March 2016

APPENDIX A
CONSULTATION MATERIALS

March 2016

BEAR PAW PIPELINE

REPORT OF OPEN HOUSE IN GOLDBORO

December 8th 2015

1. PURPOSE

Bear Paw is committed to reaching out to everyone with an interest both in the proposed Bear Paw Pipeline and in the LNG export project at large. To this end Bear Paw have met with representatives from First Nations, fishers, harbour and port authorities, community leaders and elected officials. Bear Paw have made several public presentations, and held direct consultations with a wide range of parties. The Open House held in Goldboro on December 8th was another forum at which interested individuals could receive information and pose questions about the Project. As the following sections indicate, the matters raised at this Open House Fall broadly into one of the following categories:

2. ADVERTISING OF THE EVENT

The timing and location of the Open House was advertised in the Chronicle Herald and the Guysborough Journal on the 2nd December, 2015. Notice was also announced on the radio in the days leading up to the event. In addition to these public announcements, the advertisement was e-mailed to a number of parties who had expressed an interest in the Project and had asked to be kept informed; these included members of the local municipal councils, provincial and federal government representatives and the Strait Area Chamber of Commerce. Copies of the newspaper advertisements are provided in Appendix B.

3. LOCATION

The Open House took place in the Goldboro Interpretation Centre between the hours of 3:30 and 8:00 p.m.

4. STORY BOARDS AND HAND OUT

To enable people to attain a good understanding of the nature of the Bear Paw Pipeline Project, the team had prepared a number of story boards that indicated where the Project would be located; provided information on the proponent, on the nature of Liquefied Natural Gas (LNG), on the regulatory process; on the environmental studies that were being undertaken; and referenced the issues of perceived concern. A brief handout on the Project was also available that attendees could take away with them. Appendix C provides copies of the story boards. Appendix D provides a copy of the handout.

5. NUMBERS ATTENDING

37 people signed in at the reception desk at the venue between 3:30 and 8:00 p.m. Given the numbers circulating in the hall, it is estimated that perhaps 10% of those attending did not sign in. The total number attending approximated 40.

6. COMMENT FORMS

Of those attending, 13 completed a "Comment Form" and left the completed form at the reception desk. There were four questions to which people responded. These and a synopsis of the matters raised are outlined below.

#1. Are you supportive of the natural gas pipeline from Goldboro to the future location of Bear Head's LNG's export facility in Point Tupper, Nova Scotia?

Of the 13 respondents, all but one indicated that they were supportive of the development of the Bear Paw pipeline.

#2. What benefits do you think the pipeline will have for Guysborough, Inverness and Richmond Counties? Please describe.

The factors raised included the following:

- *Create must needed economic activity;*
- *Provide direct and spin-off opportunities for local businesses;*
- *Employment opportunities; and*
- *None, except some "dollars" for the "town" of Guysborough.*

#3. Please identify any comments, suggestions, concerns or issues that you have with respect to the construction and operation of the pipeline.

The matters raised included the following:

- *No concerns as long as all aspects of the EA are followed;*
- *That procurement opportunities be available through an open and fair process; and*
- *Nothing in this project that will benefit the local area in the long term.*

#4. Additional comments.

The following reproduces the key additional comments expressed in the comment forms returned:

- *Get started;*
- *To know that communities and First Nations have been consulted thoroughly gives me peace of mind. Great project. Great company. I look forward to witnessing the development;*
- *This is an important project for NS and will have a positive impact on the provincial economy;*
- *This is an excellent project for eth area;*
- *Thanks for hosting this session, very informative;*
- *A major project like this will help all companies that provide services, keep local people employed and gain experience working on a major project; and*
- *Well done public process.*

7. PROJECT TEAM OBSERVATIONS

After the last attendee had left the hall, the Project Team debriefed to identify and summarise the comments and input that they had received from attendees. The following sections capture the main issues raised.

a) *Land Related Matters*

All land owners had received prior individual notification of the alignment through direct contact by the land agents. A number of land owners also took the opportunity to attend the Open House to see what was being presented and to talk further with the land agents and the proponent.

b) *Employment and Consulting Opportunities*

There was a real interest in the employment and constructing opportunities that the construction and eventual operation of the proposed pipeline might generate. A number of attendees were representatives of local companies who could provide services or product to facilitate the development of the pipeline. This extended from the ability of local land owners to provide crushed rock/gravel to a number of the trades.

c) *Timeline and Scepticism*

A number of attendees expressed support for the Project, but were somewhat sceptical that it would actually be realised. As they indicated, there had been comparable promises made in the past by other proponents, but little or no substantive investment in the industrial fabric in the Municipality of Guysborough over the past decade. The underlying interest was when work would get underway, i.e., the development schedule was of real interest.

d) *Environmental Matters*

- Pointed out that a good rainfall would cause as much sedimentation and disturbance to streams as would the proposed construction if the latter was done according to all regulatory requirements;
- Several attendees talked in support of HDD at as mainly crossing as possible, including Milford Haven;
- Attendees expressed surprise at the amount of work that had been done and were pleased to see that the proponent was taking environmental concerns seriously; and
- Reference was made to the need to take Species at Risk into consideration in both the siting of the Right-of-Way and its subsequent construction and operation.

e) *Other Matters*

- There was an opinion expressed that the proposed investment across the county would not benefit the rural residents. That the monies accrued in taxes to the Municipality would be spent in services that would benefit residents of the towns and villages, e.g., Guysborough;

8. CONCLUDING OBSERVATIONS

The Open House was well attended given the very rural area in which it was held. Indeed several attendees travelled considerable distances to attend, e.g., from Antigonish and Sydney. Approximately a third of those who attended completed the comment form. Although there was discussion of a few individual property matters and the articulation of some environmental considerations, particularly with respect to water crossings, the overall response was positive

and supportive. The story boards and the presence of a professional and well qualified project team, including the land agents, who were able to respond to questions did much to address the questions posed. The underlying message was to get the project underway and bring the investment to the area.

BEAR PAW PIPELINE

REPORT OF OPEN HOUSE IN MULGRAVE

December 9th 2015

1. PURPOSE

Bear Paw is committed to reaching out to everyone with an interest both in the proposed Bear Paw Pipeline and in the LNG export project at large. To this end Bear Paw have met with representatives from First Nations, fishers, harbour and port authorities, community leaders and elected officials. Bear Paw have made several public presentations, and held direct consultations with a wide range of parties. The Open House held in Mulgrave on December 9th was another forum at which interested individuals could receive information and pose questions about the Project. As the following sections indicate, the matters raised at this Open House Fall broadly into one of the following categories: economic development and ensuring that the project proceeds as detailed.

2. ADVERTISING OF THE EVENT

The timing and location of the Open House was advertised in the Chronicle Herald and the Guysborough Journal on the 2nd December, 2015. Notice was also announced on the radio in the days leading up to the event. In addition to these public announcements, the advertisement was e-mailed to a number of parties who had expressed an interest in the Project and had asked to be kept informed; these included members of the local municipal councils, provincial and federal government representatives and the Strait Area Chamber of Commerce. Copies of the newspaper advertisements are provided in Appendix B.

3. LOCATION

The Open House took place in the Mulgrave Fire Hall between the hours of 3:30 and 8:00 p.m.

4. STORY BOARDS AND HAND OUT

To enable people to attain a good understanding of the nature of the Bear Paw Pipeline Project, the team had prepared a number of story boards that indicated where the Project would be located; provided information on the proponent, on the nature of Liquefied Natural Gas (LNG), on the regulatory process; on the environmental studies that were being undertaken; and referenced the issues of perceived concern. A brief handout on the Project was also available that attendees could take away with them. Appendix C provides copies of the story boards. Appendix D provides a copy of the handout.

5. NUMBERS ATTENDING

53 people signed in at the reception desk at the venue between 3:30 and 8:00 p.m. Given the numbers circulating in the hall, it is estimated that perhaps 10% of those attending did not sign in. The total number attending approximated 55-60.

6. COMMENT FORMS

Of those attending, 7 completed a "Comment Form" and left the completed form at the reception desk. There were four questions to which people responded. These and a synopsis of the matters raised are outlined below.

#1. Are you supportive of the natural gas pipeline from Goldboro to the future location of Bear Head's LNG's export facility in Point Tupper, Nova Scotia?

Of the 13 respondents, all but one indicated that they were supportive of the development of the Bear Paw pipeline. The exception did not indicate in favour or opposed.

#2. What benefits do you think the pipeline will have for Guysborough, Inverness and Richmond Counties? Please describe.

The factors raised included the following:

- *Will provide the necessary infrastructure to support the development of the LNG terminal;*
- *Create must needed economic activity; and*
- *Employment opportunities.*

#3. Please identify any comments, suggestions, concerns or issues that you have with respect to the construction and operation of the pipeline.

The matters raised included the following:

- *No concerns as long as all environmental matters are addressed;*
- *No concerns – there is a pipeline there already;*
- *Concern about the pipeline thickness and associated safety factors; and*
- *As a marine pilot would like to ensure that this pipeline is laid as close as possible to the existing pipeline in the Strait of Canso to minimise the area where ships anchors cannot be dropped in the event of emergencies.*

#4. Additional comments.

The following reproduces the key additional comments expressed in the comment forms returned:

- *Everyone on the floor were knowledgeable and helpful. Look forward to reading and hearing good things;*
- *Need opportunities for the young people to keep them in Nova Scotia;*
- *Hope the project starts soon.*

7. PROJECT TEAM OBSERVATIONS

After the last attendee had left the hall, the Project Team debriefed to identify and summarise the comments and input that they had received from attendees. The following sections capture the main issues raised.

a) Land Related Matters

All land owners had received prior individual notification of the alignment through direct contact by the land agents. A number of land owners also took the opportunity to attend the Open House to see what was being presented, to talk further with the land agents and the proponent and to articulate specific questions with respect to their property and clarify procedures going forward. These questions addressed by the land agents that were present.

b) Employment and Consulting Opportunities

There was a real interest in the employment and constructing opportunities that the construction and eventual operation of the proposed pipeline might generate. A number of attendees were representatives of local companies who could provide services or product to facilitate the development of the pipeline. This extended from the ability of local land owners to provide crushed rock/gravel to a number of the trades.

c) Timeline and Scepticism

A number of attendees expressed support for the Project, but were somewhat sceptical that it would actually be realised. As they indicated, there had been comparable promises made in the past by other proponents, but little or no substantive investment in the industrial fabric in the Municipality of Guysborough over the past decade. The underlying interest was when work would get underway, i.e., the development schedule was of real interest.

d) Environmental Matters

- Several attendees talked in support of HDD at as many crossings as possible, including the Strait of Canso;
- Concerns raised about potential consequences to the fishery, particularly in the Strait of Canso;

e) Other Matters

- Questions raised about the width of the Right-of-Way and how the numerous streams and water bodies, including the Strait of Canso, would be crossed;
- Questions regarding the source of the gas;

8. CONCLUDING OBSERVATIONS

The Open House was well attended, but few completed the comment forms. There was discussion of a few individual property matters, but these were addressed by the land agents who described the procedures going forward. Although there was some articulation of environmental matters, particularly with respect to the Strait of Canso, the overall response was positive and supportive. The story boards and the presence of a professional and well qualified project team, including the land agents, who were able to respond to questions raised by property owners did much to address the questions posed. The underlying message was to get the project underway and bring investment to the area.

Distillery nearing completion

SOMETHING'S BREWING: The soon-to-be completed Authentic Seacoast craft distillery and brewery on Ferry Lane, Guysborough. Contributed Photo

From page 1

including cedar shingles. But they're actually one connected complex, allowing for the interconnected equipment and computer systems that drive the brewing and distilling processes from grain delivery to product packaging. It'll all take place right here in Guysborough, providing local jobs and giving the area a much-needed signature attraction.

Williams expects to double Authentic Seacoast's current workforce of 23-24 with the new distillery and brewery. He says he needs three more staff immediately.

The facility is expected to have its grand opening in the spring. Visitors will be greeted in a beautifully designed reception centre, featuring a large stone fireplace and Douglas Fir beams secured with oak pegs. They'll be introduced to local craft beer and spirits at a sampling bar. And there's a conference room for presentations just off the reception area.

Staff will offer a behind-the-scenes tour of the impressive operation that produces award-winning spirits and beer.

A few steps down the hall from the reception area is the still house and blending operation. This is where spirits will be produced and blended. Right now the focus is on craft blending. Basic rum from the Caribbean is used to create the award-winning Fortress Rum and Sea Fever Rum. Sea Fever Rum oak barrels are stored in Guysborough while the Fortress Rum barrels are stored at Fortress Louisbourg.

"Then they come back here for blending with our 'secret sauce' and Guysborough water," says Williams.

"We have really good water here," he says, which contributes to the great taste of the finished product.

The tall copper and stainless steel distilling equipment was custom-designed by Williams, who has a background in mechanical engineering, and manufactured in Kentucky.

The next large room is the brew hall. The massive brewing system here was manufactured in PEI by Diversified Metal Engineering.

Grain arrives at the back of the building and gets pumped into a milling room. Once the barley is milled, the grist gets pumped into a cooler. Hot water is added and the mixture soaks. The process is the same as what happens at the Rare Bird Brewery on Main Street – just 10 to 20 times bigger in scale. Here the equipment includes four 90-barrel fermenters.

From the soaking process, a "sweet tea" is produced. This liquid is separated from the solids. Williams says they hope to sell those solids to local farmers as nutritious animal feed. The sweet tea, called wort, goes into the fermenters for about a week. Solids settle in a cone at the bottom of the fermenter and the liquids go to another tank where carbon dioxide is added, making "conditional" beer.

Nearby a large refrigerated box is the keg-filling room. Another room is a large beer fridge. Further along is a big space for packaging, which will be home to new equipment arriving in the coming month.

There's also a large maturation warehouse where spirits will age in oak barrels. "Many years of production will go in here," Williams says of the 5000 sq ft warehouse.

Williams says part of the thinking behind this ambitious development is that "people want to do something; they want to learn."

He notes that the tourism industry in NS recognizes the importance of these kinds of "signature" experiences.

"The Eastern Shore is amazing. It's totally gorgeous. What we can do here is create a signature experience that is world class."

The building is expected to be "substantially complete" in December, says Williams. "It'll take a few months to get everything up and running."

Fortress Rum has already been a top seller at NSLC stores across the province.

Authentic Seacoast is now in its 10th year of operation in Guysborough.

Big changes for Antigonish newspaper

Casket to be delivered with flyers in quad counties

By Helen Murphy

The *Halifax Herald*, owners of the *Antigonish Casket*, are taking the historic community newspaper in a new direction. Starting with the Nov. 18 issue, *The Casket* has replaced the *Quad County Extra* as a free publication wrapped around flyers delivered weekly in Antigonish, Guysborough, Richmond and Inverness counties.

With the move, which the Halifax owners say is in response to changes in the newspaper industry, *The Casket* is reducing its news staff and increasing advertising sales staff.

"This is a curious decision since doing so will dilute coverage of community news while distributing to three additional counties," says *Guysborough Journal* publisher Allan Murphy.

"We all have to respond to changes in our industry, but this kind of change appears to be designed to try to increase advertising sales, while reducing community journalism," said Murphy. "That's definitely not our model.

"Those who study the shifting newspaper industry across North America predict that the very big and the very small – the hyper-local – will survive and thrive," said Murphy. "We can see papers like the *New York Times* at the big end of that spectrum, and locally targeted, quality community news at the other. We see a bright future for the kind of community-based journalism that's at the heart of our business.

"Our advertisers see the value of what the *Guysborough Journal* brings to our readers. They understand the investment we have made in keeping the news flowing to our readers and we appreciate their ongoing support, despite the economic challenges facing small businesses these days."

The *Guysborough Journal* is based on Main Street in Guysborough and employs staff through Guysborough County and Sheet Harbour in writing, production, delivery and office administration.

The Journal is currently undergoing a major redevelopment of its online presence, to be launched in January.

Oil recovery complete

From page 1

cargo of 108,000 barrels of oil when it sank.

"Since October 22, when we first started pumping the tanks, we pumped the two that were on the open end of the vessel; basically where the sheen was coming from that was reported on August 28. We have not had any other reported sheens on the water...We had an overflight last week and there was no sheen at the site," said Laidlaw.

The Coast Guard plans to monitor the site going forward and do further assessment.

"We plan on going back in the near future to do a dive and an ROV assessment of the hull. We will continue to monitor with Transport Canada...in that area on a regular basis. They will continue to check it for sheens as an area of interest."

As for the future of the SS Arrow, it will remain at its current location. There are no plans for salvage. "The wreck has been down there since 1970. It is basically an artificial reef...The hull is deteriorated, which is why we got the sheen. Nothing is impossible but there are no plans for removing the wreck," said Laidlaw.

On Tuesday, November 24, 2015 Canso and Area Development Association (CADA) held an Annual General Meeting (AGM) at the Canso Library and Resource Centre. Pictured above, from left to right: Tino Winter (board member), Sandy Winter (board member), Bill MacMillan (Secretary/Treasurer), Joe Walsh (Vice-Chair), Ann Marie Bagnall (board member) and Harold Roberts (President). Contributed Photo

Fisherman drowns on dumping day

Monday, November 30 was dumping day, the official start of the lobster fishing season in districts 33 and 34 in Nova Scotia. The day ended tragically with the death of one fisherman from Cape Breton.

At approximately 9 a.m., Barrington RCMP was notified that a man fell overboard from a fishing vessel. A preliminary investigation has determined that a 53-year-old male was setting lobster traps off the coast of Southwestern Nova Scotia when he fell overboard. The crew pulled him out of the water and called the Joint Rescue Coordinator Centre (JRCC) for assistance. JRCC responded and deployed Search and Rescue Technicians (SART) by plane to assist. The male and SARTs were then transferred to the Canadian Coast Guard vessel Clarke's Harbour. The male was then transferred via helicopter to Yarmouth Regional Hospital. A short while later, the man was pronounced deceased.

Minister of Labour and Advanced Education Kelly Regan sent condolences to the family of the fisherman. "This is such sad news," said Regan. "I know I'm joined by many across the province in expressing my heartfelt sympathy to his loved ones."

Progressive Conservative MLA for Argyle-Barrington Chris d'Entremont also offered his condolences. "My deepest condolences to the Cape Breton man's family and friends," said d'Entremont. "Our community mourns with you."

"This is an awful way to start the season," said d'Entremont. "Today's tragedy is a harsh reminder of how dangerous fishing can be and how relentless and unforgiving the ocean is."

There have been 25 workplace fatalities this year, and this is the seventh as the result of an accident. In 2014, 20 Nova Scotians died at work or from a work-related illness.

The incident remains under investigation by the RCMP, the Transportation and Safety Board and the Department of Labour and Advanced Education, Occupational Health and Safety.

Three dead in Richmond Co. crash

PORT MALCOLM – Richmond County District RCMP was on the scene of a fatal four vehicle collision in Port Malcolm Tuesday afternoon.

At approximately 12:40 p.m., Richmond County District RCMP, EHS, Louisdale Fire Department and Port Hawkesbury Fire Department responded to a report of a four vehicle head on-collision on Highway 104 in Port Malcolm. A preliminary investigation has determined that three occupants of one of the vehicles died as a result of their injuries. The driver, a 26-year-old female from Louisdale and the rear seat passenger, a 12-year-old female from Louisdale, died at the scene. The front seat passenger, a 13-year-old female from Mexico was transported to Strait Richmond Hospital where she was prounounced deceased. No other injuries were sustained by those involved.

The investigation is ongoing. Highway 104 was closed to traffic and expected to be closed for the remainder of the day. Traffic was being diverted onto Highway 4 at Exit 43 (Melville) and Exit 44 (Lower River Inhabitants).

This Christmas, The Guysborough And Area Food Bank will distribute approximately 110 Christmas Food Hampers to needy families in our Coverage Area. We are asking for your assistance with our Annual Turkey Drive.

Anyone who would like to make a $20 donation (or less) to purchase a turkey for a needy family this Christmas Season may do so by calling Elizabeth Connolly at 902-533-2248 or by mail to Box 284, Guysborough, NS BOH 1NO. Please inform your friends and neighbors of this need.
(Receipts for Income Tax purposes can be issued)

Welcome

Open House for Bear Paw Pipeline

Purpose of the Open House

Representatives will be on hand to share information about Bear Paw Pipeline and Bear Head LNG. They can also provide you information regarding the environmental assessment being prepared and the Registration Document to be submitted to Nova Scotia Environment. Our project team is available to answer your questions and to hear your input.

It is important that we hear from the community about the proposed natural gas transmission pipeline.

We also want to ensure that we keep you up to date about the proposed project and the regulatory approval process.

We appreciate your input!

If you would like to leave your thoughts, a Comment Form is available.

BEAR PAW PIPELINE

About Bear Paw Pipeline & Bear Head LNG

Bear Paw Pipeline Corporation and Bear Head LNG Corporation are 100% owned by Liquefied Natural Gas Limited (LNGL). LNGL purchased Bear Head LNG and all assets associated with the Bear Head site at Point Tupper in 2014.

Liquefied Natural Gas Limited:

- A global LNG export terminal developer
- An over $1.5 billion Australian public company focused on projects that will utilize wholly-owned LNG technologies
- Owner and originator of OSMR® LNG production technology

Other Projects Under Development by LNGL

Magnolia LNG near Lake Charles, Louisiana

Fisherman's Landing LNG at Gladstone, Australia

Liquefied Natural Gas Limited

Project Team

John Godbold – Project Director, Chief Operating Officer
Darshi Jain – Vice President of Engineering and Construction
Paul MacLean – Strategic and Regulatory Affairs Advisor
Dean Hart – Manager of Environmental and Construction Permitting
Ghislain Pitre – Manager
Alice McCarron – Public Relations

Please provide direction on if we want this list and who should be on it.

All Permits In Place for LNG Export Facility

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

- **All required initial permits are now in place to construct the Bear Head LNG export facility.**
- **Canada's National Energy Board and the U.S. Department of Energy have granted export licenses for the facility.**
- **Bear Head development started in 2001 and substantial site improvements are already in place.**

Location of LNG Facility at Point Tupper

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Pipeline Project Overview

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Bear Paw Pipeline Corporation Inc. plans to construct and operate a natural gas pipeline between gas supply sources near Goldboro, Nova Scotia, and the Bear Head LNG Corporation's liquefied natural gas (LNG) export facility within the Point Tupper Industrial Park near Port Hawkesbury on the Strait of Canso.

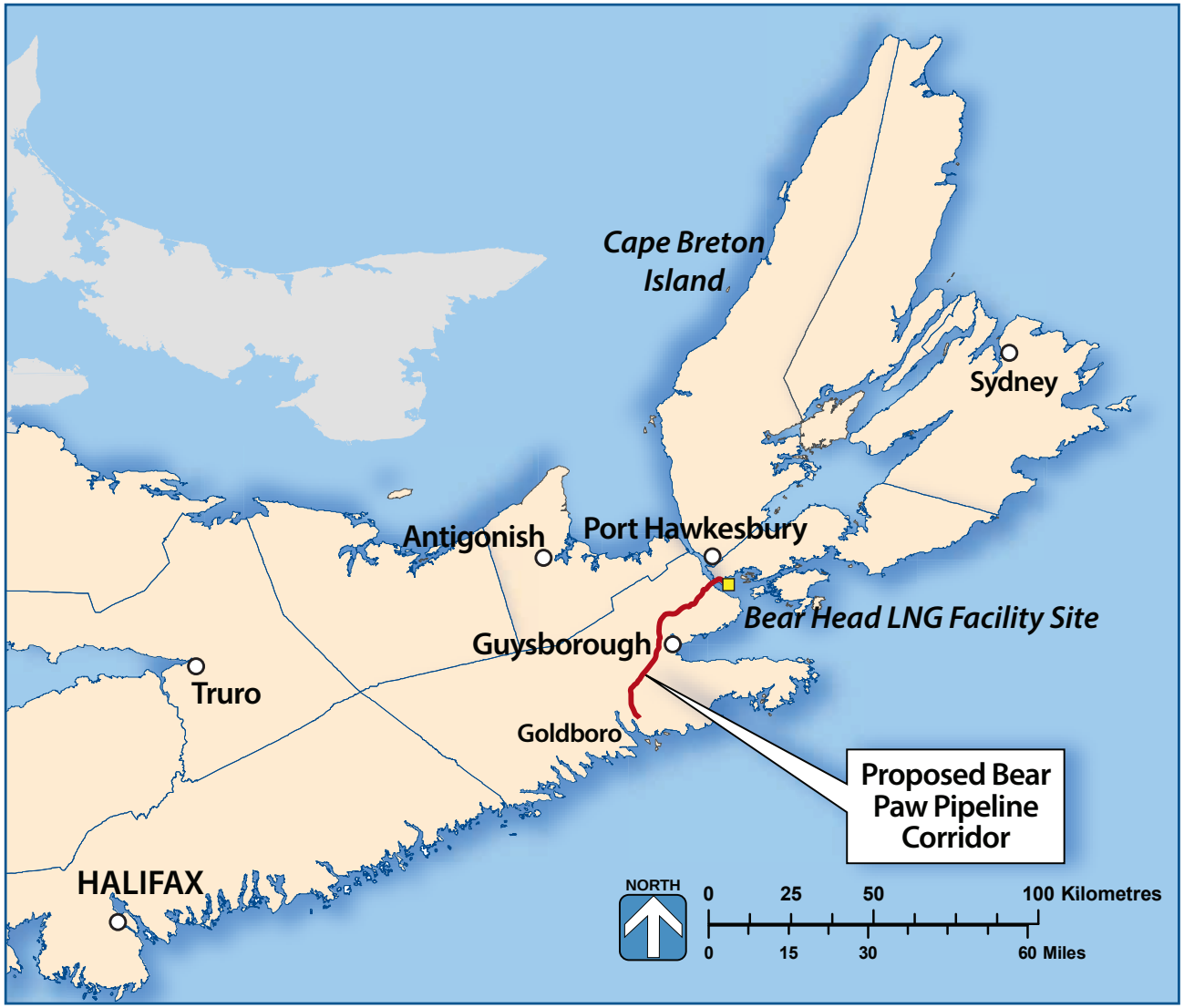
PIPELINE ESSENTIAL

The 42-inch pipeline will supply the natural gas that will be converted to LNG and is essential to the development of the Bear Head LNG export facility.

PLANNING CORRIDOR

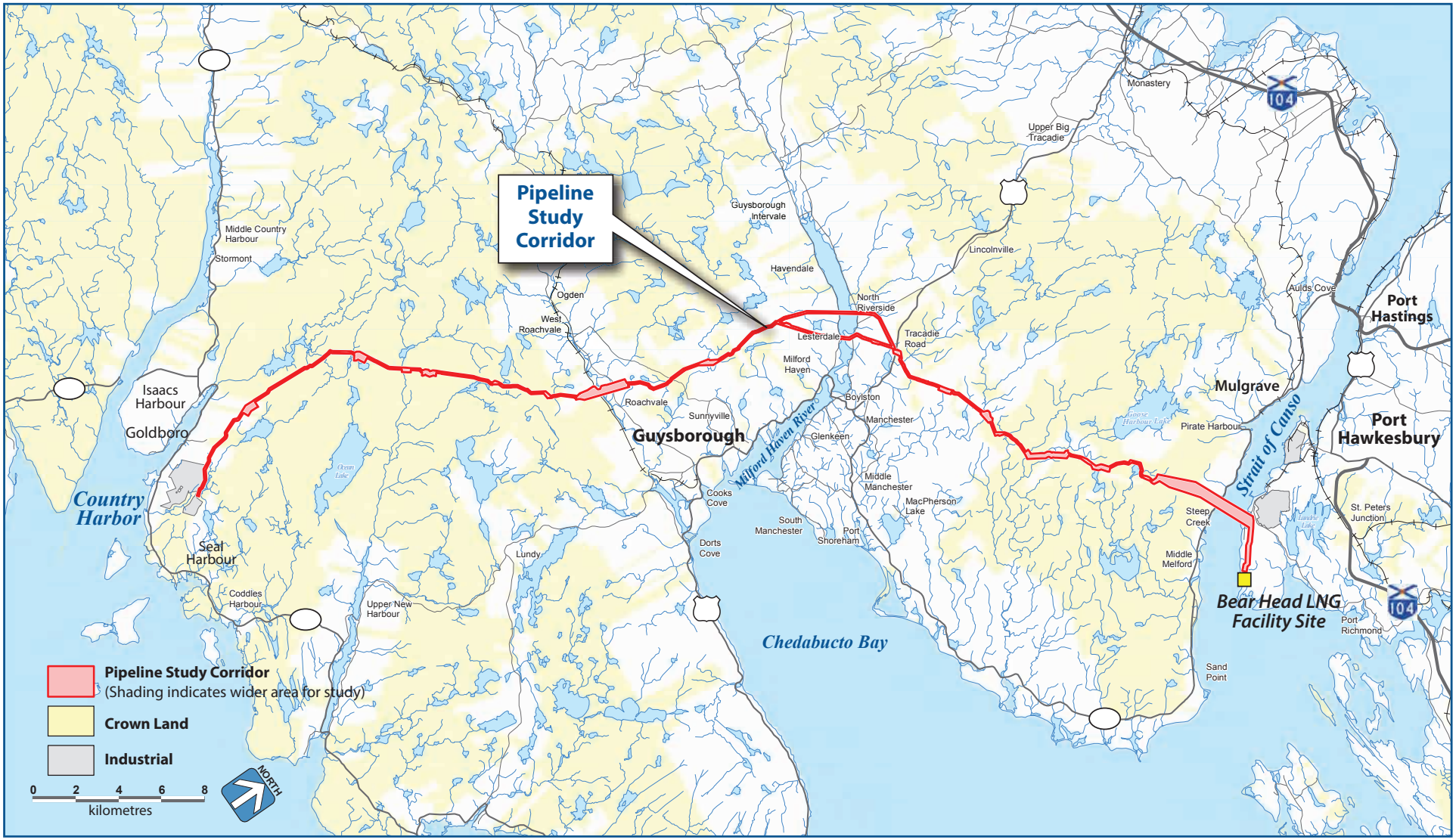
For planning and environmental assessment purposes, an assessment corridor has been selected for the pipeline.

The assessment corridor is approximately 100 metres wide for most of the length of the pipeline. The right-of-way width required for actual construction will be approximately 35 metres, including workroom areas.



Pipeline Project Location

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited



Pipeline Project Components

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Planning and Regulatory

- Environmental studies, permits and approvals
- Engineering and Routing

Construction

- Site preparation
- Pipeline installation
- Watercourse crossings
- Site restoration

Operation and Maintenance

- Pipeline maintenance
- Right-of-way maintenance

Components by the Numbers

- Pipeline Length: Approximately 62.5 km
- Approximately 35 metre wide construction work area
- 42" diameter pipe with maximum allowable operating pressure of 1,440 psi
- A compressor station and meter stations
- A 1,320 metre crossing of Strait of Canso

Safety is the core value for Bear Paw Pipeline in construction, operation and maintenance.

Environmental Setting in Assessment Corridor

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

- Located in mostly rural area
- Approximately 50% Crown Land
- 26.4 ha of provincially mapped wetlands
- 69 watercourses to cross
- 92.3 ha of deer wintering areas

Assessment Process Timetable

The environmental assessment process and stakeholder engagement started in the fall of 2015. Public meetings are being held with landowners and stakeholders to share information and to address concerns.

Environmental assessment documents will be submitted to provincial regulators in 2016 and a public comment period will follow.

The pipeline could be put in service as early as 2019.

To the extent feasible the Bear Paw pipeline corridor generally parallels the existing M&NP Point Tupper Lateral natural gas pipeline and the Sable Offshore Energy Inc. natural gas liquids pipeline.

The Environmental Assessment Process

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

An Environmental Assessment registration is being prepared in accordance with the Nova Scotia Environment Act. It focuses on:

- Atmospheric environment
- Vascular plants
- Wetlands
- Birds and Wildlife
- Freshwater Fish and Fish Habitat
- Marine Environment
- Land and Resource Use
- Archaeological and Heritage Resources
- Mi'kmaq Traditional Use

Environmental Assessment Surveys

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Studies completed or underway in support of the environmental assessment include:

- Wetland surveys
- Wildlife including moose surveys
- Fish and fish habitat surveys
- Marine environment surveys
- Archaeological and heritage resources surveys

Mi'kmaq Knowledge Study

A Mi'kmaq Ecological Knowledge Study has been commissioned which is gathering and documenting Mi'kmaq use and knowledge of resources in the project area to be considered in the environmental assessment.

Landowners Have An Important Role

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Once the pipeline is constructed, landowners have an important role to play to ensure safety.

- Easement agreements for the required right-of-way are negotiated between the landowner and Bear Paw Pipeline.
- Bear Paw Pipeline will be acquiring rights to use the land for the construction, operation and maintenance of its pipeline.
- Ownership of the land in the right-of-way remains with the landowner.
- All activities within the right-of-way are governed by the Nova Scotia Utilities and Review Board (UARB).

To ensure safety, landowners will need to get written approval for most activities on the right-of-way. Unauthorized excavation, construction or installation of facilities over or near a pipeline is unlawful.

A safety zone extends 30 metres (100 feet) on either side of the right-of-way. Development is not precluded in this zone but some activities require prior approval.

Natural Gas Pipeline Safety

Bear Paw PIPELINE
A subsidiary company of Liquefied Natural Gas Limited

- Pipelines are the safest method to transport natural gas across the country. Canada has more than 500,000 kilometres of pipeline transmitting natural gas.
- Canadians safely live, work and travel over pipelines every day. Like other natural gas delivery systems, the Bear Paw Pipeline will be designed, built and operated to equal or exceed the highest codes and standards.
- Bear Paw Pipeline Corp. is committed to minimizing impacts during pipeline installation and to continuous attention to safely operating the pipeline system.

Bear Paw Pipeline Commitment

Bear Paw Pipeline Corp. is committed to reducing potential effects to the environment and addressing all regulatory requirements including appropriate mitigation measures. This includes issues raised by stakeholders, landowners, the public and Mi'kmaq communities.

An Opportunity for Nova Scotia

Bear Paw Pipeline
A subsidiary company of Liquefied Natural Gas Limited

Changes in the world energy marketplace have created an LNG export opportunity at the Strait of Canso site.

Benefits for the Community

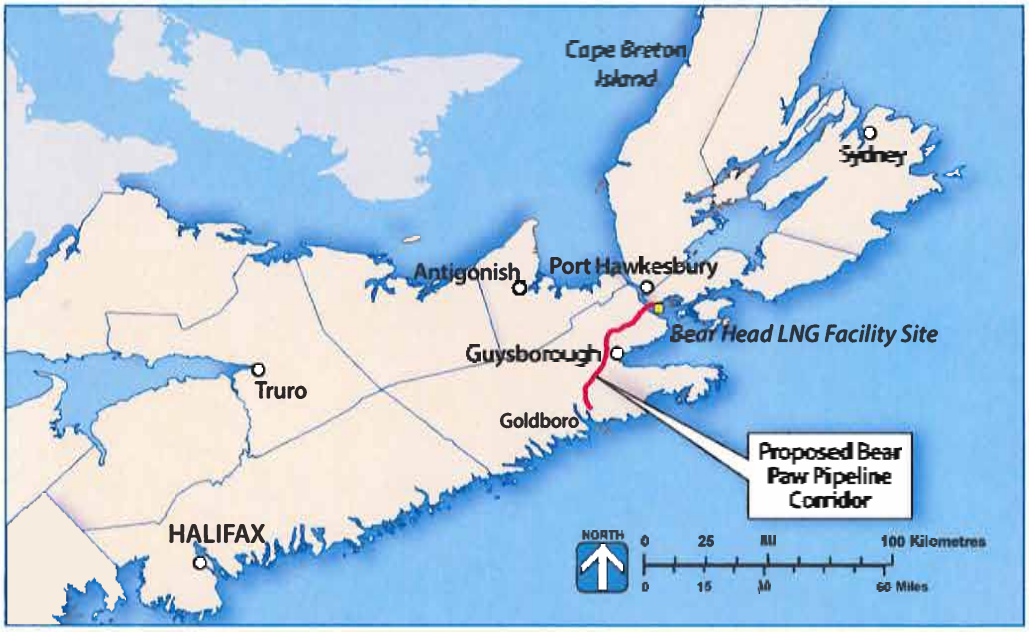
The Bear Paw Pipeline and Bear Head LNG facility will benefit the community, region and province through opportunities in labour and skills development. The increased level of industrial activity in the region will provide direct and indirect jobs for years to come.

- Training and employment during pipeline construction and ongoing operations
- 40 to 70 permanent direct jobs at Bear Head
- More permanent indirect jobs
- Major additions to the property tax base of Guysborough and Richmond Counties
- Continued company participation in the community as a committed corporate citizen
- Will work with the Community College and other academic institutions to support First Nations' aspirations and the needs of the Bear Head and Bear Paw projects

Thank You For Coming

Please consider taking a moment to fill out a Comment Form

Bear Paw Pipeline's Proposed
Goldboro to Point Tupper Pipeline Project



Bear Paw Pipeline is proposing to construct and operate a natural gas transmission pipeline to move gas from the Goldboro, NS area to the location of a proposed liquefied natural gas (LNG) export facility at Bear Head in Point Tupper, Nova Scotia.

A pipeline study corridor has been identified for routing purposes. This study corridor is approximately 100 m wide for most of the length, and wider in areas where additional engineering information is needed. The width required for the construction period will be reduced to approximately 35 m in most areas. The pipeline corridor parallels an existing pipeline right-of-way wherever possible.

PROJECT OVERVIEW

- A natural gas pipeline from the Goldboro area to the Bear Head LNG export facility site on the Strait of Canso
- Following an existing pipeline right-of-way where possible

PROJECT COMPONENTS

- Approximately 62.5 km in length
- Approximately 35 m width during construction
- Pipe outside diameter of 42 inches
- Compressor station

PROJECT ACTIVITIES

Planning and Regulatory

- Environmental studies, permits and approvals
- Final engineering

Construction

- Site preparation
- Pipeline installation
- Watercourse crossings
- Site restoration

Operation and Maintenance

- Pipeline maintenance
- Right-of-way maintenance
- Periodic inspection operations

ENVIRONMENTAL REGULATORY PROCESS

The Project will be subject to an environmental assessment (EA) under the Nova Scotia Environment Act, triggering a Class I environmental registration under the Nova Scotia Environmental Assessment Regulations given the pipeline will be approximately 62.5 km in length with a maximum allowable operating pressure of approximately 1,440 psi.

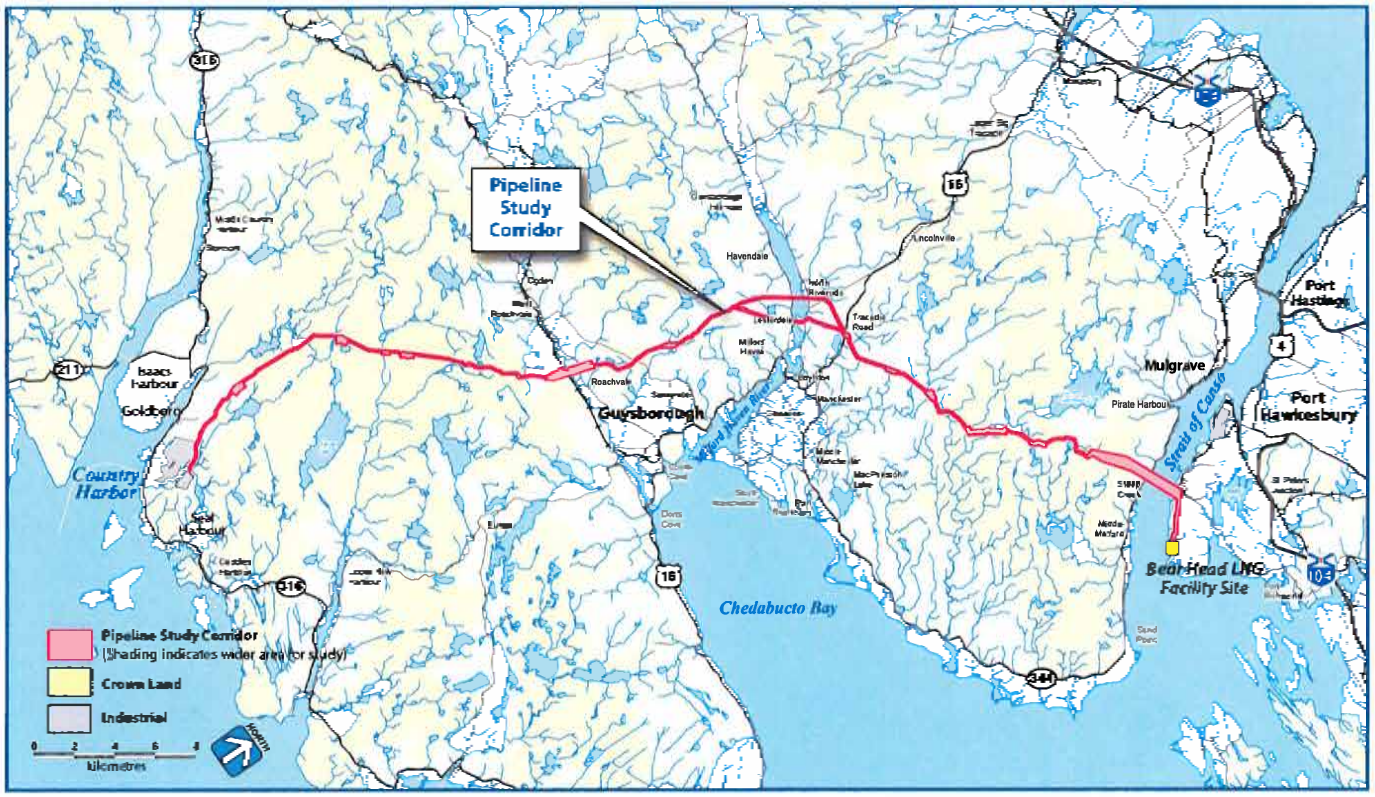
CORRIDOR SELECTION

The Pipeline Corridor generally parallels the existing M&NP Point Tupper Lateral natural gas line and the Sable Offshore Energy Inc. natural gas liquids line to the extent feasible. Bear Paw Pipeline will carefully evaluate areas where the preferred corridor may have to deviate from the existing right-of-way due to areas of:

- Wetlands
- Water crossings
- Other sensitive habitat
- Near structures/buildings
- Steep and/or rocky terrain
- Sharp bends

Bear Paw PIPELINE

Bear Paw Pipeline Project



PROJECT LOCATION

Located in a mostly rural area of Nova Scotia, the pipeline corridor covers approximately 3,112 ha area of land (approx. 50% is Provincial crown land). Small clusters of residential dwellings are located in the vicinity of the corridor in Guysborough County.

The pipeline corridor on the Cape Breton Island side of the Strait of Canso (approx. 2.5 km in length), is entirely in an area designated for port or heavy industrial development as part of the Point Tupper Industrial Park.

ENVIRONMENTAL ASSESSMENT

Bear Paw Pipeline is committed to:

- Reducing potential effects to the environment
- Addressing regulatory requirements
- Addressing issues raised by stakeholders, landowners, the public and Mi'kmaq communities
- Integrating engineering design and mitigation into the environmental management planning process

STUDIES TO SUPPORT THE ENVIRONMENTAL ASSESSMENT

- Freshwater surveys
- Marine surveys
- Rare plant survey
- Wetland delineation
- Wildlife surveys
- Mi'kmaq Ecological Knowledge Study

PROJECT BENEFITS

The Project will provide direct and indirect economic benefits to local communities as well as the region.

- Jobs and training for the local and regional communities
- Use of local goods and services where applicable
- Local employment during construction, operation and maintenance
- Significant municipal tax revenue

PROJECT SCHEDULE

The environmental assessment and stakeholder engagement process started in the fall of 2015. A public open house and potential town hall meetings will be held with landowners and stakeholders to share information and to address concerns. The environmental assessment will be submitted in 2016 and a public comment period will follow. The pipeline could be put in service as early as 2018.

CONTACT US

We invite you to contact Bear Paw Pipeline with any questions related to the proposed pipeline project.

Phone: 1-902-625-6011
email: info@BearPawPipeline.com

BEAR PAW PIPELINE

March 2016

APPENDIX B
MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY

March 2016

Bear Paw Pipeline Project

Mi'kmaq Ecological Knowledge Study

Prepared for: Stantec Consulting Ltd. and
Bear Paw Pipeline Corporation Inc

Membertou
GEOMATICS SOLUTIONS

March 2016
Version 1

M.E.K.S. Project Team

Jason Googoo, Project Manager

Dave Moore, Author and Research

Craig Hodder, Author and GIS Technician

Laura Wensink, Editor and GIS Technician

Sadie Sylliboy, MEKS Interviewer

Special Thanks to

Josephine Poulette, Paq'tnkek Mi'kmaw Nation

Tracy George, Potlotek First Nation

Prepared by:

_____

Craig Hodder, Author

Reviewed by:

_____

Jason Googoo, Manager

Executive Summary

This Mi'kmaq Ecological Knowledge Study, also commonly referred to as a MEKS or a Traditional Ecological Knowledge Study (TEKS), was developed by Membertou Geomatics Solutions (MGS) for Stantec Consulting Ltd., on behalf of Bear Paw Pipeline Corporation Inc. (Bear Paw Pipeline) with regards to the Bear Paw Pipeline Project (the Project).

This MEKS mandate is to consider land and water areas which the proposed project will utilize, and to identify what Mi'kmaq traditional use activities have occurred, or are currently occurring within, and what Mi'kmaq ecological knowledge presently exists in regards to the area. In order to ensure accountability and ethic responsibility of this MEKS, the MEKS development has adhered to the "Mi'kmaq Ecological Knowledge Protocol, 2nd Edition". This protocol is a document that has been established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which speaks to the process, procedures and results that are expected of a MEKS.

The Mi'kmaq Ecological Knowledge Study consisted of two major components:

- **Mi'kmaq Traditional Land and Resource Use Activities**, both past and present,
- A **Mi'kmaq Significance Species Analysis**, considering the resources that are important to Mi'kmaq use.

The Mi'kmaq Traditional Land and Resource Use Activities component utilized interviews as the key source of information regarding Mi'kmaq use in the Project Site and Study Area. The Project Site is 500m wide and extends 62.5 km roughly between Goldboro and Port Hawkesbury, Nova Scotia. The Project Site follows 60 km of the existing Maritimes & Northeast Pipeline main transmission line, terminating at the site of the future Bear Head Liquefied Natural Gas export facility near Port Hawkesbury. The Study Area will consist of areas within a 5 km radius of the Project Site boundaries.

Interviews were undertaken by the MEKS Team with Mi'kmaq hunters, fishers, and plant gatherers of the Paq'tnkek, Potlotek, Waycobah, Wagmatcook and Sheet Harbour (Millbrook)

communities who shared details of their knowledge of traditional use activities. The interviews took place from December 2015 to February 2016.

Informants were shown topographical maps of the Project Site and Study Area and then asked to identify where they undertake their activities as well as to identify where and what activities were undertaken by other Mi'kmaq, if known. Thirty-nine (39) individuals were contacted to provide any land use knowledge they had in the Study Area. In total seventeen (17) agreed to provide fishing, hunting, gathering information and details of any other cultural activity in the area. Permission was requested of the interviewee(s) to have their information incorporated into the GIS data. These interviews allowed the team to develop a collection of data that reflected the most recent Mi'kmaq traditional use in this area, as well as historic accounts. **All interviewee's names are kept confidential and will not be released by MGS as part of a consent agreement between MGS and the interviewee to ensure confidentiality.**

The data gathered was also considered in regards to its significant to the Mi'kmaq people. Each species identified was analyzed by considering their use as food/sustenance resources, medicinal/ceremonial plant resources and art/tools resources. These resources were also considered for their availability or abundance in the areas listed above, and their availability in areas adjacent or in other areas outside of these areas, their use, and their importance, with regards to the Mi'kmaq.

Historic Review Summary

The Project Corridor crosses 6 known and probably ancient travel routes from the coasts of Chedabucto Bay and the Atlantic, leading deep into the interior of the Province and connecting with head waters of other rivers flowing to all coasts. There is little archaeological evidence within this Region to indicate the presence of early peoples which may be factor of too little investigation and a light population resulting in fewer accidental archaeological finds. A review of historical maps and documents reveals the Mi'kmaq connection to the land.

The last known Traditional Hunting Territories within or adjacent to the Project Corridor include Traditional Territory No. 43 which covers the area of Loon Lake, No. 42 which covers the area of Isaacs Harbour, No. 44 is along the Strait of Canso. Adjacent hunting territories in Cape Breton include No. 47, which covers much of Cape Breton Island and No. 48 which includes Ile Madame.

The shores and islands of Chedabucto Bay and particularly the Canso area were favorite landings for European fishermen to dry their catches and for the Mi'kmaq to trade with the Europeans since the mid 1500's. Chedabucto Bay was chosen for Nicolas Denys' trading and fishing station who constructed Fort Chedabucto at present-day Guysborough Harbour about 1659 and within close proximity to the Salmon River and the network of travel routes.

During the early 1680's, the Mi'kmaq had an encampment in the area of the present-day Guysborough town site. Nineteenth century Mi'kmaq encampments are reported at School House Brook, Issacs Harbour and another where the Issacs Harbour River flows into the harbour. The School House Brook location is also thought to be a Mi'kmaq burial site. Other sources place Mi'kmaq encampments along the Strait of Canso at McNairs Cove and Melford Point.

A review of historic maps of Guysborough County in the late 1800's show very little recorded evidence of Mi'kmaq settlements within the Project Corridor or some of the locations along Chedabucto Bay and Eastern Shore as reported in the sources. However, a Census of the early 1900's enumerated the Mi'kmaq of "Cooks Cove Micmac Reservation" of unknown location, which indicated a population of approximately 40 persons identifying themselves as Mi'kmaq near the community of Guysborough.

A review of current Land Claims show no current active claims within the Project Site and Study Area Project Corridor.

Traditional Use - Project Site Summary

Based on the data documented and analyzed, it was concluded that some Mi'kmaq use has been reported on the Project Site, or in the immediate vicinity. Trout fishing and deer hunting activities were found to occur at various points along the proposed pipeline. These two activities were found to be the most reported activity, but other uses were reported by informants along the Project Site. Some other examples were salmon fishing, rabbit hunting, and blueberry gathering.

Traditional Use - Study Area Summary

Based on the data documentation and analysis, it was concluded that the Mi'kmaq have historically undertaken traditional use activities within the Study Area, and that this practice continues to occur today. These activities primarily involve harvesting of fish and animals, but also include harvesting plants, and tree species; all of which occurs in varying locations throughout the Study Area and at varying times of the year.

Trout and salmon were found to be the most fished species within the Study Area. Deer and rabbit were found to be the most hunted within the Study Area. With the relatively small number of gathering areas identified, it is difficult to categorize the area as a particular gathering area type as there was a variety of species harvested in the area for different purposes.

Other Information

Informants had described settlements in or around the Guysborough area during the early 1900's and in the 1970's. Settlements were also described in Goldboro and close to Pirate Harbour near Mulgrave.

Table of Contents

1.0 INTRODUCTION

1.1 Membertou Geomatics Solutions

Membertou Geomatics Solutions (MGS) is a Membertou First Nation company that was developed as a result of the 2002 Supreme Court Marshall Decision. MGS was established as a commercially viable company that could provide expertise in the field of GIS Services, Database Development, Land Use Planning Services and Mi'kmaq Ecological Knowledge Studies (MEKS). MGS is one of many companies established by the Membertou First Nation – Membertou Corporate Division and these companies provide employment opportunities for aboriginal persons and contribute to Membertou's efforts of growth and development. As well, Membertou's excellent management and accountability of their operations is further enhanced by their ISO 9001:2008 certification.

For the development of this MEKS, MGS brings to the table a team whose expertise and skills with land documentation have developed a sound MEKS. The team skills include knowledge of historical Mi'kmaq research, GIS data analysis, Mi'kmaq ecological and cultural knowledge, and Mi'kmaq community connections.

1.2 Bear Paw Pipeline Project

Bear Paw Pipeline proposes to construct a natural gas pipeline (Bear Paw). Bear Paw would interconnect the Maritimes & Northeast Pipeline (M&NP) mainline, offshore gas and other supplies near Goldboro, Nova Scotia, to Bear Head which lies within the Point Tupper Industrial Park, near the town of Port Hawkesbury, Nova Scotia.

Bear Paw consists of the following components:

- a 42" pipeline with a maximum operating pressure of 9930 kPa (1440 psig) extending approximately 62.5 km from a point along the existing M&NP main transmission line near Goldboro, Nova Scotia to Bear Head, near Port Hawkesbury, Nova Scotia;

- compression, metering and associated facilities; and
- temporary ancillary facilities and access roads.

It will operate as a standalone pipeline, but the assessment corridor follows 60km of the existing right-of-way (RoW) of existing pipelines. Presently two pipelines connect Golboro and Port Hawkesbury; the buried Sable Offshore Energy Project NPS 8 (or 8") Natural Gas Liquids Pipeline and the M&NP NPS 8 Natural Gas (NG) Pipeline.

Bear Paw will be operated as a standalone pipeline serving the needs of Bear Head and will not be subject to the control or direction of M&NP or any other pipeline company.

2.0 MI'KMAQ ECOLOGOCAL KNOWLEDGE STUDY SCOPE & OBJECTIVES

2.1 Mi'kmaq Ecological Knowledge

The Mi'kmaq people have a long-existing, unique and special relationship with the land and its resources, which involves the harvesting of resources, the conservation of resources and spiritual ideologies. This relationship is intimate in its overall character, as it has involved collective and individual harvesting of the resources for various purposes, be it sustenance, medicinal, ceremonial and/or conservation. This relationship has allowed the Mi'kmaq to accumulate generations of ecological information and this knowledge is maintained by the Mi'kmaq people and has been passed on from generation to generation, youth to elder, ***kisaku kinutemuatel mijuijij***.

The assortment of Mi'kmaq Ecological Information which is held by various Mi'kmaq individuals is the focus of Mi'kmaq Ecological Knowledge Studies (MEKS), also commonly referred to as Traditional Ecological Knowledge Studies (TEKS). When conducting a MEKS, ecological information regarding Mi'kmaq/Aboriginal use of specific lands, waters, and their resources are identified and documented by the project team.

Characteristically, MEKS have some similar components to that of an Environmental Assessment; yet differ in many ways as well. Among its purpose, Environmental Assessments seek to measure the impact of developmental activity on the environment and its resources. This is often done by prioritizing significant effects of project activities in accordance with resource legislation, such as the Federal *Species at Risk* and the Nova Scotia Endangered Species Act.

Mi'kmaq Ecological Knowledge Studies are also concerned with the impacts of developmental activities on the land and its resources, but MEKS do so in context of the land and resource practices and knowledge of the Mi'kmaq people. This is extremely important to be identified when developing an environmental presentation of the Study Area as Mi'kmaq use of the land, waters and their resources differs from that of non-Mi'kmaq. Thus, the MEKS provides ecological data which is significant to Mi'kmaq society and adds to the ecological understandings of the Study Area.

2.2 Mi'kmaq Ecological Knowledge Study Mandate

Membertou Geomatics Solutions was awarded the contract to undertake a Mi'kmaq Ecological Knowledge Study for the proposed Bear Paw Pipeline Project. This project will require the documentation of key environmental information in regards to the project activities and its possible impacts on the water, land and the resources located here. The MEKS must be prepared as per the **Mi'kmaq Ecological Knowledge Study Protocol** ratified by the Assembly of Nova Scotia Mi'kmaq Chiefs on November 22, 2007, and the 2nd Edition released in 2014.

MGS proposed to assist with the gathering of necessary data by developing a MEKS which will identify Mi'kmaq traditional land use activity within the proposed project site and in surrounding areas within a 5 kilometer radius of the project site. The proposed MEKS would identify, gather, and document the collective body of ecological knowledge which is held by individual Mi'kmaq people. The information gathered by the MEKS team is documented within this report and presents a thorough and accurate

understanding of the Mi'kmaq's use of the land and resources within the Project Site/Study Area.

MGS understands that this study could be included in the Environmental Assessment under the Nova Scotia Environmental Assessment Act that will be submitted to the Nova Scotia Department of Environment by Stantec Consulting Ltd., and will be used as an indicator identifying Mi'kmaq traditional land and resource use within the Study Area.

It must be stated, however, that this MEKS should not be used for Consultation purposes by government and/or companies, nor should this report replace any Consultation process that may be required or established in regards to Aboriginal people. As well, this report cannot be used for the justification of the Infringement of S.35 Aboriginal Rights that may arise from the project.

2.3 Mi'kmaq Ecological Knowledge Study Scope & Objective

This MEKS will identify Mi'kmaq ecological information regarding Mi'kmaq traditional land, water and resource use within the Project Site/Study Area. The data that the study will gather and document will include use from both the past and present time frame. The final MEKS report will also provide information that will identify where the proposed project activities may impact the traditional land and resource of the Mi'kmaq. If such possible impact occurrences are identified by the MEKS then the study will also provide recommendations that should be undertaken by the proponent. As well, if the MEKS identifies any possible infringements with respect to Mi'kmaq constitutional rights, the MEKS will provide recommendations on necessary steps to initiate formal consultation with the Mi'kmaq. Finally, through the development of this MEKS, Mi'kmaq ecological knowledge and traditional land, water and resource usage will be identified for those parties that are considering the Bear Paw Pipeline Project.

2.4 MEKS Study Area

The proposed pipeline will extend approximately 62.5 km from a point along the existing M&NP main transmission line near Goldboro, Nova Scotia, to the site of the future Bear

Head LNG export facility, near Port Hawkesbury, Nova Scotia. Approximately 60 km of the Study Corridor follows the existing right-of-way (RoW) for two existing 8" pipelines, the Sable Offshore Energy Project NPS 8 (or 8”) Natural Gas Liquids Pipeline and the M&NP NPS 8 Natural Gas (NG) Pipeline.

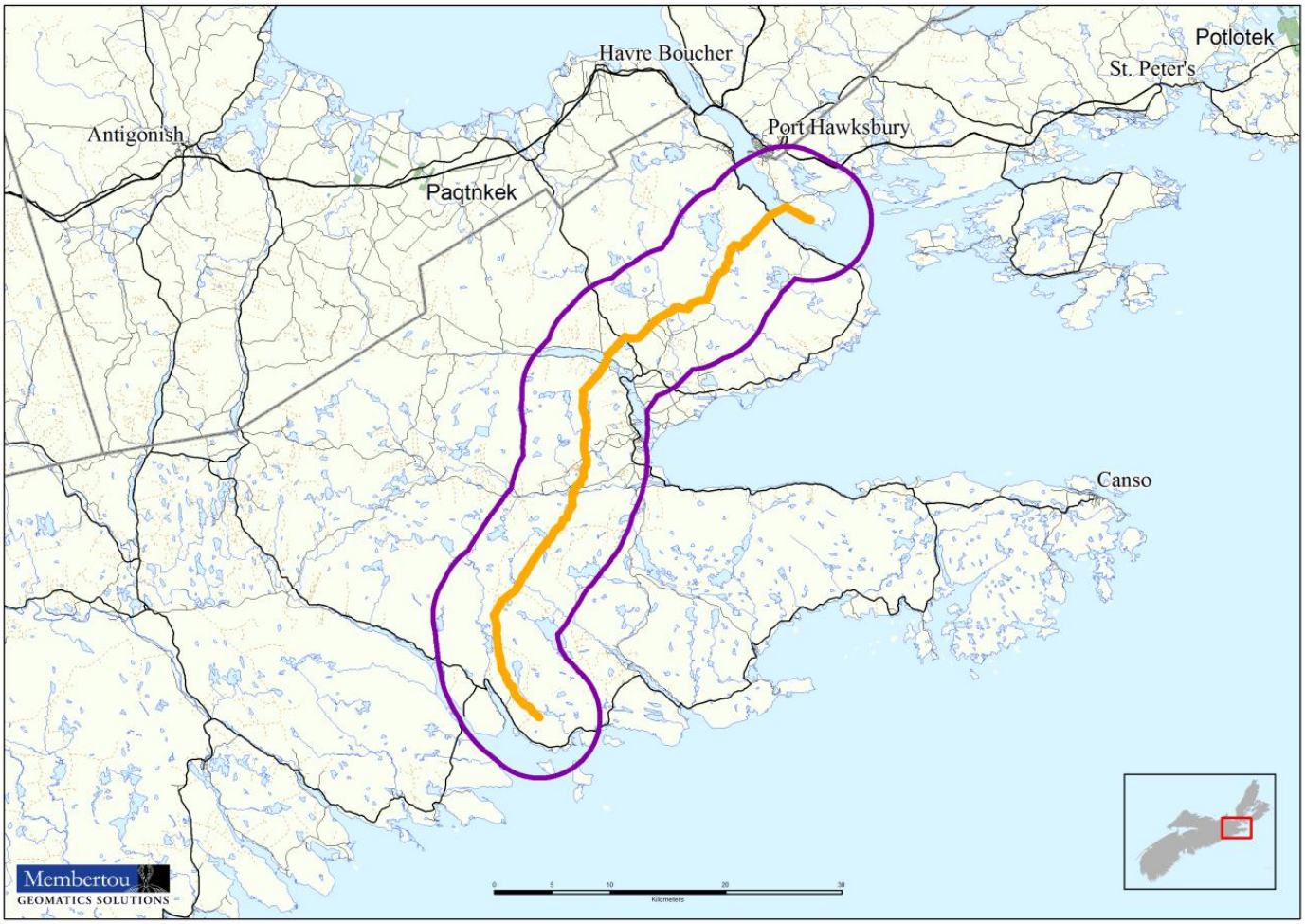


Fig 1: Interview Map: Project Site (orange highlight) and Study Area (purple line)

This MEKS will focus on the 500 m wide *Study Corridor* within which the proposed pipeline will be located, this area will be defined as the Project Site. It should be noted that although the Project Site will cover a large area, the construction RoW will be much smaller (approximately 35 m). The Study Area will consist of areas within a 5 km radius of the Project Site boundaries.

3.0 METHODOLOGY

3.1 Interviews

As a first step to gathering traditional use data, the MEKS team initiated dialogue and correspondence with Mi'kmaq communities in close proximity of the Project Site: Paq'tnkek, Potlotek, Waycobah, Wagmatcook and Sheet Harbour (Millbrook).

Discussions occurred to identify individuals who undertake traditional land use activities or those who are knowledgeable of the land and resources. An initial list of key people is then developed by the team. These individuals were then contacted by the MEKS team members and interviews were scheduled from December 2015 to February 2016.

For this MEKS, thirty-nine (39) individuals were asked if they had any land use knowledge of the Study Area. Seventeen (17) individuals were able to provide information in regards to past and present traditional use activities. Interviewees resided within or were from the communities of Paq'tnkek, Potlotek, Waycobah, Wagmatcook and Sheet Harbour (Millbrook). All of the interviews that were completed following the procedures identified within the Mi'kmaq Ecological Knowledge Protocol (MEKP) document. Prior to each interview, interviewees were provided information about the MEKS, including the purpose and use of the MEKS, an agreement of non-disclosure of their personal information in any reports, and the future use of the traditional use information they provided.

Interviewees were asked to sign a consent form, providing permission for MGS to utilize their interview information within this MEKS. During each interview, individuals were provided a map of the Project Site/Study Area (Fig 1) and asked various questions regarding Mi'kmaq use activities, including where they undertook their activities or where they knew of activities by others, when such activities were undertaken, and how that type of resource was utilized. When required or preferred, interviews were conducted in the Mi'kmaq language.

3.2 Literature and Archival Research

With regards to this MEKS, various archival documents, maps, oral histories and published works were reviewed in order to obtain accurate information regarding the past or present Mi'kmaq use or occupation relevant to the Project Site and Study Area. A complete listing of the documents that were referenced is outlined within the *Sources* section.

3.3 Field Sampling

Site visits to the Project Site took place over a 5 day period in late fall, 2015 by MGS staff members, guided by a Mi'kmaq ecological knowledge holder.

Pic 1: Snowberry seen throughout the Project Area during the site visit

The site visits consisted of a site recon, and walkthroughs of the Project Site, noting and identifying any particular species in the area, plant and animal habitats, or other land/water features or areas that would be of importance to the Mi'kmaq.

Observation points were recorded by GPS either at approximate set intervals, or whenever there was a species or feature deemed worthy to note. The existing right of

ways, for the Maritime Northeast Pipeline, were used to access and survey the Project Site. The team would only utilize right of ways on public or crown lands. Areas of the Project Site on privately owned land were not surveyed for this project.

Site Visit Observations

Throughout the entire site visit, sixty six (66) categories of plant and tree species, animal signs, and other features were recorded in eight hundred and sixty (860) observation points. The top five most common observations recorded were maple trees (with 78 observation points), balsam fir trees (60 observation points), black spruce trees (59 observation points), partridge berry (54 observation points) and blueberries (37 observation points).

Pic 2: Labrador Tea found on site visit

Table 1: Site Observations

Observation Species/Category	No. of Observations	Observation Species/Category	No. of Observations
MAPLE	78	BALSAM	60
BLACK SPRUCE	59	PARTRIDGE BERRY	54
BLUEBERRY	37	WHITE BIRCH	35
FERN	31	BLACKBERRY	30
ALDER	28	SWEETGALE	26
SNOWBERRY	24	LABRADOR TEA	23
SERVICE BERRY	22	TAMARACK	22
WOMAN'S SAGE	22	GOLDEN ROD	19
MOUNTAIN ASH	19	PINCHERRY	19
SASSPARELLA	18	CROWBERRY	17
WILLOW	17	MAYFLOWER	16
STRAWBERRY	16	GOLDTHREAD	15
OSTRICH FERN	14	LILY OF THE VALLEY	13
LARCH	10	GREY BIRCH	9
DEER SIGNS	8	MOSS	8
YELLOW BIRCH	8	RASPBERRY	7
WHITE SPRUCE	7	CARIBOU MOSS	4
PINE	4	PORCUPINE DROPPING	4
RED MAPLE	4	ROSE BUSH	4
WOOD SORREL	4	BAYBERRY	3
GROUND JUNIPER	3	MILKWEED	3
RABBIT DROPPING	3	WHITE ASH	3
WILD PLUM	3	HIGH BRUSH BLUEBERRY	2
KINIKINIK	2	MUSHROOM	2
OLD FENCE	2	SILVER MAPLE	2
WHITE PINE	2	APPLE	1
BUNCHBERRY	1	CAT TAIL	1
CHOKE CHERRY	1	CLOUDBERRY	1
COYOTE DROPPING	1	CRANBERRY	1
ELDERBERRY	1	HEMLOCK	1
JUNIPER	1	PITCHER PLANT	1
POPLAR	1	SPRUCE	1
STRIPED MAPLE	1	TEABERRY	1

4.0 MI'KMAQ LAND, WATER AND RESOURCE USE

4.1 Overview

The Mi'kmaq Land, Water and Resource Use Activities component of the MEKS provides relevant data and analysis in regards to Mi'kmaq traditional use activities that are occurring or have occurred within the Study Area. It identifies what type of traditional use activities are occurring, it provides the general areas where activities are taking place and it presents an analysis regarding the significance of the resource and the activity as well.

The Mi'kmaq traditional use activities information that is provided by interviewees is considered both in terms of "Time Periods" and in regards to the "Type of Use" that the resource is being utilized. The Time Periods that the MEKS team differentiates traditional use activities by are as follows:

"Current Use" – a time period within the last 10 years
"Recent Past" – a time period from the last 11 – 25 years ago
"Historic Past" – a time period previous to 25 years past

The "Type of Use" categories include spiritual use, and sustenance use, such as fishing, hunting or medicinal gathering activities.

Finally, the study analyzes the traditional use data in consideration of the type of land and resource use activities and the resource that is being accessed. This is the Mi'kmaq Significant Species Analysis, an analysis which ascertains whether a species may be extremely significant to Mi'kmaq use alone and if a loss of the resource was to occur through project activities, would the loss be unrecoverable and prevent Mi'kmaq use in the future. This component is significant to the study as it provides details as to Mi'kmaq use activities that must be considered within the environmental understanding of the Project Site and Study Area.

By analyzing the traditional use data with these variables, the MEKS thoroughly documents Mi'kmaq traditional use of the land and resources in a manner that allows a detailed understanding of potential effects of project activities on Mi'kmaq traditional use activities and resources.

4.2 Limitations

By undertaking a desktop background review and interviews with Mi'kmaq participants in traditional activities, this study has identified Mi'kmaq Traditional Use activities that have occurred or continue to occur in the Study, and few uses within the Project Site. This has allowed the study to identify traditional use activities in a manner that the MEKS team believes is complete and thorough, as required by the MEKP. Historical documents within public institutions were accessed and reviewed and individuals from nearby Mi'kmaq communities were interviewed. The interviews were undertaken with key Mi'kmaq community people, identified initially by the MEKS team, who are involved and are knowledgeable regarding traditional use activities. Through the historical documentation review and the interview process, the MEKS team is confident that this MEKS has identified an accurate and sufficient amount of data to properly reflect the traditional use activities that are occurring in the Study Area.

The MEKS process is highly dependent on the information that is provided to the team. Because only some of the Mi'kmaq traditional activity users and not all Mi'kmaq traditional activity users are interviewed, there is always the possibility that some traditional use activities may not have been identified by this MEKS.

4.3 Historical Review Findings

The Landscape

The 0km Post at Goldboro is at roughly 46m elevation on coastal plateau with a gentle slope southeast to the sea at Cooks Cove. There are a couple of promontories of 47m and 59m roughly 1.5km to the southwest. (1)The land is covered with a thin Stony Till. (2) The MEKS Study Area (Study Corridor) takes in the shorelines of Country Harbour from

Seal Cove to Stormont including Isaacs Harbour. The shoreline provided access to any slate found in the mostly the Goldenville Formation bedrock with a band of Halifax Formation exposed at Goldboro, Isaac Harbor and just north of the ferry crossing of Country Harbour. (3)

Moving inland the land dramatically increases in elevation with Quinces Hill of approximately 60- 70m separating Isaac Harbour from Country Harbour. The Corridor curves to the northeast over the high ground separating Isaac Harbour from New Harbour and encounters the New Harbour River System just past the 13km Post. (1) A roughly 5km x 7km area of exposed bedrock is found east of the Study Corridor 13km post. (2) The bedrock exposed is a 375 Ma old fine grained Leucomonzogranite (M-LDflmg) of the Liscomb Complex. (3) Another exposed area of bedrock is located 3km southwest of the 19km post. The bedrock exposed is the older Halifax Formation slate, siltstone and minor sandstone of 510 Ma. A small exposed patch of 510 Ma and older Goldenville Formation is located just east of the Study Corridor centerline at the 22km post. (3)

The Salmon River system is encountered at the 23km Post after a 100m drop in elevation over 1km to the Salmon River. The Corridor climbs north out of the valley to approximately 130m at the 25km Post and crosses a large plateau from the 26km Post to the 33km Post where the Corridor turns northeast and slopes down from 170m to meet the Milford Haven River at about the 35km Post. (1) Between the 25km and 35km posts exists a large area of exposed bedrock of several types within the Study Corridor. (2) A narrow band of 375 Ma Sunnyville Formation consisting of basalt, andesite and rhyolite, winds its way through the exposed area flanked by Glenkeen Formation and surrounded by Clam Harbour River Formation. (3) Rhyolite would have been of interest to Early Peoples.

Crossing the Milford Haven River at Bowles Point, the Corridor Centerline climbs out of the valley northeast to approximately 90m elevation and crosses a large plateau strewn with drumlin fields between the 39km Post to 56km Post at approximately 150m in elevation. (1) There is a large area extending north from between the 36km and 44km

posts along the Study Corridor which is completely underlain with Horton Group Sedimentary rock as are the areas exposed northwest of 45km to 57km posts. (3) These elevated areas of exposed bedrock are dotted with Silty Drumlin fields deposited from the former ice sheets. (2)

The Corridor drops 150m over 1.5k to the Strait of Canso just northwest of Steep Creek. On the northeastern shore of the Strait of Canso the Corridor emerges from the Strait a Ship Rock and steeply climbs to 25m elevation and follows the 40m contour southeast to the 61km Post plus 0.5km. (1)

The Ice

The Project Site and Study Corridor were some of the last regions of the Province to be ice free with the last ice sheets centered approximately midway of the Strait of Canso with Project Site near the southwest ice margin approximately 10,500 BP. Evidence from deep-ocean sediments indicate that there have been at least 16 glacial periods that lasted approximately 100 thousand years each. The last glacial period was the Wisconsin Glaciation which began 75 thousand years ago and ended between 12 and 10 thousand years ago. During this period glaciers both crossed over and formed within the province while being fed by the high amounts of precipitation in the region. Recently after extensive sampling in Nova Scotia, evidence indicates that successive glaciation had four distinct phases with different and shifting ice centers. *(4)*

The Phase 1 ice flows moved eastward across the region including Prince Edward Island and Cape Breton Island before shifting flow direction southeastward across the present day Bay of Fundy, Mainland Nova Scotia and Cape Breton Island. The Ice flowed across the Project Site and Study Corridor in this phase in an eastward direction and then at some time shifted to a southeast flow direction. *(4)*

The Phase 2 ice center was located north of present day Prince Edward Island with flow direction south over mainland Nova Scotia and southeast over lower southeast portions of

Cape Breton Island. The Phase 2 ice flow direction was south to southeast over the Project Site and Study Corridor. *(4)*

The Phase 3 ice center was parallel to the present day Nova Scotia Atlantic Coast and extended on land from Cape Sable, through Cape Canso to offshore and approximately south of present day Louisbourg, Cape Breton Island. From this ice divide, ice flows moved northeast across eastern portions of Cape Breton Island, northwest across western portions of Cape Breton Island, northeast across northern portions of the mainland from Cape George to Minas Basin west to northwest across the present day Annapolis Valley. On the Atlantic side of the ice divide, all flow directions were in a southeast direction over the Scotia Shelf. The Ice sheet center was over the southern portions of Project Centerline and Study Corridor during this phase with the flow moving northeast and southwest from the Ice Divide*(4)*

Phase 4 was a period when several remnant ice sheets were located throughout the province and advanced and receded in a radial direction from the ice centers. Cape Breton had two glaciers that were centered on the Highlands and another centered on the Bas d'Or Lakes. The Chedabucto Glacier filled the present day Chedabucto Bay and St. Georges Bay with a westward ice flow direction across the central portion the province into the Northumberland Strait, Minas Basin and the Atlantic. The Chignecto Glacier was centered near Baie Verte and Cape Tormentine and the South Mountain Ice Cap was centered between the Bay of Fundy and Atlantic Coast near present day Kejimkujik National Park. The direction of ice advance of the Chedabucto Bay Glacier was a west to southwest flow direction across the mainland. *(4)*

The last of the glaciers gradually receded with the Bay of Fundy being ice free between 16 and 14 thousand years ago. Northern portions of the province experienced periodic advancement and stalls in movement of a remnant ice cap centered near the Antigonish Highlands approximately 15 thousand years ago. The flow direction was westward into lowlands and southwestward over the Project Site to offshore of present day Sheet Harbour. By 13 thousand years ago the ice sheets had receded to the approximate

coastline of today and then only residual ice caps remained in highland areas at approximately 12 thousand years ago. *(4)*

Between 11 and 10 thousand years ago there was an abrupt climate change with a cold period lasting approximately 200 years known as the Younger Dryas. During the Younger Dryas Period previously colonized plants that followed the receding glaciers were covered in permanent snowfields and some large mammals became extinct. *(5)*

As the last remnant glaciers receded and the climate warmed again. The landscape was gradually colonized by tundra vegetation of willow shrubs and herbaceous plants between 10 and 7.5 thousand years ago and were replaced by boreal vegetation such as fir, spruce and birch until 6 thousand years ago when pine and oak was prominent. *(6)* Temperatures were 2 degree Celsius warmer than today for period until 4 thousand years ago and forests of hemlock mixed with beech and maple was the dominant vegetation. Gradual cooling to present day temperatures and increased moisture favoured spruce forests. *(7)*

It is also theorized that a terrestrial refuge for plants and animals existed near the edge of the continental shelf where arctic and boreal species survived the last ice age and eventually repopulated the newly exposed mainland landscape as the ice sheets receded and before the sea level rise. However, since the end of the last ice age the Chignecto Isthmus provided the land corridor for plants and animals to migrate into Nova Scotia as well as assisted airborne species migrations. *(8)*

People on the Land

Much of the archaeological record found to date is the decay resistant stone tools, cookware and ornamentation. The artifacts found have a consistency in style and manufacture over long periods with sudden disappearance of old styles and techniques and the appearance of new and different styles and manufacturing methods. The tools styles together with carbon dating, archeologists and researchers can create time periods and approximate distribution and movement of peoples or cultural groups. The changes

in tool styles and tool manufacture techniques were thought to be brought about through an early network of trade where peoples quickly adopted technological changes, stylizations and ideas. *(9)*

Some archaeological artifacts found along the St. Mary's River system 30 km west of the Project Corridor centerline were made of Quartz. *(10)* Exposed veins of Quartz in the bedrock were of importance to early peoples along the Eastern Shore. A special effort was made to explore the St. Mary's River System of Guysborough County in 1990. The 1990 reconnaissance did not discover any new sites to those already known. The study noted that common early tool making materials of Chalcedonies and Cherts are scarce in the region but there was an abundance of exposed quartz veins that supplied the raw material for tool making. Many of the artifacts recovered from the known Silver's Garden Site near at the intersection of the East St. Mary's River and the West St. Mary's River near Glenelg-Aspen, were of white quartz. Other sources of raw material can be found in green Quartzite and banded Argillite found eroding from the banks near Eden Lake, Pictou County and among the river cobble. *(10)*

The Natural History of Nova Scotia lists 5 Archaeological time periods for the Province of Nova Scotia that are prior to and including European contact with the Mi'kmaq (11):

11,000-10,000 Years BP, Paleo-Indians

The earliest evidence of early peoples east of the State of Maine is found at the foot of the Cobequid Mountains at Debert, Nova Scotia. There is evidence of an encampment on the site dated to be in use roughly 11,000 to 10,500 years BP (42). At this time, local ice sheets remained centered at locations of Bras d'Or Lakes/Highlands of Cape Breton, Canso, Baie Verte and South Mountain adjacent the Annapolis Valley. There was a large ice sheet centered on the Eastern Mainland of province with ice flows into St. Georges Bay, Minas Basin and along the Eastern Shore (2). The time of the Debert Site occupation is within the same period of the glacial re-advances of the Younger Dryas Period of 11,000 and 10,000 years BP. Increasingly harsh conditions are thought to have caused the early peoples to abandon the region. (11)

10,000-5,000 Years BP, The Great Hiatus

The rising sea levels and submerging coastlines are thought to be responsible for the lack of physical evidence of early peoples for this time period. Any evidence of coastal settlements of that period would be lost to coastal erosion and submergence. (11)

Archaeological evidence is scarce for a period of 10 to 5 thousand years ago which is thought to be due to the rise in sea levels that submerged former coastal sites. *(11)* Sea level rise on the Atlantic Coast was a combination of land rebound after ice sheets receded, rising ocean temperatures and water released by melting glaciers. *(11)* As the thick and heavy ice sheet centers depressed the earth's mantle, the areas of mantel along the ice sheet margins were less weighted by ice and rose slightly through displacement. There was an ice sheet center located in the Gulf of St Lawrence. As the weight of the ice sheets diminished with melting, the depressed center areas rebounded and rose in elevation while the mantel of the former ice margin areas lowered in elevation. *(13)*

5,000-3,500 Years BP, The Archaic Period

A period characterized by physical evidence of stone tools some of which are found offshore and possibly lost during deep water fishing. There was an influence or peoples present in the southern part of the province dated at a time between 3,500 and 2,500 BP known as the Susquehanna Tradition. The Susquehanna Tradition originated in area of the mid-Atlantic states of today and is identified by some unique artifacts. (11)

2,500-500 Years BP, The Ceramic Period

Evidence of pottery is introduced to the archaeological record during this period as are burial mounds. Ceramic period sites are scattered throughout the province and a 10m diameter burial mound was discovered at Whites Lake, HRM dated at 2,300 BP. (11)

Stone and ceramic of the Ceramic (Woodland) Period were found on the western side of Isaacs Harbour. (40)

500-100 Years BP, The Contact Period

The first European contact with the Mi'kmaq was most likely with Portuguese fishermen roughly 500 years ago. (11)

As early as 1481, fishing fleets from Bristol, England were sailing to the Atlantic Coast of North America. Most likely, fleets of French and of peoples from the Basque Provinces were also sailing to these Atlantic Coasts. One such Bristol fleet recorded finding an island they called the Isle of Brasil and no doubt found the fishing grounds of the Grand Banks. Due to competition, news of discoveries was kept quiet as to exploit the resources unhindered by competing fleets. *(14)*

Recent research has confirmed a Basque whale fishery had visited the Gulf of St. Lawrence and Labrador coast from the 1540's to the early 1600's. The Basque also participated in the cod fishery while establishing ports such as Plaisance (Placentia) in Newfoundland and Cape Breton until the arrival of other nation's fleets. *(15)*

By 1534, there was a fishery of ports, watering places along the Atlantic Coast from Southeastern Labrador to Southern Nova Scotia. As a sideline to fishing, fishermen began trading with the Mi'kmaq, Beothuk and Montagnais-Naskapi, the peoples that they encountered while drying their catch along the shores. *(14)*

In the 1500's the shorelines of hunting and fishing territories were being spoiled by European fishermen hunting and frequently burning to clear land for fish processing and shelter. Newfoundland natives may have retaliated in some form as in 1565 it was recorded that *"between Cape Race and Cape Breton live a cruel and austere people with whom it is impossible to deal with…"(16)*

By 1502 the fishery off the coasts of the new found land had been established and countries and captains had their preferred fishing areas and fishing stations. Ocean crossing became more common place as captains established their routes and landmarks.

French records alone have 70 vessels travelling to the New World between 1523 and 1556. *(16)*

The Contact Period is followed by the Acadian Period of 1605-1755 and the overlapping British Period of 1749-1867, followed by the Twentieth Century period with each period having significant impact on Mi'kmaq history. (11)

Table 2: Mi'kmaq Place Names

Name	**Mi'kmaq Name**	**Meaning**
Liscomb	*Megadawik*	"where the big eels are taken"
Tor Bay	*Tabooesimkak*	"having two branches" or "two in company picking berries"
New Harbour	*Ansaakw*	"a lonely rock"
	Okoboogwek	"Foaming with discoloured foam"
Stillwater	*Petawagumegek*	"running through barrens"
Wine Harbour	*Pelumke egunech*	"fish spawning place" or "an outlet cut in the sand"
Country Harbour	*Moolaboogwek*	"deeply gullied out"
Port Hillford	*Utkogumoogwode*	"where the tomcods resort in the
Guysborough	*Sedabocktook*	"a bay running far back" or "deep extending harbour"
Port Shoreham	*Assugadich*	"clam ground"
Sand Point	*Amaltunik*	"sandy point"
Pirate Harbour	*Tesogwode*	"place where goods were sorted"
Mulgrave	*Wolumkwagagunutk*	"Lobster ground"

The history of Mi'kmaq presence within the Study Corridor begins with the few Archaeological finds located within the Region. Arrow heads and stone tools have been found in the region with no specific locations given. One source reviewed mentions a seventeenth century burial find on the Salmon River. The find was the remains of a young Mi'kmaq woman wrapped in furs and accompanied by or contained within a large copper pot. A Mi'kmaq burial ground was found in the area of Sonora, 25 km southwest of the project corridor. (26) A First Nations burial site is believed to be located at Stormont. (40) The low population and sparse infrastructure along the Eastern Shore and

Chedabuctou Bay may be responsible for the very few accidental finds by passing people or during farming and construction activities. (26)

There are a few surviving Mi'kmaq place names within the region. The following are some former Mi'kmaq place names since replaced by the present-day place names (Table 2). (37)

Traditional Mi'kmaq Territory

Traditional Mi'kmaq territory is called *Mi'kma'ki* and covered an area that extended from the St. John River east to include Cape Breton Island, southern Newfoundland and from the Gaspe' Peninsula, south to the south shore of Nova Scotia. Mainland peninsular Nova Scotia is named *Kmitkinag* by Mi'kmaq and Cape Breton Island is named *Unimaki*. *Mi'kma'ki* is further divided into seven political districts: *(17)*

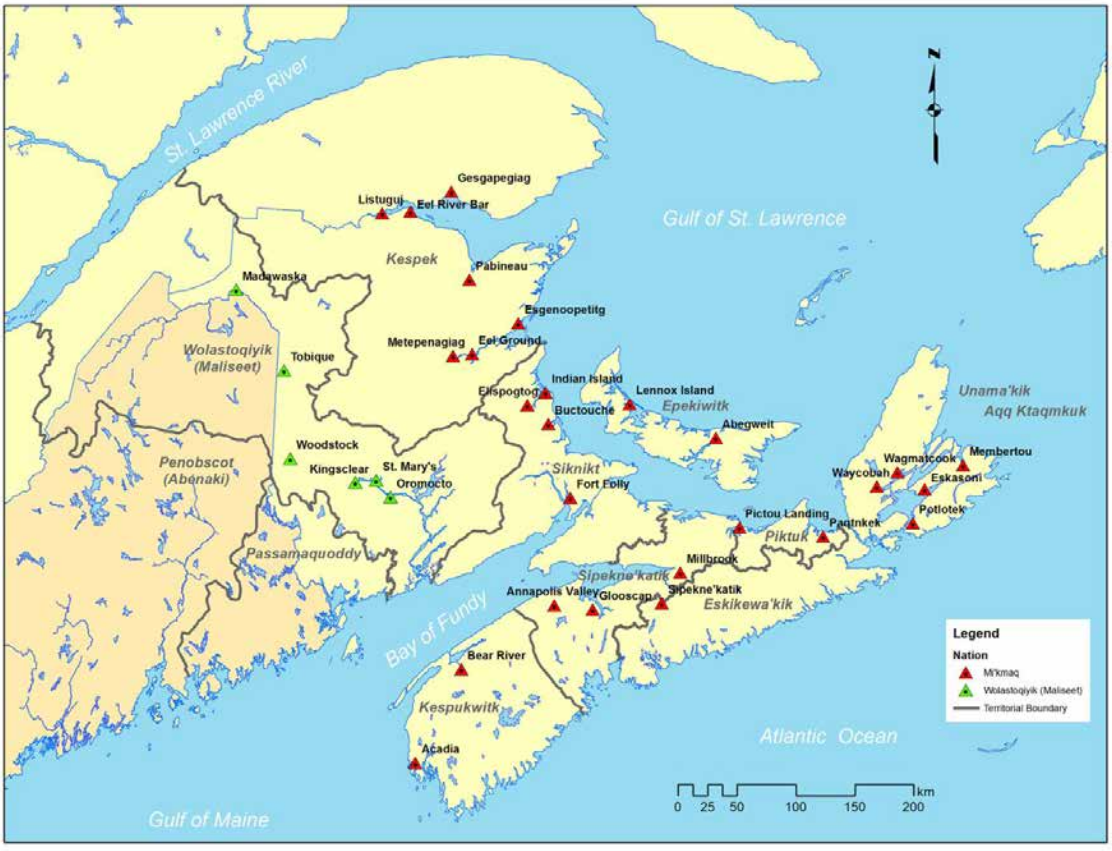


Fig 2: Mi'kmaq Political Districts with Maliseet, Passamaquoddy and partial Penobscot Traditional Territories. *(17)(18)(19)(20)*

Table 3: Mi'kmaq Place Names

District (Various Spellings)	***Geographic Territory***
Unimaki (17) (Unama'kik) (18)(19)(20)	Cape Breton Island
Esgigeoag (17) (Eskikewa'kik) (18) (Eski'kewag) (19)	Canso-Sheet Harbour
Sipeknekatik (17) (Sipekne'katik) (18) (Sikepne'katik) (19)	Sheet Harbour-LaHave
Kespukwitk (17)(18)(19)	Southern Nova Scotia,
Pittukewwaq (17) (Epexiwitk) (18) (Epekwitk) (19)	Prince Edward Island
Aqq Epekwtk (17) (Agg Piktuk) (18) (Piktuk) (19)	Shediac to Canso Strait
Kespekewaq (17) (Kespek) (18) (Kespe'kewag) (19)	Chaleur Bay to Gaspe
Sikniktewaq(17) (Siknikt) (18) (Sikniktewag) (19)	Chaleur Bay to Shediac

Three of these political districts are close proximity to each other and converge to share a portion of the Bay of Fundy and Minas Basin. *Pittukewwaq agg Epekwtk* (P.E.I and Northumberland Strait from Shediac to Canso Strait) territory is only the distance of the width of the Chignecto Isthmus to access the Bay of Fundy. *(17)* Other sources indicate different interpretation of the bounds of Pittukewwaq agg Epekwtk as being separate districts with Pittukewwaq being only PEI and agg Epekwtk being an area between approximately Merigomish Harbour and Canso Strait. *(18)(19)* The same sources interpret Esgigeoag district as extending from Canso through to St. Margarets Bay and Sipeknekatik as extending northwest through to the Northumberland Strait as shown on above Map. *(18)(19)*The Study Corridor is within the Mi'kmaq Political District of *Eskikewa'kik* of the Eastern Shore from Sheet Harbour to Canso. *(18)*

Mi'kmaq had an intimate knowledge of the ecology of their territory and fit their lives to seasonal cycles of the vegetation and animals and fish. Due to climate conditions, agriculture for food was a risk for Mi'kmaq. *(21)* Highly mobile Bands consisting of several related families would assemble at favorite camp sites. In the fall and winter the camps would disperse into small groups of 10-15 people for winter hunting. *(21)*

It was the duty and responsibility of the chief of each political district to assign the hunting territories to families and any changes were made in the presence of the Council of Elders which met in the spring and fall of every year. *(22)* Hunting districts of approximately 200-300 square miles were assigned to families. *(21)*

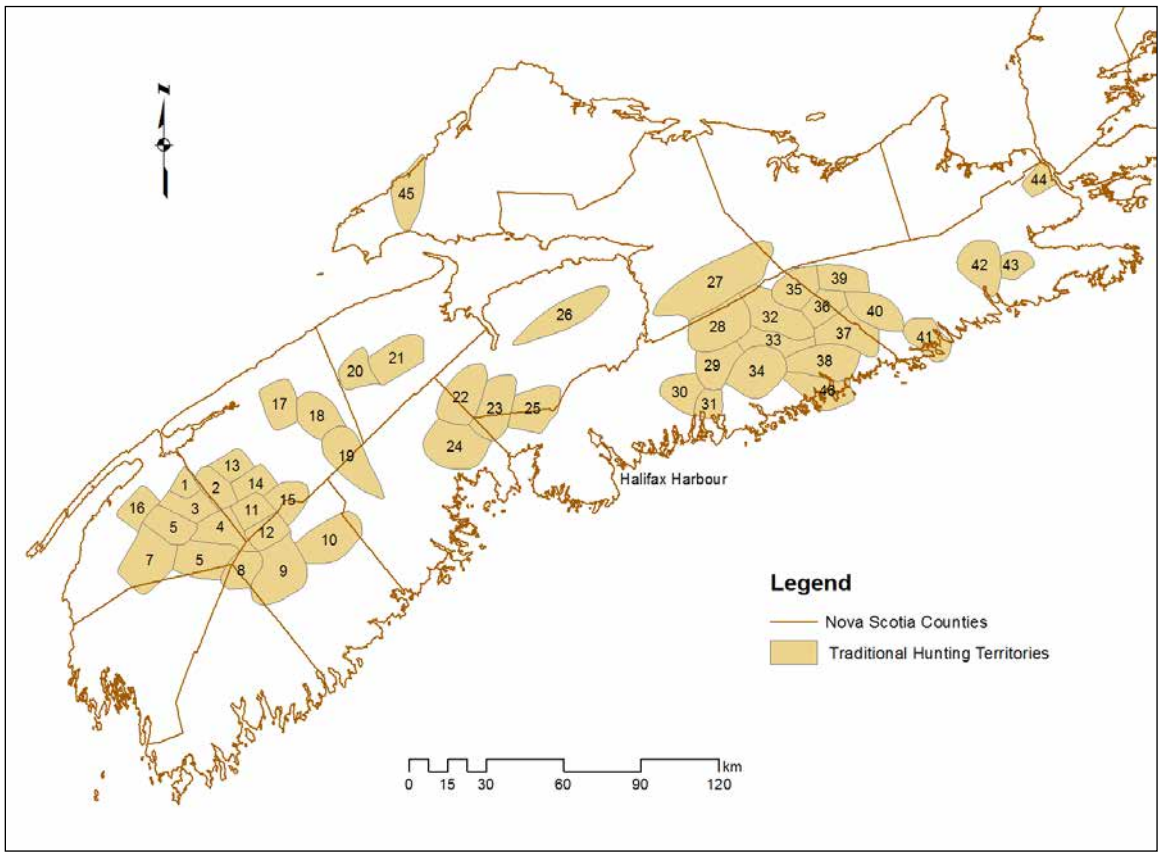


Fig 3: Mainland Nova Scotia Traditional Hunting Territories *(23)*

Table 4: Mainland Nova Scotia Traditional Hunting Territories Recorded Circa 1919 *(23)*

Map Reference	Name of Family	Geographic Territory
42	Newell Denis	Country Harbor, Isaacs Harbor, and North
43	Steve Malone	Loon Lake
44	Peter Anthony (half-breed)	Mill Village River, near Port Mulgrave

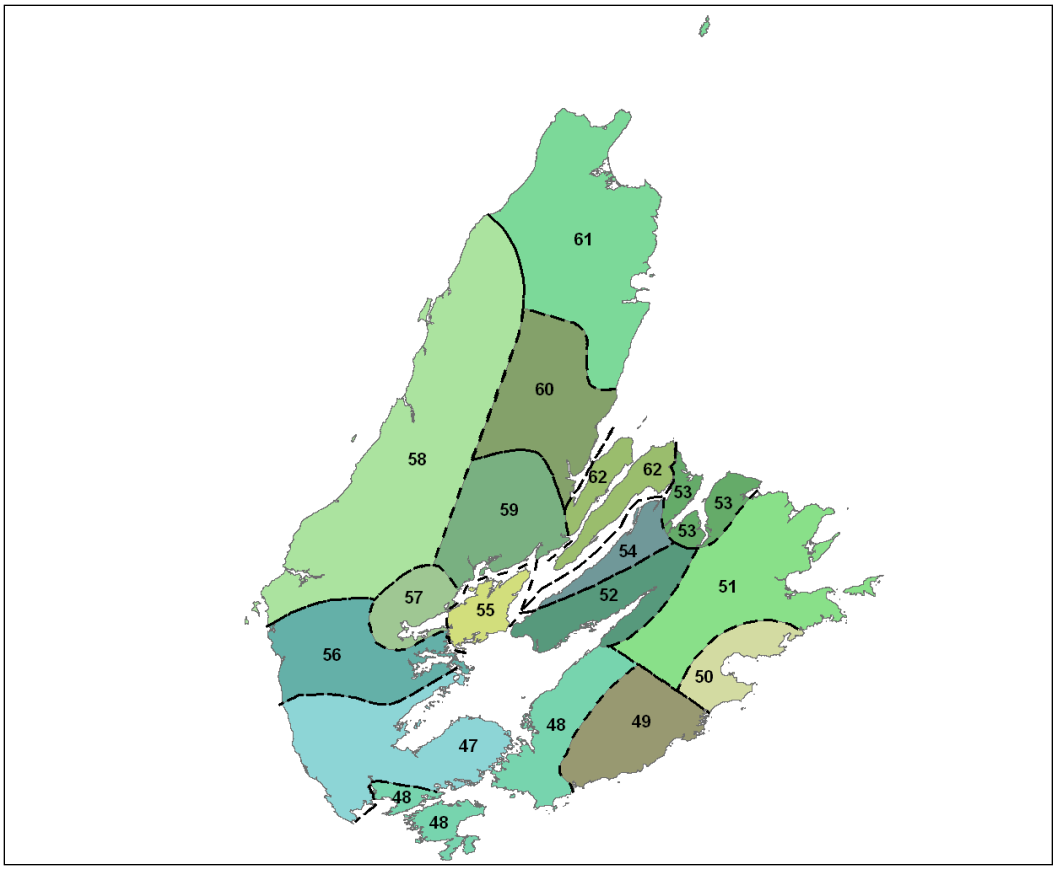


Fig 4: Cape Breton Traditional Hunting Territories *(23)*

Table 5: Cape Breton Island Hunting Territories Recorded Circa 1919 *(23)*

Map Ref.	Family Assigned	Family Hunting District	Traditional Name
47	Newell Denys (Nu'weli'dj – "Little Newell") (Noel?)	West Bay, Strait of Canso to Craigmore on St Georges Bay	Wi'a'yadjitck "Little place where red paint is found
48	Matthew Morris (Mu'lis) East Bay	East Bay, St. Peters Canal north to Salmon River	Muyala'yatc "Narrow Gorge"

The districts were usually surrounded lakes and rivers and were passed on to sons unless there were no sons where the district was then assigned to another family. *(23)* The Mi'kmaq respected the boundaries of the assigned territories and only took from the land what they needed for the family to survive thereby preserving game and fish for the family's future survival. *(22)*

The hunting territories of the mainland Nova Scotia were numerous compact interior territories that encompassed the watersheds of interior lakes and rivers as Mi'kmaq did most their game hunting during colder months of the year when they moved inland from the summer coastal camps. *(23)(22)* Cape Breton Island Mi'kmaq hunting territories are larger and more regional encompassing shorelines and interior river systems indicating a more sparse population. *(23)*

The nearest known Traditional Hunting Territory to the Project Corridor area is Territory No. 43 last assigned to Steve Malone and covers the area of Loon Lake, 45km east of Canso and near the community of Lundy. Adjacent to Malone's territory is hunting territory No. 42 assigned to Newell Denis and covers the area of Country Harbor, Isaacs Harbor, and north inland to span the area between the communities of Goshen and Salmon River Lake. A third known Tradition Hunting Territory, No. 44 is along the Strait of Canso and assigned to Peter Anthony. No. 44 covers the area of Mill Village River, near Port Mulgrave. *(23)* Across the Strait of Canso, the Project Corridor passes through Territory No. 47 of Cape Breton Island which was last assigned to Newell Denys was a large territory covering all the shores of West Bay, South Mountain, half of North Mountain, the west shore of St Peters Inlet, Lennox Passage and the shoreline along the Strait of Canso to Craigmore. Traditional Territory No. 48 covered Ile Madame and the Lower River Inhabitants area as well as the east shore of St. Peters Inlet and along the Atlantic coast to Grand River and inland to about Big Pond on East Bay. No. 48 last assigned to Matthew Morris. The territorial reference numbers pertain to the source's original reference system and it is unknown if territorial numbers were assigned by Chiefs. (23)

Table 6: Mi'kmaq Annual Subsistence *(25)*

Month	Seasonal Locations	Seasonal Groupings	Food Resource
Jan.	Sea Coast	Bands	Smelt, Tomcod, Seals & Walrus Beaver, Moose, Bear, Caribou
Feb. (Period of Winter Famine Begins)	Inland	Bands & Family Units	Smelt, Tomcod (ending) Seals & Walrus, Beaver, Moose, Bear, Caribou
Mar. (Period of Winter Famine)	Inland	Bands & Family Units	Smelt, Seals & Walrus (ending) Scallops, Crab, Urchins, Winter Flounder, Beaver, Moose, Bear, Caribou
April (Period of Winter Famine ends)	Sea Coast	Villages	Smelt, Winter Flounder, Scallops, Crab, Urchins, Sturgeon, Brook Trout, Alewife, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
May	Sea Coast	Villages	Smelt, Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates, Herring, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jun.	Sea Coast	Villages	Scallops, Crab, Urchins, Sturgeon, Salmon, Brook Trout Alewife, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou
Jul.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Capelin, Shad, Mackerel, Skates Lobsters, Spring Bird Migrations, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries
Aug.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates Lobsters, Beaver, Moose, Bear, Caribou, Strawberries, Raspberries, Blueberries, Ground Nuts
Sept.	Sea Coast	Villages	Scallops, Crab, Urchins, Codfish, Skates, Salmon, Herring, Eels, Fall Bird Migrations, Beaver, Moose, Bear, Raspberries, Blueberries, Ground Nuts, Cranberries
Oct.	Small Rivers	Villages	Scallops, Crab, Urchins, Smelt Codfish, Skates, Salmon, Herring, Eels, Brook Trout, Fall Bird Migrations, Beaver, Moose, Bear, Blueberries, Ground Nuts, Cranberries
Nov.	Inland	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts, Cranberries
Dec.	Rivers	Bands	Smelt, Tomcod, Turtles, Seals, Beaver, Moose, Bear, Ground Nuts,

The warmer months were times of abundance with surrounding areas of coastal camps providing fish, shellfish, fowl and eggs. Offerings were made to spirits but the Mi'kmaq rarely stockpiled enough food for the entire winter. They brought with them from the coast smoked and sun-dried seafood, dried and powdered hard boiled eggs. Berries were boiled and formed into cakes and were sun-dried. Grease and oils from boiled marrow and fat were stored and transported in animal bladders. Root vegetables such as *segubun* (wild potato) which was similar to today's sweet potatoes and wild nuts were also part of the winter food supply. *(22)*

Although most historic records very rarely report cultivation of crops as a food source for the Mi'kmaq of Acadia some sources do mention the presence of corn in villages and that corn was grown by tribes of the Gulf of Maine.

When fish, game and plants within the proximity of an encampment became scarce, the Mi'kmaq moved the encampment miles away to a new location with the women being responsible for breaking camp, transporting and setting up the next camp. *(24)(22)*

Travel Routes

The Project Study Corridor crosses six known and probably ancient travel routes from the coasts of Chedabucto Bay and the Atlantic, leading deep into the interior of the Province and connecting with head waters of other rivers flowing to all coasts. The major routes include the Strait of Canso, Guysborough Harbour-Milford Haven River, Salmon River, New Harbour River, Isaac Harbour River and Country Harbour River.

The inlets and harbours along the Eastern Shore and Chedabuctou Bay reach deep inland as do the rivers that empty into them. The river valleys provide access to a vast interior network of interconnected river branches flowing to all coasts. While some rivers and joining lakes are navigable for canoe, all valleys provide access to the interior for even the earliest peoples to exploit resources and interaction with other coastal encampments.

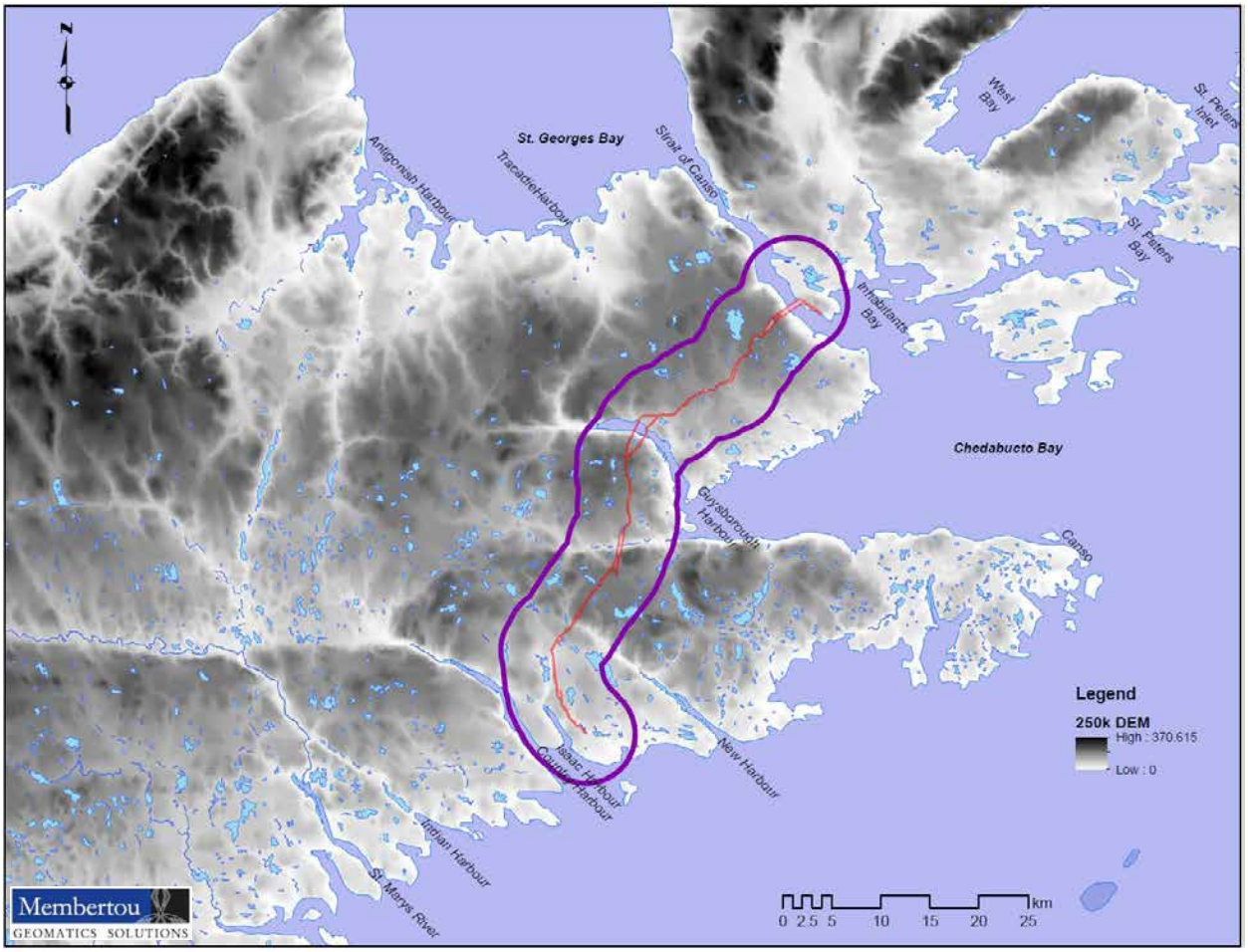


Fig 5: Regional Travel Connections

One example given is a Mi'kmaq winter travel route between New Harbour and Issacs Harbour was via travel up the New Harbour River to Ocean Lake and west overland to the Issacs Harbour River and downriver to Issacs Harbour and Country Harbour. (38) Another source describes most all possible connections among the river valley travel routes with the most important being the Salmon River on Chedabuctou Bay. (26) The roughly 5km Salmon River Estuary provides deep access to another approximately 32km of river and lakes leading to the river's origins. Approximately 8km north of this point are the headwaters of the South River which flows into St. Georges Bay the Gulf through Antigonish Harbour. South are the origins of the Country Harbour River flowing to the Atlantic. From the headwaters of the Salmon River, the eastern branches of St Mary's River are approximately 16km west and leading to either the Atlantic or ascending an

additional 48km on the West River to the headwaters of the East River flowing into Pictou Harbour. From here there are connections to the south with the origins of the Sheet Harbour River, to the southwest are the headwaters of the Musquodoboit River and west are the origins of the Stewiacke River flowing to the Minas Basin and access to the western portions of the Province and Bay of Fundy. (26)

Local History

The Study Corridor and the surrounding area including the coastal inlets and islands as well as the inland forests and lakes of Guysborough County today are within the Mi'kamaq Traditional Territory of *Eskikewa'kik. (18)* The Territory was an important region for the Mi'kmaq. *Unama'kik (18)* (Cape Breton Island) was the traditional residence of the Grand Chief and political center of Mi'kmaq Territory due to being far removed from Iroquois and Inuit enemies. *Eskikewa'kik* was also far removed from enemies and also a crossing point between *Unama'kik* and the mainland Atlantic Coast and other mainland territories. *(26)*

Being the most easterly point of the Mainland Province combined with the barren shores and islands made the Canso area an attractive and important landing early in the 17th century for early European fishermen to dry their catch before returning to their home ports with their holds filled with dried fish. Fishermen would set up temporary seasonal fish drying camps on the level beaches and were trading with the Mi'kmaq during their stay. *(27)*

In 1606, after 8 weeks at sea the French ship *Jonas* arrived at Canso with lawyer turned adventurer Marc Lescarbot onboard. Lescarbot authored records of his experiences and of the early days of Champlain's Port Royal. When they arrived at Canso they were approached by 2 Basque long-boats under sail with one boat crewed by fishermen out the French port of St. Marlo and the other was captained and crewed by Mi'kmaq who painted a large moose on their sail. *(27)*

During their long association with the Basque the Mi'kmaq became excellent sailors which would be later exploited by the French to harass the English fishing fleets. The Mi'kmaq also developed a trading language that Lescarbot described as half Basque but was functional enough to enable communication with the new arrivals on the *Jonas*. *(27)*

The French had also had a long association with fishing the Eastern Shore of the Province and trading with the Mi'kmaq beginning as early as 1504. *(28)* In 1518, Baron de Lery of France attempted to establish a settlement in Acadia but found the climate disagreeable and left cattle at Canso and Sable Island before returning to France and did not return. *(28)*

Canso was a favorite port of fishermen and traders as indicated in 1609 by an old Mariner named Scavalet who claimed to have made 40 previous voyages to Canso. *(28)*

The Salmon River strategic access to the land routes attracted Nicholas Denys to set up one of two fishing and trading stations in the Region sometime about1659(37), with the other station located on a short portage between the Bras D'or Lakes and the Atlantic at present-day St. Peters. (26) Denys' operation consisted of fortifications named Fort Chedabuctou at the mouth of the Harbour and behind the beach bar. There were 20 acres cleared land and employed up to 120 men when it was attacked and destroyed in 1667 over territorial and rival trade disputes. With the presence of a trading station in the area, there would have been a Mi'kmaq presence nearby with much foot traffic and canoeing along the network of river routes.

The French were trading in the Chedabuctou Bay area as early as 1629 when a French captain built a house at Fort Point and traded with the Mi'kmaq until1635 when it was attacked by enemies not specified in the source.

During the early 1680's, the Mi'kmaq had an encampment in the area of the present-day Guysborough town site. (36) During this time the French established Fort St. Louis on the

ruins of Fort Chedabuctou early in the 1680's which was later captured in 1690 by Sir William Phips. (37)

Under British rule, Guysborough's history begins to fade between the 1690' and 1780's although the Acadians of Chedabuctou appear to have remained on their lands during the province wide expulsion of the Acadians in 1755. There were 14 Acadian families at Chedabuctou in 1764. (39) It was at this time the last of the Acadians at Chedabuctou left for Isle Madame and St. Pierre et Miquelon leaving abandoned homes, farms and industry. (36)

The British had establish fortifications at Canso in 1720 thereby further diminishing Chedabuctou's importance in the region (39) Nine families of settlers arrived in the Cook's Cove area sometime about 1768 and were present when the first of the disbanded troops arrived in 1784. (37) The new arrivals utilized the cleared lands left by the Acadians and found the remains of a French village at Guysborough Intervale consisting of a house, shipyard and forge. (37)

The Pre-Loyalist arrivals were from the 13 Colonies and were lured to the area by opportunity observed from previous visits and trade with the Acadians and by the cleared cultivated Acadian lands.

A review of the local history of Guysborough County during the 1780's revealed some parallels with the present day refugee crises in Europe. In 1783 there was a mass of people who were displaced by war and persecution in the former British 13 Colonies. From as far south as Florida, people and the military moved north to British Territory. Most sources reviewed briefly mention the Mi'kmaq in the region's history and with the exception of sporadic warfare at Canso between the French backed Mi'kmaq and both English and New England ships and subjects, most sources report a more congenial existence between the Mi'kmaq and the influx of peoples in the area. However, unlike the Loyalists who were able to escape war and persecution by the Americans and flee to

friendly territory, the Mi'kmaq existed within unfriendly British territory since the French loss of Acadia and later Ile Royale. (26)

Guysborough County Region's history provides a good context of a period when so many displaced peoples of different backgrounds came together under desperate circumstances and all the while the Mi'kmaq are reported to have been welcoming. (26) Guysborough County's history is one story of many stories that were being written at the same time in other parts of the province after the fall of Louisbourg, Quebec and later the British evacuation of New York.

In 1783 the War of Independence was winding down and the British Military and those loyal to the crown from all along the 13 colonies as far south as Florida, were on the move north to British Territory. Those amassed at New York had to be shipped out elsewhere and Regiments were disbanded rather than transported to another theater. The evacuation of New York began in the fall of 1783 and 800 of those evacuated landed at Port Mouton on the province's south shore. It was winter and 300 houses were erected and everyone waited for spring. When spring arrived, 200 of the settlers left and later established St. Stephen, New Brunswick. Those that remained had to start over again as a fire in the spring of 1784 destroyed everything they had built and had brought with them. They were hastily provided provisions and transported to Chedabuctou Bay. They established a new town site and transferred the name of their first intended settlement to their new settlement of Guysborough. (36)

The first wave of Loyalists to the Region arrived at present-day Guysborough in May of 1784 aboard the Transport *Content* with 149 settlers consisting of a varied mix of officers and soldiers and others of varied background thrown together by circumstances. Of the 149 onboard, only 9 were women and 5 were children. (36)

Another group arrived in June and in addition to soldiers consisted of 275 men, 65 women, 85 children as well as 250 Blacks. Each private was granted 100 acres of land

and grant sizes increased depending on rank and 50 acres given to everyone for each child. (36)

A third group arrived in July consisting of the 60th Regiment including German and Swiss allies. The group had 76 men, 34 women, 19 children and 4 servants. (36)
The fourth group of Loyalists to arrive at Guysborough came from the southern colonies and the long journey left them poor and distressed. The choice lots were taken by the previous arrivals and they were in no position to request another location so they settled in the Strait of Canso area and abandoned their plantation life for a life of fishing. (36)
Country Harbour received 900 settlers of the Kings Rangers of the Carolinas during the winter of 1784 and 300 are reported to have died before spring. An 1817 gale destroyed the settlement and the surrounding forest leaving little reason to stay. Some of the settlers went to Guysborough and others went to Halifax or scattered throughout the Province. (38)

Not all the Loyalists were suited to the hardships of settler life as they were a mix of soldiers, merchants, aristocrats and craftspeople. There was a long delay in resolving some property disputes at Guysborough and when the Government provisions had been exhausted and enough time had passed to return to the United States, some of the Loyalists left the region and abandoned the homes and lands they had occupied. (36)
14 Mi'kmaq families moved from the Antigonish to the Guysborough area in 1801 and settle in the Salmon River area and were in need of food and shelter in addition to the 5 wigwams they had pitched along the river. (40)

These abandoned lands would be taken up by arrival of the Irish in the 1810's and1820's. The Irish were escaping poverty and persecution in their homeland and were in a poor state upon their arrival. However, the Irish were more suited to settler's life and the climate than were some of the earlier Loyalists. With more freedom in a new land, the Irish in the region prospered and boosted the fledgling economy of the time. The 1840's to the 1890's was Guysborough's golden age. (36)

What remained in Country Harbour in 1830 was a farm and Black farmer Isaac Webb who was well known to sailors and the Mi'kmaq who had an encampment at the head of the harbour. Fishermen who were storm stayed at Isaac's Place explored the lands and returned the next spring with their families and a sawmill. Soon after more followed and the sawmill business prospered with large homes being built as more families settled in the area. (38)

The sources provide general locations of nineteenth century Mi'kmaq encampments at School House Brook, Issacs Harbour and another where the Issacs Harbour River flows into the harbour. The School House Brook location is also thought to be a Mi'kmaq burial site. (38) Indian Harbour and Indian Harbour Lake located about 20km southwest of the project corridor, were named so because the area was a favorite Mi'kmaq hunting and fishing territory. (37) Indian Harbour is also connected to the province wide network of travel routes. A Field Reconnaissance in of the Isaacs Harbour River crossing in 2005 provided no evidence of a First Nation settlement and the topography and river flow seemed not suitable for a encampment or settlement site. (40)

Other sources place the Mi'kmaq along the Strait of Canso at McNairs Cove and Melford Point in 1856 petitions by concerned citizens for relief supplies from the Government for starving Mi'kmaq. *(29)* Another reference to Mi'kmaq in the Canso area is made in the biography of Hannah Norris, a school teacher in Canso sometime after 1861. In addition to teaching the children at Canso, she also taught the Mi'kmaq children of the nearby islands. *(30)*

The Mi'kmaq remained a presence in the area until at least the early 1900's. Guysborough County was experiencing an economic decline after the 1890's and a large portion of the Region's young people left the Region to find employment in Boston which at the time was the destination of choice as is "going out west" is the choice of young people today. (36)

A 1911 Census enumerated 41 residents of the Cooks Cove Micmac Indian Reserve of which only 2 were not Mi'kmaq. All others were listed as "Mic Mac" for Nationality and "Indian" as Language Commonly Spoken. Of the Non-Mi'kmaq enumerated, 1 was an adopted family member and the other was a lodger. *(32)* An earlier 1901 census of the Guysborough area has the 40 persons whose family names of similar to the 1911 census although some were listed as "English" for Nationality, others as "MickMack" and "English" listed as Language Commonly Spoken others listed "MickMack" was the entry for language spoken even though the some of the same persons were listed as "English" in Nationality. *(33)*

A review of the 1876 A. F. Church County Map, Guysborough County, shows no indication of Mi'kmaq settlements ("Indian Camp") within the vicinity of McNairs Cove, Melford Point or Indian Harbour. There is no indication of a Mi'kmaq settlement at Cooks Cove but there are 2 houses on the interior south shore the mouth of the Salmon River, 3km west of Dorts Cove and marked as T. Johnson and J. Johnson as being the occupants. A review of the entire 1876 map shows no indication of Mi'kmaq settlements or encampments although the Mi'kmaq "Indian Burying Island" at Glenelg and the "Colored Settlement" at Birchtown, north of Guysborough are shown on the map. *(31)*

A review of the Nova Scotia Land Grant Index Sheets for the Cooks Cove area show that the location of 2 houses of the Johnson's as marked on Church's map were at once a 700 acre parcel granted to James Stewart. Land on the eastern shore of St. Marys River near the Community of Sonora was set aside for "Indian Burials" *(34)*

Local Mi'kmaq Family Names

There were many variations in the spelling of some of the Mi'kmaq family names but the spellings are very close to the spelling of the names of today as listed below:

1911 Census, District 44, Guysborough, Subdistrict 30, Cooks Cove I. R. Population 41: *(32)*

Marshall

Prosper

Gabriel

Johnson

1901 Census, Guysborough, G, Selected Population 40: *(33)*

Marshall

Prosper

Gabriel

Johnson

Laboe

A review of current Land Claims show no current active claims within the Project Site and Study Corridor. *(35)*

Historic Review Summary

The MEKS Study Area (Project Corridor) was one of the last areas of the Province to be free of ice at the end of the last Ice Age that left landscape of river valley cuts on the elevated plateaus of thinly covered or exposed igneous and metamorphic bedrock. The plateaus are typically landscapes of wetlands, lakes and strewn with drumlin fields.

There is little archaeological evidence within this Region to indicate the presence of early peoples which may be factor of too little investigation and a light population resulting in fewer accidental archaeological finds.

Archaeological finds along the St Marys River system have been white quartz tools rather than the preferred chalcedonies and cherts of other regions of the province. Exposed quartz veins in the bedrock would have been of interest to early peoples in the Region

The Project Corridor is within the Mi'kmaq Political District of *Eskikewa'kik* of the Eastern Shore from Sheet Harbour to Canso.

The Project Corridor crosses 6 known and probably ancient travel routes from the coasts of Chedabucto Bay and the Atlantic, leading deep into the interior of the Province and connecting with head waters of other rivers flowing to all coasts. The major routes include the Strait of Canso, Guysborough Harbour-Milford Haven River, Salmon River, New Harbour River, Isaac Harbour River and Country Harbour River.

The last known Traditional Hunting Territories within or adjacent to the Project Corridor include Territory No. 43 last assigned to Steve Malone and covers the area of Loon Lake, hunting territory No. 42 assigned to Newell Denis and covers the area of Country Harbor, Isaacs Harbour, hunting territory, No. 44 is along the Strait of Canso and assigned to Peter Anthony. The Project Corridor passes through Territory No. 47 of Cape Breton Island which was last assigned to Newell Denys was a large territory including access to the shores of The Bras d'Or Lakes, Atlantic Ocean and St Georges Bay to the Gulf of St Lawrence. Adjacent Traditional Territory No. 48 also provided access to the Bras d'Or lakes and the Atlantic including covered Ile Madame and was last assigned to Matthew Morris.

The shores and islands of Chedabucto Bay and particularly the Canso area were favorite landings for European fishermen to dry their catches and for the Mi'kmaq to trade with the Europeans since the mid 1500's.

Chedabucto Bay was chosen for Nicolas Denys' trading and fishing station who constructed Fort Chedabucto at present-day Guysborough Harbour about 1659 and within close proximity to the Salmon River and the network of travel routes. Other Forts were built and subsequently destroyed during French occupation of the area while the Acadian settlers seemed to remain as a presence in the area until about 1764. New England fishermen were not long in arriving to take over the cleared Acadian lands and building foundations.

During the early 1680's, the Mi'kmaq had an encampment in the area of the present-day Guysborough town site.

There were waves of Loyalist and their Black servants who abandoned their homes in the southern colonies as well as disbanded British and allied soldiers and who arrived in 1784 to populate the Chedabuctou Bay and Eastern Shore inlets. The inlets reach far inland to interior resources and were exploited by the Mi'kmaq prior to being settled by the French Acadians, New England Pre-loyalists, Loyalist-Blacks, disbanded British soldiers and later the Irish.

Nineteenth century Mi'kmaq encampments are reported at School House Brook, Issacs Harbour and another where the Issacs Harbour River flows into the harbour. The School House Brook location is also thought to be a Mi'kmaq burial site. Other sources place Mi'kmaq encampments along the Strait of Canso at McNairs Cove and Melford Point.

A review of historic maps of Guysborough County show very little recorded evidence of Mi'kmaq settlements within the Project Corridor or some of the locations along Chedabucto Bay and Eastern Shore as reported in the sources. The Mi'kmaq burial ground at Sonora is shown on the Land Grant Index Map of the area. A review of the 1876 A. F. Church Map of Guysborough County shows the "Indian Burying Island" at Glenelg on the 1876 Map.

The Mi'kmaq remain a presence in the area until at least the early 1900's as a Census of the early 1900's enumerated the Mi'kmaq of "Cooks Cove Micmac Reservation" of unknown location which indicated a population of approximately 40 persons identifying themselves as Mi'kmaq near the community of Guysborough.

The Region suffered economic decline after the 1890's and many young people left the area for Boston to find employment and better prospects.

A review of current Land Claims show no current active claims within the Project Site and Study Area Project Corridor.

4.4 Mi'kmaq Traditional Use Findings

The traditional use data gathered for this MEKS was drawn from one primary source: the Mi'kmaq individuals who reside in the surrounding Mi'kmaq communities and those who are familiar with or undertake these types of activities. This data was acquired through interviews with informants that allowed the study team to identify the various traditional use activities, resources and areas that are currently or have been used by the Mi'kmaq, and any information that was gathered in previous MEKS in the area. Interviewees were asked to identify areas within the Study Area and Project Site where they knew of traditional use that had taken place, or currently in use. These interviews took place from December 2015 to February 2016.

To easily identify the traditional use data findings of this study, the analysis has been categorized into two geographic areas. The first is the Project Site area, the 50m surrounding the proposed pipeline and the second is the Study Area which includes areas that fall within a 5 km radius of the Project Site.

4.4.1 Project Site

The Project Site, as well as locations in the *immediate* vicinity (<50 meters) of the Project Site, will be considered when analyzing traditional use activities.

Fishing

Trout fishing was the predominant fishing activity by the informants within the Project Site. Twelve (12) areas were identified within the areas of:

- Goldboro, Issacs Harbour, and Meadow Lake areas
- Ephraims Lake and New Harbour River
- Eight Mile Lake and Northeast Branch Lake areas
- Salmon River
- Milford Haven River

- Meaghers Hill areas
- Strait of Canso

Five (5) salmon fishing areas were identified as occurring within the areas of:

- Ephraims Lake and New Harbour River
- Salmon River
- Melford Haven River
- Near Meaghers Hill
- Strait of Canso

Other species identified in the Project Site are striped bass (2 areas), mackerel (1 area), and sea urchin (1 area) (Appendix B).

Hunting

Ten (10) deer hunting areas were found to be located near:

- Golboro, Meadow Lake, Beech Hill Lake areas
- Areas near Eight Mile Lake and Northeast Branch Lake
- Meagher Lake
- Steep Creek by Middle Melford
- Bear Head

Rabbit hunting was identified in eight (8) areas located near:

- Gold Brook Lake and Meadow Lake
- Little Beech Hill Lake and Ephraims Lake
- Eight Milk Lake and Northeast Branch Lake
- Meaghers Brook
- Steep Creek
- Bear Head

Other hunted species in the Project Area are partridge (4 areas) and duck (1 area) (Appendix C).

Gathering

Five (5) blueberry gathering locations were identified to be located near:

- Gold Brook Lake and Meadow Lake to Little Beech Hill Lake areas
- Eight Milk Lake and Northeast Branch Lake
- Meaghers Hill

Other gathering activities taking place within the Project Site are mushroom gathering (4 areas), balsam fur (2 areas), spruce (2 areas), cranberries (1 area), and sweetgrass (1 area) (Appendix D).

4.4.2 Study Area

As mentioned previously, the MEKS data is also drawn from the Study Area which encompasses areas within a five (5) kilometer radius from the Project Site boundaries. The purpose of this portion of the study is to portray other land use activities that may have been missed in the Project Site data analysis.

Fishing

From the data gathered, this study found that trout and salmon fishing were the most reported fishing activities by the informants in the Study Area.

Twenty six (26) trout fishing areas were found to be located within:

- Country Harbour
- Issacs Harbour
- Areas surrounding Goldboro and Meadow Lake
- Ephraims Lake and New Harbour River area
- Rocky Lake, Eight Mile Lake, and Northeast Branch Lake area
- Tom Lake
- Salmon River from Cooks Cove to Roachvale
- Lakes and streams surrounding Guysborough

- Milford Haven River from Guysborough to Havendale
- Areas surrounding Boylston
- Clam Harbour River north of Manchester
- Clam Harbour Lake, Sundown Lake, Neds Lake, and Meaghers Hill areas
- Goose Harbour Lake
- Strait of Canso
- Areas surrounding Port Malcolm

Salmon fishing was reported in ten (10) areas throughout the Study Area:

- New Harbour River from Lower Stillwater to Ephraims Lake
- Areas surrounding Donahue Lake
- Salmon River from Cooks Cove to West Roachvale
- Milford Haven River from Guysborough to northwest of Milford Haven
- Areas surrounding Boylston and Manchester including Simpsons Lake, Birchtown Lake, and Levi Harts Pond
- Strait of Canso near Steep Creek to Pirate Harbour

Other species fished in the Study Area are mackerel (5 areas), eel (4 areas, including 1 elver area), sea urchin (2 areas), striped bass (2 areas), clam (1 area), lobater (1 area), and scallops (1 area) (Appendix B).

When analyzing timelines for fishing activities, activities occurring in the Current Use and Recent Past were reported in the same amount of areas with approximately forty three percent (43%) of data collected for each category. Historic Past use accounted for approximately fourteen percent (14%) of the information.

Nearly all the fishing areas described by informants were used for harvesting purposes, with the exception of three fishing areas used for commercial purposes (sea urchin and elvers).

Hunting

Deer and rabbit hunting activities were reported in the Study Area the most by the informants.

Thirteen (13) deer hunting areas were found to be located:

- Drum Head and Goldboro area to Ephraims Lake, Eight Mile Lake area, and to Tom Lake and Donahue Lake area
- Near Roachvale
- Cooks Cove and Guysborough area
- Around Boylston, Simpsons Lake, and Manchester to Lincolnville
- Near the shoreline of the Strait of Canso from Pirate Harbour to Sand Point
- In the Bear Head and Port Malcolm area

Rabbit hunting areas were described in eleven (11) areas located:

- North of Goldboro near Meadow Lake and Gold Brook Lake to Ephraims Lake, Eight Mile Lake, Northeast Branch Lake, to Donahue Lake areas
- Roachvale
- Cooks Cove and Guysborough areas
- From Boylston and Manchester to Meaghers Hill and Clam Harbour Lake areas
- Near the shoreline of the Strait of Canso from Pirate Harbour to Sand Point
- In the Bear Head and Port Malcolm area

Other species hunted within the Study Area are partridge (5 areas) and duck (3 areas) (Appendix C).

Like fishing, these activities have been primarily occurring over the Current Use and Recent Past timelines. Recent Past activities was categorized in approximately eighty one percent (81%) of the data gathered, and Current Use activities were reported in seventy five percent (75%) of the information. Some Current Use activities have been carried on for longer than the last 10 years and are also counted as Recent Past as well. Historic Past use accounted for approximately fifty percent (50%) of the data.

For the most part, this Study Area, in relation to hunting activities, is utilized for harvesting purposes. Only one informant had reportedly hunted ducks for the purpose of commercial uses.

Gathering

Five (5) blueberry gathering areas were reported by informants in the following locations:

- North of Goldboro near Gold Brook Lake, Meadow Lake, and Little Beech Hill Lake
- Areas surrounding Rockly Lake, Eight Mile Lake, and Northeast Branch Lake
- Near Meaghers Hill, surrounding Clam Harbour Lake, Ned Lake, and Sundown Lake

Balsam Fir was gathered in four (4) areas:

- From North of Goldboro near Gold Brook Lake and Meadow Lake, to Little Beech Hill Lake, Ephraims Lake, Eight Mile Lake, Tom Lake to Cooks Cove
- Roachvale
- From Boylston and Manchester area to Meaghers Hill
- Near the shoreline of the Strait of Canso from Pirate Harbour to Sand Point

Four (4) Spruce tree gathering activities were found to be located:

- From North of Goldboro near Gold Brook Lake and Meadow Lake, to Little Beech Hill Lake, Ephraims Lake, Eight Mile Lake, Tom Lake to Cooks Cove
- Roachvale
- From Boylston and Manchester area to Meaghers Hill
- Near the shoreline of the Strait of Canso from Pirate Harbour to Sand Point

Mushroom gathering activities were described four (4) times within the areas of:

- Near Meaghers Hill, surrounding Clam Harbour Lake, Ned Lake, and Sundown Lake
- Areas surrounding Bear Head and Port Malcolm

Other gathering activities described by informants were cranberry (2 areas), sweetgrass (1 area), and “wood splint” (1 area) gathering areas (Appendix D).

Approximately eighty one percent (81%) of the activities reported occurred in the Current Use category. A third of the data was analyzed to be Recent Past, and another third Historic Past. Gathering in this area seems to be primarily an activity that is occurring currently.

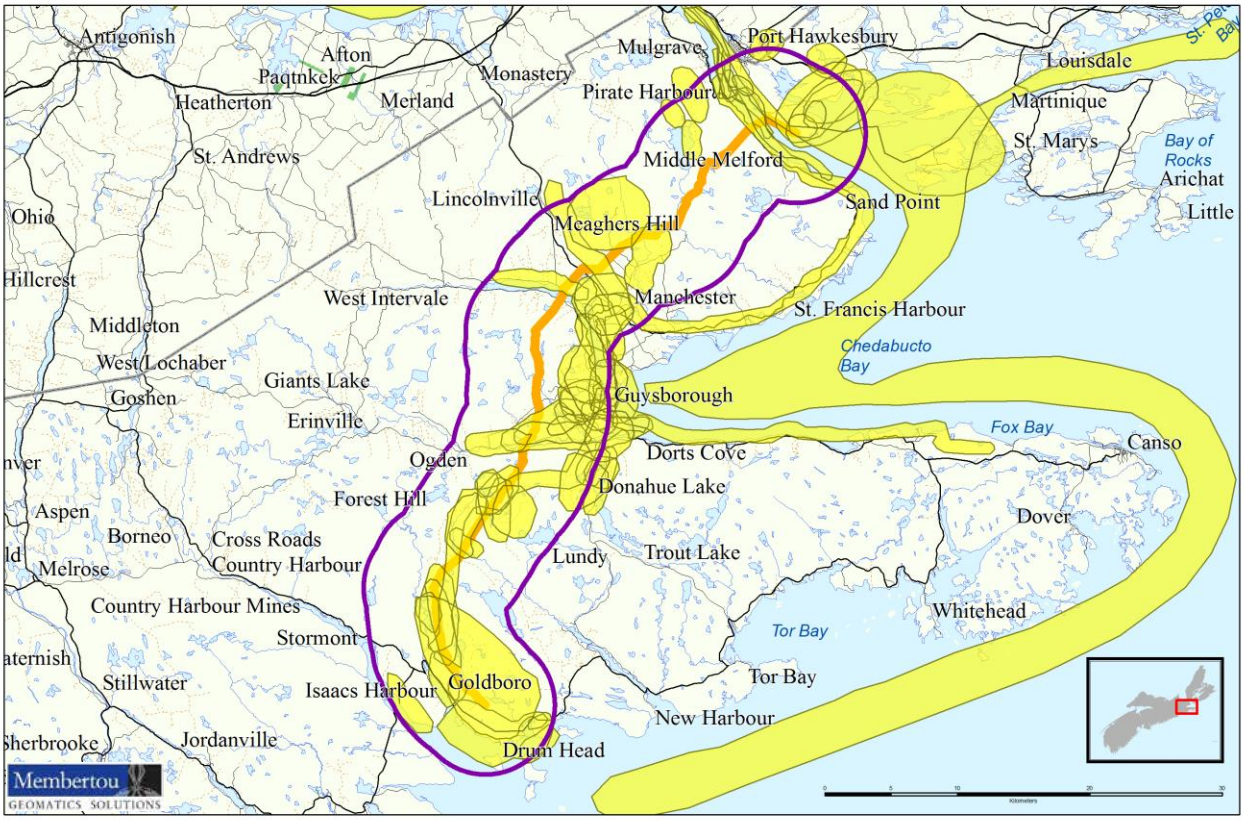


Fig 6: Map of Traditional Use within the Project Area and Study Area including hunting, fishing, gathering and culturally significant areas, each occurrence in yellow.

Other Information

During the interviews with informants, they were given the opportunity to describe any other information they felt would be considered a culturally significant area, or information about an area. Generally, this where informants would describe, for example, areas of past settlements, migration routes, or places with ties to legends. Four informants had mentioned settlements primarily focused in the Guysborough area during the early 1900's, and briefly in the 1970's. Other settlement areas were described near Goldboro, and another just west of Pirate Harbour near Mulgrave.

Informants were also given the chance to speak generally how they felt about the project, or the land itself. One informant had expressed concern of any damages to the land or water (by construction or rupture of the pipeline) would have a great impact on the land, the resources the Mi'kmaq receive from the land and waters, which in turn will affect their communities.

4.5 Mi'kmaq Significant Species Process

In order to identify possible project activities which may be of significance to the Mi'kmaq with regards to traditional use of the Study Area, the project team undertakes a number of steps in order to properly consider the MEK data. This involves three main components: Type of Use, Availability, and Importance.

Type of Use

The first component of analysis is the "Type of Use" of the resource which involves the categorization of the resource. All resources are placed into various general categories regarding the Type of Use**.** The category headings are Medicinal/Ceremonial, Food/Sustenance, and Tool/Art. These general headings are used so as to ensure further confidentiality with respect to the resources and the area where they are harvested. As well, the total number of instances where a resource harvest has been documented by the study is quantified here as well.

Availability

After the data is considered by the Type of Use, it is considered in accordance with its availability: this involves considering whether the resource is abundant in the Study Area or whether it is rare or scarce. Based on the information that is provided to the team from the ecological knowledge holders and/or written literature sources, the availability of the resource is then measured in regards to other water or land areas that are outside of the Study Area. This measuring is primarily done in the context of the areas adjacent to the Study Area, and if required, other areas throughout the province. By proceeding in this manner, the study can provide an opinion on whether that resource may be **Rare, Scarce** or **Abundant**.

The data is classified in accordance with following:

Rare – only known to be found in a minimum of areas, may also be on the species at risk or endangered plants list;
Common – known to be available in a number of areas; and
Abundant – easily found throughout the Study Area or in other areas in the vicinity.
This allows the study team to identify the potential impact of a resource being destroyed, by the proposed project activities, will affect the traditional use activity being undertaken.

Importance

The final factor the MEKS team considers when attempting to identify the significance of a resource to Mi'kmaq use is whether the resource is of major importance to Mi'kmaq traditional use activities. This can be a somewhat subjective process, as any traditional resource use will be of importance to the individual who is acquiring it, regardless of whether its use is for food or art, and regardless if the resource is scarce or abundant. However, to further identify the importance, the MEKS team also considers the frequency of its use by the Mi'kmaq; whether the resource is commonly used by more than one individual, the perceived importance to the Mi'kmaq in the area, and finally the actual use itself. These factors support the broad analysis of many issues in formulating an opinion on significance and supports identifying whether the loss of a resource will be a significant issue to future Mi'kmaq traditional use, if it is impacted by the project activities.

4.6 Mi'kmaq Significance Species Findings

This MEKS identified resource and land/water use areas within the Project Site and Study Area that continue to be utilized by the Mi'kmaq people, to varying degrees.

Type of Use

The study identified the following in the Study Area:

Table 7: Resource Use within Study Area

TYPE OF USE	NUMBER OF AREAS	NUMBER OF SPECIES
Food/Sustenance	96	18
Medicinal/Ceremonial	8	3
Tools/Art	10	4

Availability

During the information gathering for the Study Area, informants had mentioned the fishing for salmon. The Atlantic Salmon is considered an endangered species in Canada. *(41)* No other rare or endangered species were identified by informants.

Importance

While stated above, it is worth noting again that assigning an importance designation for any activity done by Mi'kmaq can be a subjective process, and that all activities are considered ways of preserving the Mi'kmaq way of life, in some shape or form.

As noted previously, Atlantic Salmon is considered an endangered species in Canada and the Mi'kmaq still rely on this species for sustenance and cultural ceremonies and disturbances to their habitats could have an impact on Mi'kmaq use.

Sweetgrass gathering is considered an important activity to the Mi'kmaq due to the use of sweetgrass. It is used during ceremonies to smudge, or cleanse oneself of negativity. Trout fishing, due to the frequency of the activity, is an important activity for this area. Trout fishing has been, according to the information provided by the informants, an activity that has been occurring historically, recently, and currently.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This Mi'kmaq Ecological Knowledge Study has gathered, documented and analyzed the traditional use activities that have been occurring in the Project Site and the Study Area by undertaking interviews with individuals who practice traditional use, or know of traditional use activities within these areas and reside in the nearby Mi'kmaq communities.

The information gathered was then considered in regards to species, location, use, availability and frequency of use to further understand the traditional use relationship that the Mi'kmaq maintain within the Project Site and Study Area.

Traditional Use - Project Site Summary

Based on the data documented and analyzed, it was concluded that some Mi'kmaq use has been reported on the Project Site, or in the immediate vicinity. Trout fishing and deer hunting activities was found to occurring at various points along the proposed pipeline. These two activities were found to be the most reported activity, but other uses were reported by informants along the Project Site. Some other examples were salmon fishing, rabbit hunting, and blueberry gathering.

Traditional Use - Study Area Summary

Based on the data documentation and analysis, it was concluded that the Mi'kmaq have historically undertaken traditional use activities within the Study Area, and that this practice continues to occur today. These activities primarily involve harvesting of fish and animals, but also include harvesting plants, and tree species; all of which occurs in varying locations throughout the Study Area and at varying times of the year.
Trout and salmon was found to be the most fished species within the Study Area. Deer and rabbit was found to be the most hunted within the Study Area. With the relatively small number of gathering areas identified, it is difficult to categorize the area as a particular gathering area type as there was a variety of species harvested in the area for different purposes.

Other Information

Informants had described settlements in or around the Guysborough area during the early 1900's and in the 1970's. Settlements were also described in Goldboro and close to Pirate Harbour near Mulgrave.

RECOMMENDATION

The Bear Paw Pipeline MEKS has identified some Mi'kmaq Traditional Use Activities occurring in the Project Site, as well as activities that have occurred in the past and present in the Study Area. Based on the information gathered and presented in this report, there is potential this project could affect some Mi'kmaq traditional use, such as some fishing and hunting activities identified in the Project Site and Study Area.

It is recommended that the proponent communicate with the Assembly of Nova Scotia Mi'kmaq Chiefs to discuss future steps, if required, with regards to Mi'kmaq use in the area.

Sources

1 Online: Nova Scotia Topographic Database https://gis8.nsgc.gov.ns.ca/DataLocatorASP/Search.aspx?typeofaction=login

2 Online: Fisher, B., DP ME 36, Version 2, 2006 Digital Version of Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, Stea, R., Conley, H., Brown, Y., Nova Scotia Department of Natural Resources, 2011 http://www.gov.ns.ca/natr/meb/download/dp036dds.asp

3 Keppie, J. D., *Geological Map of the Province of Nova Scotia*, Nova Scotia Department of Natural Resources, Minerals and Energy Branch, 2000

4 Online: Nova Scotia Museum of Natural History, *T3.3 Glaciation, Deglaciation and Sea-Level Changes*, Natural History of Nova Scotia, Volume 1, Topics and Habitats, 2011 http://ojs.library.dal.ca/NSM/search/titles

5 Online: Nova Scotia Museum of Natural History, *T4.1 Post-Glacial Climatic Change*, Natural History of Nova Scotia, Volume 1, Topics and Habitats, 2011 http://ojs.library.dal.ca/NSM/search/titles

6 Online: Nova Scotia Museum of Natural History, *T4.2 Post-Glacial Colonization by Plants*, Natural History of Nova Scotia, Volume 1, Topics and Habitats, 2011 http://ojs.library.dal.ca/NSM/search/titles

7 Online: Nova Scotia Museum of Natural History, *T4.1 Post-Glacial Climatic Change*, Natural History of Nova Scotia, Volume 1, Topics and Habitats, 2011 http://ojs.library.dal.ca/NSM/search/titles

8 Online: Nova Scotia Museum of Natural History, *T4.3 Post-Glacial Colonization by Animals*, Natural History of Nova Scotia, Volume 1, Topics and Habitats, 2011
http://ojs.library.dal.ca/NSM/search/titles

9 Bourque, Bruce J., *Twelve Thousand Years, American Indians in Maine*, University of Nebraska Press, 2001

10 *Archaeology in Nova Scotia 1989 and 1990, Curatorial Report 77*, Nova Scotia Museum,1993

11 Online: Davis, D. Brown, S., *The Natural History of Nova Scotia, Volumes 1, 2*, Nova Scotia Museum, Department of Education and Culture, Province of Nova Scotia, Nimbus, 1996
http://ojs.library.dal.ca/NSM/search/titles

12 Whiteley, Erin, Thesis: *Post-Glacial Landscapes and their Influence on Paleo-Indian Migration into Nova Scotia*, St. Mary's university, 2001.

13 DeMont, John, *In the eye of the storm*, Canadian Geographic, October 2010, Volume 130, No. 5, Canadian Geographic Enterprises, 2010

14 Martin, Calvin, *Keepers of the Game, Indian-Animal Relationships and the Fur Trade*, University of California Press, 1978

15 O'shea, W., Corbin, C., Krause, E., *Aspects of Louisbourg*, The Louisbourg Institute, The University of the College of Cape Breton Press, 1995

16 Hoffman, Bernard G., *Cabot to Cartier, Sources for a Historical Ethnography of Northeastern North America, 1497-1550*, University of Toronto Press, Halifax, 1961

17 Wicken,William C., *Thesis: Encounter with Tall Sails and Tall Tales: Mi'kmaq Society,1500-1760*, McGill University, 1994

18 Paul, Daniel M., *We Were Not Savages, A Collision Between European North American Civilizations*, 3rd ed. Fernwood, Halifax, 2006

19 UINR, CMM, NCNS., *The Mi'kmaw Resource Guide*, 3rd ed., Eastern Woodland Publishing

20 Pastore, Ralf T., *Newfoundland MicmacA History of Their Traditional Life*, Pamphlet No. 5, Newfoundland Historical Society, 1978

21 Prins, Harold E. L., *The Mi'kmaq Resistance, Accommodation and Cultural Survival*, Case Studies in Cultural Anthropology, Holt, Rinehart and Winston, 1996

22 Robertson, M., *Red Earth*, Nova Scotia Museum, 1969

23 Speck, Frank G., *Indian Notes and Monographs, Beothuk and Micmac, Part II, Micmac Hunting Territories in Nova Scotia and Newfoundland*, Museum of the American Indian, AMS Press, New York, 1922

24 Denys, Nicolas, *The Native People of Acadia by Nicholas Denys*, 1672, Retold by Ian Maxwell, Little Daisy Press, 1993

25 *Who Ate What in the Maritimes, A Chart of Micmac Annual Subsistence*, Issue 21, Cape Breton's Magazine.

26 Jost, A. C., *Guysborough Sketches and Essays,* The Kentville Publishing Company Limited, Kentville, Canada, 1950

27 Faragher, John M., *A Great and Noble Scheme*, W. W. Norton & Company, New York, 2005

28 Hart, Harriet C., *History of Canso, Guysborough Co., N. S.*, Collections of the Nova Scotia Historical Society, Volume XXI, The Royal Print & Litho Ltd., Halifax, 1927.

29 Online: Mi'kmaq Holdings Resource Guide, Nova Scotia Archives, 2013. http://www.gov.ns.ca/nsarm/virtual/mikmaq/

30 Online: Robertson, Allen B., Norris, Hannah Maria, Dictionary of Canadian Biography, Vol. 14, University of Toronto, 1998. http://www.biographi.ca/en/bio.php?id_nbr=7621

31 Church, A. F., Guysborough County, A. F. Church County Map, 1876.

32 Online: 1911 Census, District 44, Guysborough, Sub-district 30, Cooks Cove Micmac Indian Reserve. http://automatedgenealogy.com/census11/Test3.jsp?did=44

33 Online: 1901 Census, Guysborough G. http://automatedgenealogy.com/census/EnumerationDistrict.jsp?id=1950

34 Online: Nova Scotia Land Grant Index Sheet No. 102, Guysbourgh County. http://novascotia.ca/natr/land/grantmap.asp

35 Online: Status Report on Specific Claims, Indigenous and Northern Affairs Canada , 2016. http://services.aadnc-aandc.gc.ca/SCBRI_E/Main/ReportingCentre/External/externalreporting.aspx

36 Cook, Christopher A., *Along the Streets of Guysborough,* The Casket Printing and Publishing Co., Antigonish, 2003

37 Online: *Place-Names and Places of Nova Scotia*, Nova Scotia Archives http://novascotia.ca/archives/places

38 Cooke, Findlay, *History and Stories of Isaac Harbour and Goldboro*, Formac, Antigonish, 1976

39 Grant, John N., *Historic Guysborough, Images of the Past.* Nimbus, 2004

40 Davis, S. A., MacIntyre, A. D., *Antigonish-Drum Head Highway, Archaeological Impact Assessment.* Davis Archaeological Consultants Limited, Halifax, 2005

41 Online: *Species at Risk in Nova Scotia: Identification & Information Guide, Mersey* Tobiatic Research Institute, 2008. http://www.speciesatrisk.ca/SARGuide/download/SAR%20Guide.pdf

42 Online: Canadian Museum of History, The Debert Palaeo-Indian National Historic Site, 2014 http://www.historymuseum.ca/cmc/exhibitions/tresors/ethno/etb0370e.shtml

APPENDICES

Map A
Mi’kmaq Traditional and Current Use Areas

Bear Paw Pipeline MEKS

Mi'kmaq Traditional and Current Use Areas

Legend

- Study Area
- Project Site
- Traditional Use Areas
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers
- Reserve Land

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Datum: UTM NAD83
Zone 20
Scale: 1:250,000

Version: 1
4 Mar 2016

Membertou GEOMATICS SOLUTIONS

Map B
Mi'kmaq Traditional and Current Fishing Areas

Bear Paw Pipeline MEKS

Mi'kmaq Traditional and Current Fishing Areas

Legend

- Study Area
- Project Site
- Fishing Areas
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers
- Reserve Land

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Datum: UTM NAD83
Zone 20
Scale: 1:250,000

Version: 1
4 Mar 2016

Membertou GEOMATICS SOLUTIONS

0 5 10 20 30
Kilometers

Antigonish
Afton
Paqtnkek
Heatherton
Merland
Monastery
Mulgrave
Port Hawkesbury
Pirate Harbour
Louisdale
Martinique
St. Marys
Bay of Rocks
Arichat
Little
St. Andrews
Middle Melford
Lincolnville
Sand Point
Ohio
Meaghers Hill
Hillcrest
West Intervale
Manchester
St. Francis Harbour
Middleton
Chedabucto Bay
West Lochaber
Giants Lake
Goshen
Guysborough
Erinville
Fox Bay
Canso
Ogden
Dorts Cove
Donahue Lake
Forest Hill
Aspen
Dover
Borneo
Cross Roads Country Harbour
Lundy
Trout Lake
Melrose
Country Harbour Mines
Whitehead
Tor Bay
Stormont
Goldboro
Tor Bay
Stillwater
Isaacs Harbour
New Harbour
Jordanville
Drum Head

Map C
Mi’kmaq Traditional and Current Hunting Areas

Bear Paw Pipeline MEKS

Mi'kmaq Traditional and Current Hunting Areas

Legend

- Study Area
- Project Site
- Hunting Areas
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers
- Reserve Land

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Datum: UTM NAD83
Zone 20
Scale: 1:250,000

Version: 1
4 Mar 2016

Membertou GEOMATICS SOLUTIONS

0 5 10 20 30
Kilometers

Map D
Mi'kmaq Traditional and Current Gathering Areas

Bear Paw Pipeline MEKS

Mi'kmaq Traditional and Current Gathering Areas

Legend

- Study Area
- Project Site
- Gathering Areas
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers
- Reserve Land

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

Datum: UTM NAD83
Zone 20
Scale: 1:250,000

Version: 1
4 Mar 2016

Membertou GEOMATICS SOLUTIONS

0 5 10 20 30
Kilometers

Antigonish
Afton
Paqtnkek
Heatherton
Merland
Monastery
Mulgrave
Port Hawkesbury
Pirate Harbour
Louisdale
Martinique
St. Marys
Bay of Rocks
Arichat
Little
St. Andrews
Middle Melford
Lincolnville
Sand Point
Ohio
Meaghers Hill
Hillcrest
West Intervale
Manchester
St. Francis Harbour
Middleton
Chedabucto Bay
West Lochaber
Giants Lake
Goshen
Guysborough
Erinville
Fox Bay
Canso
Dorts Cove
Ogden
Donahue Lake
Forest Hill
Aspen
Dover
Borneo
Cross Roads Country Harbour
Lundy
Trout Lake
Melrose
Country Harbour Mines
Whitehead
Tor Bay
Stormont
Goldboro
Isaacs Harbour
Stillwater
Tor Bay
New Harbour
Jordanville
Drum Head

Map E
Mi’kmaq Culturally Significant Areas

Bear Paw Pipeline MEKS

Culturally Significant Areas

Legend

- Study Area
- Project Site
- Culturally Significant Areas
- County Border
- Highway
- Trunk Road
- Collector Road
- Local Road
- Loose Surface/Cart Track
- Rivers
- Reserve Land

Disclaimer

This map is a graphical representation of Mi'kmaq ecological knowledge gathered throughout the study, and should not be used for navigation purposes. Features presented may not accurately representaactual topographical or proposed features.

The Mi'kmaq ecological knowledge data presented is a sampling of knowledge held by those interviewed and should not be interpreted as an absolute measure of Mi'kmaq ecological knowledge and land use.

N

Datum: UTM NAD83
Zone 20
Scale: 1:250,000

Version: 1
4 Mar 2016

Membertou
GEOMATICS SOLUTIONS

0 5 10 20 30
Kilometers

Antigonish
Afton
Paqtnkek
Heatherton
Merland
Monastery
Mulgrave
Port Hawkesbury
Pirate Harbour
Louisdale
Martinique
St. Marys
Bay of Rocks
Arichat
Little
St. Andrews
Middle Melford
Lincolnville
Sand Point
Ohio
Meaghers Hill
Hillcrest
West Intervale
Manchester
St. Francis Harbour
Middleton
Chedabucto Bay
West Lochaber
Giants Lake
Goshen
Guysborough
Erinville
Fox Bay
Canso
Ogden
Dorts Cove
Donahue Lake
Forest Hill
Aspen
Dover
Borneo
Cross Roads
Country Harbour
Lundy
Trout Lake
Melrose
Country Harbour Mines
Whitehead
Tor Bay
Stormont
Stillwater
Isaacs Harbour
Goldboro
Tor Bay
New Harbour
Jordanville
Drum Head

March 2016

APPENDIX C
ATMOSPHERIC ENVIRONMENT DATA

March 2016

March 2016

APPENDIX C1
AIR DISPERSION AND ACOUSTIC MODELLING METHODS

March 2016

March 2016

AIR DISPERSION MODELLING

Stantec conducted air dispersion modeling to estimate the ground level concentrations of particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), nitrogen dioxide (NO_2) and carbon monoxide (CO) from the operation of the head compressor site.

Specifics of the model selection and all model input information, including meteorological data, terrain data, receptors, and sources, are described in the following sub-sections.

Model Selection

There is no one specified dispersion model required for use by Nova Scotia Environment (NSE), but the recommended US EPA models have been routinely accepted by NSE for projects such as this. The plume dispersion model AERMOD was selected for this modelling study. AERMOD is the US EPA preferred model for regulatory air dispersion modelling of industrial sources, replacing the previously endorsed ISC model. AERMOD is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases and multiple sources (including, point, area and volume sources).

Study Area

Study area boundaries were established to focus the scope of the assessment and to provide a meaningful analysis of potential effects on air quality from the operation of the head compressor site. For this assessment a study area of 10 km by 10 km, centered on the compressor site, was used to determine the potential effects of Project emissions on air quality (see Figure 1 in Attachment 1). From previous experience, this distance is sufficient to account for all maximum ground-level impacts (i.e., 1 hr, 24 hr, annual).

The precise location of the head compressor site is still under evaluation; however, a few options, all within 5 km of each other, are being considered. The location chosen for this assessment was based on greatest proximity to residential receptor locations and is the preferred option to date.

Meteorological Data

Five years (2010-2014) of MM5 processed meteorological data, representing the general location of the proposed head compressor site was acquired from Lakes Environmental and used in this study. MM5 data is a gridded data set conventionally used in these applications to interpolate meteorological information to site-specific coordinates in an AERMET input file. This AERMET ready meteorological data file was processed by the meteorological preprocessor to AERMOD, AERMET, to make the dataset that is read directly by AERMOD.

A joint wind direction and speed frequency diagram, or wind rose, of the MM5 processed meteorological data is presented in Figure 2.

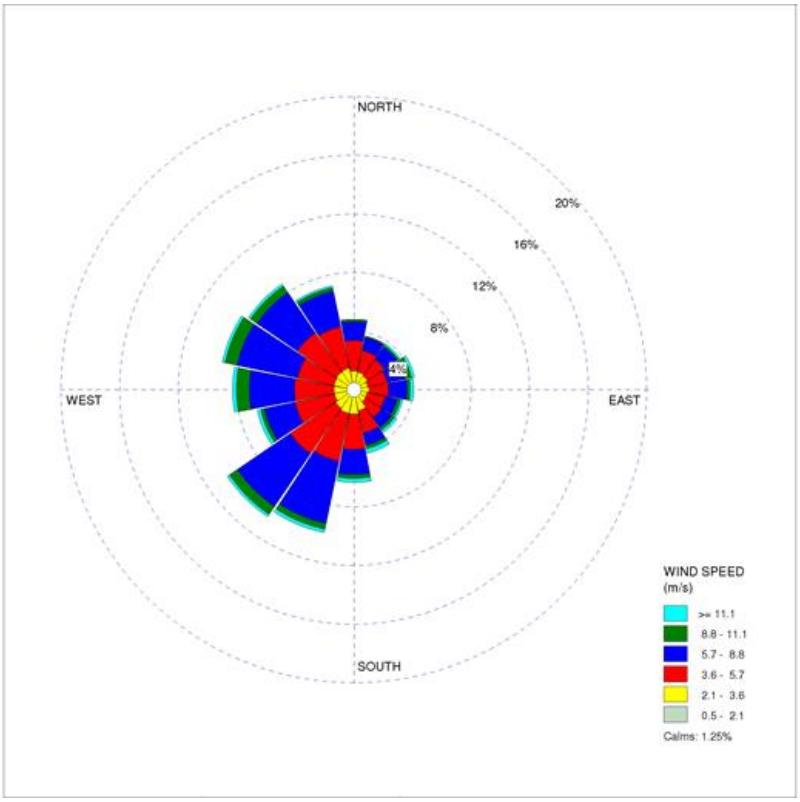


Figure 2 Joint Wind Speed and Direction Frequency Diagram (Winds Blowing From)

Receptor Grid

The receptor grid array for the dispersion modelling consisted of a series of nested Cartesian receptor grids with increasing receptor spacing with distance from the head compressor site. The receptor grid used for this assessment is represented in Figure 3 in Attachment 1, and includes the following spacing:

- 20 m receptor spacing along the fence line of the head compressor site;
- 25 m spacing within 800 m of the fence line;
- 50 m spacing's' between 800 m and 1,000 m;
- 100 m spacing's between 1,000 m and 2,000 m; and
- 500 m spacing's between 2,000 m and 5,000 m.

Discrete receptors (443), representing all structures located within the modelling domain, were also included in each modelling computation. Four of the discrete receptors were selected for data tabulation, representing the nearest residential areas (within 1 km) to the head compressor site. The discrete receptor locations are shown on Figure 1 in Attachment 1.

Terrain Data

Terrain elevations were determined for all receptors used in the dispersion modelling. The terrain elevations used in this modelling study were acquired from online topographic data from the Shuttle Radar Topography Mission (SRTM) (resolution 90 m by 90 m).

Terrain elevation data for the study area is illustrated on Figure 4 in Attachment 1.

Building Downwash Effects

Buildings or other solid structures can affect the flow of air near a source and may induce building downwash effects, which have the potential to reduce plume rise and affect dispersion.

Building downwash effects were considered for all point sources. The buildings and structures that were considered in the dispersion modelling are summarized in Table C1 and illustrated in Figure 5 in Attachment 1.

Table C1 Buildings and Structures Considered in Dispersion Modelling

Building ID	Building Description	Height (m)	Length (m)	Width (m)
1	Compressor Building Unit 1	10.1	12.7	16.3
2	Compressor Building Unit 2	10.1	12.7	16.3
3	Compressor Building Unit 3	10.1	12.7	16.3
4	Compressor Building Unit 4	13.6	27.0	21.0
5	Compressor Building Unit 5	13.6	27.0	21.0
6	Compressor Building Unit 6	13.6	27.0	21.0
7	Heated Storage Building	6.5	20.0	12.0
8	Domestic Water/Waste Water Skid	5.0	9.0	3.6
9	Personnel/Control Skid	4.9	15.2	3.8
10	Electrical Skid #1	5.3	20.0	3.6
11	Electrical Skid #2	5.3	20.0	3.6
12	Mechanical Skid #1 (Boilers)	4.9	22.0	4.2
13	Mechanical Skid #2 (Boilers)	4.9	22.0	4.2
14	Mechanical Skid #1 (Compressed Air)	4.8	17.5	4.2
15	Generator Skid #1	4.5	11.0	4.3
16	Generator Skid #2	4.5	11.0	4.3
17	Generator Skid #3	4.5	11.0	4.3
18	Generator Skid #4	4.5	11.0	4.3
19	Generator Skid #5	4.5	11.0	4.3
20	Coolers			

March 2016

Project Sources of Emissions

As currently planned, the head compressor site will be equipped with six gas turbine driven compressors (five operating and one spare), four gas boilers and five prime power gas generators. The sources and emission rates applied in the air dispersion model are summarized in Table C2.

Source parameters and emissions data were provided by the design engineers and published emissions rates from the United States Environmental Protection Agency's (US EPA) Emission Factor's and AP42, Compilation of Air Pollutant Emission Factors where specific factors were not available.

NO_x to NO_2 Conversion

Oxides of nitrogen (NO_X) comprise nitric oxide (NO) and nitrogen dioxide (NO_2). Most combustion sources emit primarily NO that can react with ambient ozone (O_3) to produce NO_2. The final quantity of NO_2 then becomes a function of the available O_3 in the atmosphere during the release and mixing in the atmosphere.

Only ground-level concentrations of NO_2 are regulated in Nova Scotia, therefore a method is needed to determine the amount of NO_2 present in the plume. For this assessment, the plume volume molar ratio method (PVMRM) was used for NO_x to NO_2 conversion. The following NO_2/NO_x stack ratios were assumed: 0.6 for compressors and gas turbines; 0.2 for power generating units and 0.1 for the power boilers. Ozone data was acquired from the ambient air monitoring station located in Port Hawkesbury. These assumptions follow guidance provided by the Government of Newfoundland and Labrador in "Guideline for Plume Dispersion Modelling" (2012). Such conversion methodology has been previously accepted by NSE.

Dispersion Modelling – Determination of Compliance

Maximum predicted ground level concentrations for each discrete receptor are presented in Table 1 in Attachment 1 and concentration mapping for each contaminant modelled is presented in Figures 6 to 11 in Attachment 1.

The results shown in these attachments indicate compliance of this Project with the air quality regulations of Nova Scotia for each pollutant and each applicable averaging time at the nearest receptors. Further discussion of the results can be found in the Bear Paw Pipeline Environmental Impact Assessment, see Chapter 5.

Table C2 Source Characteristics and Emission Rates

Source Parameter	Compressor 1	Compressor 2	Compressor 3	Compressor 4	Compressor 5	Compressor 6	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Boiler 1	Boiler 2	Boiler 3	Boiler 4
Source Type	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**	**Point**
Location (UTM)															
Easting (m)	607386	607409	607440	607466	607495	607527	607435	607443	607452	607461	607469	607462	607460	607472	607468
Northing (m)	5004184	5004149	5004115	5004076	5004035	5003994	5003868	5003874	5003880	5003886	5003892	5003846	5003851	5003853	5003857
Stack Height (m)	12.17	12.17	12.17	16.35	16.35	16.35	5.45	5.45	5.45	5.45	5.45	5.91	5.91	5.91	5.91
Stack Diameter (m)	1.25	1.25	1.219	3.27	3.27	3.27	0.356	0.356	0.356	0.356	0.356	0.508	0.508	0.508	0.508
Exit Temperature (K)	719	719	783	736	736	736	1146	1146	1146	1146	1146	398	398	398	398
Exit Velocity (m/s)	31.5	31.5	41.1	16.9	16.9	16.9	40.2	40.2	40.2	40.2	40.2	15.2	15.2	15.2	15.2
Flow Rate (m3/s)	38.6	38.6	48.0	142.2	142.2	142.2	4.00	4.00	4.00	4.00	4.00	3.04	3.04	3.04	3.04
Emissions (g/s)															
NO_x	0.75	0.75	0.86	2.71	2.71	2.71	1.56	1.56	1.56	1.56	1.56	0.14	0.14	0.14	0.14
CO	0.92	0.92	1.05	3.30	3.30	3.30	1.1	1.1	1.1	1.1	1.1	0.08	0.08	0.08	0.08
$PM_{2.5}$	0.04	0.04	0.05	0.16	0.16	0.16	9.62E-05	9.62E-05	9.62E-05	9.62E-05	9.62E-05	0.01	0.01	0.01	0.01

Source: US EPA 2000a; US EPA 2000b; US EPA 1998; Alberta Government 1996; Preliminary Project Data Provided by Bear Paw Pipeline Corporation Inc.

March 2016

March 2016

ACOUSTIC MODELLING

Model Description

The dispersion and attenuation of sound in the atmosphere is modelled using algorithms based on the conservation of energy and the absorption of the expanding sound waves by the atmosphere and barriers in the path. There are numerous software packages available for modeling sound transmission in the atmosphere. Some use proprietary algorithms, and some are based on published methods that have international recognition. Cadna (Computer Aided Noise Abatement, version 4.5), produced by Datakustik in Germany, is a software program that is based on the propagation models in ISO 9613. This ISO standard is in two parts. ISO 9613-1 is concerned with the attenuation of sound by the constituents of air. ISO 9613-2 incorporates the atmospheric absorption component into a framework that models the attenuation of sound by the geometric spreading of sound in the free atmosphere.

CadnaA was used in this study to predict sound pressure levels resulting from the operation of the Project. It is capable of predicting sound levels at specified receiver positions originating from a variety of sound sources and can also account for such factors as:

- distance attenuation (*i.e.*, geometrical dispersion of sound with distance);
- geometrical characteristics of the source and receivers;
- atmospheric attenuation (*i.e.*, the rate of sound absorption by atmospheric gases in the air between sound sources and receptors);
- ground attenuation (*i.e.*, effect of sound absorption by the ground as sound passes over various terrain and vegetation types between source and receptor);
- screening effects of surrounding terrain or vegetation; and
- meteorological conditions and effects.

The application of the sound model requires a number of input variables. The most important variables are those that indicate the relative geometric position of the source and receiver. Both the receiver and source coordinates are input as an x, y, and z value. The x value is the "easting" horizontal coordinate, and the y is the "northing" horizontal coordinate. The z value is the height above ground of the receiver. A height of 4.5 m, about 15 feet, is used to represent the height of second story windows where sound levels are slightly higher than those at ground level. CadnaA uses the receptor height and the terrain height in the calculations.

Conservative modeling assumptions have been applied when analyzing the sound impacts of the Project, and these are discussed in the following description of the influences of meteorology and terrain and vegetation

Meteorological Factors

Meteorological factors, such as temperature, humidity, wind speed and direction, influence sound propagation. The effects of wind on outdoor sound propagation during different weather conditions could cause variations in Project-related sound levels measured at a receptor. If the receptor is upwind of the facility, the wind could cause greater sound attenuation, and lower sound levels at the residence. However, if the residence is downwind of the facility, the opposite effect could occur, resulting in higher sound levels at the residence. Crosswinds have less effect on outdoor sound propagation. The ISO algorithms in Cadna were designed to reflect a situation where there is a modest wind direct from the source to the receiver; that is, the receiver is considered to be always downwind of all sources.

The following meteorological elements that represent low air absorption of sound are customarily used and were assumed for the sound assessment:

- temperature = 10°C (50°F);
- relative humidity = 70 percent; and
- wind conditions = variable.

These meteorological parameters can be considered typical of night-time conditions in the spring and summer (when outdoor activities are more likely) and representative of the sound effects during these seasons; they also represent optimum conditions for sound transmission in the atmosphere.

Terrain and Vegetation

Factors such as terrain conditions, types of vegetation and ground cover can all affect the absorption that takes place when sound waves travel over land. For example, if the ground is moist or covered in fresh snow or vegetation, it will be absorptive and aid in sound attenuation. In contrast, if the ground is hard-packed or frozen, it will be reflective and will not aid in sound attenuation. There are no water bodies of significant size between the sources and potentially affected receptors in this Project. Psychologically, trees and thick brush are beneficial in isolating the sound source and receiver; however, the actual degree of sound attenuation is limited. A thick growth of trees and brush about 30 m (100 ft) deep will achieve a noise reduction of 3 to 4 dBA. If the vegetation is deciduous, the loss of the leaves means a loss in the attenuation properties, and the vegetation must be in the line of sight to achieve a reduction. Note also that some part of the sound energy will refract over the bush, just as it can refract over hills, and doubling the depth of the forest will not necessarily double the reduction in sound transmission.

The ground in the Project area is generally vegetated, or a soil surface that may be overlain with snow in the winter season yielding surface absorption that could approach 80 percent. However, this study takes a conservative approach, assuming that there is no intervening vegetation between the sources and receivers to reduce sound levels, and using an assumed absorption factor of 50 percent.

Assessment Scenarios

The modelling scenarios considered in this Assessment are:

- construction (Horizontal Directional Drilling (HDD)); and
- operation of the head compressor site.

The laying of the pipeline involves crossing two major marine watercourses (Strait of Canso and the Milford Haven River) and a number of freshwater watercourses, including one major freshwater course, the Salmon River. Although not yet finalized, a watercourse crossing method being considered for all three of these crossings is Horizontal Directional Drilling (HDD). The potential effects from HDD activity at each watercourse crossing were determined through acoustic modelling using CadnaA.

The operation of the Project will involve the operation of a head compressor site in Goldboro, NS to pressurize the gas prior to transport to the Bear Head LNG Plant via the proposed pipeline. The potential effects of the noise generating sources associated with the operation of the head compressor site were analyzed through acoustic modelling using CadnaA. The exact location of the compressor location is, at the time of writing, still undergoing detailed engineering; therefore, modelling was conducted on the preferred head compressor site layout which was also determined to be worst case, that is, located closest to residential receptors. Receptors not presented in this report, or in the case that an alternate compressor site were selected, would experience a reduced noise level due to greater separation distances.

The input modelling data used in each of these scenarios (construction and operation) are provided below under Project Noise Sources and Sound Power Levels.

Receptors

In addition to the 443 discrete receptors used in the analysis, a grid was overlain on the map to enable the spatial distribution of sound levels to be assessed. The receptor grid array for the HDD models consisted of a 3.5 km (west to east) by 3.5 km (north to south) with a 5 m grid spacing.

The receptor grid array for the modelling of the head compressor site consisted of a 6 km (west to east) by 6 km (north to south) grid with 25 m grid spacing. A number (443) of discrete receptors, within 3 km, were also incorporated into the acoustic modelling and four of the nearest receptors were selected for tabulation to illustrate worst-case effects.

March 2016

Project Noise Sources and Sound Power Levels

Construction

The exact equipment to be used during HDD at the marine and freshwater crossings is currently unknown, and will be determined upon construction tendering after detailed engineering is complete. To assess the potential effects resulting from the HDD activities at these three locations, a representative number and type of equipment typically used at HDD sites (Table C3) was assumed.

Table C3 Typical HDD Equipment

Noise Generating Equipment - HDD	Quantities
Entry Pad	
Primary Drill Rig & Power Unit[1]	1
Mud Pump	2
60 kw Generator[2]	1
Trash Pump	1
Drill Fluid Mixing Unit	1
Drill Fluid Recycling/Solid Control Unit with Three Centrifugal Pumps	1
Support Equipment (two flatbed trucks, two water tankers, two backhoes)	1
Exit Pad	
Secondary Drill Rig and Power Unit (365 hp diesel engineer)	1
Mud Pump	1
60 kw Generator[2]	1
Drill Fluid Mixing Unit	1
Notes: 1 Two primary drill rigs for the Milford Haven Crossing. 2 Power source for the Mud Pumps.	

Sound emissions of HDD operations at each of three watercourse crossings were modeled based on documented sound data for equipment sized similarly to that presented in Table C3 (DEFRA 2006). For each work site, the sound power levels of all anticipated equipment were combined and distributed over the footprint of the entry and exit pads. Area sources were applied at a 4.5 meter height at each entry and exit location. Each of the noise models represents the predictable worst case scenario in which all equipment is considered to be operating simultaneously, at full load.

For the Salmon River Crossing two routes are currently being evaluated, a shorter and longer route. The analysis presented here focuses on the shorter alignment as it places the entry and exit pads roughly 800 m apart, with the potential for overlapping effects at the nearest residents due to the simultaneous operation of HDD equipment at both the entry and exit pad. The majority of the receptors in this area are located closer to the shorter alignment.

If the longer alignment is chosen, receptors located to the north of Salmon River would experience similar effects to those predicted for the shorter alignment. Those receptors to the south would, for the most part, experience a lesser effect, as the HDD equipment would be positioned further away, except for the one receptor that would be located within 100 m of the HDD equipment.

Operation

To predict the sound pressure levels resulting from the operation of the head compressor site, one operational scenario was modeled, which included all equipment running continuously twenty-four hours per day, seven days per week.

A list of the noise generating equipment associated with the operation of the head compressor site and their corresponding sound power levels (including octave band analysis) used to predict operation sound pressure levels are provided in Table C4.

Sound emissions of the operation of the head compressor site were modeled based on manufacturer sound data (Solar Turbines Inc., 2005), and sound level measurements of similar equipment from Stantec noise databases. Noise generating equipment was represented in the model by the appropriate source type (point, line, area, vertical area) based on the nature of the source's sound emission characteristics. For example, small ventilation openings, or exhaust stacks were modeled as point sources, and exposed piping was modeled as line sources. Building façade breakout noise was modelled as area and vertical area sources applied over the building's outside surface, and was calculated based on the radiated noise from the subject equipment with transmission losses applied for building walls. The modeled scenario represents the predictable worst case scenario in which all regular operation equipment is modeled as operating simultaneously, at full load.

Table C4 Head Compressor Site Noise Generating Equipment and Associated Sound Power Levels

Major Noise Generating Equipment - Operation	Quantity	Source Type	Octave Band Analysis (dB)									Overall Sound Power Level (Lw) (dBA) at Source
			31	63	125	250	500	1000	2000	4000	8000	
Head compressor site												
Compressor 1 and 2 - Gas Turbine Inlet	2	Point	109.5	115.5	121.5	122.5	123.5	125.5	128.5	151.5	143.5	152.9
Compressor 1 and 2 - Gas Turbine Exhaust	2	Point	118.5	126.5	122.5	124.5	123.5	122.5	115.5	106.5	100.5	125.8
Compressor 3 – Gas Turbine Inlet	1	Point	110.5	116.5	122.5	123.5	124.5	126.5	129.5	154.5	146.5	155.9
Compressor 3 – Gas Turbine Exhaust	1	Point	125.5	128.5	125.5	129.5	131.5	127.5	121.5	114.5	101.5	132
Compressor 4,5,6 – Gas Turbine Inlet	3	Point	122.5	128.5	134.5	135.5	136.5	136.5	141.5	171.5	163.5	172.9
Compressor 4,5,6 – Gas Turbine Exhaust	3	Point	132.5	136.5	134.5	137.5	141.5	136.5	128.5	118.5	108.5	141.2
Generator Intake	5	Point	59.6	85.9	95.5	91.7	90.5	90.1	80.8	61.6	95.8	59.6
Generator Exhaust	5	Point	87.1	113.4	123	119.2	118	117.6	108.3	89.1	123.3	87.1
Generator Discharge	5	Point	59.6	85.9	95.5	91.7	90.5	90.1	80.8	61.6	95.8	59.6
Ventilation Fan	6	Point	112.6	106.8	101	102.1	90	85.1	80.9	73	68.5	95.7
Aerial Cooler Bay	12	Point	112.6	106.8	101	102.1	90	85.1	80.9	73	68.5	95.7
Lube Oil Cooler	6	Point	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5	103
Boiler Exhaust	4	Point	102.5	102.5	101.5	99.5	96.5	93.5	90.5	87.5	84.5	99.2
Discharge Piping	36	Line	67	70	74	80	86	89	92	89	86	96.4
Exhaust Ducting	6	Line	118.5	126.5	122.5	124.5	123.5	122.5	115.5	106.5	100.5	125.8
Inlet Dusting	6	Line	109.5	115.5	121.5	122.5	123.5	125.5	128.5	151.5	143.5	152.9

Table C4 Head Compressor Site Noise Generating Equipment and Associated Sound Power Levels

Major Noise Generating Equipment - Operation	Quantity	Source Type	Octave Band Analysis (dB)									Overall Sound Power Level (Lw) (dBA) at Source
			31	63	125	250	500	1000	2000	4000	8000	
Head compressor site												
Compressor Building Façade (Compressors 1 - 2)	2	Vertical Area	0	85.2	83.1	79.1	79	74	71.7	70.3	70.1	80.8
Compressor Building Façade (Compressors 3)	1	Verti-cal Area	0	85.2	83.1	79.1	79	74	71.7	70.3	70.1	80.8
Compressor Building Façade (Compressors 4-6)	3	Verti-cal Area	0	90.7	91.9	83.6	77.9	73.2	74	87	77.8	89.2
Compressor Building Roof (Compressors 1 – 2)	2	Area	0	85.2	83.1	79.1	79	74	71.7	70.3	70.1	80.8
Compressor Building Roof (Compressors 3)	1	Area	0	85.2	83.1	79.1	79	74	71.7	70.3	70.1	80.8
Compressor Building Roof (Compressors 4 - 5)	3	Area	0	90.7	91.9	83.6	77.9	73.2	74	87	77.8	89.2
Source: Hoover & Keith Inc. 1981; Bies and Hansen 2009; Solar Turbines Incorporated 2005; Caterpillar Inc. 2013; Stantec Noise Database												

Mitigation

A number of mitigation measures were incorporated into the acoustic modelling of the proposed head compressor site including silencers and air filters on the inlet to the gas compression turbines, silencers on the exhaust of the gas compression turbines and silencers on the exhausts of the prime power generators. The attenuation applied to these sources is presented below in Table C5.

Table C5 Attenuation Applied to Gas Compression Turbines and Prime Power Generators

Mitigation	Attenuation - Octave Band Analysis (dB)									
	31.5	63	125	250	500	1000	2000	4000	8000	Rw
Pulse Cleaning Updraft Air Filter	2	4	8	9	13	26	27	27	23	19
Generator Exhaust Silencer	0	0	11	22	30	30	30	30	27	29
Compressor 1 & 2 Inlet Silencer	8	9	10	11	24	32	46	47	36	26
Compressor 1 & 2 Exhaust Silencer	8	14	19	25	30	34	31	27	23	32
Compressor 3 Inlet Silencer	8	9	10	11	24	32	46	47	36	26
Compressor 3 Exhaust Silencer	8	14	24	29	36	40	37	33	29	38
Compressor 4, 5 & 6 Inlet Silencer	8	12	18	28	41	50	50	58	63	39
Compressor 4, 5 & 6 Exhaust Silencer	9	20	31	39	47	47	47	47	44	47

Notes:
R_w = Sound Reduction Index.
Source: Solar Turbines Incorporated 2005, Stantec Noise Database

Acoustic Modelling – Determination of Compliance

The determination of compliance of Project construction and operation (head compressor site) was determined based on whether or not the predicted sound pressure levels from the construction and operation meet noise limits and criteria set by the Municipality of Guysborough and Health Canada at the nearest receptor locations. Results for each watercourse crossing are presented in Figures 12 – 14 in Attachment 1 and are discussed in Section 5.1.7 of the Bear Paw Pipeline Environmental Impact Assessment. Predicted sound pressure levels resulting from the operation of the head compressor site are presented on Figure 15 in Attachment 1 and are discussed in Section 5.1.7 of the Bear Paw Pipeline Environmental Impact Assessment. The results indicate that the Project, as currently planned, would be compliant with applicable criteria (< 65 dBA during the daytime and < 55 dBA during the nighttime; Change in %HA < 6.5) (see EA Sections 5.1.1 and 5.1.7).

1.1 REFERENCES

Alberta Government. 1996. Code of Practice for Compressor and Pumping Stations and Sweet Gas Processing Plants.

Bies and Hansen. 2009. Engineering Noise Control 4th Edition. E & FN Spon

Canadian Standards Association. 2003. National Standard of Canada CAN/CSA-ISO 1996:1:05, Acoustics – Description, Measurement and Assessment of Environmental Noise, Part 1, Basic Quantities and Assessment Procedures.

Caterpillar Inc. 2013. CAT C27ATAAC Diesel Engine. Available online: http://s7d2.scene7.com/is/content/Caterpillar/C10001713 (Accessed November 23, 2015)

Department for Environment, Food and Rural Affairs (DEFRA). 2007. Update of Noise Database for Prediction of Noise on Construction and Open Sites. Nobel House

Government of Newfoundland and Labrador, Department of Environment and Conservation. 2012. Determination of Compliance with the Ambient Air Quality Standards.

Government of Newfoundland and Labrador, Department of Environment and Conservation. 2012. Guideline for Plume Dispersion Modelling.

Hoover & Keith Inc. 1981. Noise Control for Buildings and Manufacturing Plants.

Solar Turbines Incorporated. 2005. Noise Prediction Guidelines for Industrial Gas Turbines. Caterpillar Inc.

United States Environmental Protection Agency (US EPA). 1998. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 1.4, Natural Gas Combustion.

United States Environmental Protection Agency (US EPA). 2000a. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 3.1, Stationary Gas Turbines.

United States Environmental Protection Agency (US EPA). 2000b. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors – Chapter 3.2., Natural Gas-fired Reciprocating Engines.

March 2016

March 2016

ATTACHMENT 1
SUPPLEMENTARY INFORMATION

March 2016

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
608,412	5,003,461	37.5	2.23	40.0	29.6	0.38	0.05
608,435	5,003,432	36.4	2.15	40.0	28.8	0.37	0.04
608,198	5,003,013	33.8	1.89	39.9	23.8	0.33	0.03
606,228	5,003,628	31.3	0.84	38.2	21.3	0.24	0.02
606,094	5,004,275	52.5	0.65	69.9	39.3	0.28	0.01
606,160	5,004,547	58.6	0.56	64.1	38.8	0.31	0.01
606,162	5,004,576	63.3	0.55	64.5	42.4	0.29	0.01
606,179	5,003,649	32.3	0.79	39.0	20.7	0.22	0.02
606,118	5,004,506	51.1	0.56	59.7	31.4	0.30	0.01
606,121	5,004,532	54.3	0.55	61.1	31.1	0.31	0.01
606,053	5,004,266	54.7	0.64	68.3	35.8	0.26	0.01
606,074	5,003,894	46.0	0.73	61.3	38.7	0.33	0.02
606,242	5,003,514	32.2	0.85	38.7	18.0	0.23	0.02
606,043	5,003,997	48.7	0.72	66.8	29.6	0.31	0.01
606,232	5,003,501	32.3	0.84	38.6	17.6	0.23	0.02
606,062	5,003,862	41.1	0.71	56.6	33.0	0.30	0.02
606,029	5,004,302	51.8	0.61	66.9	38.4	0.27	0.01
606,044	5,003,901	47.0	0.71	60.8	38.2	0.33	0.02
606,033	5,003,957	48.7	0.71	67.3	36.1	0.35	0.01
606,022	5,004,284	53.1	0.62	68.0	36.4	0.26	0.01
606,017	5,004,371	50.7	0.58	59.1	36.1	0.30	0.01
606,249	5,003,419	32.0	0.84	39.4	15.9	0.22	0.02
606,096	5,003,672	34.6	0.71	38.4	19.2	0.21	0.01
606,059	5,003,731	37.3	0.68	37.1	16.9	0.22	0.01
605,998	5,004,373	51.0	0.58	58.7	36.2	0.30	0.01
606,059	5,003,711	36.2	0.68	36.8	17.6	0.22	0.01
605,978	5,004,244	57.5	0.60	67.0	37.7	0.24	0.01
606,010	5,003,840	41.6	0.67	51.9	26.9	0.27	0.01
605,974	5,004,279	54.4	0.59	66.2	33.3	0.25	0.01
606,014	5,003,799	41.3	0.66	38.2	17.6	0.22	0.01
606,051	5,003,691	35.3	0.68	36.6	18.2	0.21	0.01
606,035	5,003,727	38.1	0.67	36.8	16.7	0.21	0.01
606,022	5,003,761	39.8	0.66	36.1	15.2	0.21	0.01
606,478	5,003,022	31.3	0.85	38.8	19.3	0.21	0.01
606,191	5,003,425	32.1	0.78	38.4	15.4	0.21	0.01
606,466	5,003,037	31.6	0.85	38.7	19.2	0.21	0.01
606,233	5,003,361	31.7	0.80	37.6	16.4	0.21	0.01
606,529	5,002,952	32.6	0.85	35.9	17.5	0.22	0.01
605,942	5,004,183	60.1	0.60	61.5	35.7	0.25	0.01
606,548	5,002,922	32.6	0.84	35.9	16.3	0.22	0.01
605,946	5,004,268	55.9	0.59	65.4	35.4	0.23	0.01
606,568	5,002,889	33.2	0.83	35.4	15.1	0.22	0.01
605,919	5,004,144	59.4	0.60	66.8	39.9	0.25	0.01
605,928	5,004,310	54.0	0.57	65.1	34.5	0.25	0.01
605,923	5,004,286	54.5	0.57	65.8	33.1	0.24	0.01
606,645	5,002,789	33.6	0.83	38.5	17.6	0.21	0.01
606,629	5,002,802	33.3	0.82	38.6	16.6	0.21	0.01
605,925	5,003,959	50.4	0.64	63.9	33.0	0.33	0.01
606,605	5,002,805	33.8	0.81	37.9	15.7	0.21	0.01
605,880	5,004,163	59.2	0.57	62.4	37.8	0.24	0.01
605,876	5,004,146	58.7	0.58	66.7	38.9	0.24	0.01
605,877	5,004,232	58.3	0.56	67.0	34.9	0.24	0.01
605,865	5,004,090	54.8	0.59	62.0	37.3	0.23	0.01
605,885	5,004,432	54.0	0.52	55.9	31.9	0.28	0.01
605,823	5,004,244	57.5	0.54	65.4	33.6	0.23	0.01
605,823	5,004,378	55.7	0.52	58.1	34.5	0.24	0.01
605,791	5,004,344	56.0	0.52	61.9	31.6	0.23	0.01
606,753	5,002,539	39.3	0.74	38.8	23.5	0.20	0.01
605,777	5,004,456	56.6	0.50	54.7	31.7	0.27	0.01
605,747	5,004,326	56.0	0.51	62.9	29.9	0.21	0.01
606,727	5,002,514	40.9	0.71	38.7	22.9	0.19	0.01
605,738	5,004,350	57.2	0.50	62.2	30.0	0.22	0.01
605,738	5,004,402	57.7	0.50	56.1	32.9	0.23	0.01
605,709	5,004,402	57.8	0.49	56.7	32.3	0.22	0.01

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
606,806	5,002,413	42.7	0.69	37.3	21.1	0.19	0.01
606,867	5,002,375	41.7	0.70	35.3	18.6	0.18	0.01
608,920	5,003,074	46.2	1.20	37.7	18.7	0.25	0.03
608,875	5,002,996	46.3	1.20	38.8	18.1	0.25	0.03
605,689	5,004,468	58.0	0.47	52.4	31.3	0.25	0.01
605,683	5,004,495	59.0	0.46	52.7	30.7	0.25	0.01
605,681	5,004,516	59.9	0.46	53.5	30.9	0.25	0.01
605,656	5,004,439	60.3	0.47	51.4	31.6	0.23	0.01
605,674	5,004,536	60.3	0.45	53.1	31.6	0.24	0.01
605,653	5,004,450	59.3	0.47	51.4	31.4	0.23	0.01
605,657	5,004,486	58.7	0.46	52.3	30.9	0.25	0.01
605,641	5,004,536	61.0	0.44	53.1	30.8	0.24	0.01
605,630	5,004,527	60.3	0.44	52.6	29.9	0.24	0.01
605,631	5,004,564	60.5	0.43	51.5	31.5	0.23	0.01
605,648	5,004,644	61.8	0.42	54.1	29.3	0.22	0.01
605,617	5,004,557	62.1	0.43	52.4	31.0	0.23	0.01
605,629	5,004,635	61.1	0.42	53.8	30.2	0.22	0.01
608,976	5,002,957	46.6	1.10	38.8	17.0	0.23	0.02
605,650	5,004,728	63.9	0.41	51.5	24.1	0.22	0.01
609,013	5,002,988	47.0	1.08	37.8	17.2	0.23	0.02
605,639	5,004,719	63.7	0.41	54.0	25.3	0.22	0.01
607,088	5,002,146	44.7	0.67	38.3	17.0	0.15	0.01
605,746	5,003,297	42.6	0.53	32.9	13.2	0.16	0.01
605,590	5,004,671	60.8	0.40	53.5	28.6	0.22	0.01
607,073	5,002,131	45.4	0.66	38.1	17.1	0.15	0.01
605,613	5,004,748	64.3	0.40	50.3	23.4	0.22	0.01
605,604	5,004,729	64.4	0.40	54.2	25.2	0.21	0.01
605,706	5,003,291	41.5	0.51	32.1	13.2	0.15	0.01
605,577	5,004,777	62.6	0.39	48.8	22.0	0.22	0.01
605,801	5,003,119	44.6	0.54	34.4	15.8	0.16	0.01
605,568	5,004,758	63.9	0.39	51.8	23.9	0.21	0.01
605,566	5,004,804	63.6	0.38	51.1	22.7	0.22	0.01
605,807	5,003,057	43.2	0.53	33.2	17.7	0.16	0.01
605,775	5,003,090	44.1	0.52	34.0	16.2	0.16	0.01
606,727	5,002,146	42.9	0.56	33.1	17.6	0.15	0.01
606,727	5,002,145	42.9	0.56	33.0	17.5	0.15	0.01
606,683	5,002,162	45.5	0.56	35.1	18.7	0.16	0.01
605,539	5,004,833	62.0	0.37	52.5	22.7	0.21	0.01
605,515	5,004,790	62.4	0.38	49.6	22.7	0.21	0.01
605,530	5,004,826	62.7	0.37	51.3	22.6	0.21	0.01
605,649	5,003,228	42.8	0.49	33.0	12.1	0.15	0.01
605,723	5,003,115	42.9	0.51	33.1	14.2	0.16	0.01
605,790	5,003,021	41.3	0.52	33.8	18.1	0.16	0.01
605,672	5,003,185	43.5	0.50	33.6	11.3	0.16	0.01
605,531	5,004,853	62.4	0.37	53.0	22.6	0.21	0.01
605,487	5,003,542	43.9	0.44	33.8	14.8	0.14	0.01
605,786	5,003,006	42.4	0.52	34.6	18.2	0.16	0.01
605,514	5,004,847	61.6	0.37	52.2	22.7	0.21	0.01
605,528	5,004,879	61.3	0.37	52.0	24.4	0.20	0.01
605,545	5,003,361	39.5	0.46	31.4	13.8	0.13	0.01
605,787	5,002,976	43.6	0.52	36.3	18.4	0.15	0.01
605,873	5,002,844	40.4	0.53	32.5	15.6	0.15	0.01
605,826	5,002,899	44.2	0.52	37.0	17.6	0.15	0.01
606,513	5,005,895	76.3	0.46	65.1	28.1	0.15	0.01
605,454	5,003,498	43.1	0.44	33.2	14.8	0.14	0.01
605,558	5,003,251	39.2	0.47	32.2	12.8	0.14	0.01
605,518	5,004,980	70.5	0.35	62.0	26.8	0.16	0.01
605,487	5,004,935	62.8	0.35	54.8	25.7	0.18	0.01
605,475	5,003,378	38.4	0.45	31.8	14.0	0.13	0.01
605,460	5,004,890	61.1	0.36	52.2	22.3	0.20	0.01
605,475	5,003,365	38.5	0.45	31.8	13.8	0.13	0.01
605,449	5,004,882	60.5	0.35	51.7	22.4	0.20	0.01
605,747	5,002,917	47.1	0.50	37.0	18.1	0.15	0.01
605,333	5,003,762	39.9	0.40	33.3	14.5	0.14	0.01

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
605,438	5,004,900	60.7	0.35	51.9	22.3	0.20	0.01
605,395	5,003,501	42.6	0.42	33.1	14.3	0.13	0.01
605,431	5,004,909	60.5	0.35	51.8	22.1	0.20	0.01
605,319	5,003,723	40.1	0.39	33.3	10.6	0.13	0.01
605,843	5,002,731	45.8	0.50	35.3	12.4	0.14	0.01
605,341	5,003,611	38.1	0.40	33.2	12.7	0.13	0.01
605,348	5,003,587	39.8	0.40	32.7	13.2	0.13	0.01
605,388	5,003,462	41.4	0.42	33.0	14.4	0.13	0.01
605,298	5,003,717	41.7	0.39	33.4	10.7	0.13	0.01
605,825	5,002,719	45.5	0.49	35.1	12.4	0.14	0.01
605,411	5,004,950	58.4	0.34	51.0	23.8	0.18	0.01
605,276	5,003,735	42.7	0.39	33.5	11.5	0.13	0.01
605,247	5,003,778	43.9	0.39	33.7	16.7	0.15	0.01
605,387	5,004,958	58.4	0.34	50.3	23.4	0.18	0.01
605,387	5,004,983	60.3	0.33	52.8	24.7	0.17	0.01
605,227	5,003,803	47.0	0.39	37.3	19.7	0.15	0.01
605,271	5,003,583	38.5	0.39	33.3	12.7	0.13	0.01
605,210	5,003,845	55.0	0.40	42.3	23.6	0.17	0.01
605,641	5,002,851	47.0	0.47	36.2	17.5	0.14	0.01
605,184	5,003,897	55.7	0.41	42.9	25.6	0.19	0.01
605,169	5,003,977	59.6	0.42	45.7	25.8	0.23	0.01
605,163	5,003,913	53.7	0.41	41.9	25.4	0.20	0.01
605,165	5,003,875	56.2	0.40	43.2	25.0	0.17	0.01
605,186	5,003,713	43.4	0.37	34.0	10.6	0.13	0.01
605,138	5,003,950	54.9	0.41	42.1	24.6	0.21	0.01
605,180	5,003,688	43.9	0.37	33.8	10.8	0.12	0.01
605,364	5,005,109	71.0	0.31	63.2	24.0	0.13	0.01
605,172	5,003,675	43.5	0.37	33.9	10.9	0.12	0.01
605,122	5,003,977	58.6	0.41	45.0	25.7	0.22	0.01
605,194	5,003,581	41.0	0.38	33.9	12.2	0.12	0.01
605,125	5,003,925	53.3	0.40	41.7	24.9	0.20	0.01
605,120	5,003,960	56.4	0.41	43.3	25.1	0.22	0.01
605,169	5,003,629	42.1	0.37	33.6	11.3	0.12	0.01
605,102	5,004,041	64.8	0.41	49.7	24.1	0.21	0.01
605,148	5,003,633	42.5	0.37	33.4	11.3	0.12	0.01
605,082	5,004,086	60.0	0.40	46.1	21.7	0.19	0.01
605,131	5,003,694	44.1	0.36	33.8	10.7	0.12	0.01
605,133	5,003,664	43.7	0.36	33.8	10.9	0.12	0.01
605,301	5,005,100	65.5	0.31	58.1	25.0	0.14	0.01
606,922	5,006,359	104.9	0.49	83.9	32.9	0.20	0.01
605,072	5,003,878	54.3	0.39	41.8	24.6	0.17	0.01
605,050	5,004,115	60.5	0.39	46.2	20.0	0.18	0.01
605,050	5,004,053	63.7	0.40	48.9	23.7	0.21	0.01
605,283	5,005,129	66.7	0.30	59.4	24.4	0.13	0.01
605,089	5,003,676	44.0	0.36	33.8	10.8	0.12	0.01
605,034	5,004,158	59.0	0.38	45.2	20.4	0.17	0.01
605,065	5,003,725	44.0	0.35	33.7	11.1	0.13	0.01
605,294	5,005,196	72.8	0.29	65.4	20.5	0.11	0.01
605,001	5,004,171	57.4	0.38	44.0	20.1	0.16	0.01
605,246	5,005,162	66.8	0.29	59.6	23.8	0.12	0.01
605,042	5,003,660	43.9	0.35	33.6	10.9	0.12	0.01
606,734	5,006,389	89.4	0.44	71.6	24.3	0.15	0.01
604,979	5,004,230	60.7	0.36	46.5	22.2	0.15	0.01
604,966	5,004,262	63.4	0.35	48.7	22.5	0.15	0.01
604,953	5,004,286	62.9	0.35	48.3	22.3	0.16	0.01
604,936	5,004,239	60.4	0.36	46.3	21.8	0.15	0.01
604,921	5,004,227	57.7	0.36	44.2	21.3	0.15	0.01
604,886	5,004,319	59.5	0.34	45.8	21.3	0.16	0.01
604,843	5,004,223	53.7	0.35	41.6	20.0	0.15	0.01
604,815	5,004,263	59.1	0.34	45.3	20.7	0.14	0.01
604,812	5,004,455	53.6	0.31	44.0	21.0	0.16	0.01
604,795	5,004,270	59.3	0.34	45.5	20.6	0.14	0.01
604,809	5,004,489	55.0	0.31	42.8	22.0	0.15	0.01
604,733	5,004,566	57.3	0.30	44.0	21.2	0.14	0.01

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
604,733	5,004,583	58.8	0.30	45.2	20.7	0.14	0.01
605,013	5,005,405	69.3	0.25	62.9	16.2	0.11	0.00
604,688	5,004,578	56.5	0.30	43.4	21.0	0.14	0.01
604,981	5,005,398	67.3	0.25	61.0	17.8	0.11	0.00
604,661	5,004,586	56.2	0.30	43.2	20.9	0.14	0.01
604,648	5,004,586	55.6	0.29	42.7	20.9	0.14	0.01
604,647	5,004,612	57.7	0.29	44.4	19.9	0.14	0.01
604,940	5,005,417	66.4	0.24	60.2	17.9	0.11	0.00
604,616	5,004,842	50.8	0.28	39.0	22.3	0.16	0.00
604,562	5,005,012	50.7	0.25	39.0	21.6	0.14	0.00
604,529	5,004,971	49.9	0.26	38.5	21.5	0.14	0.00
604,811	5,005,622	67.8	0.22	62.3	14.1	0.09	0.00
604,483	5,005,053	50.1	0.24	38.5	21.0	0.14	0.00
604,520	5,005,215	49.9	0.24	38.5	16.1	0.12	0.00
604,468	5,005,088	50.2	0.24	38.6	20.5	0.14	0.00
604,451	5,005,048	48.5	0.24	37.3	20.9	0.13	0.00
604,511	5,005,273	47.0	0.24	36.2	17.1	0.12	0.00
604,499	5,005,322	49.9	0.23	38.3	18.2	0.12	0.00
604,491	5,005,311	47.9	0.23	36.8	17.9	0.12	0.00
604,453	5,005,238	49.3	0.23	38.0	16.1	0.12	0.00
604,497	5,005,363	52.7	0.23	40.4	18.4	0.12	0.00
604,449	5,005,261	47.8	0.23	36.9	15.1	0.12	0.00
604,451	5,005,307	46.6	0.23	35.6	17.0	0.12	0.00
604,492	5,005,417	51.7	0.23	40.8	17.7	0.11	0.00
604,482	5,005,399	52.6	0.23	40.4	18.1	0.12	0.00
604,455	5,005,373	51.6	0.23	39.7	18.3	0.12	0.00
604,404	5,005,334	46.6	0.23	35.6	17.0	0.12	0.00
604,433	5,005,400	51.9	0.23	39.9	18.2	0.12	0.00
604,393	5,005,314	46.3	0.23	35.6	16.1	0.11	0.00
604,399	5,005,374	48.8	0.23	37.5	17.8	0.12	0.00
604,382	5,005,356	46.9	0.23	35.9	17.2	0.12	0.00
608,651	5,000,961	40.6	0.45	31.4	11.9	0.10	0.01
604,304	5,005,218	47.4	0.22	36.4	18.1	0.13	0.00
604,395	5,005,454	51.1	0.22	39.3	17.6	0.11	0.00
608,673	5,000,937	40.3	0.45	31.1	11.9	0.10	0.01
604,358	5,005,396	48.5	0.22	37.2	17.7	0.11	0.00
604,386	5,005,473	50.3	0.22	40.0	17.3	0.11	0.00
604,345	5,005,400	48.0	0.22	36.9	17.6	0.11	0.00
604,356	5,005,488	49.9	0.22	39.9	17.1	0.11	0.00
604,321	5,005,475	50.5	0.22	38.8	17.5	0.11	0.00
604,605	5,005,981	63.6	0.20	59.6	19.3	0.09	0.00
604,632	5,006,034	62.4	0.21	58.8	19.4	0.09	0.00
604,621	5,006,021	62.8	0.20	59.0	19.5	0.09	0.00
604,627	5,006,030	62.5	0.21	58.9	19.4	0.09	0.00
604,298	5,005,489	50.2	0.22	38.6	17.4	0.11	0.00
608,828	5,000,868	39.4	0.42	30.5	12.5	0.10	0.01
604,246	5,005,499	49.5	0.21	38.1	17.4	0.11	0.00
604,572	5,006,050	61.8	0.20	58.2	19.3	0.09	0.00
604,569	5,006,067	61.4	0.20	57.8	19.2	0.09	0.00
604,566	5,006,085	60.9	0.20	57.5	19.0	0.08	0.00
604,217	5,005,506	49.0	0.21	37.7	17.3	0.11	0.00
604,248	5,005,613	47.6	0.21	42.8	17.9	0.09	0.00
604,217	5,005,600	45.8	0.21	41.2	17.2	0.09	0.00
604,254	5,005,715	52.9	0.20	47.9	18.0	0.09	0.00
604,533	5,006,154	59.1	0.20	55.9	18.8	0.08	0.00
604,203	5,005,632	47.1	0.20	42.4	17.6	0.09	0.00
604,474	5,006,083	60.9	0.19	57.1	18.7	0.08	0.00
604,246	5,005,728	53.1	0.20	48.2	17.8	0.09	0.00
604,254	5,005,746	54.2	0.19	49.2	17.4	0.09	0.00
604,236	5,005,749	53.7	0.19	48.8	17.5	0.09	0.00
604,181	5,005,647	47.1	0.20	42.4	17.6	0.09	0.00
604,199	5,005,683	49.5	0.20	44.7	18.1	0.08	0.00
604,245	5,005,773	55.0	0.19	50.0	16.8	0.10	0.00
604,453	5,006,114	60.1	0.19	56.5	18.7	0.08	0.00

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

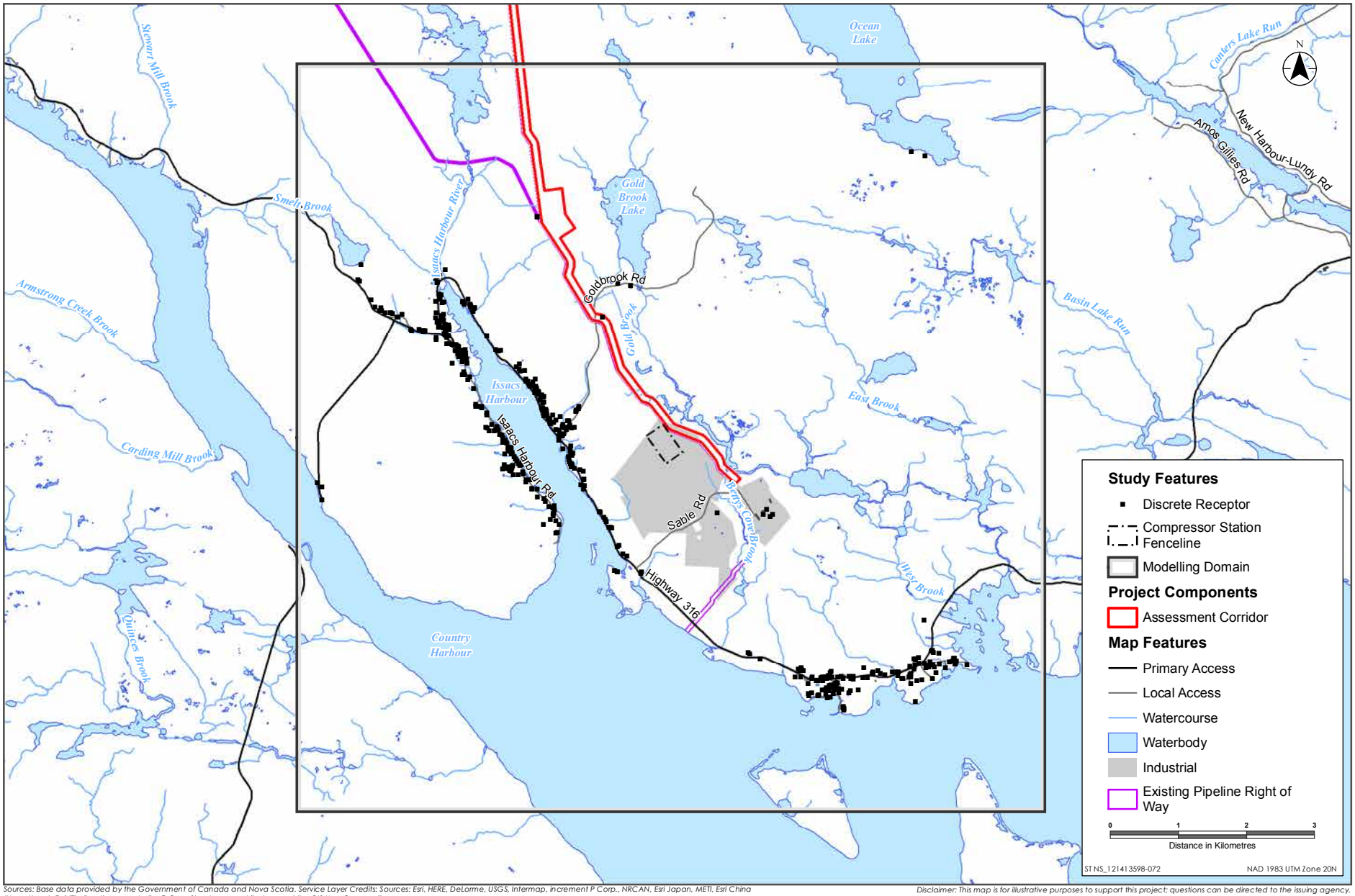
Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
604,458	5,006,131	59.7	0.19	56.2	18.7	0.08	0.00
604,176	5,005,736	51.2	0.19	46.4	17.9	0.08	0.00
604,201	5,005,784	54.1	0.19	49.2	17.0	0.09	0.00
604,061	5,005,567	46.6	0.20	35.8	16.7	0.10	0.00
604,064	5,005,592	47.5	0.20	36.5	16.7	0.10	0.00
604,136	5,005,746	50.5	0.19	45.7	17.8	0.08	0.00
604,172	5,005,848	55.6	0.19	50.8	15.5	0.10	0.00
604,097	5,005,749	49.8	0.19	45.0	17.6	0.08	0.00
604,159	5,005,872	56.1	0.18	51.2	14.8	0.10	0.00
604,107	5,005,792	51.8	0.19	47.0	17.4	0.08	0.00
604,114	5,005,810	52.7	0.19	47.9	17.1	0.09	0.00
604,149	5,005,893	56.4	0.18	51.6	14.2	0.10	0.00
604,170	5,005,940	58.0	0.18	53.2	14.0	0.09	0.00
604,091	5,005,829	52.9	0.19	48.0	16.9	0.09	0.00
604,137	5,005,915	56.8	0.18	52.0	13.9	0.10	0.00
604,094	5,005,844	53.5	0.19	48.7	16.5	0.09	0.00
604,076	5,005,824	52.4	0.19	47.5	17.0	0.08	0.00
604,056	5,005,876	54.0	0.18	49.1	16.2	0.09	0.00
605,551	5,007,368	104.8	0.38	218.8	62.1	0.20	0.01
604,179	5,006,114	60.0	0.18	55.8	13.1	0.08	0.00
605,547	5,007,377	104.8	0.38	217.0	61.7	0.19	0.01
604,065	5,005,955	56.8	0.18	52.0	13.7	0.10	0.00
604,152	5,006,098	60.0	0.18	55.6	11.7	0.08	0.00
609,391	5,000,723	37.3	0.38	28.9	10.2	0.09	0.01
609,428	5,000,739	37.2	0.38	28.8	9.7	0.09	0.01
603,903	5,005,691	45.9	0.19	36.1	15.9	0.10	0.00
603,882	5,005,694	45.8	0.19	35.5	15.9	0.10	0.00
609,411	5,000,699	37.0	0.38	28.7	10.1	0.09	0.01
603,873	5,005,682	45.5	0.19	35.0	16.0	0.10	0.00
609,435	5,000,707	37.0	0.38	28.6	9.8	0.09	0.01
604,127	5,006,153	60.0	0.18	55.7	13.1	0.08	0.00
603,865	5,005,697	45.6	0.19	35.1	15.9	0.10	0.00
609,461	5,000,704	36.8	0.37	28.5	9.5	0.09	0.01
604,137	5,006,215	59.3	0.18	55.3	15.3	0.08	0.00
609,340	5,000,601	36.9	0.36	28.6	11.0	0.09	0.01
604,057	5,006,124	59.6	0.17	55.2	12.2	0.08	0.00
604,113	5,006,238	59.0	0.17	55.1	15.4	0.08	0.00
603,812	5,005,714	45.1	0.19	34.7	15.8	0.09	0.00
609,427	5,000,608	36.8	0.36	28.5	10.2	0.09	0.01
603,706	5,005,697	42.4	0.19	32.6	15.0	0.09	0.00
603,692	5,005,706	42.3	0.19	32.5	15.0	0.09	0.00
609,594	5,000,600	36.1	0.36	28.0	8.8	0.08	0.01
604,087	5,006,409	55.5	0.17	52.3	17.0	0.08	0.00
604,079	5,006,401	55.8	0.17	52.5	17.0	0.08	0.00
609,587	5,000,581	36.0	0.35	27.9	8.7	0.08	0.01
604,120	5,006,484	53.0	0.17	50.2	16.8	0.08	0.00
604,198	5,006,588	48.0	0.17	45.7	16.5	0.08	0.00
609,529	5,000,511	35.7	0.35	27.7	9.5	0.08	0.01
604,119	5,006,506	52.3	0.17	49.6	17.0	0.07	0.00
604,057	5,006,467	54.7	0.17	51.7	16.6	0.08	0.00
604,070	5,006,485	54.0	0.17	51.1	16.3	0.08	0.00
609,656	5,000,543	35.5	0.35	27.5	8.7	0.08	0.01
609,724	5,000,591	35.6	0.35	27.6	8.8	0.07	0.01
609,744	5,000,598	35.7	0.35	27.6	8.8	0.07	0.01
609,874	5,000,684	35.6	0.35	27.6	8.9	0.07	0.01
609,744	5,000,590	35.6	0.35	27.6	8.8	0.07	0.01
609,679	5,000,542	35.1	0.35	27.3	8.7	0.08	0.01
609,773	5,000,607	35.5	0.35	27.6	8.9	0.07	0.01
609,744	5,000,581	35.5	0.35	27.5	8.8	0.07	0.01
609,857	5,000,659	35.5	0.35	27.5	8.9	0.07	0.01
609,797	5,000,605	35.2	0.35	27.3	8.8	0.07	0.01
609,833	5,000,627	34.9	0.35	27.0	8.9	0.07	0.01
609,802	5,000,587	35.2	0.35	27.3	8.8	0.07	0.01
609,751	5,000,550	35.3	0.34	27.3	8.7	0.07	0.01

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
609,829	5,000,593	34.7	0.35	26.9	8.8	0.07	0.01
609,540	5,000,363	35.2	0.33	27.3	9.8	0.08	0.01
609,886	5,000,598	35.0	0.34	27.1	8.8	0.07	0.01
609,584	5,000,366	35.1	0.33	27.2	9.4	0.08	0.01
609,548	5,000,328	34.8	0.32	27.0	9.8	0.08	0.01
603,563	5,005,930	41.2	0.18	37.1	14.3	0.09	0.00
609,965	5,000,596	34.8	0.34	27.0	8.7	0.07	0.01
610,017	5,000,615	34.1	0.34	26.3	8.8	0.08	0.01
609,744	5,000,408	34.6	0.33	26.8	8.3	0.07	0.01
603,504	5,005,898	43.0	0.18	33.9	14.6	0.09	0.00
609,803	5,000,445	34.4	0.33	26.7	8.4	0.07	0.01
609,855	5,000,478	34.7	0.33	26.9	8.5	0.07	0.01
609,844	5,000,469	34.7	0.33	26.9	8.5	0.07	0.01
609,868	5,000,481	34.6	0.33	26.8	8.5	0.07	0.01
609,782	5,000,418	34.3	0.33	26.6	8.4	0.07	0.01
603,491	5,005,899	43.0	0.18	33.6	14.6	0.09	0.00
609,939	5,000,515	34.3	0.33	26.6	8.5	0.07	0.01
609,794	5,000,408	34.2	0.33	26.5	8.4	0.07	0.01
609,674	5,000,326	34.4	0.32	26.7	8.7	0.07	0.01
609,688	5,000,332	34.3	0.32	26.6	8.5	0.07	0.01
609,688	5,000,332	34.3	0.32	26.6	8.5	0.07	0.01
609,864	5,000,452	34.6	0.33	26.8	8.4	0.07	0.01
609,963	5,000,521	34.5	0.33	26.8	8.5	0.07	0.01
609,949	5,000,510	34.4	0.33	26.6	8.5	0.07	0.01
610,045	5,000,577	34.2	0.33	26.2	8.7	0.07	0.01
609,869	5,000,450	34.5	0.33	26.8	8.4	0.07	0.01
609,928	5,000,488	33.8	0.33	26.2	8.5	0.07	0.01
609,823	5,000,408	34.1	0.32	26.4	8.4	0.07	0.01
609,898	5,000,456	34.2	0.33	26.6	8.4	0.06	0.01
609,845	5,000,405	34.2	0.32	26.5	8.3	0.07	0.01
609,944	5,000,475	33.8	0.33	26.2	8.5	0.07	0.01
610,137	5,000,610	34.9	0.33	26.7	8.8	0.08	0.01
609,795	5,000,350	34.6	0.32	26.5	8.2	0.07	0.01
609,919	5,000,417	34.1	0.32	26.5	8.3	0.06	0.01
610,195	5,000,611	35.4	0.33	27.1	8.6	0.08	0.01
603,419	5,005,947	42.6	0.18	33.7	14.3	0.09	0.00
610,353	5,000,731	34.5	0.33	26.4	8.9	0.08	0.01
610,165	5,000,576	35.0	0.33	26.8	8.7	0.08	0.01
603,401	5,005,948	42.8	0.18	33.3	14.3	0.09	0.00
609,982	5,000,430	33.6	0.32	26.0	8.3	0.06	0.01
603,385	5,005,948	42.9	0.18	33.0	14.3	0.09	0.00
609,905	5,000,361	34.0	0.32	26.4	8.2	0.06	0.01
610,199	5,000,569	35.3	0.33	27.0	8.6	0.08	0.01
609,814	5,000,292	35.0	0.31	26.8	8.1	0.07	0.01
609,857	5,000,310	34.2	0.31	26.2	8.1	0.07	0.01
610,023	5,000,422	33.8	0.32	26.2	8.3	0.07	0.01
609,985	5,000,368	33.3	0.31	25.9	8.2	0.06	0.01
610,339	5,000,592	35.1	0.32	26.9	8.7	0.08	0.01
603,312	5,005,961	43.0	0.17	33.1	14.4	0.09	0.00
610,489	5,000,678	34.2	0.31	26.2	8.6	0.08	0.01
610,471	5,000,651	34.5	0.31	26.4	8.6	0.08	0.01
610,157	5,000,406	34.7	0.31	26.6	8.2	0.07	0.01
610,406	5,000,592	35.3	0.31	27.0	8.7	0.08	0.01
610,488	5,000,646	34.5	0.31	26.4	8.6	0.08	0.01
603,264	5,005,986	43.4	0.17	33.4	14.4	0.09	0.00
610,136	5,000,367	34.3	0.31	26.2	8.1	0.07	0.01
610,560	5,000,691	33.0	0.31	25.6	8.3	0.07	0.01
611,240	5,001,440	34.5	0.31	26.4	10.4	0.07	0.01
603,231	5,005,983	42.7	0.17	32.8	14.3	0.08	0.00
603,252	5,006,036	43.7	0.17	33.7	14.1	0.09	0.00
610,267	5,000,409	34.8	0.31	26.7	8.3	0.07	0.01
610,598	5,000,650	32.8	0.30	25.4	8.3	0.07	0.01
610,052	5,000,174	33.2	0.29	25.4	7.8	0.06	0.01
603,165	5,006,042	43.3	0.17	33.3	14.2	0.09	0.00

Table 1 Overall Maximum Predicted Ground Level Concentrations, Head Compressor Site

Receptor Location UTM		Maximum Predicted Ground Level Concentrations (µg/m^3)					
Easting (m)	Northing (m)	1-hour NO_x	Annual NO_2	CO 1-hour	CO-8-hour	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual
610,666	5,000,632	33.3	0.30	25.5	8.4	0.07	0.01
610,047	5,000,151	33.7	0.29	25.8	7.8	0.06	0.01
610,063	5,000,141	33.5	0.29	25.6	7.7	0.06	0.01
610,061	5,000,140	33.5	0.29	25.7	7.7	0.06	0.01
610,062	5,000,115	33.8	0.29	25.9	7.7	0.06	0.01
610,774	5,000,675	33.5	0.29	25.7	9.2	0.07	0.01
603,107	5,006,149	42.2	0.17	34.4	14.0	0.09	0.00
610,840	5,000,672	34.4	0.29	26.3	9.5	0.06	0.01
610,860	5,000,679	34.5	0.29	26.5	9.6	0.06	0.01
610,853	5,000,621	33.8	0.28	25.9	9.2	0.06	0.01
611,094	5,000,869	31.7	0.28	24.4	9.7	0.06	0.01
611,114	5,000,867	32.1	0.28	24.6	9.5	0.06	0.01
611,027	5,000,765	34.0	0.28	26.1	10.2	0.06	0.01
611,109	5,000,851	31.7	0.28	24.3	9.7	0.06	0.01
611,159	5,000,882	33.5	0.28	25.7	9.1	0.06	0.01
611,107	5,000,782	33.3	0.28	25.6	10.0	0.06	0.01
610,917	5,000,579	34.0	0.28	26.0	9.3	0.06	0.01
610,927	5,000,588	34.2	0.28	26.2	9.4	0.06	0.01
611,164	5,000,805	31.6	0.28	24.3	9.6	0.06	0.01
611,088	5,000,713	33.9	0.28	26.0	10.1	0.06	0.01
611,044	5,000,652	34.3	0.28	26.3	10.0	0.06	0.01
611,029	5,000,630	34.2	0.27	26.3	9.9	0.06	0.01
611,351	5,000,982	34.4	0.28	26.4	8.0	0.06	0.01
611,359	5,000,991	34.3	0.28	26.3	8.2	0.06	0.01
611,017	5,000,600	34.1	0.27	26.2	9.8	0.06	0.01
611,044	5,000,599	34.1	0.27	26.1	9.9	0.06	0.01
611,246	5,000,804	33.1	0.27	25.4	9.1	0.06	0.01
611,376	5,000,959	34.4	0.27	26.4	8.0	0.06	0.01
611,330	5,000,825	34.3	0.27	26.3	8.2	0.06	0.01
611,043	5,000,511	34.2	0.27	26.2	9.4	0.06	0.01
611,268	5,000,741	31.8	0.27	24.4	9.4	0.06	0.01
602,942	5,006,423	45.3	0.16	41.0	16.0	0.08	0.00
611,306	5,000,773	33.4	0.27	25.6	8.9	0.06	0.01
611,459	5,000,949	34.0	0.27	26.1	8.2	0.06	0.01
611,306	5,000,751	32.9	0.27	25.2	9.1	0.06	0.01
611,129	5,000,554	34.1	0.27	26.2	9.9	0.06	0.01
602,913	5,006,440	45.0	0.16	40.8	15.8	0.07	0.00
602,386	5,003,396	33.3	0.14	25.6	10.5	0.06	0.00
611,369	5,000,784	34.1	0.27	26.2	8.3	0.06	0.01
611,206	5,000,559	33.7	0.26	25.9	10.0	0.06	0.01
611,388	5,000,751	33.9	0.26	26.0	8.5	0.06	0.01
602,381	5,003,199	33.6	0.14	25.8	10.3	0.05	0.00
602,313	5,003,456	33.3	0.14	25.6	10.0	0.06	0.00
602,962	5,006,669	52.5	0.15	48.1	13.2	0.09	0.00
611,461	5,000,786	34.0	0.26	26.1	7.7	0.06	0.01
611,418	5,000,662	32.6	0.26	25.0	9.0	0.06	0.01
611,361	5,000,582	32.5	0.26	25.0	9.7	0.05	0.01
611,610	5,000,824	33.6	0.25	25.8	7.9	0.06	0.01
611,552	5,000,739	33.8	0.25	26.0	7.5	0.06	0.01
611,673	5,000,874	33.2	0.25	25.5	8.5	0.06	0.01
611,109	5,000,248	32.6	0.25	25.0	8.2	0.06	0.01
611,650	5,000,830	33.6	0.25	25.8	8.1	0.06	0.01
611,686	5,000,874	33.1	0.25	25.4	8.5	0.06	0.01
611,716	5,000,836	33.2	0.25	25.5	8.3	0.06	0.01
611,700	5,000,804	33.5	0.25	25.7	8.1	0.06	0.01
611,694	5,000,786	33.5	0.25	25.7	7.9	0.06	0.01
611,873	5,000,783	32.6	0.24	25.0	8.5	0.06	0.01
611,049	5,008,332	34.2	0.25	26.3	9.3	0.06	0.01
611,255	5,008,265	34.9	0.24	26.9	9.3	0.06	0.01



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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

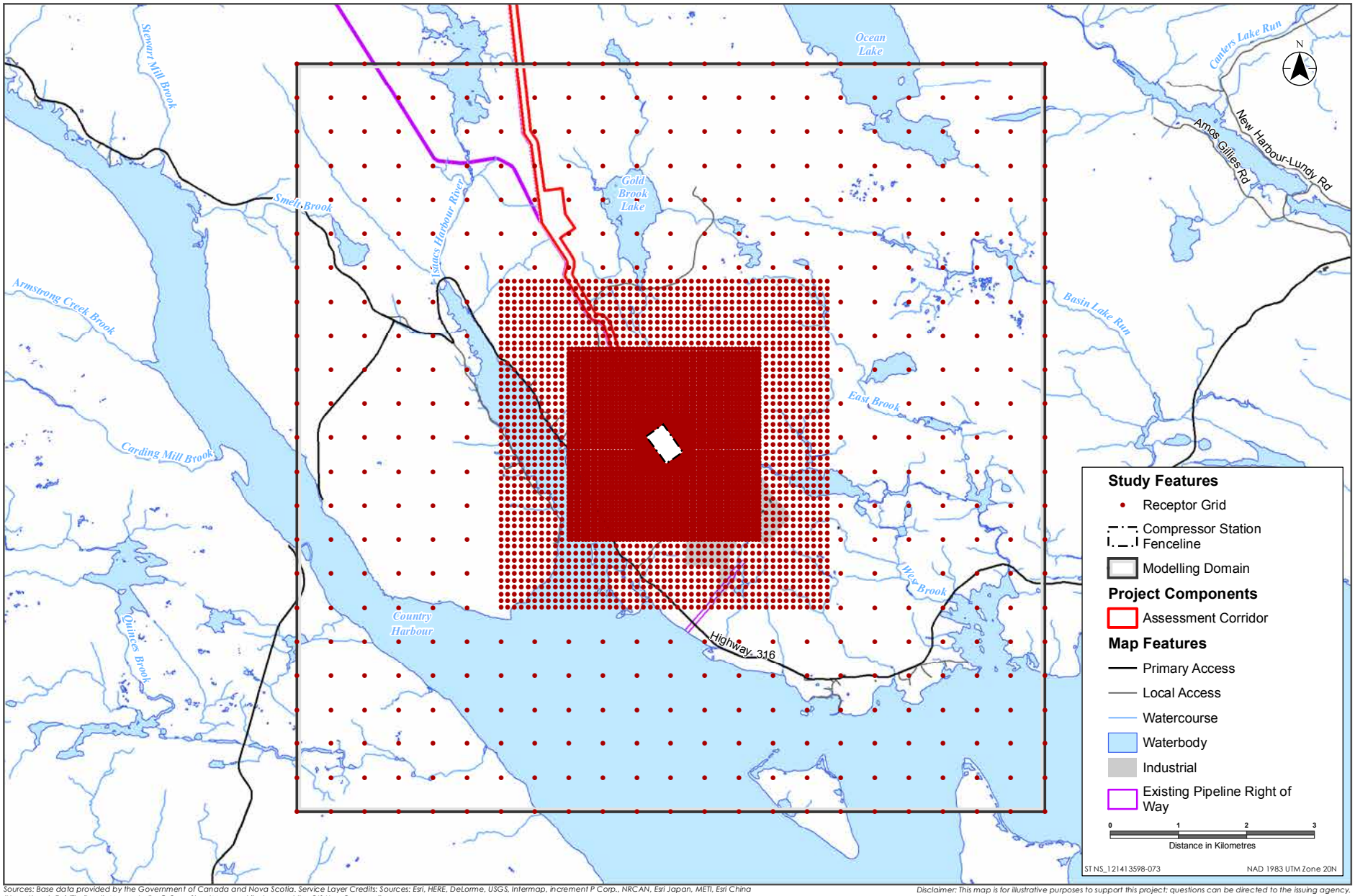
BEAR PAW PIPELINE

Stantec

BEAR PAW PIPELINE PROJECT

Air Dispersion Modelling Domain and Discrete Receptors

Figure 1



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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

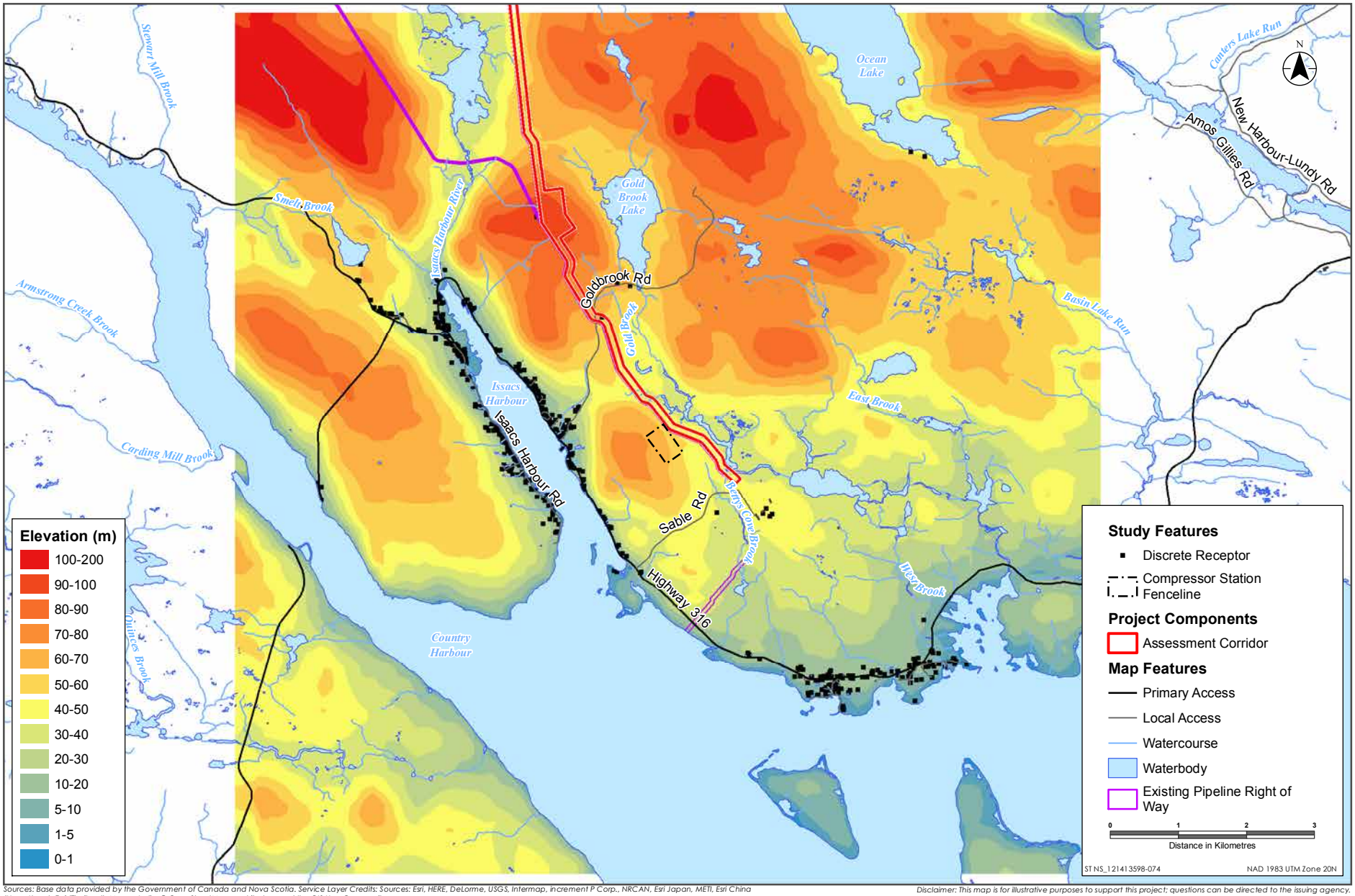
Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Air Dispersion Modelling Receptor Grid

Figure 3



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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

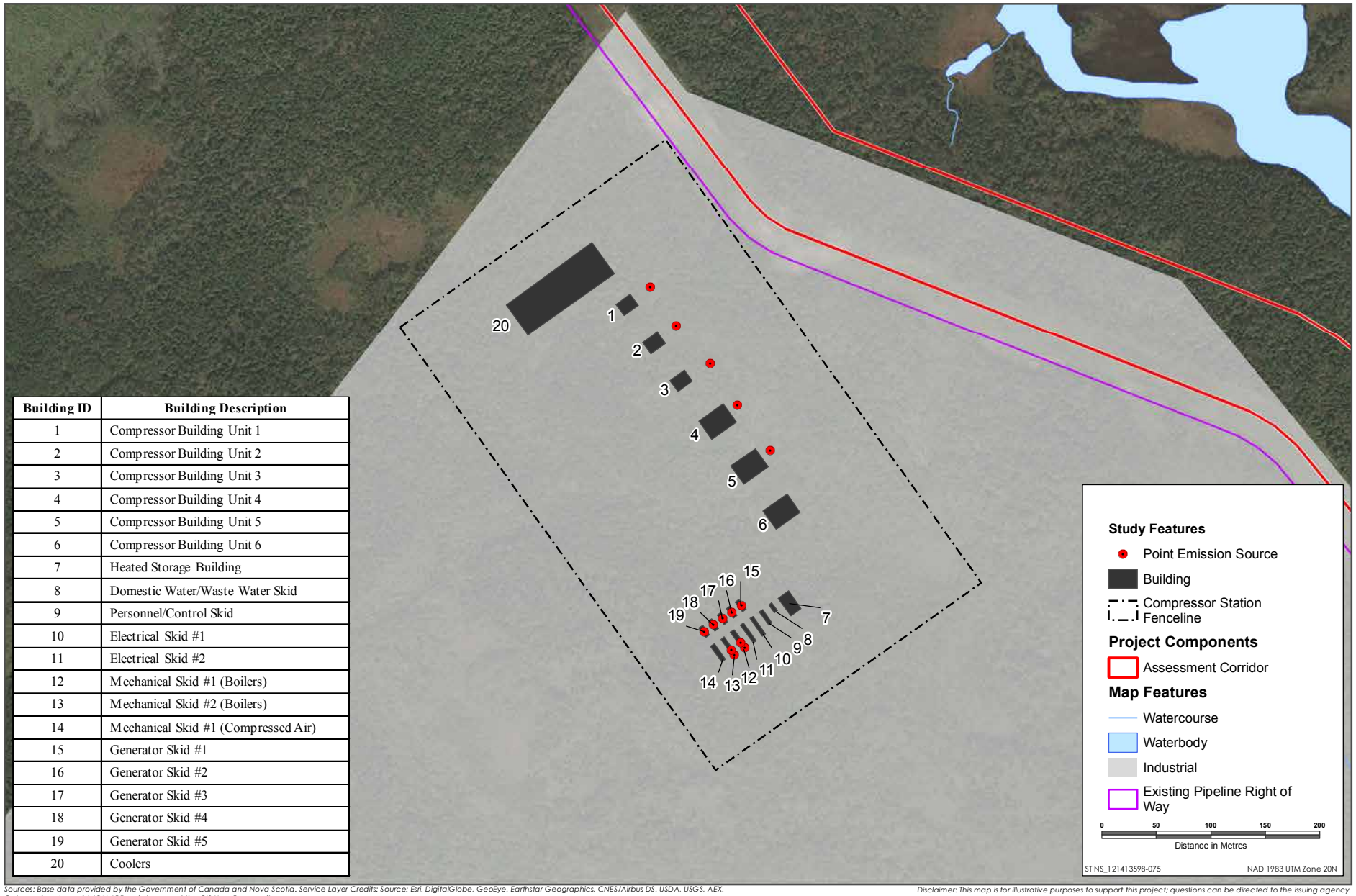
Bear Paw Pipeline

Stantec

BEAR PAW PIPELINE PROJECT

Terrain Elevation Data

Figure 4



Building ID	Building Description
1	Compressor Building Unit 1
2	Compressor Building Unit 2
3	Compressor Building Unit 3
4	Compressor Building Unit 4
5	Compressor Building Unit 5
6	Compressor Building Unit 6
7	Heated Storage Building
8	Domestic Water/Waste Water Skid
9	Personnel/Control Skid
10	Electrical Skid #1
11	Electrical Skid #2
12	Mechanical Skid #1 (Boilers)
13	Mechanical Skid #2 (Boilers)
14	Mechanical Skid #1 (Compressed Air)
15	Generator Skid #1
16	Generator Skid #2
17	Generator Skid #3
18	Generator Skid #4
19	Generator Skid #5
20	Coolers

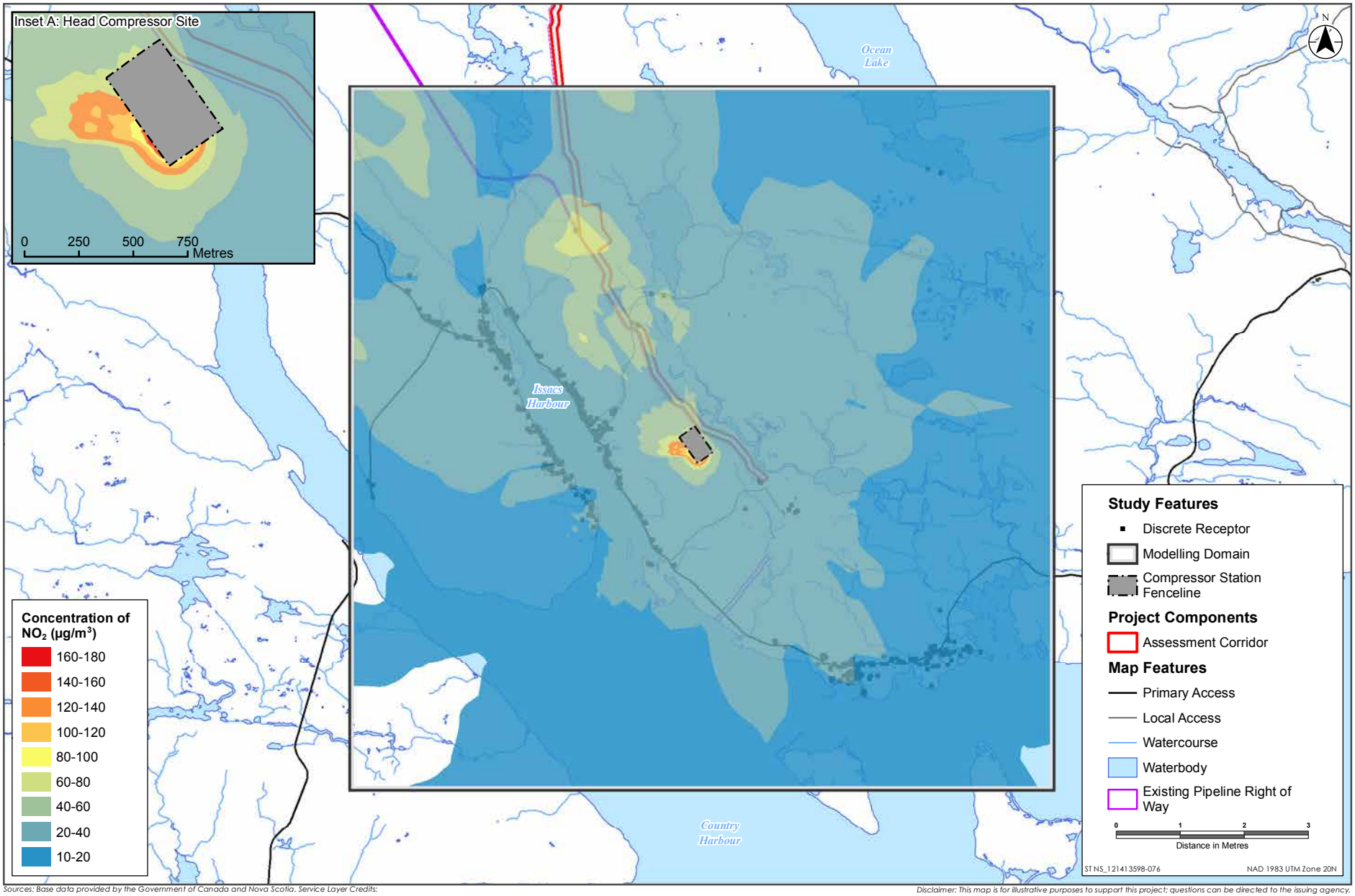
BEAR PAW PIPELINE

Stantec

BEAR PAW PIPELINE PROJECT

Buildings and Point Emission Sources

Figure 5



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

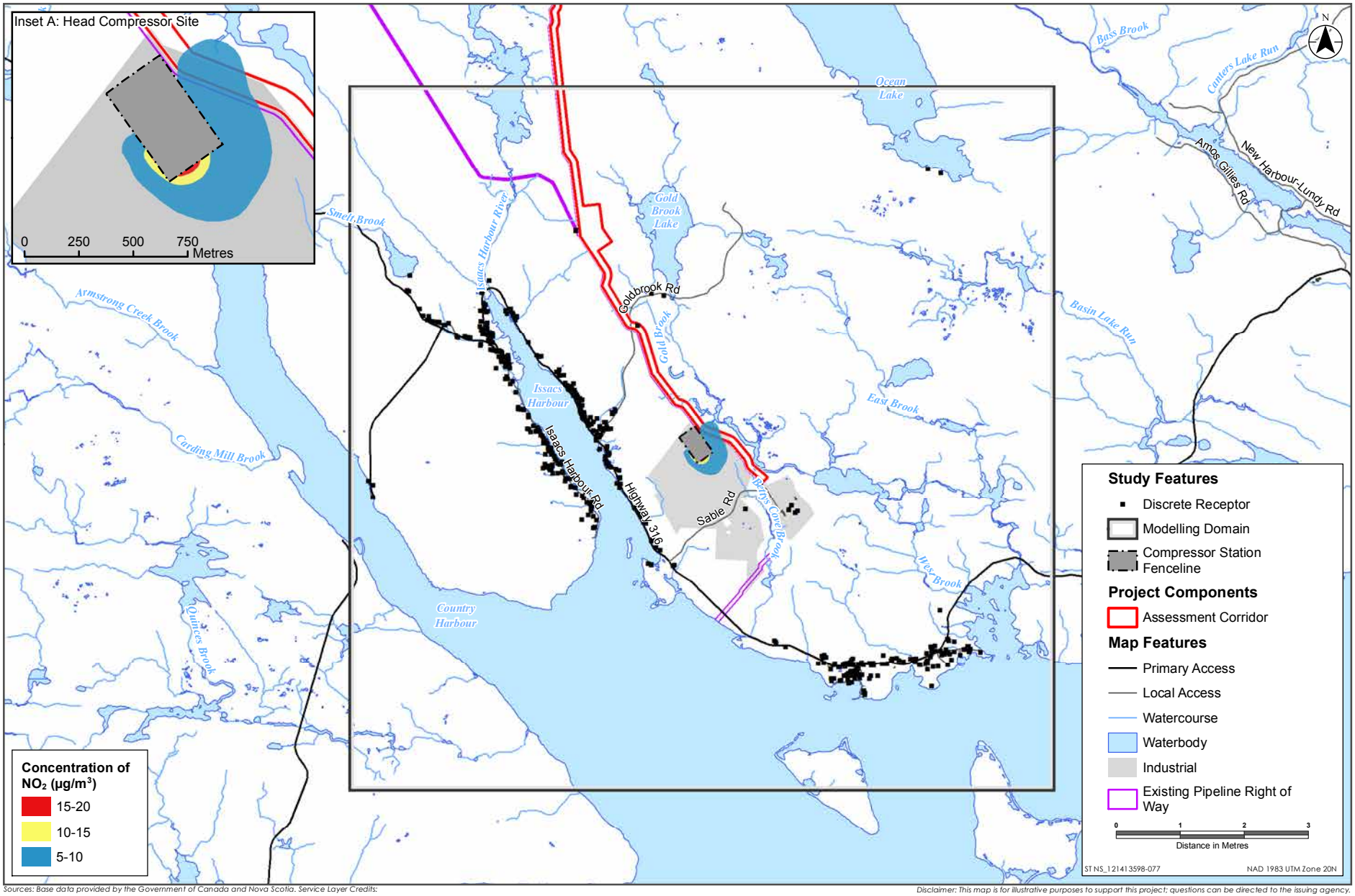
Stantec

BEAR PAW PIPELINE PROJECT

Maximum Predicted 9th Highest 1-hour Ground Level Concentrations of NO_2

Regulatory Limit = 400µg/m³

Figure 6



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

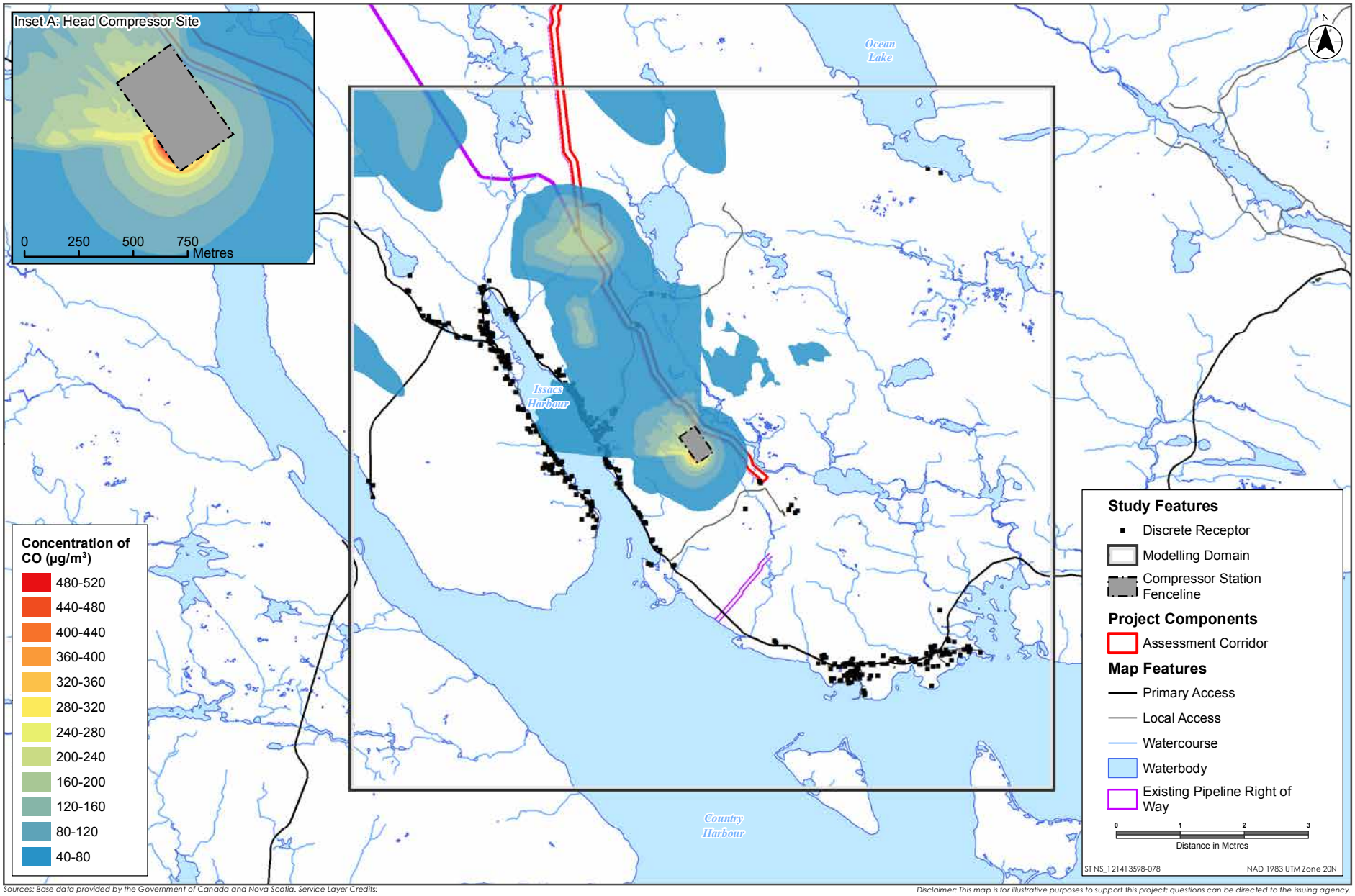
Stantec

BEAR PAW PIPELINE PROJECT

Maximum Predicted Annual Ground Level Concentrations of NO_2

Regulatory Limit = 100µg/m³

Figure 7



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

Bear Paw Pipeline

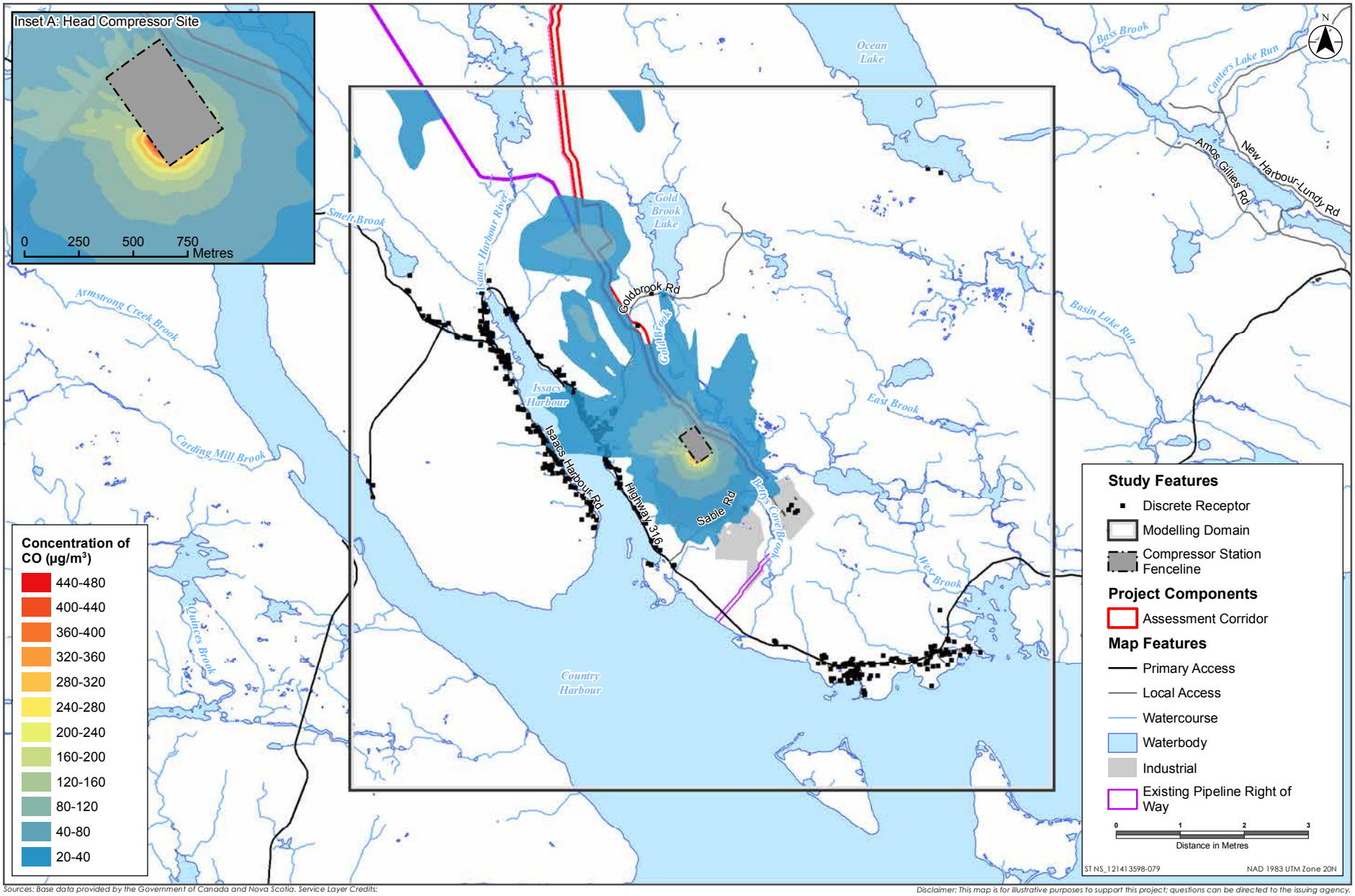
Stantec

BEAR PAW PIPELINE PROJECT

Maximum Predicted 9th Highest 1-hour Ground Level Concentrations of CO

Regulatory Limit = 34,600µg/m³

Figure 8



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

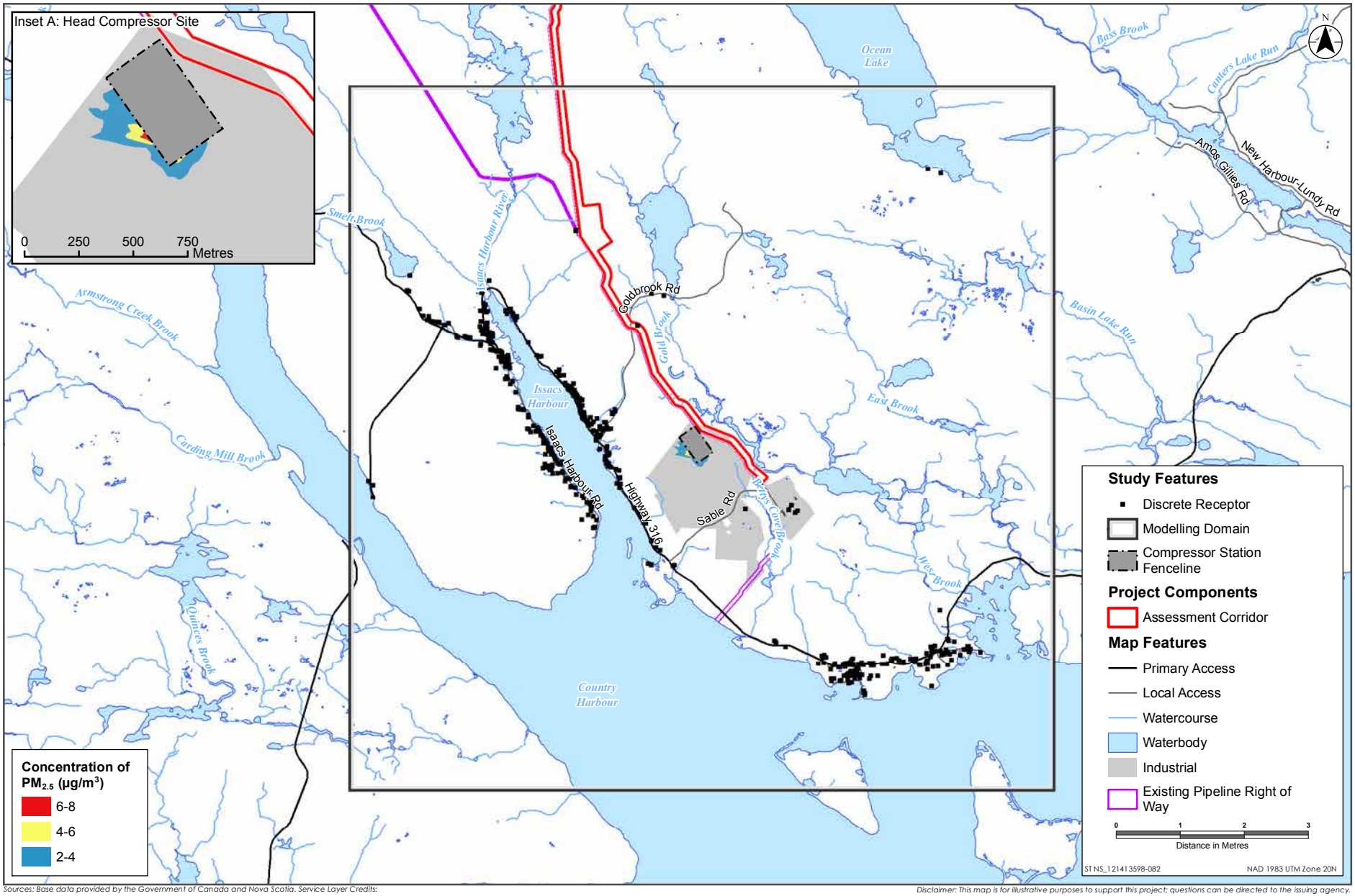
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Maximum Predicted 3rd Highest 8-hour Ground Level Concentrations of CO

Regulatory Limit = 12,700µg/m³

Figure 9

BEAR PAW PIPELINE PROJECT



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

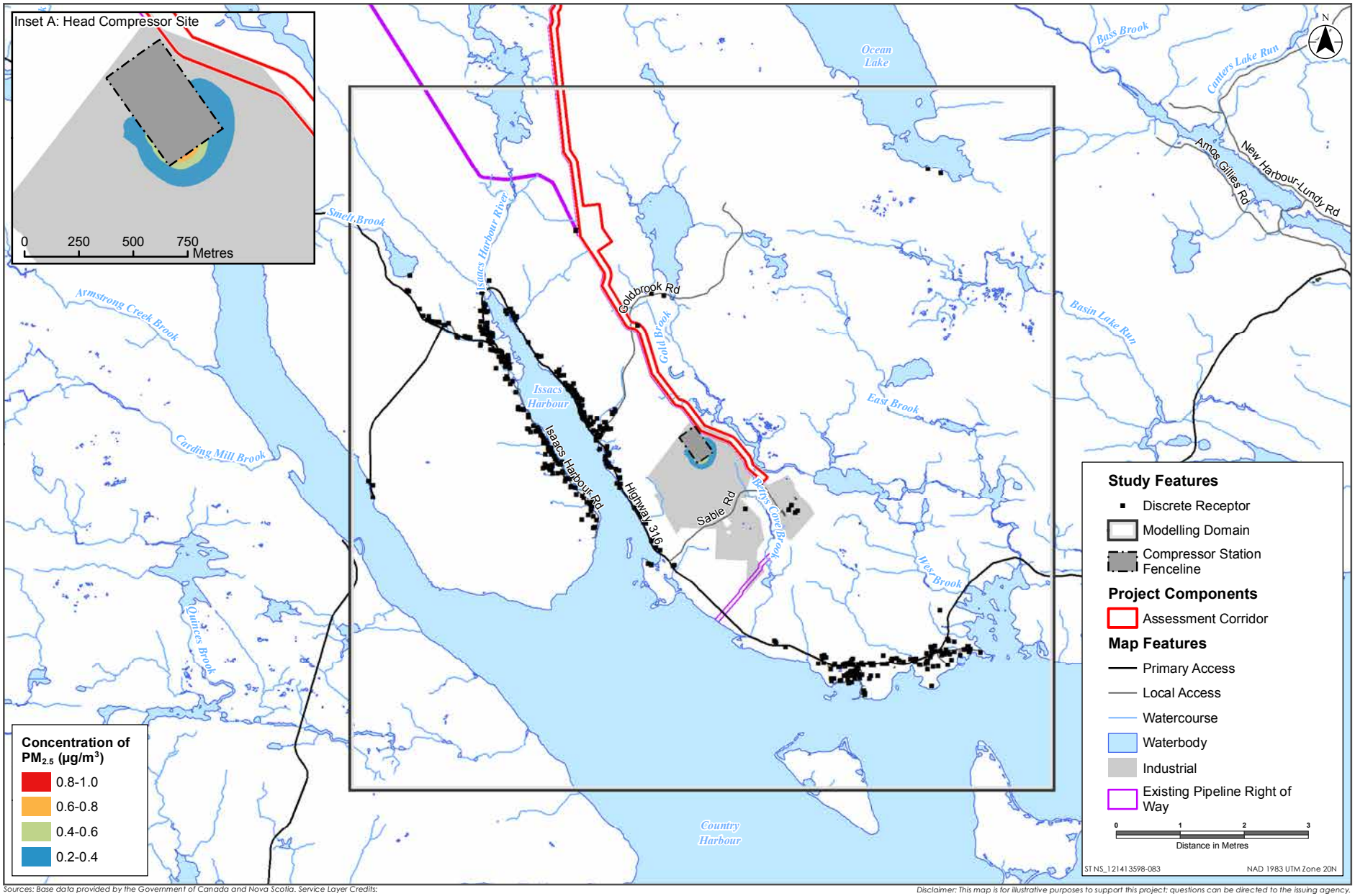
Disclaimer: This map is for illustrative purposes to support this project; questions can be directed to the issuing agency.

Maximum Predicted 2nd Highest 24-hour Ground Level Concentrations of $PM_{2.5}$

Regulatory Limit = 27µg/m³

Figure 10

BEAR PAW PIPELINE PROJECT



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

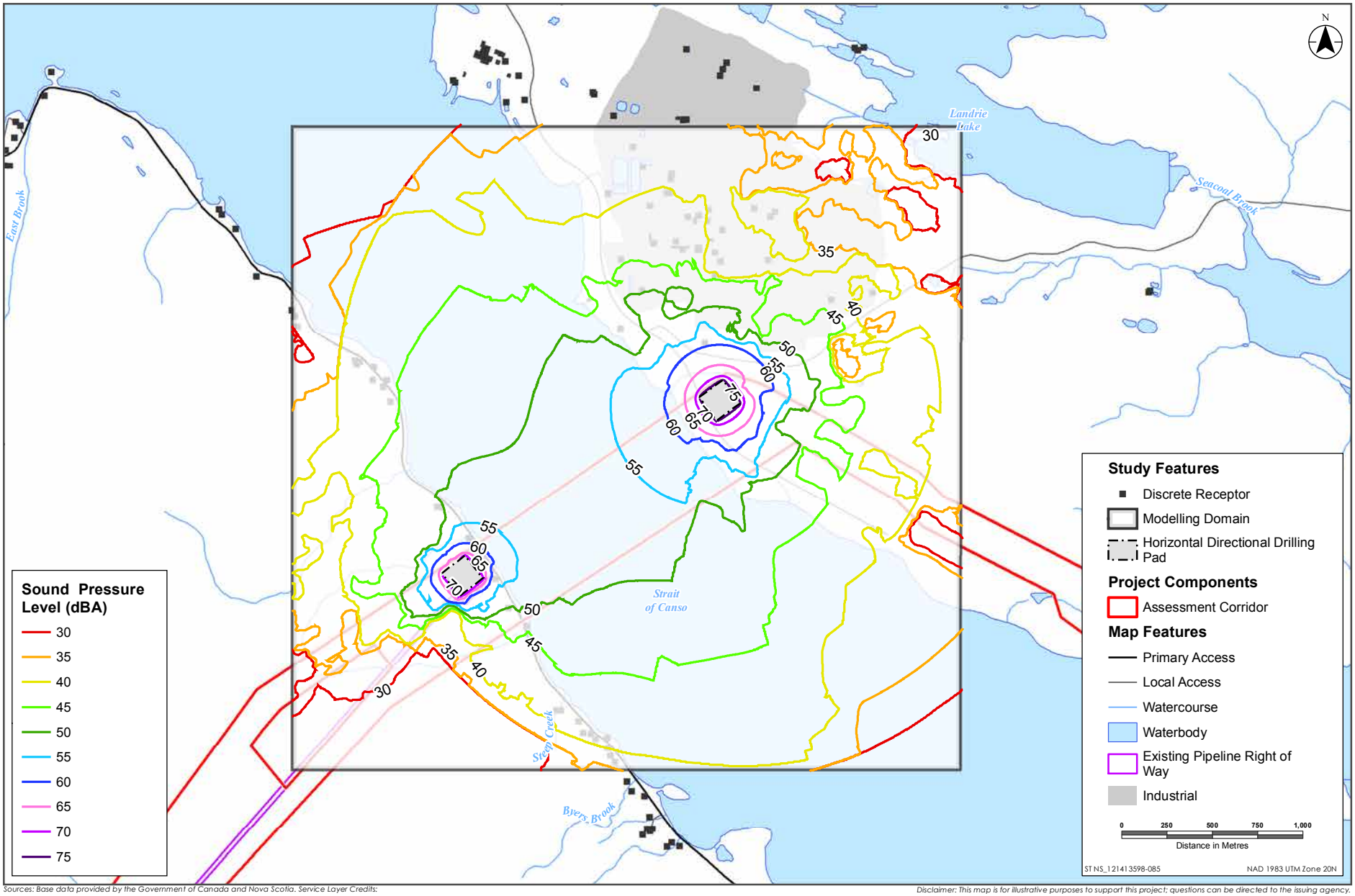
Stantec

BEAR PAW PIPELINE PROJECT

Maximum Predicted Annual Ground Level Concentrations of $PM_{2.5}$

Regulatory Limit = 8.8µg/m³

Figure 11



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

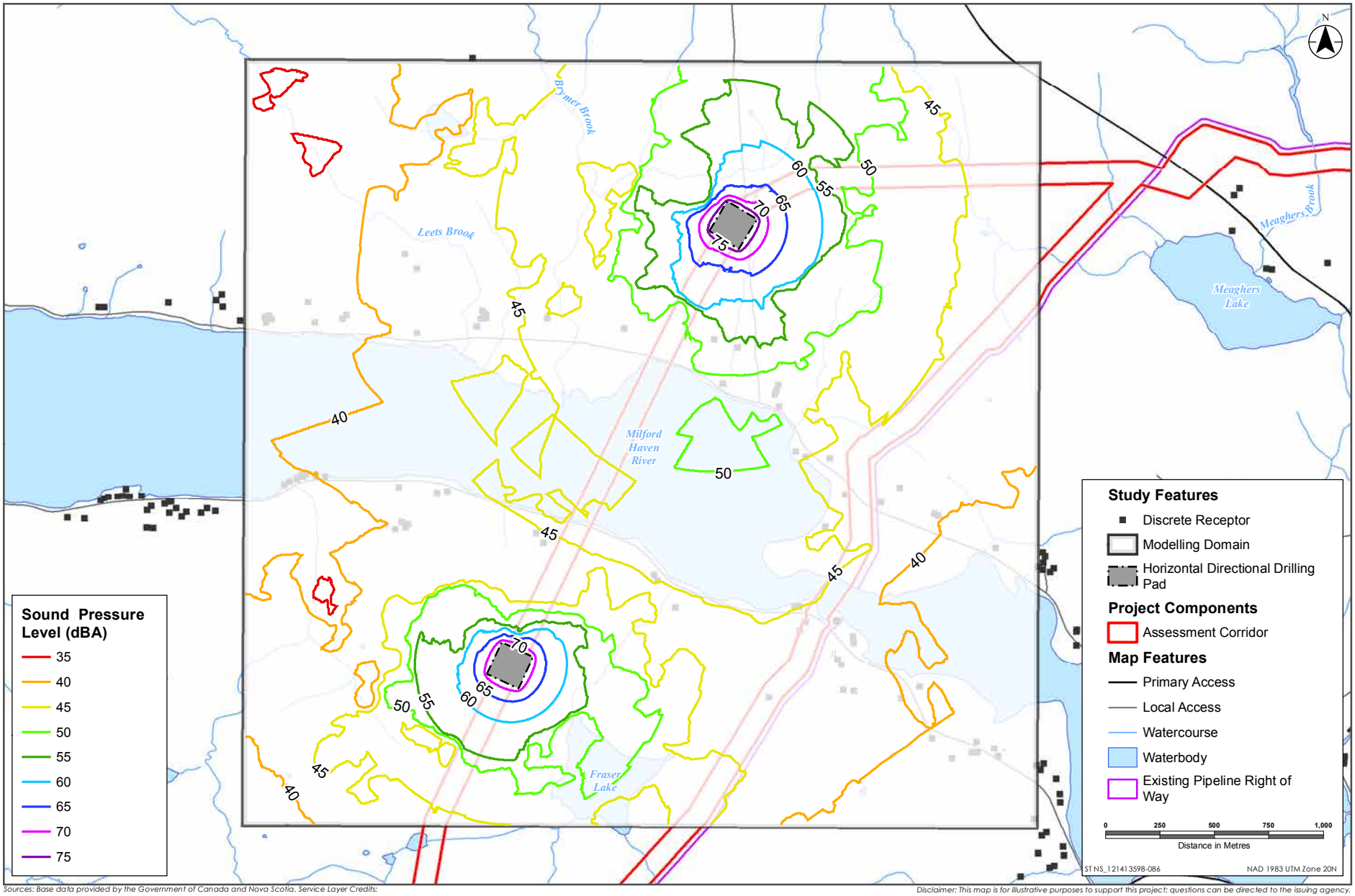
Stantec

BEAR PAW PIPELINE PROJECT

Predicted Sound Pressure Levels for HDD, Strait of Canso

Municipality of Guysborough Noise Limits
Daytime (6:00 am to 11:00 pm), 65 dBA
Nighttime (11:00 pm to 6:00 am), 55 dBA

Figure 12



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

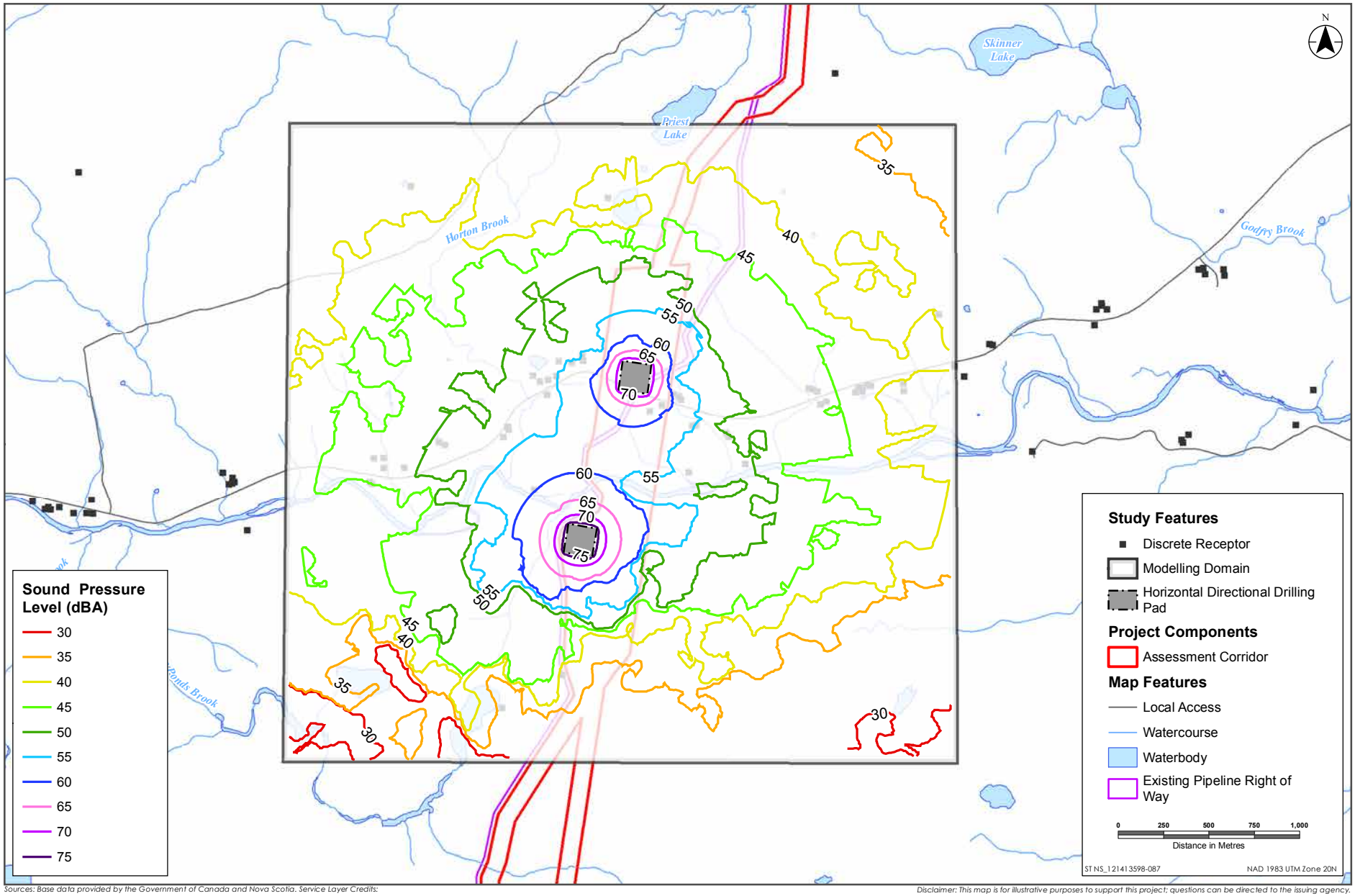
Stantec

BEAR PAW PIPELINE PROJECT

Predicted Sound Pressure Levels for HDD, Milford Haven River

Municipality of Guysborough Noise Limits
Daytime (6:00 am to 11:00 pm), 65 dBA
Nighttime (11:00 pm to 6:00 am), 55 dBA

Figure 13



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

BEAR PAW PIPELINE

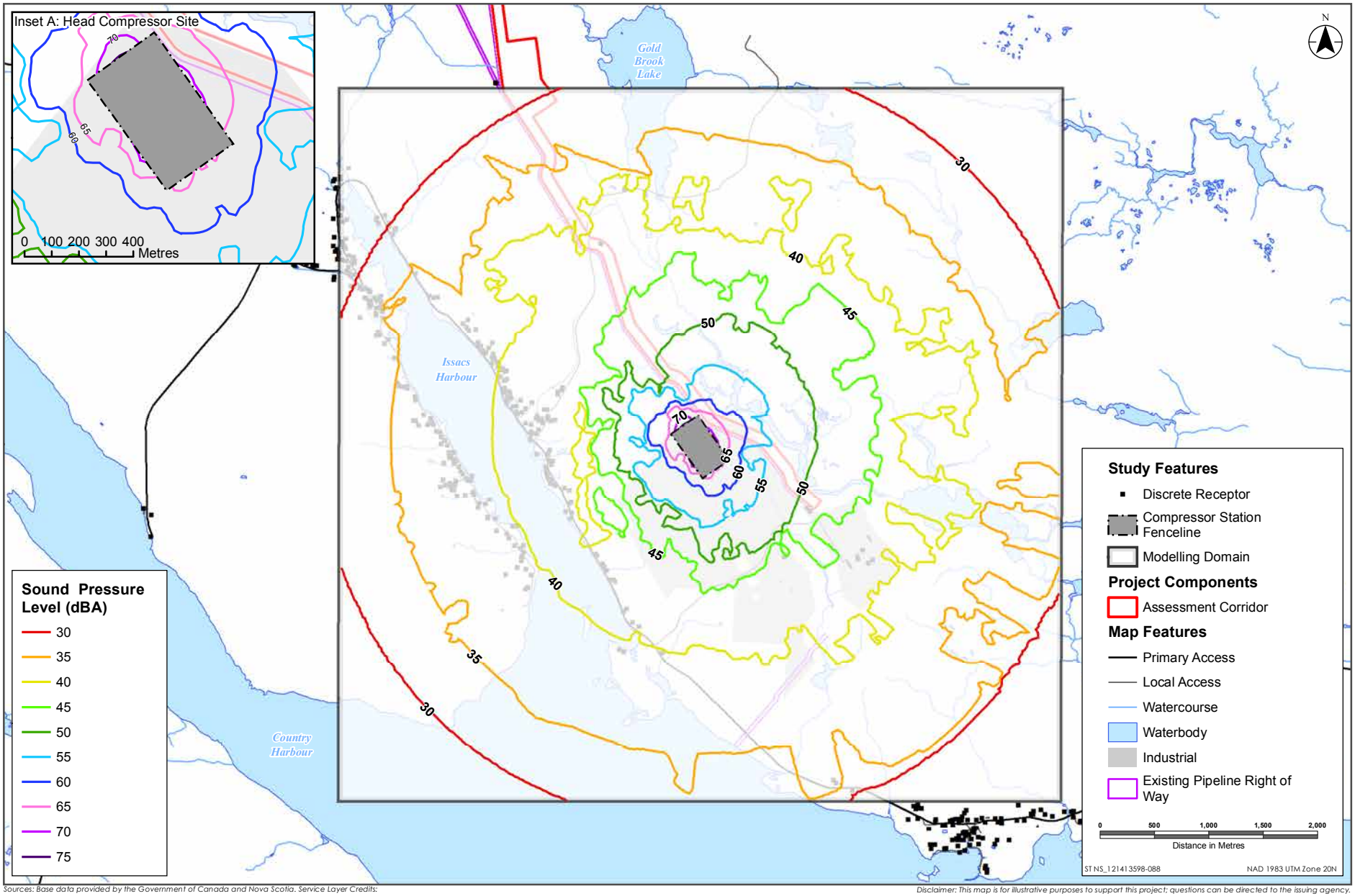
Stantec

BEAR PAW PIPELINE PROJECT

Predicted Sound Pressure Levels for HDD, Salmon River

Municipality of Guysborough Noise Limits
Daytime (6:00 am to 11:00 pm), 65 dBA
Nighttime (11:00 pm to 6:00 am), 55 dBA

Figure 14



Sources: Base data provided by the Government of Canada and Nova Scotia. Service Layer Credits:

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

Predicted Sound Pressure Levels for the Operation of the Head Compressor Site

Municipality of Guysborough Noise Limits
Daytime (6:00 am to 11:00 pm), 65 dBA
Nighttime (11:00 pm to 6:00 am), 55 dBA

Figure 15

BEAR PAW PIPELINE PROJECT

March 2016

APPENDIX C2
ANNUAL EMISSIONS CALCULATIONS

March 2016

March 2016

Emissions Calculations for CACs

Compressors (Gas Turbine Driven)

Assumptions

- Six compressors, five operating and one spare (compressors 1 and 2 are assumed to be Solar Centaur 40 SoLoNO$_x$ (4,700 hp), compressor 3 a Solar Taurus 60 SoLoNO$_x$ (7,700 hp) and compressors 4, 5 and 6 are Solar Titan 250 SoLoNO$_x$ (30,000 hp)).
- Operating hours for each compressor – 8,760 hours/year.
- Natural gas fuel combustion.
- Heat Rate for the Solar Centaur 40 SoLoNO$_x$ = 9,125 BTU/hp-hr (42.9 MMBtu/hr); Heat Rate for the Solar Taurus 60 SoLoNO$_x$ = 7,965 BTU/hp-hr (61.3 MMBtu/hr); Heat Rate for the Solar Titan 250 SoLoNO$_x$ = 6,360 BTU/hp-hr (190.8 MMBtu/hr).
- Emissions of NO$_x$ = 25 ppm, typical guarantee point for Dry Low Emissions Turbo-Compressor Packages.
- Emissions of CO = 50 ppm, typical guarantee point for Dry Low Emissions Turbo-Compressor Packages.
- Emission factor for PM from US EPA AP-42 Chapter 3.1 Stationary Gas Turbines, combustion turbine with water-steam injection (6.60E-03 lb/MMBtu).
- Stack gas flow rates (corrected for temperature) for the Solar Centaur 40 SoLoNO$_x$ = 16.0 m^3/s; Solar Taurus 60 SoLoNO$_x$ = 18.3 m^3/s; Solar Titan 250 SoLoNO$_x$ = 57.6 m^3/s.

Emissions Calculations

For NO$_x$:

Concentration of NO$_x$ at 25 ppm = 47.0 mg/m^3 at 298 K (assuming molecular weight of NO$_2$)

For compressors 1 and 2:
Stack Gas Emission Rate = (47.0 mg/m^3 x 16.0 m^3/s) x 0.001 g/mg
= 0.75 g/s

Annual Emissions = ((0.75 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 t/g
= 47.3 tonnes/yr

For compressor 3:
Stack Gas Emission Rate = (47.0 mg/m^3 x 18.3 m^3/s) x 0.001 g/mg
= 0.86 g/s

Annual Emissions = (0.86 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 0.000001 tonnes/g
= 27.1 tonnes/yr

For compressors 4 and 5:
Stack Gas Emission Rate = (47.0 mg/m^3 x 57.6 m^3/s) x 0.001 g/mg
= 2.71 g/s
Annual Emissions = ((2.71 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 tonnes/g
= 171 tonnes/yr

<u>For CO:</u>

Concentration of CO at 50 ppm = 57.3 mg/m^3

For compressors 1 and 2:
Stack Gas Emission Rate = (57.3 mg/m^3 x 16.0 m^3/s) x 0.001 g/mg
= 0.92 g/s

Annual Emissions = ((0.92 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 tonnes/g
= 57.8 tonnes/yr

For compressor 3:
Stack Gas Emission Rate = (57.3 mg/m^3 x 18.3 m^3/s) x 0.001 g/mg
= 1.05 g/s

Annual Emissions = (1.05 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 0.000001 tonnes/g
= 33.0 tonnes/yr

For compressors 4 and 5:
Stack Gas Emission Rate = (57.3 mg/m^3 x 57.6 m^3/s) x 0.001 g/mg
= 3.30 g/s

Annual Emissions = ((3.30 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 tonnes/g
= 208 tonnes/yr

For PM:

For compressors 1 and 2:
Stack Gas Emission Rate = ((6.60E-03 lb/MMBtu x 42.9 MMBtu/hr) x 453.592 g/lb)/(60 min/hr)/(60 sec/min)
= 0.04 g/s

Annual Emissions = ((0.04 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 tonnes/g
= 2.24 tonnes/yr

For compressor 3:
Stack Gas Emission Rate = ((6.60E-03 lb/MMBtu x 61.3 MMBtu/hr) x 453.592 g/lb)/(60 min/hr)/(60 sec/min)
= 0.05 g/s

Annual Emissions = (0.05 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 0.000001 tonnes/g
= 1.61 tonnes/yr

For compressors 4 and 5:
Stack Gas Emission Rate = ((6.60E-03 lb/MMBtu x 190.8 MMBtu/hr) x 453.592 g/lb)/(60 min/hr)/(60 sec/min)
= 0.16 g/s

Annual Emissions = (0.16 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 2) x 0.000001 tonnes/g
= 10 tonnes/yr

Boilers

Assumptions

- Four boilers, Package type - Bryan HE-RV800.
- Natural gas fuel combustion.
- Operating hours for each boiler – 8,760 hours/year.
- 85% efficiency.
- Heat input = 8 MMBtu/hr.
- Emission factors for NOx, CO and PM were acquired from the US EPA AP-42 Chapter 1.4, Natural Gas Combustion (low NOx burners) – NOx = 0.137 lb/MMBtu; CO = 0.082 lb/MMBtu; PM = 0.007 lb/MMBtu.

Emissions Calculations

For NO_x:

For Boilers 1 – 4:

Stack Gas Emission Rate = ((0.137 lb/MMBtu x 8 MMBtu/hr)/60/60) x 453.592 g/lb
= 0.138 g/s

Annual Emissions = ((0.138 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x 0.000001 tonnes/g
= 17.5 tonnes/yr

For CO:

For Boilers 1 – 4:

Stack Gas Emission Rate = ((0.082 lb/MMBtu x 8 MMBtu/hr)/60/60) x 453.592 g/lb
= 0.083 g/s

Annual Emissions = ((0.083 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x 0.000001 tonnes/g
= 10.5 tonnes/yr

For PM:

For Boilers 1 – 4:

Stack Gas Emission Rate = ((0.007 lb/MMBtu x 8 MMBtu/hr)/60/60) x 453.592 g/lb
= 0.0075 g/s

Annual Emissions = ((0.0075 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x 0.000001 tonnes/g
= 0.9 tonnes/yr

Generators

Assumptions

- Five Prime Powered Generators (Caterpillar G3516 Gas Generator Set).
- Power Rating 936 kW each (1254 hp).
- Natural gas fuel consumption.
- Operating hours for each generator – 8,760 hours/year.
- Heat rate = 7,899 Btu/hp-hr.
- Emission factors for CO and PM were acquired from the US EPA AP-42 Chapter 3.2, Natural Gas Fired Reciprocating Engines (4-stroke lean burn); CO = 0.847 lb/MMBtu, PM = 7.71E-05 lb/MMBtu.

- Emission factor for NO_x was acquired from the Government of Alberta's "Environmental Code of Practice for Compressor and Pump Stations and sweet Gas Processing Plants"; NO_x = 6 g/kw-hr.

Emissions Calculations

For NO_x:

For generators 1-5:

Stack Gas Emission Rate = 6 g/kW-hr x 938 kW / 3600 sec/hr)
= 1.56 g/s

Annual Emissions = ((1.56 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x
0.000001 tonnes/g
= 246 tonnes/yr

For CO:

For generators 1-5:

Stack Gas Emission Rate = 0.847 lb/MMBtu x 7.89 MBtu/hp / 1000 MBtu/MMBtu x 1254 hp / 3600 sec/hr x 453.592 g/lb
= 1.10 g/s

Annual Emissions = ((1.10 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x
0.000001 tonnes/g
= 173.4 tonnes/yr

For PM:

For generators 1-5:

Stack Gas Emission Rate = 7.71×10^{-5} lb/MMBtu x 7.89 MBtu/hp / 1000 MBtu/MMBtu x 1254 hp / 3600 s/hr x 453.592 g/lb
= 0.11 g/s

Annual Emissions = ((0.11 g/s x 365 days/year x 24 hr/day x 60 min/hr x 60 sec/min) x 4) x 0.000001 tonnes/g
= 17.97 tonnes/yr

March 2016

Emissions Calculations for GHGs

Compressors (Gas Turbine Driven)

Assumptions

- Six compressors, five operating and one spare (compressors 1 and 2 are assumed to be Solar Centaur 40 SoLoNO$_x$ (4,700 hp), compressor 3 a Solar Taurus 60 SoLoNO$_x$ (7,700 hp) and compressors 4, 5 and 6 are Solar Titan 250 SoLoNO$_x$ (30,000 hp)).
- Operating hours for each compressor – 8,760 hours/year.
- Natural gas fuel combustion.
- Volumetric Exhaust Rate (in m^3/day): Solar Centaur 40 SoLoNO$_x$ = 28,000; Solar Taurus 60 SoLoNO$_x$ = 40,000; Solar Titan 250 SoLoNO$_x$ = 126,000.
- Emissions of CO_2 = 1.879 kg/m3 (emission factor from WCI.20, Table 20-3 for Ontario).
- Emissions of CH_4 = 0.49 kg/m3 (emission factor from WCI.20, Table 20-4).
- Emissions of N_2O = 0.049 kg/m3 (emission factor from WCI.20, Table 20-4).

Emissions Calculations

For CO_2:

For compressors 1 and 2:
Annual Emissions = (1.879 kg/m^3 / 1,000 tonnes/kg x 365 days/year x 28,000 m^3/day) x 2

= 38,838 tonnes/year

For compressor 3:
Annual Emissions = 1.879 kg/m^3 / 1,000 tonnes/kg x 365 days/year x 40,000 m^3/day

= 27,770 tonnes/year

For compressor 4 and 5:
Annual Emissions = (1.879 kg/m^3 / 1,000 tonnes/kg x 365 days/year x 126,000 m^3/day) x 2

= 172,784 tonnes/year

For CH_4:

For compressors 1 and 2:
Annual Emissions = (0.49 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 28,000 m^3/day) x 2

= 10.1 tonnes/year

For compressor 3:
Annual Emissions = 0.49 g/m^3 / 1,000,000 tonnes/kg x 365 days/year x 40,000 m^3/day

= 7.24 tonnes/year

For compressor 4 and 5:
Annual Emissions = (0.49 g/m^3 / 1,000,000 tonnes/kg x 365 days/year x 126,000 m^3/day) x 2

= 45 tonnes/year

For N_2O:

For compressors 1 and 2:
Annual Emissions = (0.049 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 28,000 m^3/day) x 2

= 1.02 tonnes/year

For compressor 3:
Annual Emissions = 0.049 g/m^3 / 1,000,000 tonnes/kg x 365 days/year x 40,000 m^3/day

= 0.72 tonnes/year

For compressor 4 and 5:
Annual Emissions = (0.049 g/m^3 / 1,000,000 tonnes/kg x 365 days/year x 126,000 m^3/day) x 2

= 4.5 tonnes/year

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4 and N_2O):

For compressors 1 and 2:
Annual Emissions = 38,838 tonnes/year + (25 x 10.1 tonnes/year) + (298 x 1.02 tonnes/year)

= 39,392 tonnes/year

For compressor 3:
Annual Emissions = 27,770 tonnes/year + (25 x 7.24 tonnes/year) + (298 x 0.72 tonnes/year)

= 28,167 tonnes/year

For compressor 4, 5, and 6 (spare):
Annual Emissions = 172,784 tonnes/year + (25 x 45 tonnes/year) + (298 x 4.5 tonnes/year)

= 175,250 tonnes/year

Boilers

Assumptions

- Four boilers, Package type - Bryan HE-RV800.
- Natural gas fuel combustion.
- Operating hours for each boiler – 8,760 hours/year.
- 85% efficiency.
- Volumetric exhaust flow rate (m^3/day): 5,290.
- Emission factor for CO_2 were acquired from WCI.20 Table 20-3. Emissions factors for CH_4 and N_2O were acquired from WCI.20 Table 20-4.

Emissions Calculations

For CO_2:

For boilers 1-4:
Annual Emissions = (1.879 kg/m^3 / 1,000 tonnes/kg x 365 days/year x 5,290 m^3/day) x 4

= 14,504 tonnes/year

For CH_4:

For boilers 1-4:
Annual Emissions = (0.49 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 5,290 m^3/day) x 4

= 3.8 tonnes/year

For N_2O:

For boilers 1-4:
Annual Emissions = (0.049 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 5,290 m^3/day) x 4

= 0.38 tonnes/year

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4 and N_2O):

For boilers 1-4:
Annual Emissions = 14,504 tonnes/year + (25 x 3.8 tonnes/year) + (298 x 0.38 tonnes/year)

= 14,712 tonnes/year

Generators

Assumptions

- Five Prime Powered Generators (Caterpillar G3516 Gas Generator Set).
- Power Rating 936 kW each (1254 hp).
- Natural gas fuel consumption.
- Operating hours for each generator – 8,760 hours/year.
- Volumetric exhaust flow rate (m^3/day): 6,500.
- Emission factor for CO_2 were acquired from WCI.20 Table 20-3. Emissions factors for CH_4 and N_2O were acquired from WCI.20 Table 20-4.

Emissions Calculations

For CO_2:

For generators 1-5:
Annual Emissions = (1.879 kg/m^3 / 1,000 tonnes/kg x 365 days/year x 6,500 m^3/day) x 5

= 22,445 tonnes/year

For CH_4:

For generators 1-5:
Annual Emissions = (0.49 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 6,500 m^3/day) x 5

= 5.85 tonnes/year

For N_2O:

For generators 1-5:
Annual Emissions = (0.049 g/m^3 / 1,000,000 tonnes/g x 365 days/year x 6,500 m^3/day) x 5

= 0.6 tonnes/year

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4 and N_2O):

For generators 1-5:
Annual Emissions = 22,445 tonnes/year + (25 x 5.85 tonnes/year) + (298 x 0.6 tonnes/year)

= 22,770 tonnes/year

Fugitive and Venting

Assumptions

- Length of pipeline = 65 km
- Number of compressors = 5
- Number of valve stations = 2
- Emission factors for fugitive emissions were acquired from the Interstate Natural Gas Association of America (INGAA 2005), Tier 3 Emission Factors

Emissions Calculations

Fugitive Compressor Station Count

For CO_2:

Annual Emissions = 7,813.1 lb CO_2/station-yr x 1 station x 0.000454 tonnes/lb
= 3.5 tonnes/yr

For CH_4:

Annual Emissions = 135,260 lb CH_4/station-yr x 1 station x 0.000454 tonnes/lb

= 61.4 tonnes/yr

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4):

Annual Emissions = 3.5 tonnes/year + (25 x 61.4 tonnes/year)

= 1,539 tonnes/year

Fugitive Centrifugal Compressor Count

For CO_2:

Annual Emissions = 27,014 lb CO_2/comp-yr x 5 comp x 0.000454 tonnes/lb

= 61.3 tonnes/yr

For CH_4:

Annual Emissions = 467,660 lb CH_4/ comp-yr x 5 comp x 0.000454 tonnes/lb

= 1,062 tonnes/yr

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4):

Annual Emissions = 61.3 tonnes/year + (25 x 1,062 tonnes/year)

= 26,611 tonnes/year

Fugitive Protected Steel Pipeline Length

For CO_2:

Annual Emissions = (1.30 lb CO_2/mile-yr x 65 km x 0.6214 miles/km x 0.000454 tonnes/lb) + (0.90 lb CO_2/mile-yr x 65 km x 0.6214 miles/km x 0.000454 tonnes/lb)

= 0.04 tonnes/yr

For CH_4:

Annual Emissions = (15.10 lb CH_4/mile-yr x 65 km x 0.6214 miles/km x 0.000454 tonnes/lb)

= 0.28 tonnes/yr

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4):

Annual Emissions = 0.04 tonnes/year + (25 x 0.28 tonnes/year)

= 7.04 tonnes/year

Venting Compressor Station Count

For CH_4:

Annual Emissions = (223,758.00 lb CH_4/station-yr x 1 comp station x 0.00454 tonnes/lb) + (29,817.00 lb CH_4/station-yr x 2 valve stations x 0.00454 tonnes/lb)

= 128.5 tonne/yr

For CO_2e (based on Global Warming Potentials from Fourth Assessment Report for CH_4):

Annual Emissions = 25 x 128.5 tonnes/year

= 3,213 tonnes/year