish habitat. A detailed analysis of the habitat types to be lost and options for replacing this habitat have been evaluated and the results of this investigation will be incorporated into a Habitat Compensation Plan (HCP) presently being discussed with DFO. The loss of marine habitat is considered a non-significant effect (Table 15) because, the area is not considered critical or limiting habitat for any of the species identified as being in the area, the magnitude of the effect is considered Low (affects a specific group or critical habitat for one generation or less (refer to Section 8.2), the effect does not extend out beyond local boundaries, it will not occur frequently, and the effect is considered reversible through implementation of the HCP. Although the impacts are permanent (habitat in the infilled area will be permanently lost) it should be noted that this lost habitat is considered to be impacted and of low quality (refer to Section 7.3). Compensated habitat will make up for this loss through the creation of useable, non-contaminated marine habitat. The implementation of measures outlined in the HCP will therefore offset any losses.

All vessels will comply with federal guidelines for the release of ballast water.

Operation

An EMP will be developed and implemented for the project. Furthermore, a site specific EPP will also be developed and implemented.

Control of sediment run-off will be covered in the EMP/EPP under an Erosion and Sediment Control Plan, and Stormwater Management Plan. Mitigative measures could include use silt booms and/or silt curtains.

10.2.5 Monitoring

Monitoring of marine habitat will be developed in consultation with DFO and implemented as part of the HCP to document the success.

Stormwater runoff will be monitored to ensure that the total suspended solids (TSS) concentrations meet regulatory standards.

10.2.6 Residual Effects

Overall effects on the marine habitat during construction and operation are not expected to be significant. Habitat loss is dealt with in the HCP.

Table 15 Marine Habitat – Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Sediment run-off	A	o Use of silt booms or curtains; o Erosion and Sediment Control Plan; o Stormwater Management Plan	Low	Water column within plume of runoff	Construction	R	Potential fish habitat	NS
Re-suspension of impacted sediments from dredging	A	o Slow ascent and descent bucket speeds; o Attempt to achieve full bucket capacity; o Completely empty the bucket after material is emptied and before continuing; o Use of a rinse tank to remove build-up; o Do not use bucket for leveling; o Limit dredging activities to periods when tidal currents are weakest; o Use of silt booms or curtains	Low	Project footprint and immediate surrounding area	Construction	R	Potential fish habitat	NS
Re-suspension of impacted sediments from propeller wash	A	o Vessels may be docked with the assistance of tugs	Low	Shallow water areas surrounding the site	Construction (but frequency is low: 1-2 vessels during this phase)	R	Potential fish habitat	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Introduction of invasive species from ballast and/or wastewater	A	o Vessels will comply with all federal guidelines for the release of ballast water	Low	Halifax Harbour and potentially Atlantic waters	Permanent	R	Potential fish habitat	NS
Permanent loss of marine habitat from dredging	A	o HCP	Low	Area to be infilled	Permanent	R	Affected habitat type is considered low quality and will be compensated with the creation of better quality habitat. HCP being negotiated with DFO.	NS
Removal of impacted sediment	P	o N/A	Medium	Area to be infilled	Long term	N/A	Improved marine habitat	N/A
Operation								
Sediment run-off	A	o Use of silt booms or curtains; o Erosion and Sediment Control Plan; o Stormwater Management Plan	Low	Water column within plume of runoff	Intermittent for operation phase	R	Potential fish habitat	NS

10.3 Marine Fauna

For the purposes of this assessment marine fauna includes fish and shellfish, marine mammals, sea turtles, benthic invertebrates, and marine invertebrates/plankton. Commercial fisheries are dealt with as a separate VEC.

10.3.1 Boundaries

Temporal Boundaries

The temporal boundaries include the construction and operation phase of the Project. Activities related to decommissioning are expected to remain within the impacts associated with the construction phase.

Migration patterns dictate that not all species of marine fauna will be in the study area on a year round basis; however the area is host to fauna throughout the year (refer to Section 5.5.4).

Spatial Boundaries

The spatial boundaries encompass the extent of Halifax Harbour, throughout the water column.

10.3.2 Threshold for Determination of Significance

Marine benthos is a component of fish habitat and therefore is subject to regulations under the federal *Fisheries Act*. Section 35 (1) of the *Fisheries Act*, states that no one shall carry on any work or undertaking that results in a HADD.

The protection of marine fauna, including marine benthos and plankton/invertebrates, falls under the jurisdiction of the federal *Fisheries Act* and the administration of DFO; however, Environment Canada administers those aspects of the *Fisheries Act* dealing with pollutants affecting fish (Sections 36-42). Section 35 (1) of the *Fisheries Act* states that no one shall carry on any work or undertaking that results in a HADD. Species at risk fall under the federal SARA and/or the provincial NSESA.

A significant adverse effect on marine biota is defined as one that is likely to cause any one of the following:

- adverse changes to critical habitats;
- further impairment of the ecological functioning of the biotic community;
- mortality or serious injury to SAR;
- a reduction in the abundance of one or more non-listed species from the existing level from which recovery of the population is uncertain, or more than one season would be required for a locally depleted population or altered community to be restored to pre-event conditions; and
- increased ecological risk to a level that long term effects to the health of aquatic biota is predicted.

10.3.3 *Effects*

Construction

Construction activities will have both positive and adverse effects on marine habitat in the immediate area.

Potential interactions from the construction phase include:

- sediment run-off from construction activities close to and on shore;
- siltation from marine construction;
- loss of habitat from infilling;
- re-suspension of sediments from propeller wash;
- introductions of invasive species;
- direct mortality of individuals through the process of infilling and/or dredging; and
- avoidance of the area due to noise and other disturbances.

Siltation (dredging) and removal and loss (dredging and infilling) of habitat will occur, thereby creating adverse effects on marine fauna. However, as shown by sediment studies (Section 7.3) the substrate in this area has been impacted with compounds (PAHs) readily found in emissions from the incomplete combustion of fossil fuels, as well as metals, and TPH and. The removal of sediment from the substrate will therefore create an overall positive effect.

Propeller wash from ships/barges (that may be delivering equipment and/or Project components) in the area can negatively affect fauna through the re-suspension of sediment resulting in siltation that can smother invertebrates, cover hard bottoms and negatively affect the ability of species such as mussels and scallops to settle and develop. This effect is further exacerbated by the fact that the sediment is impacted.

Potential adverse effects on marine fauna can also occur from the discharge of wastewater and bilge water from ships/barges that can introduce invasive species.

Infilling and dredging activities may result in mortalities of marine fauna in the area to be infilled and immediately adjacent. Fish, marine mammals, and sea turtles will be minimally affected as the habitat being lost is not considered limited or critical for species survival, mammals and turtles are unlikely to be present, and these species will be able to easily move to other areas. Any benthic invertebrates, including larval species, and some shellfish (e.g. blue mussels (*Mtyilus edulis*)) within the footprint of the infill and dredge area will be lost during the construction phase, as they do not have the ability to move to a new location.

Potential siltation from construction activities will destroy habitat adjacent to the immediate area designated to be infilled/dredged. Sediment plumes have the potential to smother sessile benthic invertebrates and demersal fish eggs, although the lack of proper vegetative species (refer to Section 7.3) required for fish spawning means that loss of fish eggs is unlikely.

Sources of construction noise (i.e. pile driving, dredging) may produce underwater noise at levels that can adversely affect marine fauna and may cause marine fauna to move out of the affected areas close to the source. There is considerable variation in the hearing ability within marine species therefore it is difficult to make general statements about behaviour related to this activity. Potential impacts to marine mammals include interfering with communications, foraging, echolocation, and breeding (David, 2006), however the likelihood that marine mammals will be in the area is low. The species most likely to occur in the area are seals. Caltran (2001) studied the effects of pile driving on harbour seals and found that most individuals vacated the area within 500 m of the activity. Tyack (1982) suggests that avoidance behaviour due to intermittent sounds, such as those produced during pile driving, occurs only when noise levels exceed 160 to 170 dB 1mPa.

The physical effects on fish have been examined by Turnpenny and Nedwell (1994) and include the following reactions to noise levels:

- transient stunning at 192 dB re 1 µPa;
- internal injuries at 200 dB re 1 µPa;
- egg/larval damage at 220 dB re 1 µPa; and
- fish mortality at 230-240 dB re 1 µPa.

In addition, Pearson et al. (1992) notes that the lower noise threshold that can cause subtle changes in fish behaviour is approximately 160 dB.

Disposal of dredge spoils will be land disposed so there will be no effects from smothering due to disposal activities. NSPI will designate on site storage areas for excavated materials unsuitable for reuse on this project, prior to disposal at an approved treatment/disposal facility.

Operation

There remains a potential to release sediment into the marine environment via run-off during operation.

10.3.4 Mitigation

Construction

An EMP will be developed and implemented for the project. Furthermore, a site specific EPP will also be developed and implemented.

Control of sediment run-off will be covered in the EMP/EPP under an Erosion and Sediment Control Plan, and Stormwater Management Plan. Mitigative measures could include use silt booms and/or silt curtains.

To minimize the re-suspension of sediments in the water column during dredging the following measures should be implemented:

- Ensure that the dredge bucket descends to the bottom in manner which reduces the potential re-suspension of sediments as the bucket contacts the bottom;
- Minimize the potential for washing of material from the bucket during ascent by having the operator try to achieve full bucket capacity;
- Control the rate at which the bucket ascends to reduce the potential of winnowing of sediment;
- Empty the bucket after material is unloaded before continuing to dredge;
- Use a rinse tank to remove build-up on the bucket;
- Do not drag the bucket on the bottom for the purposes of leveling;
- If necessary, limit dredging activities to periods during which tidal currents are weakest; and
- Use of silt booms or curtains to contain sediment wherever feasible.

Infilling activities will result in the permanent loss of approximately 2920m^2 of marine habitat. The *Fisheries Act* and relevant policies of the DFO (*Policy for the Management of Fish Habitat*) require that NSPI compensate for these losses/alterations to the satisfaction of DFO and with the objective of achieving a “no net loss” of fish habitat. A detailed analysis of the habitat types to be lost and options for replacing this habitat have been evaluated and the results of this investigation will be incorporated into a Habitat Compensation Plan (HCP) presently being discussed with DFO. The loss of marine habitat is considered a non-significant effect (Table 14) because, the area is not considered critical or limiting habitat for any of the species identified as being in the area, the magnitude of the effect is considered Low (affects a specific group or critical habitat for one generation or less (refer to Section 8.2)), the effect does not extend out beyond local boundaries, it will not occur frequently, and the effect is considered reversible through implementation of the HCP. Although the impacts are permanent (habitat in the infilled area will be permanently lost) it should be noted that this lost habitat is considered to contaminated, low quality, and low in species diversity (refer to Section 7.3). Compensated habitat will make up for this loss through the creation of useable, non-contaminated marine habitat. The implementation of measures outlined in the HCP will therefore offset any losses.

If depths are shallow enough to create concern with respect to propeller wash, vessels may be docked with the assistance of tugs.

All vessels will comply with federal guidelines for the release of ballast water.

To mitigate against mortalities to marine fauna, works should be completed during periods of least biological activity/sensitivity, where practicable.

Noise will be unavoidable however the following mitigative measures may be employed, where feasible:

- Mask noise through the use of bubble curtains, where practical;
- Use ramped warning signals; and
- Make use of alternative techniques to pile driving such as vibratory pile driving.

Operation

An EMP will be developed and implemented for the project. Furthermore, a site specific EPP will also be developed and implemented.

Control of sediment run-off will be covered in the EMP/EPP under an Erosion and Sediment Control Plan, and Stormwater Management Plan. Mitigative measures could include use silt booms and/or silt curtains.

10.3.5 Monitoring

Monitoring of marine habitat will be developed in consultation with DFO and implemented as part of the HCP to document the success.

Stormwater runoff will be monitored to ensure that the total suspended solids (TSS) concentrations meet regulatory standards.

10.3.6 Residual Effects

Overall effects on the marine habitat during construction and operation are not expected to be significant (Table 16) Habitat loss is dealt with in the HCP.

10.4 Marine Resources (Commercial and Recreational Fisheries)

10.4.1 Boundaries

Temporal Boundaries

The temporal boundaries include the construction phase of the Project. Activities related to decommissioning are expected to remain within the impacts associated with the construction phase. The seasons in which fisheries, both commercial and recreational take place within the stated spatial boundaries, is also considered a temporal boundary.

Spatial Boundaries

The spatial boundaries encompasses the area of Halifax Harbour in the vicinity of the Project site (i.e. the Narrows), and throughout the water column.

Table 16 Marine Habitat - Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects: Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Sediment run-off	A	o Use of silt booms or curtains; o Erosion and Sediment Control Plan; o Stormwater Management Plan	Low	Water column within plume of runoff	Construction	R	Potential fish habitat, sessile organisms/ eggs	NS
Re-suspension of impacted sediments from dredging	A	o Slow ascent and descent bucket speeds; o Attempt to achieve full bucket capacity; o Completely empty the bucket after material is emptied and before continuing; o Use of a rinse tank to remove build-up; o Do not use bucket for leveling; o Limit dredging activities to periods when tidal currents are weakest; o Use of silt booms or curtains	Low	Project footprint and immediate surrounding area	Construction	R	Potential fish habitat sessile organisms/ eggs	NS
Re-suspension of impacted sediments from propeller wash	A	o Vessels may be docked with the assistance of tugs	Low	Shallow water areas surrounding the site	Construction (but frequency is low: 2 vessels during this phase)	R	Potential fish habitat sessile organisms/ eggs	NS
Introduction of invasive species from ballast and/or wastewater	A	o Vessels will comply with all federal guidelines for the release of ballast water	Low	Halifax Harbour and potentially Atlantic waters	Permanent	R	Potential fish habitat	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Permanent loss of marine habitat from dredging	A	o HCP	Low	Area to be infilled	Permanent	R	Affected habitat type is considere low quality and w be compensated with the creation of better quality habitat	NS
Direct mortalities from infilling and dredging activities	A	o Works to be completed during periods of least biological activity / sensitivity, where practicable	Low	Project site and surrounding waters	Construction (sho term)	NR	Aquatic biota	NS
Impacts of noise	A	o Make use of ramped warning signals o Mask noise through the use of bubble curtains, where practical o Make use of alternative techniques to pile driving such as vibratory pile driving	Low	Project site and immediate surrounding area	Construction (intermittent and short-term)	R	Aquatic biota (especially marir mammals, fish)	NS
Removal of impacted sediment	P	o N/A	Medium	Area to be infilled	Long term	N/A	Improved marine habitat	N/A
Operation								
Sediment run-off	A	o Use of silt booms or curtains; o Erosion and Sediment Control Plan; o Stormwater Management Plan	Low	Water column withir plume of runoff	Intermittent for operation phase	R	Potential fish habitat	NS

10.4.2 Threshold for Determination of Significance

A significant adverse effect on commercial and recreational fisheries is defined as one that is likely to cause any one of the following:

- adverse changes to critical habitats;
- further impairment of the ecological functioning of the biotic community;
- a reduction in the abundance of one or more non-listed species from the existing level from which recovery of the population is uncertain, or more than one season would be required for a locally depleted population or altered community to be restored to pre-event conditions; and
- increased ecological risk to a level that long term effects to the health of aquatic biota is predicted.

10.4.3 Effects

Construction

Construction activities could have minor adverse effects on commercial and recreational fisheries in Halifax Harbour.

The potential effects on fisheries will be small as most of the fishing activity is concentrated in the outer Harbour areas (refer to Figure 7).

The effects, mitigation and monitoring for commercial and recreational fish species are the same as those described for the marine fauna VEC (refer to Section 9.3).

Additional effects of construction include:

- Lighting effects on lobster fishing areas that occur adjacent to Tufts Cove;
- Disruption of fishing activities from increased activity and noise;
- Potential collisions with new/temporary structures in the water.

10.4.4 Mitigation

Construction

Adverse effects of lighting on lobster areas adjacent to Tufts Cove can be mitigated by implementing the following measures:

- No unnecessary lighting will be used;
- Area lighting will be angled directly at work areas and shielded where possible; and
- Implementation of a lighting plan, if required.

While some occasional fishing may indeed occur in the vicinity of the proposed Project area, the limited impact on the marine environment and the passive nature of the Project will have little long-term impact to these activities. With regards to short-term disturbances that may occur during the construction of the project, NSPI will provide public notification of the timing of the marine construction activities (i.e. infilling, pile driving). This will provide an awareness of the Project and the timing of activities to local commercial/recreational fishers, to allow them to adjust fishing activities in effected areas.

Proper warning signage and lighting should also be provided for any equipment or newly installed structures that are in the water, to avoid collisions.

10.4.5 Monitoring

NSPI will engage all regulatory planning processes to ensure navigation safety and will maintain an open dialogue with the Public throughout Project planning and construction.

10.4.6 Residual Effects

Overall effects on the marine resources are not expected to be significant (Table 17).

10.5 Terrestrial Fauna including Birds

10.5.1 Boundaries

Temporal Boundaries

The temporal boundaries include the construction phase of the Project. Activities related to decommissioning are expected to remain within the impacts associated with the construction phase.

Spatial Boundaries

The spatial boundaries include the Project site and neighbouring areas.

10.5.2 Threshold for Determination of Significance

A significant adverse effect on terrestrial fauna, including birds, is defined as one that is likely to cause any one of the following:

- adverse changes to critical habitats;
- further impairment of the ecological functioning of the biotic community;
- mortality or serious injury to SAR;
- a reduction in the abundance of one or more non-listed species from the existing level from which recovery of the population is uncertain, or more than one season would be required for a locally depleted population or altered community to be restored to pre-event conditions; and
- increased ecological risk to a level that long term effects to the health of aquatic biota is predicted.

Table 17 Marine Resources - Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Adverse effects of lighting	A	o No unnecessary lighting will be used o Area lighting will be angled directly at work areas and shielded where possible o Implementation of a lighting plan, if needed	Low	Fishing areas immediately adjacent tc Tufts Cove	Construction (shc term)	R	Commercial fishery	NS
Increased activity and noise	A	o Public notification of the timing of marine construction activities	Low	Halifax Harbour – close to the Project site (i.e. the Narrows)	Construction	R	Disruption of fishing activities	NS
Adverse effects from equipment and/or structures in the water	A	o Proper warning signage o Proper lighting	Low	Halifax Harbour - close the Project site (i.e. the Narrows)	Construction	R	Marine resourc use, navigation	NS

Note: The effects, mitigation and monitoring for commercial and recreational <u>fish species</u> are the same as those described for the marine fauna VEC (Table 14).

10.5.3 Effects

Construction

Construction activities (i.e. clearing and grading) associated with the Project could impact wildlife and bird species in the area. The creation of dust from movement of construction and transportation machinery, and storage of soil and construction materials may have marginal adverse effects on wildlife in the area. However, these effects are not considered to be significant. Noise and activity associated with construction activities may disturb wildlife, especially birds and bats. Disturbances may disrupt normal wildlife behaviour, such as roosting, feeding, courtship, and rearing of young. Affected wildlife may also abandon suitable habitat. Construction noise and activity may startle nesting birds causing them to temporarily or permanently leave their nest and may result in decreased productivity from factors such as nest predation, temperature loss, and changes to less favourable nesting sites. Anthropogenic disturbance already exists in the Project area (industry, residences, roads, etc). Therefore, it can be assumed that the wildlife already present (i.e. raccoon, squirrel) are not very sensitive to human activities. Additionally, extra lighting will not be used at night time so it is expected that there will be no additional impacts to wildlife (i.e. birds) during construction. Human presence may attract omnivorous predators such as raccoons, particularly if workers leave leftover food at the Project site.

Operation

Operational noise levels will decrease when Tufts Cove #6 is added to the operation of this generating station. The effect of operation is therefore positive on wildlife, especially birds.

10.5.4 Mitigation

Construction

An EMP will be developed and implemented for the project. Furthermore, a site specific EPP will also be developed and implemented. Dust-abatement measures will be included in these plans such as:

- Applying water or dust suppressants to disturbed areas, as necessary, to reduce vehicle traffic dust;
- Covering open hauling trucks with tarps, as necessary;
- Limiting vehicle speeds to reduce dust generation; and
- Upon completion of construction activity, stabilize disturbed areas.

All construction equipment should have appropriate noise-muffling equipment installed and in good working order in order to minimize noise disturbance. The duration of noise disturbance should be minimized. Mitigation measures are particularly important during the breeding season when nest failure could result if incubating adults are repeatedly flushed from active nests.

Workers will be instructed to not leave any food items and garbage at the Project Site in order to avoid attracting omnivorous predators.

10.5.5 Monitoring

Environmental management considerations for the Project include monitoring and maintenance programs such as EEM and ECM. Generally particulate emissions will be managed by responding promptly to any significant particulate emission concerns that occur during construction and by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented.

The details of the monitoring programs will be determined in consultation with regulatory agencies and documented in the Project EMP.

10.5.6 Residual Effects

Overall effects on the terrestrial fauna, including birds, during construction are not expected to be significant (Table 18). Operational effects are expected to be positive.

10.6 Noise

10.6.1 Boundaries

Temporal Boundaries

The temporal boundaries include the construction phase of the Project. Activities related to decommissioning are expected to remain within the impacts associated with the construction phase.

Spatial Boundaries

The spatial boundaries include the Project site and neighboring areas, which encompasses the receptor sites 7, 9, 10 and 11 (as shown in Figure 12).

10.6.2 Threshold for Determination of Significance

A significant adverse effect from noise is defined as one that is likely to cause any one of the following:

- a measureable increase in the baseline noise levels (dBA); or
- customer complaints related to noise levels.

Table 18 Terrestrial - Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects: Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Creation of fugitive dust	A	o EMP and EPP o Apply water or dust suppressants to disturbed areas o Cover open hauling trucks o Limit vehicle speeds o Stabilize disturbed areas	Low	Project site and adjacer neighbouring areas	Construction	R	Impacts to wildlif	NS
Noise and increased activity	A	o Use of noise-muffling equipment o Construction equipment should be in good working order o Minimize duration of noise, where possible o Mitigation measures are particularly important during the bird breeding season	Low	Project site and adjacer neighbouring areas	Construction	R	Disturbance/ disruption of wildlife behaviou	NS
Human presence may attract omnivorous predators (i.e. raccoons)	A	o Maintain a clean Project site	Low	Project site	Construction	R		NS
Operation								
Decreased operational noise	P	o N/A	High	Project site and adjacer neighbouring areas	Project life	N/A	Improved habitat	N/A

10.6.3 Effects

Construction

Construction noise and activity may lead to additional noise from tools and installation of equipment.

Operation

Operational noise levels will decrease when Tufts Cove #6 is added to the operation of this generating station. The effect of operation is therefore positive on the area.

10.6.4 Mitigation

Construction

All construction equipment should have appropriate noise-muffling equipment installed and in good working order in order to minimize noise disturbance. The duration of noise disturbance should be minimized. Work during daylight hours whenever possible to reduce any possible noise during the night.

10.6.5 Monitoring

A qualified consultant will be retained to monitor and report noise levels during the commissioning stage of Unit 6 to provide initial noise level information resulting from the inclusion of the new unit.

A qualified consultant will be retained to carry out and report noise levels under full operation of all six units and baseline noise monitoring (Units 1 through 5). The report shall include an evaluation of pre and post noise levels.

NSPI will comply with the current noise levels as outlined in the most recent Tufts Cove Industrial Approval (2003-035183-A02) which commits to the measured operational noise levels associated with Units #1 through #4. These NSE accepted values at the 4 receptor sites are as follows:

Receptor Site	Measured Noise Value (dB)
7	63
9	57
10	60
11	58

Note: Noise values were measured with TUC Units #1-#4 generating at full capacity

NSPI will conduct noise monitoring post TUC6 construction to establish new baseline conditions for the station.

10.6.6 Residual Effects

One of the many benefits of the once through stream generation technology (OTSG) planned for the Tufts Cove waste heat recovery project is an improvement in noise level reduction from the present state. The manufacturer of the technology is predicting a 58 dB sound pressure level at a distance of 50m from the center of the exhaust stack. Beyond the 50m distance, a noise level drop of at least 1 dB per 5m is predicted which will result in reduced noise levels at the current receptor points. These values generated by the manufacturer did not take into account the existing site mitigative measures such as the acoustic barrier constructed in 2008. Further tuning of the model is required to establish more accurate site specific noise values but based on the values predicted which would represent 'worst case', the expected results are favourable. Results of additional modeling will be forwarded to NSE upon receipt. Some additional site specific measures incorporated into the TUC6 design that will aid in the mitigation of noise are:

- The steam turbine generator will come with an acoustic enclosure;
- The turbine generator will be installed inside the new turbine hall;
- 100% of the bypass steam during startup is being captured by the condenser and not being released to vents;
- Traditional HRSGs will not be used. Instead a Once Through Steam Generator (OTSG) which is smaller and does not have as many auxilliary systems to consider for noise control will be used.
- The power transformer design criteria for TUC 6 is set at 10dBA below CSA standards;
- The powerhouse will be designed for acoustic abatement and all openings, including ventilation and doors, will face the harbour.

Table 19 Noise - Summary of Effects and Significance

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation	Significance Criteria for Environmental Effects					
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility (R=reversible NR=Nor reversible	Ecological/Social-cultural and Economic Context	Significant (S) or Not Significant (NS)
Construction								
Noise and increased activity	A	o Use of noise-muffling equipment o Construction equipment should be in good working order o Minimize duration of noise, where possible o Refrain from overnight work, when possible	Low	Project site and adjacent/ neighbouring area	Construction	R	Disturbance of neighbours	NS
Operation								
Decreased operational noise	P	o N/A	High	Project site and adjacent/ neighbouring area	Project life	N/A	Improved ambient noise levels	N/A

11 SYNTHESIS

Tufts Cove 6 will be designed and constructed as a 50 MW combined cycle generation unit. For a project of the economic and engineering magnitude of TUC6, the environmental impacts are minimal and contrary to most industrial projects, TUC6 will predictably improve existing environmental conditions. A waste heat recovery system will capture and utilize 25 MW of waste heat from TUC4 and TUC5 and combined with an additional 25 MW production capacity of highly efficient, low emission natural gas duct burners, the added 50 MW of production will benefit Nova Scotians and the environment.

11.1 Key Project Environmental Aspects

11.1.1 Air Emissions

Tufts Cove has increased its use of natural gas in recent years in Units 1 to 5. As a result of burning less oil, air emissions from this power plant have declined steadily. Burning natural gas releases virtually zero sulphur dioxide (SO_2) emissions and relative to other fossil fuels, natural gas results in lower levels of oxides of nitrogen (NO_X) and carbon dioxide (CO_2).

For the Tufts Cove 6 project, the 25 megawatts of electricity from waste heat will not produce additional air emissions. The 25 megawatts of electricity from duct firing will produce carbon dioxide (CO_2) and oxides of nitrogen (NO_X). The benefit of the two combined, however, is a lower intensity of emissions, i.e. emissions per MWh generated.

As was the case for Tufts Cove 4 & 5, air modelling shows that even with the natural gas duct firing capacity of Tufts Cove 6, the additional NO_X emissions are small compared to both existing background concentrations and levels specified in the NSAQR.

Combustion turbine units in simple-cycle configuration operate with possibly the highest available efficiency in the industry and have lower carbon intensity from burning natural gas which has a much lower quantity of CO_2 released per unit of energy production than for oil or coal.

11.1.2 Infill

The construction of Tufts Cove 6 requires a 2920 m^2 infill of Halifax Harbour along the shoreline of the existing plant site into Tufts Cove. The infilled area is required to support construction activities and provide for post construction access to the site.

The surrounding marine benthic habitat and sediment was studied in 2006 and 2007. Dive surveys using videography showed the seafloor nearest the Tuft's Cove generating station is comprised mainly of soft sediments which are subject to high organic loading from the storm water outflow and support low species biodiversity. Marine flora is very limited and little was observed during the dive surveys. There do not appear to be any sensitive areas in the immediate vicinity of the project site.

The alteration of the marine habitat in Tufts Cove is regulated by the Federal Fisheries Act and will require mitigation and/or habitat compensation.

11.1.3 Cooling Water System

As a requirement under section 30 of the *Fisheries Act*, NSPI is obligated to screen or guard against fish passage into the cooling water intake structure. NSPI researched several intake designs and decided that a two staged system consisting of a coarse box screen at the intake end-of-pipe and a finer wedge wire “V” shaped screen system located in the cooling water pump house.

The two staged design system will entrain some small fish however, the eductor system combined with the use of the wedge wire “V” shaped screens will effectively promote fish passage and minimize fish mortality. The alternative wedge wire end-of-pipe intake screen design is predominantly being used in freshwater applications and lacked conclusive anti-fouling performance evidence.

After circulating once through the cooling condensers, cooling water will be discharged back into the Halifax Harbour marine environment. The 2006/2007 cooling water study performed by AMEC resulted in minimal incremental increases in background Harbour temperatures ranging from approximately 0.75°C within 20 to 30 m of the cooling water outfall, to less than 0.5°C at 50 m from the outfall, to less than 0.25°C at 200 m from the outfall.

11.1.4 Noise

Mitigation of low frequency noise has been the objective of NSPI since the inception of the LM6000 units 4 and 5. In addition to the acoustic barrier constructed in 2008, the anticipated reduction in operational noise from the addition of the combined cycle unit should further aid in decreasing the noise levels in the surrounding area. The conversion of LM6000 units 4 and 5 to combined cycle operation will achieve a substantial reduction in low frequency noise emission from the exhaust stacks. Additional mitigative measures already incorporated into the design of TUC 6 include:

- The steam turbine generator will come with an acoustic enclosure;
- The turbine generator will be installed inside the new turbine hall;
- 100% of the bypass steam during startup is being captured by the condenser and not being released to vents;
- Traditional HRSGs will not be used. Instead a Once Through Steam Generator (OTSG) which is smaller and does not have as many auxilliary systems to consider for noise control will be used.
- The power transformer design criteria for TUC 6 is set at 10dBA below CSA standards;
- The powerhouse will be designed for acoustic abatement and all openings, including ventilation and doors, will face the harbour.

With the expected decrease in noise levels as a result of the installation of the OTSG combined with the design measures described above, NSPI will comply with the existing noise limits set for the TUC5 Operating Approval (2003-035183-A02) even with the additional generation. The noise limits as set in the TUC5 approval are:

Receptor Site	Measured Noise Value (dB)
7	63
9	57
10	60
11	58

11.2 Summary

The conversion of Tufts Cove #4 and #5 to a combined cycle operation, i.e. Tufts Cove #6, will result in a facility that is the most efficient thermal generating station in NSPI's fleet, and also adds 25 megawatts of capacity with no fuel cost or emissions to the NSPI generation portfolio (the remaining 25 MW is achieved through duct-firing). The benefit of the combined cycle operation is a lower intensity of emissions, i.e. emissions per MWh generated.

The increase in gas-fired generation will facilitate the expansion of NSPI's renewable generation portfolio by increasing the Company's ability to accommodate additions of intermittent supply sources (e.g. wind power) as well as providing fast-response backup generation. The project also facilitates the development of Demand Side Management (DSM) programs as the addition of 50 MW of capacity will delay the need for a much larger-scale generating facility. Increased gas-fired generation will contribute positively to NSPI's operating and fuel flexibility and security of supply through increased reserve margins, access to lower-emission energy, reliability of service and consumption of an indigenous fuel source.

On the basis of the information provided in this report, it is recommended that this project be approved for construction and operation.

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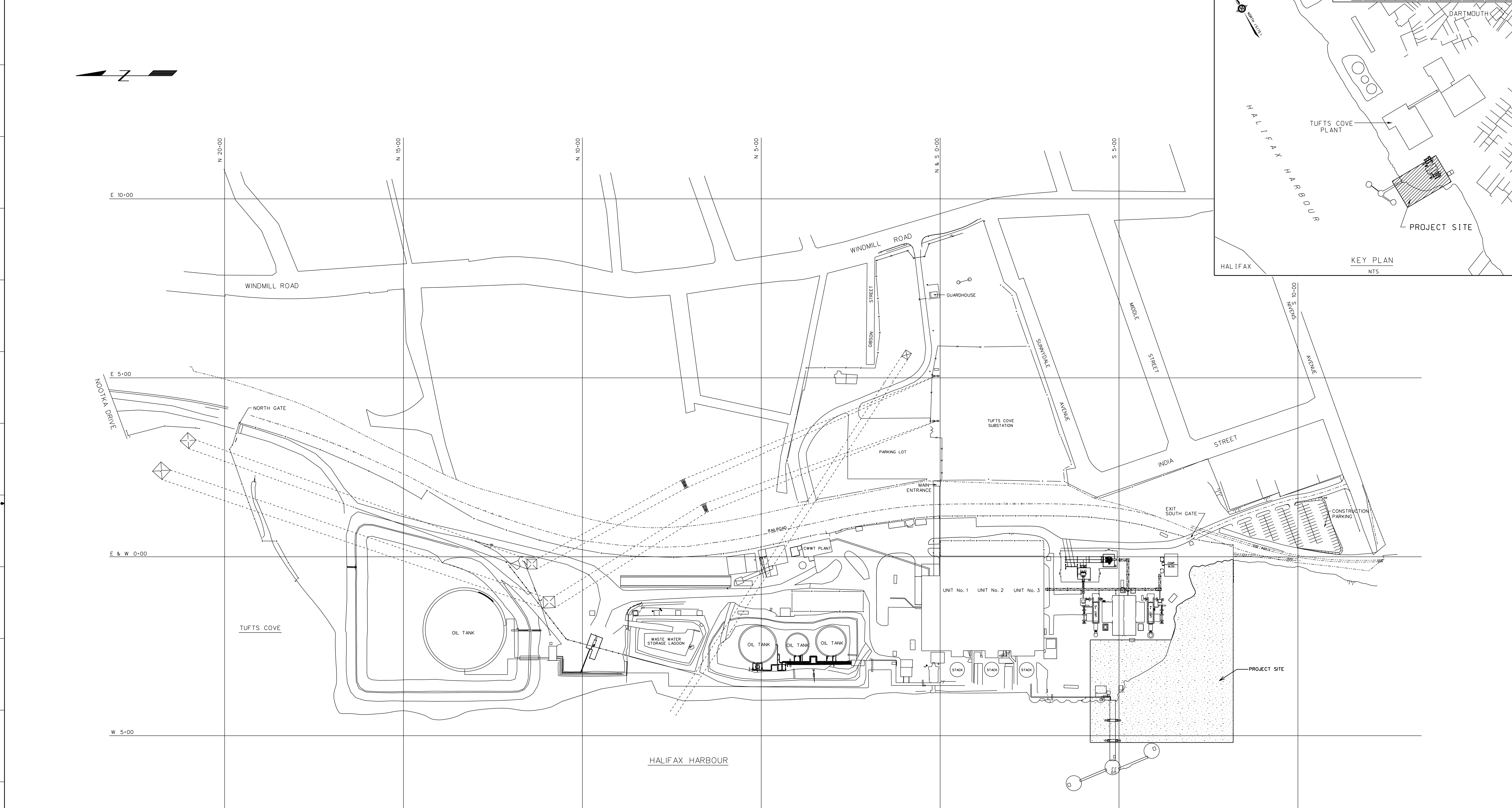
APPENDIX A

Maps and drawings Tufts Cove

Drawing # A 091H6 1 856 00 002 - Project Site – Location Plan
Drawing # A 091H6 1 856 00 003 - Project Site – New Construction Zone
Drawing # A 091H6 1 856 00 004 – Project Site - Harbour Infill and Circulating Water Intake Details and Sections



PROJECT SITE LOCATION PLAN

FOR INFORMATION ONLY

REFERENCE DRAWINGS	DWG.NO.

A REV	/ DS	/ CIVIL	/ MECH	/ E & I	/ CONST

ISSUE FOR INFORMATION ONLY

BY: D. MAXWELL DATE: 2009-01-22

SEAL

DEPARTMENTAL APPROVALS: CIVIL, E & I, MECH, CONST

APPROVED

DATE ....

SCALE 1"=100'
UNITS FEET & INCHES
DESIGNED
DRAWN D. MAXWELL
CHECKED
CHECKED
DATE 2009-01-19
W.O.

Nova Scotia Power Inc.
Halifax, Nova Scotia, Canada

TUFTS COVE GENERATING STATION
UNIT No. 6
PROJECT SITE
LOCATION PLAN

DWG.NO. A091H6 1856 00 002 REV. A

SYSTEM-
SOFTWARE-
VERSION-

$$$$$$$SYTIME$$$$$$$
DGN$SPECIFICATION********
USER$NAME

$$REFO1$$
$$REFO2$$
$$REFO3$$
$$REFO4$$
$$REFO5$$
$$REFO6$$

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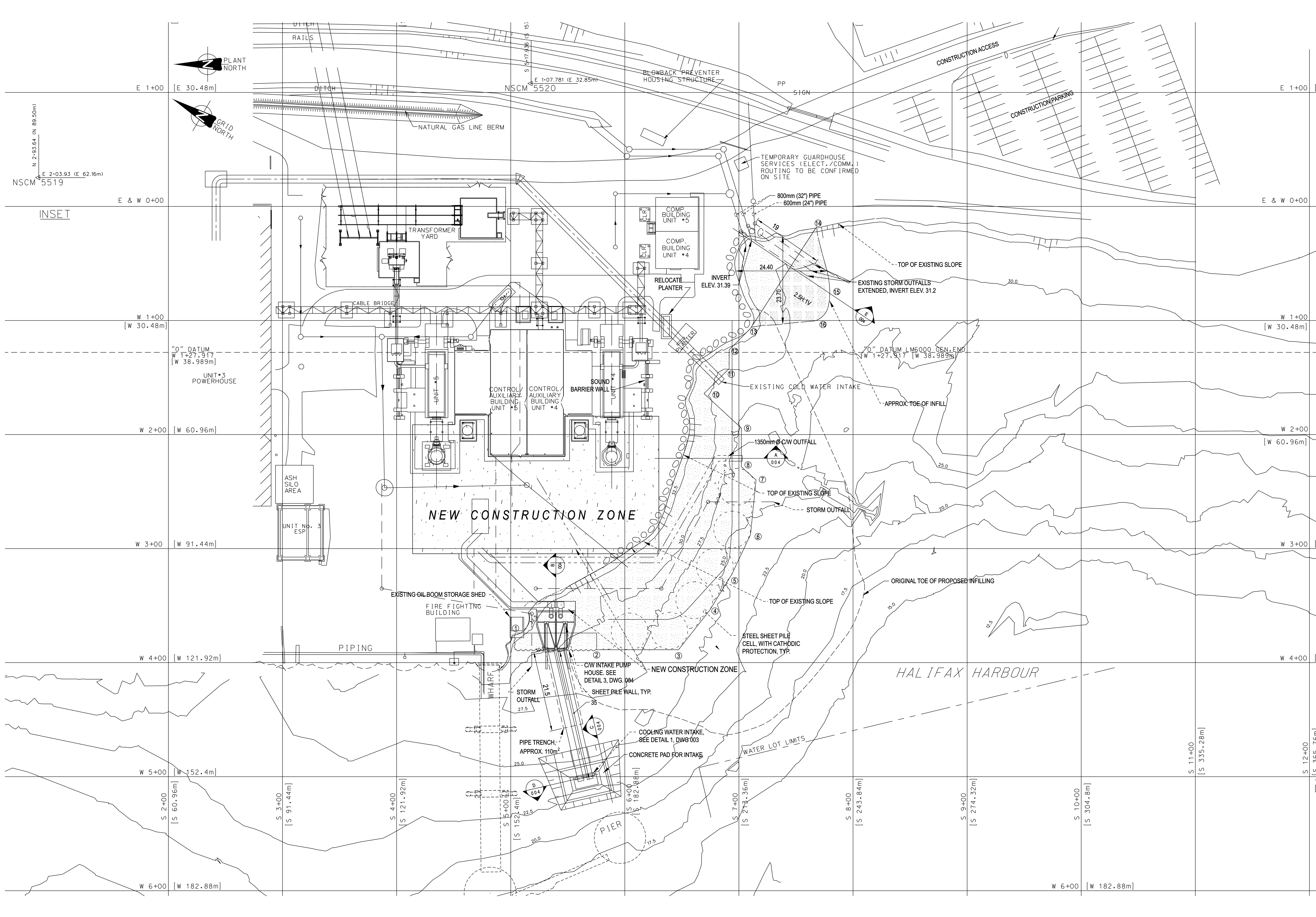

NOTES:

1. HARBOUR BOTTOM CONTOUR DATA SUPPLIED BY NSPI IN FEET TO PLANT DATUM. CONTOURS SHOWN HAVE BEEN CONVERTED BY AMEC AND ARE IN METERS.
2. ALL ELEVATIONS SHOWN ARE IN METRES AND REFER TO HALIFAX CHART DATUM.
3. HALIFAX CHART DATUM IS EQUIVALENT TO 96.43 FT (29.39 METRES) TUFTS COVE SITE DATUM. (=GEODETIC DATUM + 30.48 METRES).
4. HALIFAX CHART DATUM IS 3.57 FT (1.088 METRES) BELOW GEODETIC DATUM.
5. INFILL LIMITS BASED ON PRELIMINARY TOP OF SLOPE ELEVATION 32.92 METRES AND 2.5H:1V SLOPE TO HARBOUR BOTTOM.

COORDINATE MONUMENTS:

NSCM 5519
ATS 77 DATUM
N 4949052.295, E 5571683.596, Elev 11.0m
Long 44°-40'-40.48"N, Lat 63°-35'-44.92" W
PLANT DATUM
N 293.64 ft., E 203.93 ft., ELEV. 136.23 ft.

NSCM 5520
ATS 77 DATUM
N 4948823.793, E 5571782.686, Elev 3.17m
Long 44°-40'-33.042"N, Lat 63°-35'-40.535" W
PLANT DATUM
N -517.936 ft., E 107.781 ft., ELEV. 112.597 ft.

FILL/CUT QUANTITIES:

INFILL AREA = $2520m^2$

INFILL INSIDE SHEET PILING AND CAISIONS = $7300\ m^3$

INFILL VOLUME NEAR RAILWAY = $572\ m^3$

TOTAL INFILL = $7872\ m^3$

EXCAVATION VOLUME FOR INTAKE STRUCTURE AND PIPES = $700\ m^3$

COOLING WATER INTAKE TRENCH AREA = $110m^2$

COOLING WATER INTAKE CONCRETE PAD EXCAVATION AREA = $290m^2$

INFILL CO-ORDINATES:

1	W374.0 [W 114.0m], S503.8 [S 153.56m]
2	W388.7 [W 118.48m], S575.4 [S 175.38m]
3	W388.7 [W 118.48m], S647.1 [S197.24m]
4	W354.2 [W 107.96m], S674.3 [S 205.53m]
5	W322.8 [W 98.38m], S693.7 [S 211.45m]
6	W287.7 [W 87.68m], S710.2 [S 216.47m]
7	W239.8 [W 73.08m], S715.0 [S 217.93m]
8	W228.2 [W 69.57m], S702.1 [S 214.0m]
9	W194.3 [W 59.22m], S702.1 [S 214.0m]
10	W164.1[W 50.02m], S669.4 [S 204.04m]
11	W142.2 [W 43.33m], S691.4 [S 210.73m]
12	W125.7 [W 38.33m], S691.4 [S 210.74m]
13	W107.0 [W 32.61m], S710.0 [S 216.41m]
14	W18.0 [W 5.49m], S768.0 [S 234.09m]
15	W78.2 [W 23.83m], S779.6 [S 237.61m]
16	W99.4 [W 30.31m], S768.9 [S 234.35m]

FOR INFORMATION ONLY

REFERENCE DRAWINGS | DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST	DESCRIPTION	BY	DATE
B	/	/	/	/	/	REVISED INFILLING LIMITS AND ADDED ORIGINAL INFILL LIMIT EXTENTS	D. MAXWELL	2009-03-03
A	/	/	/	/	/	ISSUED FOR NWP TUC #6 PERMIT FOR INFORMATION ONLY	D. MAXWELL	2009-01-22

SEAL

DEPARTMENTAL APPROVALS: CIVIL | E & I | MECH | CONST

APPROVED

DATE ....

SCALE N.T.S.
UNITS
DESIGNED
DRAWN STAFF
CHECKED
CHECKED
DATE 2009-01-19
W.O.

Nova Scotia Power Inc.
Halifax, Nova Scotia, Canada

TUFTS COVE GENERATING STATION
UNIT No. 6

PROJECT SITE
NEW CONSTRUCTION ZONE

DWG.NO. A091H61856000003 REV. B

SYSTEM-
SOFTWARE-
VERSION-

\$\$\$\$\$\$\$SYTIME\$\$\$\$\$\$\$
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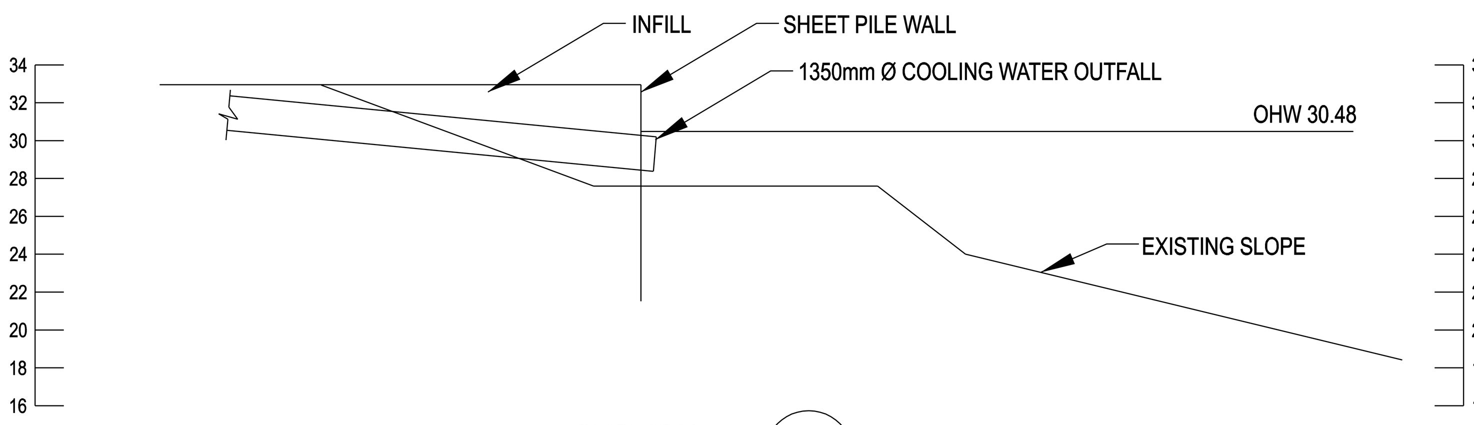

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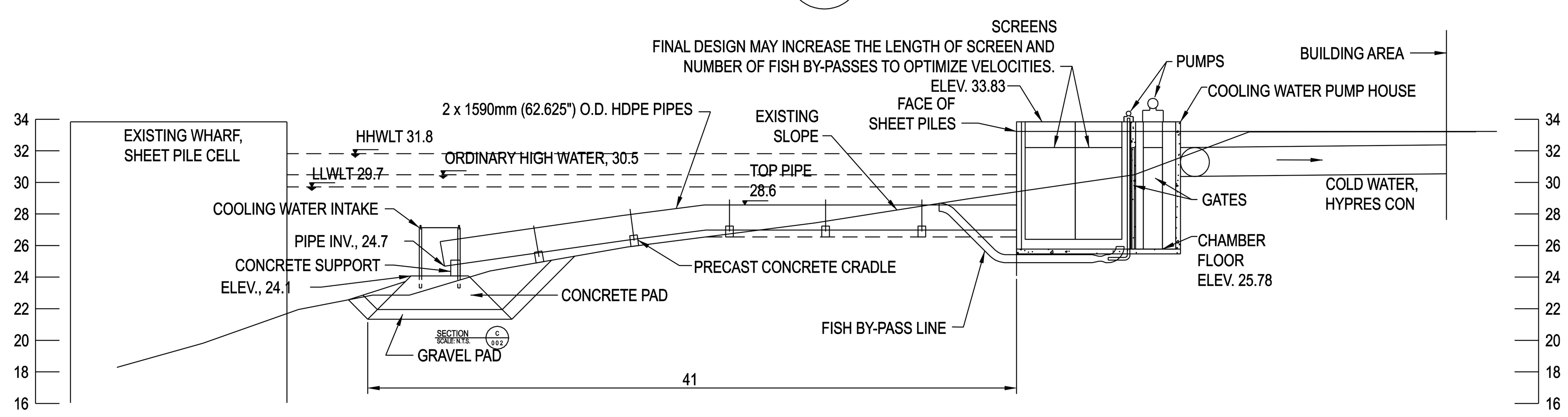

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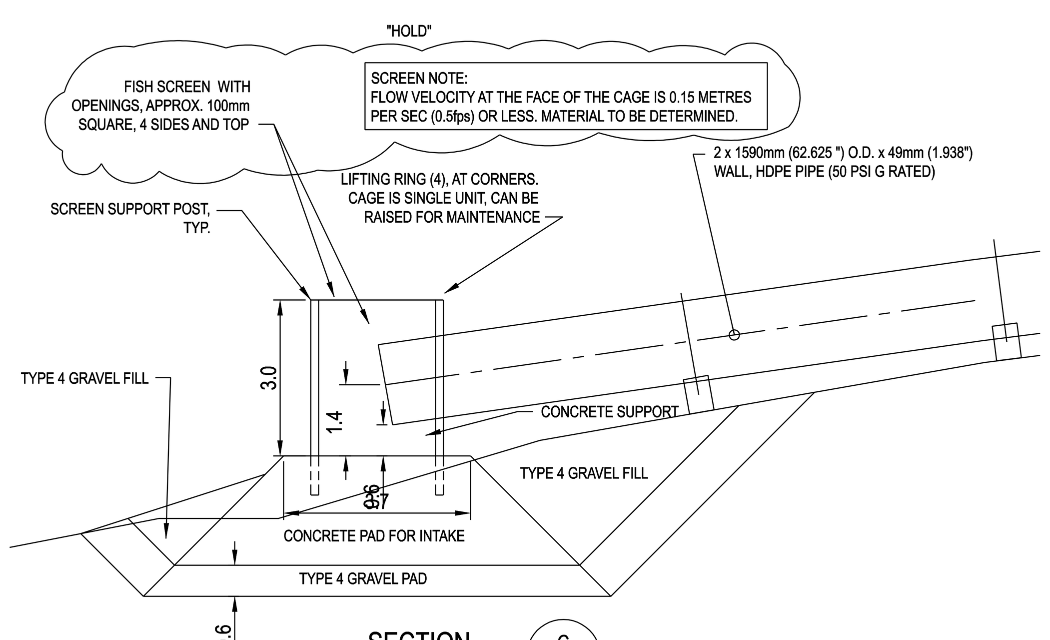

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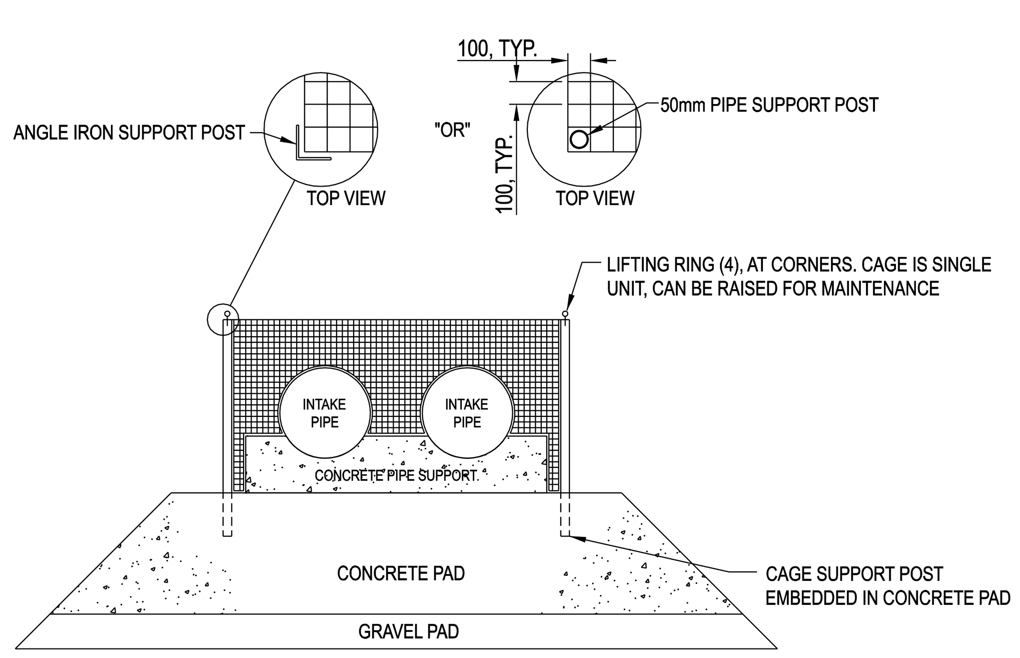
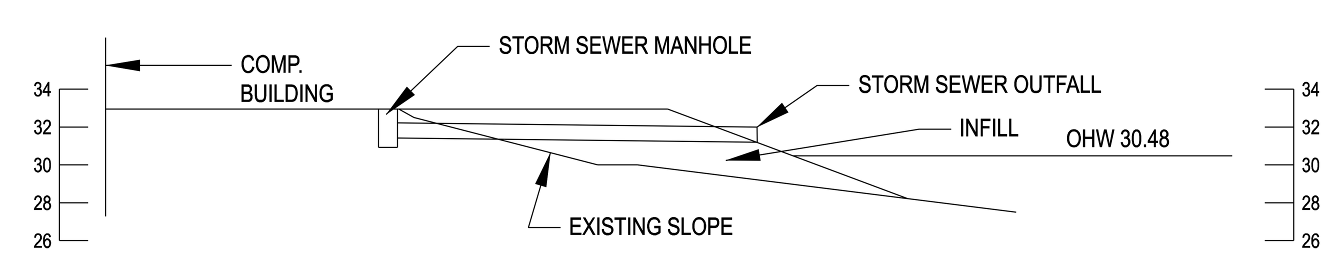


SCREEN DETAIL AT PIPE ENTRANCE D 003
SCALE 1:100



SECTION E 003
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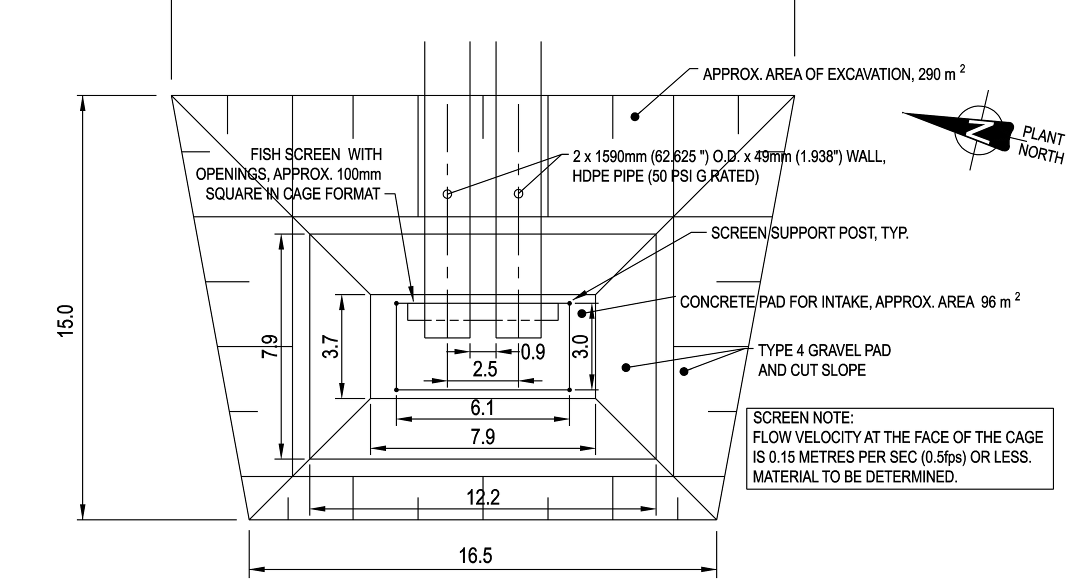

INTAKE DETAIL 1 003
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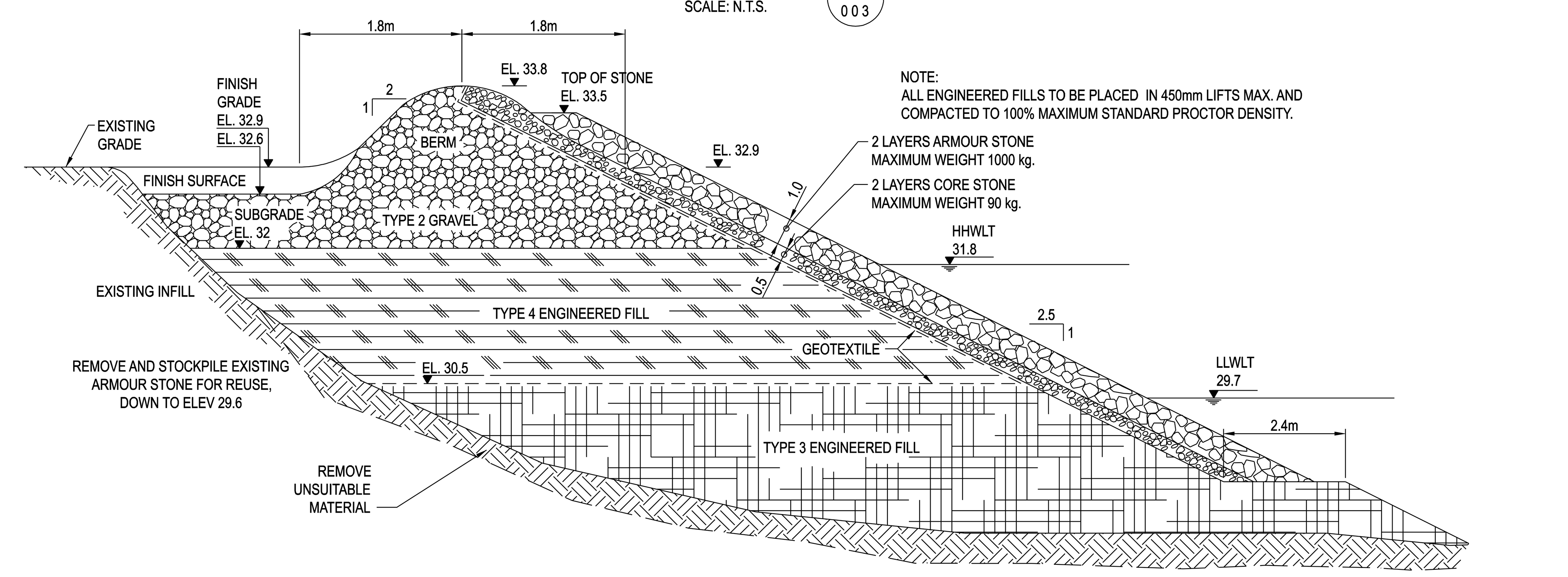
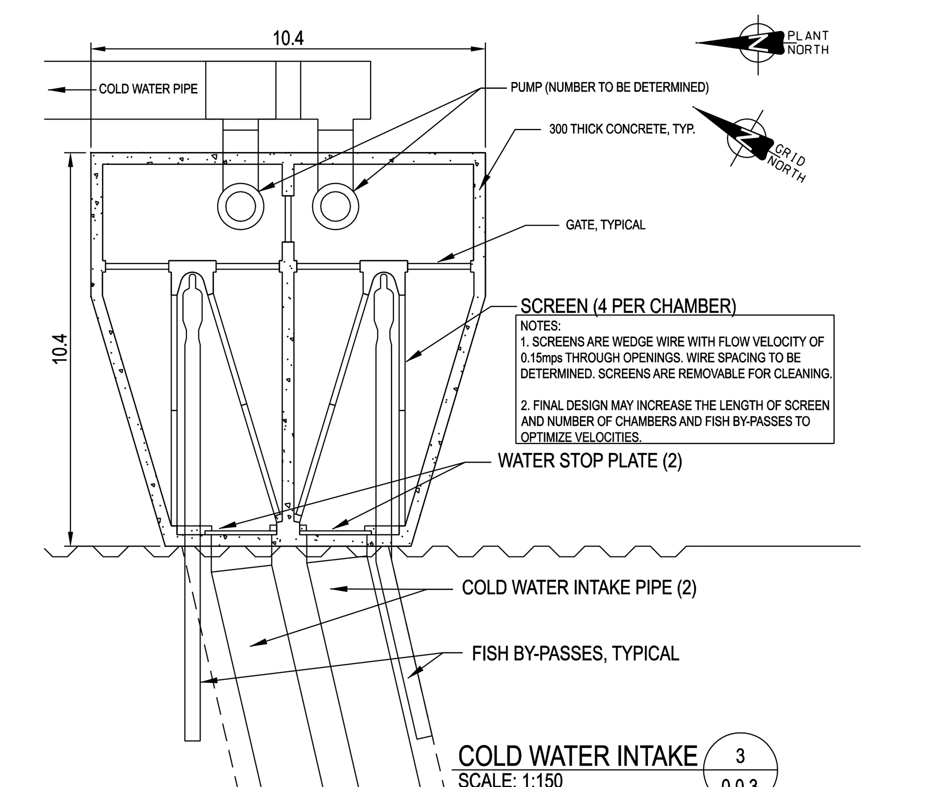


TYPICAL INFILL DETAIL
SCALE: NTS



COLD WATER INTAKE 3 003
SCALE: 1:150

NOTE:

1. HARBOUR BOTTOM CONTOUR DATA WAS SUPPLIED BY NSPI IN FEET TO PLANT DATUM. CONTOURS SHOWN HAVE BEEN CONVERTED BY AMEC AND ARE IN METERS
2. INFILL LIMITS BASED ON PRELIMINARY TOP OF SLOPE ELEVATION 32.92 METERS AND 2.5H:1V SLOPE TO HARBOUR BOTTOM.

FOR INFORMATION ONLY

REV	DS	CIVIL	MECH	E & I	CONST	DESCRIPTION	BY	DATE
B	/	/	/	/	/	REVISED SECTION 'A'	D. MAXWELL	2009-03-03
A	/	/	/	/	/	ISSUED FOR NWP TUC #6 PERMIT FOR INFORMATION ONLY	D. MAXWELL	2009-01-22

REFERENCE DRAWINGS | DWG.NO.

SEAL

DEPARTMENTAL APPROVALS: CIVIL | E & I | MECH | CONST

APPROVED

DATE ....

SCALE N.T.S.
UNITS
DESIGNED
DRAWN D. MAXWELL
CHECKED
CHECKED
DATE 2009-01-19
W.O.

Nova Scotia Power Inc.
Halifax, Nova Scotia, Canada

TUFTS COVE GENERATING STATION
UNIT No. 6
PROJECT SITE
HARBOUR INFILL & CIRCULATING WATER
INTAKE DETAILS & SECTIONS

DWG.NO. A091H6 1856 00004 REV. B

SYSTEM- SOFTWARE- VERSION-

$$$$$$$SYTIME$$$$$$$
DGN$SPECIFICATION•••••••
USER$NAME

$$REFO1$$ $$REFO2$$ $$REFO3$$ $$REFO4$$ $$REFO5$$ $$REFO6$$

85600004.dgn 3/4/2009 11:42:51 AM

APPENDIX B

Site Plan and List of NSPI Property Deeds and Leases Associated with Tufts Cove Generation Station

91H

Tuft's Cove Properties

Province of Nova Scotia

CITY OF DARTMOUTH

HALIFAX COUNTY

SCALE 1 INCH = 200 FEET

Tufts Cove Plant

91H

Lot	Book	Page	MF Number	Grantor	Date
1	2386	182	085300061	Her Majesty the Queen	May 8/70
2	2335	240	085300062	Her Majesty the Queen	Aug 27/69
3	1896	606	085300113	S. Jachimowicz Ltd.	Apr 30/63
4	1863	106	085300116	Mary Roberts	Nov 5/62
5	1861	191	085300117	Ferguson's Ltd.	Nov 2/62
6	1528	169	085300086	Mary Margaret Tufts, et al	Apr 10/58
7	1925	276	085300111	Her Majesty the Queen	May 6/63
8	1461	765	085300082	Atlantic Meat Packers	Apr 11/57
9	1695	539	085300188	Edward A. Payzant	Aug 17/60
10	1695	542	085300189	Edward A. Payzant	Sept 9/60
11	1966	834	085300112	Joseph Strickland et ux	Sept 19/62
12	2256	49	085300146	James V. Glawson	Jul 8/68
13	1834	647	085300107	George Brander	Jun 29/62
14	1837	834	085300108	William H. Lovett, et ux	Jul 16/62
15	1400	219 & 223	085300081	James H. Dauphinee	May 31/56
16	1522	319	085300088	William Lovett	Mar 17/58
17	1930	703	085300110	City of Dartmouth	Jun [illegible]
18	1446	406	085300118	Eastern Trust Co.	Dec 17/56
19	1445	18	085300100	Joseph C. Thompson	Dec 13/56
20	1527	348	0853000083	County of Halifax	Mar 19/58
21	2693	234	085300056	Gerald F. Naugle	May 9/73
22	19[illegible]	588	085300133	City of Dartmouth	Mar 11/64
23	1531	769	085300087	Leslie A. Jennex, et ux	May 9/58
24	1537	478	085300182	John Leahy, et ux	Jun 2/58
25	1885	347	085300115	City of Dartmouth	Feb 25/63
26	2027	428	085300137	Her Majesty the Queen	Aug 29/63
27	1923	699	085300120	Eastern Trust Co.	Jul 23/63
28	1703	98	085300095	Canada Permanent Trust	Oct 13/60
29	1522	203	085300089	Edith H. Snow	Mar 14/58
30	1468	281	085300091	George Howie, et ux	May 15/57
31	1468	278	085300092	William Grandy, et ux	May 15/57
32	1547	323	085300084	Gladys Boston	Jul 16/58
33	1648	332	085300093	Robert Brownrigg	Nov 23/59
SOLD 34	1648	322	085300094	T. Harold Johnson et al	Oct 23/59
SOLD 35	1648	319	085300096	Harold Metcalfe	Nov 20/59
36	1647	350	085300097	Roy R. Elliott	Nov 16/59
37	1647	347	085300098	Mary Elliott	Nov 17/59
SOLD Easement Retained 38	1537	475	085300085	Edward H. Yetter, et ux	Jun 2/58
39	781	1201	085300157	Michael A. Lahey, et ux	Oct 25/38
40	781	1197	085300156	Catherine Kerwin	Oct 26/38
41	1311	594	085300173	Charles M. Aucoin	Apr 8/55
42	1311	598	085300174	Charles M. Aucoin, et ux	Apr 8/55
43	1315	5	085300175	Raymond Richard	Apr 25/55
44	1612	776	085300184	Mabel Barrett	May 15/59
45	781	949	085300160	Michael Lahey, et ux	Jul 27/38
46	782	178		Trustees of School Section 88	Nov 16/38
47	1614	256		Frank M. Leaman Ltd.	May 25/59
SOLD 48	1614	703		Frank M. Leaman Ltd.	Oct 22/58
49	1612	783		Frank M. Leaman Ltd.	Apr 22/59
50	1578	523		Albert Kelly, et ux	Nov 17/58
50A	1615	192		Frank M. Leaman LTD	[illegible] 30/59
SOLD 51	1647	967	08530125	Frank M. Leaman Ltd.	Nov 19/59
SOLD 52	1635	955	085300124	Frank M. Leaman Ltd.	Jul 25/59
SOLD 53	803	206	085300080	Dartmouth Manufacturing Co. Ltd.	Mar 15/39
54	1385	243	085300121	Frank M. Leaman Ltd.	Mar 23/56
55	3594	905	085300003	STJEPAN RUDIC et. ux.	JULY 21/82
56	3582	651	085300324	GLENDA NEIFORTH et. al.	MAY 27/82

Easement Retained

See 1" = 200' Mapping (#7) in Mapping Cabinet

All Lots identified with M.F. Numbers

Lot	Book	Page	MF Number	Grantor	Date
LOT 57	BK.4611	PG.601-605	085300345	HORACE KENNETH STAPLES	REC.- AUG, 5/88
LOT 58	EXPROPRIATION #1836, JUNE 7, 1966				
Lot 59	BK 6552	Pg 670	085300396	The Shaw Group Limited	Rec- May 1st, 2000
Lot 60	BK 6809	Pg 1013	085300399	Canadian National Railway	Rec- July 19, 2001
Lot 61	Doc# 82074189		085300400	Enfield Hardware	Rec- May 31, 2005

	5N11-89	5N11-99	5P11-09	5P11-19
	5N11-88	5N11-98	5P11-08	5P11-18
	5N11-87	5N11-97	5P11-07	5P11-17
		5N11-96	5P11-06	5P11-16
			5P11-05	5P11-15

SHEET 5N11-97

Tufts Cove Generation Station Properties - Halifax County, NS					
Site	**Lot#**	**Grantor**	**Book#**	**Page#**	**Date**
Tufts Cove Generation Station Properties - Halifax County, NS	2	Her Majesty the Queen	2335	240	8/27/1969
	3	S. Jachimowica Ltd.	1896	606	4/30/1963
	4	Mary Roberts	1863	106	11/5/1962
	5	Ferguson's Ltd.	1861	191	11/2/1962
	6	Mary Margaret Tufts, et al.	1528	169	4/10/1958
	7	Her Majesty the Queen	1925	276	5/6/1963
	8	Atlantic Meat Packers	1461	765	4/11/1957
	15	James H. Dauphinee	1400	219	5/31/1956
	17	City of Dartmouth	1930	703	6/19/1963
	18	Eastern Trust Co.	1446	406	12/17/1956
	19	Joseph C. Thompson	1445	18	12/13/1956
	20	County of Halifax	1527	348	3/19/1958
	23	Leslie A. Jennex, et ux.	1631	769	5/9/1958
	24	John Leahy, et ux.	1537	478	6/2/1958
	25	City of Dartmouth	1885	347	2/25/1963
	27	Eastern Trust Co.	1923	699	7/23/1963
	28	Canadian Permanent Trust	1703	98	10/13/1960
	29	Edith H. Snow	1522	203	3/14/1958
	30	George Howie, et ux.	1468	281	5/15/1957
	31	William Grandy, et ux.	1468	278	5/15/1957
	32	Gladys Boston	1547	323	7/16/1958
	57	Horace Kenneth Staples	4611	601-605	8/5/1988
	58	Expropriation # 1836, June 7, 1966	-	-	6/7/1966
		Dumaresq et ux., Dubey and Webb	1907	259	6/10/1963
		Halifax Port Commission Lease	-	-	8/1/1998

APPENDIX C

Status/Ranking Category Descriptions

SARA

- **Endangered** - a species facing imminent extirpation or extinction.
- **Threatened** - a species likely to become endangered if limiting factors are not reversed.
- **Vulnerable** - a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

- **Endangered** - a species facing imminent extirpation or extinction.
- **Threatened** - a species likely to become endangered if limiting factors are not reversed.
- **Special Concern -** (formerly "vulnerable") a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Provincial General Status Rankings

- **Red** - any species known to be, or believed to be, at risk.
- **Yellow** - any species known to be, or believed to be, particularly sensitive to human activities or natural events.
- **Green** - any species known to be, or believed to be, not at risk.
- **Grey** - Indeterminate species, insufficient information to determine status