Environmental Assessment Registration for the National Gypsum Mine Extension

Project No. 121511228

Prepared for:
National Gypsum (Canada) Ltd.
1707 Highway 2
Milford NS B0N 1Y0

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LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Center
AQHI	Air Quality Health Index
AN	Ammonium Nitrate
ANFO	Ammonium Nitrate Fuel Oil
BBS	breeding bird surveys
BC RIC	British Columbia Resources Inventory Committee
CABIN protocol	Canadian Aquatic Biomonitoring Network
CAPP	Canadian Association of Petroleum Producers
CC&H	Communities, Culture and Heritage
CCME-FAL	Canadian Council for the Minsters of the Environment - Guidelines for the Protection of Freshwater Aquatic Life
CHAPS	Corridor Horse & Pony Society
CMM	Confederacy of Mainland Mi'kmaq
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRA Fishery	Commercial, Recreational or Aboriginal Fishery
CWS	Canadian Wildlife Service
dB	decibels
dBA	decibels ("A" weighted scale)
DBH	diameter at breast height
DC	drainage channel (*e.g.*, DC-1)
DFO	Fisheries and Oceans Canada
DO	dissolved oxygen
EA	Environmental Assessment
EC	Environment Canada
EGSPA	*Environmental Goals and Sustainable Prosperity Act*
EPP	Environmental Protection Plan
GW	Groundwater Region
ha	hectare
HRM	Halifax Regional Municipality
hrs	hours
k	hydraulic conductivity
Ka	thousands of years
km	kilometre
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
m	metre
MBBA	Maritimes Breeding Bird Atlas
MBCA	*Migratory Birds Convention Act*
MEKS	Mi'kmaq Ecological Knowledge Study
mm	millimeter
MOU	Memorandum of Understanding
NAPS	National Air Pollution Surveillance Program
NBDNR	New Brunswick Department of Natural Resources

NCNS	Native Council of Nova Scotia
NGC	National Gypsum (Canada) Ltd.
NO_2	nitrogen dioxide
NS ESA	Nova Scotia *Endangered Species Act*
NS WLD	Nova Scotia Well Log Database
NS	Nova Scotia
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NWWG	National Wetlands Working Group
O_3	ozone
OAA	Office of Aboriginal Affairs
OBBN	Ontario Benthos Biomonitoring Network
$PM_{2.5}$	particulate matter
RQG	Rock Quality Designation
SARA	*Species at Risk Act*
SOCI	Species of Conservation Interest
SPL	sound pressure level
TSP	total suspended particulate
TSS	total suspended solids
µg	micrograms
UNSI	Union of Nova Scotia Indians
US NSN	United States Nightjar Survey Network
VC	Valued Component
WC	watercourse (*e.g.*, WC-1)
WL	wetland (*e.g.*, WL1)
WNS	white-nose syndrome

1.0 Proponent and Project Identification

1.1 PROPONENT INFORMATION

Name of the Proponent:	National Gypsum (Canada) Ltd.
Postal Address:	1707 Highway 2 Milford NS B0N 1Y0 Tel.: (902) 883-2224 x 227 Fax: (902) 758-3955

Registry of Joint Stocks for the Proponent's company is included in Appendix A.

Company President and/or Environmental Assessment Contact

Name:	Mr. Jeff Newton
Official Title:	Plant Manager
Address:	As Above
Tel.:	(902) 883-2224 x 227
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Jeff Newton Feb 9/15

Signature of Company Date

Jeff Newton, Plant Manager

Environmental Consultant Contact

Name:	Ms. Kelley Fraser, MES
Official Title:	Project Manager Stantec Consulting Ltd.
Address:	102 – 40 Highfield Park Drive Dartmouth, NS B3A 0A3
Tel.:	(902) 468-7777
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1.2 PROJECT INFORMATION

Name of the Undertaking:	National Gypsum Mine Extension
Location of the Undertaking:	Milford, Halifax County, Nova Scotia

2.0 Project Information

2.1 DESCRIPTION OF THE UNDERTAKING

National Gypsum (Canada) Ltd. (NGC; the Proponent) owns and operates the NGC mine, located in Milford, Halifax County, Nova Scotia (Figure 2.1). The mine is currently operating under an Industrial Approval (No. 89-100) that was obtained from Nova Scotia Environment (NSE) in 1989, pursuant to Division V of the Activities Designation Regulations. In July 2013, additional Non-Mineral Registration tracts were approved by the Minister of Natural Resources. Copies of the above documents, other permits, and the Registry of Joint Stocks for NGC are included in Appendix A.

NGC proposes to extend its mining activities at the existing facility. The mineral deposit that NGC has been mining since 1954 has produced over 134 million tonnes of gypsum. The deposit is continuous and runs for at least four kilometers in the northeast direction. The current operation is approximately 301 ha in area. The proposed extension will incorporate adjacent land northeast of the existing mine, continuing along the current deposit. The mine currently supplies gypsum rock for several wallboard plants in the Maritimes and eastern US.

NGC proposes to extend the approved mine site to occupy an additional 144 ha of land in total (including buffers), to allow for continued gypsum production (blasting, crushing, and stockpiling) and the possibility of mining anhydrite rock (used mainly in the production of cement). This extension is hereinafter referred to as the Project. Over the next 35 to 40 years (depending on market demand), the extension will advance in the northeastern direction. Appendix B shows the Proposed Mine Development Plan. The Proponent owns the existing mine lands and the majority of lands in the Proposed Extension Area. It is assumed that an agreement will be developed over time for the use of any lands within the Proposed Extension Area not currently owned by NGC. Much of the land is not forecasted to be mined for several decades (see Appendix B). The surrounding lands are mostly residential, agricultural, or undeveloped. Carrolls Corner is a small community located east of the Proposed Extension Area.

The Study Area or original extension area footprint was approximately 165 ha. However, after field and desktop studies were undertaken for this EA, the original footprint was reduced to the current Proposed Extension Area which is 144 ha. Only 135 ha will support mining activities; the remaining 9 ha (*i.e.*, the eastern portion of the Proposed Extension Area) will be set aside as an Ecological Buffer Zone in which no mining or development will occur. By reducing the original extension area and establishing the Ecological Buffer Zone, potential Project interactions are avoided with 78% of the wetland habitat present within the Study Area, as well as a watercourse that is hydrologically connected to fish-bearing waters. Table 2.1 summarizes the areas described above. Sections 5.2 and 5.5 provide further information on watercourses and wetlands.

Table 2.1 Descriptions and Size (ha) of Areas Discussed in EA

Area Descriptions	Approximate Area (ha)
Study Area (original extension area)	165
Proposed Extension Area	144
Proposed Extension Area excluding Ecological Buffer Area (referred to as the Project Footprint)	135
Ecological Buffer Zone Area (within the Proposed Extension Area)	9
Ecological Buffer Zone Area (Total Area; includes area inside and outside of the Proposed Extension Area)	31

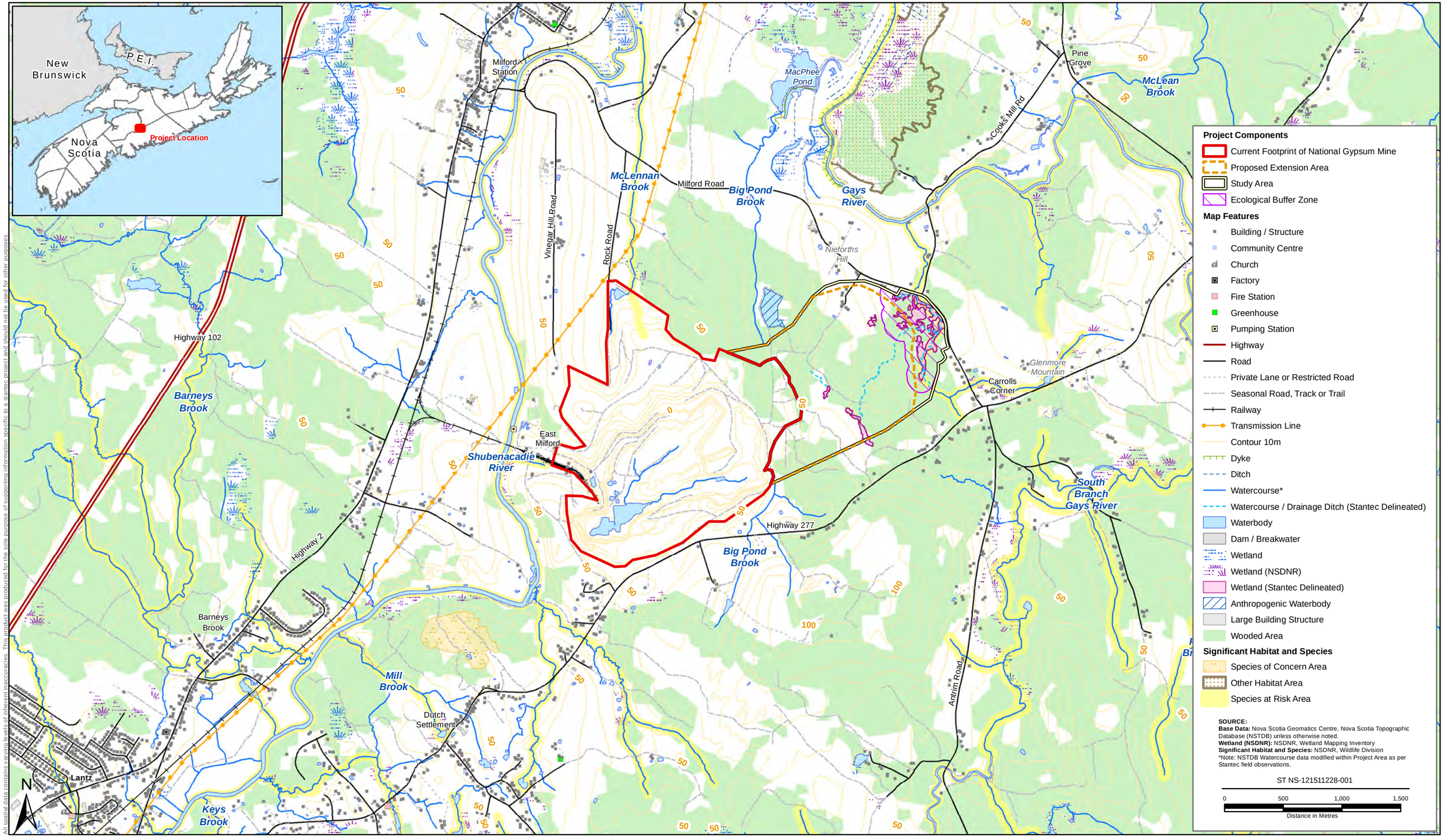
As a result of field and desktop studies undertaken in support of this EA, the Proposed Extension Area has been located, in part, to reduce potential adverse environmental effects including effects on local residents.

The anticipated average production rate for the expanded mine facility will be at the 20 year average of 3.1 million tonnes of product per year, depending on market demand. The current and anticipated future operating schedule is 16 hours/day, five days per week, 52 weeks/year, weather permitting. However, depending on the demand, the plant has run 24/7 to ensure required production is met. Based on current estimates, there are approximately 100 million tonnes of rock reserves within the Proposed Extension Area. The proposed mining operations will take place according to the preliminary Mine Development Plan (Appendix B), taking into account market demand. The ability to access lands with gypsum over an extended period of time is critical for the operation to be successful and to continue to provide local and regional benefits through employment, procurement of goods and tax payments.

2.2 GEOGRAPHIC LOCATION

The existing NGC mine is in the community of Milford, Halifax County, Nova Scotia (Figure 2.1). It is located along Highway 277, and is accessed via a private road that branches off from the main public road. The surrounding lands are mostly residential, agricultural, or undeveloped. Carrolls Corner is a small community located east of the Proposed Extension Area.

The existing mine and the majority of the Proposed Extension Area are situated on lands that are owned by the Proponent. Discussions have been held between NGC and the landowners of the remaining parcels. It is assumed that an agreement will be developed over time for the use of any lands within the Proposed Extension Area not currently owned by NGC. The Proposed Mine Development Plan shows that the extension would take place over an extended time frame (Appendix B).



PREPARED BY: R Sutcliffe	National Gypsum Mine Extension	FIGURE NO.: 2.1	
REVIEWED BY: C Shupe	**Project Location**	DATE: Nov 04, 2014	
CLIENT: National Gypsum (CANADA) LTD.		Stantec	

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The Proposed Extension Area is comprised mainly of a mixture of forest, forested wetland, recent clear cuts, and some agricultural land (active and abandoned). Forests in the Proposed Extension Area vary in age from recently harvested stands to mature forest. Mature mixedwood forest is present mainly in the eastern, central and northern part of the Proposed Extension Area. Mature hardwood forest is present along the southern boundary of the property. Mature softwood forest is present mainly in the eastern half of the property (Figure 2.2).

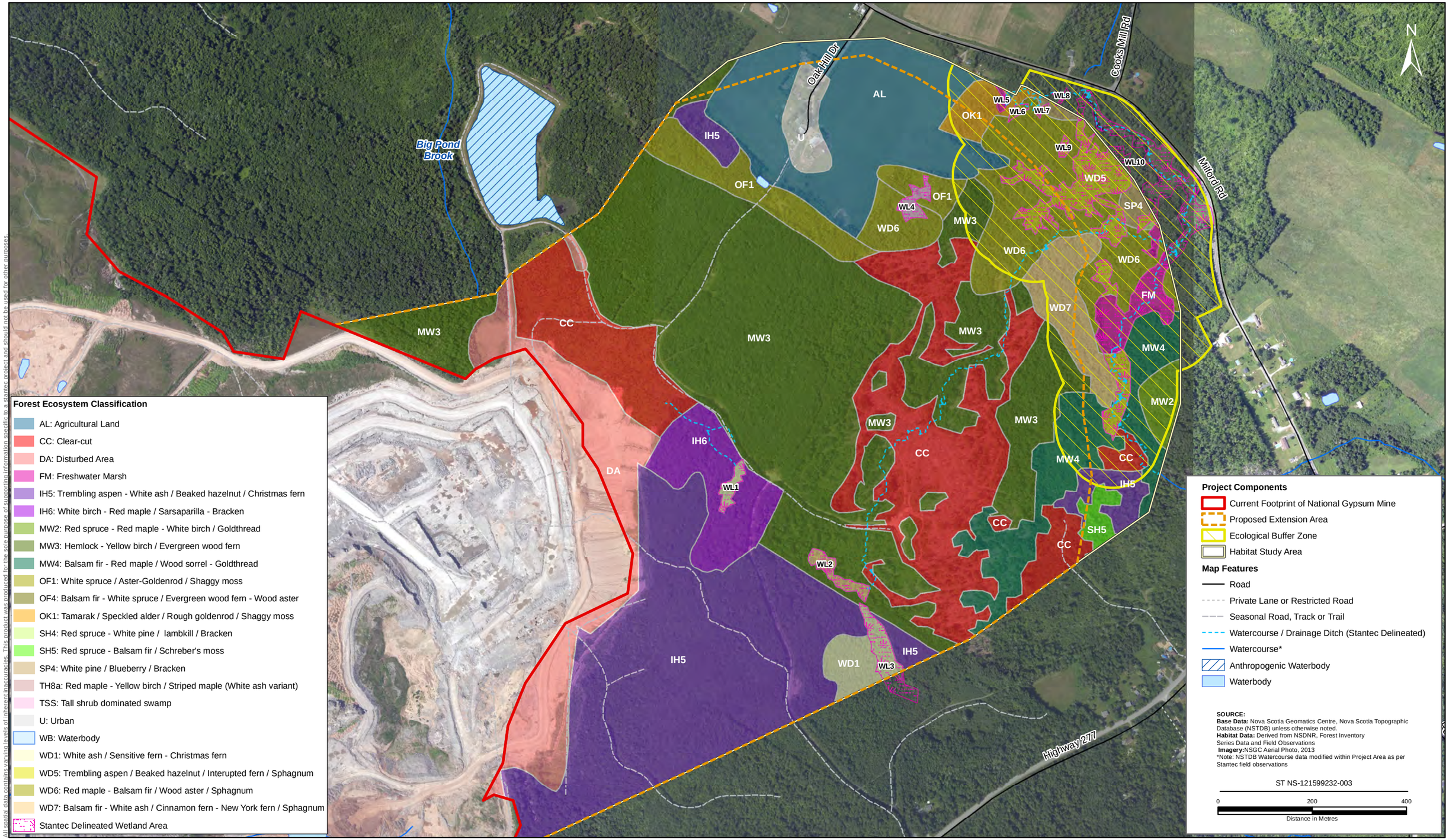
Ten wetlands of varying size were found within the Study Area (original extension area), four of which are in the Proposed Extension Area (refer to Section 5.5 for further information). Wetlands 1 - 3 are located in the southern portion of the proposed footprint while Wetlands 4 - 10 are clustered near the north-eastern boundary (see Figure 5.1). Nine of the wetlands identified are classified as swamps. These swamps are a combination of shrub, tall shrub, treed and forested. There is also a freshwater marsh, located just outside the northeastern boundary in association with a small anthropogenic pond (Pond-1 on Figure 5.1). Six of these wetlands (*i.e.*, WL4, WL6, WL7, WL8, WL9, WL10 on Figure 5.1), comprising 78% of the total wetland area within the Study Area as well as the only watercourse (WC-1) on the site, will be protected by an Ecological Buffer Zone occupying a total area of approximately 31 ha in the eastern portion of the Study Area (9 ha in the Proposed Extension Area; Table 2.1). Additional potential habitats include four drainage channels, old roads, and disturbed areas which surround and contain the various activities related to present mining operations.

Rural residential development is located in the immediate vicinity of the existing NGC mine and the Proposed Extension Area (Figure 2.1). Refer to Section 5.9 for more information on the "windshield survey" that was conducted for this Project.

The mine is located on land that is zoned for resource uses such as extractive facilities with the issuance of a development permit (Halifax Regional Municipality 2012).

2.3 PHYSICAL PROJECT COMPONENTS

The existing mining operations consist of a working / laydown area for the stationary crushing equipment, screening, rail car load out facility, rail yard, various gypsum rock stockpiles, mine pit, sedimentation ponds, and tailings management areas. The principal access to the site is via a private access road is located off Hwy 277. Site access is also provided across a timber railway bridge which crosses the Shubenacadie River linking Route 2 to the administrative area of the mine. The following equipment is available on site, at all times and for use in an emergency: three 12 yard front-end loaders, six 70 ton off- highway dump trucks, three 17 cu track-type bulldozers, two excavators, one road grader, one water truck (9,000 L), one fuel -lube truck, track drill, one yard shunter and one anfo-truck.



Forest Ecosystem Classification

- AL: Agricultural Land
- CC: Clear-cut
- DA: Disturbed Area
- FM: Freshwater Marsh
- IH5: Trembling aspen - White ash / Beaked hazelnut / Christmas fern
- IH6: White birch - Red maple / Sarsaparilla - Bracken
- MW2: Red spruce - Red maple - White birch / Goldthread
- MW3: Hemlock - Yellow birch / Evergreen wood fern
- MW4: Balsam fir - Red maple / Wood sorrel - Goldthread
- OF1: White spruce / Aster-Goldenrod / Shaggy moss
- OF4: Balsam fir - White spruce / Evergreen wood fern - Wood aster
- OK1: Tamarak / Speckled alder / Rough goldenrod / Shaggy moss
- SH4: Red spruce - White pine / lambkill / Bracken
- SH5: Red spruce - Balsam fir / Schreber's moss
- SP4: White pine / Blueberry / Bracken
- TH8a: Red maple - Yellow birch / Striped maple (White ash variant)
- TSS: Tall shrub dominated swamp
- U: Urban
- WB: Waterbody
- WD1: White ash / Sensitive fern - Christmas fern
- WD5: Trembling aspen / Beaked hazelnut / Interupted fern / Sphagnum
- WD6: Red maple - Balsam fir / Wood aster / Sphagnum
- WD7: Balsam fir - White ash / Cinnamon fern - New York fern / Sphagnum
- Stantec Delineated Wetland Area

Project Components

- Current Footprint of National Gypsum Mine
- Proposed Extension Area
- Ecological Buffer Zone
- Habitat Study Area

Map Features

- Road
- Private Lane or Restricted Road
- Seasonal Road, Track or Trail
- Watercourse / Drainage Ditch (Stantec Delineated)
- Watercourse*
- Anthropogenic Waterbody
- Waterbody

SOURCE:
Base Data: Nova Scotia Geomatics Centre, Nova Scotia Topographic Database (NSTDB) unless otherwise noted.
Habitat Data: Derived from NSDNR, Forest Inventory Series Data and Field Observations
Imagery: NSGC Aerial Photo, 2013
*Note: NSTDB Watercourse data modified within Project Area as per Stantec field observations

ST NS-121599232-003

0 200 400

Distance in Metres

PREPARED BY:	R Sutcliffe
REVIEWED BY:	C Shupe
CLIENT:	National Gypsum (CANADA) LTD.

National Gypsum Mine Extension

Habitat and Forest Ecosystem Classification Overview

FIGURE NO.:	2.2
DATE:	Nov 05, 2014

Stantec

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Table 2.2 presents the hazardous products stored on site.

Table 2.2 Hazardous Products List and Maximum Quantities Stored on Site

Hazardous Products	Maximum Quantity on Site (at any given time)
Diesel fuel	50,000 L maximum
Furnace fuel	9,000 L maximum
Gasoline	9,000 L maximum
Used oils	10,000 L maximum
Motor oils	5,000 L maximum
Hydraulic oils	3,000 L maximum
Propane	5 X 12 kg. containers
Oxygen	35 X 244 cu. ft.
Acetylene	12 X 300 cu. ft.
Ammonium Nitrate	80,000 kg Maximum
Explosives	10,000 kg magazines
Blasting cap magazines	12,000 units

There is no planned storage of other hazardous materials. NGC has best practices in place for handling of hazardous materials as well as an established "Contingency Plan and Procedures for Releases of Dangerous Goods and Hazardous Wastes" and an "Emergency Procedures Plan" (Appendix C).

Topsoil, grubbing material and overburden (mainly glacial till with high clay content) that have been stripped prior to drilling and blasting are stored on-site. The overburden is backfilled into previously mined out sections of the mine. Topsoil and grubbing materials have been stabilized for subsequent use during site reclamation. The piles have been seeded to reduce potential for erosion and sedimentation. Similar practices will continue throughout the development and operation of the Proposed Extension Area. Refer to pictures of existing site activities on storyboards presented at community open house (Appendix D).

The working / laydown area is located on the mine floor. The rock is processed by stationary crushing equipment that is located largely underground, which reduces noise and dust. Stockpiles are currently located at various places within the mine limits.

Drainage entering the mine from overland runoff or from groundwater seepage is collected in perimeter drains and ditching, treated by allowing it to settle, and conveyed to one of the three main sumps. The water is monitored to meet final effluent discharge level limits (*i.e.*, pH, suspended solids, oil and grease, toxicity and ammonia as nitrogen), as stated in the facility's Industrial Approval (No. 89-100; Appendix A). Monitoring data from 2007-2014 are provided in Appendix H. The treated water is then pumped to the Shubenacadie River downstream of the mine. Similar to the current mine, mine drainage and surface runoff collection and controls for the mine extension will be refined at the Industrial Approval amendment stage.

The proposed Mine Development Plan shows the general direction of mine advancement will be northeast from the existing mine and occur over the next 35 to 40 years. Refer to to the proposed Mine Development Plan in Appendix B.

2.4 SITE PREPARATION AND CONSTRUCTION

The existing mine has been in operation since 1954. Access to the existing mine development is along existing roads. To reduce the potential for erosion and sedimentation and to preserve natural areas as long as possible, grubbing and removal of overburden has been and will continue to be conducted on an as needed basis, to accommodate blasting activities. Topsoil, grubbed material and overburden are stockpiled on-site and have been stabilized via seeding for subsequent use during site reclamation. These, or similar stabilization procedures will continue throughout the operations of the proposed Project.

Drainage entering the mine from overland runoff or from groundwater seepage is collected in perimeter drains and ditching, treated by settling, and conveyed to one of the three main sumps. The water is monitored to meet final effluent discharge level limits (*i.e.*, pH, suspended solids, oil and grease, toxicity and ammonia as nitrogen), as stated in the facility's Industrial Approval (No. 89-100; Appendix A). Monitoring data from 2007-2014 are provided in Appendix H. The treated water (via settling) is then pumped to the Shubenacadie River downstream of the mine. Similar to the current mine, mine drainage and surface runoff collection and controls for the mine extension will be refined at the Industrial Approval amendment stage. Water that has pooled in the mine pit will be used to provide a water supply for dust suppression during crushing in dry periods, and is also a potential source for washing rock material.

While working around drainage channel locations (see Section 5.2.3), appropriate sediment and erosion control measures will be used to reduce downstream effects on receiving waters containing fish habitat. The methods to reduce erosion and sediment transport in the vicinity of all watercourses and, as appropriate, drainage channels during construction will include:

- the control of surface runoff;
- specific procedures for storage and handling of excavated materials;
- provision of temporary erosion control measures after initial clearing is completed;
- avoidance of introduction of deleterious materials (mineral and organic) into channels or wetlands not protected by the Ecological Buffer Area;
- timely revegetation/stabilization of area after construction.

Sediment and erosion control measures will to be included in the Project-specific Environmental Protection Plan (EPP) that will update the existing plans for the extension site, and be submitted to NSE as part of the Industrial Approval amendment application.

2.5 OPERATION AND MAINTENANCE

The proposed Project activities will be consistent with the current mining operations approved by NSE (Approval No. 89-100). The Industrial Approval stipulates the following (see Appendix A):

- Particulate emissions (dust) limits;
- Sound level limits; and
- Final effluent discharge level limits (pH, suspended solids, oil and grease, toxicity and ammonia as nitrogen; see Table 5.3 in Section 5.2.2);
- Blasting limits;
- Requirements for a reclamation plan and security bond.

Gypsum production begins with drilling and blasting. It is anticipated that blasting of gypsum will continue to occur twice per day with ongoing crushing depending on market demand. This is consistent with current approved operations. A qualified blasting employee will conduct this work. The blasting employee is responsible for blast designs and methods in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). Blasting activity will be conducted in accordance with the Industrial Approval and the future Industrial Approval amendment when prepared for the proposed Project.

The blasted rock will be processed by stationary crushing equipment that will be on-site. The gypsum rock will be stockpiled in designated areas within the mine. Material is hauled and moved within the mine with trucks to the processing plant where it is crushed to less than 6 in diameter and screened to remove all minus ¼ in rock, referred to as tailings. The tailings are conveyed to a tailings management area on the mine property (see pictures on storyboards presented at community open house in Appendix D). The non-tailings material is placed into rail cars where they are shipped daily to port facilities located in Dartmouth on the Halifax Harbour. At current production, the site ships one train load made up of 66 rail cars per day, five days per week. The site has shipped two train loads per day in the past. The site ships by rail to two wallboard plants in New Brunswick on average 15 cars per day. The site also ships some material via dump triaxle trailer mainly during the spring and summer months, with approximately 20 to 30 trucks per day. Operations for the proposed Project will be consistent with current rail and truck volume at the existing mine and could increase, for a short period, depending on market demand.

The anticipated/proposed average production rate for the expanded mine facility will be at the 20 year average of 3.1 million tonnes of product per year, depending on market demand. The current operating schedule is up to 16 hrs/day, five days per week, 52 weeks/year, weather permitting. However, the plant has run 24/7 to ensure required production is met. Due to increasing demands, the facility will be required to operate a backshift for overburden removal for approximately 6 months of the year.

NGC currently employs approximately 60 hourly workers and staff at the site. If volume increases, there will be a need to add further hourly workers and staff. This number can fluctuate depending on the activities taking place on-site. Employment levels are expected to remain the same following mine extension. Hauling of materials (via rail or trucking) from the mine involves additional labour and equipment requirements, and is arranged by the Proponent.

2.6 EFFLUENTS AND EMISSIONS

Devices such as diversion ditches, settling ponds, straw hay mulch and seeding are and will be used if necessary to control sedimentation. Best management practices for the control of runoff/overflow and erosion/sedimentation will be implemented to prevent runoff and sediments from entering into the Ecological Buffer Zone. In accordance with best practices and standard NSE requirements, runoff controls will continue to be in place at the mine. The Proposed Extension Area footprint (Figure 2.1) is expected to extend to depths of 54.9 m below mean sea level to extract buried gypsum and underlying anhydrite deposits. Mining will extend northeastward from the existing pit, and will include cutting and grubbing of existing vegetation and soils; excavation and stockpile of surficial materials in the pit; and breaking and blasting of the bedrock for extraction. Drainage, originating as direct precipitation, runoff and seepage from encountered groundwater flows, will be directed via perimeter drains and ditching to one of the three main sumps.

At the existing mine, collected water is monitored to meet final effluent discharge level limits (*i.e.*, pH, suspended solids, oil and grease, toxicity and ammonia as nitrogen, as stated in the facility's Industrial Approval No. 89-100; Appendix A) and discharged to the Shubenacadie River via Pumps 4 and 6 in the 3rd Level Sump. Water collected in the Level 5 (bottom) sump is pumped to Level 3 sump for subsequent discharge to the Shubenacadie River. Monitoring data from 2007-2014 are provided in Appendix H.

Discharged water will continue to be monitored and sampled according to the terms and conditions of the existing Industrial Approval (and future updates) so total suspended solids (TSS) levels do not exceed the approved final effluent discharge limits (*i.e.*, TSS quarterly geometric mean of <25 mg/L, see Appendix A). In the unlikely event that overflow associated with a significant rain fall exceeds final effluent discharge limits as determined through monitoring, contingency measures will continue to be in place. A Stormwater Management Plan for the existing mine is in Section 2.3 of Appendix C and updates for the proposed Project will be submitted as part of the Industrial Approval amendment process.

Additional overflow volume will be installed, as required, in accordance with NSE's Erosion and Sedimentation Control Handbook for Construction Sites (NSE 1988) and the mine's approval to operate, and in consultation with NSE's engineers/inspectors. Details regarding additional perimeter drains and ditching required for proposed extended mining operations will be further refined at the Industrial Approval amendment stage.

Dust emissions will continue to be controlled with the application of water, obtained from the water that is pooled in the mine pit. To reduce generation of dust, the following actions are currently undertaken at the existing mine:

- Water spray in the hopper where the trucks dump the rock into the crusher.
- Water spray at the primary crusher.
- Water with dust suppression chemical (Zinkin DT10) spray at the tail of Conveyor #3 (this is the conveyor that stockpiles the rock).
- Water spray at the head of Conveyor #3 as the rock falls off the belt onto the stockpile.

All of these sprays are active so if there is material going through the system, the sprays would be on. In 2015, NGC plans to install a water spray system in the car loading area which would spray down each loaded car before transport to the dock.

Dust generated by rock movement along the access road will be reduced by speed control (*i.e.*, maximum of 70 km/hour, and operators are to adjust their speed necessary to the road conditions), proper truck loading, application of dust suppressants, proper construction of on-site roads, and/or other means as required by NSE.

Monitoring of airborne particulate emissions (dust) will be conducted at the request of NSE and in accordance with the existing Industrial Approval (no. 89-100; Appendix A), the Nova Scotia Air Quality Regulations and shall not exceed the following limits at the property boundaries:

- Annual Geometric Mean 70 µg/m^3; and
- Daily Average (24 hrs) 120 µg/m^3.

Combustion emissions will be generated from the operation of vehicles and equipment during Project activities. These emissions will be similar in quantities to the current operation. Emissions will be reduced through proper equipment maintenance and inspection practices for efficient operation. Consideration will be given to methods to reduce truck and equipment idling, as feasible.

Stationary crushing equipment is located below grade which greatly reduces noise. There is noise from back-up beepers on equipment which is a safety requirement. This noise has been identified as a concern by several local residents. The Proponent is reviewing options for the use of strobe lights on trucks to reduce noise levels (from back-up beepers).

As per the existing Industrial Approval (no. 89-100; Appendix A), sound levels from mine operations will be maintained at a level not to exceed the following sound levels (Leq) at the property boundaries:

- L_{eq} 65dBA 0700-1900 hours (Days);
  60dBA 1900-2300 hours (Evenings); and
  55dBA 2300-0700 hours (Nights).

Details of any monitoring programs required by NSE (*e.g.*, surface water, noise, dust) will be developed in consultation with NSE and outlined in the Industrial Approval amendment application.

There is currently one permanent administrative building located on this site. All solid waste is collected, separated into recyclable and non-recyclable materials. The existing site currently has an onsite septic bed. Portable facilities are used during stripping operations so employees do not have to come all the way into the plant.

During crushing and screening operations, hazardous materials anticipated on-site will be those associated with the normal operation of construction equipment. These substances include: gasoline, diesel fuel, lubricants and antifreeze liquid. A qualified employee conducts regular maintenance of equipment. With the exception of large or complicated repairs, the majority of these equipment maintenance services are currently carried out on-site, with oils and tools stored in sufficient quantities to accommodate these activities. A waste oil tank with a storage capacity of 10,000 L is present on-site (see Section 2.3). In late 2014, waste oil burners will be added to burn the waste oil and generate heat for the buildings.

All hazardous wastes will be fully contained and temporarily stored in a designated area until they are removed from the site by a licensed contractor and recycled or disposed at an approved facility. Other control measures include implementing NGC's existing best practices for handling of hazardous materials as well as an established "Contingency Plan and Procedures for Releases of Dangerous Goods and Hazardous Wastes" and an "Emergency Procedures Plan" (Appendix C).

Refuelling of equipment will be conducted on-site on a regular basis via the existing diesel fuel tanks which are re-filled by a tanker truck. Refuelling activities will not be conducted within 100 m of any active stream or any of the water courses or wetlands identified in the field surveys (Sections 5.1 and 5.3). Equipment operators will remain with the equipment at all times during refuelling in accordance with the Petroleum Management Regulations of the Nova Scotia *Environment Act* and NGC best practices for handling of hazardous material. It is noted that at the existing mine, equipment is fueled next to ponds in the lower benches in the mine. NGC control when they are pumped, and in the unlikely event of a spill, water would be contained by ceasing pumping and all fuel would be cleaned up as per regulations and the NGC Spill Contingency Plan.

All employees and temporary site workers will review the NGC Spill Contingency Plan (as per NGC's "Contingency Plan and Procedures for Releases of Dangerous Goods and Hazardous Wastes" and "Emergency Procedures Plan" in Appendix C) as part of their site orientation. If an accidental spill of hazardous materials occurs, the NGC Spill Contingency Plan will be initiated, which includes immediate reporting of any spill (regardless of size) to a supervisor immediately and taking measures to stop and contain the release immediately. Supervisors will notify proper agencies, put in place controls to prevent further spill or release, and initiate clean up to pre-spill conditions. Requirements for containment, clean-up, site restoration, disposal and reporting are

provided in the Spill Contingency Plan, as well as a list of hazardous materials on site and equipment available for emergency response to a spill. All spills will be reported to the 24-hour environmental emergencies reporting system (1-800-565-1633) in accordance with the Emergency Spill Regulations.

2.7 DECOMMISSIONING AND RECLAMATION

The existing mine will be left as a flooded pond, and the shore line slopes will be constructed in accordance with Nova Scotia Department of Natural Resources' (NSDNR) general expectations (maximum shore line slopes of 5H:1V for 2 vertical m below the low water line and 1 vertical m above the high water mark).

NGC will undertake a progressive rehabilitation program at the mine site to offset phased stripping/grubbing activity. The timing and specifics of progressive rehabilitation efforts will depend on production volumes and will therefore vary accordance with the intensity of production-related stripping/grubbing activity. In this phased construction and progressive reclamation process, only the area needed for mine extension in any one year will be grubbed and all areas affected by mine activities will be eventually rehabilitated. The overburden of this area will be placed in a portion of the mine that is no longer in use. Subsoil and topsoil will be stockpiled for use in future reclamation.

Reclamation plans will provide for both natural and active re-vegetation programs – contouring, topsoil placement, fertilization, and seeding and/or planting in order to re-vegetate disturbed areas. Seeding stockpiles, as conducted for current operations, will be conducted in future activities. If it is necessary to seed reclaimed areas where grubbings have not produced sufficient plant biomass to stabilize soils, seed mixtures free of noxious weeds and invasive species will be used. Native plants may be used for site reclamation. In lieu of native species, seed mixes containing naturalized species which are well established in Nova Scotia and which are free of invasive species and are not aggressive weeds in the wetland and forest plant communities present in the area may be used for reclamation. Refer to pictures of existing site reclamation activities on storyboards presented at community open house (Appendix D).

As distinct areas within the mine become inactive, the earthen areas will be graded to a stable slope (max 3:1) or rock slopes (max 1:1), where required, or leveled to allow for future uses. These inactive areas will be covered with overburden and seeded in the absence of laying a root mat.

Those areas that have been stripped clean of all overburden and have been worked to the appropriate elevation (*i.e.*, mine floor) will form part of the staging area for the stockpiles of newly exposed and blasted rock. Once the operations reach a stage where the storage area can be reduced, these areas will be rehabilitated as per the above requirements.

A detailed reclamation plan was developed for NGC in 1995 (Porter Dillon 1995). This plan will be revised for the extended site and submitted to NSE. The revised reclamation plan will include

updated information on items such as the proposed final topography, maximum slopes, re-vegetation plans and an outline of the plan for progressive reclamation at the site.

The Mi'kmaq will continue to be engaged after the EA stage during permitting and reclamation planning. Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of mitigation measures and confirm effects prediction and any required adaptive management.

3.0 Scope

3.1 SCOPE OF THE UNDERTAKING

Section 2.0 describes the scope of the undertaking (*i.e.*, the proposed Project) that is the subject of the environmental assessment including spatial assessment boundaries (*e.g.*, Project footprints and zones of influence) and temporal assessment boundaries (*e.g.*, Project time frames).

3.2 PURPOSE AND NEED FOR THE UNDERTAKING

The purpose of the proposed Project is to allow NGC to extend the existing mine footprint and continue operations at their mine in Milford, Nova Scotia. The mine is currently operating under an Industrial Approval (No. 89-100), issued by NSE in 1989. In July 2013, additional Non-Mineral Registration tracts were approved by the Minister of Natural Resources. Copies of the above documents and other permits are included in Appendix A.

The mine currently supplies gypsum rock for several wallboard plants in the Maritimes and eastern US. The Proponent anticipates the source material in the Proposed Extension Area to be of similar quality to the material currently extracted at the existing mine.

The Project under consideration as well as other mines and quarries in Nova Scotia are an important component of the natural resource sector of the economy and provide essential raw materials to the region's industrial sector. The mine also provides direct and indirect employment for its workers and suppliers, as well as for the transportation and construction industries. The ability to access lands with gypsum over an extended period of time is critical for the operation to be successful and continue to provide local and regional benefits through employment, procurement of goods and gypsum tax payments.

3.3 CONSIDERATION OF PROJECT ALTERNATIVES

Other methods for carrying out the undertaking may include different methods of extraction of the resource and alternative facility locations. The current method of rock extraction at the NGC mine is drilling and blasting. Alternative methods for extraction of the rock (*i.e.*, mechanical means) are not practical or feasible in this instance due to the nature and characteristics of the rock. Therefore, there are no feasible alternatives to drilling and blasting as a means of extracting this material. Overburden removal, however, is done with excavators.

An alternative facility location is also not a feasible alternative. The extension is occurring in an area that has been previously disturbed and is already exposed to mining activities. The existing mine has been in operation for 60 years (since 1954). Extension of the mine will not require immediate construction of any new facilities (*i.e.*, roads or buildings), as the existing facilities are at present sufficient for the current and extended operations. Additional flow retention structures will be installed/constructed, if required, as the mine develops to accommodate the additional surface runoff and mine drainage.

Gypsum from the mine is used to make wallboard at the only wallboard plant in Nova Scotia (at Port Hawkesbury) as well as other wallboard plants in the Maritimes and eastern US. Wallboard from the Port Hawkesbury plant is sold throughout the Maritimes for the construction of homes and offices. Without a local manufacturer, wallboard would need to be transported a greater distance to end users in Nova Scotia. This additional transportation would result in the emission of additional greenhouse gases, a contributor to climate change. Many wallboard manufacturers build their manufacturing plants as close to the source of their raw materials as possible in order to reduce monetary costs and environmental costs.

The Study Area or original extension area footprint was approximately 165 ha. However, after field and desktop studies were undertaken for this EA, the original footprint was reduced to the current Proposed Extension Area which is 144 ha. Only 135 ha will support mining activities; the remaining 9 ha (*i.e.*, the eastern portion of the Proposed Extension Area) will be set aside as an Ecological Buffer Zone in which no mining or development will occur. This will allow for continued gypsum mining and the possibility of mining anhydrite rock.

3.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The proposed Project must be registered for environmental assessment under the Environmental Assessment Regulations of the Nova Scotia *Environment Act* as a Class I Undertaking. This report substantially fulfils the requirements for Project registration under this legislation.

No requirements under the Canadian Environmental Assessment Act, 2012 (CEAA 2012) are anticipated as gypsum mining is not listed as a designated project as per Section 2 of the *Regulations Designating Physical Activities.*

3.4.1 Valued Component (VC) Identification

The Environmental Assessment Registration is prepared in accordance with the *Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia* (NSE 2009) (EA Guide). The EA Guide is used to provide consistency and a greater degree of certainty regarding information submitted for mining projects in Nova Scotia and identifies the type of information required as part of the registration (NSE 2009). NSE does not provide explicit terms of reference for environmental registrations for Class I Undertakings. It was confirmed that a One-Window process for mining projects is not necessary at this stage where this is an existing project proposing to expand and mineral licenses have been obtained (Bridget Tutty, NSE, Pers. comm., December 10, 2013 and September 10, 2014).

The scope of the EA for the proposed Project has been determined by the Proponent and Stantec and is based upon the proposed Project elements and activities, the professional judgment of the study team, consultations with the public and regulatory authorities on this and similar projects, and the results of field studies conducted in support of this environmental assessment. The Proponent and Stantec met with NSE on December 5, 2013 to discuss the location of proposed extension, and elements and activities associated with the proposed Project, in an effort to further focus the scope of the assessment. Landowners near the mine

were also contacted for the purpose of issues identification (see Section 4.3). A public open house was held on October 22, 2014 and comments received are in Section 4.3.

This EA evaluates the potential environmental effects of the proposed Project elements and activities, for all Project phases for each Valued Component (VC). VCs allows for considerations of social and economic components in addition to ecosystem considerations. VCs are broad components of the biophysical and socio-economic environments that, if altered by the Project, may be of concern to regulatory agencies, the Mi'kmaq of Nova Scotia, scientists, and/or the general public.

Table 3.1 indicates the components recommended for consideration by the EA Guide as well as the scoping considerations and selection of VC used in the EA.

Table 3.1 Scoping of VCs Using *Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia* (NSE 2009).

Component	Scoping Considerations	VC
Biophysical Environment		
Geology	Geology, in itself, is not a valued environmental component. Geological features of the site, including mapping, are presented in the discussion of effects on groundwater.	• Groundwater Resources
Surface Water	Project will interact with surface water onsite. Hydrological conditions and potential effects on water quality and quantity, including potential effects on the one watercourse (WC-1) and four drainage channels within the Proposed Extension Area are addressed.	• Fish and Fish Habitat
Groundwater	Project will interact with groundwater resources. Effects to domestic wells and the Shubenacadie River were identified as issues of concern in previous mine approval applications for the site. Effects on groundwater quality and quantity, with an emphasis on domestic wetland the Shubenacadie River are addressed.	• Groundwater Resources
Wetlands	Project will result in direct and indirect effects to several wetlands within or immediately adjacent to the proposed mine boundaries. Wetlands are valued resources, protected by the Nova Scotia *Environment Act* and Regulations.	• Wetlands
Flora and Fauna Species and Habitat	The Project will result in habitat loss and disturbance to wildlife. Rare plant species were identified in the Proposed Extension Area and overall Study Area during vegetation surveys. Rare species are protected by the Nova Scotia Endangered Species Act and the federal Species at Risk Act. Migratory birds are protected by the Migratory Birds Convention Act. Flora and fauna are assessed separately as rare and sensitive plants and wildlife.	• Rare Plants • Wildlife

Table 3.1 Scoping of VCs Using *Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia* (NSE 2009).

Component	Scoping Considerations	VC
Fish and Fish Habitat	Fish and fish habitat are protected by the federal *Fisheries Act*. There is one watercourse (WC-1) and also four drainage channels within the Proposed Extension Area. Discussion of effects on surface water quality and quantity addresses potential effect on habitat considering that WC-1 will be buffered in the Ecological Buffer Zone.	• Fish and Fish Habitat
Atmospheric Conditions/Air Quality	Project activities will result in release of air emissions (particularly dust). Dust was not identified as a concern during public consultation. Climate is addressed in Section 7.0 (effects of the Environment on the Project).	• Atmospheric Environment
Noise Levels	Project activities will result in noise emissions (*e.g.*, blasting, trucking). Noise was identified as a concern during public consultation.	• Atmospheric Environment
Socio-economic Conditions		
Economy	The Project is not proposed to increase production rates beyond that at the existing NGC mine. No new jobs are predicted at this time as the mine will be operated by existing employees at the NGC mine. However, if volume increases there will be a need to add further hourly workers and staff.	• Land and Resource Use
Land Use	The Project will interact with surrounding land uses including residential and recreational land use.	• Land and Resource Use
Transportation	The Project is not proposed to increase production rates beyond that at the existing NGC mine. Transportation of gypsum from the NGC mine will continue to be via a private access road to the rail line adjacent to the existing mine. There is therefore no anticipated net change in traffic. Details on existing mine traffic are provided in Section 2.0.	• Land and Resource Use
Recreation and Tourism	Existing and planned recreation and tourism activities are discussed with respect to land use.	• Land and Resource Use
Human Health	Potential effects on human health are addressed through the assessment of air, noise, groundwater and surface water effects. Public safety measures such as controlled site access, fencing and signage are discussed the Land and Resource Use VC.	• Atmospheric Environment • Groundwater Resources • Fish and Fish Habitat • Land and Resource Use
Cultural and Heritage Resources	Ground disturbance associated with mine extension could affect subsurface archaeological or heritage resources that may be present. The mastodon remains that were found at the existing mine in 1991 and 1993, indicate the potential for additional paleontological resources, which are also discussed in the context of Archaeological and Heritage Resources.	• Archaeological and Heritage Resources

Table 3.2 summarizes the final VCs assessed in this report and selection rationale.

Table 3.2 Valued Components (VCs) and Selection Rationale

VC	Rationale for Selection			Where VC is addressed in EA
	Public/ Stakeholder Concerns	Regulatory Considerations	Professional Judgment	
Fish and Fish Habitat	✓	✓	✓	Section 5.1
Rare Plants		✓	✓	Section 5.2
Wildlife	✓	✓	✓	Section 5.3
Wetlands	✓	✓	✓	Section 5.4
Groundwater Resources	✓	✓	✓	Section 5.5
Archaeological and Heritage Resources	✓	✓	✓	Section 5.6
Atmospheric Environment	✓	✓	✓	Section 5.7
Land and Resource Use	✓	✓	✓	Section 5.8

3.4.2 Spatial and Temporal Boundaries

Boundaries provide a focus for an environmental assessment. Temporal and spatial boundaries encompass those periods and areas within which the VCs are likely to interact with, or be influenced by, the Project. Spatial boundaries for this assessment are generally limited to the Proposed Extension Area and immediately adjacent areas unless otherwise noted. Temporal boundaries are generally limited to the duration of, and for a period of time after, the Project activities. In this case, the temporal boundaries include the entire lifetime of the mine including reclamation and decommissioning activities (*e.g.*, >35 to 40 years). This EA assesses potential effects of the Project throughout the year. Temporal boundaries also address other temporal issues such as seasonal sensitivities (*e.g.*, bird breeding) and dust generation.

3.4.3 Field Studies and Data Collection

Field studies were conducted by Stantec to investigate and establish the existing conditions and to determine appropriate mitigation, if necessary, to manage environmental effects from the proposed Project. The Project footprint is the Proposed Extension Area. However, the original expansion area (referred to as the Study Area) was larger (*i.e.*, approximately 165 ha vs 144 ha) and encompasses the scope of where field data were collected. These data were carried into the VC assessments as the information is relevant to the discussion related to how the footprints for the Proposed Extension Area and Ecological Buffer Zone were established.

Field studies covered four seasons (fall 2013, and winter, spring, summer 2014) and consisted of the following surveys (dates are within the individual VCs in Section 5.0):

- Wildlife (breeding bird, mammal, and herpetile) surveys were initiated by qualified terrestrial ecologists in the fall of 2014 and completed in late spring and summer 2014;
- Vegetation field surveys were initiated by qualified terrestrial ecologists the fall of 2014 and completed in early and late summer 2014;
- Wetland delineations were initiated by qualified terrestrial ecologists in the fall of 2014 and wetland delineations/surveys were completed by qualified terrestrial ecologists and qualified hydrogeologist/wetland scientist in late spring and early/late summer 2014;
- Moose tracks surveys undertaken by a qualified terrestrial ecologist in January, February and March 2014. Tracks and observations for other wildlife were also recorded during the winter surveys;
- Aquatic field surveys were undertaken by two qualified aquatic ecologists in late summer 2014;
- A qualified archaeologist conducted a desktop assessment of potential archaeological and heritage resources, followed by a field survey in the summer of 2014; and
- A windshield survey was conducted by a qualified land use planner and environmental specialist in the summer of 2014.

Desktop studies included: atmospheric environment (air and noise) study, groundwater resources, and land and resource use.

Additional information, in support of the field and desktop studies and the assessment, was gathered through a review of: air photos; site mapping; the Atlantic Canada Conservation Data Centre (ACCDC), and other data sources including but not limited to Statistics Canada, Nova Scotia Museum, Nova Scotia Department of Natural Resources (NSDNR), Nova Scotia Geomatics Centre (NSGC), and Nova Scotia Topographic Database (NSTDB).

3.4.4 Effects Analysis Methods

A focused approach is used for the EA using VCs and boundaries identified in a scoping process described in Sections 3.4.1. Environmental assessment is used as a planning tool not only to identify predicted Project effects, but also to design mitigative strategies to reduce adverse effects and propose monitoring programs where substantial risk or uncertainty remains.

For each VC, existing conditions in the Proposed Extension Area are described. The description is restricted to a discussion of the status and characteristics of the VCs within the boundaries established for the assessment. Potential Project-VC interactions are identified and effects, including proposed mitigation, are predicted. Effects are analyzed qualitatively, and, where possible, quantitatively, using existing knowledge, professional judgment and other analytical tools, where appropriate.

To assess the potential environmental effects of the Project and determine the significance of an effect, the study team has considered the magnitude, frequency, duration, geographical extent and reversibility of the potential effect, where applicable. In particular, regulatory standards were used, where appropriate, to determine thresholds of significance for predicted environmental effects after application of mitigation (*i.e.*, residual effects). Where regulatory standards are not available, other key factors such as the sustainability of biological populations, and rarity of species and critical habitats, have been used as indicators of significance.

Table 3.3 presents the temporal and spatial boundaries and effects significance criteria for each VC for this assessment. With regard to significance criteria, definitions are provided for a significant adverse environmental effect and a positive effect.

Requirements for follow-up and monitoring are linked to the sensitivity of a VC to predicted environmental effects as well as levels of uncertainty with respect to the prediction of effectiveness of mitigation.

Table 3.3 Assessment Boundaries and Significance Criteria

VC	Assessment Boundaries	Significance Criteria
Fish and Fish Habitat	**Spatial boundaries** for the assessment of Freshwater Fish and Fish Habitat are based on secondary watershed areas potentially affected by surface runoff from the Project. In this case, the Project is located within the Shubenacadie River Secondary Watershed 1DG-1. **Temporal boundaries** are continuous throughout the life of Project operations including construction, operation, accidents and malfunctions, decommissioning and reclamation activities. Specific temporal boundaries include those times when fish and their habitat within the Project footprint are particularly sensitive (*e.g.*, spawning or migration).	A **significant adverse environmental effect** on fish is one that results in: • **A change in Fish Habitat** (measureable parameters include habitat quality, quantity and water quantity or quality); • **A change in Fish Abundance**(measureable parameters include abundance, population structure, or community structure); or • **A Change in Fish Mortality** (measurable parameters include direct and indirect mortality risks). A *significant effect to freshwater fish habitat* is one that results in a permanent alteration or destruction of fish habitat that results in serious harm to fish that are part of a Commercial, Recreational, or Aboriginal (CRA) fishery or species listed under SARA and these effects cannot be mitigated or offset. A *significant effect to freshwater fish abundance* is one that occurs when the relative abundance decreases below a threshold by which a CRA fishery is not as productive or sustainable and where recovery to baseline is uncertain. A *significant effect to freshwater fish mortality* occurs when a CRA fishery's productivity or sustainability is negatively affected and where recovery to baseline is uncertain. For SARA listed species (i.e Inner Bay of Fundy Salmon) a significant effect to freshwater fish occurs where death or a life threatening injury occurs to one or more individuals.
Rare Plants	**Spatial boundaries** for the assessment of rare and sensitive flora includes those flora species and associated habitat that occur within or immediately adjacent to the Proposed Extension Area such that their habitat could be affected by Project activities. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on rare and sensitive flora occurs when the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment would not return the population to its former level within several growing seasons.

Table 3.3 Assessment Boundaries and Significance Criteria

VC	Assessment Boundaries	Significance Criteria
Wildlife	**Spatial boundaries** for the assessment of wildlife include wildlife and their habitat occurring within or immediately adjacent to the proposed mine boundaries (*i.e.*, the Proposed Extension Area) such that they could be disturbed by noise or other stimulus. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on wildlife occurs when the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction and immigration from unaffected areas) would not return the population to its former level within several generations.
Wetlands	**Spatial boundaries** for the assessment of wetlands includes wetlands occurring within or immediately adjacent to the proposed mine boundaries such that their hydrologic regime could be affected. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities. Other temporal boundaries include those periods of increased sensitivity to wildlife inhabiting the wetlands (*e.g.*, bird or herpetiles breeding).	A **significant adverse environmental effect** on wetlands occurs when there is a net loss of wetland functions in a wetland of significant value as determined through a recognized wetland evaluation system.
Groundwater Resources	**Spatial boundaries** for the assessment of groundwater resources are based on a combination of aquifer hydraulic properties, expected groundwater flow directions and the distance between the mine and wells that may be affected by excavation and/or blasting. The area of influence or capture area of a typical domestic well is usually less than 100 m. Vibration damage to a well is generally a function of distance between the energy source and the well and the seismic properties of the aquifer materials. Risk from blasting is expected to be minimal beyond about 200 m in soft rock terrain, but an 800 m area of influence is used to be conservative. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on groundwater resources is defined as one in which the Project causes one or more of the following: • yield from an otherwise adequate well supply decreases to the point where it is inadequate for intended use; • the quality of groundwater from an otherwise adequate well supply that meet guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2012 or latest on-line up-date); and/or • The aquifer is physically or chemically altered to the extent that interaction with local surface water results in stream flow or chemistry changes that adversely affect aquatic life or surface water supply.

Table 3.3 Assessment Boundaries and Significance Criteria

VC	Assessment Boundaries	Significance Criteria
Archaeological and Heritage Resources	**Spatial boundaries** for the assessment of archaeological and heritage resources include the area within or immediately adjacent to the Proposed Extension Area. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on archaeological and heritage resources is defined as any Project-related disturbance to, or destruction of, archaeological or heritage resources considered by affected Aboriginal and other communities, or provincial heritage regulators to be of major importance due to factors such as rarity, condition, spiritual importance, or research importance, and that cannot be mitigated.
Atmospheric Environment	**Spatial boundaries** for the assessment of air quality and the acoustic environment this would include the airshed within which sensitive receptors (*e.g.*, residential communities) could potentially experience a measurable change in regulated air quality parameters (*e.g.*, airborne particulates) and sound levels. In this case, 5 km is considered a sufficient spatial boundary. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** with respect to air quality is defined as one that would reduce air quality at the site property boundaries, such that the level of total suspended particulate matter exceeds 120 µg/m^3 over a 24 hour averaging period or 70 µg/m^3 over an annual averaging period. A **significant adverse environmental effect** with respect to the acoustic environment is defined as one that would result in an increase in existing sound levels that exceed 65 dBA during the day (7:00 to 19:00), 60 dBA during the evening (19:00 – 23:00) and 55 dBA during the night (23:00 – 7:00).
Land and Resource Use	**Spatial boundaries** for the assessment of land use include lands within 1-2 km of the Proposed Extension Area boundaries with a focus on those land uses that could be directly affected by noise or other stimulus (*e.g.*, views). In general, the focus is on the community of Carrol's Corner. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities. Other temporal boundaries include those periods of increased land use activity (*e.g.*, summer).	A **significant adverse residual environmental effect** is one where the proposed use of land for the Project is not compatible with adjacent or historical land use activities as designated through a regulatory land use process, and/or the proposed use of the land will create a change or disruption that widely restricts or degrades present land uses to a point where the activities cannot continue at current levels and for which the environmental effects are not mitigated or compensated.

4.0 Public Consultation and Mi'kmaq Engagement

4.1 OVERVIEW

Consultation with potentially affected stakeholders, the general public and regulatory agencies, and engagement with the Mi'kmaq community is an essential component of any EA.

The purpose of community engagement and consultation is to inform stakeholders, the Mi'kmaq and the community about existing and proposed activities and to identify any issues of concern raised by stakeholders and the Mi'kmaq during the planning and design of the Project and continuing into operation. The public consultation and engagement program conducted as part of the EA process to date has been an important vehicle for the identification, scoping, and resolution or mitigation of potential issues or concerns, and for the exchange of information in respect of the Project.

To achieve its consultation and engagement goals, NGC is committed to a public and stakeholder consultation and Aboriginal engagement program based on open, forthright and responsive communication with the public, regulatory agencies, other stakeholders and the Mi'kmaq. The objectives of the consultation and engagement program implemented for Project have been to:

- Provide information about the Project to members of the general public, the Mi'kmaq, stakeholders and interested parties, and seek their input;
- Identify, document, and monitor issues and concerns arising from the consultation process;
- Request information on the current use of lands and resources for traditional purposes by Mi'kmaq persons in the vicinity of the Project activities and how those activities might be affected by the Project; and
- Identify the need for planning, design and management measures that will mitigate or resolve the issues raised through the consultation process.

Issues identified in the course of consultation and engagement activities were tracked and were responded to when appropriate. Issues, questions, concerns or comments raised through consultation and engagement initiatives during the environmental assessment process were documented as they arose so that they could be considered, as appropriate, in the scoping or conduct of the environmental assessment.

Consultation and engagement will continue as the proposed Project proceeds through the approvals and permitting process. For example, this EA Registration will be made available to the public as part of the requirements under the provincial EA process. Comments regarding the EA Registration will be collected and reviewed by NSE to inform the Minister's decision regarding the Project proposal.

4.2 REGULATORY CONSULTATION

A meeting was held on December 5, 2013 at NSE in Halifax and included representatives from NGC, Stantec, and NSE EA Branch. The purpose of the meeting was to: provide information about the Project; identify and discuss issues and concerns to inform the scope of the EA; discuss the proposed Project schedule and regulatory approvals process; and discuss approach to public and Mi'kmaq engagement.

Project information and mapping was sent to Nova Scotia Department of Natural Resources (NSDNR), Communities, Culture and Heritage (CC&H), and the Office of Aboriginal Affairs (OAA) and any feedback received has been incorporated into the EA. Comments received during the regulatory review process for the Draft EA have been addressed in the Final EA Registration.

4.3 PUBLIC CONSULTATION

An open house session was held at the Carrolls Corner Community Centre on October 22, 2014 from 4:00 pm to 7:00 pm. In order to publicize the event, Project Information Bulletins were distributed to approximately 200 area residents living within approximately 1 - 2 km of the existing mine and the Proposed Extension Area (*i.e.*, those who are potentially most affected) (Appendix D). Copies of the open house invitation and Project Information Bulletin were provided to NSE, KMKNO, Sipekne'katik First Nation, Millbrook First Nation, Confederacy of Mainland Mi'kmaq (CMM), Native Council of Nova Scotia (NCNS), and local elected officials (*i.e.*, East Hants Chamber of Commerce, Carrolls Corner Community Association, MLA Hants East, MLA Colchester-Musquodoboit Valley, Alan Davidson of NSDNR and Councilor Versteeg of Municipality of East Hants Milford) to inform them of the Open House.

The event was also advertised on the Carrolls Corner Community Centre posted on their outside sign the day of the open house (see photograph below). The intent of the open house session was to:

- encourage dialogue between members of the Project Team (representatives from NGC and Stantec) in attendance and the general public and stakeholders;
- to enable the public and stakeholders to obtain Project information and ask questions;
- to view mapping showing the proposed Project; and
- to participate in the EA process.

The open house session was informal and consisted of: a series of poster storyboards (Appendix D); maps of the Proposed Extension Area; descriptions of the Project components and activities; and regulatory approval processes for the Project. NGC staff and consultants were available to discuss the Project, answer questions, and document and discuss issues and information related to the Project with interested members of the public.

Attendees were asked to sign-in (optional) and were encouraged to complete a feedback form prior to leaving the sessions (Appendix D). Approximately 30 people attended the event. Attendees included local residents, landowners, NGC employees, as well as a representative from East Hants Municipality. The community commented that they appreciated the informative storyboards, mapping and knowledgeable staff.

Issues raised at the open house and throughout the public consultation process have been tracked and are summarized in Table 4.1 along with where the issues are addressed in the EA.

Table 4.1 Key Issues Raised During Regulatory and Public Consultation

Issue	Comment Originator	Section of EA where addressed
• Provide a map showing existing mine and Proposed Extension Area	• NSE/Public	• Figure 2.1
• Location of the Project with respect to existing buildings/structures and other features.	• NSE/Public	• Figure 5. 7 (Land Use)
• Operating schedule and Proposed Mine Development Plan map	• NSE/Public	• Operating schedule (Sections 2.1 and 2.5) • Proposed Mine Development Plan (Appendix B)
• Land reclamation	• NSE/Public	• Section 2.7 (Decommissioning and Reclamation)
• Conduct winter moose tracking surveys for EA	• NSE	• Methods and results in Section 5.3 (Wildlife)
• Moose sighting reported in area (south of Cooks Mill Road, approximately 1 km northeast of Proposed Extension Area)	• Public	• Noted in wildlife VC (Section 5.4)
• Address whether Proposed Extension Area has potential bat hibernacula	• NSE	• Section 5.3 (Wildlife)
• Address paleontology concerns (*e.g.*, contingency planning for mastodon finding)	• NSE	• Section 5.6 (in Archaeological and Heritage Resources VC)
• Noise from mine (mostly backup beepers and truck rear gates slamming). Also noise	• Public	• Section 2.6 (Effluents and Emissions)

Table 4.1 Key Issues Raised During Regulatory and Public Consultation

Issue	Comment Originator	Section of EA where addressed
from other mining/quarry operations in the vicinity.		• Section 5.7 (Atmospheric Environment)
• Proximity to homes and properties - some were accustomed living near the mine. Others had concerns reduced when shown Proposed Mine Development Plan map that shows the extension will take place over a very long time frame	• Public	• Land and Resource Use VC (Section 5.8) • Proposed Mine Development Plan (Appendix B)
• Many current and retired mine employees came to demonstrate support and discussed long history of mine in the community	• Public	• Section 4.3 (Public Consultation)
• Interested in learning more about effects on the local economy	• Public/East Hants Municipality	• Section 2.5 • Land and Resource Use VC (Section 5.8) • Continued operation of the mine will result in economic benefits, including ongoing employment and business opportunities.

Comments received during the regulatory review process for the Draft EA have been addressed in this Final EA Registration. This Final EA Registration document will be subject to a public review process as required under provincial legislation. The document will be posted on the NSE website (http://www.novascotia.ca/nse/ea/) with paper copies at several locations including near the Project Area. Publication dates and Registration document locations will be advertised in one Province-wide newspaper and one local newspaper. Public comments will be solicited by NSE as part of this process.

4.4 MI'KMAQ ENGAGEMENT

NGC has endeavored to develop a positive relationship with the Mi'kmaq People. The following list summarizes Mi'kmaq engagement activities conducted by the proponent.

- **February/March 2014:** Meeting at mine with Chief Copage on February 14, 2014 to discuss the Project, future employment, timelines, environmental surveys. Also provided a site tour and offered to take other representatives from Sipekne'katik First Nation upon request. Chief Copege identified potential for ancient burial grounds. NGC offered to have a Sipekne'katik representative review mapping and/or accompany Stantec archaeologist during field surveys. Followed up with calls and also communicated that the MEKS was initiated in the spring.

- **April 2014:** Meeting at mine with Jennifer Copage from the Sipekne'katik First Nation on April 10, 2014 to discuss the Project, operations, reclamation, environmental surveys, and provided

a site tour. NGC again extended the offer to have a Sipekne'katik representative accompany Stantec archaeologist during field surveys. Followed up with mapping and emails. The offer still stands for a future visit if requested.

- **May 2014 to October 2014:** In order to determine Mi'kmaq traditional and current uses of the area, Membertou Geomatics Solutions undertook a Mi'kmaq Ecological Knowledge Study (MEKS) on behalf of the Proponent. The MEKS, initiated in May 2014 and finalized in October 2014, is included in Appendix F. A summary of Information from the MEKS is included in Section 5.8. The MEKS followed the MEKS Protocol developed by the Assembly of Nova Scotia Mi'kmaq Chiefs (http://mikmaqrights.com/consultation/meks-protocol/)

- **September 2014:** Meeting at mine on September 4, 2014 with Twila Gaudet and Melissa Nevin of the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO). The purpose of the meeting was to provide information about the Project, identify and discuss issues and concerns, and discuss the proposed Project schedule and regulatory approvals process.

- **September 2014:** Project Information Bulletins and open house invitations were sent to the KMKNO, the Confederacy of Mainland Mi'kmaq (CMM), the Native Council of Nova Scotia (NCNS), the Union of Nova Scotia Indians (UNSI), and the Sipekne'katik (Shubenacadie) First Nation and Millbrook First Nation to encourage the submission of comments, concerns, and questions regarding the Project and invite them to the open house (Appendix D).

- **September 2014:** Meeting with the Human Resources Director at Sipekne'katik First Nation and discuss the future hiring needs of the mine and the skills required.

- **September 2014:** The proponent had a telephone conversation with Chief Gloade from the Millbrook First Nation to discuss the Project. A meeting and a site tour were offered for when it is convenient for Chief Gloade and Council.

- **October 2014:** Correspondence (Appendix D) with Jennifer MacGillivary, Benefits Officer for Sipekne'katik First Nation.

In addition, NGC has a signed Memorandum of Understanding (MOU) with the Native Council of Nova Scotia, where NGC is willing to provide pre-apprentice training and work experience.

Issues raised during the Mi'kmaq engagement process conducted by NGC have been tracked and are summarized in Table 4.2 along with where the issues are addressed in the EA.

Table 4.2 Key issues raised during Mi'kmaq engagement conducted by NGC

Issue	Section of EA where addressed
• Provide a map showing existing mine and Proposed Extension Area	• Provided at meeting with KMK and via email. • Figure 2.1
• Location of the Project with respect to other features	• Provided site map at meeting with KMK and via email (Figure 2.1) • Figure 5. 7 (shows land use in area) • Ecological Buffer Zone added to mapping to protect large wetland and watercourse at eastern end of Proposed Extension Area.
• Operations schedule and Proposed Mine Development Plan map	• Operations schedule is discussed in Section 2.5 • Proposed Mine Development Plan is in Appendix B.
• Recommended that a MEKS be conducted	• A MEKS was conducted. Refer to Appendix F and summary in Section 5.8 (Land and Resource Use)
• Suggested Proponent's archaeologist contact Heather MacLeod-Leslie from the KMK and provide report. Chief Copage identified potential for ancient burial grounds.	• NGC offered to have a Sipekne'katik representative review mapping and/or accompany Stantec archaeologist during field surveys. Followed up with calls and also communicated that the MEKS was initiated in the spring. The offer still stands for a future visit if requested. • Ms. MacLeod-Leslie was contacted by the Proponent's archaeologist to discuss findings and EA will be shared during the draft and final EA review process.
• Opportunities for employment	• NGC met with the Human Resources Director at Sipekne'katik First Nation and discuss the future hiring needs of the mine and the skills required. • NGC has a signed MOU with the NCNS, where NGC is willing to provide pre-apprentice training and work experience. • Employment for current operations is discussed in Section 2.5. Continued operation of the mine will result in economic benefits, including ongoing employment and business opportunities.
• Benefits program opportunities and encouraged proponent to meet with KMK benefits representative Jennifer MacGillivary	• NGC has had correspondence with the Benefits Officer for Sipekne'katik First Nation (letter sent to Jennifer MacGillivary in October 2014) and an offer for a meeting still stands.
• Acknowledged Proponent's outreach to Sipekne'katik First Nation and said to also engage Millbrook First Nation	• The Proponent had a telephone conversation on September 11, 2014 with Chief Gloade from the Millbrook First Nation to discuss the Project. An in-person meeting and site tour were offered when it is convenient for Chief Gloade and Council.
• Ongoing engagement after EA	• Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of mitigation and confirm effects prediction and any required adaptive management.

To date, no additional comments have been received in response to the Project Information Bulletin that was sent to the KMKNO, CMM, NCNS, UNSI, Sipekne'katik (Shubenacadie) First Nation and Millbrook First Nation. The proponent will follow up with additional communication and engagement around any expressed issues of concern (if applicable).

The EA Registration will be subject to a public review process, and in addition to being posted on the NSE website (http://www.novascotia.ca/nse/ea/), copies of the EA will also be shared with the KMKNO, Sipekne'katik First Nation and Millbrook First Nation.

NGC will continue to listen to concerns from the Mi'kmaq and share the steps that are taken to address any concerns. Engagement with the Mi'kmaq will continue after the EA stage during permitting and reclamation planning. Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of mitigation measures and confirm effects prediction and any required adaptive management.

4.5 COMMUNITY INVOLVEMENT

NGC is proud of its community involvement, and annually provides financial support to the following organizations in the area: Lions Club, Carrolls Corner Community Association, Mission to Seafarers, Milford-Lantz United Church, East Hants Chamber of Commerce, and the Corridor Horse & Pony Society (CHAPS). The company has also donated land on the border of the mine property to be developed into a walking trail, provides scholarship funds to the schools in the area, and has in the past donated pieces of heavy equipment to be used on different community projects.

Several letters of support for the Project have been received and are included in Appendix E. To date, letters of support have been received from:

- Carrolls Corner Community Center;
- East Hants Chamber of Commerce;
- Municipality of East Hants;
- Milford and District Lions Club;
- Milford and District Emergency Services (Fire Station);
- Milford Recreation Association;
- Milford Lantz United Church; and
- Shaw Resources.

NGC has a long-standing history in the community. Continued operation of the mine will result in economic benefits, including ongoing employment and business opportunities.

5.0 Valued Components and Effects Management

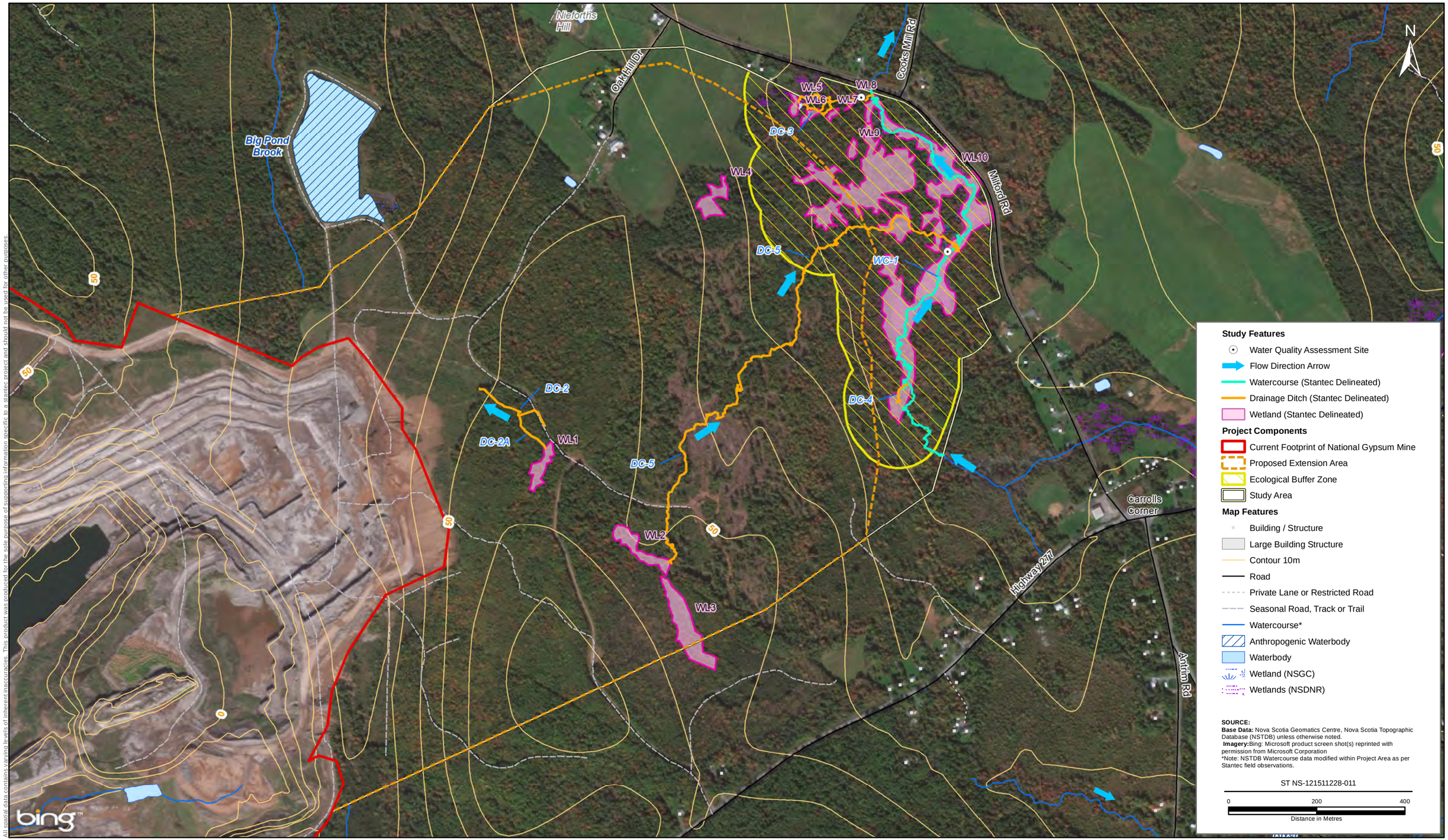
Field studies were conducted by Stantec over four seasons (fall 2013, and winter, spring, summer 2014) to investigate and establish the existing conditions and to determine appropriate mitigation, if necessary, to manage environmental effects from the proposed Project. The Project footprint is the Proposed Extension Area. However, the original expansion area (referred to as the Study Area) was larger (*i.e.*, approximately 165 ha vs 144 ha) and encompasses the scope of where field data were collected (Figure 2.1). These data were carried into the VC assessments as the information is relevant to the discussion related to how the footprints for the Proposed Extension Area and Ecological Buffer Zone were established.

5.1 FISH AND FISH HABITAT

5.1.1 Description of Existing Conditions

Fish and fish habitat is included as a VC because of the potential interactions that both may have with the Project and because both fall under regulatory protection. Surface water quality and quantity is also a component of fish habitat and is included in this VC. Freshwater fish and fish habitat are also affected by changes in associated wetlands and hydrology; however, potential interactions between Project activities and these components of the aquatic environment are also addressed in Section 5.4 (Wetlands) and Section 5.5 (Groundwater Resources).

The existing mine is situated in the secondary watershed of the Shubenacadie River (area 2,500 km^2) and the primary watershed of the Shubenacadie/Stewiacke Rivers. The Shubenacadie River is tidally influenced for over 35 km from a tributary located on the east side of the mine to the sea, and forms a defined channel west of the mine. The existing mine lies between the Shubenacadie River and Big Pond Brook. The topography rises over 70 m above mean sea level in the central portion of the site and then slopes to the west towards the natural course of Big Pond Brook and east towards a series of wetlands associated with the eastern watercourse (WC-1). The Study Area encompassed two mapped watercourses, one anthropogenic pond and multiple wetlands. Aquatic scientists conducted habitat assessments on the two mapped watercourses located within the Study Area and determined that one watercourse (Big Pond Brook) had been previously diverted under Approval (Appendix A) from NSE and now flows into the mine's surface water collection system. For the purpose of this EA this would no longer be considered a watercourse. While conducting these assessments, four additional dry drainage channels were identified. These features are identified on Figure 5.1 as WC-1, Pond-1and DC-2 through DC-5.



PREPARED BY: C Shupe	National Gypsum Mine Extension	FIGURE NO.: 5.1
REVIEWED BY: M Huskins-Shupe	**Wetlands and Watercourses / Drainage Locations**	DATE: Nov 05, 2014
CLIENT: National Gypsum (CANADA) LTD.		Stantec

File Path: V:\1215\active\121510xxx\121511228_national_gypsum_ea\geomatics\mapping\mxd\report\ST NS-121511228-011_WetlandsWatercoursesDrainage.mxd

The fish and fish habitat surveys were conducted on August 27, 2014 and September 12, 2014 using a Stantec sampling protocol. The protocol used is based on multiple existing protocols including the Environment Canada CABIN protocol (Canadian Aquatic Biomonitoring Network; Reynoldson *et al.* 2007), the Ontario Benthos Biomonitoring Network (OBBN) protocols (Jones *et al.* 2005), and the modified New Brunswick Department of Natural Resources (NBDNR) and Fisheries and Oceans Stream Assessment Protocol (Hooper *et al.* 1995). The stream assessment included the identification of physical units (*i.e.*, run, riffle, or pool), designation of substrate type, and description of the riparian zone. The presence or absence of macrophytes, algae, over-head cover, and woody debris was recorded. The depth, width and velocity of the watercourses were also taken and the presence of existing anthropogenic effects were noted. Electrofishing surveys were not conducted as the waters downstream of the Study Area are listed under *SARA* as Protected. Individuals of the Inner Bay of Fundy Population of Atlantic Salmon may be present within the Shubenacadie River into which the watercourses in the Project Area drain via Gays River; therefore electrofishing is generally prohibited. Where fish were observed within watercourses, an attempt was made to identify them to species level.

The species observed and the fish habitat data are provided below for the assessed streams. This information details the watercourse survey results and characterizes the habitats. The *in-situ* water quality results are listed for each watercourse, where water was present. Water quality is reviewed to determine the capacity for the watercourse to support aquatic life through comparison with guidelines from the Canadian Council for the Minsters of the Environment Guidelines for the protection of Freshwater Aquatic Life (CCME-FAL).

Fish Habitat

The Study Area is located on a local drainage divide with water draining to the northeast on the east half of the Study Area and northwest on the western side. Any surface water from the Study Area entering WC-1 will eventually drain into the Shubenacadie River through the Gays River. Individual wetlands are present in the southwest portion of the Study Area with a complex wetland buffering WC-1 in the North. Watercourses and drainage channels are generally associated with the larger wetlands located within the Study Area.

WC-1 is located within wetland WL10, the channel WC-1 is largely defined and deeply entrenched with an organic silt substrate. Abundant macrophtyes are present above and below the water surface and the flow is negligible along the reach. The banks are stable with little erosion and the riparian vegetation is full and consists largely of grasses and shrubs. Fish were observed within this watercourse. Although no fish were retained, aquatic biologists identified brown bullhead, stickleback species, minnows, and salmonids (likely brook trout). Representative photos of the habitat units from the surveyed watercourse are provided in Appendix H.

The remaining four channels on the Study Area (Figure 5.1) were identified as drainage channels as they are either partially or completely dry during the summer months. Channels DC-3 and DC-4 were similar narrow channels entrenched in a treed wetland with soft substrates composed

of organics and silt. Vegetation within each channel was thick and algae were present. Channels DC-3 and DC-4 were each less than 100 m in length and frequently subterranean. Both channels originated from wetlands and drained into WC-1. These channels contained water in their lower reaches, though this could be considered more of a backwater from WC-1.

Channel DC-2 is approximately 125 m in length and originates from wetland WL1 receiving additional input from a forestry road ditch. The channel is located in an area of mixed wood forest with a moderate grade sloping down to the north. The substrate was mostly pebble, gravel and sand with little organic or silt. The banks were eroding along most sections of the channel and it appears the channel flows only during heavy precipitation events. This channel flows northwest toward the current mine footprint. At the terminal end of DC-2 the channel dissipates and any flow likely goes subterranean or percolates within the wetland.

Channel DC-5 was the longest and widest channel on-site at 1,290 m and 1.2 m, respectively. DC-5 was dry at the time of assessment; the substrate was hard and consisted of cobble, rubble and pebble. The banks were moderately stable though it appears the channel experiences high flow events as scouring was apparent in sections.

Pond-1 is located on the edge of the agricultural lands to the north of the Study Area. This pond is anthropogenic and likely created as a water supply. There is no connectivity to fish bearing waters and likely provides habitat for amphibians, reptiles, invertebrates and wetland vegetation. As this pond does not provide fish habitat the area is further described in Sections 5.2 and 5.3.

A summary of physical habitat data from the field surveys conducted August 27 and September 12, 2014 are listed in Table 5.1with the raw data included in Appendix H.

Fish Survey Results

Electrofishing surveys were not conducted as noted above, although fish observations were recorded.

The sole watercourse (WC-1) in the Study Area is fish bearing and observed species included brown bullhead (*Ameiurus nebulosus*), stickleback species, minnows, and salmonids (likely brook trout). Water contained in the WC-1 has direct connection downstream to Gays River which supports multiple recreational fisheries. Mitigation must therefore be undertaken during mine extension to prevent downstream effects on fish and fish habitat to meet DFO standards.

All four of the drainage channels observed were dry at the time of the assessment and do not constitute fish habitat based on their ephemeral nature and lack of connectivity. Three of these four drainage channels slope towards WC-1(DC-3, DC-4 and DC-5) and during periods of high flow are likely to alter the water quality in WC-1. Mitigation must therefore be undertaken during mine extension to prevent downstream effects on fish and fish habitat to meet DFO standards.

Table 5.1 Summary of Stream Assessments at National Gypsum Mine Study Area

Site Description	WC-1: Tributary to Gays River	DC-2: Unnamed Tributary	DC-3: Tributary to WC-1	DC-4: Tributary to WC-1	DC-5: Tributary to WC-1	Pond-1: Anthropogenic Pond
Date & Time	August 27, 2014	September 12, 2014	September 12, 2014	September 12, 2014	September 12, 2014	September 12, 2014
Site Coordinates	469250E;4985160N	468297E;4985167N	469143E;4985739N	496239E;4985111N	468881E;4985174N	468508E;4985627N
Site Measurements and Characteristics						
Precipitation Previous 24 hrs	None	None	None	None	None	None
Wetted Width - Average (m)	2.54	Dry	Dry	Dry	Dry	20
Bankfull Width - Average (m)	3.11	0.7	1.1	0.7	1.2	25
Depth - Range (m)	0.09 – 0.40	Dry	Dry	Dry	Dry	2.5
Bank Stability - Left/Right	Stable/Stable	Eroding	Stable	Stable	Stable	Bare Stable
Woody Debris (Present/Absent)	Present	Present	Present	Present	Present	Present
Macrophytes (Sub, Emerg, Float, Root)	Sub, Emerg, Root	Absent	Absent	Absent	Absent	Emerg, Root
Algae (Slime, Attach, Filament, Float)	Slime, Float	Absent	Slime	Absent	Absent	Slimes, Floating
Canopy Cover - Average (%)	40	60	25	30	25	5
Riparian Vegetation (Dominant Forest Type)	Wetland	Mixed	Mixed	Mixed	Mainly Coniferous	Pasture
Substrate						
Organics	10	-	10	10	10	20
Fines (1 – 2 mm)	80	-	50	50	30	80
Sand (2 – 5 mm)	-	40	25	40	-	-
Gravel (5 – 10 mm)	5	30	15	-	-	-
Pebble (10 – 25 mm)	5	30	-	-	5	-
Rubble (25 – 50 mm)	-	-	-	-	20	-
Cobble (50 – 100mm)	-	-	-	-	35	-
Rock (100 – 250mm)	-	-	-	-	-	-
Boulder (>250 mm)	-	-	-	-	-	-
Bedrock	-	-	-	-	-	-

Macrophytes: Sub=Subbmergent; Emerg=Emergent, Float=Floating; Root=Rooted

Algae = Slime=Slimes; Attach=Attached; Filament=Filamentous; Float=Floating

Water Quality

In-situ Water Quality measurements were collected from WC-1 and Pond-1, and these measurements were compared against the CCME-FAL. The data is listed in Table 5.2 along with relevant guideline values.

Table 5.2 Water Quality Results

Site Description	CCME FAL Guidelines	WC-1: Tributary to Gays River	DC-3: Tributary to WC-1
Date & Time	-	August 27, 2014	September 12, 2014
Site Coordinates	-	469250E;4985160N	469143E;4985739N
Water Quality			
pH	6.5 – 9.0	6.7	6.1
Dissolved Oxygen (mg/L)	>9.5	8.6	9.3
CCME FAL – DO (mg/L) Warm water species early life stage >6.0 mg/L CCME FAL – DO (mg/L) Warm water species other life stage >5.5 mg/L CCME FAL – DO (mg/L) Cold water species early life stage >9.5 mg/L CCME FAL – DO (mg/L) Cold water species other life stage >6.5 mg/L			

The *in-situ* water quality results measured at the time of the survey for WC-1 and Pond-1 (Table 5.2) indicate that the water quality was below the CCME-FAL for pH and dissolved oxygen (*i.e.*, less than desirable). The CCME-FAL includes four values for dissolved oxygen. These values are based on two factors: fish habitat thermal preference and fish life stage. Thermal preference is divided into warm or cold water ecosystems. Generally, species who inhabit warm water ecosystems are more adapted to low dissolved oxygen concentrations and the guideline values are subsequently lower. The life stage factor is divided into early life stages (eggs to juveniles) and other life stages (adults) with eggs/juveniles requiring the highest dissolved oxygen concentrations. The dissolved oxygen content of WC-1 was measured to be 8.6 mg/L and DC-3 was 9.3 mg/L; these concentration falls below the guideline value (9.50 mg/L) for cold water early life stages, the most sensitive group. Dissolved oxygen concentrations of this level may cause physiological and behavioral effects in cold water species such as salmonids. While this may not result in direct mortalities in adults, survival of juvenile cold water fish may be reduced. The *in-situ* water quality results obtained during the field surveys are not unusual for slow moving watercourses with organic substrate in Nova Scotia and are unrelated to the operation of the mine.

As is often observed in various areas in Nova Scotia, the pH level measured was acidic (6.1 – 6.7). The pH measured in WC-1 was outside the CCME guideline range of 6.5-9.0 but is known to support aquatic life in Nova Scotia. Low pH or acidic waters are common in various areas of the province. Acidification can be caused by a variety of combinations of anthropogenic and natural soil composition conditions such as high sulfur content which can oxidize and lower the pH of ground and surface water (Goodwin 2004). Decomposing organic material, such as found in wetlands, can also create acidic conditions in slow moving aquatic environments (Clair 2011).

None of the watercourses identified on the Study Area are known to support drinking water supplies or other protected surface waters. Groundwater wells are addressed in Section 5.5. There are no known Protected Water Areas (PWA) in the vicinity of the Proposed Extension Area or Study Area.

5.1.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

Fish and Fish Habitat was selected as a VC because of the potential for Project activities to interact with the freshwater environment. The potential effects of the Project on fish and fish habitat include:

- A **change in Fish Habitat** within the Project Area (measureable parameters include: habitat quality, quantity and water quantity or quality)
- A **change in Fish Abundance** within the Project Area (measureable parameters include: abundance, population structure, or community structure); or
- A **Change in Fish Mortality** within the Project Area (measurable parameters include: direct and indirect mortality risks for fish and other aquatic life).

Changes to the *Fisheries Act* came into force on November 25, 2013 and resulted in changes, most notably, to Section 35 which defines serious harm to fish and their habitat. Changes were also made to Sections 6, 20, 21 of the *Fisheries Act* which pertain to the regulatory review process and fish passage/obstructions.

The defining amendment to the *Fisheries Act* is the change in focus from *habitat* protection to *fisheries* protection. The amendments in the *Fisheries Act* adopt "*serious harm to fish*" to replace "*harmful alteration, disruption or destruction, of fish habitat*".

These provisions apply to species of fish that are part of a **commercial, recreational or Aboriginal (CRA) fishery** or **fish that support such a fishery**. The *Fisheries Protection Policy Statement* interprets CRA fisheries to be those fish that are: harvested under the authority of a license for sale, trade, or barter; harvested under the authority of a license for personal use or sport; or those that can be fished by Aboriginal persons for food, social or ceremonial purposes or for purposes set out in a land claims agreement. "Fish that support" these fisheries are those fish that contribute to the productivity of a fishery (often, but not exclusively, as prey species). The "fish that support" may reside in water bodies that contain the CRA fisheries or in water bodies that are connected by a watercourse to such water bodies.

The updated *Fisheries Protection Policy Statement* interprets *serious harm* to CRA fisheries and supporting fish as:

- a **permanent alteration** to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing,

or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes;

- the **destruction** of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes; and

- the **death of fish**.

With the new amendments, the requirement under the Act to gain authorization will apply only where a project results in "serious harm" to a fishery as defined above. Any "alteration" must now be deemed to be permanent to be of regulatory consequence under the Act.

Construction

During construction, clearing, grubbing, and topsoil stripping activities can increase the potential for sediment erosion and deposition of sediment, minerals or ions down gradient, particularly during periods of heavy rainfall or snow melt. These activities will also result in a reduction of evapotranspiration and a corresponding increase in surface runoff, which in turn increases potential for sediment erosion and deposition. This is because clearing reduces canopy cover, which reduces evaporation and transpiration from the canopy during rain events so more rain contacts the soil, which increases runoff. Without the implementation of appropriate mitigation measures, the Project could result in sedimentation effects on fish habitat present down-gradient, outside the proposed Study Area boundaries. Mining below the water table can result in groundwater extraction and subsequent reduction in surface water flows.

National Gypsum has revised the Proposed Extension Area to exclude the majority of wetland WL10 and all of WC-1 (Figure 5.1). The remaining portion of wetland WL10 within the Proposed Extension Area is excluded from development by an Ecological Buffer Zone (shown on Figure 5.1). The buffer zone will consist of an area where no mining or development will occur, and natural vegetation will be maintained. All portions of wetlands WL9 and WL10 located within the Proposed Extension Area are entirely encompassed by the Ecological Buffer Zone. This buffer will also mitigate against the permanent alteration or destruction of fish habitat within WC-1. It is anticipated that *Fisheries Act* Authorizations and subsequent alteration of the watercourses will not be required during the life of the mine extension.

In addition to encompassing wetlands WL9 and WL10, the Ecological Buffer Zone protects the riparian zone within 100 m of the watercourse and likely includes the majority of overland drainage which enters watercourse WC-1. This 100 m buffer zone more than meets the separation distance requirements from watercourses typically required without government authorization (*i.e.*, 30 m). The buffering of the riparian zones will mitigate against the permanent deterioration of water quality and quantity from construction activities.

As noted in Section 5.2.1, DC-2, DC-3, DC-4 and DC-5 are not considered watercourses and a separation distance is therefore not applicable for these drainage channels. While working

around DC-3, DC-4 and DC-5, appropriate sediment and erosion control measures will be used to reduce downstream effects on receiving waters containing fish habitat. The methods to reduce erosion and sediment transport in the vicinity of all watercourses and, as appropriate, drainage channels during construction will include:

- the control of surface runoff;
- specific procedures for storage and handling of excavated materials;
- provision of temporary erosion control measures after initial clearing is completed;
- avoidance of introduction of deleterious materials (mineral and organic) into channels or wetlands not protected by the Ecological Buffer Area;
- timely revegetation/stabilization of area after construction.

Typical sediment and erosion control measures are illustrated in Figures 2.3, 2.4 and 2.5 in Section 2.5. The EPP will include an Erosion and Sediment Control plan that will be developed during the Industrial Approval Amendment stage.

Outside of the Ecological Buffer Zone (*i.e.*, in the portion of the Proposed Extension Area that will be subject to development and operation of the extended mine), 30 m buffers will be maintained from all wetlands not intended to be mined.

Operation

The use of properly sized flow retention structures is expected to mitigate erosion and sedimentation effects in all identified watercourses during operation activities. Additionally, as the mine site develops, exposed soil and stockpiles capable of producing sediment laden-runoff will be stabilized.

Additional retention capacity will be created as the mine expands and additional settling pond volume will be installed, as needed. The water quality of the effluent entering the Shubenacadie River will meet parameters as stated in the facility's Industrial Approval (No. 89-100; Appendix A) and future amendments. The discharge limits are listed in Table 5.3 for each of the parameters listed in the facility's Industrial Approval:

Table 5.3 Industrial Approval Discharge Limits

Parameter	Maximum in a Grab Sample	Quarterly Arithmetic Mean
pH (units)	5.0 – 10.0	6.9 – 9.0
Total Suspended Solids (mg/L)	50.0	25.0
Oil and Grease (mg/L)	1.0	1.0
Toxicity	Pass	Pass
Ammonia as Nitrogen (mg/L)	No limit	No limit

Surface water monitoring data from 2007-2014 are provided in Appendix H.

Project-related contamination (*e.g.*, accidental petroleum hydrocarbon spills from machinery or blasting chemicals) (*i.e.*, fuel oil and nitrate) could affect the surface water bodies in the Study Area and potentially flow to downstream waterbodies. The only watercourse on site (WC-1) will be protected by the Ecological Buffer Zone, though the surrounding drainage channels have the potential to be a conduit for spills. To mitigate the potential for spills there will be no storage of fuel or blasting chemicals in the Proposed Extension Area; the main source of contamination will be fuel in machinery or the amounts of blasting chemicals present for use in a particular blasting event.

All employees and temporary site workers will review the NGC Spill Contingency Plan (Appendix C) as part of their site orientation. If an accidental spill of hazardous materials occurs, the NGC Spill Contingency Plan will be initiated, which includes immediate reporting of any spill (regardless of size) to a supervisor immediately and taking measures to stop and contain the release immediately. Supervisors will notify proper agencies, put in place controls to prevent further spill or release, and initiate clean up to pre-spill conditions. Requirements for containment, clean-up, site restoration, disposal and reporting are provided in the Spill Contingency Plan, as well as a list of hazardous materials on site and equipment available for emergency response to a spill. If not contained at the source, most spills will be contained within drainage and conveyance features that manage seepage and runoff within in the mine and will not have an opportunity to enter surface water bodies.

The use of explosives will follow DFO's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998). The existing permit related to blasting (Industrial Approval No 89-100) and other permitting is in Appendix A. Current practices will be followed for the mine extension. A blast management plan will be provided to NSE, if requested.

Monitoring and Follow-up

A phased approach to the extension of the mine will allow for an adaptive approach to monitoring and management of potential effects to surface water and groundwater resources which in turn may affect fish habitat downstream. The water quality of the effluent exiting any on-site settling ponds will continue to meet parameters as stated in the facility's current Industrial Approval and future amendments. This includes any surface water quality and quantity monitoring required by NSE.

Summary

Based on the results of the watercourse assessment, the use of an Ecological Buffer Zone, and the mitigation proposed, there is very low potential for mine activities to interact with fish and fish habitat and significant adverse Project-related effects on fish and fish habitat are not likely to occur.

5.2 RARE PLANTS

The rare plants VC is included because of the potential for interactions between vegetation and Project activities, particularly species or communities that are of conservation interest. Provincial and federal legislation provides protection to designated plant Species at Risk. Furthermore, wetlands may support rare plants or uncommon species assemblages and provincial policy and permitting processes are directed at preventing loss of important wetland functions. Further discussion of the effects of the Project on wetland vegetation is provided in Section 5.4.

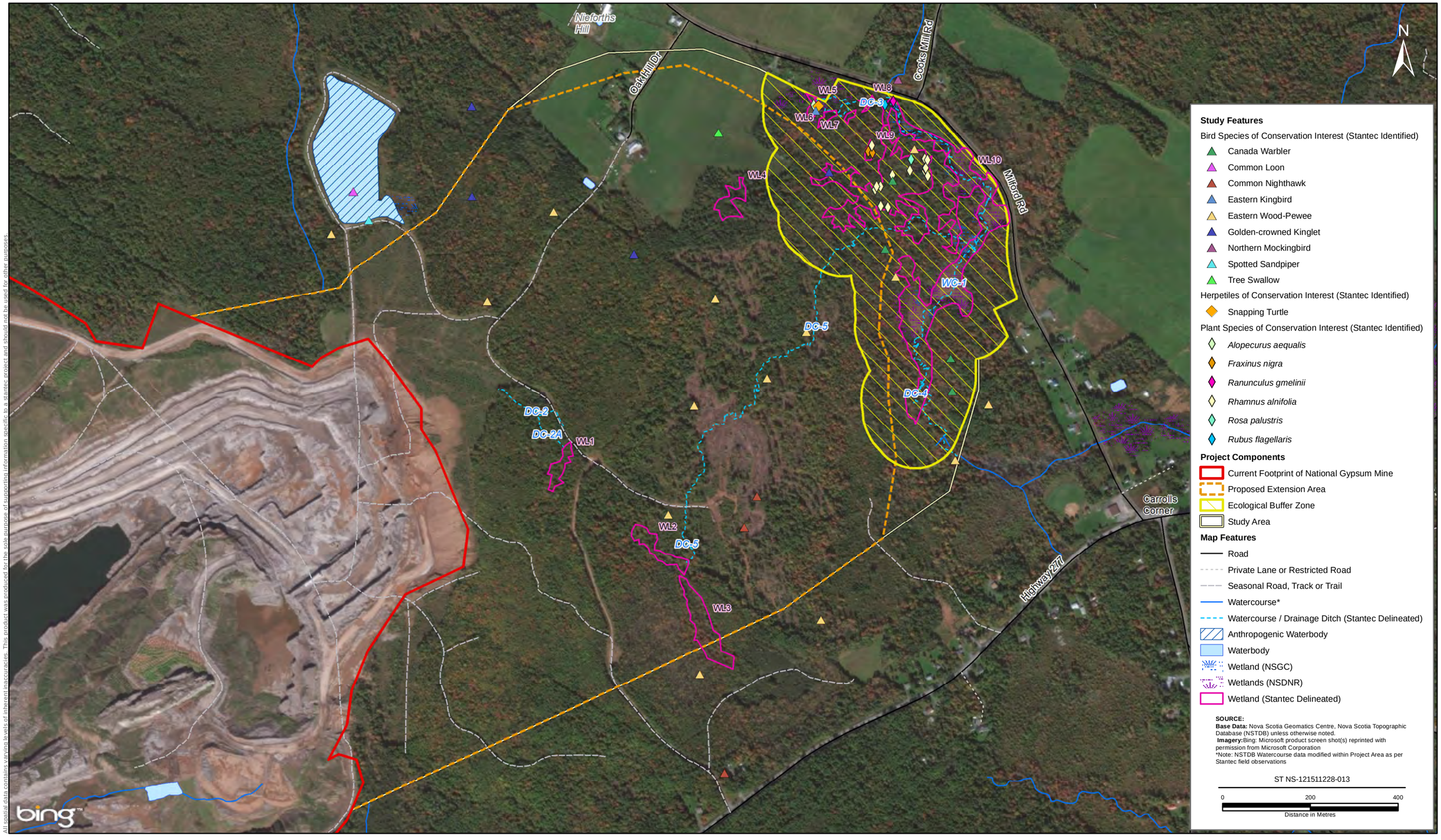
5.2.1 Description of Existing Conditions

The site was surveyed by Stantec botanists during June 16, 17 and 19; and August 14, 22 and 23, 2014 (Figure 5.2). A vascular plant inventory and characterization of vegetation types in the Study Area was compiled during each of these surveys. The provincial forest inventory mapping was used to provide the initial mapping of the distribution of vegetation types in the Study Area (Figure 2.2 in Section). Recent clear-cuts were present in the Study Area which had not been mapped on the forest inventory mapping. Satellite imagery from 2013 was used to update the distribution of recent clear-cuts on the forest inventory mapping. Wetland field delineations were used to identify the distribution of wetland vegetation types in the Study Area. These field delineated wetland polygons were used to replace the existing wetland map polygons on the vegetation type mapping. Where possible, field vegetation type descriptions were conducted in the various vegetation map polygons to verify the vegetation type classifications of the forest inventory mapping. In instances where no field derived data was available for a particular vegetation type map polygon, the forest inventory mapping was used to classify the vegetation type present in the mapped polygon. Forested vegetation types were classified using the Forest Ecosystem Classification for Nova Scotia (Neily *et al.* 2011). The distribution of vegetation types in the Study Area is presented in Figure 2.2. The areas occupied by each vegetation type are presented in Appendix I.

Upland Vegetation Types

The Study Area is comprised mainly of a mixture of forest, forested wetlands and agricultural land. Forests in the Study Area vary in age from recently harvested stands to mature forest.

Mature mixedwood forest is present mainly in the central and northern part of the Study Area (Figure 2.2). Stands situated in well drained areas are dominated by a mixture of red maple (*Acer rubrum*) and eastern hemlock (*Tsuga canadense*), with lesser amounts of yellow birch (*Betula allegheniensis*), white birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), white ash (*Fraxinus americana*), and American beech (*Fagus grandifolia*) also present in the overstory. The shrub understory is typically composed mainly of a mixture of advanced regeneration of balsam fir, eastern hemlock and red spruce. These stands correspond best to the Hemlock – Yellow birch/ Evergreen wood fern (MW3) vegetation type.



Study Features

Bird Species of Conservation Interest (Stantec Identified)
- Canada Warbler
- Common Loon
- Common Nighthawk
- Eastern Kingbird
- Eastern Wood-Pewee
- Golden-crowned Kinglet
- Northern Mockingbird
- Spotted Sandpiper
- Tree Swallow

Herpetiles of Conservation Interest (Stantec Identified)
- Snapping Turtle

Plant Species of Conservation Interest (Stantec Identified)
- *Alopecurus aequalis*
- *Fraxinus nigra*
- *Ranunculus gmelinii*
- *Rhamnus alnifolia*
- *Rosa palustris*
- *Rubus flagellaris*

Project Components
- Current Footprint of National Gypsum Mine
- Proposed Extension Area
- Ecological Buffer Zone
- Study Area

Map Features
- Road
- Private Lane or Restricted Road
- Seasonal Road, Track or Trail
- Watercourse*
- Watercourse / Drainage Ditch (Stantec Delineated)
- Anthropogenic Waterbody
- Waterbody
- Wetland (NSGC)
- Wetlands (NSDNR)
- Wetland (Stantec Delineated)

SOURCE:
Base Data: Nova Scotia Geomatics Centre, Nova Scotia Topographic Database (NSTDB) unless otherwise noted.
Imagery: Bing: Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation
*Note: NSTDB Watercourse data modified within Project Area as per Stantec field observations

ST NS-121511228-013

0 200 400
Distance in Metres

PREPARED BY: C Shupe REVIEWED BY: M Huskins-Shupe CLIENT: National Gypsum (CANADA) LTD.	National Gypsum Mine Extension **Plants and Wildlife Species of Conservation Interest**	FIGURE NO.: 5.2 DATE: Nov 05, 2014 Stantec

File Path: V:\1215\active\121510xxx\121511228_national_gypsum_ea\geomatics\mapping\mxd\report\ST NS-121511228-013_RarePlantsWildlife_20141104b.mxd

Much of the central part of the property has been recently clear-cut (Figure 2.2). The youngest stands, estimated to be approximately two years old, consist of a patchy cover of balsam fir and red maple. Older clear-cuts, estimated to be approximately five years old, are dominated by a moderately dense cover of white birch, red maple and pin cherry (*Prunus pensylvanica*) along with lesser amounts of eastern hemlock, balsam fir, and red spruce. These regenerating stands were situated on well drained sites and are expected to eventually develop into the MW3 vegetation types.

The western end of the property is well drained and was harvested 20 to 30 years ago. The areas harvested approximately 30 years ago support two different vegetation types, one dominated by hardwood and the second composed of a mixture of hardwood and softwood species. The hardwood dominated stands have a tree canopy dominated by red maple, white birch, eastern hemlock, and yellow birch, as well as a few trembling aspen (*Populus tremuloides*). The understory of these stands is relatively open and composed of a mixture of eastern hemlock, American beech, yellow birch, and balsam fir advanced regeneration. These stands correspond best to the White birch – Red maple / Sarsaparilla – Bracken (IH6) vegetation type (Figure 2.2).

The 30 year old mixedwood stands have canopies dominated by red maple, eastern hemlock and balsam fir, with smaller amounts of red spruce (*Picea rubens*), white birch, yellow birch, and red oak (*Quercus rubra*). The understory of these stands is relatively dense and is composed mainly of balsam fir and eastern hemlock as well as a few American beech. These stands correspond best to the Trembling aspen – White ash / Beaked hazelnut / Christmas fern (IH5) vegetation type (Figure 2.2).

The younger 20 year old stands present at the western end of the property have canopies dominated by trembling aspen and red maple. Other species present in the canopy include white birch, balsam fir and red oak. The understory of these stands consists of a dense cover of balsam fir along with some eastern hemlock. These stands correspond best to the Trembling aspen – White ash / Beaked hazelnut / Christmas fern (IH5) vegetation type (Figure 2.2).

Mature hardwood forest is present along the southern boundary of the property. This imperfectly drained stand is approximately 50 years old and the tree canopy is composed of a mixture of white ash and red maple. The shrub understory is relatively sparse and is composed mainly of advanced regeneration of white ash and speckled alder (*Alnus incana*). This stand is most similar to the White ash / Sensitive fern – Christmas fern (WD1) vegetation type (Figure 2.2).

The eastern end of the property is generally characterized by low relief and imperfectly drained soils; however, there are two well drained areas that support mixedwood forest and a third that supports softwood forest. The eastern most of these stands is occupied by a mature mixedwood forest dominated by a mixture of red maple and red spruce. The understory of this stand is quite dense and is composed of advanced regeneration of balsam fir and red maple. This stand is most similar in species composition to the Red spruce – Red maple – White birch / Goldthread (MW2) vegetation type.

The second well drained mixedwood site in the eastern part of the property supports stands ranging in age from 20 to 50 years. These stands are composed mainly of a mixture of red maple, balsam fir and red spruce with lesser amounts of white spruce (*Picea glauca*) and gray birch (*Betula populifolia*) also present. The understory consists mainly of advanced regeneration of balsam fir, red spruce and red maple. The most abundant ground vegetation species are bracken fern (*Pteridium aquilinum*), Schreber's moss (*Pleurozium schreberi*), stair-step moss (*Hylocomium splendens*), and broom moss (*Dicranum* sp.) These stands correspond best to the Balsam fir – Red maple / Wood sorrel – Goldthread (MW4) vegetation type (Figure 2.2).

The well drained softwood stands are found on low mounds located along Watercourse 1 (WC-1). These stands are characterized by a moderately dense multi-layered tree canopy composed largely of a mixture of eastern white pine (*Pinus strobus*), red maple, red spruce, and black spruce. The shrub understory is well developed and is composed mostly of balsam fir, red spruce, black spruce, and red maple regeneration as well as wild raisin (*Viburnum nudum*). Schreber's moss, bracken fern, Canada blueberry (*Vaccinium myrtilloides*) and shaggy moss (*Rhytidiadelphus triquetris*) are the most abundant species of the ground vegetation layer. This vegetation type best matches the White pine / Blueberry / Bracken (SP4) vegetation type (Figure 2.2).

Most of the eastern end of the Study Area is imperfectly drained. Stands in this area are fairly young with an estimated age of approximately 30 years. These imperfectly drained stands are typically composed of a mixture of red maple, balsam fir, trembling aspen and black spruce (*Picea mariana*). Small numbers of tamarack (*Larix laricina*), red spruce and eastern white pine are also present in the canopy. The understory is typically composed of a moderately dense cover of balsam fir and black spruce as well as some speckled alder. These stands correspond best to the Red maple – Balsam fir / Wood aster / Sphagnum vegetation type (WD6) (Figure 2.2). In somewhat drier areas white birch and eastern hemlock are also present in the canopy.

On a somewhat richer imperfectly drained site in the southeastern portion of the Study Area, the forest stand is dominated by a mixture of red maple and balsam fir in the overstory and balsam fir and white ash in the understory. This corresponds most closely to the Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum spp. (WD7) vegetation type (Figure 2.2). This vegetation type is considered to be uncommon in Nova Scotia (NSDNR 2010).

Agricultural land is present at the northern tip of the Study Area (Figure 2.2). This area is used as pasture for beef cattle. Tree and shrub cover are not present and the vegetation is composed largely of a mixture of forage grasses such as Timothy (*Phleum pratense*), Kentucky blue grass (*Poa pratense*), and colonial bent-grass (*Agrostis capillaris*) and agricultural weeds such as creeping buttercup (*Ranunculus repens*), black knapweed (*Centaurea nigra*) and Canada goldenrod (*Solidago canadensis*).

Several areas of abandoned agricultural land are present in the Study Area. These areas have been abandoned for many years and now support forest stands. Imperfectly drained old field is now occupied by a stand dominated by a mixture of eastern white pine and tamarack. Scattered red maple and gray birch are also present in the tree canopy. The understory is

composed mainly of scattered speckled alder, white spruce and balsam fir. The ground vegetation layer is composed of a variety of species, the most abundant of which are dwarf red raspberry (*Rubus pubescens*), fowl manna-grass (*Glyceria striata*), creeping buttercup (*Ranunculus repens*), Schreber's moss, and shaggy moss. This stand corresponds best to the Tamarack / Speckled alder / Rough goldenrod / Shaggy moss (OF2) vegetation type (Figure 2.2).

Better drained sites support stands dominated by white spruce and balsam fir. The understory is characterized by a patchy cover of balsam fir regeneration. The ground vegetation layer is also rather patchy and composed largely of Schreber's moss, shaggy moss and scattered rough goldenrod. These stands correspond best to the White spruce / Aster – Goldenrod / Shaggy moss (OF1) vegetation type (Figure 2.2).

Wetland Vegetation Types

Wetland is scattered over much of the Study Area; however, wetlands are most abundant along the relatively flat, imperfectly drained eastern edge of the Study Area. Most wetlands in the Study Area are forested wetlands. The vegetation of these wetlands was classified using the Forest Ecosystem Classification for Nova Scotia (NSDNR 2010). The forested wetlands fall into four vegetation types including White ash / Sensitive fern – Christmas fern (WD1), Trembling aspen / Beaked hazelnut / Interrupted fern / Sphagnum (WD5), Red maple – Balsam fir / Wood aster / Sphagnum (WD6), and Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum (WD7). Three of these vegetation types (WD1, WD6 and WD7) were encountered in both imperfectly drained upland sites in the Study Area as well as areas that were classified as wetland. The following vegetation type descriptions apply to stands that were classified as wetlands.

The White ash / Sensitive fern – Christmas fern (WD1) vegetation type was found in two wetlands at the western end of the Study Area (WL1and WL3) (Figure 2.2). These swamps are characterized by a moderately dense tree overstory composed of red maple, white ash and yellow birch. The shrub understory is variable. In WL3, it is composed largely of speckled alder, common winterberry (*Ilex verticillata*), and saplings of white ash and red maple. In WL1 the shrub understory is composed mostly of advanced regeneration of trees, the most common of which are balsam fir, striped maple (*Acer pensylvanicum*), white ash, and yellow birch. The ground vegetation layer is composed largely of fowl manna-grass, dwarf red raspberry, smooth goldenrod (*Solidago gigantea*), sensitive fern (*Onoclea sensibilis*), and New York fern (*Thelypteris noveboracensis*).

Trembling aspen / Beaked hazelnut / Interrupted fern / Sphagnum (WD5) is present in two wetlands at the eastern end of the Study Area (WL9 and WL10) (Figure 2.2). These stands are characterized by a moderately dense canopy composed mainly of trembling aspen and red maple along with lesser amounts of white spruce and balsam fir. The shrub understory is characterized by the presence of a well-developed tall shrub layer composed of speckled alder and common winterberry. Other common constituents of the shrub understory include white meadowsweet (*Spiraea alba*) and advanced regeneration of balsam fir and white ash. The

ground vegetation layer is characterized by the presence of dwarf red raspberry, sensitive fern, fringed sedge (*Carex crinita*), bristly-stalk sedge (*Carex leptalea*), fowl manna-grass, and sphagnum moss (*Sphagnum* spp.). This vegetation type is uncommon in Nova Scotia (NSDNR 2010). It is of particular importance in the Study Area since it provides habitat for five plant species of conservation interest recorded during the field surveys.

Red maple – Balsam fir / Wood aster / Sphagnum (WD6) is also present in two wetlands at the eastern end of the Study Area (WL6, WL7, and WL8) (Figure 2.2). On these wetland sites, this vegetation type was characterized by a moderately dense tree canopy composed mainly of red maple and balsam fir along with smaller amounts of white spruce and trembling aspen. The shrub understory is fairly open and consists largely of speckled alder, balsam fir and white meadowsweet. Fowl manna-grass, sensitive fern and spotted jewelweed (*Impatiens capensis*) are the most abundant ground vegetation species. Other common species of the ground vegetation layer include hairy flat-top white aster (*Doellingeria umbellata*), Canada goldenrod (*Solidago canadensis*), and sphagnum moss.

Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum (WD7) was found in one wetland in the Study Area (WL2) (Figure 2.2). Tree cover in this forested wetland consists mainly of a mixture of red maple, balsam fir, yellow birch, and eastern hemlock. Speckled alder and common winterberry are the dominant species of the shrub understory. Other common species of this layer include beaked hazelnut (*Corylus cornuta*) and advanced regeneration of balsam fir and white ash. This vegetation type is considered to be uncommon in Nova Scotia (NSDNR 2010).

Non-forested wetland vegetation types present in the Study Area include tall shrub dominated swamp, freshwater marsh, and shallow water wetland. Tall shrub dominated swamp is found at a few sites in the eastern portion of the Study Area (WL4 and WL10) (Figure 2.2). This vegetation type is characterized by a dense tall shrub overstory composed of speckled alder. The shrub canopy is punctuated by scattered trees including red maple, grey birch and white spruce. The ground vegetation layer consists of a mixture of dwarf red raspberry, fowl manna-grass, various mosses, hairy flat-top white aster, and creeping buttercup.

Freshwater marsh is found along the margins of water courses in the Study Area (Figure 2.2). Two distinct freshwater marsh vegetation types are present. One is found around the margin of a small, species rich pond of recent anthropogenic origin at the northern end of the Study Area (WL5). It consists of a dense cover of graminoids, the most abundant of which are broom sedge (*Carex scoparia*), mosquito bulrush (*Scirpus hattorianus*), soft rush (*Juncus effusus*), fox sedge (*Carex vulpinoidea*), and soft-stemmed bulrush (*Schoenoplectus tabernaemontani*). Tree cover is absent and shrub cover consists of a few scattered speckled alder and young crack willow (*Salix fragilis*).

The second and largest areas of freshwater marsh are found along the floodplain of Watercourse 1 where it flows through Wetland WL10 (Figure 2.2). These marshes are subject to both seasonal flooding and periodic long term inundation caused by beaver activity. These marshes consist of a dense sward of blue-joint reedgrass (*Calamagrostis canadensis*). The

ground vegetation layer also contains small amounts of sphagnum moss, tussock sedge (*Carex stricta*), broad-leaved cattail (*Typha latifolia*), and marsh cinquefoil (*Comarum palustre*). In some areas where the freshwater marsh borders Milford Road, the blue-joint reedgrass has been partially replaced by reed canary grass (*Phalaris arundinacea*). No tree cover is present in this vegetation type and shrub cover is largely restricted to the margins of the wetland and consists mainly of speckled alder and white meadow-sweet.

Shallow water wetland is associated with ponds and sluggish streams in the eastern end of the Study Area (Figure 2.2). A shallow anthropogenic pond in wetland WL5 supports a dense growth of submerged, emergent and floating leaf aquatic plants, the most abundant of which are ribbon-leaved pondweed (*Potamogeton epihydrus*), rice cutgrass (*Leersia oryzoides*), small yellow pond-lily (*Nuphar lutea* ssp. *pumila*), soft-stemmed bulrush, and turion duckweed (*Lemna turionifera*).

The shallow stillwater portion of Watercourse 1 (WC-1) supports a relatively dense growth of submergent, emergent and floating leaf aquatic plants. The most abundant of these species are American bur-reed (*Sparganium americanum*), marsh seedbox (*Ludwigia palustris*), variegated pond-lily (*Nuphar lutea*), rice cutgrass, and Gmelin's water-buttercup (*Ranunculus gmelinii*).

Rare Vascular Plants

A rare wildlife modeling exercise was performed to determine the likelihood of Species of Conservation Interest (SOCI) within the Proposed Extension Area. SOCI were defined as those:

- listed under the Nova Scotia *Endangered Species Act* (NS ESA) or the federal *Species at Risk Act* (SARA) as being either *endangered*, *threatened*, *vulnerable*, or of *special concern* (*i.e.*, Species at Risk);
- not yet listed under provincial or federal legislations but identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being either *endangered*, *threatened*, or of *special concern;*
- listed by the NSDNR (2014) to be *at risk*, *may be at risk*, or *sensitive* to human activities or natural events; and
- ranked as *S1*, *S2*, or *S3* by the ACCDC (2014).

As part of the modeling exercise, all records of plant species listed by the NSDNR (2014) to be At Risk, May be at Risk, Sensitive to human activities or natural events, or ranked as S1, S2, or S3 by the ACCDC (2014) within a radius of 20 km from the center of the Study Area were compiled by means of an ACCDC data search. The habitat requirements of those species that had been recorded within 20 km from the center of the proposed development were then compared to the range of environmental conditions within the Study Area to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the Study Area was determined through site visits as well as interpretation of aerial photography, forest inventory, and

topographic mapping. In instances where appropriate habitat was present for a particular species, that taxon was considered to be potentially present in the Study Area, and the habitat was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the Project Area was also incorporated into the model in order to determine when the rare or sensitive taxa would be best identified.

A total of 55 vascular plant Species of Conservation Interest (SOCI) have been recorded within 20 km of the center of the Study Area. Based on the results of the habitat model, there is potential for 27 of these species to be found within the Study Area. Two rare non-vascular taxa have been recorded within the 20 km radius around the Study Area, neither of which was considered to have potential to exist in the Project Area. A list these species, their preferred habitats and their phenology is provided in Appendix G.

The results of the habitat modeling exercise (as summarized in Appendix G) indicated that all of the habitat types present in the Study Area could potentially harbor SOCI. However, because many of the plants were associated with wetlands or riparian areas, these habitats were considered to be most likely to harbor plants considered SOCI. Therefore, although all habitat types present in the Study Area were surveyed, particular attention was paid to the aforementioned areas.

The vegetation field surveys were conducted on June 16, 17, and 19; and August 14, 21 and 22 2014. A list of the 329 vascular plant taxa found on the site during field surveys is provided in Appendix I. Twenty-six of the 27 vascular plant species highlighted by the model as potentially present in the Study Area could be readily identified during the June and August field surveys. Four of these species were recorded in the Study Area. The remaining 22 species were not encountered during these surveys suggesting that these species were not present in the Study Area. One species, silky willow (*Salix sericea*), would potentially not be identifiable during the field surveys. This species is best identified using flowering material which for this species is only available from late March to early May. Silky willow has leaves that are lance shaped, serrated and have a silvery silky covering of hairs on the bottom of the leaves. During the field surveys, no willows having these characteristics were encountered in the Study Area, suggesting that silky willow was not present.

All vascular plants encountered during the surveys were identified to species (when possible) and their population statuses in Nova Scotia were determined through a review of the species status reports prepared by NSDNR (NSDNR 2014a), ACCDC (ACCDC 2014), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2014), and Species at Risk in Nova Scotia (NSDNR 2014b). No plant species listed under Schedule 1 of the national *Species at Risk Act* (SARA) were encountered during the field surveys. One species listed as Threatened under the Nova Scotia *Endangered Species Act* was found during the surveys. This was the black ash (*Fraxinus nigra*) which was found in Wetland WL9 (Figure 5.2). Two small black ash were recorded in WL9; one had a diameter at breast height (DBH) of approximately 10 cm and the second had a DBH of approximately 5 cm. Black ash has been listed as a Threatened species in Nova Scotia for several reasons. Mature black ash are very rare in Nova Scotia. Only 12 of the estimated 1,000 black ash known from Nova Scotia are mature trees (NSDNR 2013a). Black ash

are slow growing, are poor competitors and are prone to fungal infections. In addition, they are very susceptible to the emerald ash borer, a non-native insect which is currently colonizing central North America and is expected to eventually reach Nova Scotia potentially resulting in heavy mortality of black ash.

Two species listed as Sensitive by NSDNR were recorded during the field surveys including short-awned foxtail (*Alopecurus aequalis*) and alder-leaved buckthorn (*Rhamnus alnifolia*) (Figure 5.2). Short-awned foxtail is a slender upright grass that is typically found around the muddy or gravelly margins of ponds and rivers. It is intolerant of competition with other plant species resulting in it being restricted to moist highly disturbed sites unoccupied by other plants. This species is listed as Sensitive by NSDNR and listed as rare to uncommon (S2S3) by ACCDC. Short-awned foxtail was found around the margin of a small pond located at the northern end of the Study Area (Wetland WL5). It was relatively common at this location but was not encountered anywhere else in the Study Area.

Alder-leaved buckthorn is a low shrub that is generally found in swamps that receive calcareous seepage. It is listed as Sensitive by NSDNR and listed as uncommon (S3) by ACCDC. Alder-leaved buckthorn was found in two wetlands in the Study Area (WL9 and WL10). One patch of alder-leaved buckthorn was found in WL9 and 13 patches were found in WL10. It is likely that each patch is composed of only a few genets (genetically distinct individuals). The number of alder-leaved buckthorn shoots in each patch ranged from 1 to 200 with an average 0f 35 shoots present in each patch. Alder-leaved buckthorn patches were generally found around the margin of the wetlands at the interface between upland and wetland vegetation.

Two species listed as uncommon by ACCDC but considered by NSDNR to have Secure populations in Nova Scotia were recorded in the Study Area including swamp rose (*Rosa palustris*) and Gmelin's water buttercup (*Ranunculus gmelinii*) (Figure 5.2). Both of these species were found in wetland WL10. One swamp rose was found in the northern half of Wetland WL10. A patch of Gmelin's water buttercup several meters long was encountered at the northern tip of WL10. ACCDC ranks Gmelin's water buttercup as uncommon (S3) while swamp rose is ranked as uncommon to fairly common (S3S4).

The last plant considered SOCI that was recorded during the field surveys was northern dewberry (*Rubus flagellaris*) which was also found at the northern tip of Wetland WL10 (Figure 5.2). This species is ranked as possibly very rare (S1?) by ACCDC and is listed as Status Undetermined by NSDNR. The indeterminate population status for this species is largely attributable to the fact that *Rubus* species frequently hybridize making identification to species very difficult.

5.2.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

The Project has the potential to influence the populations of several of the plant considered SOCI as a result of direct habitat loss and indirectly through changes in habitat conditions, such as hydrological regimes.

All of the plant SOCI that were recorded in the Study Area were found in wetlands. Black ash and alder-leaved buckthorn were found in Wetland WL9, Alder-leaved buckthorn, swamp rose, Gmelin's water buttercup, and northern dewberry were found in Wetland WL10 and short-awned foxtail was found in Wetland WL5.

Four of the six SOCI are located within the Study Area (Figure 5.2). These four species could potentially be affected by direct loss of habitat through mining activities. The presence of a deep excavation associated with the mine in close proximity to the wetlands where these species are found could result in changes to wetland hydrology and adverse effects to the resident species. In order to reduce potential changes to wetland and the plant SOCI, the Proponent subsequently decreased the size of the original extension area (the Study Area) (Figure 5.2) and established an Ecological Buffer Zone to protect the wetlands and Watercourse 1 (WC-1). This resulted in all of the plants considered SOCI to be situated outside of the Proposed Extension Area and not be subjected to direct habitat loss and also protected against indirect hydrological changes.

Standard mitigative measures to reduce other environmental effects of the Project on plant communities include the use of seed mixtures free of noxious weeds and invasive species during site reclamation. Wherever practical, native plants should be used for site reclamation. In lieu of native species, seed mixes containing naturalized species which are well established in Nova Scotia and which are free of invasive species and are not aggressive weeds in the wetland and forest plant communities present in the area may be used for reclamation.

Monitoring and Follow-up

A hydrological monitoring program (refer to Section 5.4 Wetlands) will be established to verify the optimal buffer width and detect changes in surface water and shallow groundwater hydrology and allow for adaptive management as the mine progresses. The implementation of these mitigation measures to protect the wetlands will effectively protect the plant SOCI found in them.

Summary

In summary, assuming implementation of recommended mitigative measures (*e.g.*, establishing the Ecological Buffer Zone and using native seed mixes), significant Project-related effects on rare plants (SOCI) are not likely to occur.

5.3 WILDLIFE

Wildlife is selected as a VC because of potential for interactions between wildlife and Project activities, particularly species that are of conservation interest. Provincial and federal legislation provides protection to designated bird, mammal, herpetile, and other wildlife Species at Risk. In addition, most bird species are protected under the *Migratory Birds Convention Act*. The wildlife VC is linked to Wetlands (Section 5.4) which integrates wildlife, vegetation, hydrology, land form,

and soils. Relevant information is also provided in Section 5.2 (Rare Plants) which incorporates plant community descriptions and mapping that provide information on wildlife habitat.

5.3.1 Description of Existing Conditions

Information regarding use of the Study Area by wildlife was derived from several sources including field surveys and review of existing information sources.

5.3.1.1 Existing Information

A rare wildlife modeling exercise was performed to determine the likelihood of Species of Conservation Interest (SOCI) within the Proposed Extension Area. SOCI were defined as those:

- listed under the Nova Scotia *Endangered Species Act* (NS ESA) or the federal *Species at Risk Act* (SARA) as being either *endangered*, *threatened*, *vulnerable*, or of *special concern* (*i.e.*, Species at Risk);
- not yet listed under provincial or federal legislations but identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being either *endangered*, *threatened*, or of *special concern;*
- listed by the NSDNR (2014) to be *at risk*, *may be at risk*, or *sensitive* to human activities or natural events; and
- ranked as *S1*, *S2*, or *S3* by the ACCDC (2014).

As part of the modeling exercise, all records of SOCI within a radius of 20 km from the center of the Study Area were compiled by means of an ACCDC data search. The habitat requirements of those species were then compared to the range of environmental conditions within the Study Area to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the Study Area was determined through an interpretation of aerial photography, topographic, and geological mapping, as well as prior visits to the site. In instances where appropriate habitat was present for a particular species, that taxon was considered to be potentially present in the Study Area, and the habitat was identified as a target for field surveys.

Data from the Maritimes Breeding Bird Atlas (MBBA) database (MBBA 2014) was also used to obtain information on the use of the surrounding landscape by breeding birds. The MBBA provides information on the distribution and abundance of birds across the Maritime Provinces of Canada. The Study Area is located in MBBA square number 20MQ68 and is also in close proximity to 20MQ78. Data for both squares was therefore obtained to determine species expected in the Study Area and their breeding status. Data collected during both the first atlas (Erskine 1992) and the second atlas (MBBA 2014) was derived from the MBBA web site (MBBA 2014). The breeding status of each species was determined from the criteria used in the MBBA (Erskine 1992). The provincial population status of each bird species identified in the MBBA square was also assessed using information from the General Status of Wildlife in Nova Scotia (NSDNR 2014a), Species at Risk in Nova Scotia (NSDNR 2014b), and the ACCDC (ACCDC 2014). The status of nationally rare species was obtained from SARA and COSEWIC (2014).

Forest Inventory Data (NSDNR 2003) was obtained for the purpose of describing existing conditions within the Study Area and aiding in the design of field surveys. Due to concerns regarding the distribution and accuracy of age and maturity class information associated with the data (NBDNR 2011), a quantitative estimate of interior forest conditions (*i.e.*, continuous stands of forest greater than 10 ha, with a maturity class of either "mature" or "overmature", and free of edge effect (*i.e.*, more than 100 m from a natural or anthropogenic edge) was not completed. However, a qualitative evaluation of the potential for the Study Area to support species that may be dependent on "interior forest" conditions was completed based on familiarity with conditions obtained through site visits.

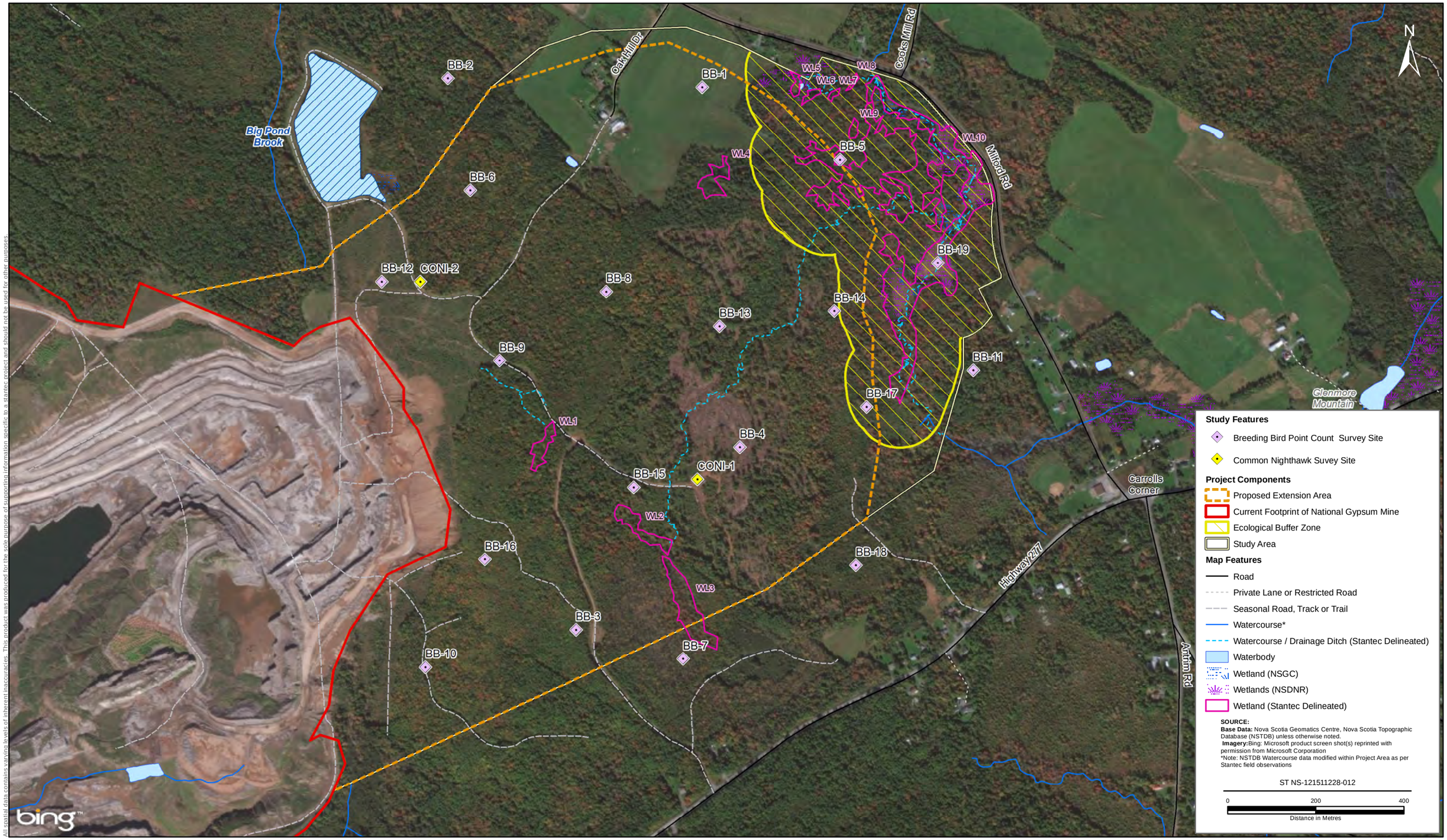
Additional references, including the Nova Scotia Significant Habitat Mapping Database (NSDNR 2014c) were also consulted to provide records of wildlife SOCI in the vicinity of the Study Area and to help direct field surveys.

5.3.1.2 Field Surveys

Birds

Information on bird use of the Study Area was obtained through directed breeding bird surveys and incidental observations obtained during other wildlife, vegetation, and wetland surveys.

Point counts were conducted at 19 sites (Figure 5.3) to obtain information on breeding songbirds and other passerines. Sites were distributed to obtain representative sampling in each major "land cover type" of the Study Area, using data on vegetation structure and composition (*i.e.,* forest cover and maturity) from NSDNR (2003). Site locations were randomly identified within each of the major land cover types prior to field surveys and restricted to be >100 m from their edges where possible and >250 m from each other. As a result of concerns regarding the accuracy of NSDNR forest cover data, particularly maturity classes (NSDNR 2011b), point count sites were re-classified following field programs. In particular, sites were classified into groups depending on the current vegetation condition within their survey boundaries (Table 5.4). The vegetation types described in the Forest Ecosystem Classification for Nova Scotia (Neily *et al.* 2011) was used as a basis for classifying vegetation conditions within the Study Area (see Section 5.2 Rare Plants).



PREPARED BY: C Shupe	National Gypsum Mine Extension	FIGURE NO.: 5.3
REVIEWED BY: M Huskins-Shupe	**Breeding Bird Point Count Locations**	DATE: Nov 05, 2014
CLIENT: National Gypsum		Stantec

File Path: V:\1215\active\121510xxx\121511228_national_gypsum_ea\geomatics\mapping\mxd\report\ST NS-121511228-012_BreedingBirdPointCounts.mxd

Table 5.4 Point Count Replication and Vegetation Classification

Point Count	Land Cover Class (NSDNR 2003)	Vegetation Type (Stantec 2014)[1]	Vegetation Group
1	Agriculture	Agricultural	Agricultural
2	Mature softwood	MW3	Mixedwood
3	Young softwood	IH5	Intolerant Hardwood
4	Mature mixedwood	Clearcut / MW3	Mixedwood / Clearcut
5	Mature mixedwood	WD6 / Wetland	Wet Deciduous / Wetland
6	Mature mixedwood	MW3	Mixedwood
7	Mature hardwood	WD1	Wet Deciduous / Wetland
8	Mature mixedwood	MW3	Mixedwood
9	Mature mixedwood	MW3 / Clearcut / IH6	Mixedwood / Clearcut
10	Young mixedwood	IH5	Intolerant Hardwood
11	Mature mixedwood	MW2	Mixedwood
12	Young mixedwood	Clearcut	Clearcut
13	Mixedwood (uneven aged)	MW3 / Clearcut	Mixedwood / Clearcut
14	Mixedwood (uneven aged)	MW3 / Clearcut / WD7	Mixedwood / Clearcut
15	Mixedwood (uneven aged)	MW3 / Clearcut	Mixedwood / Clearcut
16	Young mixedwood	IH5	Intolerant Hardwood
17	Regenerating forest	MW4	Mixedwood
18	Regenerating forest	Clearcut	Clearcut
19	Wetland	Wetland / WD6	Wet Deciduous / Wetland

[1]Codes (*e.g.*, MW3) refer to the FEC Vegetation Types (Neilly *et al.* 2011) discussed in Section 5.2 of the report

Point counts were surveyed twice during the breeding season and conducted following guidelines outlined by the CWS (Environment Canada 2007). At each point count site, the numbers of birds heard or observed over a ten minute period were recorded. Specific data recorded for each observation during this time include the species, distance from the observer, angle from survey location (collected for SOCI), breeding evidence encountered, the type of observations (*i.e.*, visual, auditory, fly-over), whether an observation was of a pair, and other notes on behavior when applicable. The survey period was treated as two independent 5-minute surveys (*i.e.*, a bird that is observed during both periods was recorded for each of them) but observers kept track of those recorded during the second half of the survey that were not observed in the first half. Other information collected during the surveys included location, survey time, temperature, wind speed using the Beaufort scale, wind direction, cloud cover, visibility, and habitat type (including approximate stand age and height, where applicable). The first round of surveys was conducted during June 17, 19 and 20, 2014 whereas the second was performed July 2 and 3, 2014.

Dedicated common nighthawk surveys were performed at two locations during the morning of June 20, 2014. Survey site locations were identified prior to field surveys and were chosen based on access and proximity to suitable nesting habitat. One site was located in a recently cut-over forested area whereas another was in proximity to the edge of the existing mine development

and associated disturbed areas. The surveys consisted of a 6-minute silent listening period at each station, consistent with the protocols of BC RIC (1998) and US NSN (2010), followed by two minutes of playbacks, and 2 minutes of silent listening (*i.e.,* 10 min total). Information recorded during the surveys include the period in which any Common Nighthawks were observed (*i.e.,* 1st 3 min, 2nd 3 min, 2 min playback, or last 2 min), information on their behavior, evidence of breeding status, and location (*i.e*., distance and angle from the observation point).

Additional information on the presence and breeding status of birds within the Study Area was opportunistically obtained during dedicated wildlife (*e.g*., while travelling between point counts), vegetation, and wetland surveys. All wetlands were visited during the breeding season and the list of species observed in or in proximity to a given wetland was recorded. Playbacks for Canada warbler (*Wilsonia canadensis*) were also performed in forested wetlands with potentially suitable habitat, including wetlands WL1, WL2, WL3, WL6, WL7, WL8, WL9 and WL10.

Breeding status information was collected following criteria used by the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992). "Possible" breeders are generally those birds that have been observed or heard singing in suitable nesting habitat. "Probable" breeders include those that exhibited any of the following: courtship behavior between a male and female; visiting a probable nest site; displaying agitated behavior; and/or male and female observed together in suitable nesting habitat. "Confirmed" breeders are those birds that exhibited any of the following: nest building or adults carrying nesting materials; distraction display or injury feigning; recently fledged young; occupied nest located; and/or adult observed carrying food or fecal sac for young. The population status of all bird species encountered during the site visits were assessed using information from SARA, COSEWIC (2014), the General Status of Wildlife in Nova Scotia (NSDNR 2014a), Species at Risk in Nova Scotia (NSDNR 2014b), and the ACCDC (ACCDC 2014).

Songbird data collected using points counts were used to estimate densities of species (# territories / 100 ha) within groups, and to calculate their average species richness. For these analyses, only data for birds recorded within 100 m of center of point count was used, with observations recorded farther away being treated as incidental observations. Data from the entire 10 min survey were used (*i.e*., individuals from the second five minute period were included if they had not been detected during the first five minutes). The highest number of individuals that were recorded for a particular species at a specific point count site during either the first or second round of surveys was used to account for variation in species detectability.

Species for which vocalizations are not reliable indicators of the number of breeding pairs (*e.g*., raptors, waterfowl, corvids, and colonial species) were omitted from the analyses. Most birds detected on breeding birds surveys are singing males, and singing males were assumed to represent an active territory (Bibby *et al.* 2000). However, all other records were scrutinized to determine whether they should be included in density calculations, with valid indicators of territoriality being considered to be:

- Male singing or performing territorial display

- Female incubating, carrying food, or performing distraction display
- Adult of either sex carrying food or faecal sac, building or entering a nest, or behaving agitatedly and giving anxiety calls in response to the observer's presence
- Active nest (eggs or young), even if neither adult is present during the period of observation

Where multiple individuals of a species were recorded at a point, total territories were calculated as the number of territorial males, or if sex is unknown, as half of the total number of adults observed, rounding up for odd numbers (Bibby *et al.* 2000). To calculate density for species in a given land cover class, the following equation was used:

$$\text{Density (\# territories/100 ha)} = \frac{\text{sum of all territories counted}}{\text{number of points surveyed}} \times 31.83$$

The factor of 31.83 represents the number of point count circles within 100 ha, assuming a standard count radius of 100 m, which has an area of 3.14 ha.

Density estimates were derived by treating all data within the 100 m circle equally and do not incorporate a measure of species detectability, as may be determined through use of distance measurements or repeat surveys over the breeding season. Due to difficulties in calculating accurate numbers of territories, density estimates used in this report are meant to be used as relative measures of species affinity and abundance within particular groups, rather than be interpreted as absolute values.

Mammals

A winter track survey was conducted on three occasions during the winter of 2013/2014 (January 31, 2014: February 12, 2014; and March 12, 2014). The main objective of the winter track surveys was to determine if the Study Area is used by moose (*Alces americanus*). The secondary objectives were to determine if the Study Area is used as a deer wintering area and to provide information regarding mammal species present in the Study Area. A survey route was established through the Study Area which followed existing geotechnical drilling paths, skidder trails and woods roads. The same route was walked on the three survey dates. Surveys were conducted within 48 hours of a snowfall event. The observer walked the route and recorded each location where mammal tracks crossed the trail. The location of each track crossing as well as the species that made the tracks was recorded along with weather conditions, average snow depth and snow conditions for the day.

Additional information on the use of the area by mammals was obtained through incidental field observations. Incidental observations were recorded by experienced biologists during other wildlife, wetland, and vegetation field programs and focused on collecting information on the use of the Study Area by SOCI. Data collected during incidental observations of mammals included the date, observer, location, species, and number; with additional notes on type of sign (scat, tracks, *etc.*), habitat association, condition, and behavior, also sometimes being recorded.

Amphibians and Reptiles (Herpetiles)

Incidental observations conducted during wildlife, wetland, and vegetation survey efforts were used to collect information on the presence of herpetiles within the Study Area, with an emphasis on SOCI. Data collected during incidental observations of herpetiles included date, observer, location, species, and number; with additional notes on habitat association, condition, and behavior also being recorded for SOCI where applicable.

5.3.1.3 Results

The Study Area has moderate wildlife habitat diversity. The majority of the Study Area is occupied by upland forest, particularly mixedwood. Much of the forest is in a relatively mature successional stage; but recent forest harvesting activities have occurred throughout the south-central part of the Study Area and adjacent to the existing mine at its western end. Stands of intolerant hardwood are also abundant throughout the Study Area, with softwood-dominated forest being relatively minor in abundance. Ten wetlands have been identified within the Study Area (Figure 2.2) and are primarily comprised of treed and tall-shrub dominated swamp, with occurrences of freshwater marsh being found in association with the riparian zone of a watercourse and a small anthropogenic pond. Anthropogenic environments represented within the Study Area include pasture, hayfields, existing residential infrastructure, and the disturbed edges of the existing mine footprint. Much of the forested habitat within the Study Area is highly fragmented by old roads and other anthropogenic features, including recent clearcuts, the existing mine, and lands that support agriculture. For additional information on vegetation conditions within the Study Area, refer to Section 5.2 (Rare Plants).

5.3.1.3.1 Birds

Existing data sources indicate that 140 bird species have been recorded in the landscape surrounding the Study Area. The ACCDC database identifies 53 birds that have been recorded within 20 km of the center of the Study Area, 34 of which are SOCI (Appendix G). Of these, 34 have also been recorded within the atlas squares in the vicinity of the Study Area by the MBBA, along with an additional 84 species (total of 123 species in the MBBA squares). Of these, the breeding status of 93 has been confirmed, 15 are considered probable, and another 15 are considered possible breeders. Desktop data sources indicate that eight of the species recorded in the surrounding landscape are listed by either the federal SARA or the NS ESA as being *endangered, threatened, vulnerable,* or of *special concern* and are therefore considered Species at Risk for the purpose of this report, including rusty blackbird (*Euphagus carolinus*), Canada warbler, chimney swift (*Chaetura pelagica*), barn swallow (*Hirundo rustica*), olive-sided flycatcher (*Contopus cooperi*), common nighthawk, bobolink (*Dolichonyx oryzivorus*), and eastern wood-pewee (*Contopus virens*). Existing data sources indicate that an additional 31 bird SOCI have been identified within the surrounding landscape. A full list of all species identified from desktop studies, including breeding status, is presented in Appendix I.

Fifty-nine bird species were identified within or adjacent to the Study Area during 2014 field surveys (Table 5.5). Of these, 49 were recorded during dedicated point count surveys, and ten others were recorded as incidentals. Nine of the species were identified as confirmed breeders,

including American black duck (*Anas rubripes*), American robin (*Turdus migratorius*), American woodcock (*Scolopax minor*), black-capped chickadee (*Poecile atricapilla*), common yellow-throat (*Geothlypis trichas*), dark-eyed junco (*Junco hyemalis*), red-breasted nuthatch (*Sitta canadensis*), ruffed grouse (*Bonasa umbellus*) and spotted sandpiper (*Actitis macularius*). Another nine species were identified as "probable" breeders, 35 species were identified as "possible" breeders, and six species were simply observed but did not show evidence of breeding in the Study Area. Of the bird species detected during the surveys, three are federally or provincially designated Species at Risk, including Canada warbler, common nighthawk, and eastern wood pewee. An additional six species have been ranked as *sensitive* or *may be at-risk* by NSDNR, or have a S-Rank of *S3*, and are therefore considered here to be SOCI, including common loon (*Gavia immer*), eastern kingbird (*Tyrannus tyrannus*), golden crowned kinglet (*Regulus satrapa*), northern mockingbird (*Mimus polyglottos*), spotted sandpiper and tree swallow (*Tachycineta bicolor*). Information on the occurrence of these SOCI in association with the Study Area and other information on their life history and ecology is provided below.

Table 5.5 Bird species identified during 2014 field surveys

Common Name	Scientific Name	SARA	COSEWIC	NS ESA	General Status Rank	ACCDC S-RANK	Observed Breeding Status (2014 Field Surveys)
Common Loon	*Gavia immer*	-	Not At Risk	-	May Be At Risk	S3B,S4N	Possible
Wood Duck	*Aix sponsa*	-	-	-	Secure	S4S5B	Observed
American Black Duck	*Anas rubripes*	-	-	-	Secure	S5	Confirmed
Mallard	*Anas platyrhynchos*	-	-	-	Secure	S5	Observed
Bald Eagle	*Haliaeetus leucocephalus*	-	-	-	Secure	S4	Observed
Red-tailed Hawk	*Buteo jamaicensis*	-	-	-	Secure	S5	Observed
Ruffed Grouse	*Bonasa umbellus*	-	-	-	Secure	S4S5	Confirmed
Spotted Sandpiper	*Actitis macularius*	-	-	-	Sensitive	S3S4B	Confirmed
American Woodcock	*Scolopax minor*	-	-	-	Secure	S4S5B	Confirmed
Mourning Dove	*Zenaida macroura*	-	-	-	Secure	S5	Possible
Barred Owl	*Strix varia*	-	-	-	Secure	S5	Observed
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened	At Risk	S3B	Possible
Ruby-throated Hummingbird	*Archilochus colubris*	-	-	-	Secure	S5B	Possible
Yellow-bellied Sapsucker	*Sphyrapicus varius*	-	-	-	Secure	S4S5B	Possible
Downy Woodpecker	*Picoides pubescens*	-	-	-	Secure	S5	Observed
Hairy Woodpecker	*Picoides villosus*	-	-	-	Secure	S5	Possible
Northern Flicker	*Colaptes auratus*	-	-	-	Secure	S5B	Possible
Pileated Woodpecker	*Dryocopus pileatus*	-	-	-	Secure	S5	Probable
Eastern Wood-Pewee	*Contopus virens*	-	Special Concern	Vulnerable	Sensitive	S3S4B	Possible
Alder Flycatcher	*Empidonax alnorum*	-	-	-	Secure	S5B	Possible
Least Flycatcher	*Empidonax minimus*	-	-	-	Secure	S4B	Possible
Eastern Kingbird	*Tyrannus tyrannus*	-	-	-	Sensitive	S3S4B	Observed
Tree Swallow	*Tachycineta bicolor*	-	-	-	Sensitive	S4B	Possible

Table 5.5 Bird species identified during 2014 field surveys

Common Name	Scientific Name	SARA	COSEWIC	NS ESA	General Status Rank	ACCDC S-RANK	Observed Breeding Status (2014 Field Surveys)
Blue Jay	*Cyanocitta cristata*	-	-	-	Secure	S5	Possible
American Crow	*Corvus brachyrhynchos*	-	-	-	Secure	S5	Possible
Common Raven	*Corvus corax*	-	-	-	Secure	S5	Possible
Black-capped Chickadee	*Poecile atricapilla*	-	-	-	Secure	S5	Confirmed
Red-breasted Nuthatch	*Sitta canadensis*	-	-	-	Secure	S4S5	Confirmed
White-breasted Nuthatch	*Sitta carolinensis*	-	-	-	Secure	S4	Possible
Winter Wren	*Troglodytes troglodytes*	-	-	-	Secure	S5B	Possible
Golden-crowned Kinglet	*Regulus satrapa*	-	-	-	Sensitive	S4	Possible
Veery	*Catharus fuscescens*	-	-	-	Secure	S4B	Possible
Swainson's Thrush	*Catharus ustulatus*	-	-	-	Secure	S4S5B	Possible
Hermit Thrush	*Catharus guttatus*	-	-	-	Secure	S5B	Possible
American Robin	*Turdus migratorius*	-	-	-	Secure	S5B	Confirmed
Northern Mockingbird	*Mimus polyglottos*	-	-	-	Secure	S3B	Possible
Cedar Waxwing	*Bombycilla cedrorum*	-	-	-	Secure	S5B	Possible
European Starling	*Sturnus vulgaris*	-	-	-	Exotic	SNA	Possible
Blue-headed Vireo	*Vireo solitarius*	-	-	-	Secure	S5B	Probable
Red-eyed Vireo	*Vireo olivaceus*	-	-	-	Secure	S5B	Probable
Northern Parula	*Parula americana*	-	-	-	Secure	S5B	Probable
Chestnut-sided Warbler	*Dendroica pensylvanica*	-	-	-	Secure	S5B	Possible
Magnolia Warbler	*Dendroica magnolia*	-	-	-	Secure	S5B	Possible
Yellow-rumped Warbler	*Dendroica coronata*	-	-	-	Secure	S5B	Possible

Table 5.5 Bird species identified during 2014 field surveys

Common Name	Scientific Name	SARA	COSEWIC	NS ESA	General Status Rank	ACCDC S-RANK	Observed Breeding Status (2014 Field Surveys)
Black-throated Green Warbler	*Dendroica virens*	-	-	-	Secure	S4S5B	Possible
Blackburnian Warbler	*Dendroica fusca*	-	-	-	Secure	S4B	Possible
Black-and-white Warbler	*Mniotilta varia*	-	-	-	Secure	S4S5B	Probable
American Redstart	*Setophaga ruticilla*	-	-	-	Secure	S5B	Possible
Ovenbird	*Seiurus aurocapillus*	-	-	-	Secure	S5B	Possible
Common Yellowthroat	*Geothlypis trichas*	-	-	-	Secure	S5B	Confirmed
Canada Warbler	*Wilsonia canadensis*	Threatened	Threatened	Endangered	At Risk	S3B	Probable
Savannah Sparrow	*Passerculus sandwichensis*	-	-	-	Secure	S4B	Possible
Song Sparrow	*Melospiza melodia*	-	-	-	Secure	S5B	Probable
Swamp Sparrow	*Melospiza georgiana*	-	-	-	Secure	S5B	Probable
White-throated Sparrow	*Zonotrichia albicollis*	-	-	-	Secure	S5B	Probable
Dark-eyed Junco	*Junco hyemalis*	-	-	-	Secure	S4S5	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	-	-	-	Secure	S4S5B	Possible
Purple Finch	*Carpodacus purpureus*	-	-	-	Secure	S4S5	Possible
American Goldfinch	*Carduelis tristis*	-	-	-	Secure	S5	Possible

Species of Conservation Interest

Common Loon

Common loons are found on freshwater lakes and ponds throughout Nova Scotia during the summer months, where they feed primarily on fish. They are a diving water bird that is acrobatic and fast under water, but slow and awkward on land. As such, they generally only go to shore when nesting. Nests are located near the edge of water on islands, to protect against predators. Usually, only one pair or loons will occupy a small lake (Tufts 1986). Common loons are vulnerable to human disturbance and require quiet, clear lakes. They are particularly sensitive to water pollution and contaminants, such as mercury and lead. In the winter, loons move to the ocean, where they are generally found near shore or in bays or inlets.

The Nova Scotia general species ranks indicate that loons *may be at risk* in the province. They have an ACCDC rank of *S3* (uncommon) for breeding, and S4 (fairly common) for non-breeding. One common loon was observed on the pond located to the north of the Study Area (Figure 5.3) in mid-June but was not observed at the site during subsequent visits. This species was classified as a possible breeder as a result of being observed in potentially appropriate breeding habitat but is considered unlikely to utilize the pond features for nesting purposes. In particular, the small size of the pond (*i.e.*, approximately 3 ha) is unlikely to be attractive for breeding purposes. For example, common loons were not found to attempt to breed on lakes smaller than 5.3 ha on Ontario (Alvo *et al.* 1988); they typically require at least 20 ha in Minnesota (but are occasionally found on lakes of 5-6 ha) (McIntyre 1988); require a minimum lake size of 40 ha in southwest Nova Scotia (Kerekes 1992), and did not occur in lakes of Maine having 7 ha or less of open water (Gibbs *et al.* 1991). They also typically select lakes with convoluted, deeply indented shorelines (McIntyre and Barr 1997) and choose islands as nesting sites (Tufts 1986); these characteristics are absent from the pond of interest.

Spotted Sandpiper

Spotted sandpipers are a species of shorebird found not only on the coast, but throughout Nova Scotia. They can be found near lakes, ponds or streams throughout the summer, and tend to favor rocky shores. Spotted sandpipers build their nests on the ground near water, and it is the male who incubates the eggs and take care of the young. In Nova Scotia, this species arrives in late-April or May, and generally leaves in August or September (Tufts 1986). Winters are spent in Mexico, Central or South America. At a provincial level, Spotted sandpipers are listed as *sensitive* by NSDNR and are ranked as S3S4B by the ACCDC, indicating that breeding birds are considered uncommon to fairly common. The general trend observed in the breeding bird surveys (BBS) indicate that this species is declining both in Canada, and in Nova Scotia (Environment Canada 2014). A loss of wetland habitat or compromised water quality may be contributing to this decline. An adult and recently fledged flightless juvenile were observed along the edge of the pond located outside the Study Area to the north during the breeding bird survey. As such, this species has been identified as a confirmed breeder at that site.

Common Nighthawk

The Common Nighthawk is a member of the goatsucker family and is most active at dawn and dusk but also forages during the day and after dark. They are listed as t*hreatened* under SARA, COSEWIC, and the NS ESA. They also have a General Status rank of *at risk* within the province (NSDNR 2014a) and are ranked S3B by the ACCDC (2014), indicating that breeding individuals are uncommon.

Common Nighthawks forage on the wing for high flying insects and nest on the ground in open habitats with little vegetation, such as recent burns and clear-cuts, rocky barrens, rocky outcrops, grasslands, peat bogs, marshes, dunes, beaches, lake shores and river banks (COSEWIC 2007). BBS data indicate that the Canadian population of common nighthawk has declined significantly from the early 1980s through to 2000. The population has been relatively stable since 2000 at very low levels but the Nova Scotia population has generally declined since 1970. Although the exact causes for the decline of this species are not well understood, it may be related to the widespread decrease in insect populations upon which this species relies for food (COSEWIC 2007). Other factors that may contribute to the decline of common nighthawk populations include loss or modification of breeding habitat such as reforestation of abandoned agricultural land and logged areas, intensive agriculture, forest fire suppression programs, and the gradual loss of buildings with gravel covered roofs. Increased predator populations, roadkill and climate change may also be contributing to declines in common nighthawk populations.

Two common nighthawks were observed in a recently harvested area near the south central portion of the Study Area (Figure 5.3) during a dedicated survey for this species. They were observed in flight at heights of 0 to 100 m, and were calling and booming throughout the extent of the survey. A common nighthawk was also recorded incidentally in the same general vicinity during vegetation surveys in mid-August 2014 and they are likely to be utilizing the recently scarified ground for nesting purposes. An incidental record of common nighthawk was also made from a roadside to the south of the Study Area on the morning of the dedicated survey in mid-June and may be of the same birds as heard in association with the recently harvested forest stand. Although the edge of the existing mine provides potentially suitable habitat for this species, no common nighthawks were observed in that area during surveys. Furthermore, a nest sweep of the edge of the mine and adjacent disturbed habitats was performed on July 8, 2014 and did not identify any common nighthawks in the area.

Eastern Wood Pewee

Eastern Wood Pewees are typically associated with deciduous or mixedwood forest although they often nest in ornamental groves, particularly those dominated by elms. They are often associated with forest edges. This species is listed as *vulnerable* under the NS ESA and as a species of *special concern* at the federal level (COSEWIC 2014). It is also currently provided a rank of *sensitive* by NSDNR and ACCDC lists this species as *S3S4B* indicating that it is an uncommon to fairly common breeding bird species in Nova Scotia. BBS data for Canada (Environment Canada 2014) reveals that eastern wood pewee abundance has declined steadily since 1970. The trend for Nova Scotia is different with a rapid decline from 1970 to 1976

followed by slower decline between 1976 and 1989 followed by a period from 1989 until 2009 in which the population was relatively stable. The cause of the decline in eastern wood pewee abundance is poorly understood but is believed to be related to habitat loss.

Eastern wood pewees were observed throughout the Study Area during 2014 field surveys (Figure 5.3) where they were typically associated with mature hardwood and mixedwood forest stands, and the edges of these formed by recent tree harvesting practices. Although 14 locations for eastern wood pewees are presented in Figure 5.3, many of these observations are likely to be of the same individuals as this species was often recorded singing from relatively far distances (*i.e.*, 100 to 200 m from point of observation). The eastern wood-pewee has been classified as a possible breeder within the Study Area.

Eastern Kingbird

The eastern kingbird is a large flycatcher that is generally found in orchards, along forest edges, on agricultural land or in fields with scattered shrubs and trees. This species eats insects, and will often sit in a high perch in open areas to wait for insects to fly by. They also consume fruit, which is a particularly important part of their diet in the fall and winter months. Nests are built in trees in open areas, and are made up of twigs and vegetation. In Nova Scotia, nesting occurs in June and eastern kingbirds have only one brood (Tufts 1986). They are a feisty bird and will defend their nests aggressively, even against much larger birds. Winter months are spent in South America.

Long term data from BBS (Environment Canada 2014) indicates that eastern kingbird populations have had a steady decline in both Canada and Nova Scotia since 1970. This species is listed as *sensitive* by the NSDNR and has an ACCDC ranking of *S3S4B*, indicating that they are generally uncommon, but are usually widespread in Nova Scotia for breeding. One eastern kingbird was observed as a fly-over in mid-August towards the northern extent of the Study Area (Figure 5.3). Because of the nature and timing of the observation, this species is not expected to breed in the area.

Tree Swallow

Tree Swallows are often found in open habitats in Nova Scotia, such as fields and wetlands. They nest in unoccupied woodpecker holes or in man-made nest boxes. They feed largely over lakes, rivers and wetlands containing open water, and nests are often situated near these foraging sites. Insects make up the majority of their diet. The Nova Scotia population has been in decline since the early 1990s. Tree swallows are currently ranked as a *sensitive* species in Nova Scotia by NSDNR and as *S4B* by the ACCDC, indicating that they are fairly common and widespread. A lack of cavity trees and/or decreasing insect populations may be contributing to their population decline. Two tree swallows were observed in flight over agricultural land in the northern portion of the Study Area (Figure 5.3).

Golden-crowned Kinglet

Golden-crown kinglets are a northern species and are typically found in dense coniferous stands of Nova Scotia, where they are year-round residents. They build their nests in the tops of conifers and typically have two broods a year. They feed primarily on insects.

Golden-crowned Kinglets have been assigned a status of *sensitive* by NSDNR and are ranked *S4* by the ACCDC indicating that although they are fairly common throughout their range in the province, they are of long-term concern. BBS data (Environment Canada 2014) indicate that golden-crowned kinglet abundance has declined over the past 20 years although abundance is still within ranges present in the 1970s and 1980s. There are concerns that extensive harvesting of softwood forest in recent decades and other factors such as possible reduction in softwood forest cover as a result of climate change could result in substantial long term reductions in the abundance of this species in Nova Scotia. Four golden-crowned kinglets were observed in or near the Study Area during field surveys (Figure 5.3) all of which were located in relatively mature mixedwood or softwood stands.

Northern Mockingbird

Northern mockingbirds are extremely vocal songbirds that are generally found in rural areas, parks, forest edges and open areas. These birds are omnivores, and primarily consume insects in the summer and fruit in the winter. They nest in thick bushes and construct their nests out of twigs, grass stems and rootlets (Tufts 1986). Although their population is considered *secure* by NSDNR, they are assigned a rank of *S3B* in Nova Scotia by the ACCDC, which indicates that they are an uncommon breeder in the province. One northern mocking bird was heard singing just outside the Study Area (Figure 5.3) and was associated with a residential property.

Canada Warbler

The Canada warbler can be found in a wide range of forest types, including deciduous, coniferous, and mixedwood forests. It is often associated with moist mixedwood forest and riparian shrub forests on slopes and ravines (COSEWIC 2008a). The presence of a well-developed shrub layer also seems to be associated with preferred Canada warbler habitat and nests are typically constructed on Sphagnum moss hummocks or among the exposed roots of wind thrown trees. In Nova Scotia nesting begins in early June and most young are fledged by mid-July (Erskine 1992).

Canada Warbler is ranked as *threatene*d on Schedule 1 of SARA and has just recently been designated as *endangered* under the Nova Scotia ESA. Significant declines in the population of this species have been continuing for nearly three decades and although the reasons are not well understood, potential factors for the decline of this species include the loss of habitat in the wintering range (*i.e.*, forests of the northern Andes, primarily Colombia) and the conversion of swamp and forests to agricultural and urban lands in the species' breeding range. Approximately 80% of the entire breeding range for this warbler is located in Canada (COSEWIC 2008a), where it can be found breeding in every province and territory except Newfoundland

and Labrador and Nunavut. Four Canada warblers were observed in the Study Area during 2014 field surveys. All were located at the far eastern portion of the Study Area in association with imperfectly to poorly drained deciduous or mixedwood forest. Although playbacks for this species were performed in multiple wetlands with potentially suitable habitat, Canada warblers were only found in association with Wetland WL10.

Bird Species Richness and Densities within Vegetation Groups

The average number of species observed within the boundaries of the point counts was approximately nine, but varied from six to over 11 within vegetation groups (Table 5.6). The highest species richness was observed where point counts were conducted at areas that contained a mixture of mixedwood forest, clearcuts, and associated edges. Conversely, the agricultural land that was surveyed had relatively low species richness compared to other vegetation groups, which likely reflects the generally homogeneous form of that habitat, its low structural complexity and high levels of human activities. Results should be interpreted with caution because of the low number of replicates for the vegetation groups, particularly with regard to agricultural and clear-cut areas. The number of species recorded at a single site ranged from five to 15, with the highest number of recordings observed at a mixedwood/clearcut site.

Table 5.6 Bird Species Richness by Vegetation Group

Forest Group	Number of Sites	Average Species Richness per site
Agricultural	1	6.0
Wet Deciduous / Wetland	3	9.7
Mixedwood	5	10.4
Mixedwood / Clearcut	5	11.4
Clearcut	2	9.5
Intolerant Hardwood	3	7.0
Average		8.9

Species density (number of territories per 100 ha) varies among the vegetation groups (Table 5.7). The highest overall species density was recorded in the mixedwood forest/clearcut vegetation group, which had a total of 497 territories/100 ha. The lowest species densities were recorded on agricultural lands, followed by intolerant hardwood, with densities of 286 and 308 species/100 ha, respectively. These numbers must be interpreted with caution due to the low number of sites in each vegetation group. American robin (*Turdus migratorius*) was the only species observed in all six forest groups, but several others were recorded in five of the six forest groups: black-and-white warbler (*Mniotilta varia*), blue-headed vireo (*Vireo solitarius*), black-throated green warbler (*Dendroica virens*), common yellowthroat (*Geothlypis trichas*), northern parula (*Parula americana*), red-eyed vireo (*Vireo olivaceus*), and song sparrow (*Melospiza melodia*). The most abundant species within individual vegetation groups were as follows:

- Agricultural: savannah sparrow (*Passerculus sandwichensis*) and common yellowthroat (*Geothlypis trichas*)

- Wet Deciduous/Wetland: ovenbird (*Seiurus aurocapillus*), red-eyed Vireo, and American robin
- Mixedwood: ovenbird, American robin, and black-throated green warbler
- Mixedwood/Clearcut: red-eyed Vireo, ovenbird, and hermit thrush (*Catharus guttatus*)
- Clearcut: alder flycatcher (*Empidonax alnorum*), black-and-white warbler, chestnut-sided warbler (*Dendroica pensylvanica*), American robin, and song sparrow
- Intolerant Hardwood: red-eyed vireo, ovenbird, and American robin

Table 5.7 Bird Species Density by Vegetation Group (# territories/100 ha)

Common Name	Agricultural	Wet Deciduous/Wetland	Mixedwood	Mixedwood/Clearcut	Clearcut	Intolerant Hardwood
American Goldfinch	0.0	0.0	6.4	6.4	0.0	0.0
Red-winged Blackbird	0.0	0.0	0.0	0.0	15.9	0.0
Dark-eyed Junco	0.0	10.6	6.4	6.4	0.0	0.0
White-throated Sparrow	0.0	10.6	12.7	25.5	0.0	0.0
Swamp Sparrow	0.0	10.6	0.0	0.0	0.0	0.0
Song Sparrow	31.8	10.6	0.0	12.7	47.7	21.2
Savannah Sparrow	127.3	0.0	0.0	0.0	0.0	0.0
Canada Warbler	0.0	0.0	6.4	0.0	0.0	0.0
Common Yellowthroat	63.7	21.2	25.5	25.5	31.8	0.0
Ovenbird	0.0	53.1	63.7	57.3	0.0	63.7
American Redstart	0.0	0.0	6.4	0.0	0.0	21.2
Black-and-white Warbler	0.0	31.8	31.8	31.8	47.7	21.2
Blackburnian Warbler	0.0	10.6	0.0	0.0	0.0	0.0
Black-throated Green Warbler	0.0	31.8	38.2	31.8	31.8	10.6
Yellow-rumped Warbler	0.0	21.2	6.4	0.0	15.9	0.0
Magnolia Warbler	0.0	0.0	19.1	25.5	0.0	0.0
Chestnut-sided Warbler	0.0	0.0	0.0	25.5	47.7	0.0
Yellow Warbler	0.0	0.0	0.0	0.0	15.9	0.0
Northern Parula	31.8	10.6	25.5	25.5	15.9	0.0
Red-eyed Vireo	0.0	53.1	31.8	63.7	31.8	74.3
Blue-headed Vireo	0.0	31.8	25.5	25.5	31.8	10.6
American Robin	31.8	42.4	44.6	19.1	47.7	42.4
Hermit Thrush	0.0	10.6	25.5	57.3	0.0	0.0
Swainson's Thrush	0.0	0.0	0.0	12.7	0.0	0.0
Veery	0.0	31.8	0.0	0.0	0.0	21.2
Golden-crowned Kinglet	0.0	0.0	12.7	0.0	0.0	0.0
Winter Wren	0.0	0.0	12.7	19.1	0.0	0.0
Alder Flycatcher	0.0	0.0	6.4	19.1	79.6	21.2

Table 5.7 Bird Species Density by Vegetation Group (# territories/100 ha)

Common Name	Agricultural	Wet Deciduous/Wetland	Mixedwood	Mixedwood/Clearcut	Clearcut	Intolerant Hardwood
Northern Flicker	0.0	10.6	0.0	6.4	0.0	0.0
Mourning Dove	0.0	0.0	6.4	0.0	0.0	0.0
Total	286.5	403.2	413.8	496.5	461.5	307.7

5.3.1.3.2 Mammals

Evidence of 15 species of mammals were recorded during field surveys (Table 5.8), none of which are considered SOCI for the purposes of this report.

Table 5.8 Mammal species identified during field surveys

Common Name	Scientific Name	General Status Rank	ACCDC S-Rank
Masked Shrew	*Sorex cinereus*	Secure	S5
Snowshoe Hare	*Lepus americanus*	Secure	S5
Eastern Chipmunk	*Tamias striatus*	Secure	S5
Red Squirrel	*Tamiasciurus hudsonicus*	Secure	S5
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure	S5
American Beaver	*Castor canadensis*	Secure	S5
Deer Mouse	*Peromyscus maniculatus*	Secure	S5
North American Porcupine	*Erethizon dorsatum*	Secure	S5
Eastern Coyote	*Canis latrans*	Secure	S5
Red Fox	*Vulpes vulpes*	Secure	S5
Northern Raccoon	*Procyon lotor*	Secure	S5
Short-tailed Weasel	*Mustela erminea*	Secure	S5
Striped Skunk	*Mephitis mephitis*	Secure	S5
Bobcat	*Lynx rufus*	Secure	S5
White-tailed Deer	*Odocoileus virginianus*	Secure	S5

Although no evidence of mammal SOCI were observed during field surveys, several are known to occur within the vicinity of the Project. In particular, several species of bats have been recorded in the surrounding landscape and moose have been occasionally reported in the general area. At the open house for this Project, it was noted that a moose was observed approximately 1 km northeast of Proposed Extension Area Cooks Mill Road.

Moose are commonly associated with wilderness boreal and mixedwood habitats. Their preferred food are the twigs, stems and foliage of young deciduous trees and shrubs, as may be found within forest landscapes recently disturbed by fire, wind, disease or timber harvesting activities. In summer, moose prefer habitats interspersed with wetlands that allow access to submergent and emergent aquatic vegetation and refuge from high temperatures and biting insects. Landscapes which support recently disturbed mixed forests for food and adjacent mature conifer cover for escape and shelter are preferred in winter. Although the Study Area is well outside the core areas of distribution for this species (Parker 2003), it provides potential moose foraging habitat, and individuals may occasional wander through the area for this purpose.

The three winter track surveys did not reveal the presence of moose in the Study Area. Biologists familiar with moose spoor were present in the Study Area during the months of January, February, March, June, August, October, and November. No evidence of moose (tracks, feces or rubs) was encountered during any of these field surveys. It is highly unlikely that the Study Area provides important habitat for this species.

Seven species of bats have been recorded in Nova Scotia (Broders, Quinn & Forbes 2003). Of these, four are migratory bats for which only sparse records exist. The remaining three species include little brown bat *(Myotis lucifugus*), northern long-eared bat *(M. septentrionalis*), and tri-coloured bat *(Perimyotis subflavus*), all of which can be found in Nova Scotia year-round. All three of these species were identified in the ACCDC data search, with the closest record being approximately 24 km away (Appendix G). These bats rely on forested and rural areas in the summer for roost sites and foraging opportunities. The little brown bat also readily occupies man-made structures, such as barns or attics; maternity colonies found in these structures can number in the hundreds. All three species of resident bats rely on underground openings in the winter for hibernation, which include natural caves and abandoned mines. In Nova Scotia, many of these underground spaces are found in gypsum. Bats require very specific conditions for hibernation in regards to humidity and temperature (Raesly and Gates 1987). Little brown bats, northern long-eared bats and tri-coloured bats will often hibernate together at the same sites. In 2013, all three species of bats commonly found in Nova Scotia were listed as *endangered* by the NSDNR. The populations of these three species have declined rapidly since 2011, due to white-nose syndrome (WNS), which is a disease caused by the fungus *Pseudogymnoascus destructans*. In five hibernation sites in mainland Nova Scotia, populations have declined by at least 95% as a result of this disease.

There is one known bat hibernacula located approximately 4 km south-east of the Project, known as the "Cave of the Bats" (Moseley 2007). This site is a gypsum cave that had a hibernating population of 100-150 bats before WNS. The status of the current population is unknown; however, based on the effects of WNS at other Nova Scotia caves, it is likely that very few bats remain, if any. Conservation of any remained bats is of high priority in the province. The Study Area was extensively searched but no karst topography or gypsum outcropping was found within the Study Area. The Study Area is overlain by a thick continuous layer of relatively impermeable over burden. Under these conditions, it is unlikely that solution caves emerge at the surface within the Study Area. The likelihood of a bat hibernaculum being present on the site is low. Areas of mature forest in the Study Area could provide roosting sites and maternity colony sites for bats. Suitable roosting and maternity colony habitat are widespread on the landscape and the Study Area would not be particularly valuable in this regard.

Hoary bats are a migratory species not affected by WNS are present in Nova Scotia only during the summer months. They are listed as *may be at risk* in Nova Scotia and have an ACCDC ranking of *S1*. Hoary bats occur irregularly in Nova Scotia and it is likely that this species reaches the northeastern limit of its range here. They typically roost in either coniferous or deciduous trees usually near the edge of a clearing. Given the habitat preferences of this species, it is possible that it could occur in the Study Area. However, if it were present it would likely occur in very low numbers and they would only occur seasonally and as transients. The closest known ACCDC record of hoary bat is approximately 25 km away from the Study Area.

A review of the NSDNR significant habitat mapping database (NSDNR 2014) did not reveal the presence of any mammal SOCI within the Study Area or critical habitat such as deer wintering areas. In addition, all of the habitats present within the Study Area are commonly encountered

throughout the province and are unlikely to provide habitat for mammal SOCI. The winter track surveys revealed that white-tailed deer were widely distributed through much of the Study Area in January and February. Deer were most frequently detected in mature mixedwood forest and recent clear-cuts. There was little deer activity recorded in young (20 to 30 year old) hardwood dominated stands. It is likely that deer were using the mature mixedwood forest for thermal cover and were foraging in adjacent clear-cuts. Average snow depths were 15 cm on January 31, 20 cm on February 12 and 27 cm on March 12. Deer movement did not appear to be substantially impaired by snow depths as indicated by the widespread distribution of tracks. In March, white-tailed deer were present only in the northeastern end of the Study Area. The abandonment of the western portion of the Study Area may have been attributable to several factors including predation pressure and snow cover. Eastern coyote tracks were commonly encountered in the western part of the Study Area and a deer that had been fed on by coyotes was found in this area during the January survey. At the time of the March survey, warmer day time temperatures combined with wind scour had exposed the ground surface of many local hay fields and pastures. Many deer were observed foraging in these snow free areas. The combination of predation pressure and new food sources may have prompted deer leave the western part of the Study Area.

5.3.1.3.3 Herpetiles

Seven species of herpetiles were recorded during field surveys in support of the Project (Table 5.9). All encountered species are generally abundant and widespread within the province and have populations that are considered *secure*. However, snapping turtle (*Chelydra serpentina*) is listed as a species of *special concern* by COSEWIC and SARA, and has a designation of *vulnerable* in the Province of Nova Scotia.

Table 5.9 Herpetile species identified during field surveys

Common Name	Scientific Name	SARA / COSEWIC	NS ESA	General Status Rank	ACCDC S-Rank
American Toad	*Bufo americanus*	-	-	Secure	S5
Green Frog	*Rana clamitans*	-	-	Secure	S5
Maritime Garter Snake	*Thamnophis sirtalis pallidulus*	-	-	Secure	S5
Pickerel Frog	*Rana palustris*	-	-	Secure	S5
Snapping Turtle	*Chelydra serpentina*	Special Concern	Vulnerable	Secure	S5
Spring Peeper	*Hyla crucifer*	-	-	Secure	S5
Wood Frog	*Rana sylvatica*	-	-	Secure	S5

The snapping turtle has a widespread distribution in North America, ranging from Texas in the south to Manitoba in the north. Within Canada, it can be found from Nova Scotia to southeastern Saskatchewan. It is absent from the northern parts of many of the provinces in its range, as summers are likely too cool for embryonic turtles to successfully complete their development (COSEWIC 2008b). Snapping turtles tend to return annually to their summer home ranges and winter hibernacula, with males traveling greater distances after emergence from hibernation (Brown and Brooks 1993). They generally inhabit ponds, sloughs, streams, rivers, and

shallow bays that are characterized by slow moving water, aquatic vegetation, and soft, muddy bottoms. Females show strong nest site fidelity and nest in sand or gravel banks at waterway edges in late May or early June (COSEWIC 2008b). Snapping turtles have natural constraints of having a life-history strategy that includes slow recruitment and late sexual maturation. In Canada, they are also naturally limited by their reduced hatching success as a result of a short and cool summer season. The main threat to this species is from road mortality which effects adult survivorship, which in turn greatly influences population sizes due to the late sexual maturation of this species. In addition, mortality from ingesting fishing hooks and dead fish, and from persecution due to their 'aggressive' nature play strong roles in the decline of this species. Other threats include unnaturally high rates of nest predation, legal and illegal harvesting of individuals, and water contamination (COSEWIC 2008b). One snapping turtle (sex undetermined) was observed in a small anthropogenic pond at the northern end of the Study Area (Figure 5.3). This species has potential to overwinter within this pond and to nest in nearby areas.

A review of the ACCDC data indicates that one other herpetile SOCI, the four-toed salamander (*Hemidactylium scutatum*) has been recorded within a 20 km radius of the Study Area (Appendix G). The four-toed salamander is not listed provincially or federally, but has an ACCDC ranking of S3, indicating that it is uncommon in the province. Four toed salamanders are associated with wetlands, including swamps and bogs containing sphagnum moss. This salamander is small and secretive, and records are relatively uncommon in Nova Scotia. Potentially suitable habitat for this species is present within the Study Area in association with Wetland WL10.

Although wood turtles (*Glyptemys insculpta*) were not detected during field surveys and are not included in the distributed ACCDC records, information indicates that there is some potential for this species to be found in the Study Area. Wood turtles are considered *threatened* under SARA, *vulnerable* under the NS ESA, ranked as *S3* (uncommon) by the ACCDC, and are regarded as *sensitive* by NSDNR. They are typically associated with watercourses and the riparian habitats associated with them. Individuals nest on sandy or gravelly riverbanks but will also make use of other features such as sand pits and road embankments near water courses that provide a sandy or gravelly substrate. Deep pools in larger rivers are often used as hibernaculum sites during the winter and riparian habitats along watercourses are typically used as feeding sites. Although the watercourse that is present at the northeastern end of the Study Area does not provide ideal habitat for wood turtles (*i.e.*, general lack of sandy banks that would provide nesting opportunities and shallow water depths are not suitable for hibernaculum sites) there is potential for this species to occur in this area. In particular, wood turtles have potential to occur in the area during summer months when individuals can wander upstream from nesting and hibernaculum sites for foraging purposes. Similarly, there is also some potential for wood turtles to wander up the drainage ditch that runs near the center of the Study Area (see Section 5.1 Fish and Fish Habitat for the location of this feature). Although unlikely, there is also some potential for wood turtles to utilize disturbed areas near watercourses for nesting purposes if they provided appropriate substrate conditions.

5.3.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

A number of activities (*i.e.*, clearing, grubbing, topsoil stripping, and blasting) associated with the Project could interact with wildlife. Potential effects on wildlife include direct mortality, habitat loss, sensory disturbance, and fragmentation. These potential effects, along with mitigation and likely residual effects of the Project are discussed in the following sections.

Direct Mortality

The nesting season is generally the most critical life history stage for birds, because eggs and nestlings cannot move from a source of disturbance. In Nova Scotia, breeding season generally occurs between May 1st and August 31st. While most bird species construct nests in trees and shrubs, a number of species of birds nest at ground level (*e.g.*, common nighthawk, spotted sandpiper). Eggs and nestlings located in areas to be cleared would likely be destroyed if clearing occurred during the breeding season. Furthermore, there is potential for bank swallows (*Riparia riparia*) to establish colonies in vertical banks or areas of stockpiled product comprised of sandy material and to be directly disturbed by Project activities. Potential adverse effects due to noise on bird breeding may also result in abandonment of the nest or increased rates of predation and exposure of hatchlings and eggs during temporary abandonment.

Migratory birds are protected under the federal *Migratory Birds Convention Act* (MBCA) which prohibits killing migratory bird species, their eggs or young; except under authority of a permit thereof. Other bird species not protected under the federal Act, such as raptors, are protected under the provincial *Wildlife Act*. In order to avoid contravening these regulations, clearing, grubbing and stripping of areas to be used for the Project will be preferentially conducted outside of the breeding season of most bird species (May 1 to August 31) so that the eggs and flightless young of birds are not inadvertently destroyed. Preferentially, the Proponent will conduct clearing outside the bird breeding period, which should provide adequate protection for migratory birds. However, in case this is not possible, the Proponent will review the best practical mitigation measures and apply them in accordance with the MBCA. At a minimum, if complete avoidance of these activities during the specified timeframe is not feasible, nest searches will be undertaken by a qualified biologist and avoidance setbacks will be established around active nests.

Additional mitigative measures will reduce potential interactions with species that are attracted to cleared areas for nesting, or other features that may be created during Project activities. Should there be a delay between clearing and operational activities such that operations are initiated during the breeding season, nest surveys will be carried out by experienced observers for the purpose of determining the presence and activities of birds, such as common nighthawk, that are known to target cleared areas for nesting. Workers will receive training and reference material that will help them to identify species that could be attracted to habitats created by project operations (*e.g.*, common nighthawks and bank swallow). If workers encounter birds that they suspect may be nesting, an ornithologist or other suitably qualified professional will be

brought on site to determine whether nesting is occurring and to find the nest (nest locations will not be flagged as this increases the risk of nest predation). If a nest is found, an appropriate setback will be established around the nest in which human activities will be restricted until the young fledge and leave the area or until the nest naturally fails. The period for which bank swallow nests would be considered active would include not only the time when birds are incubating eggs or taking care of flightless chicks, but also a period of time after chicks have learned to fly since swallows return to their colony to roost. If there is ultimately a need to decommission a building or structure used for nesting migratory birds (*e.g.*, gulls or swallows), Environment Canada's Canadian Wildlife Service (CWS) will be consulted in a timely manner in advance of any proposed decommissioning activities for species-specific considerations.

Adult birds are unlikely to be killed or injured during construction activities as they would flee the area when exposed to human activity in close proximity. Such avoidance behaviour by adult birds could result in changes in normal movements, migrations and other life history processes. The effects of such avoidance behaviour would be temporary, as birds would likely return to adjacent habitats after construction is complete provided that this habitat is not already fully occupied by that species or a species with a similar niche.

Limited direct mortality of some small wildlife, such as rodents, shrews and herpetiles, is likely to occur during certain activities associated with mine development such as clearing and grubbing. Small animals tend to stay in close proximity to cover when exposed to high noise levels, making them vulnerable to injury and death due to heavy equipment during site clearing and grubbing. Large and medium sized mammals are unlikely to suffer direct mortality from clearing activities as they would flee the area in response to human presence and noise. Such avoidance behaviour by mammals could result in changes in normal movements, migrations and other life history processes. Displaced wildlife species would disperse to adjacent suitable habitat but if those habitats are already occupied by that species or a species with a similar niche the addition of new individuals could result in greater competition for resources and increased levels of mortality as a result of that competition or increased predation. Any avoidance behaviour and associated wildlife displacement effects are expected to be limited and highly localized since the mine has been operational for many years and species particularly sensitive to human activities may be expected to have already left the area.

Potential effects to wildlife through indirect or direct mortality will also be mitigated through training of key employees to identify key species of interest (*e.g.,* wood turtles and snapping turtles) and increased knowledge of relevant acts and regulations (*e.g.*, SARA, NS ESA, and the MBCA). As part of this exercise, regulators (*i.e.*, CWS and NBDNR) will be consulted to identify appropriate responses and pathways of communication should wildlife species or features of interest be identified during Project operations.

Habitat Loss

The Project will result in the direct loss of vegetation communities within the extension footprint. Data on the amounts of vegetation types present and potentially affected by the Project are

provided in Section 5.2 of this report. Although disturbance activities associated with the extension result in the direct loss of wildlife habitat, this is unlikely to cause a significant effect to any of the wildlife species in the area.

Three bird SOCI were identified in the Study Area: Canada warbler, common nighthawk and eastern wood-pewee. All four Canada warblers observed were located in association with poorly to imperfectly drained forest at the eastern end of the Study Area. Following field and desktop studies, the Proponent reduced the original extension area to the current "Proposed Extension Area" and has committed to providing an Ecological Buffer Zone around wetlands located within this area (Figure 5.1); therefore areas that currently provide habitat for Canada warbler will not be directly disturbed through Project activities. Common nighthawks breed in association with disturbed habitats, such as recent clearcuts, where they will nest on exposed ground. These habitats are widespread throughout Nova Scotia and they are only found temporarily in the Study Area. A review of the proposed Mine Development Plan for the proposed Project (Appendix B) indicates that the clear-cut areas where common nighthawks were observed during the field surveys will not be cleared and stripped of topsoil until between 2029 and 2034. By this time, the clear-cut areas will be re-vegetated to the point where they are no longer provide suitable common nighthawk nesting habitat. As such, this species may relocate to near-by suitable habitat, which is readily available, with time. Conversely, because common nighthawks occupy unvegetated areas, the amount of potentially available nesting habitat for this species may actually increase as the mine extension occurs. Although eastern wood-pewees were abundant throughout the site, a number of records collected near the edge of the Study Area indicate that they are also abundant within the surrounding landscape and that their regional population would not be significantly affected. Eight out of 14 eastern wood-pewees recorded during the field surveys were encountered in areas that will not be directly affected by the mine extension. Eastern wood-pewees are known to have an affinity for forest edges (COSEWIC 2012) and within the Study Area they were most frequently encountered at the interface between mature mixedwood forest and recent clear-cuts. It will take 15 to 20 years for mining activities to reach the areas where the six eastern wood-pewees present in the proposed mine footprint were found. As forest cover establishes in the clear-cuts, the value of these areas as eastern wood-pewee nesting habitat may diminish.

Other bird SOCI found in the Study Area include common loon, eastern kingbird, golden crowned kinglet, northern mockingbird, spotted sandpiper and tree swallow. The common loon and spotted sandpiper were observed in association with a pond outside of the Study Area, which will not be directly altered by the mine extension. This pond is currently in close proximity to the existing mine and wildlife associated with it is likely habituated to the ongoing activities of the current mine operation (*e.g.*, blasting, which regularly occurs within 1 km of the pond). Common loons are highly unlikely to utilize the pond for breeding purposes. Eastern kingbirds, northern mockingbirds and tree swallows are associated with open and edge habitats, which are readily available in the region surrounding the Project. Tree swallows also have a preference for wetlands and streams when foraging, and therefore may benefit from the preservation of wetlands in the eastern section of the Study Area. Golden crowned kinglets are relatively

widespread throughout the province, as is the mixedwood and coniferous forests on which they depend. There is no critical habitat for bird SOCI present in the Study Area.

The field surveys did not reveal the presence of any mammal SOCI within the Study Area. The ACCDC modeling exercise indicated that there was a small possibility that hoary bat may make use of the Study Area but the Study Area is not expected to provide particularly valuable habitat for this species. Clearing of vegetation outside of the breeding season for birds which will be used to minimize potential for contravention of the *Migratory Birds Convention Act* will also reduce potential for adverse effects of the Project on hoary bats since this species is not present in the winter. The habitats present in the Study Area are common throughout the province and are unlikely to provide habitat for small mammal SOCI. No critical areas for mammals such as deer wintering areas are known to exist within the Study Area.

Three herpetile species of conservation concern have potential to occur within the Study Area four-toed salamander, common snapping turtle, and wood turtle. Of these, only the snapping turtle was observed in the Study Area. All species require wet areas; the four-toed salamander is found in sphagnum bogs and swamps, the snapping turtle resides in or near streams or ponds, and the wood turtle is generally found in association with watercourses and riparian areas. The commitment to preserving the wetlands and watercourse in the eastern section of the Study Area (Ecological Buffer Zone) will mitigate potential effects on the snapping turtle, as this is the area where the species was observed. Preservation of this area will also reduce potential effects to wood turtle which are most likely to occur in association with the watercourse and associated riparian habitat. It is unknown if the four-toed salamander is present in the Study Area but the most suitable habitat is present in the wetland area that is being preserved.

Sensory Disturbance

Human presence and noise during mining activities may discourage wildlife species from using habitats in close proximity to these activities. However, because the mine has been operating for many years, it is unlikely that species particularly sensitive to human activities are currently present in close proximity to the mine site.

Mine activities potential to cause adverse effects to hibernating bats. Blasting may cause underground vibrations, which could arouse hibernating bats, thus causing them to deplete energy stores. Vibrations may also cause a partial or full collapse of underground structures. Collapses could alter underground habitat, especially if the entrance is altered (West Virginia Department of Environmental Protection 2006). Humidity and temperature conditions are important determinants of hibernacula, therefore changes in airflow patterns or internal structures of caves could make them unsuitable habitat. The magnitude of effects on hibernacula depends on the force of the blast, and the distance from a hibernation site. Although the ACCDC data search revealed three resident bat species to have potential to occur in the vicinity of the Project, they are unlikely to hibernate in the Study Area itself. The proposed mine site is overlaid with a thick layer of till and it is unlikely that any bat-accessible openings exist in the underlying gypsum of the Study Area. However, it is possible for blasting and

other mining activities to affect bat populations in nearby areas. The Study Area is located slightly farther from the known hibernacula known as "Cave of the Bats" than is the currently mined area. Because work has been going on at the mine for years, and the bats continued to use the hibernacula (prior to WNS), it is unlikely that the mine extension will have significant adverse effects on the bat population if a hibernating population remains at all post-WNS.

Some wildlife, such as herpetiles, black bear, raccoon, skunk, and various rodents hibernate or go through prolonged periods of sleep during the winter months. An animal disturbed during periods of extended winter inactivity may die from exposure or subsequent starvation due to expenditure of energy. Therefore, wildlife species in winter sleep are sensitive to disturbance during construction activities. However, because mining activities have been taking place at the existing mine for many years (including regular blasting) this does not represent an additional source of disturbance to animals in the vicinity of the site and they exposed to this during selection of their hibernaculum.

Fragmentation

Developments resulting in the removal of wildlife habitat and/or the introduction of noise, visual and olfactory stimuli have the potential to fragment natural habitats. Fragmentation is the partitioning of habitat into discrete units, where some mechanism (*e.g.*, human presence) impedes or prevents the exchange of wildlife between habitat units. Species with limited dispersal capabilities are generally most susceptible to fragmentation.

The mine extension will contribute to local habitat fragmentation while it is operational. There will be little vegetation in the mine which will make it difficult for wildlife, particularly herpetiles and small mammals, to move from one side of the mine to the other due to lack of cover and increased risk of predation. Forest interior birds are also sensitive to habitat loss because they are affected both by direct habitat loss and through adverse edge influences. However, the Study Area is currently fragmented by human activity, including clearcuts, agriculture and roads. Many of the most common bird species within the Study Area, including American robin, song sparrow, and common yellowthroat, regularly occupy forest edges and prefer habitat near open areas. As such, it is unlikely that the fragmentation caused by the mine extension will have major adverse effects on many of the wildlife species in the area.

Monitoring and Follow-up

Based on a consideration of existing conditions and likely residual effects of the Project, no monitoring programs are currently recommended for wildlife.

Summary

In summary, assuming application of the mitigation measures described above (*e.g.*, Ecological Buffer Zone in the eastern portion of the Proposed Extension Area, conducting clearing activities outside of the breeding season for most birds to facilitate compliance with MBCA, and worker

training for identifying key SOCI and assisting compliance with relevant acts and regulations), significant Project-related effects on wildlife are not likely to occur.

5.4 WETLANDS

Wetlands are selected as a VC because of the potential for interactions between Project activities and wetlands, and because of their relationship with vegetation and wildlife, as well as other biological and physical environments addressed as VCs in this report. Wetlands are a priority ecosystem for conservation concern in Nova Scotia due to the valued functions these ecosystems provide as well as the large historic loss of wetlands in the province to coastal development, agriculture, industry and urbanization. The Nova Scotia Wetland Conservation Policy was introduced in 2011 as a direct result of an enactment in 2007 that legislated the development of a policy to prevent the net loss of wetlands in Nova Scotia (*Environmental Goals and Sustainable Prosperity Act (EGSPA*) 2007). The Wetland Conservation Policy provides direction and a framework for conservation of wetlands and identifies the existing tools available to prevent net loss of wetlands. The existing tools include, most notably, the *Environment Act*, which provides the definition of wetland ecosystems and the ministerial authority over them. The Environmental Assessment Regulations under the *Environment Act* require that projects causing alterations to a total of two or more hectares of any wetland must undergo an environmental assessment.

Wetlands in the Study Area were identified in the field during the terrestrial and aquatic studies (wildlife, vegetation and watercourse mapping). In Nova Scotia, wetlands are defined as "*Land commonly referred to as marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions* (Nova Scotia *Environment Act* as amended in 2006). Wetlands were delineated in the field by applying a combination of soil, vegetation and hydrology indicators of conditions meeting the definition of wetland in Nova Scotia.

Delineated wetlands were classified according to the Canadian Wetland Classification System (NWWG 1997). An assessment of function was completed for each wetland in the field, supported by secondary information (*e.g.,* site topography maps and results of wildlife, vegetation, hydrogeology and watercourse component studies) using the Nova Scotia Wetland Evaluation Technique (NovaWET 3.0).

5.4.1 Description of Existing Conditions

Ten wetlands were found within the Study Area (see Figure 5.1) and are summarized in Table 5.10. Wetlands 1-3 are located in the southern portion of the proposed extension while wetlands 4-10 are clustered near the north-eastern boundary of the Study Area. Nine of the wetlands identified are classified as swamps. These swamps are a combination of shrub, tall shrub, treed and forested. There is also a freshwater marsh, located just outside the north-eastern boundary in association with a small anthropogenic pond.

Descriptions for each wetland are presented in the following sections. Plant lists for each wetland are provided in Appendix I. Wetland evaluation data sheets are presented in Appendix J.

Wetland WL1

WL1 is located in the center of the Study Area, nearest to the advancing face of the existing mine (Figure 5.1). This wetland is classified as a forested basin swamp, 0.24 ha in area. This wetland is of natural origin and is largely undisturbed. The surrounding upland is forested and a narrow woods road is present along the downgradient (southern) boundary of the wetland.

WL1 was dry at the time of assessment but evidence of inundation suggests that this wetland is seasonally saturated with occasional pooling. Concave unvegetated surfaces, stained leaves and water carried debris suggest some water retention in the wetland. Some soil erosion and sediment deposits suggest that the wetland may experience flow during extreme high water events. The wetland basin is elongated, and the dominant drainage is from north-northeast to south-southwest along the length of the wetland. The water source is primarily drainage from upland runoff. During extreme high water events the wetland drainage may overtop a slight rise between the downgradient end of the wetland and the road and discharge to a small ditch along the north side of the road. The ditch was dry at the time of observation but eroded soils in the ditch indicate that flows may be energetic. Water that does not overtop the rise between the wetland and the ditch expected to be retained in the wetland until it discharges to groundwater or evaporates/transpires to the atmosphere. Groundwater recharge is considered a critical wetland function; however the groundwater at this location currently flows to the exposed tills in the open pit of the mine and is therefore not a sustaining flow for human or ecological uses. This wetland does not contribute to stream flow directly, but indirectly when high water levels enter the ditch along the road.

No plant SOCI were present in this wetland. WL1 is characterized by a moderately dense tree overstory composed red maple, white ash and yellow birch with a shrub understory dominated by regenerating trees (mainly balsam fir, striped maple, white ash, and yellow birch). The ground vegetation layer is composed largely of fowl manna-grass, dwarf red raspberry, smooth goldenrod, sensitive fern, and New York fern.

WL1 does not support fish habitat but likely provides habitat for mammals. There was no evidence of community use of this wetland.

Wetland WL2

WL1 is located toward the southern center part of the Study Area (Figure 5.1). WL2 is considered to be marginal in character; it meets the minimum definition of a wetland but has the character of non-wetland ecosystems. WL2 is of recent origin (ten to twenty years) and has formed as a result of the combination of canopy removal and soil compaction and scouring from forestry practices in this area. Mosses and grasses have colonized tire ruts but they are still evident. The

wetland boundary does not follow the natural basin topography but the zone affected by tree removal and soil disturbance. It is 0.39 ha in area and classified as a tall shrub basin swamp.

WL2 shows evidence of seasonal saturation (*e.g.*, water stained leaves). Hummock and hollow topography is present as a result of the in-situ decomposition and moss colonization of stumps and fallen trees. There is no clear inflow or outflow from this wetland. The capture area for runoff is small compared to the size of the wetland, however retention of runoff and direct precipitation appear to dominate the water balance in this wetland. Some small isolated pools are present in the pits left from the roots of wind-fallen trees and in ruts left from machinery. This wetland is not expected to contribute substantially to water quality improvement or groundwater recharge locally. The wetland does provide some surface water detention.

No plant SOCI were identified in WL2. Tree cover in this forested wetland consists mainly of a mixture of regenerating red maple, balsam fir, yellow birch, and eastern hemlock. Speckled alder and common winterberry are the dominant species of the shrub understory. Other common species of this layer include beaked hazelnut and advanced regeneration of balsam fir and white ash. This vegetation type is considered uncommon in Nova Scotia (NSDNR 2010).

WL2 is part of contiguous upland 25-50 ha and likely supports habitat for a number of wildlife species; deer tracks were seen in the wetland during field surveys. Eastern wood-pewee, a SOCI, was identified near this wetland but not in it. Eastern wood-pewee has an upland habitat preference. There was no evidence of community use of this wetland with the exception of past forestry activity that may have contributed to its formation.

Wetland WL3

WL3 is located in a small linear depression near the southern extent of the Study Area (Figure 5.1). This wetland is 0.80 ha and classified as a complex of basin forested swamp (10%) and basin shrub swamp (90%). The wetland is natural in origin and largely undisturbed with no major stressors within the wetland or within the watershed contributing to the wetland. No critical functions were attributed to this wetland.

This wetland is seasonally saturated (likely in the spring) with very little pooling of surface water. The only surface water is found in small, isolated hollows less than 0.15m deep and amounting to no more than 5% of the wetland surface area. There is hummock and hollow topography in the centre of this linear wetland, resulting from the slow decomposition of fallen trees and colonization of fallen trees by blankets of moss. The wetland has no channel inflow or outflow. It appears to be expanding into the adjacent upland forest through paludification (peat initialization at the leading edge of sphagnum growth). The wetland was attributed the function of water management and water quality improvement as a result of its collection of runoff from surrounding slopes and its high surface roughness. There are no sources of water quality degradation in the upland areas. This wetland likely contributes to groundwater recharge locally.

No plant SOCI were identified in this wetland. The vegetation is characterized by a moderately dense tree overstory composed of red maple, white ash and yellow birch. The shrub understory is composed largely of speckled alder, common winterberry, and saplings of white ash and red maple. The ground vegetation layer is composed largely of fowl manna-grass, dwarf red raspberry, smooth goldenrod, sensitive fern, and New York fern.

The wetland provides habitat for grouse and deer, in addition to various other mammals and amphibians. The wetland does not support fish habitat. Eastern wood-pewee, a SOCI, was identified within 100m of this wetland. Eastern wood-peewee has an upland habitat preference. There was no evidence of community use of this wetland or its products.

Wetland WL4

This 0.31 ha wetland is found in the eastern portion of the Study Area (Figure 5.1). Like WL2, WL4 is considered marginal in character. WL4 is a swamp complex. In the southern lobe, it is a dense, dry, alder thicket, infrequently saturated in the spring (likely one in two years on average). In the north, it is a treed swamp that is more frequently saturated and has some organic soils in low lying areas.

WL4 is geographically isolated and has strong potential to maintain its characteristic hydrologic regime. During field surveys, standing water was observed at a depth of 0.05 m. Other signs of surface water retention were evident, including water stained leaves, pit and mound topography and buttressed trunks. Disturbance of wetland soils is low. This wetland has a natural water source and moderate ability to alter flows but is not important for maintaining stream flow. Vegetation in the wetland has potential to settle suspended sediments and there was minimal evidence of excess nutrient inputs. The wetland is categorized as a groundwater discharge site, but does not have a channel outflow. There was no evidence that this wetland contributes to water quality.

WL4 is characterized by a dense tall shrub overstory composed of speckled alder. The shrub canopy also contains a scattered amount of trees including red maple, grey birch and white spruce. Ground vegetation consists of dwarf red raspberry, fowl manna-grass, various mosses, hairy flat-top white aster, and creeping buttercup. Adjacent upland is forested with soils consisting of silt/loam. The average width of the naturalized buffer is >15 m and the vegetation condition, diversity and structure in the adjacent area is high, supporting water quality functions and wildlife habitat. The wetland itself supports habitat for amphibians, reptiles and mammals including deer, hare, ruffed grouse, and crow. WL4 does not support fish habitat and there was no evidence of community use.

Wetland WL5

WL5 is located within the Study Area but outside of the Proposed Extension Area (Figure 5.1). WL5 is a permanently flooded, freshwater marsh with a shallow-water wetland component that borders a constructed pond in the northern end of the Study Area. Approximately one third of this 0.08 ha wetland is inundated and standing water has an average depth of 1.5 m. WL5 is

geographically isolated and has moderate potential to detain stormwater and agricultural runoff. There is little evidence of excess nutrient loading or contamination inputs, and the wetland does not likely contribute to improvements in water quality. The adjacent upland is a mix of forest (60%) and pastures (40%) and stressors to the wetland include fill, mowing, and nutrient enrichment. The water source is mostly natural and wetland soils are highly disturbed as a result of agricultural pond construction. Soils in the adjacent upland are silt/loam in texture.

This marsh contains some shrubs but is mostly characterized by a dense cover of graminoids (broom sedge, mosquito bulrush, soft rush, fox sedge, and soft-stemmed bulrush are most abundant). There is no tree cover but marginal shrub cover consists of speckled alder and young crack willow. This pond also supports submerged, emergent and floating leaf aquatic plants, including ribbon-leaved pondweed, rice cutgrass, small yellow pond-lily, soft-stemmed bulrush, and turion duckweed. Short-awned foxtail was found around the margin of WL5. This species is listed as Sensitive by NSDNR and rare to uncommon (S2S3) by ACCDC. It was relatively common at this location but was not encountered anywhere else in the Study Area.

As part of contiguous upland (25-50ha), WL5 provides habitat for amphibians, waterfowl and mammals, but does not support fish habitat. Wildlife SOCI associated with the wetland include a snapping turtle (observed during field surveys) and eastern kingbird. Community use of the wetland is rated as moderate; it is visible from vantage points and has aesthetic value. It appears that it was excavated to supplement agricultural water supplies.

Wetland WL6 and WL7

WL6 and WL7 are located within the Study Area but outside of the Proposed Extension Area (Figure 5.1). Both of these wetlands are natural treed basin swamps that are temporarily flooded and seasonally saturated. WL6 is 0.07 ha and WL7 is 0.04 ha. Adjacent upland is forested and the naturalized buffer is > 20 m. Slopes in the surrounding area are mostly gentle with some moderate slopes. Adjacent land supports water quality functions and wildlife habitat.

Stressors in the wetland area include forestry activity; there is a small logging road and some older evidence of channelization. General condition of these wetlands is high, as is the overall condition of adjacent land. Soils adjacent to the wetland are predominantly silt/loam.

Wetlands WL6 and WL7 are geographically isolated with small outflow channels (dry at the time of investigation). During field surveys, both wetlands had isolated pools of standing water roughly 0.05m deep within the otherwise dry channel, water stained leaves, pit and mound topography, and buttressed trunks-indicating surface water retention. The wetlands' have potential to alter/retard flows, as they capture and filter runoff and direct precipitation (natural water source). WL6 and WL7 have characteristics that indicate they could contribute to water quality improvement however there is no evidence of excess nutrient loading or contamination input.

These wetlands provide habitat for wildlife; evidence of deer, grouse and leopard frogs was observed during field surveys. No fish were observed, however, and these wetlands do not appear to support fish habitat. There were no SOCI recorded in the wetland.

Wetland WL8

WL8 is 0.04 ha and is located along the northern edge of the Study Area but outside of the Proposed Extension Area (Figure 5.1). This wetland is a treed swamp and shows evidence of temporary flooding and seasonal saturation. There was no evidence of past disturbance in this wetland. WL8 has a naturally sourced surface water inflow and outlet. The wetland fringes a stream that is less than 4 m wide and has the ability to alter flow in its meandering channel. WL8 is considered a groundwater discharge site in its upper end and a recharge site at its downgradient end. WL8 is able to detain surface water, with a water storage depth of 0.15 – 0.30 m. Surface water retention is evidenced by standing water (0.10 m), water stained leaves and debris, water marks at 0.15 m, pit and mound topography and buttressed trunks. The wetland displays characteristics to improve water quality and does not appear to have excess nutrient loading/contamination inputs. WL8 may contribute to downstream water quality improvement.

Adjacent land is primarily forested; however this wetland is in close proximity (less than 10 m) of Highway 2. There is minor alteration to wetland hydrology due to ditching along these roads. The naturalized buffer is, on average, greater than 20 m wide. Slopes in adjacent land are mostly gentle with some moderately steep slopes, and upland soils are silt and loam. The surrounding land supports water quality functions and wildlife habitat.

WL8 is characterized by a moderately dense canopy of red maple and balsam fir with some white spruce and trembling aspen. The shrub understory consists largely of speckled alder, balsam fir and white meadowsweet. Ground vegetation species are fowl manna-grass, sensitive fern and spotted jewelweed with some amounts of hairy flat-top white aster, Canada goldenrod, and sphagnum moss. Although fish were not observed during field surveys, WL8 has the potential to support fish habitat (see Section 5.2, Fish and Fish Habitat). The wetland also provides habitat for other wildlife including amphibians and mammals, such as deer. WL8 does not appear to have any community use.

Wetland WL9

WL9 is located in the eastern end of the Study Area but outside of the Proposed Extension Area (Figure 5.1). WL9 is 0.07ha and is classified as a shrub swamp of natural origin, with a water regime consisting of temporary flooding and seasonal saturation. Upland is forested and there are minor stressors to the wetland, including a small logging road adjacent to the wetland.

WL9 is geographically isolated, has a natural water source and has a moderate capacity to detain surface water. Standing water was 0.05 m deep where present at the time of field surveys and other signs of surface water retention include water stained leaves, pit and mound topography and buttressed trunks. Disturbance of wetland soils is low, and soils in the adjacent area consist of silt/loam. WL9 is classified as a discharge site (likely small discharges or water table at or near surface).

This wetland is classified as WD5 according to FEC, which is an uncommon vegetation type in Nova Scotia (Neily *et al.* 2011). Trembling aspen and red maple are most abundant, with lesser amounts of white spruce and balsam fir. Shrub understory consists mostly of speckled alder and common winterberry with some white meadowsweet, balsam fir and white ash. Dwarf red raspberry, sensitive fern, fringed sedge, bristly-stalk sedge, fowl manna-grass, and sphagnum moss form the ground vegetation layer.

SOCI are found within this wetland. Two small black ash (DBH=10 cm and 5 cm) were found in this wetland. Black ash is listed as Threatened under the Nova Scotia *Endangered Species Act*. Mature black ash is very rare in Nova Scotia. Alder-leaved buckthorn is a low shrub generally found in swamps receiving calcareous seepage. NSDNR lists alder-leaved buckthorm as Sensitive, while ACCDC categorizes it as uncommon (S3). One patch of alder-leaved buckthorn was found in the wetland.

WL9 also provides habitat for amphibians and mammals, but does not support fish or fish habitat. Wildlife SOCI found associated with the wetland include the eastern wood-pewee, the golden-crowned kinglet and the Canada warbler. There was no evidence of community use or value of this wetland.

Wetland WL10

WL10 is the largest wetland near the eastern boundary the Study Area, including a portion within the Proposed Extension Area (Figure 5.1). It is classified as a naturally developed complex of freshwater marsh (85%) and tall shrub swamp (15%). The wetland is 6.98 ha and has an outlet and an inlet, through which water enters from a natural source that may have some human influence.

Roughly 60% of wetland area is seasonally saturated while another10% is permanently saturated. Approximately 20% of the wetland area is seasonally flooded, while another10% is permanently flooded. Signs of surface water retention and detention include standing water (depth up to 1 m), water-stained leaves and debris, water marks (0.20 m), silt deposits (0.30 m), algae, pit and mound topography, aquatic invertebrates, buttressed trunks, adventitious roots, and a watermark at the culvert inflow (0.20 m). Stormwater runoff is filtered through dense hummocks of grass and shrubs before entering the wetland, where it is held. Soils adjacent to the wetland are primarily clay and bedrock, and there is moderate potential for sediment input from surrounding land. The wetland exhibits substantial flood/stormwater attenuation as constrictions (culverts and debris) on the watercourse outflow from the wetland impounds water and floods in the upper wetland areas. The wetland is largely undisturbed. There is moderate evidence of nutrient loading due to the presence of algae. WL10 has characteristics that would contribute to downstream water quality improvement. Fish were observed during field surveys (see Section 5.2, Fish and Fish Habitat).

According to the Forest Ecosystem Classification for Nova Scotia, WL10 is vegetation type WD5, which is uncommon in Nova Scotia. WD5 is characterized by a canopy of trembling aspen and red maple with some white spruce and balsam fir. The shrub understory contains speckled alder

and common winterberry with lesser amounts of white meadowsweet, balsam fir and white ash. Ground vegetation includes dwarf red raspberry, sensitive fern, fringed sedge, bristly-stalk sedge, fowl manna-grass, and sphagnum moss.

SOCI in WL10 include alder-leaved buckthorn, swamp rose, Gmelin's water buttercup, and northern dewberry. Thirteen patches of alder-leaved buckthorn were found in this wetland. This species is listed as uncommon (S3) by ACCDC and sensitive by NSDNR. ACCDC ranks Gmelin's water buttercup as uncommon (S3) while swamp rose is ranked as uncommon to fairly common (S3S4), but both are considered by NSDNR to have Secure populations in Nova Scotia. Northern dewberry was also found in WL10. This species is ranked as possibly very rare (S1?) by ACCDC and is listed as Status Undetermined by NSDNR.

The wetland provides habitat for a variety of animals including deer, raccoons, muskrat, snake, frogs (leopard and green), pheasant, grouse and porcupine. Because the wetland is connected to permanent water, it rates high for supporting fish habitat, and provides habitat for a number of water birds. WL10 supports potentially suitable habitat for a number of SOCI. The four-toed salamander has an ACCDC ranking of S3, which means it is uncommon in Nova Scotia and the salamander's preferred habitat is wetlands (swamps and bogs) containing sphagnum moss. The Canada Warbler, which is ranked as *threatene*d on Schedule 1 of SARA and has recently been designated as *endangered* under the Nova Scotia ESA was found in association with WL10. The eastern wood-pewee was also identified near this wetland, and is rates as *vulnerable* under the Nova Scotia ESA.

This wetland has high community use potential, although it is unknown whether it is used. WL10 is surrounded by a greenbelt and has public access, supporting opportunities for wildlife viewing and exploration. It is a classically aesthetic wetland, visible from several easily accessed vantage points.

Summary

Table 5.10 provides a summary of the wetland and functions in the Study Area. There are no wetlands greater than two hectares that will be affected by this Project.

Table 5.10 Summary of Wetlands and Functions in the Study Area

Wetland ID	Classification	Functions Identified	Size (ha)
WL1	Forested swamp	• supports wildlife habitat • groundwater recharge	0.243
WL2	Tall shrub swamp	• surface water detention • uncommon vegetation type • supports wildlife habitat	0.388
WL3	Complex: 90% Shrub swamp 10% Forested swamp	• stormwater management • water quality improvement • groundwater recharge • supports wildlife habitat	0.800

Table 5.10 Summary of Wetlands and Functions in the Study Area

Wetland ID	Classification	Functions Identified	Size (ha)
WL4	Complex: Treed swamp/Alder thicket	• surface water retention • supports wildlife habitat	0.306
WL5*	Freshwater marsh	• Critical Functions o SOCI-short-awned foxtail found around margin of wetland o SOCI-snapping turtle and eastern kingbird found in association with this wetland • moderate community use value	0.077
WL6*	Treed swamp	• water quality improvement • stormwater management • surface water retention • supports wildlife habitat	0.068
WL7*	Treed swamp	• water quality improvement • stormwater management • surface water retention • supports wildlife habitat	0.035
WL8*	Treed swamp	• water quality improvement • stormwater management • supports fish and wildlife habitat	0.040
WL9*	Shrub swamp	• surface water retention • uncommon vegetation type • Critical Functions o SOCI-black ash, alder-leaved buckthorn found within wetland o SOCI-eastern wood-pewee, golden-crowned kinglet, Canada warbler	0.067
WL10	Complex: 85% Forested swamp 15% Tall shrub swamp	• Critical Functions o water quality improvement o supports fish o SOCI-potential habitat for four-toed salamander, Canada warbler, and eastern wood-pewee o uncommon vegetation type o SOCI include alder-leaved buckthorn, swamp rose, Gmelin's water buttercup, northern dewberry • stormwater management • surface water retention • community use	6.974
		Total	**9.0 ha**

*Found within field work Study Area but located not within footprint of the Project Extension Area. WL 10 is partially within the section of Proposed Extension Area; but this portion will be the Ecological Buffer Zone

5.4.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

The Environmental Assessment Regulations under the *Environment Act* require that projects causing alterations to a total of two or more hectares of any wetland must undergo an environmental assessment. There are no wetlands greater than two hectares that will be affected by this Project.

Also under the *Environment Act, t*he Activities Designation Regulations include a requirement for an approval from NSE before any alteration of a wetland. The Wetland Conservation Policy clarifies this approval process, providing details on the studies and documentation required to support an application, as well as exceptions from the approval process, priorities and tools for wetland conservation (*e.g.,* the mitigative sequence), and requirements to offset unavoidable wetland alterations to achieve no net loss of wetlands in the province.

The mitigative sequence for decision making is the foundation for achieving wetland conservation in Nova Scotia, as described in the Wetland Conservation Policy. The sequence – avoidance, minimization, compensation – assists proponents in planning and designing project proposals that will not result in a net loss of wetland. "Avoidance" is the priority, and requires consideration of project alternatives that would have less adverse effect on the wetland. "Minimization" requires that the Project be designed and implemented using techniques, materials and site locations that reduce or remediate the Project effects on the wetland. "Compensation" requires that the residual effects on the wetland functions are compensated for by the enhancement, restoration or creation of wetland ecosystem at an area ratio commensurate with the loss.

Avoidance and Minimization

Wetlands may be directly and indirectly affected by the Project. As the mine advances, vegetation, soils and surficial materials will be removed from the surface of the gypsum bedrock. Wetlands that are present within the area of future extension will be completely removed (Table 5.11). It is not feasible to mine gypsum deposits without stripping the vegetation, soils and surficial soils from the surface, and Project objectives could not be achieved if gypsum deposits beneath all wetlands delineated on site were left in place. Complete avoidance of wetlands on site is not possible.

Table 5.11 Summary of Wetland Alteration and Conservation

Wetland ID	Critical Functions Identified	Total Wetland Area (ha) *includes wetland area outside of Study Area	Wetland Area in Study Area (ha) *also referred to as original extension area	Area within Ecological Buffer Zone (ha)	Area Proposed for Alteration (ha)
WL1		0.24	0.24	-	0.24
WL2		0.39	0.39	-	0.39
WL3		0.80	0.56	-	0.80 (0.56 directly and 0.24 indirectly)
WL4		0.31	0.31	-	0.31
WL5	Yes	0.08	0.08	0.08	-
WL6		0.07	0.07	0.07	-
WL7		0.04	0.04	0.04	-
WL8		0.04	0.00	-	-
WL9	Yes	0.07	0.07	0.07	-
WL10	Yes	6.97	5.05	5.05	-
Grand Total		**9.00**	**6.79**	**5.30**	**1.74**

Evaluation of the functions performed by wetlands in the Project Area revealed that there are wetlands providing habitat for SOCI on site (WL5, WL9 and WL10), which is considered a critical function by NSE. Wetlands with critical functions are a priority for conservation because replacement or compensation for loss of this critical function may be difficult or impossible to achieve, and the function will be lost to the detriment of the environment or watershed. As a result of this finding, the original extension area (Study Area) was reduced to the current footprint. In addition, an Ecological Buffer Zone has been identified (Figure 5.1). The mine will not expand into this area, which includes six of the ten wetlands identified on site (WL4, WL6, WL7, WL8, WL9, WL10). This will reduce the total area of wetland habitat loss as a result of the Project from 9.00 ha (*i.e.*, wetland area delineated in the Study Area) to 1.74 ha, with all on-site wetlands of significant value (providing critical functions) preserved (Table 5.5).

The wetlands that will be completely altered are WL1, WL2 and WL4. A portion (0.56 ha) of WL3 will be altered directly and due to the proximity of the mine activities, it is expected that the remaining portion (0.24 ha) will be altered indirectly by the resulting change to its hydrology. Of the affected wetlands, WL2 and WL4 are considered marginal in character; they meet the minimum definition of a wetland but have the character of non-wetland ecosystems. These wetlands are not associated with any valued functions that are associated particularly with wetlands and not provided by the surrounding upland areas. The vegetation community found in WL2 (Balsam fir – White ash / Cinnamon fern – New York fern / Sphagnum) is, however, considered to be uncommon in Nova Scotia (NSDNR 2010). WL1 and WL3 are present on ephemeral seepage tracts and are attributed the potential for providing water management and water quality improvement functions but their source waters are natural and

uncontaminated by sediment or nutrients. There is evidence that WL1 contributes to groundwater, which is considered a critical function. The shallow groundwater flow path from WL1 is towards the open pit of the mine and is therefore considered not critical in this case.

The Ecological Buffer Zone provides a buffer of 100 m between the preserved wetlands and the maximum extent of vegetation, soil and till removal for gypsum mining. Other mine-related activities in this region will be limited to further protect wetlands from indirect effects:

- there will be no machinery, vegetation removal or soil disturbance within 30 m of a wetland in this area;
- maintenance of natural flow paths to existing wetlands will be a priority for all types of permanent and temporary developments in the Ecological Buffer Zone; and
- an erosion prevention and sediment control plan will be designed and implemented for any surface disturbance required within or near the Ecological Buffer Zone.

The groundwater levels in the surficial aquifer may be at or near surface and supplying water to some wetlands within the Ecological Buffer Zone. Wetland assessments suggest that WL4, WL8, WL9, and WL10 are sustained in part by shallow groundwater inputs. WL6 and WL7 are sustained primarily by surface runoff from the immediate capture zone. As the mine advances and surficial materials are removed, the gradient for groundwater flow from the surficial materials into the mine will likely increase. This could reduce the groundwater flow reaching these wetlands, thereby drawing water levels down in affected systems. The likelihood of this effect is considered low because of the low hydraulic conductivity of the till (see Section 5.5 Groundwater Resources); the volumes of water coming from off-site along watercourse 1; the dominance of other sources of water to these wetlands from channel flow and runoff; and the distance between wetlands and the furthest extent of the mine (100m).

To confirm that surficial groundwater drawdown is not occurring in the Ecological Buffer Zone it is recommended that a monitoring plan be designed and implemented. In general, this plan will include three multi-level monitoring wells constructed in the surficial materials between the advancing mine and the wetlands. If a trend of water level decline is observed in wells positioned between the advancing mine and the wetlands, mitigative action can be implemented prior to observing effects in the wetlands. Mitigative action may include redirection of surface flow to infiltration galleries upgradient of wetlands that may be affected; adjusting flows at the downgradient end of WL10 to maintain water levels in WL10; or directing discharge from dewatering sumps to the infiltration galleries upgradient of wetlands that may be affected.

Long term monitoring is proposed in wetlands in the Ecological Buffer Zone to confirm the effectiveness of mitigation. Several consecutive years of baseline hydrological and ecological data can be used as a basis for change monitoring in later years. Recommended baseline monitoring (years 1, 2 and 3) includes:

- inventory of ground vegetation and shrub species coverage in semi-permanent 1m vegetation quadrats along a transect from the wetland edge to the wetland center. A second transect is recommended perpendicular to this transect, intersecting nearest the centre of the wetland. The number of transects and the number of quadrats on the transect will depend on the wetland size and complexity of community types;

- point count and trunk diameter of tree species within 2 m of each transect; and

- installation of piezometers (hand-installed stand-pipe perforated to allow inflow from the upper 0.30 m of wetland soils or to capture the free water surface in wetlands with permanent pools) instrumented with water level loggers to monitor water level fluctuation from May 1 to September 30 of each year. One piezometer is sufficient in each wetland, with the exception of WL10, which due to the size, should have three.

After the three year baseline study, baseline conditions should be confirmed on a 5 year frequency to capture natural change. The frequency should be re-evaluated if groundwater monitoring in wells constructed in the surficial aquifer indicate a declining trend in water levels; if the mine advances within 100 m of the Ecological Buffer Zone; or if ground disturbance activities are required in the Ecological Buffer Zone (*e.g.*, road construction).

Compensation

The Project is expected to result in a permanent loss of 1.74 ha of wetland habitat on site. Wetland alterations require prior approval by Nova Scotia Environment and the proponent is obligated to offset approved alterations by restoring, creating or enhancing wetland habitat at another location (*i.e.*, compensation). The required area for compensation of wetland alteration depends on the type of compensation being completed. For example, a wetland restoration project is considered high value and to have a high certainty for success and would require a low area ratio to alterations to meet offset obligations (*e.g.*, 2:1). Creating wetland habitat in an area that was previously upland is considered to have a low certainty for success and lower value than a natural system and would require a higher area ratio to alterations to meet offset obligations (*e.g.,* 10:1). Approvals will be sought in advance for any wetland alterations required for this Project. During this approval process, NGC will plan and implement compensation to offset wetland losses such that the Project will result in no net loss of wetland.

Monitoring and Follow-up

Refer to monitoring discussed above in the "Avoidance and Minimization" section.

Summary

In summary, assuming the application of proposed mitigation measures, including avoidance and reduction of both direct and indirect influences by employing the Ecological Buffer Zone, wetland buffers and maintaining existing site drainage conditions, monitoring to confirm effectiveness of mitigation, as well as providing compensation for loss of wetland functions

where effects are unavoidable, significant Project-related effects on wetland function are not likely to occur.

5.5 GROUNDWATER RESOURCES

Groundwater is considered a VC for the assessment of effects from mine extension because of the importance to local ecosystems (*e.g.*, wetlands and watercourses) and as a local public and private potable water supply. Groundwater is an integral component of the hydrologic cycle that originates from the infiltration of precipitation or surface water into the ground. This infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures and other void spaces which have developed in consolidated materials. Within the sub-surface, the upper surface of the saturated zone is called the water table. Where the water table intersects the ground surface, interaction between groundwater and surface water can occur. In general, groundwater flows through soil, glacial overburden and bedrock from areas of high elevation (recharge areas) to areas of low elevation (discharge areas) where it discharges from the sub-surface to springs, streams, and lakes. There is a dynamic interaction between groundwater resources and surface water resources in Nova Scotia. Groundwater generally sustains the base flow of streams and certain wetlands during dry periods of the year. More rarely, surface water bodies can contribute to groundwater storage under certain hydrogeological conditions.

An aquifer is a geological formation or group of formations that can store or yield useable volumes of groundwater to wells or springs. The yield of dug or drilled water wells can vary greatly, depending on the hydraulic properties of overburden or bedrock aquifers into which the wells are constructed. Within an aquifer, the natural groundwater quality is directly influenced by the geochemical composition of the sub-surface materials through which the water passes, and the time the water resides within those materials.

5.5.1 Existing Conditions for Groundwater Resources

Physiography and Drainage

The Study Area is irregular in shape extending northeast from the existing mine footprint. The Study Area lies immediately northeast of the existing mine. Figure 5.1 shows the present and Study Area along with local topography, watercourses, wetlands, water bodies, roads and dwellings.

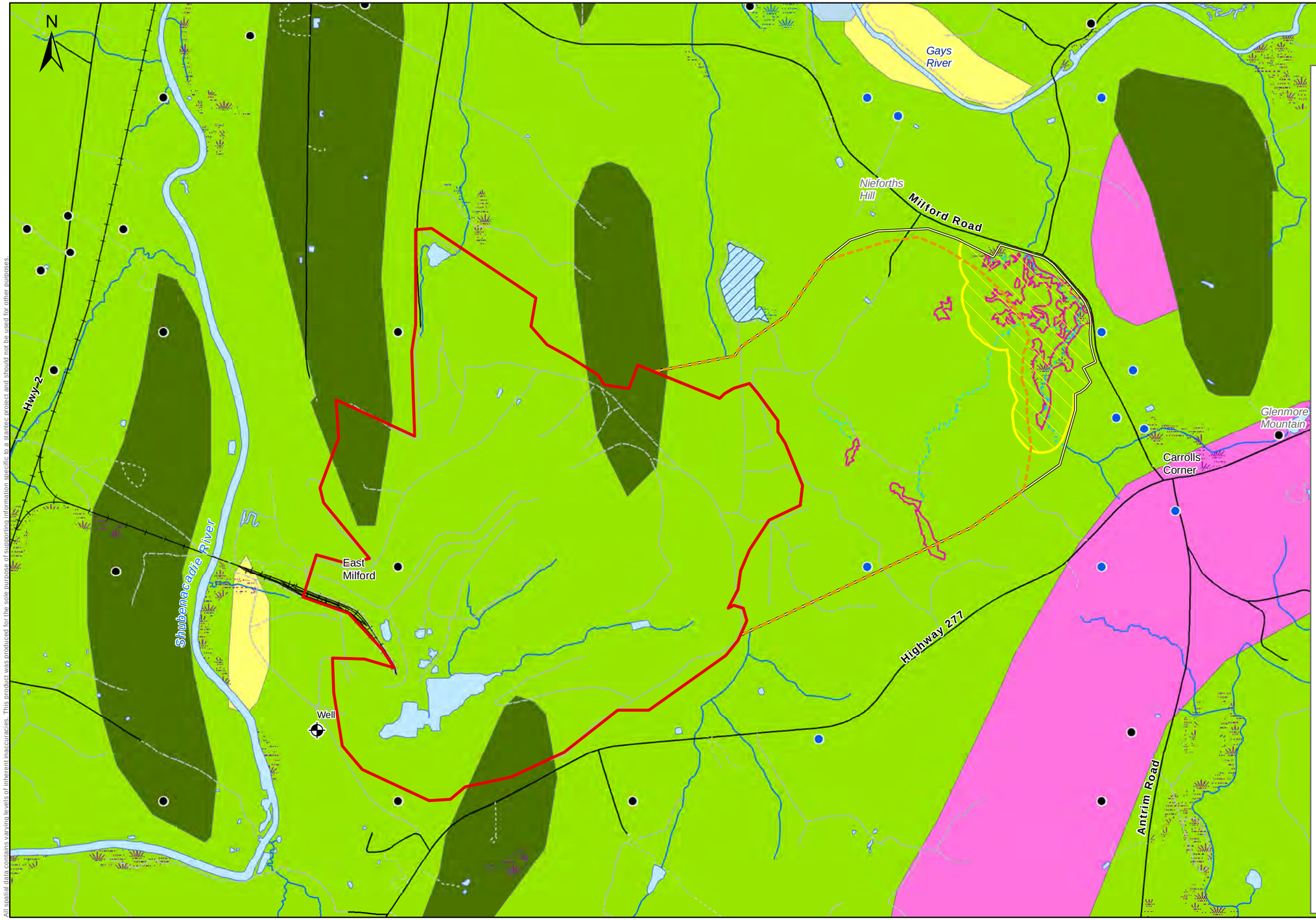
The existing mine is situated in the secondary watershed of the Shubenacadie River (area 2,500 km^2) and the primary watershed of the Shubenacadie/Stewiacke Rivers. The Shubenacadie River is tidally influenced for over 35 km from a tributary located on the east side of the mine to the sea, and forms a defined channel west of the mine. Inferred regional groundwater flow is towards the Shubenacadie River, northwest from the Proposed Extension Area. The existing mine is separated from the Shubenacadie River by roads and overburden storage areas at the western and to northern extents of the mine.

The Study Area encompassed two mapped watercourses, one anthropogenic pond and multiple wetlands. As discussed in Section 5.1, it was determined that one watercourse (Big Pond Brook) had been previously diverted under Approval (Appendix A) from NSE and now flows into the mine's surface water collection system. For the purpose of this EA this would no longer be considered a watercourse. While conducting these assessments, four additional dry drainage channels were identified. These features are identified on Figure 5.1 as WC-1, Pond-1and DC-2 through DC-5.

The topography rises over 70 m above mean sea level in the central portion of the site and then slopes to the west towards the natural course of Big Pond Brook and east towards a series of wetlands associated with the eastern watercourse (WC-1). Based on available topographic mapping for the areas, the ground surface elevation in the Study Area ranges from less than 15 m to over 70 m above mean sea level. Regionally, the land slopes from over 90 m above mean sea level a kilometer southeast of the mine to less than 10 m above mean sea level at the Shubenacadie River west of the mine. This southeast to west topographic slope is also the inferred regional groundwater flow direction. The existing mine has been excavated to a maximum depth of 55 m below mean sea level. Drainage entering the mine from overland runoff or from groundwater seepage is collected in perimeter drains and ditching and conveyed to one of the three main sumps, where it is collected and pumped to the Shubenacadie River down-stream of the mine.

Surficial Geology

The surficial geology of the Study Area (Figure 5.4) reflects several periods of glaciation. The oldest deposits are lignite-bearing black clays typically found on the gypsum bedrock. These deposits are Cretaceous in age, and are found throughout the Hants Lowlands in bedrock depressions protected from later periods of glacial scouring. Similarly, gypsiferous tills and the Miller Creek Till have been protected in the karst channels and bedrock sinkholes on site. These rubble tills were laid in the Pleistocene epoch during a major ice advance across the province, and are often found beneath younger peat and wood deposits, indicating a long and warm interglacial period followed the Pleistocene ice advance in the region. It was during this interglacial (Sangamon) that a mastodon was trapped in mud in a karst sinkhole on site at the existing mine and preserved (Grantham and Kozera-Gillis 1992); it was unearthed in 1991-1992.



PREPARED BY: C Shupe	National Gypsum Mine Extension
REVIEWED BY: M Huskins-Shupe	**Surficial Geology**
CLIENT: National Gypsum (CANADA) LTD.	FIGURE NO.: 5.4
	DATE: Nov 06, 2014
	Stantec

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Deposits and glacial re-working of the East Milford Till defines the present topography of the region. The East Milford Till is Early to Middle Wisconsinan in age and formed during the Caledonia ice advance (75-40 Ka; Stea *et al.* 1992). These tills are typically 10 to 20 m in thickness in the Study Area and are characterized by well mixed reddish silty sands with gravel and cobbles. In some areas, thin sand layers are present in this till and these have been encountered during mining activities (reported in Jacques Whitford 1999). Sand and gravel deposits are thought to be associated with the low-flank of drumlins in the area, which are comprised of East Milford Till (reported in Matheson 1999). Two drumlins shaped by south-flowing glaciers during the Escuminac ice advance are present north and northwest of the existing mine footprint (Stea and Kennedy 1998). The East Milford Tills underlie fine sand and laminated lacustrine clays in several areas, deposited during the preceding interglacial (Stea *et al.* 1992; Stea and Kennedy 1998).

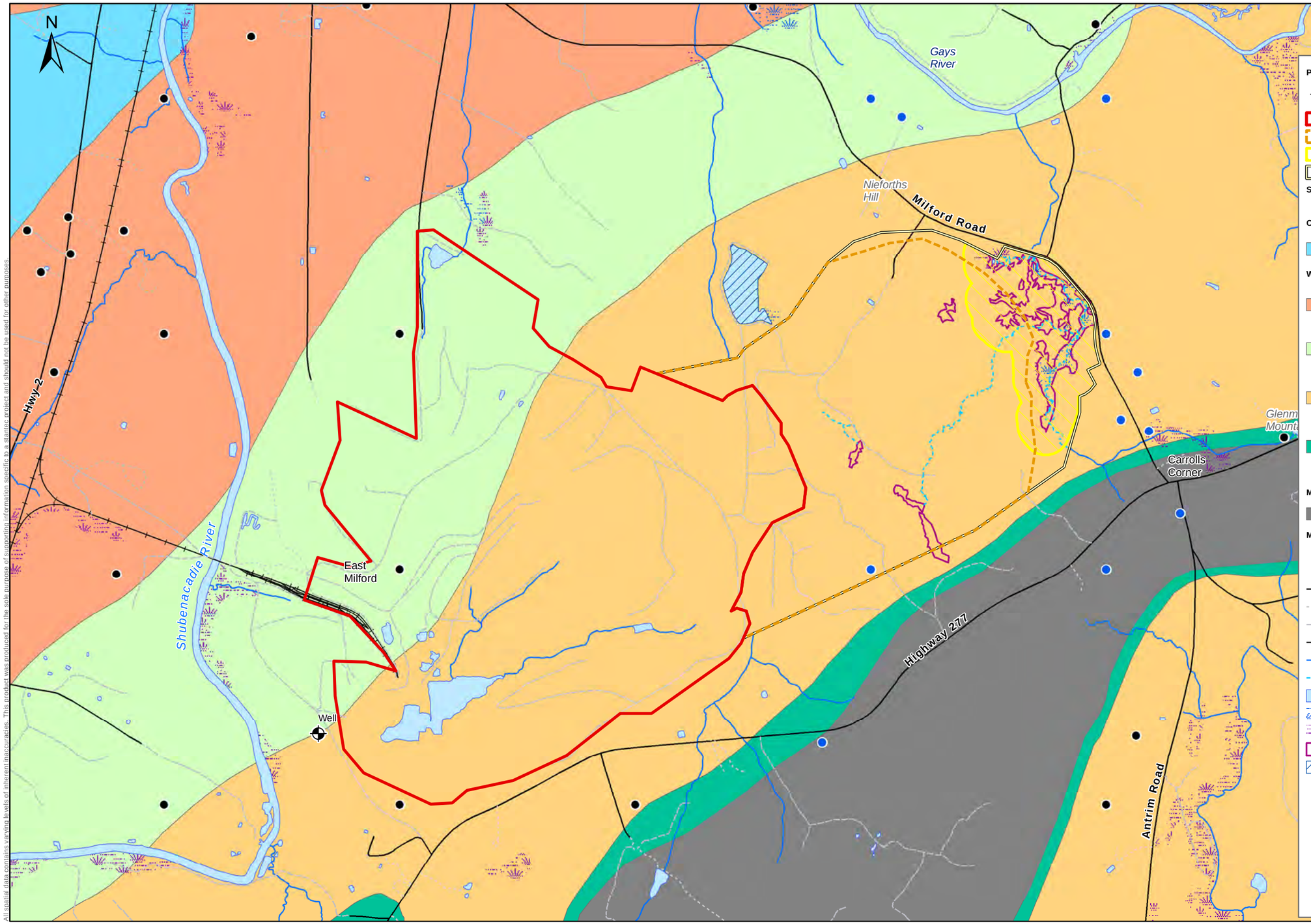
Hants Till is present at surface in the Study Area and was deposited during the southern Escuminac ice advance across the province (Middle Wisconsinan age). This till is more gravel rich than the underlying East Milford Till but otherwise of similar composition.

Glaciolacustrine clays, silts and sands are present in the eastern extent of the Study Areaunderlying organic soils associated with wetlands in the current floodplain of the eastern watercourse (WC-1) (Stea and Kennedy 1998).

Bedrock Geology

The bedrock geology of the Study Area (Figure 5.5) is comprised of Early Carboniferous aged sedimentary deposits of the Windsor Group (Keppie 2000). The mine is developed in gypsum and anhydrite of the Carrolls Corner and MacDonald Road Formations of the Lower Windsor Group (Giles and Boehner 1982). Deposits range from 50 to 90 m in vertical thickness, increasing to the north (Jacques Whitford 1999). The interbedding of clastics and carbonates is contorted, and a zone of extreme bedding disruption divides the existing mine. Mined gypsum deposits south of this divide are found to be harder and of higher purity compared to deposits to the north. Giles and Boehner (1982) and Figure 5.5 indicate it is in the middle Windsor; most of the mine is south of the contorted bedrock contact.

The gypsum deposits overlie deep (up to 300 m) deposits of anhydrite, which are exposed in areas of the mine floor (Adams 1991). It is thought that rehydration of anhydrite deposits during a subsequent oceanic transgression is the source of the rich Lower Windsor gypsum deposits (Giles 1981). The anhydrite is underlain by thin basal carbonates of the Gays River Formation.



Project Components

- On-site Monitoring Well Location
- Current Footprint of National Gypsum Mine
- Proposed Extension Area
- Ecological Buffer Zone
- Study Area

Study Features (Bedrock Geology)

Early Carboniferous

CANSO GROUP

- Watering Brook Formation : grey mudstone and shale with intercalated gypsum, anhydrite and halite; evaporites most abundant in lower part of formation (ECWB)

WINDSOR GROUP

- Green Oaks Formation : maroon to reddish brown siltstone and fine grained sandstone, with intercalated marine limestone and dolostone; with associated anhydrite or gypsum in the Shubenacadie Basin (ECGO)
- MacDonald Road Formation : gypsum, anhydrite and minor halite, with interbeds of grey and maroon siltstone and sheet-like carbonate members; cyclic repetition of these rock units is characteristic (ECMR)
- Carrolls Corner Formation : anhydrite, gypsum, with minor dolostone and mudstone in thin beds; includes undifferentiated shale and mudstone breccia with minor gypsum and anhydrite in proximity to the faulted northern margin of the Shubenacadie Basin (ECCC)
- Gays River Formation : dolostone, minor limestone, thinly bedded, argillaceous and bituminous, locally thickly bedded and highly fossiliferous in mound-shaped deposits resting upon pre-Carboniferous rocks (ECGR)

Cambrian-Ordovician

MEGUMA GROUP

- Halifax and Goldenville Formations : Halifax and Goldenville Formations: slate, meta-siltstone, meta-greywacke (COM)

Map Features

- Domestic Well (withim 800m of Project Extension Area)
- Domestic Well (greater than 800m from Project Extension Area)
- Road
- Private Lane or Restricted Road
- Seasonal Road, Track or Trail
- Railway
- Watercourse *
- Watercourse / Drainage Ditch (Stantec Delineated)
- Waterbody
- Wetland (NSGC)
- Wetlands (NSDNR)
- Wetland (Stantec Delineated)
- Anthropogenic Waterbody

SOURCE:
Bedrock Geology: Department of Natural Resources (NSDNR), Bedrock Geology Map of Nova Scotia. Map ME 2000-1.
Base Data: Nova Scotia Geomatics Centre, Nova Scotia Topographic Database (NSTDB) unless otherwise noted.
Well Data: NSDNR, Nova Scotia Well Logs Database
*Note: NSTDB Watercourse data modified within Project Area as per Stantec field observations

ST NS-121511228-009

0 200 400 600 800
Distance in Metres

PREPARED BY: C Shupe REVIEWED BY: M Huskins-Shupe CLIENT: National Gypsum (CANADA) LTD.	National Gypsum Mine Extension **Bedrock Geology**	FIGURE NO.: 5.5 DATE: Nov 06, 2014 Stantec

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Rock Quality Designation (RQD) is the sum of all core fragments exceeding 100 mm (4") in length, divided by the core recovery, presented in percent. Low RQD values are generally indicative of a low degree of bedrock fracturing. Jacques Whitford (1999) conducted a review of borehole records for exploration holes located between the advancing west high wall of the mine and Shubenacadie River supplied by NGC, but found no RQD data (no fragments). Core returns ranged from 10 to 100%, averaging 95%. This observation infers relatively "massive" gypsum bedrock or a low degree of significant fracturing and associated permeability.

Karst landscape features are observed in the area. Sinkholes and hummocky topography are observed at surface and variable water levels and high heterogeneity in borehole water level recoveries indicate subterranean karst may be present (Jacques Whitford 1989, as referenced in Jacques Whitford 1999). Bedrock sinkhole structures filled with Wisconsinan clay have been recorded on site; most notable is the sinkhole which protected mastodon remains (Grantham and Kozera-Gillis 1992).

Approximately five kilometers south of the Proposed Extension Area, rocks of the Goldenville Group underlie surficial materials at the Cooks Brook Syncline (White and Goodwin 2011; Giles and Boehner 1982).

Hydrogeology/Groundwater

Hydrogeology in the vicinity of the Study Area is characterized primarily through interpretation of well construction, chemistry and pumping test data available in the Nova Scotia Well Log Database (NS WLD; Kennedy and Fisher 2013) and the Nova Scotia Interactive Groundwater Map (NSDNR 2012); the National Gypsum Preliminary Hydrogeological Assessment (Jacques Whitford 1999); on-site well monitoring reports (most recently, Stantec 2010); and previous studies in the regional aquifer (*e.g.*, Matheson 1999; Kennedy 2014; Kennedy and Drage 2009). The following description of existing conditions includes groundwater flow and quantity followed by a summary of what is known about groundwater chemistry in the Proposed Extension Area.

Quantity and Flows

The glacial tills on site have a high silt and clay content. This material is associated with low hydraulic conductivity (k) in the order of 10^{-5} to 10^{-7} cm/s (Jacques Whitford 1999). Low hydraulic conductivity would result in low rates of groundwater infiltration and high potential for surface water retention (and wetland formation where drainage is poor).

Surficial aquifers have been mapped in the region (Kennedy 2014; Matheson 1999). These aquifers are generally characterized as saturated sand and gravel deposits of moderate to high permeability; the poorly permeable silty glacial tills are not considered to be viable aquifers. Surficial aquifers are associated with higher well yields and lower concentrations of trace metals, hardness and total dissolved solids compared with Nova Scotia's bedrock aquifers (Kennedy and Drage 2009) and are therefore considered high potential groundwater supplies. The nearest mapped surficial aquifer is located approximately one kilometer north of the active mine (SA-65; Kennedy 2014). Further north, the Shubenacadie-Milford Aquifer Complex (SMAC) is comprised

of shallow (precipitation recharged) and confined (regionally recharged) aquifers units (Matheson 1999). The distance to these aquifers and what is kn0wn about the source of groundwater to these areas suggests that they are sufficiently disconnected hydrologically from the mine to infer that they would be unaffected by mine activities.

Mine operations staff have reported the presence of a minor sand seam in the overburden. When encountered, the material is reported to dewater quickly and the seam does not seep continuously (Jacques Whitford 1999). This suggests that this sand layer is discontinuous and does not have sufficient thickness or volume to be considered a regional surficial aquifer.

The province's aquifers have been divided into five main groundwater regions based on similarities in various hydrogeological properties (Kennedy and Drage 2009). The existing mine is located in the carbonate/evaporite groundwater region (Kennedy and Drage 2008). Though not as high as aquifers within the surficial or sedimentary groundwater regions, aquifers in the carbonate/evaporite region can locally have higher yield, specific capacity and apparent transmissivity compared to aquifers in the three crystalline groundwater regions. This results from a higher frequency of fracture and dissolution channel flow in the soft, soluble rocks compared to crystalline rocks.

On-site, the carbonate/evaporite rock is massive with very little apparent fracturing and may not be representative of the average aquifer in this groundwater region. Records of boreholes drilled on site indicate that the formation is "tight" with very little fracturing (Jacques Whitford 1999). This observation is supported by Rock Quality Designation (RQD) tests and packer injection testing of boreholes on the west side of the mine with core returns averaging 95% on site, indicating a very low degree of significant fracturing (and associated permeability) (as reported in Jacques Whitford 1999).

A piezometer pair consisting of a shallow overburden well and a deep bedrock well was constructed in April 2000 at the western extent of the mine site, between the mine and the Shubenacadie River ('Well' identified in Figure 5.5). Well construction details are summarized in Table 5.12. Water levels in these wells have been recorded monthly since 2001, with some exceptions, and slug and bail tests have been intermittently performed. Well stratigraphy and testing confirms the massive nature and low hydraulic conductivity of the bedrock (Jacques Whitford 2010). A hydrograph of water levels from April 2000 to December 2014 in the deep and shallow wells is presented in Figure 5.6. It is evident that the formation at the location of the wells is highly impermeable as the water levels have still not recovered to the levels measured before the slug test in 2005. Groundwater levels in the overburden well have been stable throughout the monitoring period with no evident trends. General observations from this long term monitoring in the bedrock well are:

- Prior to the spring of 2005, the water table elevation was observed to decline approximately 7 mm per year;

- Following the introduction of water into the borehole in the spring of 2005 (slug test), and a bail down hydraulic response test performed on June 16, 2005, water levels resumed a slow decline of about 5.8 mm/year;

- Water levels stabilized between May 2006 and May 2007 at approximately 26.1 m elevation, with minor seasonal water level fluctuations of 0.52 m;

- An unexplained gradual rise in water levels by approximately 2 m occurred between May 2007 and April 2008, again followed by a consistent slow water level decline of 2.5 mm/year to May 2010;

- Static water levels in the bedrock well (24.2 m) continue to remain well above the elevation of the Shubenacadie River west of the well (approximately 7.6 m above sea level) and the mine floor (-49 m above sea level at the time of monitoring);

- The source of recharge is assumed to be from the overlying till; and

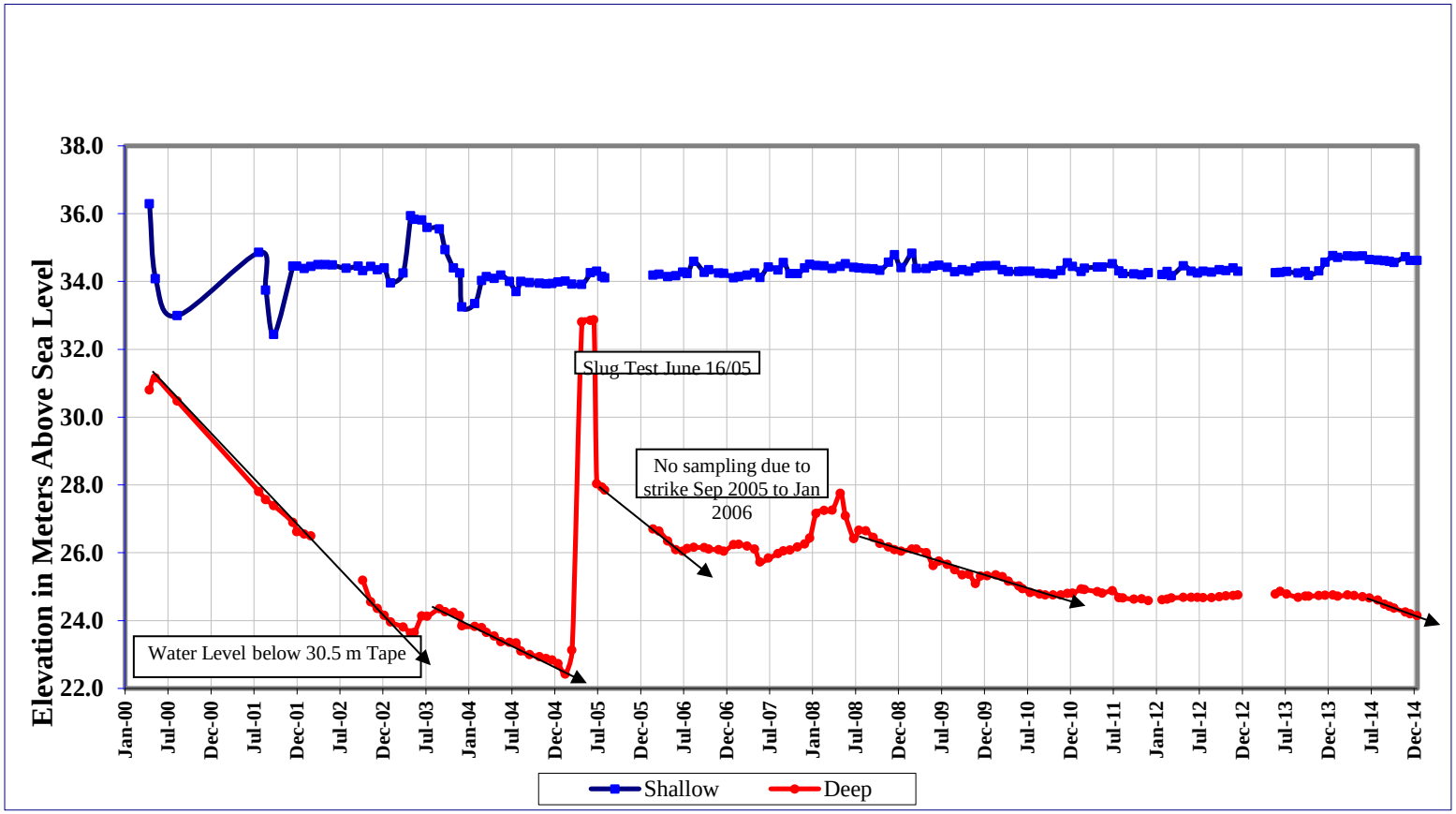
- There has been an increasing downward vertical hydraulic gradient from the overburden to the bedrock aquifers at this location (last reported at 15.3%; Stantec 2014).

Table 5.12 On-Site Monitor Well Construction Details (Apr. 2000 to Jan. 2014)

Well number	Unit	Depth (m)	Screened interval (m btoc)	Average groundwater level (m btoc)	Groundwater level range (mbtoc)	Estimated k (cm/s) [1]
BH-00-1S	Silty sand till	25.9	15.2 to 25.9	22.48	20.86 – 24.71	10^{-7} to 10^{-5}
BH-00-1D	Gypsum bedrock	106.7	61.0 to 106.7	32.59	24.28* – 34.73	10^{-11} to 10^{-6} (unfractured anhydrite)

Notes:
m btoc = meters below top of casing
*recorded during a slug test
k = hydraulic conductivity
[1] Estimated from literature values (Domenico and Schwartz 1998)

Figure 5.6 National Gypsum MW 00-1 Monthly Water Levels (April 2000 to December 2014)



Records of pumping tests are available for public supply wells drilled nearby in Windsor Group bedrock (Table 5.13; NSDNR 2012a). These wells are completed into calcareous shale and limestone, not the massive gypsum hosting the mine. These tests document the low hydraulic conductivity of the calcareous shale and limestone formation, but indicate sufficient sustainable yields (Q20) to support public supplies. A 24 hour pumping test performed on a borehole of 45 m depth on the NGC property indicated hydraulic conductivity of 10^{-5} cm/s, consistent with the findings of other pumping tests in the region (Jacques Whitford 1989).

Table 5.13 Pumping Tests Completed in Windsor Group Bedrock near Proposed Extension Area

Test For	Date	Depth (m)	Casing Diameter (mm)	Static (m)	k (cm/s)	Specific Capacity (m^2/d)	Q20 (l/min)
Carrolls Corner Community Centre, Halifax Regional Municipality	2006	56.39	152.4	5.31	5×10^{-5}	5.19	52.8
Colchester Hants East Rural High School, Municipality of the County of Colchester	1973	51.82	152.4	5.43	3×10^{-4}	18.23	204.5
Chignecto Central Regional School Board	2009	37.8	152.4	7.3	2×10^{-4}	13.1	41
Milford Station Middle School	1997	62	203.2	26.5	2×10^{-4}	36.5	290.9
Notes: Q20=sustainable yield, k= hydraulic conductivity							

Water wells within 800 m of the Study Area were identified and reviewed using the georeferenced version of the Nova Scotia Well Log Database (NS WLD; Kennedy and Fisher, 2013), which documents wells constructed and logged by drillers and well diggers between 1940 and 2012 (inclusive). Information reviewed included location, construction details, yield and use. The completeness of the inventory of well logs in the NS WLD for the Study Area was confirmed by matching well logs to residences using recent air photography and property mapping from the Service Nova Scotia Property Online database. In rural areas, it can generally be assumed that each residence, agricultural or commercial property has a dug or drilled water supply well.

Table 5.14, presents a summary of the available well log information for the 24 drilled wells and two dug wells identified within 800 m of the Study Area using the NS WLD (Kennedy and Fisher 2013).

Table 5.14 Summary of Domestic Water Well Records within 800 m of Study Area

Well Number Address Community	Depth (m)	Casing length (m)	Yield (Lpm)	Depth to Bedrock (m)	Type/ Use	Distance from Study Area (m)	Drill Date
972426 (Slate) Carrolls Corner	43.24	6.7	9.08	4.87	Drilled/Dom.	-1	5/21/1997
981634 (Sand/Gravel) RR#1 Milford Station Pine Grove	30.45	30.45	45.4	-	Drilled/Dom.	140	8/6/1998
972477 (Quartzite) 1821 Highway #277 Carrolls Corner	43.24	8.83	113.5	4.87	Drilled/Dom.	177	10/19/1998
800266 (Slate) Carrolls Corner	87.7	6.39	-	2.44	Drilled/Dom.	245	9/4/1980
800267 (Slate) Carrolls Corner	44.76	8.22	18.16	-	Drilled/Dom.		9/24/1980
812275 (Quartzite) Carrolls Corner	39.58	10.66	4.54	9.14	Drilled/Dom.		9/26/1981
832017 (Quartzite) RR#1 Milford Carrolls Corner	44.76	6.09	27.24	-	Drilled/Dom.		9/7/1983
050891 (Shale) Milford Road Carrolls Corner	56.33	12.18	54.48	1.52	Drilled/Public	303	9/23/2005
022652 (Quartzite) 1882 Highway #277 Carrolls Corner	67.6	6.09	68.1	3.04	Drilled/Dom.	458	6/13/2002
570051 Carrolls Corner	55.42	7.92	28.6	-	Drilled/Public		5/29/1957
742004 Carrolls Corner	56.33	4.57	29.51	1.52	Drilled/Dom.		6/3/1974
751810 (Quartzite) Carrolls Corner	56.33	5.48	0.57	1.52	Drilled/Dom.		5/21/1975
852237 (Quartzite) Carrolls Corner	69.73	6.7	4.54	1.52	Drilled/Dom.		11/7/1985
861761(Quartzite) Carrolls Corner	77.65	8.53	9.08	2.13	Drilled/Dom.		7/10/1986
872511(Quartzite) Carrolls Corner	56.94	6.09	6.81	2.44	Drilled/Dom.		7/13/1987
881075 (Quartzite) Carrolls Corner	67.6	12.18	2.27	12.18	Drilled/Dom.		11/10/1988
902778 (sand)	6.39	-	-	-	Dug/ Dom.		10/22/199

Table 5.14 Summary of Domestic Water Well Records within 800 m of Study Area

Well Number Address Community	Depth (m)	Casing length (m)	Yield (Lpm)	Depth to Bedrock (m)	Type/ Use	Distance from Study Area (m)	Drill Date
RR#1 Milford Station							0
961195 ("Quicksand") Carrolls Corner	50.85	21.92	15.89	-	Drilled/Dom.		9/19/1997
041792 (Gypsum) 372 Milford Road Carrolls Corner	92.26	34.71	0	34.1	Drilled/Dom.	484	6/14/2004
982181 (Gypsum) Cooks Mill Road Carrolls Corner	92.26	12.79	2.27	10.96	Drilled/Dom.	530	11/17/2011
110988 (Quartzite) 2043 Antrim Road Carrolls Corner	73.99	7.16	4.54	0.91	Drilled/Dom.	541	9/4/2007
071796 (Quartzite) 1508 Highway #277 Carrolls Corner	49.63	25.12	90.8	17.36	Drilled/Dom.		6/18/2002
020298 (Shale) 376 Milford Road, RR #1, Milford Station	42.63	30.45	90.8	33.5	Drilled/Dom.	570	6/13/2002
020299 (shale) 388 Milford Road, Rr #1, Milford Station	48.72	34.1	68.1	30.45	Drilled/Dom.		7/8/1991
910374 (Till) Pine Grove	6.39	-	-	-	Dug/ Dom.		9/23/1993
930803 (Gypsum) Carrolls Corner	49.63	21.01	5.45	18.27	Drilled/Dom.	793	9/4/1998
981286 (Gypsum) 73 Milford Road Carrolls Corner	24.06	22.53	18.16	23.14	Drilled/Dom.		5/21/1997
Min (drilled only)	6.4	4.6	0.0	0.9	NOTES: Information was obtained from the Well Log Database including wells constructed between 1940 and 2012 inclusive. Dom. = domestic; Blank = no data; lpm = litres per minute; m = metres; Estimated distance from Study Area based on well locations provided in the NS WLD; grouped distances indicate that these well records are associated with a single location in the NS WLD.		
Max (drilled only)	92.3	34.7	113.5	34.1			
Mean/Median (drilled only)	53.2/ 52.5	14.0/ 8.7	30.5/ 18.2	10.8/ 4.9			

The wells surrounding the Study Area are completed into a variety of aquifer units, including quartzite, shale, gypsum and glacial deposits. Reported yields range from 0 to 113.5 lpm in drilled wells, with a mean of 30.5 lpm, and a median of 18.2 lpm, reflecting that there are a few high-yield wells constructed in quartzite influencing the average. Wells reported to be constructed in gypsum have low yields, ranging from no yield to 18.16 lpm. It is likely that yielding wells in gypsum have intercepted a fractured zone near the surface of the bedrock; the gypsum well with the highest yield (73 Milford Road) may be getting higher yields from the overlying till, as the well casing does not extend to the bedrock. Yields from dug wells in the area are not reported.

One well is present within the boundary of the proposed extension; in the future this property may be acquired as part of the mine development. The nearest wells (within 300 m) are not constructed in the gypsum bedrock, but are reported to be constructed in quartzite or shale/slate. The nearest well in the gypsum bedrock is 484 m from the Study Area.

Water Quality

Local groundwater chemistry results are available from the Interactive Groundwater Map from communities neighbouring the Study Area (Carrolls Corner and East Milford; NSDNR 2012a). The exact locations of the wells sampled are not reported; groundwater chemistry results are assigned the location of the centroid of the enclosing Nova Scotia atlas grid, for privacy reasons. Water quality at this location is generally described as very hard with high alkalinity (Table 5.15).

Department of Natural Resources has compiled groundwater chemistry available for wells in each Groundwater Region (GWR) and provided summary statistics for common parameters for each groundwater region (Kennedy and Drage 2009; Table 5-4). Compared to the median values for available chemistry in the carbonate/evaporite groundwater region, the local chemistry has notably high concentrations of most general chemistry parameters. For example, total dissolved solids reported for the tested wells in Carrolls Corner ranges from 1,240 to 1,420 mg/L, whereas the median for the GWR is 433.0 mg/L. High TDS interferes with the concentrations at which certain constituents are detectable in laboratory analysis. For example, arsenic is reported to be 10 ug/L in samples from Carrolls Corner however this is only reflective of the higher detection limit for arsenic in the high TDS samples.

Uranium levels are low in local wells (consistent with GWR statistics). Based on these four samples, Canadian Drinking water guidelines can be exceeded for TDS, chloride and manganese, and occasionally exceeded for sodium. These samples likely represent wells completed in glacial till or calcareous shale; the gypsum groundwater quality is dominated by sulfate and would be classified as a non-potable, very hard and alkaline, calcium-sulfate water type of high TDS.

Acid production potential data is not available; however acid production has not been an issue with the existing mine operations due to the nature of the ore (gypsum) and the buffering capacity of gypsum and carbonate rocks. Acid production have not largely been associated with this formation.

Table 5.15 Bedrock Aquifer Chemistry in Wells in the Vicinity of the Study Area

Sample Date	2006	2005	2005	2010	Median	Median values reported for carbonate/ evaporite GWR (n)
Community	Carrolls Corner			East Milford		
Alk (mg/L)	260	230	260	170	245	142.5 (62)
HCO3 (mg/L)	258	225	260	173	241.5	
CO3 (mg/L)	0.5	1	0.5	1	0.75	
Na (mg/L)	140	290	190	15.4	165	37.5 (67)
K (mg/L)	1.7	1.8	2	1.28	1.75	2.2 (65)
Ca (mg/L)	260	220	290	125	240	64.3 (67)
Mg (mg/L)	33	21	38	13.2	27	11.0 (67)
F (mg/L)				0.3	0.3	
SO4 (mg/L)	140	94	120	170	130	75.0 (65)
Cl (mg/L)	490	590	600	58	540	33.9 (65)
Hardness (mg/L)	780	630	890	370	705	219.5 (64)
TDS (mg/L)	1240	1370	1420	497	1305	433.0 (60)
pH	7.11	7.84	7.25	7.96	7.5	
NO3 - NO2N (mg/L)	0.025	0.025	0.025	0.025	0.025	0.03 (61)
As (ug/L)	10	10	10	0.5	10	1.0 (61)
U (ug/L)	0.5	1.3	0.5	0.14	0.5	0.5 (58)
Fe (ug/L)	250	250	250	136	250	70.0 (67)
Mn (ug/L)	360	29	400	13.1	194.5	29.0 (67)
GWR= groundwater region						

5.5.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

The Study Area footprint is presented in Figure 5.1 and is expected to extend to depths of 54.9 m below mean sea level to extract buried gypsum and underlying anhydrite deposits. Mining will extend eastward from the existing pit, and will include cutting and grubbing of existing vegetation and soils; excavation and stockpile of surficial materials in the pit; and breaking and blasting of the bedrock for extraction. Drainage, originating as direct precipitation, runoff and seepage from encountered groundwater flows, will be directed via perimeter drains and ditching to one of the three main sumps. Collected water is discharged to the Shubenacadie River via and Pumps 4 and 6 in the 3rd Level Sump. Water collected in the Level 5 (bottom) sump is pumped to Level 3 sump for subsequent discharge to the Shubenacadie River.

There is potential for Project-related effects to local groundwater quality and quantity as a result of the proposed mine extension. Quality effects may include contamination of groundwater from accidental spills of fuel, lubricants or blasting chemicals or temporary increases in nearby turbidity in potable wells as a result of blasting vibrations.

Acid rock drainage is the result of exposure to sulphide rich rocks to oxidizing environments such as rainwater. Earthwork activities around these sulphide rich rocks can increase the rock exposure and thus the acid generation potential. Not all sulphide-containing rocks produce acid drainage. In many cases, rocks contain enough carbonate minerals to buffer the sulphide effect; in these instances acid rock drainage is not produced. In Nova Scotia, acid rock drainage is most commonly associated with slate from the Halifax Formation of the Meguma Group and coal bearing shales. Bedrock underlying the Study Area consists of massive gypsum. In general, gypsum is not known to be an acid drainage risk, particularly due to the high buffering capacity of the carbonate rich rock. Acid rock drainage is not a potential groundwater quality effect of this Project.

Effects to groundwater quantity may include a lowered local groundwater table through redirection of aquifer recharge and flows to the Shubenacadie River *via* drainage collection systems in the mine. Groundwater yields from nearby domestic wells also have the potential to be affected by damages resulting from blast vibrations.

The groundwater in gypsum in the vicinity of the current mine has been demonstrated to be isolated from groundwater flow to the Shubenacadie River through long term monitoring in a multi-level piezometer located between the active mine and the river. Breaking through the impermeable formation such that substantial seepages from the Shubenacadie River may enter the mine through the west wall has been a concern for mining in the area nearest the River (*e.g.,* the western and northwestern extents of the active mine). The proposed extension is in an easterly direction away from the River; therefore, no increased interaction with the Shubenacadie River is likely.

Spatial boundaries for the assessment of groundwater resources are based on a combination of aquifer hydraulic properties (Table 5.12 and Table 5.13), expected groundwater flow directions and the distance between the future extent of the fully developed subject property and wells (Table 5.14) or potential ecological receptors.

Water Quality Effects

Project-related contamination (*e.g.*, accidental petroleum hydrocarbon spills from machinery or blasting chemicals) (*i.e.*, fuel oil and nitrate) could theoretically affect the groundwater at the mine and potentially affect well water quality down gradient of the Project. Potential effects of Project-related contamination from accidental spills and the extent of the area potentially affected are dependent on the size and type of release, surface drainage patterns and surficial geology. It may extend 200 m in materials with the highest conductivity (*e.g.*, sand and gravel), but risks are expected to extend up to 50 m in less permeable tills like the ones found on site with high silt and clay content. There will be no storage of fuel or blasting chemicals in the Proposed

Extension Area; the main source of contamination will be fuel in machinery or the amounts of blasting chemicals present for use in a particular blasting event.

All employees and temporary site workers will review the NGS Spill Contingency Plan (Appendix C) as part of their site orientation. If an accidental spill of hazardous materials occurs, the NGC Spill Contingency Plan will be initiated, which includes immediate reporting of any spill (regardless of size) to a supervisor immediately and taking measures to stop and contain the release immediately. Supervisors will notify proper agencies, put in place controls to prevent further spill or release, and initiate clean up to pre-spill conditions. Requirements for containment, clean-up, site restoration, disposal and reporting are provided in the Spill Contingency Plan, as well as a list of hazardous materials on site and equipment available for emergency response to a spill. If not contained at the source, most spills will be contained within drainage and conveyance features that manage seepage and runoff within in the mine and will not have an opportunity to enter the groundwater. In consideration of the size and depth of the mine operation, the majority of groundwater pathways within or near the mine are inward towards the sumps, which further reduces the likelihood of off-site migration or adverse effects.

Siltation of water in domestic wells nearby the Study Area is a potential effect of the vibrations from rock blasting activities. The effect is temporary in nature and primarily the result of re-suspension of silt at the bottom of a well or from borehole walls. In aquifers with large fracture systems silt may be directly sourced from silt and sediment produced from the blasting; however, the low hydraulic conductivities and limited fracturing of the massive gypsum bedrock suggests that this is unlikely.

Twenty-seven wells are situated within 800 m of the Study Area. The potential for these wells to be affected by blasting vibrations is related to the separation distance, blast magnitude, the physical properties of the gypsum being excavated, and the actual well construction and age. Wells nearest the property, and wells located in the same hydrostratigraphic unit as the mine activities (gypsum bedrock) are the most likely to be affected. A survey of the seven wells located within 400 m of the blast areas, as well as the nearest well completed in gypsum (372 Milford Road), will be undertaken, including well head inspection, water sampling for general chemistry, metals, and bacteria; and short-term pumping tests (where wells are accessible), to determine the capacity of individual wells and nearby aquifers. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted.

It is understood that a pre-blast survey is required according to the NSE "Procedure for Conducting a Pre-Blast Survey" (NSE 1993) for all structures situated within at least 800 m of the Proposed Extension Area. Based on the results of this assessment, the 400 m well survey discussed above is proposed; however a detailed well monitoring plan and pre-blast survey will be developed in consultation with NSE at the Industrial approval amendment stage.

In summary, assuming the application of proposed mitigation measures, significant Project-related effects on groundwater quality within the 800 m assessment boundary are not likely to occur.

Water Quantity Effects

The proposed Project requires excavation of deep bedrock on site below the surficial and bedrock groundwater tables. Monitoring at the onsite nested well suggests that the average surficial water table is approximately 25 m below surface and the groundwater level in the gypsum bedrock is 30 m below surface. Excavation in the Study Area will require collection of groundwater seepage and pumping to the Shubenacadie River. As the depth of the mine increases, there is potential to increase groundwater gradients towards the open face of the glacial till and bedrock, resulting in a water table depression surrounding the mine. This depression could theoretically extend to existing wells in the vicinity, reducing the groundwater available to their wells.

Monitoring in the well at the western extent of the existing mine pit indicates that the surficial aquifer has maintained consistent water levels since 2000 without effects from the mine, despite the proximity to the deepest part of the mine (49 m below mean sea level at the time of last measurement). Static water levels in the bedrock well (25.4 m above mean sea level) continue to remain well above the elevation of the mine floor (49 m below mean sea level) and the adjacent Shubenacadie River (7.5 m above main sea level); the source of recharge is assumed to be from the overlying till. The hydraulic conductivity of the surficial materials is low locally; shallow residential dug wells in the silty-sand till are prone to dewatering and are often used as cisterns during dry summers (Jacques Whitford 1989). This low hydraulic conductivity prevents the wells from losing water rapidly, which should also prevent them from being dewatered during overburden removal in the adjacent extension.

Drilled wells with higher yields likely rely on fracture flow and potentially karst dissolution channels for their recharge. It is expected that these wells will behave similar to the monitor wells on site, in that their recharge is primarily from vertical gradients from the overburden to the fractured surface of the bedrock. The combination of differing bedrock types and the very low permeability recorded for massive gypsum in the mine suggests that domestic and public wells will be hydrologically isolated from mine activities.

Vibration damage to a drilled or dug well is a potential effect of rock blasting. The likelihood of this effect is generally a function of the distance between the energy source and the receptor well, and the seismic properties of the intervening subsurface materials. With respect to rock type, the risk of water well damage is greater for fractured crystalline bedrock than for overburden wells or soft bedrock (*e.g.*, gypsum, sandstone or shale). Based on experience, the risk from blasting or major excavation is considered to be greatest within 50 m, moderate from 50 to 200 m, and minimal beyond about 200 m. The nearest wells to the gypsum rock that will be mined area are in till, slate and quartzite. Vibration effects caused by blasting are conservatively considered in this assessment for wells within 400 m of the proposed extension.

In the event that wells are adversely or permanently affected by plant-site preparation or construction, the Proponent will repair or replace affected wells to conditions that existed prior to blasting. Mitigation measures will be implemented on the basis of the well condition survey on

wells within 400 m of the Study Area and the nearest well constructed within the gypsum bedrock. The Proponent is prepared to provide temporary water supply until a permanent resolution is made, should existing supplies be disrupted either by drawdown of the water table or by damage from blasting associated with the Project. It is understood that a pre-blast survey is required according to the NSE "Procedure for Conducting a Pre-Blast Survey" (NSE 1993) for all structures situated within at least 800 m of the Proposed Extension Area. Based on the results of this assessment, the 400 m well survey discussed above is proposed; however a detailed well monitoring plan and pre-blast survey will be developed in consultation with NSE at the Industrial approval amendment stage.

In summary, assuming the application of proposed mitigation measures, significant Project-related effects on groundwater quantity are not likely to occur.

Monitoring and Follow-up

Three multi-level (surficial and bedrock) groundwater monitoring wells will be installed between the mine area and the domestic wells identified to establish baseline groundwater quality and water level conditions in advance of the extension. Locations for these wells will be identified following the pre-blast survey and based on the level of vulnerability of wells to Project effects. It is also recommended that baseline groundwater sampling and static water level measurements be taken in the existing well at that time. Monitoring of groundwater levels adjacent to the extension will continue as the operation proceeds. All groundwater monitoring wells will be constructed to resemble a typical residential water supply well, and should be incorporated into the existing NGC mine environmental monitoring system. The wells will be periodically measured for water level, pH and other water quality parameters.

Summary

Based on the results of the groundwater resources assessment and assuming the application of proposed mitigation measures, significant Project-related effects on groundwater quality and quantity are not likely to occur.

5.6 ARCHAEOLOGICAL AND HERITAGE RESOURCES

Archaeological and heritage resources are included as a VC in this assessment in recognition of the interest of potentially affected Mi'kmaq communities, the general public, and provincial and federal regulatory agencies assuring the effective management of these resources. In this section, the environmental effects of the Project activities on archaeological and heritage resources resulting from all Project phases will be assessed. A brief discussion of the potential for paleontological resources is also provided in this VC.

For the purposes of this assessment, archaeological and heritage resources are defined as physical remains that inform us of the human use of and interaction with the physical environment. These resources may be above or below the surface of the ground and cover the earliest Pre-Contact times to the relatively recent past. Heritage resources are generally

considered to include historic period sites such as cemeteries, heritage buildings and sites, monuments, and areas of significance to Mi'kmaq or other groups. Pre-Contact refers to the time before the arrival of non-Aboriginal peoples.

Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, hells, wood, leaf impressions, footprints, burrows, and microscopic remains. The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered non-renewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced.

The assessment of archaeological and heritage resource potential within the Proposed Extension Area incorporated sources that included archaeological site records at the Nova Scotia Museum and archival resources. Background research was conducted using the records at the Public Archives of Nova Scotia, the Nova Scotia Museum, as well as those available on the Internet.

Archaeological, heritage or paleontological resource material that is disturbed, destroyed or improperly removed from a site represents a potential cultural or scientific loss of information and history that could otherwise be handled and interpreted in an efficient and appropriate manner. The *Special Places Protection Act* gives Nova Scotia's Heritage Division the mandate to protect important archaeological, historical and paleontological sites and remains (including underwater).

5.6.1 Description of the Existing Environment

Background Research

Archaeological Potential

The determination of archaeological potential is a necessary step for designing a field program, which would include a pedestrian survey and, perhaps, shovel testing if areas of high potential are identified. The archaeological potential for the Proposed Extension Area (Figure 1 in Appendix K) was determined by evaluating eight criteria:

- the presence of or proximity to recorded archaeological sites (250 m buffer);
- Presence of a water source (primary, secondary, ancient) within 300 m (primary) and 200 m (secondary);
- Elevated topography;
- Unusual land formations;
- Proximity to a resource-rich area (animal, vegetable or mineral);

- Evidence of Euro-Canadian settlement;
- Proximity to historic transportation routes (*e.g.*, road, rail, portage); and
- Is the property protected under the *Special Places Protection Act*?

These items are evaluated individually below.

Recorded Archaeological Sites

The distribution of recorded archaeological sites throughout a region can aid in predicting where unrecorded sites may be located. There are no recorded archaeological sites within the Proposed Extension Area. The nearest recorded archaeological site is BfCu-05, which is over 4 km to the southwest, on the banks of the Shubenacadie River. The site was reported by an unrecorded source; but a 1970 Nova Scotia Museum survey failed to find any physical evidence of what they suspected to be a Maritime Woodland site. It was speculated that the site was destroyed by "amateur digging". However, the lack of or abundance of recorded archaeological sites could be the result of either a lack of area or concentration of archaeological work in an area and may not be a true indicator of a lack of archaeological potential.

Water Sources

A major criterion in the determination of Mi'kmaq and historic archeological potential is the presence of watercourses that could have served as transportation routes as well as a source of food (fish and fowl). There are no primary watercourses within the Proposed Extension Area, but there are two located relatively close by. The Shubenacadie River is about 1 km west of the Proposed Extension Area. When a 300 m buffer[1] is applied to the river it does not intersect with the Proposed Extension Area (Figure 2 in Appendix K).

Gays River is a tributary of the Shubenacadie and is about 200 m to the north of the Proposed Extension Area, and it would be considered a secondary watercourse. The 200 m buffer just touches the northeast corner of the Proposed Extension Area, which is now a farm field (Figure 2 in Appendix K). While Gays River is the only primary watercourse close to the Proposed Extension Area, it is barely within the 200 m buffer and the presence of the farm field means the land would have been clear-cut, grubbed, levelled, and ploughed; this would have negatively affected any archaeological resources that may have been present.

An unnamed tributary of Gays River (referred to as Watercourse 1 or WC-1 in this EA; see Figure 2 in Appendix K) is close to the eastern edge of the Proposed Extension Area. This first order brook enters the Proposed Extension Area near the Cooks Mill Road and runs roughly parallel to the Milford Road. The roughly 1 m wide watercourse is shallow and quite rocky. The banks are grasses and rushes. The watercourse meanders into the southeast central quad before simply running out. This watercourse is most likely at its highest during spring floods but it was unlikely

[1] 300 m on the centre of the river, so the buffer is actually 600 m wide

ever navigable. It would have been a source of freshwater and a minor source of food fish. Another minor watercourse is Big Pond Brook, which runs along the west edge of the Proposed Extension Area and seems to originate from MacPhee Pond to the north. The area around the pond seems to have been heavily affected by the development of the surrounding farmland, so the brook may have once been a tributary of Gays River or the Shubenacadie. The only evidence of the watercourse near the Proposed Extension Area is an anthropogenic pond located just outside of the northwest corner (see Figure 5.1).

Elevated Topography

A digital elevation model (DEM) and a contour layer were opened in a GIS program to illustrate the contours within the Proposed Extension Area (Figure 3 in Appendix K). The map shows that the highest point in the Proposed Extension Area is on the south edge at a height of c.70m. This elevation slopes sharply down to the west, somewhat more gradually down to the northwest, north, and, east. There are no elevated areas that are significant.

Unusual Land Formations

There were no unusual land formations noted during the background research.

Natural Resources

No evidence was found that pointed to any abundance of natural resources that would have encouraged settlement or exploitation by Mi'kmaq or historic peoples.

Evidence of Euro-Canadian Settlement

The first land grants in the area of Carrolls Corner were granted after 1792, but it seems to have been named in 1843 after John Carroll, who had a house and small store there (Nova Scotia Archives Undated). The 1865 Mackinlay map, however, labels the general area of Carrolls Corner and Dutch Settlement as "Black Rock" (Figure 4 in Appendix K). While the 1869 A.F. Church map does not identify Carrolls Corner by name, it does show a "J. Carroll" on the west side of the Milford Road, near the intersection with Highway 277, outside of the Proposed Extension Area. It also shows a "J. Whipple" and "T. Hogan" on the small road near the southeast corner of the Proposed Extension Area, but this section is also outside of the Proposed Extension Area. All of the other structures shown on this map are along the Milford Road and Highway 277 and are not within the Proposed Extension Area. The 1878 Roe Brother's map, which is not very detailed, shows four buildings at the crossroads of the Milford Road and Highway 277, but nothing else within the Proposed Extension Area (Figure 5 in Appendix K). The 1889 Church's Mineral Map of Nova Scotia does not show buildings or roads, but does identify gypsum deposits between Gays River, Carrolls Corner and Dutch Settlement (Figure 6 in Appendix K). The most detailed historical evidence comes from the 1908 Geological Survey of Canada map of the area (Figure 7 in Appendix K). This map shows a small road that runs from the Milford Road, just north of the intersection with Highway 277, west for a short distance then south to meet Highway 277. This road still exists. The map shows a dwelling labelled "W. Tanner" at the corner where it

turns south, as well as two unlabelled buildings between the road and Highway 277. These buildings and the road are outside of the Proposed Extension Area. While the map does not show any other settlement features within the Proposed Extension Area, it does show a "Black Rock Gypsum Quarry", just north of Dutch Settlement, and west of the Proposed Extension Area. This would indicate that while the current mine was not in operation until 1954, there was gypsum mining in the area since at least the early twentieth century.

Historic Transportation Routes

The Shubenacadie was a major transportation route for thousands of years and it was an integral part of the Shubenacadie Canal during the nineteenth century. However, as noted above, it is well outside of the Proposed Extension Area. The most obvious historic transportation routes near the Proposed Extension Area are Highway 277 and Milford Road; what could be found on their history is presented in the section above.

Special Places Protection Act

The Proposed Extension Area is not a designated Special Place under the *Special Places Protection Act*.

Mi'kmaq Archaeological Potential

In general, the potential for an area to contain Mi'kmaq archaeological resources is tied to proximity to water. Lake and river systems not only provided food and water to the Mi'kmaq but were used for traveling between the coast and the interior. As mentioned above, there are no primary watercourses within the Proposed Extension Area, and no other resources that would have attracted settlement, so the potential for Mi'kmaq archaeological resources should be considered low.

The Mi'kmaq Ecological Knowledge Study (MEKS) conducted for this EA (MGS 2014; Appendix F) investigated Mi'kmaq archaeological potential within a 5 km radius around the Project site (the "MEKS Study Area"). Within the 5 km radius, "*archaeological evidence indicates early peoples used the Shubenacadie River System during the Archaic and Late Archaic periods with some of these sites overlain by Ceramic Period sites. Three areas of concentrated Prehistoric finds are the area of the Shubenacadie River between Grand Lake and Enfield, the area surrounding where the Nine Mile River and the Shubenacadie River meet and the area surrounding where the Stewiacke River meets the Shubenacadie River. The sites are strategic locations for fishing stations as well as intersections of travel routes from the Atlantic Coast, Cobequid Bay and interior portions of the mainland* (page 30, MGS 2014; Appendix K).

Within the Proposed Extension Area, the MEKS found no Mi'kmaq archaeological resources and the Project site is not part of any of the last known Mi'kmaq traditional hunting territories (MGS 2014; Appendix K).

Historic Archaeological Potential

There was no evidence of historic settlement within the Proposed Extension Area and the potential for historic archaeological resources is considered low.

Pedestrian Field Survey

The pedestrian field survey conducted on July 23 and August 11, 13 and 22, 2014 and consisted of a single Stantec archaeologist walking over the Proposed Extension Area to determine if there were any areas of elevated potential for containing archaeological resources (Figure 1 in Appendix K). Access to the Proposed Extension Area was through a gated and locked road that ran roughly up the central west side. The Proposed Extension Area had been actively logged until relatively recently, so access for the survey was mainly through the logging roads. The only areas the background study tentatively flagged as having elevated potential for Mi'kmaq archaeological resources were the small pond just outside of the Proposed Extension Area to the northwest and the small watercourse/wetland on the east side (WC-1 on Figure 5.1). While no specific historic archaeological resources were flagged during the background research, the areas adjacent to the two roads were considered to have elevated potential. A handheld GPS and a field map were used for navigation and tracking was turned on so the route travelled could be graphically represented (see Figure 1 in Appendix K).

The survey began at the gated road and travelled steadily uphill to the northwest, where the terrain levelled. The survey proceeded to a crossroads then travelled to the northwest in the direction of the large pond. The forest in this area was generally young, mixed wood, but with more hardwoods than soft. The terrain began to slope down to the northwest as the survey went through an area that had been clear-cut and stumped (Plates 2 to 4 in Appendix K). The berms that outlined the pond left little doubt that it was artificial and would have been created to contain and control the water flowing from Big Pond Brook to the north into the active mine (Plate 5 in Appendix K). This pond is the anthropogenic waterbody shown on Figure 5.1 and the NSE permit for Big Pond Brook is in Appendix A. The survey went south up the slope from the pond through a mixed wood forest that had been harvested possibly 30 or 40 years ago (Plate 6 in Appendix K). The slope was more than 30°, which would make all of the area on the northwest side of Oathill Road low potential. Oathill Road bisects the survey area and runs from a farm to the northeast. The area on the southeast side of Oathill Road continued to slope, but more gradually, although the terrain was very hummocky. The visibility in this section was 30 - 40 m. The survey followed a couple of old roads through this area going from the middle of Oathill Road southeast as the terrain began to slope down to the edge of the large clear-cut (Plates 7 and 8 in Appendix K). From there the survey followed logging roads southwest to the main road and back along it to the vehicle. No settlement features were found and no evidence of past settlement (*e.g.*, old field, apple trees, stone walls, *etc.*) were observed.

The next leg of the survey followed the old road at the south end, which was on the edge of the Proposed Extension Area. It was a wide track that is well-maintained as a community trail that runs from the Carolls Corner Community Centre to the east (Plate 9 in Appendix K). This trail was

followed to the east for several hundred metres and then the survey turned to the north and up onto the higher ground at the edge of a very large clear-cut. The survey returned to the community trail, following it the east then taking another old road/trail north into the southeast quadrant. The initial area was low and wet with a lot of ruts throughout it. The survey then followed an old logging road that travelled between an upslope to the west and the wetland to the east (Plate 10 in Appendix K). The survey went into the wetland through a mass of fallen, dead, trees and eventually turned west to head back up into the clear-cut, up a slight slope through scrubby, mixed forest, following the logging roads back to the crossroads. No settlement features or evidence of past settlement were observed.

The survey moved to the southwest quadrant, initially following the community trail from where it meets the main road along to the west, but the terrain quickly sloped down very sharply. The survey then moved to the north northwest into the forest, which was scrubby, mixed, and, relatively young. The terrain sloped up to the northwest and levelled off at a relatively open area with a visibility of approximately 40 to 50 m. The terrain was very hummocky, however, and, because it sloped down to the southwest, the survey followed the more level ground to the north. There were a number of deadfalls in this area and the forest adjacent to the main road to the west was a very dense thicket of young conifers. The survey returned to the main road but then followed an old logging road northwest back into the forest. It continued along this road until it against the main road just south of the crossroads. The survey moved south down the main road and then moved southeast along another old logging road/track that skirted along the east side of some sloping terrain. This area was relatively open but quite damp with visibility of 30 to 40 m. The trail ended just north of the community trail. No settlement features or evidence of past settlement were observed during this leg of the survey.

The survey then moved to the east side of the Proposed Extension Area, along the Milford Road, in the area of the small watercourse and the wetlands. Next, the survey followed northwest along an old road that paralleled the Milford Road. The vegetation consisted of alders, scrubby conifers with reeds and grasses, typical of a wet area or one that floods seasonally (Plate 11 in Appendix K). The watercourse that was noted above is very small and rocky and runs to the southeast into the wetland. It should be considered a very minor watercourse. The survey then moved up an old logging road southwest onto higher ground then up into the large clear-cut (Plate 12 in Appendix K) then returning through the woods to the starting point. No settlement features or evidence of past settlement were observed during this leg of the survey.

Paleontological Resources

Mastodon remains were found at the existing mine in 1991 (tusk and part of the jawbone of an adult mastodon) and 1993 (left half of the juvenile's jawbone about 400 feet northeast of the first discovery). The six year old juvenile is the earliest known juvenile mastodon in Canada, dating back approximately 80,000 years to the Quaternary Period. The mastodon findings indicate the potential for additional paleontological resources to be found when the mine is extended. The existing mine and Proposed Extension Area are not considered a Special Place under the *Special Places Protection Act*.

When the resources were previously found, work was immediately ceased and the Nova Scotia Museum was notified. Information on these findings is publically available on the National Gypsum website at http://ngc-heritage.com/op-halifax.htm and is also included in Appendix K.

Summary

The background research found no evidence of Mi'kmaq or historic settlement within the Proposed Extension Area. The purpose of the pedestrian field survey was to locate physical evidence of Mi'kmaq and historic archaeological resources as well as to ground-truth the conclusion that the archaeological potential for the Proposed Extension Area should be considered low. The field survey found no major watercourses within the Proposed Extension Area that could have been used by the Mi'kmaq for transportation, fishing, and hunting, which could have been the basis for settlement in the area. It is considerably more likely that the Mi'kmaq chose to concentrate their settlements along the Shubenacadie River System where much more abundant food resources were available and there was relatively easy canoe access across the province. The MEKS also found that the Shubenacadie River System and surrounding rivers (Stewiacke River, Nine Mile River) are strategic locations for Mi'kmaq fishing and travel routes.

Within the Proposed Extension Area, the MEKS found no Mi'kmaq archaeological resources and the Project site is not part of any of the last known Mi'kmaq traditional hunting territories (MGS 2014; Appendix K). The archaeological survey also failed to find any physical evidence of any Mi'kmaq or historic archaeological resources within the Proposed Extension Area. This study concludes that the archaeological potential within the Proposed Extension Area should be considered as low.

Mastodon remains were found at the existing mine in 1991 (tusk and part of the jawbone of an adult mastodon) and 1993 (left half of the juvenile's jawbone), and indicate the potential for additional paleontological resources to be found when the mine is extended.

5.6.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

Certain activities associated with the Project (*i.e.*, grubbing, blasting, road construction), could affect archaeological or heritage sites if they were present within the zone of surficial and subsurface disturbance. These disturbances, if unmitigated, could result in the loss of resources and the potential knowledge to be gained from its interpretation.

The Proposed Extension Area has low potential for identifiable human use in the pre-Contact and low potential for identifiable human use in the historic periods. It is assumed that no areas beyond the Proposed Extension Area will be disturbed during the development and operation of the proposed mine extension. The development and operation of the proposed mine is unlikely to have adverse environmental effects on unknown heritage resources and it is recommended that no further archaeology is required.

Paleontological resources were discovered at the existing mine in 1991 and 1993 and the likelihood exists that there may be additional resources found when the mine is extended. When the resources were previously found, work was ceased and the Nova Scotia Museum was notified immediately.

If archaeological, heritage or paleontological resources are discovered during any phase of the proposed Project, the following contingency plan will take place: work will be immediately stopped and the find reported to the Curator of Archaeology and/or the paleontological staff at the Nova Scotia Museum and the Manager Special Places, Heritage Division Department of Communities, Culture and Heritage. If the resources are thought to belong to Mi'kmaq, the KMKNO and the Chief of the nearest Mi'kmaq band (Sipekne'katik First Nation) will also be contacted. The appropriate authorities will determine further actions to be undertaken which could include avoidance and further assessment.

Monitoring and Follow-up

It is recommended that no further archaeological work is necessary because of the low potential or archaeological and heritage resources.

Summary

Based on the results of the desktop study and field pedestrian survey, and the mitigation proposed, the potential for archaeological and heritage resources is low and significant Project-related effects on unknown resources (assuming contingency measures are applied) are not likely to occur.

Paleontological resources were discovered at the existing mine in 1991 and 1993 and the likelihood exists that there may be additional resources found when the mine is extended. Provided that contingency plans are implemented as they have been in the past, the potential for significant Project-related effects on paleontological resources are not likely to occur.

5.7 ATMOSPHERIC ENVIRONMENT

The atmospheric environment VC was selected as a VC because of potential interactions of Project activities with air quality and sound quality. Atmospheric environment includes the assessment of the quality of ambient air and the acoustic environment due to the construction, operation and maintenance, and decommissioning and reclamation of the proposed Project.

5.7.1 Description of Existing Conditions

Air Quality

Ambient air quality in Nova Scotia is regulated by the provincial government. The federal government has set objectives for air quality, which are taken into account by federal agencies in a project review. These objectives form the basis for the air quality regulations of several

provinces, including Nova Scotia. The Nova Scotia regulated limits correspond to the upper limit of the Maximum Acceptable category for air quality, which are set under the *Canadian Environmental Protection Act* (CEPA). Air quality guidelines of tolerable, acceptable, and desirable are defined under CEPA. The maximum tolerable level denotes a concentration beyond which appropriate action is required to protect the health of the general population. The maximum acceptable level is intended to provide protection against effects on soil, water, vegetation, visibility, and human wellbeing. The maximum desirable level is the long-term goal for air quality. Additional guidelines are under development by the Canadian Council of Ministers of the Environment (CCME), and ultimately this body will develop Canada-Wide Standards that harmonize the regulations in all jurisdictions.

The Proposed Extension Area and Nova Scotia in general, has good air quality due to the combination of maritime climate and relatively small population and industrial bases (NSDOE 1998). Climatic conditions provide good dispersion of air contaminants. The ambient air quality also benefits from the infusion of relatively clean polar and arctic air masses. Occasionally, however, long-range transport of air masses from central Canada or the eastern seaboard may transfer contaminants into the area, causing occasions of poorer air quality.

Ambient air quality is monitored in Nova Scotia with a network of 13 sites, operated by NSE and Environment Canada, through the National Air Pollution Surveillance Program (NAPS). Motor vehicles, electrical power generation, pulp and paper processing and oil refining are the major local sources of air pollutants in the province. Common air pollutants monitored regularly are sulphur dioxide (SO_2), total particulate matter (TPM), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), particulate matter less than 10 microns in diameter (PM10), carbon monoxide (CO), ground-level ozone (O_3) and nitrogen dioxide (NO_2). The closest monitoring sites to the Proposed Extension Area are located in Halifax on Barrington Street and Granville Street and in Dartmouth, in Cherry Brook. The 2012 annual average data published for these sites is presented in Table 5.16. No data was available for Halifax and Dartmouth for 2013.

Table 5.16 2013 Mean Emissions Data as Reported by NAPS

NAPS Monitoring Station	NO (ppb)	NO_x (ppb)	SO_2 (ppb)			CO (ppm)*		O_3 (ppb)	$PM_{2.5}$ (µg/m³)
	Annual	Annual	1-hour	24-hour	Annual	1-hour	8-hour	1-hour	Annual
Dartmouth (Cherry Brook)	0	2	1	1	1	-	-	29	7
Halifax (Granville Street)	-	-	-	-	-	-	-	-	5
Halifax (Barrington Street)	10	20	2	2	2	0.2	0.2	22	-
Nova Scotia Air Quality Regulations	NR	NR	340	110	20	30	11	82	NR

"-" not measured at this location
NR = Not Regulated

Reference: Environment Canada 2013
*indicates 2012 data as 2013 data were not available

In June of 2009 the Government of Nova Scotia, in collaboration with Environment Canada and other non-government organizations, introduced a new air quality health tool, the Air Quality Health Index (AQHI), in six communities in Nova Scotia, Halifax, Greenwood, Kentville, Pictou, port Hawkesbury and Sydney. The AQHI measures the current levels of outdoor air pollution and related human health risks using a scale of 1 to 10 representing low to very high risk levels. Three air pollutants are measured in order to calculate the AQHI and include ground-level ozone (O_3), particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) (Government of Nova Scotia 2009). The closest community to the Proposed Extension Area that has this program implemented is Halifax and the current air quality levels in this area can be viewed online at Environment Canada.

The existing mine is located in a rural setting with little industrial development nearby. NGC conducted ambient air monitoring events in 2000, 2002 and 2004 to determine dust levels at the facility's site boundaries (Appendix L). Dust levels at the facility's site boundaries were below the Nova Scotia Air Quality Regulations for total suspended particulate (TSP) on all occasions except for the one occasion during the summer of 2004 when the measured 24-hour TSP value exceeded the regulatory limit of 120 µg/m^3. No evidence at the mine or in the immediate vicinity of the sampler was available at the time to explain the exceedance. NGC continues to place a high priority on the control of dust generation at the site. The remainder of the datasets showed no adverse effects from the mining operations.

Acoustic Environment

The sound level surrounding the Proposed Extension Area is of a concern due to the potential for Project related noise emissions to have an effect on close sensitive. Noise is defined as unwanted sound and is measured as a sound pressure level (SPL) in decibels. To reflect the sensitivity of the human ear across the audio spectrum, SPL readings are sometimes given in what is termed as the "A" weighted scale and denoted as dBA.

Humans are exposed to a broad range of sound pressure levels. A level of 0 dBA is the least perceptible sound by a human. A change in 3 dBA represents a physical doubling of the SPL but is barely perceptible as a change, whereas most people clearly notice a change of 5 dBA and perceive a change of 10 dBA as a doubling of the sound level. Typically, conversation occurs in the range of 50 to 60 dBA. Loud equipment and trucks passing on a busy road are responsible for noise levels above 85 dBA. Very quiet environments, such as a still night, typically fall below 40 dBA.

There are approximately 102 buildings/structures located within 800 m of the existing mine site and 15 additional structures within 800 m of the proposed extension area (refer to Section 5.8). These building/structures are comprised of residential dwellings, detached garages, outbuildings and farm houses. There are nine buildings/structures located within the Proposed Extension Area. Following a "windshield" survey conducted for the EA (see Section 5.8), it was determined that of these nine buildings, three are residential dwellings and remaining are outbuildings. It is assumed that the residents located within the Proposed Extension Area will be acquired. If the properties are not acquired then the boundaries would be adjusted accordingly.

The existing ambient sound levels in and surrounding the Proposed Extension Area would be characteristic of the existing mining activities and natural background sounds (*e.g.*, wind). The existing mine has recently received a noise compliant in regards to the use of back-up alarms on their trucks. Such alarms are required for safety reasons; the mine is open to investigating alternatives however, if such a problem persists. One potential mitigation measure is to minimize the backup alarms.

The Proponent conducted noise monitoring events in 1999, 2000, 2002 and 2003 to determine noise levels at the facility's site boundaries (Appendix L). The measured 1-hour Leq values were below the NSE Noise Guidelines.

5.7.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

Air Quality

Mining activities can generate dust (*i.e.*, particulate emissions) which has the potential to be transported off-site. There are a variety of activities that can lead to the generation of particulate matter on the mine site. The primary potential sources of airborne particulates include:

- Exhaust gas emissions due to incomplete combustion from diesel compression engine;
- Road dust;
- Wind erosion on storage piles;
- Removal of overburden;
- Blasting activities;
- Crushing operations;
- Material handling;
- Material transport; and
- Truck loading / truck unloading; and
- Rail car loading / unloading.

Some of the more pertinent contributor's to airborne particulates are discussed in the following:

- Blasting can result in a concentrated plume of particulate matter, but the volume and time duration of such plumes are constrained. Even when blasts result in a visible plume, the contribution to 24-hour averages, as in the Air Quality Regulations, will be negligible. Much of the material in the initial plume is larger than the aerodynamic diameter of particles that can remain suspended in the air, and deposit within a relatively short distance (*e.g.*, 100 m) of the blast site.

- Crushing is a physical operation to reduce material to smaller size ranges, and it can involve the generation of particulate emissions. Uncontrolled processing operations like these can produce nuisances and/or exceedances of particulate standards;
- Material handling activities can result in the generation of particulate matter primarily through the vertical drop of material movement. As the fine material passes through the air, the finest material may become windblown and travel downwind;
- Storage piles and exposed areas are often left uncovered due to the need for frequent material transfer, which can lead to considerable dust generation. Dust emissions can take place during several points in the storage cycle, including material loading onto the pile, disturbances by strong wind currents, and removing loads from the pile;
- Particulate emissions can occur whenever vehicles travel over both paved and unpaved surfaces; and
- Although there are also emissions of combustion gases and products of incomplete combustion from the exhaust of the on-site vehicles and equipment, these are considered nominal.

Efforts to minimize the generation of dust at the existing mine site include the use of water sprays. Currently the facility has active water spray systems installed where dump trucks dump mined rock into the crusher, at the crusher and at the head of conveyor #3, where the rock drops off the conveyor belt onto the stockpile. The tail end of this conveyor also is equipped with a water spray that also contains a dust suppression chemical. In the near future the facility also intends to install a water spray system in the rail car loading area that would spray down each loaded rail car prior to its departure. Such activities will continue when mining in the proposed extension area.

Dust generated by truck movement along unpaved roads within the facility boundaries is and will continue to be minimized by careful routing, limiting speed to 70 km/hour on access roads (and operators are to adjust their speed necessary to the road conditions), proper truck loading, application of water for dust suppression, proper construction of on-site roads, and/or other means as required by NSE.

Daily blasting activities are carried out by a licensed blasting employee and in accordance with the facilities standard operating procedure for conducting normal blasting operations (refer to Appendix C).

Exhausts emissions from equipment and vehicles will be mitigated by ensuring vehicles are maintained in good working order to ensure efficient operation and minimization of emissions. Consideration will be given to methods to reduce idling, as feasible.

Results from ambient air monitoring events in 2000, 2002 and 2004 indicated dust levels at the facility's site boundaries were below the Nova Scotia Air Quality Regulations for TSP on all occasions except for the one occasion during the summer of 2004 when the measured 24-hour TSP value exceeded the regulatory limit of 120 µg/m^3. No evidence at the mine or in the

immediate vicinity of the sampler was available at the time to explain the exceedance. NGC continues to place a high priority on the control of dust generation at the site. The remainder of the datasets showed no adverse effects from the mining operations.

NGC will develop an air monitoring program that will be submitted as part of the Industrial Approval Application amendment process. It is proposed that this program will be primarily complaint-driven. The proponent will comply with air quality limits in force at the time and stiplulated in the amended Industrial Approval for the mine extension. Any monitoring of airborne particulate emissions (dust) will be conducted at the request of NSE and in accordance with the Nova Scotia Air Quality Regulations and the facilities Approval permit (or future amendments) and shall not exceed the following limits at the property boundaries:

- Annual Geometric Mean 70 µg/m^3; and
- Daily Average (24 hrs) 120 µg/m^3.

Sound Levels

Mining activities will produce noise from equipment operation and blasting.

Blasting operations associated with the proposed extension will be conducted in accordance with current operations at the mine as permitted by NSE (Approval No. 89-100), in accordance with the facilities standard operating procedure for normal blasting activities, and with a frequency similar to past operations at the site and during daytime hours only. Blasting will be conducted in accordance with the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act* (1996). It is understood that additional blast monitoring activities and/or reporting may be required by NSE.

Efforts to minimize sound emissions related to the operation of mining equipment include the use of mufflers on all engines and vehicles and adherence to strict maintenance policies. The scheduling of any potential noisy activities will be done during daytime hours. There is noise from back-up beepers on equipment which is a safety requirement. This noise has been identified as a concern by several local residents. The Proponent is reviewing options for the use of strobe lights on trucks to reduce noise levels (from back-up beepers).

As per the requirements of the current operating Industrial Approval and standard provincial guidelines, sound levels from the operation in the Proposed Extension Area will be maintained at the following sound levels (Leq) at the property boundaries:

- L_{eq} 65 dBA 0700-1900 hours (Days);
  60 dBA 1900-2300 hours (Evenings); and
  55 dBA 2300-0700 hours (Nights).

Results from noise monitoring events conducted in 1999, 2000 and 2003 to determine noise levels at the facility's site boundaries indicated that the measured 1-hour Leq values were below the NSE Noise Guidelines.

Further sound monitoring will be conducted at the request of NSE. Details of any required monitoring will be included in the Industrial Approval application. It is proposed that this program will be primarily complaint-driven.

Monitoring and Follow-up

The proponent will develop dust and sound monitoring programs that will be submitted as part of the Industrial Approval Application amendment process. It is proposed that these programs will be primarily complaint-driven. At the request of NSE, dust and noise monitoring will be conducted as required, with additional mitigative measures taken as necessary.

Summary

The air and sound quality effects related to the proposed mine extension can be controlled with standard mitigation practices and therefore the Project is not likely to have a significant effect on the atmospheric environment.

5.8 LAND AND RESOURCE USE

Land and resource use is included as a VC in consideration of potential Project-related interactions with current and anticipated land uses in the vicinity of the Project. The land and resource use VC considers existing land development (*e.g.*, residential, mining, agriculture, forestry), transportation, recreation and tourism. This VC takes into consideration the assessment of human health (*e.g.*, consideration of dust and noise and linked to Section 5.7 Atmospheric Resources) and Mi'kmaq traditional land and resource use (from MGS 2014, Appendix F).

5.8.1 Description of the Existing Environment

Population and Employment

The existing NGC mine is physically located between East Milford and Carrolls Corner, Halifax Regional Municipality (HRM), Nova Scotia (Figure 2.1). The Halifax Regional Municipality has a population of 390,096 (Statistics Canada 2012). The population in this area has increased by 4.7% from 2006 to 2011. The employment rate in the municipality is 64.1.0% and the unemployment rate is 7.2% (Statistics Canada 2012). Over half of the experienced labour force consists of sales and service occupations (25%); business, finance and administration occupations (17%); and occupations in education, law and social, community and government services (14%) (Statistics Canada 2012).

NGC currently employs approximately 60 hourly workers and staff at the site. If volume increases, there will be a need to add further hourly workers and staff. The facility currently supplies gypsum rock for several wallboard plants in the Maritimes (two in New Brunswick and one in Port Hawkesbury, Nova Scotia). The mine also supplies wallboard and cement manufacturers with rock up the St. Lawrence seaway as well as down the east coast of the United States and a wallboard plant in Columbia.

Residential Land Use

The existing mine and Proposed Extension Area are located in a rural setting. There are 102 buildings/structures are located within 800 m of the existing mine site (considered the extreme outer limit for any effects related to blasting). There are 15 additional structures within 800 m of the extension area (Figure 5.7). These building/structures are comprised of residential dwellings, detached garages, outbuildings and farm houses. There are nine buildings/structures located within the Proposed Extension Area. Following a "windshield" survey conducted on August 7, 2014, it was determined that of these nine buildings, three are residential dwellings and remaining are outbuildings. There is also active farm land in this area (see image 10 on Figure 5.7).

Urban/residential areas are the primary current anthropogenic land uses identified within 800 m of the extension area. Carrolls Corner is a small community located east of the proposed extension (see images 6, 7 8 on Figure 2.1). Other current land uses that occur within approximately 2 km of the Proposed Extension Area include agricultural areas (see Figure 5.7).

Mining

The mine is located on land that is zoned for resource uses such as extractive facilities with the issuance of a development permit (Halifax Regional Municipality 2012).

In addition to the existing NGC mine, mining activity near the proposed mine extension includes two pits located 0.5 km and 0.8 km from the proposed extension. There is also an open pit lead/zinc mine located approximately 3.7 km east of the extension in Gays River; however, this open pit mine is not currently operational.

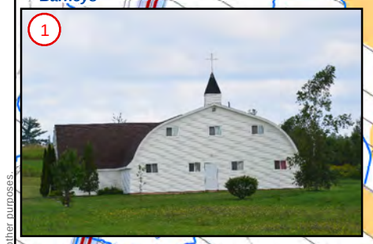
Agriculture

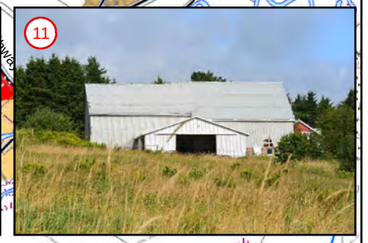
Agricultural areas are located within the general vicinity of the proposed mining extension (refer to Figure 2.1). Agricultural practices, including livestock, are presently occurring on lands within the Proposed Extension Area.

Forestry

Forestry operations have been identified in the region within and surrounding the Proposed Extension Area. Areas of clear-cut and partially depleted forest cover occur on lands surrounding the Proposed Extension Area. Within the Proposed Extension Area, much of the central part of the property has been recently clear-cut with the youngest stands, estimated to be approximately two years old and older clear-cuts estimated to be approximately five years old.

All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a stantec project and should not be used for other purposes.





Barneys
Milford Station
Shubenacadie River
Vinegar Hill Rd
McLennan Brook
Rock Rd
MacPhee Pond
Milford Rd
Big Pond Brook
Gays River
Cooks Mill Rd
Nieforths Hill
Glenmore Mountain
Carrolls Corner
Macwilliams Rd
East Milford
Highway 2
Highway 277
Big Pond Brook

SOURCE:
Base Data: Nova Scotia Geomatics Centre, Nova Scotia Topographic Database (NSTDB) unless otherwise noted.
Wetland (NSDNR): NSDNR, Wetland Mapping Inventory
Land Use (NSDNR): NSDNR, Forest Inventory data
*Note: NSTDB Watercourse data modified within Project Area as per Stantec field observations.

ST NS-121511228-002

0 500 1,000
Distance in Metres

Project Components
- Current Footprint of National Gypsum Mine
- Proposed Extension Area
- Ecological Buffer Zone

Study Features
- 1 Socioeconomic Feature (Photo Location and Number)

Map Features
- Building / Structure
- Church
- Highway
- Road
- Private Lane or Restricted Road
- Seasonal Road, Track or Trail
- Railway
- Transmission Line
- Watercourse*
- Waterbody
- Wetland (NSGC)
- Wetland (NSDNR)
- Anthropogenic Waterbody
- Auto Salvage Yard
- Cemetery
- Mine - Open Pit
- Parking Area
- Pit
- Racetrack
- Sewage Treatment Area
- Sports Field
- Storage Area
- Agriculture (NSDNR)
- Corridor (NSDNR)
- Urban (NSDNR)
- Property Boundaries (SNS 2007)

PREPARED BY: M Huskins-Shupe
REVIEWED BY: C Shupe
CLIENT: National Gypsum (CANADA) LTD.

National Gypsum Mine Extension

Land Use Features

FIGURE NO.: 5.7
DATE: Nov 05, 2014

Stantec

File Path: V:\1215\active\121510xxx\121511228_national_gypsum_ea\geomatics\mapping\mxd\report\ST NS-121511228-002_LandUse_20141006.mxd

Transportation

The existing mine is currently accessed via a private road that branches off Highway 2 and off Highway 277 (Figure 2.1). These private roads will continue to provide access to and from the extended operation.

Material will continue to be crushed, screened, and placed into rail cars where they are shipped daily to port facilities located in Dartmouth on Halifax Harbour. At current production, the site ships one train load made up of 66 rail cars per day, five days per week. The site has shipped two train loads per day in the past. The site ships by rail to two wallboard plants in New Brunswick on average 15 cars per day. The site also ships some material via dump triaxle trailer mainly during the spring and summer months, with approximately 20 to 30 trucks per day.

Recreation and Tourism

Recreational fishing and hunting are permitted in the region surrounding the existing mine and the Proposed Extension Area. The existing mine and Proposed Extension Area are located in Recreational Fishing Area 3 (Nova Scotia Fisheries and Aquaculture 2009). The nearest lakes to the Project that are included in the Provincial recreational fish stocking program are Dollar Lake (located approximately 11 km south of the Project property), and Cooks Lake (located approximately 10 km from the Project property). These lakes are stocked with speckled trout (Nova Scotia Fisheries and Aquaculture 2009).

The existing mine is situated in the secondary watershed of the Shubenacadie River (area 2,500 km^2) and the primary watershed of the Shubenacadie/Stewiacke Rivers. The sole watercourse (WC-1) in the Study Area (original extension area) is fish bearing and observed species included brown bullhead (*Ameiurus nebulosus*), stickleback species, minnows, and salmonids (likely brook trout). Water contained in the WC-1 has direct connection downstream to Gays River which supports multiple recreational fisheries.

The mine is situated in Deer Management Zone 107. Antlerless deer hunting is permitted in the region surrounding the Project Area. Antlerless deer hunting stamps are not required for Deer Management Zone 101 (NSDNR 2012b). The season for hunting deer during 2013/14 is October 25 to December 7 for the general open season and the archery and muzzleloader season ran from September 9 to December 14. All of these deer hunting seasons exclude Sundays (NSDNR 2013).

The mine extension is located 9.6 km south to Dollar Lake Provincial Park and 5.4 km northeast to Shubenacadie Wildlife Management Area, which includes the park/reserve and game sanctuary. The Project is of sufficient distance from the Park that no interactions are expected.

Informal recreation use occurs near the proposed mine extension. There is a hiking/walking trail along the south side of the existing mine that extends to Carrolls Corner soccer field. NGC provided funding and covered legal fees for this community project. At the Carrolls Corner Community Centre there is a soccer field, baseball field basketball courts and playground. It

was noted during the public open house on October 22, 2014 that areas near the mine and Proposed Extension Area are used for recreational hunting and fishing.

Human Health

Human health related aspects and potential effects on environmental health include potential effects on air quality and noise; these issues are addressed in Section 5.7.

Mi'kmaq Traditional Land and Resource Use

There are two established Mi'kmaq reserves located within 35 km of the existing mine and Proposed Extension Area. The first community is the Sipekne'katik (Shubenacadie) First Nation, located approximately 5.2 km north of the Proposed Extension Area. It is located west of the town of Shubenacadie and the Shubenacadie River. The other community is the Millbrook First Nation, and it is located approximately 33.4 km from the existing mine and Proposed Extension Area. It is north of the Project, near the town of Truro. The Mi'kmaq people of both these communities have a history of continuous occupation in this area that spans centuries and begins hundreds of years before European contact.

The Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) represents the negotiations between the Mi'kmaq of Nova Scotia, the Province of Nova Scotia and the Government of Canada. Proponents are encouraged to contact the KMKNO to discuss whether a MEKS is required for their projects. There are 13 First Nation communities with Chiefs in Council in Nova Scotia. The Sipekne'katik (Shubenacadie) First Nation is not represented by the KMKNO. Mi'kmaq people living off-reserve are represented by the Native Council of Nova Scotia (NCNS).

Mi'kmaq Ecological Knowledge Study (MEKS)

The Proponent commissioned Membertou Geomatics Solutions (MGS) to conduct a MEKS to assess the potential effects of the proposed Project on current uses of the area for traditional purposes by members of the Mi'kmaq community (Appendix F). The MEKS followed the MEKS Protocol developed by the Assembly of Nova Scotia Mi'kmaq Chiefs (http://mikmaqrights.com/consultation/meks-protocol/). The purpose of the MEKS was to:

- determine historic and current Mi'kmaq land and resource use in the Project Site (the Proposed Extension Area);
- provide an inventory of species of significance to the Mi'kmaq in the Proposed Extension Area;
- provide an analysis of potential effects of the Project on Mi'kmaq land and resource use; and
- provide recommendations for further action or mitigation.

This information is used to assess any interactions that may occur between Project activities and Mi'kmaq traditional resource use.

MEKS information was gathered by three means:

- literature and archival research;
- interviews; and
- field sampling.

For the literature and archival research, various archival documents and published works were reviewed for information regarding the past or present Mi'kmaq occupation of the MEKS Study Area. The MEKS Study Area represents areas within 5 km of the Proposed Extension Area. Reviewed documents included census records, colonial government records, and published books.

The MEKS interviews were the key source of information regarding Mi'kmaq use in the MEKS Study Area (5 km radius). Twenty-six interviews were undertaken with individuals from the Mi'kmaq communities of Millbrook and Sipekne'katik (Shubenacadie) in September 2014. All of the interviews were completed following the procedures identified within the Mi'kmaq Ecological Knowledge Protocol (MEKP). This protocol is a document that has been established by the Assembly of Nova Scotia Mi'kmaq Chiefs, which describes the process, procedures and results that are expected of a MEKS. Interviewees were shown maps of the MEKS Study Area and asked various questions regarding their Mi'kmaq traditional use activities, including where they undertook those activities, when they undertook them, and what type of resource they used.

In September 2014, site visits were undertaken over three days along the MEKS Study Area by MGS staff members, guided by a Mi'kmaq Ecological Knowledge holder. This provided the opportunity for further identification of traditional use activities occurring near the Project Site and MEKS Study Area.

Based on the data documentation and analysis, it was found that the Mi'kmaq have historically undertaken some traditional use activities, primarily fishing, in the Project Site (or adjacent to), and that this practice continues today. It appears the majority of activity that occurs in the area is trout, bass, salmon, eel and shad fishing as well as one deer hunting area (MGS 2014, Appendix F). Fishing activities were focused in the eastern portion of the Proposed Extension Area. A deer hunting area was identified in the southwest to south portion of the Proposed Extension Area. These activities also involve the harvesting of animal, plant, and tree species at various locations throughout the MEKS Study Area (5 km radius) and at different times of the year. Bass, eel, shad and trout was found to be the most fished species in the Study Area. Deer, rabbit, partridge, and pheasants were recorded as being hunting in multiple areas. Areas were identified for blueberry, goldenthread, mayflower, strawberry, raspberry, and fur bough gathering (MGS 2014, Appendix F). Further details describing historic and current use of the area are outlined in the MEKS (Appendix F).

Archaeological and heritage resources are discussed in Section 5.6 of this document.

5.8.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Potential Effects and Proposed Mitigation

Population and Employment

The mine produces valuable products that support development and infrastructure, and the growth of the region's economy. Continued direct and indirect employment associated with operation of NGC mine is beneficial to the regional economy. The proposed mine extension will allow these benefits and employment to continue at approximately current levels into the future.

Residential Land Use

The proposed Project is an extension to a currently operating mine in an area historically influenced by mining and forestry operations. The Project activities are consistent with current uses in the area and are intended to extend the life of the existing mine site. The proposed Project extension will be located closer to nearby residents and has the potential to affect those land owners. The advance of the mine will occur slowly over the next 35 years with the final phase occurring approximately from 2034 to 2050 (Appendix B). Project footprint adjustments have been made to reduce the original extension area and create an Ecological Buffer Zone (Figure 2.1) to avoid ecologically sensitive areas and increase the buffer to residential properties.

Mining activities will produce noise and dust from equipment operation and blasting which have the potential to affect the nearby residences. There are three residential dwellings located within the footprint of the Study Area as well as several residences near the Project site. It is assumed that NGC will come to agreement with landowners for the use of property within the extension area it does not currently own. Blasting operations associated with the extension area will be conducted in accordance with current operations at the mine as permitted by NSE (Approval No. 89-100), with a frequency similar to past operations at the site. The existing Industrial Approval and other permits related to blasting are in Appendix A. Blasting is/will be conducted in accordance with the General Blasting Regulations made pursuant to the Nova Scotia Occupational Health and Safety Act (1996). Onsite blasting is/will be carried out by licensed blasting employee according to an approved blasting design with monitoring conducted and reported by a competent employee. It is understood that additional blast monitoring activities and/or reporting may be required by NSE. As discussed in Section 5.7, the generation of dust and other emissions will be managed to acceptable levels.

As per the requirements of the current operating Industrial Approval and standard provincial guidelines, sound levels from the operation in the extension area will be maintained at a level not to exceed the following sound levels (Leq) from the property boundaries:

- L_{eq} 65 dBA 0700-1900 hours (Days);
  60 dBA 1900-2300 hours (Evenings); and
  55 dBA 2300-0700 hours (Nights).

Results from noise monitoring events conducted in 1999, 2000 and 2003 to determine noise levels at the facility's site boundaries indicated that the measured 1-hour Leq values were below the NSE Noise Guidelines.

Sound monitoring will be conducted at the request of NSE. Details of any required monitoring will be included in the Industrial Approval application, if requested.

As discussed in Section 5.5, 27 wells are located within 800 m of the Proposed Extension Area. The potential for these wells to be affected by blasting vibrations is related to the separation distance, blast magnitude, the physical properties of the gypsum being excavated, and the actual well construction and age. Wells nearest the property, and wells located in the same hydrostratigraphic unit as the mining activities have the most potential to be affected. A survey of the seven wells located within 400 m of the blast areas (conservatively estimated to be the highest risk area), as well as the nearest well completed in gypsum (372 Milford Road), will be undertaken to determine the capacity of individual wells and nearby aquifers. The Proponent is prepared to provide alternative water supply should existing supplies be disrupted. It is understood that a pre-blast survey is required according to the NSE "Procedure for Conducting a Pre-Blast Survey" (NSE 1993) for all structures situated within at least 800 m of the Proposed Extension Area. Based on the results of this assessment, the 400 m well survey discussed in Section 5.5.2 is proposed; however a detailed well monitoring plan and pre-blast survey will be developed in consultation with NSE at the Industrial approval amendment stage.

Transportation

The Project is not anticipated to result in a significant increase in rail or truck traffic on public roads above that associated with the existing NGC mine operation. Future hauling practices will remain consistent with current practices shipping daily to port facilities located in Dartmouth on Halifax Harbour. At current production, the site ships one train load made up of 66 rail cars per day, five days per week. The site has shipped two train loads per day in the past. The site ships by rail to two wallboard plants in New Brunswick on average 15 cars per day. The site also ships some material via dump triaxle trailer mainly during the spring and summer months, with approximately 20 to 30 trucks per day.

Recreation and Tourism

The existing mine and proposed extension of the operation are not likely to have a substantive effect on informal recreational uses in the area including hiking, hunting and recreational fishing. The mine is situated in a hunting management zone, but the Project is not located on Crown land and thus hunters will require permission from NGC to pursue their activities in the area. NGC does not currently grant permission due to concerns with site security and public safety related to the existing mine operation.

The existing mine is situated in the secondary watershed of the Shubenacadie River and the primary watershed of the Shubenacadie/Stewiacke Rivers. The water quality of the effluent entering the Shubenacadie River will meet parameters as stated in the facility's Industrial

Approval (No. 89-100; Appendix A) and future amendments. The sole watercourse (WC-1) in the Study Area (original extension area) is fish bearing and the water has direct connection downstream to Gays River which supports multiple recreational fisheries. The Ecological Buffer Zone will be established and this buffer will also mitigate against the permanent alteration or destruction of fish habitat within WC-1.

Human Health

Project activities may result in air emissions (dust) near residential properties; however, these effects will be temporary and localized and are not expected to result in any significant effects on human health. As discussed in Section 5.7 efforts will be made to reduce the generation of dust as well as mitigation to reduce exhaust emissions produced by equipment operation and blasting. Human health related issues pertaining to air quality are discussed in more detail in Section 5.7. The Project will not result in any effects on the safety of travelers, as it will not entail any significant effects on traffic on public roads. NGC has site safety and security measures as well as signage to warn the public of the active mine. The health and safety of nearby residences is not expected to be affected by the Project.

Gypsum wallboard has some important safety and environmental benefits. One of the main benefits of gypsum wallboard is that it is fire resistant. This means that in the event of a fire, walls and ceilings that are constructed of gypsum wallboard will remain standing for a significantly longer length of time compared with other materials. This provides additional time for occupants of the building to escape from the building. Therefore gypsum wallboard makes a key contribution to public safety. Gypsum wallboard is also a highly recyclable material.

Mi'kmaq Traditional Land and Resource Use

The MEKS identified Mi'kmaq traditional use activities occurring in the Proposed Extension Area as well in various locations throughout the MEKS Study Area (5 km radius of Proposed Extension Area). Based on the information gathered and presented in the MEKS, it was identified that there is a potential that the Project could affect Mi'kmaq traditional use in the area, *e.g.*, with regards to bass fishing and deer hunting. For maps of fishing, hunting and gathering areas that are used members of the Mi'kmaq community, refer to the MEKS in Appendix F. The water quality of the effluent entering the Shubenacadie River will meet parameters as stated in the facility's Industrial Approval (No. 89-100; Appendix A) and future amendments.

The majority of species traditionally harvested by Mi'kmaq are widely available in other areas; however the Mi'kmaq people continue to undertake traditional use activities within the Study Area. These activities included resource use from both land and water.

Based on the information gathered for the MEKS, it is likely that potential Project interactions with traditional land and resource use will be effectively managed through a variety of mitigative measures that are technically and economically feasible. These include mitigative measures described throughout this environmental assessment to protect other VCs that are of concern to traditional use (*e.g.*, vegetation, wildlife, fish and fish habitat). The MEKS recommended that "the

traditional use activities of the Mi'kmaq be reflected upon in the overall environmental presentation and any remediation or Project work consider the interest the Mi'kmaq have in the area."

Monitoring and Follow-up

The Proponent will provide, if requested by NSE, records of any public complaints and associated actions. Details of any monitoring programs required by NSE (*e.g.*, noise, dust) will be developed in consultation with NSE and outlined in the Industrial Approval amendment application.

Summary

In summary, the proposed Project is an extension to a currently operating mine in an area historically influenced by mining and forestry operations. The mine is located on land that is zoned for resource uses such as extractive facilities with the issuance of a development permit (Halifax Regional Municipality 2012). The Project activities are consistent with current uses in the area and are intended to extend the life of the existing mine site. Land and resource use near the Proposed Extension Area will be affected over a minimum 35 year time period by the advancing mine activities. In particular, some residential and agricultural property falls within the Proposed Extension Area and it is assumed that NGC will be able to come to an agreement for use of these lands. The original extension area boundaries have been redrawn and an Ecological Buffer Zone will also be instituted which will have the added benefit of buffering other residential areas. The water quality of the effluent entering the Shubenacadie River will meet parameters as stated in the facility's Industrial Approval (No. 89-100; Appendix A) and future amendments. Dust and noise will be mitigated as conditions of permitting, and residential wells will be surveyed and groundwater monitored. With the implementation of proposed mitigation measures, significant Project-related effects on land and resource use are not likely to occur. Continued operation of the mine will result in economic benefits, including ongoing employment and business opportunities.

The proposed Project will result in a change in traditional use reported by the Mi'kmaq in the MEKS which could persist over the life of the Project. The change in traditional Mi'kmaq land and resource use is attributable to direct and indirect disturbance/loss of resources traditionally harvested on the lands in the Project region. With the implementation of proposed mitigation and environmental protection measures, including the recommendation specified in the MEKS report (*i.e.*, consideration of Mi'kmaq interests and traditional use activities throughout the environmental planning process as well as during all Project work and remediation activities), the environmental effect of a change in land use by the Mi'kmaq is predicted to be not significant. Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of this mitigation and confirm this effects prediction and any required adaptive management.

5.9 OTHER UNDERTAKINGS IN THE AREA

Gallant Aggregates Ltd. owns a quarry (Elmsdale Quarry) that is located approximately 10 km southeast of the NGC mine. The Elmsdale Quarry received EA Approval in 2007 to expand their quarry operation. Approximately 3.7 km from the NGC mine, there is a lead/zinc mine in Gays River, although this mine is not currently in operation. There are other aggregate pits located within 2 km of the existing NGC mine (Figure 5.7). The NGC mine and the other pits and quarries in the area have been operating in relatively close proximity for years. The existing NGC operation is currently functioning without any major issues in terms of dust, emissions, traffic, water, *etc*. There has been one noise complaint this year related to the backup alarm on the trucks. NGC is currently investigating the use of strobe lighting on the trucks to reduce noise but still meet Nova Scotia Occupational Health and Safety Act (1996) requirements. Any issues that are reported are handled immediately. It is assumed that other pits and quarries and mining operations in the region are also obligated to abide by standard permit conditions to manage noise and dust and other effects potentially overlapping with mining operations at NGC. Since the proposed NGC mine extension Project does not include an increase in production, and assuming the effective application of mitigative measures at NGC and other projects operating under provincial approval, significant adverse Project-related effects regarding other undertakings in the area are not likely to occur.

The proposed Alton Gas Underground Storage Project plans to discharge diluted brine into the Shubenacadie River at a point approximately 27.5 km downstream of the NGC discharge point for mine runoff (see Sections 2.5 and 5.1). NGC has, monitored and discharged treated (via settling) water for many years under terms of provincial Industrial Approval (No. 89-100) without incident or adverse effects. No overlapping effects with the Alton Project on the Shubenacadie River are anticipated.

6.0 Effects of the Project on the Environment

Activities associated with the proposed mine extension Project, and operation of the extended mine, will be conducted in accordance with terms and conditions of the Industrial Approval No. 89-100 that was obtained from NSE in 1989, pursuant to Division V of the Activities Designation Regulations, as well as future amendments to the Approval an In July 2013, additional Non-Mineral Registration tracts were approved by the Minister of Natural Resources. Copies of the above documents, other permits, and the Registry of Joint Stocks for NGC are included in Appendix A.

Fish and Fish Habitat

One watercourse, one anthropogenic pond and four additional dry drainage channels were identified during the assessment (Figure 5.1). The water quality of the effluent entering the Shubenacadie River will continue to meet parameters as stated in the facility's Industrial Approval (No. 89-100; Appendix A) and future amendments. A phased approach to the extension of the mine will allow for an adaptive approach to monitoring and management of potential effects to surface water and groundwater resources which in turn may affect fish habitat downstream. Based on the results of the watercourse assessment, the use of an Ecological Buffer Zone, and the mitigation proposed, there is very low potential for mine activities to interact with fish and fish habitat and significant adverse Project-related effects on fish and fish habitat are not likely to occur.

Plant and Wildlife Species of Conservation Interest

Environmental effects of the proposed mine extension will include the loss of terrestrial habitat. The results of plant and wildlife habitat modeling show that there is potential for habitats in the Study Area (*i.e.*, original extension area) to support rare or sensitive species. Four of the six plant SOCI are located within the original extension area (Figure 5.2). These four species could potentially be affected by direct loss of habitat through mining activities. The presence of a deep excavation associated with the mine in close proximity to the wetlands where these species are found could result in changes to wetland hydrology and adverse effects to the resident species. In order to reduce potential changes to wetlands and the plant SOCI, the Proponent subsequently decreased the size of the original extension area (Figure 5.2) and established an Ecological Buffer Zone to protect the wetlands and watercourse. This resulted in all of the plants considered SOCI to be situated outside of the Proposed Extension Area and not be subjected to direct habitat loss and also protected against indirect hydrological changes. Assuming the implementation of recommended mitigative measures, significant Project-related effects on plant SOCI are not likely to occur.

Similar for wildlife, assuming application of the recommended mitigation measures described (establishing Ecological Buffer Area, conducting clearing activities outside of the breeding season for most birds to facilitate compliance with the MBCA, and worker training for identifying

key SOCI and assisting compliance with relevant acts and regulations), significant Project-related effects on wildlife are not likely to occur.

Wetlands

Ten wetlands of varying size were found within the Study Area (original extension area), four of which are in the Proposed Extension Area. Wetlands 1 - 3 are located in the southern portion of the proposed footprint while Wetlands 4 - 10 are clustered near the north-eastern boundary (see Figure 5.1). Nine of the wetlands identified are classified as swamps. These swamps are a combination of shrub, tall shrub, treed and forested. There is also a freshwater marsh, located just outside the northeastern boundary in association with a small anthropogenic pond (Pond-1 on Figure 5.1). Six of these wetlands (*i.e.*, WL4, WL6, WL7, WL8, WL9, WL10 on Figure 5.1), comprising 78% of the total wetland area within the Study Area as well as the only watercourse (WC-1) on the site, will be protected by an Ecological Buffer Zone occupying a total area of approximately 32 ha in the eastern portion of the Study Area/original extension area (of which 9 ha is in the Proposed Extension Area; Table 2.1). In summary, assuming the application of proposed mitigation measures, including avoidance and reduction of both direct and indirect influences by employing the Ecological Buffer Zone, wetland buffers and maintaining existing site drainage conditions, monitoring to confirm effectiveness of mitigation, as well as providing compensation for loss of wetland functions where effects are unavoidable, significant Project-related effects on wetland function are not likely to occur.

Groundwater Resources

There is potential for Project-related effects to local groundwater quality and quantity as a result of the proposed mine extension. Quality effects may include contamination of groundwater from accidental spills of fuel, lubricants or blasting chemicals or temporary increases in nearby turbidity in potable wells as a result of blasting vibrations. Project-related contamination (*e.g.*, accidental petroleum hydrocarbon spills from machinery or blasting chemicals) (*i.e.*, fuel oil and nitrate) could theoretically affect the groundwater at the mine and potentially affect well water quality down gradient of the Project. Based on the results of the groundwater resources assessment (Section 5.5) and assuming the application of proposed mitigation measures and follow-up monitoring as necessary, significant Project-related effects on groundwater quality and quantity are not likely to occur.

Bedrock underlying the Proposed Extension Area consists of massive gypsum. The potential for acid drainage production in this area is presently unknown; however, generally, gypsum is not known to be an acid drainage risk, particularly due to the high buffering capacity of the carbonate rich rock. No evidence of acid rock has been found over the 60 years that the mine has been in operation.

Archaeological and Heritage Resources

The Proposed Extension Area has low potential for identifiable human use in the pre-Contact and low potential for identifiable human use in the historic periods. It is assumed that no areas beyond the Proposed Extension Area will be disturbed during the development and operation of the proposed mine extension. The development and operation of the proposed mine is unlikely to have adverse environmental effects on unknown heritage resources and it is recommended that no further archaeology is required. Based on the results of the desktop study and field pedestrian survey, and the mitigation proposed, the potential or archaeological and heritage resources is low and significant Project-related effects on unknown resources are not likely to occur.

If archaeological, heritage or paleontological resources are discovered during development and operation of the Project, the find will be immediately stopped and reported to the Curator of Archaeology and/or the paleontological staff at the Nova Scotia Museum and the Manager Special Places, Heritage Division Department of Communities, Culture and Heritage (CC&H). If the resources are thought to belong to Mi'kmaq, the Chief of the nearest Mi'kmaq band (*i.e.*, Sipekne'katik First Nation) will also be contacted. The appropriate authorities will determine further actions to be undertaken which could include avoidance and further assessment.

Atmospheric Environment

The air and sound quality effects related to the proposed mine extension can be controlled with standard mitigation practices and therefore the Project is not likely to have a significant adverse effect on the atmospheric environment. NGC will develop dust and sound monitoring programs that will be submitted as part of the Industrial Approval Application amendment process.

Land and Resource Use

The proposed Project is an extension to a currently operating mine in an area historically influenced by mining and forestry operations. The mine is located on land that is zoned for resource uses such as extractive facilities with the issuance of a development permit (Halifax Regional Municipality 2012). The Project activities are consistent with current uses in the area and are intended to extend the life of the existing mine site. Land and resource use near the Proposed Extension Area will be affected over a minimum 35 year time period by the advancing mine activities. In particular, some residential and agricultural property falls within the Proposed Extension Area and it is assumed that NGC will be able to come to an agreement for use of these lands. The original extension area boundaries have been redrawn and an Ecological Buffer Zone will also be instituted which will have the added benefit of buffering other residential areas. The water quality of the effluent entering the Shubenacadie River will meet parameters as stated in the facility's Industrial Approval (No. 89-100; Appendix A) and future amendments. Dust and noise will be mitigated as conditions of permitting, and residential wells will be surveyed and groundwater monitored. With the implementation of proposed mitigation measures, significant adverse Project-related effects on land and resource use are not likely to occur. Continued

operation of the mine will result in economic benefits, including ongoing employment and business opportunities.

The proposed Project will result in a change in traditional use reported by the Mi'kmaq in the MEKS which could persist over the life of the Project. The change in traditional Mi'kmaq land and resource use is attributable to direct and indirect disturbance/loss of resources traditionally harvested on the lands in the Project region. With the implementation of proposed mitigation and environmental protection measures, including the recommendation specified in the MEKS report (*i.e.*, consideration of Mi'kmaq interests and traditional use activities throughout the environmental planning process as well as during all Project work and remediation activities), the environmental effect of a change in land use by the Mi'kmaq is predicted to be not significant. Ongoing engagement with local Mi'kmaq community representatives will provide feedback on the effectiveness of this mitigation and confirm this effects prediction and any required adaptive management.

Summary

Assuming the mitigative measures specified in this report are implemented, and the mine is operated according to existing and any future provincial guidelines and approvals, significant Project-related effects are not likely to occur.

7.0 Effects of the Environment on the Project

The definition of an environmental effect often includes any change to the Project that may be caused by the environment. In the case of a mining operation, potential effects of the environment on the Project are limited to climate and meteorological conditions.

Normal local temperature and precipitation conditions will not have a substantive effect on the Project such that there will be any resulting environmental effect. Air temperature and precipitation conditions of greatest concern of causing a significant adverse effect on the Project are heavy precipitation events (heavy rain or snow melt), which could result in erosion and flooding.

Heavy precipitation events can cause delays in onshore construction activities and increase the risk of erosion and sedimentation. Heavy rains or snow can temporarily restrict mining activities. Heavy precipitation events, however, are an expected work condition and the construction schedule allows for weather conditions typical for the region. The risk from erosion and sedimentation during extreme weather will be greatly reduced once site soils have been stabilized through revegetaton in rehabilitation areas. An Erosion and Sediment Control plan will be developed during the Industrial Approval Amendment stage.

Heavy precipitation events may cause short-term delays during operation of the Project, but these short-term delays are not anticipated to result in any environmental effects. Heavy precipitation will result in increases in stormwater runoff in the Proposed Extension Area, resulting in increased loadings to the stormwater collection and treatment system. A Stormwater Management Plan, including details regarding the plans for monitoring, maintenance and upgrading flow retention/siltation treatment areas will be prepared/updated at the Industrial Approval amendment stage. Design criteria will recognize the increased likelihood of intense precipitation events in coming decades.

The climate as a "natural" phenomenon is extremely complex. As indicated in Nova Scotia Environment's Guide to Considering Climate Change in Project Development in Nova Scotia (2011) it is important to understand the effects associated with climate change to reduce project risks with compliance with existing and future GHG reduction targets and legislation both in Canada related to GHGs, such as carbon cap-and-trade or carbon tax systems, certain projects will need to consider their 'carbon footprint'. Weather observations are perhaps the oldest and most reliable form of environmental monitoring. Typical and extreme weather events are well documented with reasonably good spatial coverage existing in Canada with a combination of fully instrumented, manned or automated, observation stations supplemented by a wider coverage of climatological stations. This monitoring forms the basis for the historic, current and, predicted climate conditions and trends.

The effects of climate change are becoming better understood. Since it is not possible to conduct experiments on the climate or to reproduce its intricacies in the laboratory, climate

models facilitate increased understanding of climate change (Natural Environment Research Council 2008). Climate models are based on the laws of physics to describe how temperature, pressure, winds, currents and other variables interact and change over time (Natural Environment Research Council 2008). There are many assumptions and uncertainties associated with modeling. Climate models are, thus, mathematical approximations of the climate system (Natural Environment Research Council 2008), tools to assist in decision making, but not sufficiently accurate to specifically describe future events and conditions.

Numerous climate change-related effects have been observed globally. Many of these effects are anticipated to intensify over the next century, including increased temperatures, receding glaciers, melting of permafrost, rising sea levels and coastal flooding, changing of precipitation patterns and temperatures.

Projected climate changes may affect operation of the Project in many different ways, ranging from positive to negative, and from negligible to extreme effects. Those which could potentially have an adverse residual environmental effect include increased frequency and intensity of storm surges, increased frequency of extreme storms accompanied by strong winds, increased incidence of flooding and erosion, and increased frequency of heavy precipitation events. Each of these, if not engineered and designed for, could result in damages to infrastructure that are not feasible to fix or failure of mitigation, which may in turn result in environmental effects.

There is a number of planning, design, and construction strategies intended to minimize the potential effects of the environment on the Project so that the risk of damage to the Project or interruption of service can be reduced to acceptable levels. Mitigation measures include, but are not limited to, designing and installing erosion and sediment control structures to accommodate appropriate levels of precipitation primarily in reclamation areas (including accommodation for climate change), and considering weather conditions when scheduling activities, including scheduling of activities to accommodate weather interruptions. Discharged water will continue to be monitored and sampled according to the terms and conditions of the existing Industrial Approval (and future updates). In the unlikely event that overflow associated with a significant rain fall exceeds final effluent discharge limits as determined through monitoring, contingency measures will be implemented. All Project activities will be taking place out-of-doors and thus weather has been and will be factored into all Project phases and activities. The Proponent proposes that the mine remain operational 52 weeks per year, weather permitting, and will consider severe weather conditions when planning activities. This is consistent with current operations at the existing mine. Heavy snowfalls and significant snow accumulation will have an effect on the mine's ability to remain open.

In summary, climate and meteorological conditions, including climate change, are not anticipated to significantly affect the operation of the mine over its proposed lifetime.

8.0 Other Approvals Required

As stated in Section 2.0, the Proponent is required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and *Environmental Assessment Regulations*.

Other relevant provincial regulations include the Activities Designation Regulations, which requires an amendment to the existing Industrial Approval (Approval No. Approval No. 89-100) from NSE for operation of the Project; and the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act* (1996).

No requirements under the Canadian Environmental Assessment Act, 2012 (CEAA 2012) are anticipated as gypsum mining is not listed as a designated project as per Section 2 of the *Regulations Designating Physical Activities.*

9.0 Funding

The proposed extension will be 100 percent privately funded.

10.0 Additional Information

No additional information is provided in support of this document.

11.0 References

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11.2 PERSONAL COMMUNICATION

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12.0 Appendices

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