FACILITY PROFILE

New Brunswick Power Corporation
for the
Coleson Cove Thermal Generating Station

Prepared by:
Authorizations Branch
Department of Environment and Local Government
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BACKGROUND

The Coleson Cove Thermal Generating Station is operated by the New Brunswick Power Corporation (NB Power). The province’s largest electricity generating plant, Coleson Cove is located at Tiner Point, in the community of Lorneville, approximately 20 kilometres west in the City of Saint John, New Brunswick. The facility was initially commissioned in 1976, and generates up to 1050 megawatts of electricity from the combustion of heavy fuel oil in two large boilers and a combination of heavy fuel oil and petroleum coke in a third large boiler. This generating station represents approximately 25% of NB Power’s total generating capacity.

As required under the Air Quality Regulation – Clean Air Act, Coleson Cove must conduct its operations according to conditions outlined in an Approval to Operate issued pursuant to that Regulation. The Approval to Operate specifies conditions, which must be complied with in order to prevent unfavourable air quality conditions. Conditions in approvals are generally quite wide-ranging, and may include such requirements as limitations on operational parameters, requirements for testing and monitoring, requirements to operate air pollution control equipment, limits on emissions released to the atmosphere, provisions for equipment upgrade and/or maintenance, requirements for environmental emergency and/or compliance reporting, and a variety of other conditions aimed at minimizing the plant’s impact on the environment. The Regulation provides for approvals to be issued by the Minister of the Environment for a specified period, not to exceed five years.

In October 2002, NB Power received Cabinet approval to refurbish the Coleson Cove Generating Station (CCGS) to meet new and emerging environmental standards for sulphur dioxide, nitrogen oxides and particulate matter. In addition to improving environmental performance, the refurbishment project was designed to contribute to stabilizing electricity rates, ensuring a reliable source of energy for the province and extending operation of the Coleson Cove Generating Station by an additional 13 years to 2030. The refurbishment project took place between October 2002 and June 2005 and primarily involved the installation of extensive pollution control equipment and the conversion from No. 6 fuel oil to Orimulsion®. The new air pollution control equipment included two flue gas desulphurization (FGD) units (scrubbers) to control sulphur dioxide (SO₂) emissions, two wet electrostatic precipitators (WESPs) to control fine particulate matter emissions and low NOₓ burner/flue gas recirculation technologies to control emissions of nitrogen oxides (NOₓ). As well, the project involved the refurbishment of the three existing electrostatic precipitators (ESPs) to provide better control of particulate matter emissions. The refurbishment project also saw the construction of a new wastewater treatment plant, a new solid waste disposal facility and a new stack.

A supply of Orimulsion® fuel was never secured so NB Power continued to burn heavy fuel oil (Bunker C) at Coleson Cove. The cost of heavy fuel oil is much higher than the cost of Orimulsion® fuel. In an attempt to reduce fuel costs, NB Power applied for approval to undertake a project to conduct trials on one of the three boilers at Coleson Cove using a blended fuel consisting of petroleum coke and heavy fuel oil. This demonstration project was registered and reviewed pursuant to the Environmental Impact Assessment (EIA)
The EIA determination was issued to NB Power on April 18, 2007 allowing the demonstration project to proceed. The approved demonstration project consisted of conducting trials in one boiler (Boiler #3) using various ratios of petroleum coke blended with heavy fuel oil over a 12-month period. An Approval to Construct for the demonstration project was issued to NB Power on April 25, 2007, which saw the construction of enclosed petroleum coke storage and handling facilities at the Port of Saint John and at the Coleson Cove Generating Station.

The Air Quality Approval to Operate for Coleson Cove was amended in early March 2008 to allow for the burning of petroleum coke in Boiler #3 for the demonstration project. The amended Approval to Operate required NB Power to meet the existing emission limits. There was no increase in the emission limits as a result of burning petroleum coke. Stack emissions testing was also required as part of the demonstration project to determine emissions while burning heavy fuel oil blended with petroleum coke. The results of this testing were submitted to the Department in November 2008 and demonstrated that particulate matter emissions remained within the emission limits stipulated in the Approval to Operate. As well, stack emissions of NO\textsubscript{x} and SO\textsubscript{2} were measured by the continuous emission monitors and remained within the emission limits during the trials.

In November 2008, NB Power registered a project pursuant to the EIA Regulation to continue to burn petroleum coke in Boiler #3 after the 12 month demonstration project was completed. The EIA Certificate of Determination and the amended Approval to Operate were issued in March 2009 to allow the continued burning of petroleum coke and heavy fuel oil in Unit #3 on an ongoing basis.

This document is intended to provide background information relating to the operation of the Coleson Cove Thermal Generating Station, its design, its potential environmental impacts, and the facility’s history of compliance with its existing conditions of approval.

**PLANT DESIGN**

The Coleson Cove Generating Station is an important component in fulfilling the New Brunswick demand for electricity. Although it is considered an intermediate station (as opposed to a base-loaded station which operates virtually all the time, or a peaking station which operates only during peak power demands), Coleson Cove historically operated at relatively high capacity factors; between 40 and 65% averaged over a given year. The three 350-megawatt units are of such a size that they can be started up relatively quickly and meet energy demands in the event that any of the base-loaded stations become unavailable. In the past three years, Coleson Cove has not been operated as frequently (capacity factor averaging approximately 4 %), mainly due to increased costs for heavy fuel oil.
Process Description

In the thermal electricity generation process used at Coleson Cove, high-pressure steam is generated in three 350-megawatt boilers from the combustion of heavy fuel oil (also referred to as “No. 6 fuel oil” or “Bunker C”) in two of the boilers and a blended fuel consisting of petroleum coke and heavy fuel oil in the third boiler. In the combustion process, fuel is injected into the boilers where it produces heat from the burning of the fuel. Heat is transferred through the boiler tube walls to water flowing within the boiler tubes in order to generate steam. The steam then drives turbines, which convert the heat into mechanical energy, and the turbines drive generators, which convert the mechanical energy into electricity for the New Brunswick electrical grid.

The combustion process also generates exhaust gases, generally consisting of solid particles (referred to as “particulate matter”) and combustion gases (such as sulphur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, air, and water vapour). Each boiler is now fitted with a reburn combustion system, which includes low NO\textsubscript{x} burners, reburn burners, flue gas recirculation, and overfire air injection to control emissions of nitrogen oxides at the source. Exhaust gases from each of the boilers are directed to the dry electrostatic precipitators that remove approximately 70% of the particulate matter generated in the boilers. Exhaust gases then enter two Flue Gas Desulphurization (FGD) systems that were constructed as part of the refurbishment project. The FGDs are designed to remove 70 to 90% of the sulphur dioxide contained in the flue gas leaving the boilers. Finally, flue gas enters the new Wet Electrostatic Precipitators (WESP) installed during the refurbishment project. Two WESPs will further reduce particulate matter emissions and control emissions of sulphur trioxide, which is a major component of the fine particulate that was visible in the plume exiting the stack from the former operation. The gases are then released to the atmosphere via a new stack having a height of 183 meters (600 feet) above ground level. Continuous emission monitors in the stack measure the concentration levels of nitrogen oxides and sulphur dioxide being emitted.

Air Pollution Control Equipment

As a result of the refurbishment project (during 2002 – 2005), the Coleson Cove Generating Station is now equipped extensive pollution control technologies, including the following:

A reburn combustion system. Modifications to the burner system were made that include low NO\textsubscript{x} burners, reburn burners, flue gas recirculation, and overfire air injection to control emissions of nitrogen oxides at its source in the boilers. This is considered pollution prevention technology.

Dry electrostatic precipitators (ESPs). Two of the three existing dry ESPs were strengthened to remove approximately 70% of the particulate matter generated in the boilers and the associated ductwork was also refurbished.
Flue gas desulphurization system (FGD). Two FGDs, each sized for 50% of the station full load gas flow, remove 70 - 90% of the SO₂ emissions contained in the flue gas leaving the boilers. The flue gases are scrubbed by passing them through a spray of limestone and water. This mixture reacts with the SO₂ in the flue gases and the resulting chemical reaction produces gypsum slurry. The plant provides for the removal and dewatering of gypsum slurry from the FGDs resulting in gypsum cake, which is suitable for wallboard production. The plant also includes the limestone handling and preparation system.

Wet Electrostatic Precipitators (WESPs). Two WESPs were installed to control emissions, including sulphur trioxide, a major component of fine particulate in the visible plume exiting the stack. The new WESPs along with the existing dry ESPs have resulted in a 75% reduction in the total particulate emission rate. Each WESP is located at the outlet from the FGD absorber tower.

Distributed Control System (DCS). A new DCS, including new emission control systems, the reburn combustion control, FGD and WESP, were installed and allow NB Power to optimize the plant operating performance and efficiency.

Stack. A new 183 metre tall concrete stack, which is the same height as the original stack, was constructed to receive flue gas from the FGD system.

All NB Power plants including Coleson Cove have continuous emission monitors (CEMs) in place to measure the stack emissions, which places them in a unique position in the Canadian utility industry. At Coleson Cove, emissions of nitrogen oxides (NOₓ) and sulphur dioxide (SO₂) are continuously monitored by in-stack CEMs. These instruments allow NB Power to measure emission rates of these pollutants continuously, and to adjust operating parameters when contaminant levels would indicate a potential emission problem.

Operational Procedures

As part of the refurbishment project, additional ambient air quality monitoring stations were installed to validate the predictions made in the air quality dispersion modeling analysis that was conducted for the project. This included four ambient monitoring stations in various local communities surrounding the facility and the addition of a new meteorological station at the Coleson Cove Generating Station.

Pollution Prevention Initiatives

The concept of pollution prevention is strongly supported by regulatory agencies worldwide as an effective strategy for protection and enhancement of the environment. Pollution prevention (often abbreviated "P2") aims at reducing and minimizing the formation of environmental contaminants through a number of operational changes, rather
than to attempt to control the emission of such contaminants after they have been
generated. Pollution prevention offers the added advantage of reducing emissions of
several pollutants at once, rather than adding expensive air pollution control equipment,
which is generally designed to control emissions of only one particular contaminant.

Several pollution prevention initiatives have been implemented over the years at Coleson
Cove. These include the Supplementary Control System (SCS), the ash collection and re-
injection system, the ability to start-up and operate using low sulphur light fuel oil,
improvements to the combustion efficiency of the boilers, and the collection and sale of
bottom ash from the boilers in order to enable recovery and recycling of its metal contents
(particularly vanadium). As part of the refurbishment project, modifications to the burner
system were made that include low NOx burners, reburn burners, flue gas recirculation,
and overfire air injection to control emissions of nitrogen oxides at its source in the boilers.
This reburn combustion system is considered pollution prevention technology. These
pollution prevention measures aid in reducing the environmental impact of the facility by
means other than the use of traditional pollution control equipment.

NB Power has an environmental management system in place at the Coleson Cove
Generating Station that is consistent with the ISO 14001:2015 standards.

**POTENTIAL AIR QUALITY IMPACTS**

Prior to the refurbishment project, the Coleson Cove Generating Station was the single largest
source of sulphur dioxide emissions in New Brunswick. In 2003-04, NB Power refurbished the
Coleson Cove Generating Station, which included the addition of extensive pollution control
equipment to address not only emissions of sulphur dioxide, but also emissions of nitrogen oxides
and particulate matter.

**Sulphur Dioxide Emissions**

Table 1 summarizes the historical sulphur dioxide emissions from NB Power as a whole
and for Coleson Cove specifically, for the past twenty years.
A number of observations can be made from the data in Table 1. Firstly, both emissions from Coleson Cove and NB Power as a whole generally follow a downward trend.
Secondly, it can be observed that since the refurbishment project and due to limited operation of the generating station, the emissions from Coleson Cove have been reduced significantly and now account for a relatively small portion of the total NB Power emissions.

The refurbishment of the generating station has significantly reduced emissions and resulted in a reduction in potential air quality impacts. The pollution controls for the refurbished Coleson Cove Generating Station have positive air quality benefits with a 70% reduction in the stack emission rate of $\text{SO}_2$. The measured ground level concentrations of $\text{SO}_2$ are lower than those predicted from the dispersion modelling that was conducted as part of the refurbishment project and remain well below the regulatory standards, resulting in improved air quality in the airshed.

**Nitrogen Oxides Emissions**

Nitrogen oxides are formed in any combustion process from nitrogen in the air (termed “thermal NOx”) and from the nitrogen content of the fuel (termed “fuel NOx”). In almost every combustion process utilizing fossil fuels, thermal NOx is dominant since the nitrogen content of liquid fossil fuels is relatively low.

Once emitted into the atmosphere, nitrogen oxides can combine with water vapour in the atmosphere to form wet nitrate, which may later be deposited at ground level and may contribute to acidification. Nitrogen oxides may also participate in a secondary chemical reaction with volatile organic compounds in the presence of sunlight to form ground-level ozone, the major component of photochemical smog. In general, most ground-level ozone experienced in New Brunswick originates from the long-range transport of pollutants from the eastern United States and central Canada.

Table 2 summarizes the nitrogen oxide emissions from Coleson Cove and the total NB Power network since 1994.

**Table 2: Historical Emissions of Nitrogen Oxides from NB Power Total and Coleson Cove**

<table>
<thead>
<tr>
<th>Year</th>
<th>Coleson Cove Nitrogen Oxides Emissions, as NO$_2$ (tonnes per year)</th>
<th>NB Power Total Nitrogen Oxides Emissions, as NO$_2$ (tonnes per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>8,500</td>
<td>17,070</td>
</tr>
<tr>
<td>1995</td>
<td>6,500</td>
<td>16,560</td>
</tr>
<tr>
<td>1996</td>
<td>2,500</td>
<td>12,033</td>
</tr>
<tr>
<td>1997</td>
<td>10,100</td>
<td>20,050</td>
</tr>
<tr>
<td>1998</td>
<td>17,000</td>
<td>27,260</td>
</tr>
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</table>
The refurbished generating station has significantly reduced emissions and resulted in a reduction in potential air quality impacts. There has been a reduction of more than 70% for the stack emission rate of nitrogen oxides (NO\text{\textsubscript{x}}).

**Particulate Matter Emissions**

Particulate matter forms in a combustion process from the incomplete combustion of fuel, as well as from various impurities that may be contained in the fuel such as trace metals (often collectively referred to as “ash”). Larger particles are significant mainly from a nuisance point of view, where “soot” may be deposited on neighbouring properties. However, fine particulate matter is causing increasing concern due to the potential adverse health effects of inhaling such particles.

Table 3 summarizes the particulate matter oxide emissions from Coleson Cove and the total NB Power network since 1994.
Table 3: Historical Emissions of Particulate Matter from NB Power Total and Coleson Cove

<table>
<thead>
<tr>
<th>Year</th>
<th>Coleson Cove Particulate Matter Emissions (tonnes per year)</th>
<th>NB Power Total Particulate Matter Emissions (tonnes per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>300</td>
<td>1,166</td>
</tr>
<tr>
<td>1995</td>
<td>200</td>
<td>786</td>
</tr>
<tr>
<td>1996</td>
<td>100</td>
<td>672</td>
</tr>
<tr>
<td>1997</td>
<td>500</td>
<td>1,031</td>
</tr>
<tr>
<td>1998</td>
<td>600</td>
<td>1,045</td>
</tr>
<tr>
<td>1999</td>
<td>500</td>
<td>1,114</td>
</tr>
<tr>
<td>2000</td>
<td>900</td>
<td>1,266</td>
</tr>
<tr>
<td>2001</td>
<td>1,500</td>
<td>2,057</td>
</tr>
<tr>
<td>2002</td>
<td>1,100</td>
<td>1,570</td>
</tr>
<tr>
<td>2003</td>
<td>500</td>
<td>920</td>
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<td>2004</td>
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<td>850</td>
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<td>2005</td>
<td>286</td>
<td>2,152</td>
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<td>2006</td>
<td>70</td>
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<td>2010</td>
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<td>2013</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>2015</td>
<td>6</td>
<td>88</td>
</tr>
<tr>
<td>2016</td>
<td>5</td>
<td>112</td>
</tr>
<tr>
<td>2017</td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>2018</td>
<td>4</td>
<td>214</td>
</tr>
</tbody>
</table>

Particulate matter emissions from Coleson Cove have been within the emission standard stipulated in the current Approval to Operate. The refurbishment project has reduced the particulate matter emission rate by more than 70% with the upgrade of the existing electrostatic precipitators and the addition of further pollution control equipment, including wet electrostatic precipitators and flue gas desulphurization units. This has enabled Coleson Cove to meet the national emission standards applicable to new power plants.
ENVIRONMENTAL COMPLIANCE

The Coleson Cove Thermal Generating Station operates under terms and conditions established in its Approval to Operate, issued pursuant to the Air Quality Regulation – Clean Air Act. The terms and conditions are aimed at ensuring that the station’s environmental impact during its day-to-day operations does not adversely affect air quality in surrounding areas, as well as regionally and globally. Compliance with the conditions of approval is mandatory, and any violations may be subject to enforcement measures as described in the Department of the Environment’s Compliance and Enforcement Policy.

Summary of Requirements of the Approval to Operate

The main conditions of the current Approval to Operate (No.I-8830) for the Coleson Cove Thermal Generating Station can be summarized as follows:

- Operate the air pollution control equipment, consisting of low NOx burners, electrostatic precipitators, flue gas desulphurization units, wet electrostatic precipitators, and ash collection and re-injection system at all times during which the facility is in operation;
- Operate the power plant such that the smoke density of the flue gas at the stack exit is consistent with the Smoke Density Standards stipulated in Sections 13 to 15 of the Air Quality Regulation, New Brunswick Regulation 97-133;
- Ensure that the sulphur content of the heavy fuel oil utilized at the facility does not exceed 3% sulphur by weight;
- Limit total annual emissions of sulphur dioxide to less than 25,000 tonnes per year;
- Limit sulphur dioxide (SO2) emission rates to less than 258 nanograms per Joule (0.6 lb/MMBTU) of heat input to the boilers, as determined by the 720-hour rolling average;
- Limit emission rates of nitrogen oxides (NOx) to less than 90 nanograms per Joule (0.21 lb/MMBTU) of heat input to the boilers, as determined by the 720-hour rolling average;
- Limit particulate matter emission rates to less than 4.3 nanograms per Joule (0.01 lb/MMBTU) of heat input to the boilers;
- Maintain and operate an ambient air quality monitoring network consisting of four fixed sulphur dioxide monitors and two fine particulate matter monitors capable of continuous feedback to the power plant, and one meteorological tower measuring wind speed, wind direction, temperature and pressure and capable of continuous feedback to the power plant;
- Continuously monitor the opacity of the flue gas and the emissions of nitrogen oxides and sulphur dioxide from the facility through the operation of continuous emission monitors (CEMs) and evaluate the effectiveness of such CEMs annually;
- Undertake stack sampling of flue gases from each unit for sulphur dioxide, nitrogen oxides, metals and particulate matter using appropriate source testing methods when a unit is operating or is expecting to operate at an Annual Capacity Factor of 20% or more, and provide a report of such sampling to the Department;
- Submit a quarterly report on the operation of the facility;
• Submit a detailed annual report on the operation of the facility; and
• Submit annual report containing complete hourly data from all ambient air monitoring analyzers for the facility.

**Compliance with Conditions of Approval**

With the exception of some smoke density exceedances, all conditions of the Approval to Operate have been met to date since the issuance of the approval on January 15, 2015. In accordance with the main conditions of approval listed above, the following is a summary of the facility’s compliance with its conditions of approval:

• The electrostatic precipitators, flue gas desulphurization units and wet electrostatic precipitators were operational during operation of the facility, apart from a few occasions where maintenance was being conducted, generally lasting a few hours. The ash collection and re-injection system and the low NOx burners were operational throughout;
• With the installation of additional pollution control equipment at Coleson Cove as part of the refurbishment project, smoke density issues have been resolved. On occasion during start-up Density number 2 was reached, which is allowed under the *Air Quality Regulation* for short periods of time;
• The sulphur content of heavy fuel oil varied between 1.94% and 2.97% sulphur by weight for the years 2015 through 2018 with the exception of the authorization from the Department for Coleson Cove to receive heavy fuel oil with a sulphur content in the range of +3.75% on a one time variance due to extreme cold weather, uncertain electricity import capability and the non-availability of a lower Sulphur content No 6 Fuel Oil in January, 2018.
• Since 2015, annual SO2 emissions have been well below the limit of 28,000 tonnes per year, ranging from 1111 to 1524 tonnes per year;
• Since 2015, SO2 emission rates have been maintained well below the emission limit of 258 nanograms per Joule (0.6 lb/MMBTU);
• NOx emission rates have been maintained below the emission limit of 90 nanograms per Joule (0.21 lb/MMBTU) since 2015;
• An ambient air quality monitoring network consisting of four sulphur dioxide monitors, two fine particulate matter monitors and one meteorological tower have operated throughout the period of the approval;
• Since 2015, continuous emission monitoring (CEM) systems have operated with greater than 98% reliability. CEM systems were verified quarterly and annually according to the Environment Canada protocol;
• Emissions quantification for particulate matter, sulphur dioxide and nitrogen oxides were completed, with the data used to evaluate CEM system performance; and
• Quarterly and annual reports were complete and have been submitted on time since 2015.
Enforcement

Enforcement options used by the Department of Environment and Local Government are outlined in the Department’s Compliance and Enforcement Policy. These may include but are not limited to: schedules of compliance, verbal and written warnings, orders, and prosecutions. Although not specifically outlined in the Policy, it is also possible to amend approvals with more stringent conditions, both during its valid period and at the time of renewal, to address specific compliance issues or to improve the environmental impact of the facility. There is also a regulation under the Clean Air Act that allows for the issuance of “administrative penalties” for minor violations as an alternative to traditionally used enforcement options.

Since the time the approval was issued (in January 2015), there has not been any enforcement actions related to the Coleson Cove Thermal Generating Station.

PUBLIC OUTREACH

NB Power’s position on public outreach is that in order to foster positive community relations, and as an accountability measure with New Brunswick ratepayers, it has an open-door policy regarding all of its facilities including Coleson Cove, whereby any member of the public or interested party wishing to obtain further information about the operation of its generating facilities may contact NB Power during regular business hours. The agency may also make arrangements for a tour of the facility or other community interaction as appropriate.

As part of the Coleson Cove Refurbishment Project, a Community Environmental Liaison Committee was formed in 2002 and members continue to meet on a regular basis. The committee was formed as a requirement of the Environmental Impact Assessment process in order to share information and provide community input and recommendations regarding effective mitigation and monitoring of community and environmental effects of the project. The committee continues to meet to discuss the continued operation of generating station.

NB Power makes information on its generating facilities available to any member of the public upon request. The Corporation also maintains an Internet web site, which provides information about electricity, generation facilities, environmental performance, and a variety of other issues.
CONTACT INFORMATION

For further information on the operation of the Coleson Cove Thermal Generating Station, please contact:

Anthony Bielecki
Environmental Manager
New Brunswick Power Corporation
P.O. Box 2000, 515 King Street
Fredericton, N.B. E3B 4X1
Telephone: (506) 458-6701
Fax: (506) 458-4000
Email: abielecki@nbpower.com

For information on this document, or on environmental regulations relating to air quality, please contact:

Sheryl Johnstone
Senior Approvals Engineer
Authorizations Branch
Department of Environment and Local Government
P.O. Box 6000, Marysville Place
Fredericton, NB E3B 5H1
Telephone: (506) 453-7945
Fax: (506) 457-7805
Email: sheryl.johnstone@gnb.ca

Patrick Stull
Director, Region 4 (Saint John)
Department of Environment and Local Government
P.O. Box 5001, 8 Castle Street
Saint John, NB E2L 4Y9
Telephone: (506) 658-2558
Fax: (506) 658-3046
Email: patrick.stull@gnb.ca
For comments or enquiries on the public participation process, please contact:

Chandra Clowater
Public Participation Officer
Department of Environment and Local Government
P.O. Box 6000, Marysville Place
Fredericton, NB E3B 5H1
Telephone: (506) 453-3700
Fax: (506) 453-3676
Email: chandra.clowater@gnb.ca