situated is jointly owned by B. George, J.B. George and J.R. George, and is leased to Chedabucto Aggregates.

Quarrying at the site began in 2004, under separate Approvals, with the current Approval issued in 2009. To date, a total combined area of approximately 5.17 ha has been quarried.

Additional details on individual project components is presented in Section 4.0.

3.4.1 Purpose and Need for the Project

The purpose for the Project is to allow Chedabucto Aggregates to expand the existing quarry to continue current operations at the quarry in Halfway Cove. The aggregate stone products produced by Chedabucto Aggregates are used by Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) for public infrastructure, and by local individual consumers and small commercial enterprises for private roadways, backfill for building foundations, septic beds and water systems. The Proponent anticipates the source material in the proposed extension area to be of similar quality to the material currently extracted at the existing quarries.

Aggregate quarries are an important component of Nova Scotia's natural resource sector and provide essential locally-sourced materials to the province's construction industry. As the only operational quarry in the area, Chedabucto Aggregates provides an important supply of materials to local business, sparing them the direct and ancillary costs associated with outsourcing to other areas of the province.

The quarry is a small, one-person operation, run entirely by the owner/operator. This is not expected to change with future operations, though additional jobs could be created if market demands increase. As economic development is an important issue facing residents of Guysborough County, local businesses such as this quarry create economic benefits which are valued by the surrounding community. In recognition of these potential benefits, letters of support for the Project from the Guysborough and Area Board of Trade and local business are provided in Appendix B.

3.4.2 Consideration of Alternatives

Alternative methods of carrying out the proposed Project to be considered include:

- use of alternative methods for extraction;
- use of an alternative facility location;
- use of alternative transportation modes/route;
- alternative technologies for wastewater treatment; and/or
- other rehabilitation and decommissioning options.

The existing operation utilizes current industry standard procedures during all phases of extraction, processing and transportation of the aggregate produced. Alternative methods are always under consideration in terms of efficiency, cost effectiveness and environmental advantages. Continuing operations from the Project will continue to be assessed on an ongoing basis to ensure that the best available techniques are being utilized in all phases of day to day operations.

The current primary method of extraction at the existing quarry is blasting, which is required due to the nature of the metagreywacke being extracted. Though earth movements have typically fractured the rock through faulting and jointing, in order to handle and process the rock it must be further fragmented by blasting. For this type of bedrock, existing alternative methods of extraction, such as mechanical methods, would not be feasible or practical.

Careful consideration must be given to a number of factors when deciding on the location of a quarry, including the quality and size of the bedrock deposit, the proximity of existing and future developments, and the suitability of existing roadways to provide access to the site and transportation of aggregate materials. Transportation of aggregate is an expensive exercise due to the nature of the materials; therefore the proximity from a quarry to the consumer is an important factor in the feasibility of a quarry development. The existing trucking route follows the on-site access road, continuing on to Highway 16. At the existing quarry site, alternative transportation routes in and out of the site are not currently available.

The Project involves the expansion of an area that has already been exposed to quarrying activities, rather than developing a pristine site. Re-locating operations would require the development of new facilities, access roads and ancillary infrastructure, which is not required for the proposed expansion of the existing operations. Therefore, it is expected that the development of a new site to accommodate relocation of the quarry, would likely result in greater disturbance to the natural environment and to surrounding communities than would the proposed expansion of the current quarry operations.

Wastewater, surface water runoff and erosion and sedimentation are managed in accordance with industry best practices and standard NSE requirements, to ensure that appropriate controls are utilized to avoid potential effects to natural receptors. These practices will continue to be maintained through operations at the extended quarry in accordance with provincial and industry standards. Wastewater and surface water management at the site will be upgraded as required for the expansion, and will continue to be evaluated on an on-going basis throughout the lifespan of the Project. This will allow for the implementation of new standards and technologies as they become available over the lifespan of the Project.

Site rehabilitation will be implemented via progressive rehabilitation (refer to Section 4.6). Progressive rehabilitation allows quarry operators to minimize the area of disturbance at a site. Instead of mining reserves until the quarry is exhausted, leaving a disturbance footprint the size of the entire Project Area, quarrying is done on an “as-needed” basis, with restoration and rehabilitation of exhausted areas following suite. This effectively minimizes the amount of time lands are left in a disturbed state, reducing the effect on the environment.

As progressive rehabilitation is believed to be the most effective way to re-establish natural site conditions in the shortest time frame possible, this is considered preferable to alternative methods. A preliminary Rehabilitation Plan will be provided to NSE as part of the Approval amendment application, which will follow the guideline of leaving no more than 10 ha of land open at a given time. Within twelve months of decommissioning of the quarry, the site will be rehabilitated to the satisfaction of NSE in accordance with the approved Rehabilitation Plan.

Since site rehabilitation is proposed to be done in accordance with all applicable guidelines, regulations and NSE standards, no alternatives have been considered.

3.4.3 Regulatory Framework

Federal
A federal EA is not required for the Project as it is not located on federal land or listed as a physical activity that constitutes a "designated project" as listed under the Regulations Designating Physical Activities of the *Canadian Environmental Assessment Act (CEAA) (*2012*).*

Additional federal permitting requirements are provided in Section 10.

Provincial
In proposing a quarry expansion greater than 4 ha, the Proponent is required to register the Project as a Class I Undertaking pursuant to Part IV of the NS EA, and the Environmental Assessment Regulations, prior to commencing work.

Pit and quarry operations in Nova Scotia are regulated under the Pit and Quarry Guidelines (NSE 2003) under the NS EA. These guidelines apply to all pit and quarry operations in the province of Nova Scotia, as defined under Division V Part 2 (e) and (f) of the Activities Designation Regulations. Guidelines include:

- separation distances for operations;
- liquid effluent discharge level limits;
- suspended particulate level limits;
- sound level limits;
- blasting conditions;
- site rehabilitation/reclamation requirements;
- security bond requirements; and
- groundwater protection requirements.

Additional provincial approval requirements are outlined in Section 10.

Municipal
In preparation for residential growth and economic development in the region, the MODG has recently undertaken an extensive land use planning process which includes a Municipal Planning Strategy and accompanying Land Use By-law (Appendix C), most recently amended in April 2013 (MODG 2013a). In December 2013, the Proponent made a request to the Council of the MODG for the rezoning of PID 35034784 from Mixed Use Rural Residential (MRR-1) to Industrial Heavy (I-2). In January 2014, Council passed a motion approving this rezoning, and in accordance with the *Municipal Government Act* (1998), an advertisement was placed in the Guysborough Journal, outlining the right to appeal. No appeals were received during the 14 days appeal period, and therefore the property is considered to be rezoned to Industrial Heavy (I-2) (Appendix C).

All development which falls within the Guysborough Municipal Planning area, must first obtain a municipal development permit under the By-law (MODG 2013b). A development permit will be issued only under conformity with the requirements outlined in Part 6 (General Provisions) and Part 18 (Industrial Heavy I-2 Zone) of the By-law (MODG 2013b). A copy of the relevant provisions of the Land Use By-law is outlined in Appendix C.

3.5 Scope of EA

EA is a planning tool used to predict the environmental effects of a proposed project, identify measures to mitigate adverse environmental effects, and predict whether there will be significant adverse environmental effect after mitigation is implemented.

As a Class I EA, this registration document and supporting studies have been developed to meet all requirements under Section 9(1A) of the NS EA.

In addition, the document has been prepared using the following provincial guidelines:

- "Guide for preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia" (NSE 2009a);
- "A Proponent's Guide to Environmental Assessment", published by the Environmental Assessment Branch of NSE and revised in 2009 (NSE 2009b); and
- The "Pit and Quarry Guidelines (NSE 2003)", under the NS EA, revised in 2003.

The following regulatory bodies have been contacted by the Project team to provide input into the Project planning process and advice regarding the EA scope:

- Nova Scotia Communities, Culture and Heritage (CCH);
- NSE; and
- Nova Scotia Department of Natural Resources (NSDNR).

The scope of the assessment for this Project includes:

- identification of Valued Environmental Components (VECs);
- prediction and preliminary assessment of potential interactions between the Project and VECs;
- identification of environmental effects resulting from predicted interactions;
- identification of necessary avoidance, mitigation and/or compensation strategies;
- the determination of residual (*i.e.*, following mitigation) effects and their significance; and
- the requirement for monitoring or follow up programs.

4.0 DESCRIPTION OF THE PROJECT

The existing quarries (5.17 ha total) located in Halfway Cove, have been owned and operated by the Proponent since 2004. The Proponent wishes to consolidate the two existing quarry operations and expand to a total proposed quarry area of 11.4 ha, to allow for continued aggregate production, which will continue to supply aggregate sand and gravel to local commercial contractors. The

proposed quarry expansion is intended to allow for the continuation of operations at the Halfway Cove site, maintaining production at approximately the same level as current operations. Though tonnage is variable from year to year, the annual aggregate production rate is expected to remain near the current average rate of approximately 25,000 metric tonnes per year, though maximum production rates could increase to 50,000 metric tonnes per year depending on market demand.

Chedabucto Aggregates crushes and processes a sedimentary stone called metagraywacke, a form of sandstone which has been hardened by metamorphism. Chedabucto's stone is the northern portion of a formation of sedimentary rock that begins at the southern coastline of Nova Scotia from the Atlantic Ocean near Goldboro to Chedabucto Bay, forming part of the Meguma Terrane. The aggregate produced by the quarry is used by NSTIR and commercial contractors as fill to improve land elevations, and to build roadbeds/shoulders, and asphalt pavement. Individual consumers and small commercial enterprises use the aggregate for private driveways, backfill for building foundations, erosion protection from water and runoff, and septic/water systems.

Of the total 21.9 ha area to be included within the currently proposed Project Area, approximately 11.4 ha will support quarrying activities. The remaining approximately 9.28 ha will be set aside as a Wetland Exclusion Area in which no quarrying or development will occur, thereby avoiding potential Project interactions with wetland habitat present within the Project Area. The Wetland Exclusion Area incorporates a 30 m buffer between the expansion limit and all identified wetlands.

Existing operations involve the blasting, crushing and screening of bedrock to produce a number of aggregate stone products for supply to local markets. This method of production is expected to continue with future operations at the expanded quarry. The proposed primary activities to be undertaken at the site include:

- cutting, grubbing and piling of vegetation;
- excavation and removal of overburden/top soils;
- stockpiling of overburden for use in future site rehabilitation;
- drilling and blasting;
- excavation of blasted material;
- processing of aggregate through screening and crushing;
- stockpiling of prepared sand and gravel;
- transportation of aggregate by truck via the principal quarry access road and Highway 16;
- progressive rehabilitation of quarry lands; and
- final decommissioning and site rehabilitation following closure of the quarry.

Excavation of aggregates is anticipated to occur from the existing surface elevation to an elevation one meter above the local water table. Site preparation, extraction and rehabilitation are anticipated to occur on a continuous, progressive basis throughout the lifespan of the Project. Production at the extended quarry is expected to remain consistent with current operations, though this can vary depending on demand and local market activity. The average production rate of the existing facility is variable, but averages approximately 25,000 tonnes per year. Depending on market demand, production rates may reach as high as 50,000 tonnes per year. Current estimates indicate there are approximately 1 to 2 million tonnes of rock reserves within the proposed Project Area. Future quarry

operations are expected to continue over an extended period of time until the material is exhausted. For the purpose of EA, the lifespan of the Project is estimated to be 30 years.

4.1 Geographical Location

The proposed Project is located within the MODG, approximately 13 km southeast of the town of Guysborough, NS. The Project Area is situated on PID 35034784, which is registered as a "Residential/Commercial/Resource" parcel (Drawing 2.1). The Project Property is bordered by Highway 16, and residential properties to the north, resource and residential lands to the east and west, and provincial forest to the south. Chedabucto Bay lies approximately 400 m north of the Project Area boundary. Access to the quarry is provided via a private gravel access road leading from Highway 16 (Drawing 3.3).

As a result of field and desktop studies undertaken in support of this EA registration document, the proposed Project Area has been located, in part, to reduce potential adverse environmental effects including effects on surrounding residents. Project location details are provided in Table 4.1.

Table 4.1: Property Location Information

Site Name	Chedabucto Aggregates Quarry
Civic Address	6640 Highway 16, RR # 2
PID	35034784
Community	Halfway Cove, NS
County	Guysborough
1:50 000 Topographic Map #	11F06
Grid Reference	45°20'45.14"N, 61°20'22.42"W 630078.05 E, 5022714.58 N (Zone 20T)

4.2 Physical Components

The existing physical components of the quarry operations consist of the quarry floor and working face; a laydown area for processing and loading; aggregate and overburden stockpiles; surface water drainage; a catchment pond on the quarry floor, a settling pond, and a scale house (Drawing 3.3). Access to the quarry is via a private gravel access road from off Highway 16. No utilities or sewage treatment are located on the site. Equipment on-site during various stages of production include clearing/grubbing equipment, excavators, portable aggregate crushing, screening, loading equipment and transportation vehicles.

The working / laydown area and loading area are located on the quarry floor, where extracted materials are processed using portable crushing, and screening equipment that is transported to the site on an "as-needed" basis. The proposed quarry expansion is expected to see portable crushing equipment on-site for 20-24 weeks per year, depending on production rates and demand.

Ten aggregate stockpiles are currently located within the two existing quarries. Two piles are located in the northernmost quarry, while eight are located in the southern quarry (Drawing 3.3). Topsoil, grubbing materials and overburden that have been removed prior to drilling and blasting are stored on-site, and are seeded/stabilized for future use during site rehabilitation. These overburden piles are currently located along the eastern, southern and western extents of the southern quarry. It is

expected that these practices will continue throughout the development and operation of the proposed expanded quarry.

4.3 Project Activities

4.3.1 Site Preparation and Construction

To minimize the potential for erosion and sedimentation, grubbing and removal of overburden has been and will continue to be conducted only on an as-needed basis, to accommodate drilling and blasting activities. Topsoil, grubbed material and overburden are stockpiled on-site and stabilized via seeding for subsequent use during site rehabilitation. A similar sequence of grubbing, overburden removal, stockpiling and stabilization procedures will continue throughout the operations of the proposed expansion.

The overburden piles are currently located along the eastern, southern and western extents of the quarry floor. Stockpiles have been located in areas where the gradient and drainage conditions will cause any runoff to collect in the catchment pond within the southernmost quarry. This mitigates potential siltation effects to off-site receptors associated with surface water runoff from the overburden piles. This strategy will continue to be implemented through the lifespan of the extended quarry. Site access will continue to be through the existing access road, therefore no watercourse or wetland alterations are expected as a result of new road construction.

Additional environmental management and mitigation procedures related to site preparation and construction, are provided in Section 8.0.

4.3.2 Operation and Maintenance

It is anticipated that the operations and maintenance described for the existing quarry will remain consistent through future operations following the quarry expansion. Aggregate extraction at the existing quarry begins with drilling and blasting to extract raw materials, which typically takes place one to two times per year, on average. This could vary during future operations as production activities are dependent on local market activity. Blasts conducted at the site typically produce 20,000 tonnes. The current height of the quarry face is approximately 35 ft, though the face height is expected to decrease as the quarry progresses.

All blasting activities will continue to be conducted by a qualified blasting company, who will also be responsible for blast designs and methods in accordance with the General Blasting Regulations under the *Nova Scotia Occupational Health and Safety Act* (1996). Blasting activities at the expanded quarry will be continue to comply with the Pit and Quarry Guidelines, the General Blasting Regulations and all other applicable federal and provincial regulations. The blasting limits outlined in the Approval for the facility (Table 4.2), and any amendments, will continue to be adhered to.

Table 4.2: Blasting limits

Parameter	Maximum	Monitoring Frequency	Monitoring Station
Concussion (air blast)	128 dBL	Every blast	Within 7 m of the nearest structure not located on the site.
Ground Vibration	0.5 in/sec (12.5 mm/s)	Every blast	Below grade or less than 1 m above grade in any part of the nearest structure not located on the site.

Blasted rock is processed by portable crushing equipment that is brought on-site on an as-needed basis. After the bedrock is blasted and crushed, a screening operation sorts the broken rock by size, which is then stockpiled on-site for sale to customers. Processed materials are then stockpiled in designated areas on the quarry floor (Drawing 3.3).

Material is hauled and moved within the quarry with a loader, and transported from the loading area on the quarry floor, along the on-site access road to Highway 16. Though variable depending on the type and size of contracts ongoing, the average number of trucks hauling aggregate from the quarry is estimated to be approximately 8-10 per day. When large highway Projects are ongoing, this number can temporarily increase to 20 trucks per day. The number of aggregate loads transported from the site is expected to remain consistent following the proposed quarry expansion. The anticipated average production rate is approximately 25,000 metric tonnes per year, which is consistent with the average production rate of the existing quarry. It is possible that production could increase to up to 50,000 tonnes, depending on market demand. Weather permitting, the quarry operates on average 10-12 hrs per day, five days per week, 48 weeks per year or more. A similar schedule is expected to be maintained during operations at the expanded quarry.

The quarry is a small, one-person operation, run entirely by the owner/operator. This is not expected to change with future operations, though additional jobs could be created if local market demands increase. Drilling and blasting involves additional personnel, though these activities are sub-contracted to local companies. Hauling of materials from the quarry also involves additional labour and equipment requirements, which are provided by each individual customer.

All proposed quarry activities will be conducted in accordance with the amended Approval conditions for the quarry, when approved, the Pit and Quarry Guidelines and all other applicable guidelines and regulations. Chedabucto Aggregates' existing best practices and environmental procedures will remain in place, and updated as necessary throughout the lifespan of the Project. The Proponent has notified the local emergency response organization, the Queensport Fire Department, of plans to expand the existing quarry. Correspondence is provided in Appendix B.

An Environmental Protection Plan (EPP) will be developed following EA approval of the Project, which will provide specific environmental management, contingency and emergency response procedures for future quarry operations.

Additional environmental management and mitigation procedures related to quarry operations, are provided in Section 8.0.

4.4 Surface Water and Effluents

In accordance with best practices and standard NSE requirements, appropriate controls will continue to be maintained through operations at the expanded quarry to ensure that wastewaters generated during operations are managed to avoid potential effects to natural down-gradient receptors.

Surface waters from the southernmost quarry accumulate in the catchment area on the quarry floor (Drawing 3.3). Pooled water from the quarry floor is used as a water supply for dust suppression during crushing and processing. Additional drainage is provided through ditch "A", which directs runoff towards ditching along the access road to the settling pond near Highway 16 (Pond A). Drainage ditches are lined with 4-8' stone, to prevent erosion and sedimentation. An excavation at the end of the inlet pipe serves as a catchment for sediment, and is cleaned one to two times per year. Similar surface water controls are expected to be employed during future operations of the extended quarry.

The results of a water balance calculation for the Project Area indicate that, for a total annual precipitation of 1427.8 mm, 35% (503 mm) is lost to evapotranspiration, 18% (260 mm) to infiltration and storage, and 47% (664 mm) leaves the watershed as surface runoff. Additional surface water management capacity will be created, as needed, as the quarry develops. An updated Storm Water Management Plan, including the amount of additional settling pond volume required for proposed quarry operations will be further refined at the Approval amendment stage. The Storm Water Management Plan will be designed in consideration of the increased likelihood of more frequent and intense precipitation events in the coming years, as outlined in the NSE document "Guide to Considering Climate Change in Project Development in Nova Scotia" (NSE 2010). Surface water monitoring will continue to be conducted at the request of NSE.

Additional best practices and mitigation measures for surface water management and protection of surface water resources are outlined in Section 8.0.

4.5 Erosion and Sediment Control

An Erosion and Sediment Control Plan (ESCP), including additional settling pond volume, will be updated, as needed, to meet the requirements of the proposed expansion, in accordance with NSE's Erosion and Sedimentation Control Handbook for Construction Sites (1988) and in consultation with NSE. The updated ESCP will be provided as part of the Approval amendment application.

Overflow from the settling pond, if any, will be monitored and sampled according to the terms and conditions of the updated Approval (and future updates) and the Pit and Quarry Guidelines to ensure total suspended solids levels do not exceed the approved final effluent discharge limits outlined in the Approval (Appendix A). In the unlikely event that overflow associated with a significant rain fall exceeds final effluent discharge limits as determined through monitoring, additional controls will be implemented.

The following discharge limits are to be met prior to discharge into a watercourse or wetland, as outlined in the current (2009) Approval for the quarry:

Clear flows (normal background conditions)

- Maximum increase of 25 mg/L from background levels for any short term exposure (24 hours or less);
- Maximum average increase of 5 mg/L from background levels for longer term exposure (between 24 and 30 days).

High flow (spring freshets and storm events)

- Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 mg.L and 250 mg/L;
- Shall not increase more than 10% over background levels when background is >250 mg/L.

Additional best practices and mitigation measures for erosion and sediment control (ESC) are outlined in Section 8.0.

4.6 Air Emissions and Noise

Dust emissions will continue to be controlled with the application of water pooled in the catchment pond on the quarry floor, and by covering/stabilizing excavated areas and stockpiled overburden. Dust generated by traffic on the access road will be minimized by speed control, proper truck loading, application of dust suppressants, and/or other means as required by NSE.

Monitoring of airborne particulate emissions (dust) at site boundaries will be conducted at the request of NSE, in accordance with the Pit and Quarry Guidelines, the Nova Scotia Air Quality Regulations and the facilities Approval. In accordance with the above guidelines, particulate emissions (dust) shall not exceed the following limits at the property boundaries:

- Annual Geometric Mean 70 µg/m3; and
- Daily Average (24 hrs) 120 µg/m3

As per the Pit and Quarry Guidelines and the existing quarry Approval, sound levels from quarry operations do not exceed the following sound levels (Leq) at and beyond the property boundaries:

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

Sound monitoring will continue to be conducted at the request of NSE. Additional best practices and mitigation measures for the control and management of air emissions and noise are outlined in Section 8.0.

4.7 Dangerous Goods Management

The storage of hazardous materials on site is limited to one diesel storage tank located in the northeastern portion of the Project Area, along the access road near the scale house. No other fuels, lubricants or hazardous materials are stored on the property. It is possible that the Proponent may

allow subcontractors to temporarily store equipment on the site, as well as minor amounts of fuel and lubricants during various phases of extraction and processing. Regular maintenance of equipment is typically not carried out on-site. Temporary storage of waste materials on-site is located at least 30 m from watercourses, wetlands, and water bodies. Waste materials are removed from the site by a qualified waste hauler and disposed/recycled in accordance with provincial waste regulations.

The following mitigation strategies are expected to be maintained during future operations:

- All fuels and lubricants used during quarry operations will be stored according to approved containment methods in designated areas, located a minimum 30 m from watercourses, water bodies and wetlands.
- Repairs and/or refueling of equipment will not occur within 30 m of watercourses, water bodies or wetlands.
- All refueling activities on-site will comply with the NS Petroleum Management Regulations (N.S. Reg. 44/2002). Unforeseen events such as a leak or spill will be responded to immediately according to the procedures outlined in the EPP.
- Spills will be reported to NSE in accordance with the NS Emergency Spill Regulations (N.S. Reg. 59/95).
- Storage of all hazardous materials will comply with Workplace Hazardous Materials Information System (WHMIS) requirements. Appropriate material safety data sheets will be located at the storage site.
- Contaminated materials will be stored in an appropriate manner in a designated location until it can be removed by a qualified contractor and disposed of at an approved treatment/disposal facility.
- Transportation of dangerous goods will comply with the *Transportation of Dangerous Goods Act* (1992).
- Equipment will be kept in good working order, will be inspected regularly, and any observed leaks will be repaired. All required maintenance will be performed only by qualified personnel.
- If required, all hazardous wastes to be stored on-site will be fully contained and temporarily stored in a designated area until it can be removed from the site by a licensed contractor.
- Signage, including emergency contacts and telephone numbers, will continue to be posted at the front entrance of the facility.
- Chedabucto Aggregates existing best practices will remain in place, and updated as necessary throughout the lifespan of the Project.

4.8 Decommissioning and Site Rehabilitation

In accordance with the requirements outlined in the Pit and Quarry Guidelines, the Proponent will provide to NSE a preliminary Rehabilitation Plan for the site for approval, and submit an interim security within six months of receiving the amended Approval. The Rehabilitation Plan will include plans for site decommissioning (including test pits and boreholes), and both long and short-term plans for rehabilitation. The plan will include details on proposed final topography, maximum slopes, drainage and re-vegetation, and will provide details of how rehabilitation will be achieved at the site. The plan will be based on factors such as expected post-closure land use, final land form, slope

stability and other health and safety concerns, habitat restoration objectives, and hydrology/ hydrogeology.

The Rehabilitation Plan will be based on a progressive rehabilitation strategy, incorporating sequential stripping and replacement of overburden, subsoil and topsoil which will allow the establishment of vegetation as restoration moves forward following extraction. The rehabilitation schedule will be highly dependent on the rate of production during regular operations, but the first phase is expected to commence in 2016.

A phased approach to quarry operations will ensure that only the area to be quarried in one year will be cleared at a time with no more than 10 ha of land open at a given time. Overburden removed from the active portion of the site will continue to be stockpiled for use in future rehabilitation, in an unused area on the quarry floor. Progressive rehabilitation will consist of grading and/or levelling of inactive areas as required, followed by the reinstatement of overburden. These areas will then be re-vegetated using native species, wherever possible. Care will be taken to ensure invasive or aggressive species are not used during site re-vegetation.

During the final rehabilitation phase, all equipment, stockpiles, buildings and associated infrastructure will be removed and there may be additional tree planting and other vegetation requirements to achieve complete rehabilitation of the Project Area. Within twelve months of abandonment, the entire site will be rehabilitated, leaving the site in a safe, stable condition for future use.

The Rehabilitation Plan will include the proposed monitoring programs that will be implemented to assess whether the rehabilitation plan is meeting its stated objectives. If changes occur in the operating plans for the quarry, the Rehabilitation Plan will be revised and updated accordingly.

5.0 CONSULTATION AND ENGAGEMENT

5.1 Public Consultation

5.1.1 Methods of Involvement

The Proponent has been proactive in engaging local community representatives, businesses, government officials and surrounding residents who may have an interest or wish to provide comment on the proposed Project. Letters of support for the Project from the Guysborough and Area Board of Trade and local business are provided in Appendix B.

In December 2013, the Proponent made a request to the Council of the MODG for the rezoning of PID 35034784 from Mixed Use Rural Residential (MRR-1) to Industrial Heavy (I-2), under the requirements of the new MODG Municipal Planning Strategy and By-Law. In January 2014, Council passed a motion approving this re-zoning, and in accordance with the *Municipal Government Act*, an advertisement was placed in the Guysborough Journal, outlining the right to appeal. No appeals were received during the 14 day appeals period, therefore the property is considered to be re-zoned to Industrial Heavy (I-2) (Appendix B).

The local emergency responders, the Queensport Fire Department, has been informed of the proposed expansion, and provided with information regarding the availability of water at the site and site access. The Fire Department provided a response letter in support of the quarry expansion (Appendix B).

The Proponent has also contacted and received letters of consent for continuing quarry activities from many landowners surrounding the proposed Project Area. These letters of support have been provided to NSE.

A public meeting and information session was held by the Proponent in Halfway Cove in July 2014, which was attended by five people. The five attendees were local residents with knowledge of the current quarry and the operations. Printed information was provided to attendees including maps, wildlife and field survey results, and results of the Archaeological Resource Impact Assessment (ARIA).

A complete summary of the public consultation activities is provided in Table 5.1. All related correspondence is included in Appendix B.

Table 5.1: Public Consultation Activities

Date	Participants	Format/Activity
December 2013 - February 2014	Surrounding Landowners	• Project information provided. • Letters of consent received.
January 2014	Guysborough and Area Board of Trade	• Project information provided. • Letter of support received.
January 2014	Local Community, Municipal Council	• Public hearing for zoning amendment.
February 2014	Guysborough County Truckers Association	• Project information provided. • Letter of support received.
February 2014	NSE EA Branch	• Project meeting to discuss EA scope, field studies and deliverables.
March 2014	Queensport Fire Department	• Notification of proposed expansion. • Project information, including site access provided.
April 2014		• Letter of support received.
March, 2013	NSDNR	• Consultation regarding the requirements for spring breeding bird surveys.
March, 2013	NSDNR	• Consultation regarding Mainland moose survey methodology and timing.
July 2014	Last Port Motel (Local Business)	• Project information provided. • Letter of support received.
July 2014	Local Community	• A public meeting and information session was held by the Proponent in Halfway Cove, which was attended by five members of the community.
August, 2014	NSE EA Branch	• Project meeting to discuss field results and EA draft report.

5.2 Aboriginal Engagement

In February 2014, the Council of Paq'tnkek First Nation, the Native Council of Nova Scotia, the Kwilmu'kw Maw-klusuaqn Mi'kmaq Rights Initiative (KMKNO), the Confederacy of Mainland Mi'kmaq (CMM), and the Union of Nova Scotia Indians were provided with a letter informing them of the Project and inviting them to participate in the EA consultation process or provide commentary. An example of these letters is provided in Appendix B.

Regular follow-up letters were sent by the Proponent to each of these parties, providing progress updates on the Project. As the nearest First Nations community to the Project Area, the Council of Paq'tnkek First Nation has also been provided with updates on field programs throughout the spring and summer, and the Proponent has offered to share the results of these studies. Example letters can be found in Appendix B.

A letter was sent to Paq'tnkek Council inviting them to participate in the public meeting in July, 2014. To date, no response has been received from Paq'tnkek and therefore no meetings have been held; however, the Proponent will be happy to meet with Paq'tnkek Council to discuss Project details upon request. Because the KMKNO and the CMM have expressed an interest in the Project, these groups have been copied on all ongoing correspondence to Paq'tnkek Council.

A complete summary of all Aboriginal engagement activities, to date, is provided in Table 5.2. Correspondence is included in Appendix B.

Table 5.2: Aboriginal Engagement Activities

Date	Participants	Format/Activity
February 2014	Paq'tnkek First Nation, the Native Council of Nova Scotia, the KMKNO, the CMM, and the Union of Nova Scotia Indians	• Project information letter and map provided.
March and April 2014	Paq'tnkek First Nation, the Native Council of Nova Scotia, the KMKNO, the CMM, and the Union of Nova Scotia Indians	• Follow-up letters sent to First Nations groups.
May 2014	The KMKNO and the CMM	• Letters received from the KMKNO and the CMM recommending MEKS and ARIA are completed for the Project. • Response letters provided by Proponent.
May 2014	NS Office of Aboriginal Affairs	• Project information letter and map provided. • Phone conversation and email regarding consultation.
May 2014	Paq'tnkek First Nation (cc'd the KMKNO and the CMM)	• Spring Project update provided.
July 2014	Paq'tnkek First Nation (cc'd the KMKNO and the CMM)	• Invitation sent by Proponent to attend public meeting.
August 2014	Paq'tnkek First Nation, the KMKNO and the CMM	• Summer Project update provided.
August 2014	The KMKNO and the CMM	• ARIA update provided.

5.3 Comments and Feedback

During the public meeting in July 2014, questions were raised by attendees regarding levels of employment, size of the new quarry and production levels. All questions were answered to the satisfaction of the attendees.

In response to the introductory Project information sent out in February 2014, the KMKNO and the CMM provided responses recommending that a Mi'kmaq Ecological Knowledge Study (MEKS) and an ARIA be completed for the Project.

An ARIA was completed for the Project in May 2014 (Sections 8.13 and 8.14). Following a review of the ARIA report, CCH has approved the ARIA and agrees with the recommendations provided in the report. The KMKNO and the CMM have been notified that a copy of the final ARIA report can now be obtained through CHH.

Based on the results of the ARIA, the initial screening by the CCH, and the results of the field program, the Proponent has decided not to proceed with an MEKS at this time. Though an MEKS has not been completed in support of the Project, the Proponent has offered to share the results of field studies, with both the KMKNO and the CMM, as well as with Paq'tnkek First Nation.

Correspondence with Paq'tnkek, the CMM and the KMKNO is ongoing and the Proponent is committed to ongoing consultation as needed.

To date, no additional issues or concerns have been raised during the consultation process.

6.0 ENVIRONMENTAL MANAGEMENT

6.1 Environmental Protection Plan

An Environmental Protection Plan (EPP) will be developed following EA approval of the Project. The EPP will be approved by NSE prior to start of the construction/clearing phase of the Project and will detail best practices and mitigation to be employed during the various Project phases. The EPP document is the primary mechanism for ensuring that appropriate mitigation is implemented, as determined through the EA process, to avoid or mitigate potential adverse environmental effects that might otherwise occur from Project activities, and as required by applicable agencies through permitting processes.

The EPP is a plan for reference by all Project personnel, including sub-contractors, and describes the responsibilities, expectations, and methods for environmental protection associated with Project activities. The EPP will incorporate:

- means to comply with requirements of relevant legislation;
- industry best management practices (BMPs);
- environmental protection measures identified as part of the EA;
- emergency response and contingency plans; and
- environmental commitments made as part of the EA.

A suggested Table of Contents for the EPP is provided in Appendix D.

6.2 Setback Considerations

The following setback and buffer requirements outlined in the Pit and Quarry Guidelines are applied when considering the proposed quarry expansion area (Drawing 3.3):

No person responsible for the operation of a quarry shall locate the associated works within:

- 30 m of the boundary of a public or common highway without written consent from NSTIR to operate closer;
- 30 m of the banks of any watercourse or ordinary high water mark of a water body; and
- 30 m of the boundary of the property on which the quarry is located.

No person responsible for the operation of a quarry shall conduct blasting within:

- 30 m of the boundary of the public or common highway without written consent from NSTIR;
- 30 m of the bank of any watercourse or the ordinary high water mark of a water body;
- 800 m[1] of the foundation or base of a structure located off site; and
- 15 m of the property boundary when a structure on the abutting property is not involved.

In accordance with the MODG Land Use By-law, for any Industrial (I-2) Zone, no development permit shall be issued except in conformity with the following requirements:

Table 6.1: MODG Setbacks and Lot Requirements

Requirement	Standard
Minimum Lot Area	10,000 m^2 (107 639 ft^2)
Minimum Lot Frontage	65 m (213'3")
Minimum Front Yard	10 meters (32'9")
Minimum Side Yard	10 meters (32'9")
Minimum Rear Yard	20 meters (65'7")
Maximum Building Height	15 meters (49'2")

When a yard or lot is located within an Industrial (I-2) Zone and abuts a Residential or Commercial Zone, the following restrictions apply:

a) no open storage or display shall be permitted in an abutting yard within 6m
    a. (19'8") of a side or rear lot line;
b) no parking space shall be permitted in an abutting yard within 6meters of a side
    a. or rear lot line;
c) The front and side boundaries shall either contain a 3 meters (9'10") in depth landscape strip consisting of tree saplings spaced at intervals no greater than 6 m (19'8") or an earthen berm no less than 3 m (9'10") above established grade. A Development Officer however may

[1] The separation distance is measured from the working face and point of blast to the foundation or base of the structure. Separation distances can be reduced with written consent from all individuals owning structures within 800 m (NSE 2003).

determine that the existing natural characteristics of the terrain and/or vegetation will satisfy the provisions. This strip can only be interrupted by crossings required to access the site. The owner shall be responsible for replacing any trees that die within this landscape strip during the life of the project.

d) With the exception of pump stations and supporting pipes for the purposes of accessing water, no building or storage of material shall be permitted within 100 m (328') of a lake edge.

Seven wetlands were identified during the 2014 field surveys. Most wetlands are concentrated within the south-southwestern portion of the Project Area. The Proponent has chosen to avoid these wetlands during the proposed expansion, therefore 30 m buffers have been applied. In consideration of the existing wetlands and associated buffers, the south-southwestern portion of the Project Area has been designated as a Wetland Exclusion Area (Drawing 3.3).

7.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

The methodological framework used in this EA has been developed to meet the requirements of the NS EA and EA Regulations. This framework is based on a structured approach that:

- focuses on issues of greatest concern;
- considers the concerns of Aboriginal peoples, as well as concerns raised by the public and other stakeholders; and
- integrates mitigative measures into Project design.

Project-related environmental effects are identified and assessed with respect to potential interactions; mitigation and environmental protection measures proposed to reduce or eliminate adverse environmental effects; and the characterization of the residual environmental effects of the Project. The ultimate focus of the assessment is on residual environmental effects that remain after planned mitigation has been applied. These residual effects and significance are assessed further in Section 8.0.

The following sections describe the primary steps involved in the approach used to prepare the EA registration document.

7.1 Selection of Valued Environmental Components (VECs)

The EA focuses on specific components of the biophysical and human environments called VECs that, if altered by the Project, may be of concern to stakeholders such as regulatory agencies, Aboriginal peoples, resource managers, scientists, and/or the general public. VECs incorporate biological systems as well as human, social, and economic conditions that are affected by changes in the biophysical environment. VECs can therefore relate to ecological, social, and/or economic systems that comprise the environment as a whole. Accidents and malfunctions are considered separately as a VEC.

A preliminary assessment of potential interactions between environmental components and Project activities was undertaken to identify VECs (Table 7.1).

Table 7.1: VEC Interaction Matrix

PROJECT PHASES / COMPONENTS	ENVIRONMENTAL COMPONENTS														
	BIOPHYSICAL						SOCIO-ECONOMIC								
	Geology and Groundwater	Aquatic Habitat and Fauna (including wetlands)	Terrestrial Flora	Terrestrial Fauna and Habitat (including birds and bats)	Air Quality	Noise Levels	Population and Demographics	Regional Economy	Surrounding Land Use	Traffic and Transportation	Recreation, Tourism, and Viewscape	Human Health	Cultural and Heritage Resources[1]	Aboriginal Resources[1]	Other Undertakings in the Area
SITE PREPARATION AND CONSTRUCTION															
Site Clearing/Grubbing	-	-	-	-	-	-	0	+	0	0	0	0	0	0	0
OPERATIONS AND MAINTENANCE															
Drilling	-	-	0	-	-	-	0	+	0	0	0	-	0	0	0
Blasting	-	-	-	-	-	-	0	+	-	0	0	-	0	0	0
Crushing	0	0	0	0	-	-	0	+	0	0	0	0	0	0	0
Stockpiling	0	-	0	-	0	0	0	0	0	0	0	0	0	0	0
Moving/Transporting Product	0	0	0	-	-	-	0	+	0	-	0	0	0	0	0
DECOMMISSIONING AND SITE REHABILITATION															
Removal of Equipment and Structures	0	0	0	0	0	-	0	+	0	0	+	0	0	0	0
Site Rehabilitation	+	+	+	+	+	+	0	+	0	0	+	0	0	0	0
ACCIDENTS AND MALFUNCTIONS															
Oil/Fuel Spills	-	-	-	-	-	0	0	+/-	-	0	-	-	0	0	0

+ = positive interaction; - = negative interaction; 0 = no interaction

Notes:

1. There are no known cultural, heritage or archaeological resources within the Project Area (Sections 8.13 and 8.14)

Based on the above assessment, the following VECs are expected to have a potential negative interaction with the Project and are therefore addressed in this EA:

- Geology and groundwater;
- Aquatic habitat and fauna (including wetlands);
- Terrestrial flora
- Terrestrial fauna (including birds and bats) and habitat;
- Air Quality
- Noise;
- Surrounding land-use;
- Traffic and transportation; and
- Human health.

Where identified, positive interactions are noted but are not further assessed.

7.2 Description of Baseline Conditions and Potential Negative Environmental Effects

For each VEC, an overview of the baseline conditions is described. In addition, potential negative effects resulting from interactions with Project activities are described and evaluated in detail for each VEC. Where there is potential for Project-related environmental effects, each effect is assessed using the results of preliminary investigations, guidance from regulators, and the collective knowledge and expertise of the Project team.

7.3 Mitigation

Where an adverse environmental effect on a VEC is identified, strategies for mitigation, avoidance or compensation are proposed. Where possible, mitigation measures will be incorporated into the Project design to eliminate or reduce potential adverse effects.

7.4 Effects Analysis

The determination and characterization of adverse environmental effects for each VEC is based on post-mitigation (residual) effects, rather than unmitigated potential effects in accordance with the criteria outlined in Table 7.2.

Table 7.2: Criteria for Identification and Definition of Environmental Effects

Attribute	Options	Definition
Scope (Geographic Extent)	Local	Effect restricted to area within 1 km of the Project site
	Regional	Effect extends up to several km from the Project site
	Provincial	Effect extends throughout Nova Scotia
Duration	Short-term	Effects last for less than 1 year
	Medium-term	Effects last for 1 to 10 years
	Long-term	Effects last for greater than 10 years
Frequency	Once	Occurs only once
	Intermittent	Occurs occasionally at irregular intervals
	Continuous	Occurs on a regular basis and regular intervals

Attribute	Options	Definition
Magnitude	Negligible	No measurable change from background in the population or resource; or in the case of air, soil, or water quality, if the parameter remains less than the standard, guideline, or objective
	Low	Effect causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms)
	Moderate	Effect causes 1 to 10% change in the population or resource
	High	Effect causes >10% change in population in resource

7.5 Residual Effects Analysis

If, based on the criteria in Table 7.2, a residual effect is identified the significance of the residual effect is then evaluated based on the criteria outlined in Table 7.3.

Table 7.3: Definition of Significant Residual Environmental Effect

Significance Level	Definition
High	Potential effect could threaten sustainability of the resource and should be considered a management concern. Research, monitoring, and/or recovery initiatives should be considered.
Medium	Potential effect could result in a decline in resource to lower-than-baseline but stable levels in the study area after project closure and into the foreseeable future. Regional management actions such as research, monitoring, and/or recovery initiatives may be required.
Low	Potential effect may result in slight decline in resource in study area during life of the Project. Research, monitoring, and/or recovery initiatives would not normally be required.
Minimal/None	Potential effect may result in slight decline in resource in study area during construction phase, but should return to baseline levels.

8.0 ENVIRONMENTAL EFFECTS ASSESSMENT

8.1 Geology and Groundwater

8.1.1 Description of Existing Conditions

The Project Area lies within the Eastern Shore Ecodistrict of the Atlantic Coastal Ecoregion (Neily *et al.* 2003). Topography is characterized by undulating to rolling coastal landscape and the coastline is irregular with estuaries and headlands, resulting in an indented coast with fringed islands (Webb *et al.*, 1999; Neily *et al.* 2003). The Project Property is located on a hilly terrain, sloping to the north towards Chedabucto Bay. The Project Area ranges in elevation from a high of 110 m in the central area to a low of 69 m at the northern extent. The northern and central portions of the Project Area slope to the north towards Chedabucto Bay, while lands in the southern portion of the Project Area slope to the south towards Big Lake.

Surficial Geology
Surficial geology of the Project Area varies from a well-drained, medium textured silty till plain in the north to exposed bedrock in the south (Stea *et al.* 1992) (Drawing 8.1). Based on drilled well log records in the vicinity of the Project Area, overburden thickness is reported to range from 3 - 11.5 m (NSE 2013). Three dug wells were identified within 10 km of the Project Area (NSE 2013). Well depths ranged from 3.04 m (9.9 ft) to 6.09 m (19.9 ft). Surficial material encountered included till, clay, gravel and sand.

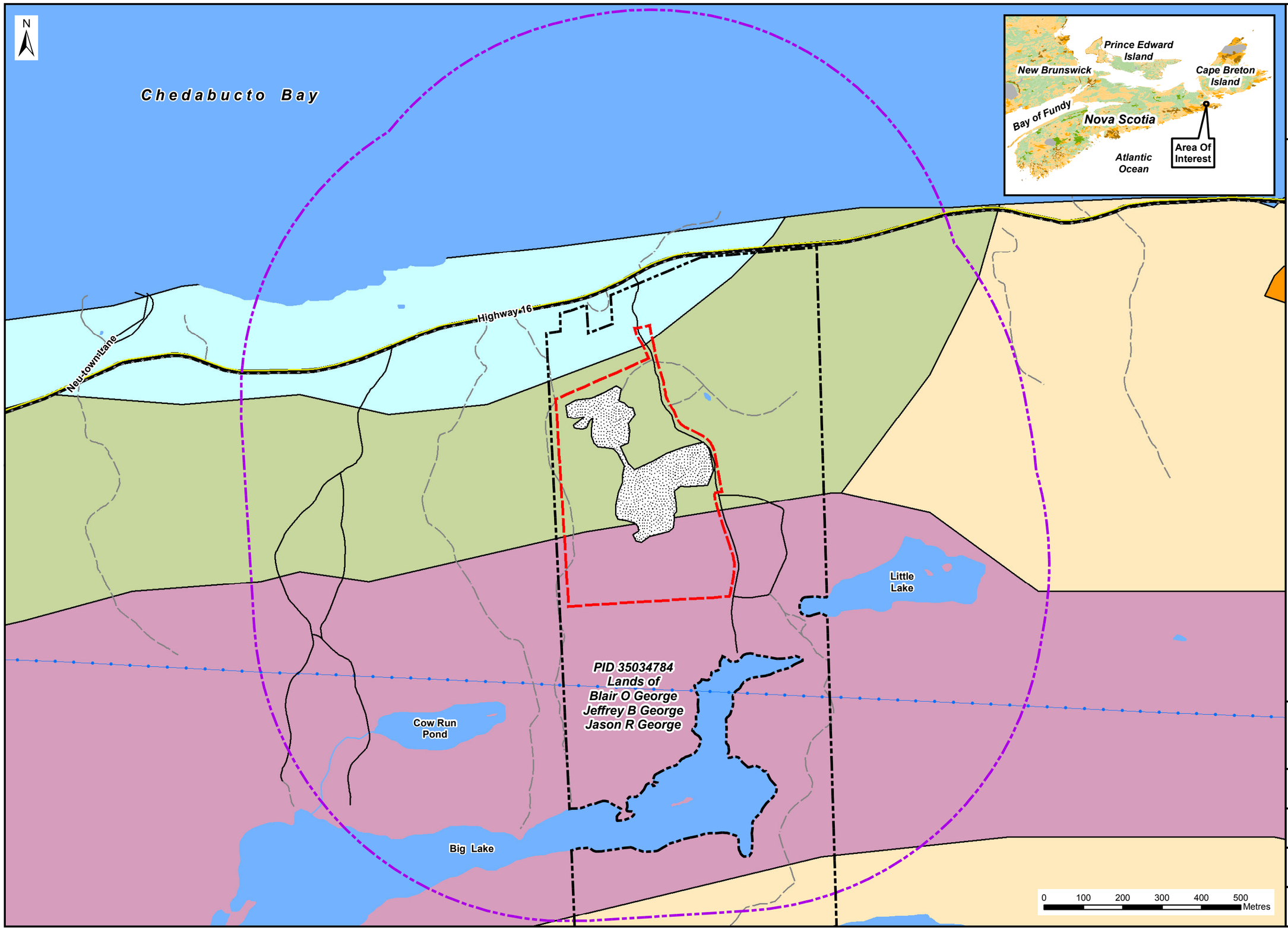
Bedrock Geology
Bedrock geology across the majority of the northern portion of the Project Property consists of Cambrian-Ordovician aged metamorphic rocks of the Goldenville Formation. The Halifax Formation bedrock aligns parallel with Highway 16 along the northern boundary of the Project Property, in addition to a second band aligned west-east in the vicinity of Hay Lake (Keppie 2000) (Drawing 8.2). The southern half of the Project Property is underlain by the Middle-Late Devonian muscovite biotite monzogranite. The Project Area in underlain entirely by the Goldenville Formation, with the exception of a narrow portion of the Halifax Formation along the access road leading to Highway 16.

The Goldenville Formation forms the lowermost part of the Meguma Group. The formation generally consists of a sequence of greywacke and arenites with less common politic horizons. Bedding is variable in thickness from massive 5-10 m thick layers to fine <1 cm thick pelitic zones (Long 1989).

The Halifax Formation forms the upper part of the Meguma Group and is generally comprised of thinly bedded slates and minor fine grained quartose sandy siltstone (Faribault 1898). Locally, the formation consists of fine grained, dark slates that carry a significant amount of iron sulphide, including pyrite, pyrrhotite and arsenopyrite. Bedding planes occur as 1 cm to 3 mm thick laminations (Long 1989).

The Cobequid-Chedabucto Fault System (also referred to as the Minas Fault Zone) is an ENE-WSW trending transpressional boundary separating the Avalon terrane to the north from the Meguma terrane to the south (Keppie and Dostal 2010). The on-land trace of the fault system is over 300 km long from Chignecto Bay in the west to Chedabucto Bay in the east, approximately 10 km north of the Project Area. The fault zone is host to over 100 mineral occurrences and small deposits of iron-oxide, copper, cobalt, gold, nickel and barite. Mineral occurrences range from single veins to breccia systems and are associated with widespread carbonate alteration along with silica and sericite alteration (Cogonov 2013). Better known mineralised occurrences are at Londonderry, Copper Lake, Bridgeville, Mt. Thom and Bass River. The eastern Chedabucto fault zone is characterized by the progressive development of S–C textures and shear bands, rotated syntectonic porphyroblasts, and asymmetric minor folds, features indicative of and caused by ductile shearing.

Hydrogeology/Groundwater
Water supplies near the Project Area are generally derived from individually drilled or dug wells. A summary of the pertinent (within 2 km of the Project Area) well properties included in NSE Well Log Database (NSE 2013) is presented in Table 8.1.



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. DP ME 36, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, scale 1:500 000, by R. R. Stea, H. Conley and Y. Brown, 1992.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Project Property
- 800m Quarry Buffer
- Project Area
- Existing Quarry
- Major Roads and Highways
- Public Roads
- Access Roads / Trails
- Existing Transmission Lines
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

Surficial Geology By Unit

- Bedrock
- Kame Fields and Esker Systems
- Marine Deposits
- Silty Till Plain
- Stony Till Plain

Chedabucto Aggregates Quarry Expansion

Surficial Geology

Strum Consulting

Date: August 2014	Project #: 13-4880
Scale: 1:9,000	Drawing #: 8.1
Drawn By: H. Serhan	
Checked By: C. Baker	

N

Chedabucto Bay

Highway 16

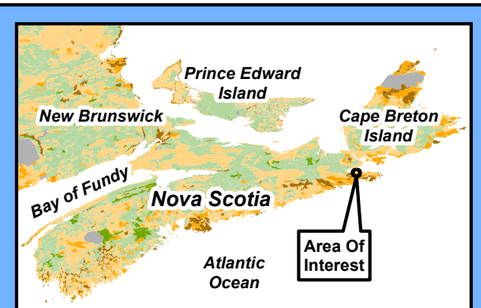
New Town Lane

Little Lake

Cow Run Pond

Big Lake

PID 35034784
Lands of
Blair O George
Jeffrey B George
Jason R George



Legend:

- Project Property
- 800m Quarry Buffer
- Project Area
- Existing Quarry
- Major Roads and Highways
- Public Roads
- Access Roads / Trails
- Existing Transmission Lines
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

Bedrock Geology By Formation

- Halifax Formation
- Goldenville Formation
- Middle - Late Devonian muscovite biotite monzogranite

0 100 200 300 400 500 Metres

Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. DP ME 43, Version 2, 2006, Digital Version of Nova Scotia Department of Natural Resources Map ME 2000-1, Geological Map of the Province of Nova Scotia, scale 1:500 000, Compiled by J. D. Keppie, 2000.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Chedabucto Aggregates Quarry Expansion

Bedrock Geology

Strum CONSULTING

Date: August 2014	Project #: 13-4880
Scale: 1:9,000	Drawing #: 8.2
Drawn By: H. Serhan	
Checked By: C. Baker	

Table 8.1: Summary of Drilled Well Records

Well #	Address	Installation Date	Well Depth (m)	Casing Length (m)	Estimated Yield (Lpm)	Hydro-stratigraphic Unit	Overburden Thickness (m)	Estimated Distance from Project Area
071227	6646 Highway #16, Halfway Cove	May 2007	92.87	6.09	1.14	Granite/Quartzite	3.05	25 m
091257	6523 Highway #16, Halfway Cove	September 2009	59.38	12.18	6.81	Granite	4.88	378 m
111415	6870 Highway #16	April 2011	74.6	6.09	4.54	Granite/Quartzite /Slate	3.96	1.07 km
071294	6310 Highway #16	May 2007	80.69	13.09	1.51	Granite	11.59	1.24 km
912090	-	June 1991	64.55	12.18	15.89	Slate/Quartzite	8.23	1.44 km
830052	-	July 1983	67.6	8.83	4.54	Quartzite	7.93	1.85 km
993218	-	September 1999	62.42	6.09	4.54	Slate	4.27	2.00 km
Minimum			59.38	6.09	1.14		3.05	
Maximum			92.87	13.09	15.89		11.59	
Average			71.73	9.22	5.57		6.27	

Source: NSE 2013

Based on short term driller's estimates for the wells in Table 8.1, the average yield is approximately 5.57 Lpm (1.2 gpm) and average well depth is approximately 71.7 m (235.2 ft). These measurements represent very short term yields estimated by the driller at the completion of well construction. Fracture depths ranged from 10.7 m (35.0 ft) to 60.4 m (198.0 ft). The closest drilled well to the Project Area is located directly across from the Project Area along Highway #16.

The NSDNR Pump Test Database (NSDNR 2012a) provides longer term yields for select wells throughout the province. One regional well, drilled through the Halifax Formation located in Half Island Cove, approximately 10 km east of the Project Area, indicates a long term safe yield (Q_{20}) of 52.3 Lpm (11.5 gpm) and an apparent transmissivity of 4.1 m^2/day.

Water Quality
Groundwater in slate, quartzite and granite are usually calcium bicarbonate waters low in dissolved solids and hardness. Groundwater within the metamorphic bedrock of the Goldenville and Halifax Formations are often slightly acidic and sometimes contain iron, manganese, and occasionally arsenic (Trescott 1969).

8.1.2 Potential Interactions and Effects
Potential adverse effects of the Project on groundwater resources include:

- Lowering of local groundwater levels;

- Decrease in well yield due to groundwater level lowering or interception of recharging bedrock fractures;
- Temporary siltation of nearby wells due to intermittent blasting or heavy equipment operation;
- Water quality deterioration at down-gradient wells from oil and nitrate contamination from blasting operations and accidental releases of deleterious substances (*e.g.*, petroleum hydrocarbons);
- Production of acid rock drainage (ARD) if a mineralized zone is encountered within the quarry area; and
- Temperature change in springs and surface-water streams.

Major excavations through glacial tills and bedrock could potentially lead to a drop in groundwater table elevation in proximity to the excavation. This could possibly affect wells and surface water. The degree of water level lowering will be proportional to the depth of the excavation below natural water table level, the distance between the well or stream and the excavation, and the hydraulic properties of the subsurface materials. Dug wells in close proximity to an excavation which, in Nova Scotia, is already susceptible to seasonal water-level fluctuations and may become dry. Drilled wells may experience similar water-level drops, although because of the larger water column of drilled wells, they are not likely to be adversely affected by average overburden or bedrock cuts. The severity of the water supply well impacts are expected to be a function of well type, age of the well, well construction method, distance from the site boundaries, overburden thickness and the hydraulic properties of the soil and bedrock. A pre-blast survey will be undertaken for all structures and water supplies within 800 m of the point of blast. Two water wells are situated within this impact area. No well related complaints have been received with respect to current operations at the existing quarry.

Depending on the floor elevation and the resulting amount of rainfall and groundwater encountered, and time of year, dewatering of the proposed quarry extension may be required which allows the quarry floor to stay dry. The drop in the water table can affect the groundwater flow in a limited area beyond the quarry. There are no plans to quarry below the bedrock groundwater table. Any water discharged from this quarry is expected to originate predominantly from direct precipitation.

Changes in water quality may theoretically occur as a result of excavations in the recharge area of the wells. Wells located down-gradient of the quarry are more likely to be affected in this manner. Potential impacts include: temporary siltation from blasting; oil and nitrate contamination from blasting operations; lubricant compounds; and other chemical releases within the quarry area.

A possible long term impact of well water quality is decreased pH or increased dissolved solids from attenuation of acidic drainage from exposed sulfide-rich bedrock. Bedrock containing sulphide bearing minerals (*e.g.*, pyrite, pyrrhotite) can potentially generate acid run-off if fresh surfaces are exposed to oxygen and water. The physical disruption of such bedrock leads to oxidation of iron-sulphide minerals and the generation of ARD (Fox *et al.* 1997). Construction activities in the presence of ARD can result in the acidification of surface and groundwater and promote the mobilization and leaching of toxic contaminants into the environment, including heavy metals. The likelihood of ARD to occur will be determined following the results of the geotechnical evaluation.

Quarries may also affect the temperature of the local surface water and groundwater. Open ponds change the thermal character of the groundwater and could conceivably change temperatures in the streams adjacent to the pits.

Dangerous/hazardous materials anticipated to be on-site during regular quarry operation include gasoline, diesel fuel and lubricants. The potential for accidental spills on site exists during construction and operation activities, though should be mitigated through adherence to the EPP.

The existing quarries have been operational for ten years without any known effects to groundwater quality or quantity.

8.1.3 Proposed Mitigation and Protective Measures

Mitigative measures to minimize the environmental effects of the Project on geology and groundwater include:

- A site specific ESCP will be updated for the quarry expansion, and submitted with the Approval amendment application.
- A geotechnical investigation and monitoring program may be required by NSE to determine the potential for and extent of sulphide bearing material at the site.
- Implementation of the EPP, including the spill prevention plan and contingency plans (as necessary).
- If sulphide bearing materials are identified through pre-construction geotechnical surveys, these areas will be referenced in the EPP.
- Rock removal in known areas of elevated potential will conform to the Sulphide Bearing Material Disposal Regulations, and in consultation with relevant regulatory departments.
- A well survey documenting all wells within the buffer is recommended to confirm water levels in these wells, in advance of the expansion to establish baseline conditions.
- All blasting activities will be conducted in compliance with the Pit and Quarry Guidelines outlined under the NS EA (1994-95).
- All blasting activities will be conducted at time intervals consistent with those outlined in the existing Approval or future amendments to the Approval.
- All blasting will be conducted and monitored by a qualified blasting contractor.
- The qualified blasting contractor will be responsible for the technical blast design and methodology, as outlined in the Pit and Quarry Guidelines, and for adherence to the Blasting Safety Regulations under the *Occupational Health and Safety Act* (1996).
- All protective measures will be outlined in the EPP for the Project and approved by NSE in advance of blasting activities.
- A pre-blast survey of all structures within 800 m of the point of blast, shall be conducted prior to any blasting activities, following the NSE document “Procedure for Conducting a Pre-Blast Survey”.
- No blasting shall take place if a thermal inversion is anticipated at the time of the proposed blast.
- No blasting will be conducted within 30 m of the bank of any watercourse or the ordinary high water mark of any water body.

- No blasting will be conducted within 800 m of the foundation or base of a structure located off site, or within 15 m of the property boundary when a structure on the abutting property is not involved. This separation distance can only be reduced with written consent from all individuals owning structures within 800 m.
- Any water supply which is lost or damaged as a result of extracting aggregate will be replaced at the expense of the proponent;
- Excavation below the water table will not take place, unless prior approval from NSE is obtained.

8.1.4 Proposed Monitoring and Follow-Up Programs

- A site specific ESCP will be updated for the quarry expansion, and submitted with the Approval amendment application.
- An EPP will be developed for the Project which will reference sulphide bearing areas (if present) and outline protective measures in advance of blasting.
- A geotechnical investigation and monitoring program may be required by NSE prior to blasting activities to determine the potential for and extent of sulphide bearing material at the site, and to manage any exposed acid generating material and associated drainage, as per the Sulphide Bearing Material Disposal Regulations. This program will be developed in consultation with NSE.
- An updated Blasting Plan will be submitted to NSE for approval, as part of Approval amendment application. The plan will include an updated Pre Blast Survey for structures and water supplies within 800 m of the blast area, a detailed Blast Monitoring Plan, and a full blast damage response policy as required by NSE. The Plan will outline proposed blasting methods and schedule.
- A pre-blast survey of all structures and wells within 800 m of the point of blast, shall be conducted prior to any blasting activities, following the NSE document “Procedure for Conducting a Pre-Blast Survey”.
- A survey of all wells within the 800 m buffer may be required to establish baseline water levels and groundwater quality in these wells in advance of the expansion, which can be used to confirm no effects to ground water as a result of the expansion.
- A groundwater monitoring program may be required in advance of the expansion to establish baseline conditions and to evaluate potential impacts to both groundwater levels and groundwater quality. Monitoring wells may need to be installed between the quarry expansion area and the domestic wells situated within 800 m of the site. If installed, the wells should be periodically measured for water level, pH and other water quality parameters.

8.1.5 Expected Residual Effects

Using criteria based on federal and provincial EA guidance (outlined in Section 7.0) an analysis of residual effects to geology and groundwater from the Project is provided in Table 8.2.

Table 8.2: Residual Effects Analysis: Geology and Groundwater

VEC	Phase	Significance Criteria	Residual Effects	Significance of Residual Effects
Geology and Groundwater	Site Preparation and Construction	Scope: Local Duration: Medium to Long-term Frequency: Continuous Magnitude: Low	Low	Not Significant
	Operations and Maintenance	Scope: Local Duration: Medium to Long-term Frequency: Continuous Magnitude: Low	Low	Not Significant
	Accidents and Malfunctions	None expected	n/a	n/a

The existing quarries have been operational for ten years without any known effects to groundwater quality or quantity. Any residual effects to groundwater resources from the expansion, would be considered local and not significant.

Risks to groundwater due to accidental spills or failure of ESC measures are expected to be addressed through the implementation of the mitigation strategies above, and the EPP. Provided the proposed mitigative measures are applied, no residual effects on groundwater are expected as a result of these incidents.

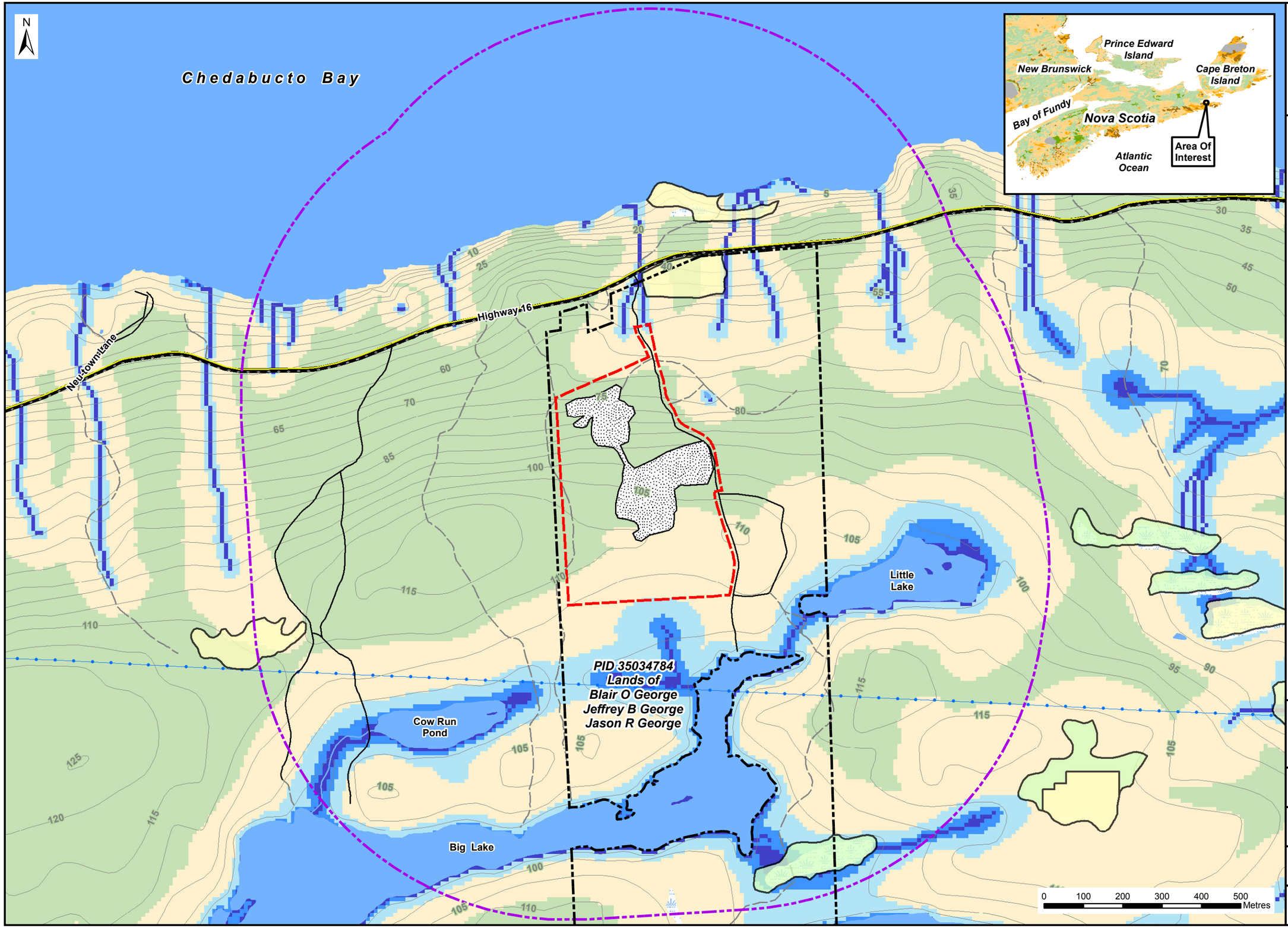
With the application of the mitigation measures and follow up programs detailed above, the quarry expansion is not expected to result in any significant residual effect on local, intermediate or regional groundwater recharge and discharge rates, on groundwater quality, or on availability and amenity of the resource for groundwater users.

8.2 Aquatic Habitat and Fauna

8.2.1 Description of Existing Conditions

The Project Property lies within the Salmon/New Harbour River watershed (1EQ). The Salmon River runs easterly, south of the town of Guysborough, before discharging into the Chedabucto Bay near the community of Cook's Cove, approximately 10 km west of the Project Area. The New Harbour River runs southeasterly through much of eastern Guysborough County before discharging into the Atlantic Ocean near the community of New Harbour, approximately 21 km southwest of the Project Area.

No watercourses, lakes or natural water bodies are present within the Project Area boundaries (Drawings 8.3 and 8.4). The nearest downstream aquatic receptors from the proposed quarry expansion boundaries are Little Lake, located approximately 340 m to the southwest, Big Lake, approximately 350 m to the south, and Chedabucto Bay, approximately 400 m to the north. The majority of proposed expansion lands slope towards the north (Chedabucto Bay).



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. Wet Areas Mapping & Wetland Inventory By Nova Scotia Department of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Project Property
- 800m Quarry Buffer
- Project Area
- Existing Quarry
- Major Roads and Highways
- Public Roads
- Access Roads / Trails
- Contours (m)
- Existing Transmission Lines
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Water Bodies

NS DNR Wetland Inventory

Wetland Type

- Bog or Fen
- Fen
- Marsh
- Salt Marsh
- Swamp

Depth to Water Table (m)

- 0 - 0.10 m
- 0.11 - 0.50 m
- 0.51 - 2 m
- 2.01 - 10 m
- > 10 m

Chedabucto Aggregates Quarry Expansion

Desktop Review Results

Strum CONSULTING

Date: August 2014	Project #: 13-4880
Scale: 1:9,000	Drawing #: **8.3**
Drawn By: H. Serhan	
Checked By: C. Baker	

N

Highway 16

Wetland 1

Wetland 2

Wetland 3A

Wetland 3B

Wetland 4

Wetland 5

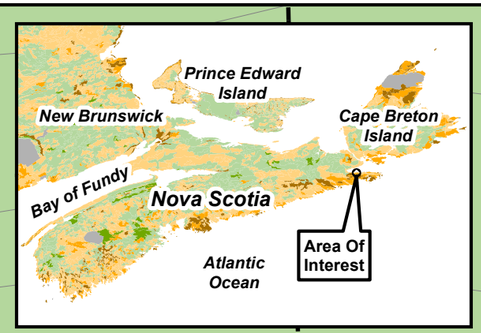
Wetland 6

Wetland 7

PID 35034784
Lands of
Blair O George
Jeffrey B George
Jason R George

Little Lake

45 50 55 60 65 70 75 80 85 90 95 100 105 110 115



0 50 100 150 200 250 Metres

Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Data Collected is Typically to +/-5m Accuracy.

Legend:

- Field Identified Drainage Channel
- Confirmed Wetland Boundary

Field Identified Wetland (Type)

- Bog
- Treed Swamp
- Project Property
- Project Area
- Existing Quarry
- Contours (m)
- Building
- Public Roads
- Access Roads / Trails
- Major Roads and Highways
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

Chedabucto Aggregates Quarry Expansion

Wetland and Watercourse Survey Results

Strum CONSULTING

Date: August 2014	Project #: 13-4880
Scale: 1:3,000	Drawing #: **8.4**
Drawn By: H. Serhan	
Checked By: C. Baker	

A desktop identification of the location and extent of potential waterbodies, watercourses, and wetlands within the Project Area was completed by reviewing the following information sources:

- Satellite and aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM) (NSDNR 2013c);
- Nova Scotia Geomatics Centre; and
- NS Wetlands Inventory Database (NSDNR 2012b).

Prominent water bodies in the watershed include Ocean Lake, Loon Lake, Bonnet Lake, Halfway Cove Lake and Donahue Lake. A number of small water bodies exist in the vicinity of the Project Area including Little Lake, Big Lake, Cow Run Pond and Hay Lake (Drawing 8.3). No lakes or waterbodies are present within the Project Area boundaries. The northern and central portions of the Project Area slope to the north towards Chedabucto Bay, while lands in the southern portion of the Project Area slope to the south towards Big Lake.

A total of 167 lakes within Guysborough County are included in the Nova Scotia Lake Inventory Program (NSE 2012), which determines the baseline biophysical attributes of lakes throughout the province. Four of these lakes are located within 10 km of the Project Area, however these lakes were assessed 17 to 40 years ago, therefore the data are considered outdated and will not be incorporated into this assessment.

The NS Wetland Inventory Database identifies 4 wetlands within 1 km of the Project area (Drawing 8.3). The closest is a 1.9 ha marsh located about 100 m north of the Project Area. Another 1.4 ha marsh is located 420 m north of the Project Area. There is also a 2.3 ha swamp located 950 m to the south of the Project Area, and a 2.1 ha marsh located 950 m to the west. No mapped wetlands are identified within the Project Area itself. WAM indicates the potential for wetland habitat and/or watercourses in a few isolated areas in the north of the Project Area along the access road from Highway 316. The topographic mapping indicates that the land encompassing the majority of the Project Area exists as a dry upland ridge that slopes steeply to the north to Chedabucto Bay.

A total of seven (7) wetlands were observed within the Project Area, three (3) of which are bogs (Wetlands 1, 5 and 7), and four (4) are swamps (Wetlands 2, 3, 4 and 6) (Drawing 8.4). The bogs occur in topographic basins or on flat areas where draining water is able to collect. These bogs can be characterized by a thick sphagnum layer growing on top of peaty soils that support a robust herbaceous layer dominated by bog laurel (*Kalmia polifolia*), cranberry (*Vaccinium microcarpum*), pitcher plant (*Sarracenia purpurea*) and black crowberry (*Empetrum nigrum*). These bogs are, for the most part, open with the exception a few eastern larch (*Larix laricina*) and black spruce trees (*Picea mariana*), and feed ephemeral drainage features that drain water downgrade. The treed swamps occur in gentle basins, on depleted mineral soils. A typically closed canopy consisting of mature balsam fir (*Abies balsamea*) and black spruce trees, with sparse red maple (*Acer rubrum*) coverage overshadows a low diversity, yet robust shrub and herbaceous community. Dominant shrub species include Canada holly (*Ilex verticillata*) and wild raisin (*Viburnum nudum*), while the dominating herbs include cinnamon fern (*Osmundastrum cinnamomeum*) and three-seeded sedge (*Carex trisperma*).

The Project Area occurs on the crest of a north facing hill. General water flow is from south to north on the north facing slope, apart from at the southern extent of the Project Area where water drains downgrade, upon the south facing slope. All wetlands source ephemeral drainage features. The majority of the wetlands (Wetlands 1, 2, 3 and 5) drain to the north toward Chedabucto Bay. Drainage from wetlands 4, 6 and 7 flows to the south or southeast, eventually draining into Big Lake.

Detailed wetland characterizations are provided in Table E1 (Appendix E).

A review of the ACCDC database for fish and aquatic invertebrate species recorded within a 100 km radius of the Project site was completed for the purposes of the EA. Fish species were screened against the criteria outlined in the document "Guide to Addressing Wildlife Species and Habitat in an EA Registration Document" (NSE 2009c) to develop a list of priority species (*i.e.*, SOCI), which are assessed further as a VEC.

In the context of this EA, SOCI include those that are:

- Listed under SARA as "Endangered", "Threatened", or "Special Concern";
- Listed under the NS ESA as "Endangered", "Threatened", or "Vulnerable";
- Assessed by COSEWIC as "Endangered", "Threatened", or "Special Concern"; or
- Assessed by NSDNR as "Red" (at risk or may be at risk) or "Yellow" (sensitive).

Table 8.3 presents fish and aquatic invertebrate SOCI recorded within a 100 km radius of the Project site, according to ACCDC.

Table 8.3: Fish SOCI Recorded within a 100 km radius of the Project Site

Common Name	Scientific Name	SARA Status[1]	NS ESA Status[2]	COSEWIC Status[3]	NSDNR Status[4]
Atlantic salmon	*Salmo salar*	No Status	Not Listed	Endangered	Red
Brook floater	*Alasmidonta varicose*	Special Concern	Threatened	Special Concern	Yellow
Eastern Lampmussel	*Lampsilis radiata*	Not Listed	Not Listed	Not Listed	Yellow
Striped bass (Bay of Fundy)	*Morone saxatilis*	No Status	Not Listed	Endangered	Red
Striped bass (Southern Gulf of St. Lawrence)	*Morone saxatilis*	No Status	Not Listed	Special Concern	Red

Source: ACCDC 2014

[1] Government of Canada 2012; [2] NS *ESA* 2013; [3] COSEWIC 2012; [4]NSDNR 2010

Atlantic Salmon

Atlantic salmon is an anadromous species native to the North Atlantic Ocean and coastal rivers, which undertakes long feeding migrations to the ocean as older juveniles and adults, and return to freshwater streams to reproduce. The species requires rivers that are clear, cool and well oxygenated, with pools and shallow riffles and gravel, rubble, rock or boulder bottoms for reproduction (NS Fisheries and Aquaculture 2007; COSEWIC 2010b). The watercourses identified at the Project site form part of the Salmon/New Harbour River watershed (1EQ) watershed,

therefore any Atlantic salmon present would form part of the NS Southern Upland population (NS Fisheries and Aquaculture 2007; DFO 2008).

The Salmon River is known to support Atlantic Salmon from this population. The Recovery Potential Assessment (RPA) for the population indicates that abundance of the species is very low in the Southern Upland designatable unit and has declined from levels observed in the 1980s and 1990s. Region-wide comparisons of juvenile density data from more than 50 rivers indicate significant ongoing declines between 2000 and 2009 and provide evidence for extirpations in some rivers. Twenty-two of 54 river systems surveyed in 2008-2009 were found to contain Atlantic salmon, including the Salmon River. Given the current status of the population and the reductions in freshwater habitat that have already occurred, all 22 of these rivers are considered important habitat for Southern Upland Atlantic salmon. The RPA identifies the Salmon River as a river of particular importance to the recovery potential of the population, with regards to within-river genetic variation (DFO 2013).

Brook Floater

The vast majority of Brook floater populations occur in running water habitats with a range of flow conditions, from small creeks and streams to large rivers (COSEWIC 2009b). In Nova Scotia, Brook Floater also occurs locally in small and medium-sized lakes with no evident water flow (COSEWIC 2009b). Brook floater prefers waters with a pH greater than 5.4, indicating that acidity may be an important factor (COSEWIC 2009b). Brook Floater has a complex life cycle and relies on a fish host to complete its life cycle.

There is a known population of Brook Floater within the Salmon River, 13 km from the Project site. A survey conducted in 2010, from the outflow of North Branch Lake in the Ogden Round Wilderness Area (approximately 27 km from the site) counted 19 individuals (COSEWIC 2009b).

Eastern Lampmussel

Eastern Lampmussel is a medium to large freshwater mussel. This species inhabits a variety of habitats, including small streams, large rivers, ponds and lakes and prefers sand or gravel substrate (NatureServe 2012). Eastern Lampmussel have a complex life cycle that relies on a fish host; several fish have been confirmed as hosts including rock bass, bluegill, longear sunfish, smallmouth bass, largemouth bass, white perch, yellow perch and bluntnose minnow, among others (NatureServe 2012). Eastern Lampmussel is widely distributed across the northeastern United States and Canada, occurring in Nova Scotia, New Brunswick, Quebec and Ontario (McAlpine and Smith 2010). Despite its wide distribution and varied habitats, the Eastern lampmussel is listed as “Yellow” (sensitive) by NSDNR.

Striped Bass

The striped bass is an anadromous species typically associated with estuaries and coastal waters, which spawns and over-winters in fresh and occasionally brackish water.

In Nova Scotia, the Annapolis River and the Shubenacadie–Stewiacke River system in the Bay of Fundy historically supported spawning populations (Rulifson and Dadswell 1995, as cited in COSEWIC 2004). Today, the species is known to spawn only in two river systems in eastern

Canada: the Miramichi and the Shubenacadie-Stewiacke systems. Catches have been recorded throughout the province, including in the Avon and Annapolis rivers, River Phillip, Shubenacadie (Grand) Lake, and the Minas Basin. ACCDC records in a 100 km radius from the Project Area are limited to striped bass catches in the Bay of Fundy and the Southern Gulf of St. Lawrence (ACCDC 2014).

8.2.2 Potential Interactions and Effects

Potential adverse effects to surface waters and wetland features include degradation of water quality, resulting in impacts to aquatic species and habitat, interference with connectivity and hydrologic regime, and interaction with other potential users of surface waters (*e.g.*, agriculture, recreation, potability). Project activities may result in erosion and sedimentation leading to the introduction of silt and sediments to downgrade aquatic receptors thereby affecting both surface water quality, and fish and fish habitat. Improper disposal of wastes throughout all Project phases can also impact surface water quality, effecting aquatic species and their habitat.

The alteration or removal of riparian vegetation may result in bank instability and erosion, leading to sedimentation of the water body and degradation of water quality. Removal of overhanging vegetation from riparian areas decreases shade/cover for fish resulting in increased vulnerability to predators, increased localized water temperatures. Upstream or downstream alterations to channel or shoreline morphology and interference with sediment transport may also lead to fish habitat modification/degradation (MTO 2009).

There are no watercourses or waterbodies present within the Project Area, therefore interaction between Project activities and fish and fish habitat is not expected.

Based on the quarry development plan (Drawing 3.3), no wetland alterations or losses are expected. The Proponent has committed to maintaining a 30 m buffer around all wetlands identified within the Project Area, as well as maintaining a Wetland Exclusion Area in the southern extent of the Project Area. The purpose of the buffer is to eliminate hydrological impacts on the wetlands by excluding development activities within 30 m of the wetland boundaries. Some development, including quarrying and overburden piling, has already taken place within 30 m of wetlands 3b and 5, yet these activities were not observed to impact the wetlands in any way. The purpose of the Wetland Exclusion Area is to exclude development altogether in the southern extent of the Project Area where a relatively high concentration of wetland habitat exists.

Wetlands 1 and 2 are both located down grade to the development area. Wetland 1 is sourced by surface water originating from the east of the Project Area. No development activities will take place in areas sourcing water to the catchment basin of Wetland 1, therefor its hydrology will remain unaffected by the quarry expansion.

Wetland 2 lies in a small basin at the toe of a steep slope which separates the wetland boundary, and the existing quarry area. Wetland 2 receives its hydrology from the existing quarry area (which exists at a higher elevation) via surface run-off, in addition to precipitation which is likely retained in the wetland due to its basin landform. The 30 m hydrology buffer to the south of the wetland boundary will maintain the provision of surface water run-off as an input to this wetland. Therefore,

the quarry expansion activities are not expected to impact the wetland's hydrological characteristics or functions.

Wetlands 3, 4, 5, 6 and 7 all lie within the Wetland Exclusion Area, which covers the majority of the south facing slope that encompasses the southern extent of the Project area. Wetlands 3, 4 and 5 are located upgrade of the proposed development area, so their source hydrology will not be impacted by the quarry expansion. Additionally, the 30 m hydrology buffer will ensure that there are no alterations to areas immediately surrounding these wetlands. All development activities will take place to the north of the topographic divide that dictates the direction of drainage flow within the Project Area. Therefore, the source water and drainage regime for Wetlands 6 and 7 will remain unaffected by the quarry expansion.

The use of explosives near watercourses or water bodies may result in a number of adverse impacts on fish and fish habitat. The detonation of explosives in or near water produces post-detonation compressive shock, followed by a rapid decay to below ambient hydrostatic pressure. It is the latter pressure deficit which causes most impacts on fish. Resulting physical damage in finfish include rupture or haemorrhage of the swimbladder, kidney, liver and spleen. Fish eggs and larvae also may be destroyed or damaged due to blasting activity (Wright 1982).

Studies have shown that an overpressure in excess of 100 kPa will result in the effects listed above. The degree of damage is related to type of explosive, size and pattern of the charge(s), method of detonation, distance from the point of detonation, water depth, and species, size and life stage of fish (Wright 1982). Sublethal effects, such as changes in behaviour of fish, have been observed on several occasions as a result of noise produced by explosives.

The use of explosives in and near aquatic receptors may also result in the physical and/or chemical alteration of the habitat. For example, sedimentation resulting from the use of explosives may cover spawning areas or may reduce or eliminate biota that fish use for food. By-products from the detonation of explosives may include ammonia or similar compounds and may be toxic to fish and other aquatic biota (Wright and Hopky 1998).

The potential for accidental spills of deleterious substances on site exists during construction and operation activities, though should be mitigated through adherence to the EPP.

8.2.3 Proposed Mitigation and Protective Measures

Potential interactions with aquatic habitat and fauna downstream of the Project Area can be mitigated through standard mitigation and best management practices. These include:

- Surface waters will be managed in a manner which maintains hydrological supply to existing wetland areas. A 30 m buffer around all wetlands within the Project Area will be maintained to eliminate hydrological impacts from the Project on the wetlands. Additionally, a Wetland Exclusion Area will be established in the southern extent of the Project Area.
- A minimum 30 m buffer will also be maintained between the associated works of the quarry and all watercourses and water bodies.

- Implementation of the EPP, including the spill prevention plan and contingency plans (as necessary).
- The ESCP will be implemented prior to clearing, grubbing, and topsoil stripping activities.
- ESC structures will be maintained and inspected regularly with particular emphasis before and after forecasted heavy rain events, and with consideration of the timing and types of activities involved.
- All overburden removed during the excavation phase will be stored according to provincial regulations and best practice guidelines.
- The length of time stockpiled overburden will be left exposed, and the length without mitigation (*e.g.,* mulching, seeding, rock cover) will be minimized through scheduled work progression.
- Exposed soils and stockpiles capable of producing sediment laden-runoff will continue to be stabilized and/or will be covered.
- Care will be taken to ensure that the potential for surface run-off containing suspended materials or other harmful substances is minimized.
- Where necessary, ESC measures will remain in place after work is completed, areas have stabilized, and natural re-vegetation occurs.
- Adequate wastewater and surface water management controls will be maintained and upgraded as needed throughout the lifespan of the quarry. Additional settling pond capacity will be created as the quarry extends, as required.
- Discharge limits will adhere to the Pit and Quarry Guidelines, the current Approval and future amendments to the Approval (Section 4.6).
- Care will be taken to ensure that the potential for surface run-off containing suspended materials or other harmful substances is minimized.
- The quarry development plan stipulates that wetlands will be avoided. If the development plan changes and a wetland becomes unavoidable, a wetland alteration will be completed in accordance with the Nova Scotia Wetland Conservation Policy and the wetland alteration application process during the permitting stage of the Project.
- Run-off from construction activities will be directed away from wetlands.
- Travel through wetlands with machinery will be avoided. If travel through a wetland is required, the appropriate mitigation measures will be employed, (*e.g.*, geotextile matting, work timed to occur during frozen ground conditions, and travel routed through drier portions of the wetland).
- Any wash water from the cleaning of construction vehicles will be disposed of on-site, using standard industry practices and following environmental regulations/guidelines for the protection of wetlands and watercourses.
- Work vehicles and/or heavy equipment will be cleaned and inspected prior to use to prevent the introduction of weed/invasive/non-native species to sensitive habitats such as wetlands.
- Wastewater/runoff controls will be updated and implemented for the quarry expansion, in accordance with best practices and standard NSE requirements.
- If required, settling pond volume will be upgraded as needed to handle overflow from the quarry floor in accordance with the NSE ESC Handbook for Construction Sites (NSE 1988).
- Appropriately sized flow retention/siltation treatment controls will be designed and implemented to meet NSE standards.

- No blasting will be conducted within 30 m of the bank of any watercourse or the ordinary high water mark of any water body. The nearest proposed quarrying boundary to a downstream aquatic receptor (Big Lake) is over 300 m.
- Setback distances from the nearest fish bearing waters exceed the recommended distances provided in the document "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters" (Wright and Hopky 1998).
- All quarry activities will adhere to *Fisheries Act* (1985) Regulations and DFO Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2014).

8.2.4 Proposed Monitoring and Follow-Up Programs

- A geotechnical investigation may be required by NSE to determine the potential for ARD at the site. The results of the geotechnical investigation will determine the need to implement additional mitigation measures or monitoring programs.
- A site specific ESCP will be updated for the quarry expansion, and submitted with the Approval amendment application.
- The EPP for the Project will reference sulphide bearing areas (if present) and outline protective measures in advance of blasting.
- The EPP will include measures for surface water protection and acceptable discharge limits.Monitoring of overflow from settling ponds, if required, will be monitored according to the Pit and Quarry Guidelines and the Approval (including amendments) for the quarry. Current discharge limits are outlined in Section 4.6.
- Surface water monitoring will continue to be conducted at the request of NSE.
- An updated Storm Water Management Plan will be submitted as part of the Approval amendment application.
- The Storm Water Management Plan will be designed in consideration of the increased likelihood of more frequent and intense precipitation events in the coming years, as outlined in NSE's "Guide to Considering Climate Change in Project Development in Nova Scotia" (NSE 2010).
- Contingency measures for storm events will be updated and included as part of the Storm Water Management Plan.

8.2.5 Expected Residual Effects

There are no watercourses or water bodies present within the Project Area; therefore interaction between Project activities and aquatic habitat and fauna are not expected.

Provided the proposed mitigative measures are implemented, direct effects to aquatic fauna are not expected as a result of Project activities. Indirect effects related to water quality and aquatic habitat are also expected to be eliminated by following appropriate mitigation techniques. Therefore, no significant adverse residual effects on aquatic habitat and fauna are expected to occur as a result of Project activities.

Risks to aquatic habitat and fauna due to accidental spills or failure of ESC measures are expected to be addressed through the implementation of the mitigation strategies above, and the EPP.

Provided the proposed mitigative measures are applied, no residual effects on aquatic habitat and fauna are expected as a result of these incidents.

8.3 Terrestrial Flora

8.3.1 Description of Existing Conditions

Forests in this Ecoregion are mostly coniferous and comprise of black spruce, white spruce (*Picea glauca*) and balsam fir. Red spruce (*Picea rubens*) is notably absent. Some tolerant hardwoods stands made up of yellow birch (*Betula alleghaniensis*) and red maple are found in sheltered areas. Forests are rooted in shallow organic soils and are prone to blow down in strong fall storms. Bogs and saltmarshes are prevalent throughout this eco region (Webb and Marshall 1999).

Habitat mapping (NSDNR 2013a) suggests that the vast majority of the Project Area is forested, with softwood forest being the dominant habitat feature (Table 8.4; Drawing 8.5).

Table 8.4: Habitat Types at the Project Area

Habitat Type	Area (Ha)	Proportion of Project Area
Clear-cut	5.01	**30%**
Softwood	11.73	**70%**
Total	**16.74**	**100%**

Source: NSDNR 2013a

Aerial imagery, combined, with field observations, reveal that the dominant habitat is indeed softwood forest. However, the proportion of intact forest stands is currently less than the habitat mapping suggests due to forestry activity that has taken place in the last 5 to 10 years. Approximately 2 ha of forested land in the northeastern extent of the Project Area has been converted to a Christmas tree farm, and approximately 6 ha of forested land in the southern extent of the Project Area has been cutover.

Intact forest stands within the Project are varied in composition depending on topography. North facing slopes are covered with white spruce, black spruce and balsam fir trees. Flat areas are a mosaic of somewhat exposed rock barrens scantly covered by black huckleberry (*Gaylussacia baccata*) and sheep laurel (*Kalmia angustifolia*) shrubs, amongst even-aged balsam fir stands. South facing slopes are covered by balsam fir and black spruce stands amongst wind throw areas characterized by dense balsam sapling fir regeneration.

A review of the Atlantic Canada Conservation Data Center (ACCDC) database for plant species recorded within a 100 km radius of the Project Area was completed for the purposes of the EA.

ACCDC records indicate that 177 flora species have been identified within 100 km of the Project Area. Of the 177 species identified by ACCDC, 158 are considered SOCI. This preliminary list was used to develop a short list of plant SOCI that might be present within the Project Area (Table F1; Appendix F).