Atlantic Minerals Limited
Lower Cove Quarry Extension

Environmental Assessment
Registration

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Executive Summary

Atlantic Minerals Limited (AML) is proposing to extend existing quarrying activities into the White Hills area over a 25-year duration. The Project, hereafter called the Quarry Extension, will be Phase 1 of a multi-phased development. The existing quarry and proposed extension are located on Route 460 between the communities of Lower Cove (2.5 km to the east) and Sheaves Cove (2 km to the southwest) on the Port au Port Peninsula. The proposed extension includes the clearing of land, removal and stockpiling of overburden and development of a quarry in the White Hills area for the purposes of quarrying high-grade calcium and dolomitic limestone reserves. The Quarry Extension has been planned to extend existing operations for approximately 25 years based on an annual total production rate of approximately three million tonnes. It is scheduled to be initiated in 2017 with on-site road construction and clearing at the White Hills area. It is anticipated that high-grade calcium limestone product will be produced before the end of 2017. Based on an average production rate of approximately two million tonnes per year of high-grade calcium limestone and one million tonnes of dolomitic limestone after 2020, operation of the White Hills quarry is scheduled from 2017 to 2042. As the extension proceeds, quarries will be progressively reclaimed as they become exhausted. Final decommissioning of the first phase for the White Hills quarry is scheduled to occur from 2041 to 2043.

AML is committed to the protection of the environment and providing employment to residents of local communities. To support these objectives, AML has undertaken several environmental initiatives. AML has held meetings with community leaders in February and July, 2015 and February 2016 and is committed to working with neighbours in a respectful environment to address as many concerns as possible. AML has also consulted with the Newfoundland and Labrador Department of Environment and Conservation (NLDEC) Environmental Assessment Division regarding the registration of the Quarry Extension and the NLDEC Wildlife Division regarding their concerns about Lindley's aster and other plant species.

The environmental assessment focuses on four Valued Environmental Components (VECs). For each VEC, the environmental assessment describes the scope of assessment, presents a summary of the existing conditions, lists Quarry Extension-VEC interactions, presents an assessment of residual environmental effects, makes a determination of significance of residual environmental effects, and proposes any required monitoring.

Atmospheric Environment

The assessment of effects of the Quarry Extension to the Atmospheric Environment includes air quality and noise. Existing ambient air quality in and surrounding the Quarry Extension site is characterized by the emissions of particulate matter and combustion gases from the activities currently taking place on-site (i.e., blasting, material handling, conveying, crushing, screening,

truck travel, and ship loading). The acoustic environment is considered rural, with the existing acoustic environment likely dominated by vehicle traffic on Route 460 and sounds from the operation of the existing quarry and associated activities. Proposed mitigation measures includes implementation of AML's Dust Control Plan, a comprehensive equipment preventative maintenance program and a reduction in the haul route distance to and from the site. **Noise is not anticipated to result in significant effects because of the distance to the nearest communities.** With implementation of the proposed mitigation, the residual environmental effects of the Quarry Extension on the Atmospheric Environment are not likely to be significant. Fugitive emissions of dust at the site level will be monitored and a dust complaint follow-up and response procedure will also be implemented as part of the Dust Control Plan. Noise monitoring will be conducted in specific noise-sensitive areas and/or along the site perimeter as the Quarry Extension proceeds, if deemed necessary.

Groundwater Resources

Groundwater Resources include domestic, commercial, and industrial groundwater-source water supplies, and the groundwater component of freshwater ecosystems. To mitigate potential groundwater effects, AML will: develop and implement a Water Management Plan; construct diversion ditches to manage surface run-off and drainage; design ditches, culverts and settling ponds for a 1-in-25 year storm event; control excavation drainage water using a settling pond; and regularly monitor the quarry walls for measurable groundwater inflows. With the proposed mitigation measures, **the adverse residual environmental effects of the Quarry Extension on Groundwater Resources are not likely to be significant.** Groundwater monitoring is a requirement of NLDEC and will include monitoring of groundwater levels and groundwater chemistry in the Quarry Extension area, as well as overall down-gradient areas of the property to detect changes in groundwater chemistry.

Rare Plants

The effects of the Quarry Extension were assessed for Rare Plants, focusing on species at risk (SAR) and species of conservation concern (SOCC). **There are no species on the Quarry Extension site listed in the federal *Species at Risk Act*. One SAR, Lindley's aster, is listed as Endangered under the *Newfoundland and Labrador Endangered Species Act*.** Six provincially tracked vascular plant SOCC were also identified: western thread-leaf pondweed (May be at Risk); giant bur-reed (*may be at risk*); northern holly fern (*may be at risk*); pulvinate pussytoes (*unranked*); forest bluegrass (*sensitive*); and limestone oak fern (*sensitive*). Mitigation measures include reducing and modifying the footprint to avoid removal of topsoil / overburden, and avoid drilling, blasting, and excavation in areas of high potential for rare plants, where practicable. Final siting of infrastructure will avoid locations of SAR and SOCC, where practicable and feasible. AML will oversee implementation of proposed mitigation measures. The Quarry Extension will not result in a change or decline in the distribution or abundance of species such that the likelihood of their long-term survival within the Local Assessment Area is substantially reduced as a result. **The adverse residual environmental effects on Rare Plants are predicted to be not significant.** Prior to Quarry Extension start-up, AML, in consultation with NLDEC Wildlife Division, will evaluate the need for monitoring to verify predicted environmental effects

and to monitor the effectiveness of mitigation measures for SAR and SOCC, and associated habitat. The success of rehabilitation will be monitored annually for the first three years after progressive reclamation or until re-vegetation is deemed successful.

Employment and Business

The Quarry Extension has the potential to have positive effects on Employment and Business through the expenditures on supplies and services and through employment of area residents. The direct, indirect, and induced effects of Quarry Extension expenditures and employment, together with other Quarry Extension-related expenses, will also contribute to the local economy. Quarry Extension effects on Employment and Business are anticipated to be largely beneficial because employment and business opportunities will be created during all Quarry Extension phases. Mitigation and management measures related to Employment and Business include the development and implementation of a strategy to encourage local and Aboriginal content in staffing. Residual environmental effects of the Quarry Extension on Employment and Business are largely anticipated to be beneficial, creating and maintaining employment and business opportunities for 25 years.

AML currently employs approximately 150 people at its Lower Cove operations. No government funding has been sought for any construction of development work and day to day operations.

As the Quarry Extension is not anticipated to result in a significant adverse residual environmental effect, and as there are few other projects that could act in combination with Quarry Extension activities, it is not likely there will be significant cumulative environmental effects on the VECs. An Environmental Protection Plan is being developed to address potential environmental concerns associated with routine daily activities on-site, as well as provide direction and guidance for the management of accidental events. The implementation of best management practices (e.g., preventative maintenance, material handling procedures) will help reduce the likelihood of accidents and malfunctions. With the application of proposed mitigation measures, including an Environmental Protection Plan that will include a contingency plan to respond to accidental events, **the Quarry Extension is not anticipated to result in significant adverse residual environmental effects.**

There is no viable alternative to the Quarry Extension that still meets its purpose as defined above. The null alternative, which consists of doing nothing and ceasing operation by 2020, would result in a loss of the local and regional employment and business that has been present in the region since the quarry started operations more than 20 years ago.

Abbreviations, Acronyms and Units of Measure

°C	degrees Celsius
%HA	percent highly annoyed
AC CDC	Atlantic Canada Conservation Data Centre
AML	Atlantic Minerals Limited
CACs	criteria air contaminants
cm	centimetre
CO	carbon monoxide
CO_{2eq}	carbon dioxide equivalent
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dBA	A-weighted decibel
EA	Environmental Assessment
EPP	Environmental Protection Plan
ERCB	Energy Resource Conservation Board
GHG	greenhouse gas
ha	hectare
km	kilometre
kV	kilovolt
LAA	Local Assessment Area
L/min	Litres per minute
m	metre
m^2	square metre
m^3	cubic metre
mbgs	metres below ground surface
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NLDEC-WRMD	Newfoundland and Labrador Department of Environment and Conservation – Water Resources Management Division
NLDNR	Newfoundland and Labrador Department of Natural Resources
NLEPA	Newfoundland and Labrador *Environmental Protection Act*
NLESA	Newfoundland and Labrador *Endangered Species Act*
NO_X	nitrogen oxides
PDA	Project Development Area
PM_{10}	particulate matter ≤10 microns
$PM_{2.5}$	particulate matter ≤2.5 microns
RAA	Regional Assessment Area

RCP	Rehabilitation and Closure Plan
SAR	Species at Risk
SARA	*Species at Risk Act*
SO_2	sulfur dioxide
SOCC	Species of Conservation Concern
TPM	total particulate matter; particulate matter ≤30 microns in diameter
US EPA	United States Environmental Protection Agency
VEC	Valued Environmental Component

Glossary of Technical Terms

Aboriginal	A collective term for the original peoples of North America and their descendants (INAC 2005) [http://www.ainc-inac.gc.ca/pr/pub/wf/trmrslt_e.asp?term=1]
Acoustic Environment	The complete set of all objects and their respective physical properties having an influence on the sound field that surrounds a listener. http://keithyates.com/glossary. htm.
Air Quality	The degree to which the ambient air is pollutant free, assessed by measuring various indicators.
Alpine	A biogeographic zone made up of slopes above timberline and characterized by the presence of rosette-forming herbaceous plants and slow-growing low shrubby woody plants. An ecological community term for high-elevation plant communities
Ambient noise	The background sound pressure level at a given location.
Anthropogenic	Resulting from or produced by human beings.
Assessment Area	A defined geographic region within which the significance of environmental effects are determined.
Aquifer	A saturated formation or group of formations that can store or transmit useable volumes of groundwater to wells or springs.
Barrens	Barren habitats (also called heathlands) are relatively unproductive, have poorly developed organic soils and are dominated by plants in the Ericaceae family. Habitats with <2 percent total vegetation cover and <10 percent cover by tree or shrub species may be defined this way.
Baseflow	Sustained low flow in a river during dry or drought conditions through contributions from interflow and groundwater discharge.
Bedrock Stratigraphy	The arrangement or sequencing of strata of the native consolidated rock underlying the surface and their interpretation in terms of mode of origin and geologic history.
Calcicolous	A calcicole, calciphyte or calciphile is a plant that thrives in lime rich soil.
Census	A periodic count of the population that usually includes social and economic information.
Census Subdivision	The general term for municipalities (as determined by provincial/territorial legislation) or areas treated as municipal equivalents for statistical purposes (e.g., Indian reserves, Indian settlements and unorganized territories).
Chionophilic	A plant or animal capable of surviving a snow cover. Chionophiles belong to the group of snow plants, in which growth processes and photosynthesis occur at temperatures around 0°C in late winter and early spring, when the plants are covered with snow.
Demographic	Characteristics of human populations, such as size, growth, density, distribution, and vital statistics.
Discharge Area	The portion of the watershed in which the net flow of subsurface water is directed upwards toward the water table and can interact with surface water on the land surface.

Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location. A community of organisms and its environment functioning as an ecological unit. For the purposes of assessment, the ecosystem must be defined according to a particular unit and scale.
Ecosystem Mapping	A system used to delineate map units that are internally consistent and sufficiently different from adjacent areas to enable separation of a landscape continuum into ecologically meaningful units. It involves a collaborative interdisciplinary process involving clear timely communication within and between offices (and scientists) and the application of consistent mapping approaches to the integration of site, soil, and vegetation information, using the best available technology and appropriately trained staff.
Ecotone	An ecotone is a transitional area between two different ecosystems, such as a forest and a wetland. In landscape ecology, an ecotone is the border areas where two patches meet that have different ecological composition. The ecotone contains elements of both bordering communities as well as species which are characteristic and restricted to the ecotone.
Fen	Sedge peat materials derived primarily from sedges with inclusions of partially decayed stems of shrubs formed in a eutrophic environment due to the close association of the material with mineral rich waters. Minerotrophic peat-forming wetlands that receive surface moisture from precipitation and groundwater. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium.
Floristic	As in flora, it is a subdomain of botany and biogeography that studies distribution and relationships of plant species over geographic areas.
Footprint	Areas where Quarry Extension related infrastructure and activities are proposed.
Greenhouse gases	Any gases that contribute to the greenhouse effect by absorbing infrared radiation and trapping heat in the atmosphere.
Groundwater	The water held beneath the Earth's surface in the pores, fractures, crevasses, and seams of bedrock and overlying surficial materials.
Hydraulic conductivity	A property of soil, or rock that describes the ease with which water can move through pore spaces or fractures.
Inflation	The rate at which general prices for goods and services rises.
Infrastructure	Facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions.
Issues Scoping	To focus an environmental assessment on a concise list of those components of the bio-physical and socio-economic environment that are "valued" (socially, economically, culturally and/or scientifically) and of interest when considering the potential environmental effects of a project.
Labour Force	Civilian non-institutional population 15 years of age and over who, during the survey reference week, were employed or unemployed.
Labour-intensive	A process or industry requiring or using a large expenditure of labour relative to the need for or use of financial resources.
Lowlands	Areas with ground slopes of less than 0.5 percent and typically poorly drained.

Measurable Parameter	A definable aspect of a Valued Environmental Component or Key Indicator that can be compared against a baseline value/condition.
Mesic	A moderate soil moisture regime value whereby water is removed somewhat slowly in relation to supply; neither wet nor dry. Available soil water reflects climatic inputs.
Mesotrophic	Moderately fertile conditions.
Mitigation	The elimination, reduction or control of the adverse environmental effects of a project. This includes restitution of any damages to the environment caused by a project though replacement, restoration, compensation or other means.
Organic Soil	A soil order that have developed primarily on organic deposits. Soils containing high percentages of organic matter (fibric and humic inclusions).
Participation Rate	Total labour force expressed as a percentage of the population aged 15 years and over. The participation rate for a particular group (for example, women aged 25 years and over) is the labour force in that group expressed as a percentage of the population for that group.
Peat	Material constituting peatlands, exclusive of live plant cover, consisting largely of organic residues accumulated as a result of incomplete decomposition of dead plant constituents under conditions of excessive moisture.
Peatland	Areas where there is an accumulation of peat material at least 40 cm thick. These are represented by bog and fen wetlands types.
Piezometric surface	An imaginary or hypothetical surface of the hydraulic head of a confined or semi-confined aquifer; analogous to the water table of an unconfined aquifer.
Recharge Area	The portion of the watershed where water predominantly flows downward through the unsaturated zone to replenish an aquifer.
Residual Effects	Those effects remaining after enhancement and mitigative measures have been applied.
S Rank	Sub-national (provincial) rarity ranking for a species
Threshold	A point that must be exceeded in order to produce a certain effect or response.
Tuckamoor	A typical Newfoundland term for the stunted balsam fir and spruce trees that grow and flourish despite harsh conditions in some alpine areas and along the coast.
Uplands	Areas where the soil is not saturated for extended periods as indicated by vegetation and soils.
Watershed	An area or region drained by a river, river system, or other body of water.

1.0 INTRODUCTION

1.1 Description of the Proponent

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1.2 Name of the Project

Lower Cove Quarry Extension (the Quarry Extension).

1.3 Overview

Atlantic Minerals Limited (AML) is proposing to extend existing operations at their Lower Cove Quarry site, on the Port Au Port Peninsula, by expanding their mining lease area to access Mineral License 022374M / Proposed Mining Lease 235, with an estimated operational life of 70 to 90 years. The Project, hereafter called the Quarry Extension, will be Phase 1 of a multi-phased development. The existing quarry and proposed Quarry Extension are located on Route 460 between the communities of Lower Cove and Sheaves Cove on the Port au Port Peninsula, approximately 2.5 km from Lower Cove, and 2 km from Sheaves Cove (Figure 1-1). The extension includes some clearing of land and overburden, and development of a quarry in the White Hills area for the purposes of mining high-grade calcium and dolomitic limestone reserves that AML has identified in the area. The Quarry Extension has been planned to extend existing operations for approximately 25 years based on an estimated annual total production rate of two million tonnes of high-grade calcium limestone, and one million tonnes of dolomitic limestone.

Figure 1-1 Location of Quarry Operations

1.4 Existing Operations

The Lower Cove Quarry began operation in 1988. AML has been the owner / operator since 1996, when it was purchased out of bankruptcy. Located on the Port au Port Peninsula, both chemical-grade high-calcium limestone and dolomite are produced, averaging 2.25 million tonnes per year over the last five years. AML currently employs approximately 150 persons, of which 95 percent are from the Port au Port Peninsula and greater Bay St. George area. More than thirty (30) or more contractors and suppliers are engaged on an annual basis. Existing operations include two quarries, processing facilities, and a ship loading facility. Quarry material is drilled, blasted, and crushed; product is graded, stockpiled, and loaded onto marine vessels by loading conveyors. The quarries operate 24 hours/day, seven days a week for nine months of the year. For the remaining three months AML performs maintenance on the plant and facilities, and completes ship loading. The high-calcium limestone and dolomite products are marketed to Labrador West, Quebec, United States, South America, and Europe for various chemical and industrial uses. Clients include the power industry to reduce carbon emissions, the steel industry, and agricultural industry.

1.5 Existing Environmental Management

AML is committed to the protection of the environment and working with neighbouring communities in a respectful environment to address as many concerns as possible.

To support these objectives, AML has undertaken a number of site environmental initiatives:

- Development of Environmental Protection Plan (including an updated Contingency Plan)
- Avifauna management
- Wildlife protection measures
- Rare plant surveys
- Dust control and mitigation
- Blast monitoring
- Stormwater Management Design
- Potable and Process Site Water Supply and Treatment Design
- Water Well Condition Survey
- Water quality compliance monitoring
- Update of Rehabilitation and Closure Plan (RCP)
- Education of staff

Completed plans are appended to the Registration; plans-in-progress will be finalized, taking into consideration comments received from stakeholders during the review period for the Registration.

AML has also engaged community leaders, providing an overview of the proposed Quarry Extension and identifying concerns and associated mitigation measures.

1.6 Need / Purpose / Rationale

Geological and diamond drilling data collected in 2013 indicated that limestone deposits in AML's current leases would be exhausted in 2016. To address this, AML has invested capital in 2015 to expose additional reserves in existing quarries, thereby extending operation until 2020. However, this is an interim measure only as the reserves will become exhausted at that time and operations will cease. To develop its business operations in an economically sustainable manner over the next several decades, and provide residents of the Port Au Port / Bay St. George Area with future stable employment, the mining lease area and associated reserves need to be extended. Accordingly, AML has applied to the Newfoundland and Labrador Department of Natural Resources (NLDNR) to extend their mining lease area to access Mineral License 022374M / Proposed Mining Lease 235.

1.7 Schedule

The Quarry Extension is estimated to be initiated in 2017 with on-site road construction and some clearing in the White Hills area. High-grade calcium limestone product will be produced before the end of the 2017 calendar year. Based on an average production rate of approximately two million tonnes of high-grade calcium limestone and one million tonnes of dolomitic limestone per year after 2020, operation of the White Hills quarry is estimated to occur from 2017 to 2042. As the Quarry Extension proceeds, existing quarries will be progressively reclaimed as they become exhausted.

1.8 Approval of the Undertaking

The permits and authorizations that may be required, or amendments to existing permits and authorizations for the Quarry Extension, are presented in Table 1.1.

Table 1.1 Potential Permits and Authorizations (or Amendments)

Permit or Authorization	Act	Agency
Certificate of Approval	*Environmental Protection Act*	Pollution Prevention Division, Newfoundland and Labrador Department of Environment and Conservation (NLDEC)
Permit to Engage in an Economic Activity	*Endangered Species Act*	Wildlife Division, NLDEC
Water Use License	*Water Resources Act*	Water Resources Division, NLDEC
Release from environmental assessment	*Environmental Protection Act*	Environmental Assessment Division, NLDEC
Mineral License	*Mineral Act*	Mines Branch, NLDNR
Mining Lease	*Mining Act*	Mines Branch, NLDNR

2.0 PROJECT DESCRIPTION - LOWER COVE QUARRY EXTENSION

2.1 Location

The Quarry Extension is located adjacent to the existing deposits under AML's current licenses, located on the Port au Port Peninsula approximately 2.5 km from Lower Cove and 2 km from Sheaves Cove in the Bay St. Georges area (see Figure 1-1). The Quarry Extension site is approximately 40 km away from the town of Stephenville.

2.2 Components

The Quarry Extension will include a new quarry adjacent to the existing operations, and the construction of a new haul road in order to gain access to the site. The new haul road will be approximately 2 to 3 km in length and approximately 25 m wide, and it will continue with the present haul road for the existing operations, for a total of approximately 4 km to 5 km from the primary crushing site. The Quarry Extension area will include development of settling ponds and installation of a temporary building for employee washrooms and eating area. Settling ponds will be constructed within the footprint to manage stormwater.

Along with site development and access roads, water infrastructure and a sump will be installed to service the Quarry Extension. A transmission line (pole line) will be installed by a third party within the existing right-of-way to power sump pumps, equipment and buildings.

The Quarry Extension will also include construction of a new office building, maintenance facility, and lunchroom / change room building. These buildings will be located east of the existing site, and will replace older facilities. The older facilities will be re-purposed or removed.

The Quarry Extension will occupy an area of approximately 140 ha. The total footprint of the Quarry Extension, including quarry, road, and new buildings, will occupy an area of approximately 160 ha.

The site lay-out is shown in Figure 2-1.

2.3 Site Preparation and Construction Activities

Construction of the new haul road for access to the White Hills area will be completed before other construction can begin. This will involve stripping the proposed road area of overburden and backfilling as construction advances. The road will be backfilled with rock and topped off with fines. Additionally, a crown will be placed on the road for water drainage, along with a ditch to catch any runoff water.

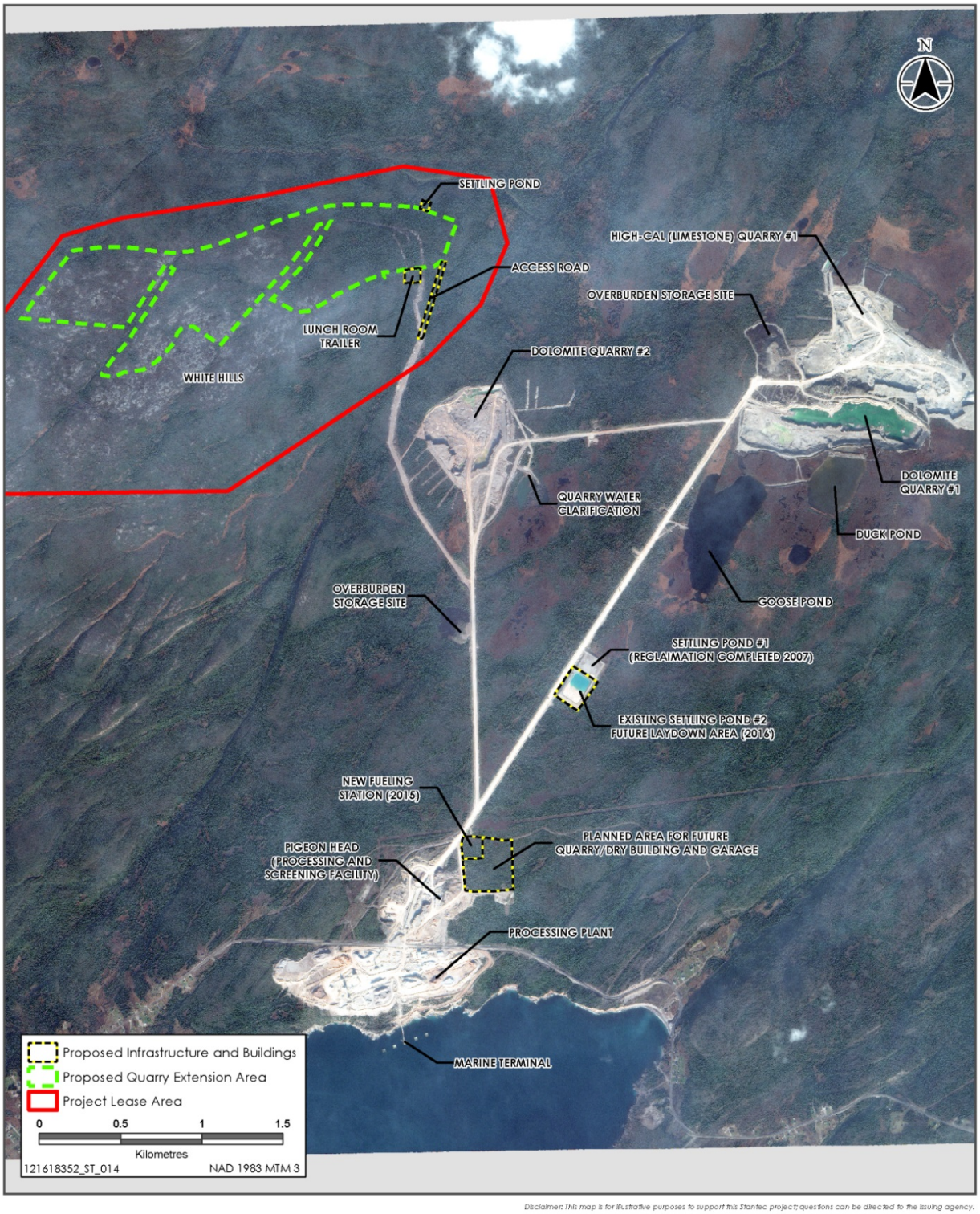


Figure 2-1 Existing and Proposed Site Plan

Once the haul road has been completed, construction of the quarry will be able to commence. This will initially involve clearing an area for space for cleared overburden storage. It is estimated that approximately 170,000 m^3 of overburden will be cleared in order to achieve the needed space for production in Year 1.

Once the overburden is cleared, excavation will begin on the Quarry Extension. A ramp will be drilled in order to create access to the quarry and the first bench is designed to be 15 m deep. A sump will be constructed and a pump installed to remove the quarry water to a drainage ditch and settling pond located on site, through a discharge water line.

A water well and associated distribution lines will be constructed to supply water to the buildings.

2.4 Operation Activities

The existing Lower Cove Quarry produces approximately 2 to 3 million tonnes of product each year. The facility operates twenty-four hours a day, seven days a week for nine months of the year, with reduced operations for plant maintenance and ship loading occurring during three months of the winter. Operations involve drilling and blasting within the limestone and dolomite quarries to extract raw material. When extracted, the material is loaded, via excavators, and transported with haul trucks approximately 4 to 5 km to the primary crusher. As the haul trucks reach the primary crusher, the extracted material is dumped from the trucks into a bin that feeds the crusher. The material is then crushed and stockpiled above a series of hoppers that feed an underground conveyor system that transports the crushed material through a screen and secondary crushing. The material is conveyed via an underground conveyor, under Route 460, where it is further processed and stockpiled.

On the south side of the site, the material is further processed via a number of screens and tertiary crushing and fines crushing. The processed material is transferred to the short-term storage stockpiles. The storage piles are equipped with hoppers that feed an underground conveyor that in turn transfers material to the ship loader.

A flow chart representing the activities, along with the step by step process from drilling and blasting to the final products, is provided in Figure 2-2.

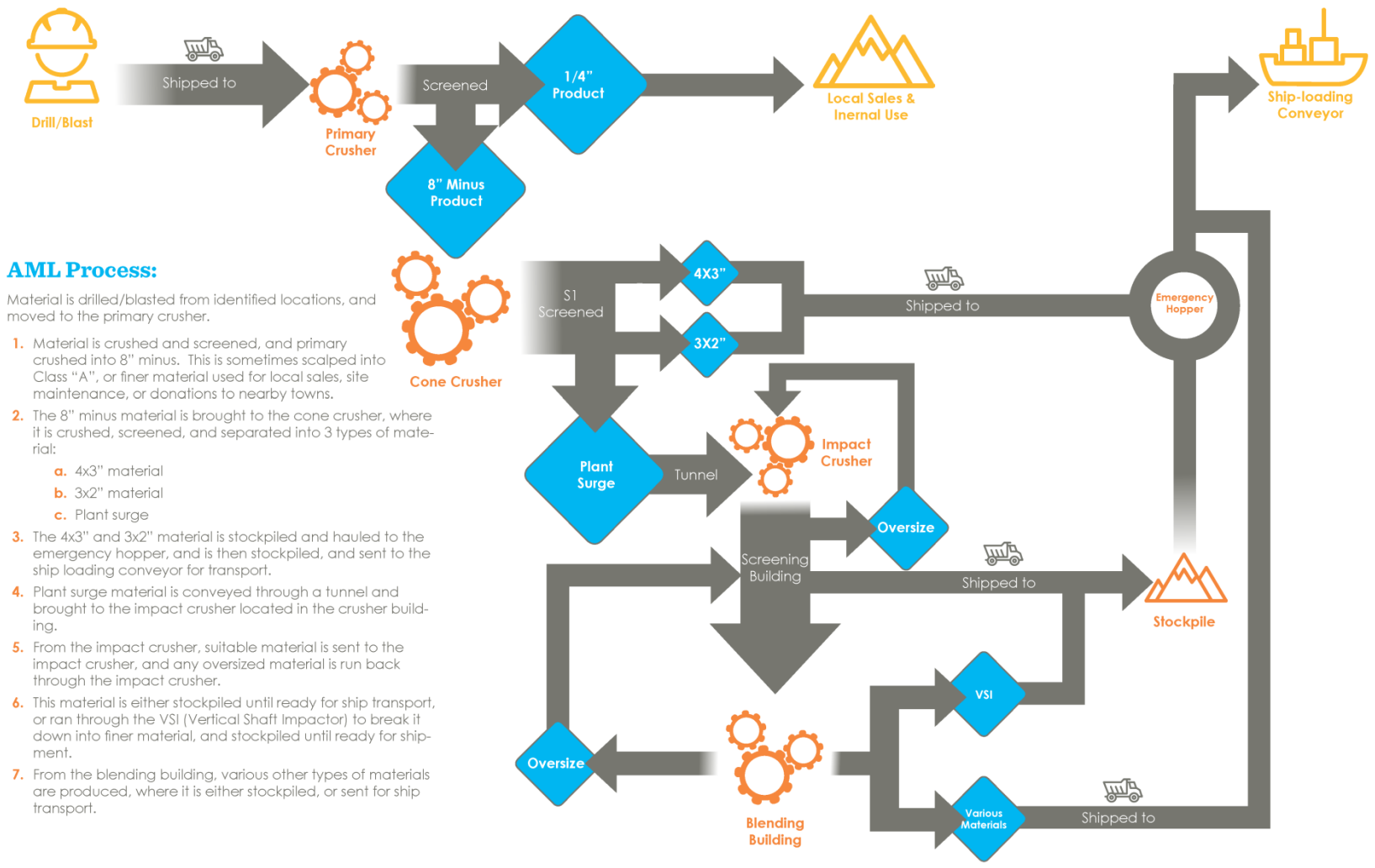


Figure 2-2 Process Flowchart

2.5 Progressive Rehabilitation

The overall objectives of the Rehabilitation and Closure Plan (RCP) proposed for the Quarry Extension include:

- Restoration of the land as close to a natural state as practicable
- Creation of a landscape which is compatible with surrounding terrain and land use
- Mitigation and control of potential sources of pollution, fire risk, and public liability to within levels acceptable to all regulatory agencies
- Provision of an environment and landscape that is suitable for long-term public access and use

The RCP is currently in preparation for NLDNR, Mines Branch. The strategies and methods that will be employed to reduce environmental disturbances during construction and operations will be described in the RCP.

The approach to rehabilitation will involve progressive (and closure) rehabilitation techniques. The RCP will be subject to reviews and updates as required.

Steps to promote the overall rehabilitation process will include the following:

- Terrain, soil, and vegetation disturbances will be limited to that which is necessary to complete the work within the defined Quarry Extension boundaries
- Organic soils, mineral soils, glacial till, and excavated rock will be stockpiled for later rehabilitation work
- Surface disturbances will be stabilized to limit erosion and promote natural revegetation
- Contractors will be required to comply with environmental protection standards and regulatory requirements
- Given the specific overburden, topography, drainage, and design conditions for the Quarry Extension, AML is committed to conducting vegetation trials (including rare plant trials) so that natural revegetation of the site is encouraged on decommissioning of the Quarry Extension

All aspects of the Quarry Extension (engineering and construction phases, including design, construction planning, and implementation), and operations planning will be conducted with full consideration of available progressive rehabilitation opportunities and closure rehabilitation requirements. Results from the revegetation trials will be integrated into ongoing progressive rehabilitation activities and used in the development of the decommissioning design. The Quarry Extension will be planned and designed to lessen the disturbed area of the site, and to avoid or reduce environmental effects.

2.6 Decommissioning

Final closure will be completed at the end of operation within the lease area. The Quarry Extension will be decommissioned when the quarry is no longer in use and can be closed without affecting continued operations.

Decommissioning activities for the Quarry Extension are anticipated to require one to two years and will generally include the following:

- Removal and re-assignment of hazardous chemicals, reagents, and other such materials for other operations within the lease area
- Equipment will be disconnected, drained and cleaned, disassembled, and re-assigned to other operations within the lease area. This includes tanks, mechanical equipment, electrical switchgear, pipes, pumps, vehicles, equipment, and office furniture
- Dismantling and removal / disposal of buildings and surface infrastructure that are no longer required
- Removal and rehabilitation of fuel storage and dispensing facilities, if no longer required
- Assessing soil and groundwater conditions in areas that warrant assessment (such as fuel dispensing facilities, chemical storage buildings, vehicle maintenance buildings, sedimentation ponds) and implementing remedial measures where necessary
- Testing of sediment in sedimentation ponds as per applicable regulations
- Stabilization and revegetation of remaining waste rock and overburden dumps
- Contouring and revegetation of remaining quarry slopes
- Following water quality testing, breaching of sedimentation ponds to allow drainage to surrounding vegetated areas for natural filtration
- Completing all necessary geotechnical, hydrological, and groundwater studies
- Grading and/or scarification of disturbed areas to promote natural revegetation, or the placement and grading of overburden for revegetation in areas where natural revegetation is not sufficiently rapid to control erosion and sedimentation
- Any additional or special rehabilitation requirements associated with the site, such as removal of culverts and power lines, and infilling of any drainage or diversion ditches that are no longer required

2.7 Employment

The anticipated labour requirements during the construction and operation phases of the Quarry Extension, by type (NOC code), timing, and duration are described in Table 2.1. As of July 2015, AML employed approximately 150 workers. It should be noted that the only additional employment will be contract workers during the construction phase. All other work will be undertaken by current AML employees, most of whom belong to the International Union of Operating Engineers and hence are subject to the provisions of the collective agreement between the International Union of Operating Engineers (I.U.O.E) Local 904 and AML. As a result,

the only post-construction labour requirement may be for replacement workers as a result of retirements and normal turnover.

Table 2.1 Estimated Quarry Extension Labour Requirements

Occupation	NOC 2006	Full / Part time	Length of employment	# of positions	AML or contractor positions	Union?
Quarry Extension Construction Phase (Estimated to be 2017 to 2020)						
Supervisors	7204	Full-time	12 months per year	2	Contractor	N/A
Carpenters	7271	Full-time	10 months per year	4	Contractor	N/A
Plumbers	7251	Full-time	10 months per year	2	Contractor	N/A
Labourers	7611	Full-time	10 months per year	10	Contractor	N/A
Quarry Extension Operations Phase (As at November 2015)						
Supervisors	8221	Full-time	12 months per year	2	Current Employee	x
Lead Hands	7302	Full-time	12 months per year	4	Current Employee	✓
Heavy Equipment Operators	7421	Full-time	12 months per year	15	Current Employee	✓
Heavy Equipment Operators	7421	Full-time	9 - 12 months per year	4	Current Employee	✓
Truck Drivers	7411	Full-time	12 months per year	10	Current Employee	✓
Truck Drivers	7411	Full-time	9 - 12 months per year	14	Current Employee	✓
Driller/Blasters	7372	Full-time	9 - 10 months per year	2	Current Employee	✓
Driller/Blaster helpers	7372	Full-time	9 - 10 months per year	3	Contractor Employee	✓
Labourers	8614	Full-time	12 months per year	8	Current Employee	✓
Civil Technologist	2231	Full-time	12 months per year	2	Current Employee	✓
Plant Operations Phase (As at November 2015)						
General Manager	0016	Full-time	12 months per year	1	Current Employee	x
Plant Manager	0714	Full-time	12 months per year	1	Current Employee	x
Plant Engineer	0211	Full-time	12 months per year	1	Current Employee	x

Occupation	NOC 2006	Full / Part time	Length of employment	# of positions	AML or contractor positions	Union?
Supervisors	8221	Full-time	12 months per year	5	Current Employee	x
Maintenance Supervisor	0714	Full-time	12 months per year	1	Current Employee	x
Administrative Officer	1221	Full-time	12 months per year	1	Current Employee	x
Security	6651	Full-time	12 months per year	4	Current Employee	✓
Maintenance (Labourers)	8614	Full-time	12 months per year	15	Current Employee	✓
Mechanics	7312	Full-time	12 months per year	7	Current Employee	✓
Plant Operators	9421	Full-time	12 months per year	4	Current Employee	✓
Lab Technicians	9415	Full-time	9 - 10 months per year	4	Current Employee	✓
Electricians	7242	Full-time	12 months per year	3	Current Employee	✓
Plant Labourers	9611	Full-time	12 months per year	21	Current Employee	✓
Plant Labourers	9611	Full-time	9 - 10 months per year	12	Current Employee	✓
Janitors	6733	Full-time	12 months per year	2	Current Employee	✓

2.8 Environmental Management

To address potential effects to rare plant species and habitat, rare plant baseline surveys have been completed and a Rare Plant Mitigation Plan, including progressive rehabilitation, will be undertaken (see Section 7.3.4.2 for details).

Consistent with current operations, air quality and noise will be mitigated through the following measures:

- Maintenance of equipment and machinery
- Equipping equipment and machinery with mufflers and air emission controls
- Operating equipment and machinery on-site only
- Servicing equipment and machinery at designated areas only
- Implementation of the Dust Control Plan during construction and operation (Appendix A)

- Management of operational and domestic waste in compliance with the Newfoundland and Labrador *Waste Management Regulations*

Dust and silica monitoring has been undertaken, and mitigation to reduce dust at the processing facility and along haul roads has been undertaken (i.e., watering trucks, dust suppressant system).

Potable and non-potable water will be required at the lunchrooms, quarry, crusher, and plant. Annual potable and non-potable water demands are approximately 30,000 l of potable water (currently bottled off site), and approximately 107,300,000 l of non-potable water from an onsite pond. AML has undertaken a Stormwater Management Design, a Potable and Process Site Water Supply and Treatment Design, a Water Well Condition Survey, and water quality compliance monitoring at established site discharge points. All discharges will comply with the Newfoundland and Labrador *Environmental Control Water and Sewage Regulations*. Potable and non-potable water will be obtained through the Water Use License process administered by Water Resources Division, Newfoundland and Labrador Department of Environment and Conservation (NLDEC). Please refer to Section 1.8 for details.

An Emergency Response Plan, including Spill Response, has been prepared and staff continue to be trained in its application. Emergency spill kits are available on site.

3.0 ALTERNATIVES ASSESSMENT

3.1 Alternatives to the Quarry Extension

The purpose of the Quarry Extension is to develop a quarry in AML's White Hills mineral lease area for the purposes of quarrying high-grade calcium and dolomitic limestone reserves in the area.

There is no viable alternative to the Quarry Extension that still meets the Quarry Extension's purpose as defined above. The null alternative, which consists of doing nothing and ceasing operation by 2020, would result in a loss of the local and regional employment and business that has been present in the region since the quarry started operations more than 20 years ago. If the Quarry Extension does not proceed, closure will result in direct job losses (i.e., to the existing regional work force of approximately 150 full and part-time employees), as well as indirect and induced jobs lost in the surrounding communities.

The Quarry Extension provides a technically feasible, economically viable, and environmentally and socially responsible means of addressing the need for, and purpose of, the development, and one that will be planned and implemented to avoid or reduce potential adverse environmental effects and optimize socio-economic benefits.

3.2 Alternative Means of Carrying Out the Quarry Extension

When AML originally proposed the extension to its quarry operations, the footprint was approximately 760 ha and was expected to have an operational life of 70 to 90 years. As part of the process to register the original Quarry Extension, AML consulted with local community leadership, the general public, and provincial and federal governments.

Through consultation with NLDEC Wildlife Division, including a meeting on September 15, 2015, concerns were provided to AML about the extent to which rare plants (specifically, Lindley's aster (*Symphyotrichum ciliolatum*)) might be affected by the Quarry Extension. To address the concerns of the Wildlife Division, the scope, cost, and schedule of the Quarry Extension were reevaluated by AML in the context of technical feasibility, economic feasibility, and operational functionality. The intent was to update the initial approach to include allowances for a modified design to mitigate potential environmental effects. Through this process, the quarry footprint was reduced and modified to avoid removal of topsoil / overburden, drilling, blasting, and excavation in areas of high potential for rare plants, where practicable. **The substantially reduced quarry footprint is now 140 ha (approximately 80 percent smaller than that of the original footprint)**, and helps to address effects to species at risk (SAR) by reducing interaction with these species. **The total footprint, including the quarry and associated infrastructure, is approximately 160 ha.**

4.0 CONSULTATION AND ISSUES SCOPING

4.1 Community Leadership Consultation

AML held meetings with community leaders on February and July of 2015, and again in February 2016 at AML's quarry in Lower Cove. Officials attended from various communities on the Port au Port Peninsula. The issues discussed at these meetings are identified in Table 4.1.

Table 4.1 Issues Identified During Consultation with Community Leaders, February and July, 2015

Issue	Specific Concerns	AML Comments
Dust	• Breathing Disorders • Poor Air Quality • Lack of Dust Control • Property covered in dust	In mid-2015 a Dust Control Plan was developed for the existing Lower Cove operation. AML has successfully used this plan to control dust on and off site.
Health / Breathing	• Dust Study / Adjacent Communities • Cancer Rates	
Communication	• Communication with Communities	AML has completed a number of Community Leader meetings to discuss concerns and future development plans.
	• Regular Discussions	Will occur depending on need and based on activity.
	• Contact Person for Community Issues	Rob Kenney, HR Manager, AML.
Support of Communities	• Financial Support for Communities	AML makes regular donations to community organizations.
Water Issues	• Apply mitigation measures so that water issues are not caused by blasting • Define Water Hydrology study • Contamination (Run Off)	AML has begun establishing ground water monitoring wells around its site and will continue to complete monthly site water discharge analysis.
Blasting	• Vibration • Advanced warning • Noise pollution • Size of Blast - Can this be managed? • Property Damage • Type of Product Used	A blast monitoring program is currently being undertaken at the site. Initial results confirm blasting operations at the existing quarry are within industry guidelines and should not result in significant adverse effects.
Wildlife / Habitat	• Destroying Wildlife Habitat • Define Closure Plan • Impact on Wildlife • Rare / Endangered Plants - Impact	An Environmental Protection Plan (EPP) and Rehabilitation and Closure Plan are in development and will be filed with regulators and implemented by AML.

Issue	Specific Concerns	AML Comments
Shipping / Ocean	• Fishing Grounds • Bilge Dumping • Pollution / Runoff Sediment • Impact on Marine Life	AML adheres to all applicable Transport Canada, Fisheries and Oceans, and Environment Canada regulations.
Loss of Land Use	• Limestone Barrens • Endangered Species • Wood, Berries • Hiking	An EPP is in development. The table of contents for the Plan is provided in Appendix G. It will be filed with regulators and implemented by AML.
Tourism	• Provide Tours of the quarry • Tourists not happy • Not Visibly Appealing	Due to safety and liability concerns tours of our quarry are limited. AML has received numerous positive comments regarding our operation in Lower Cove.
Closure Plan	• Communicate the Plan	AML will present the Closure Plan to Community Leaders.
Traffic	• Safety Issues / Heavy Trucks • Traffic Light • Lighting • Visibility / Dust on Road	AML is addressing these concerns. Flag persons are used for heavy traffic days.
Employment	• Employ More Women • More Local Employment	AML supports employment equity and diversity. 98% of AML's employees are local and 43% of respondents to a recent AML survey were self-identify as Aboriginal.

4.2 Regulatory Consultation

Provincial regulatory consultation has taken place between AML and the NLDEC's Environmental Assessment Division regarding the registration of the previous Quarry Extension application. AML withdrew that application and acquired the services of an Environmental Consultant with the intent of submitting an enhanced document for the revised registration.

A meeting with NLDEC, Environmental Assessment Division was held on June 17, 2015, to provide an overview of the Quarry Extension and to clarify issues that would require more comprehensive study for the new application. It was confirmed the main issues include:

- Rare plants
- Public concerns related to dust
- Groundwater

- Employment and business
- Alternatives to the proposed Quarry Extension

AML and study team members of Stantec met with NLDEC-Wildlife Division on September 15, 2015 to discuss Wildlife Division's identified concerns about the extent to which SAR, and more specifically, Lindley's aster, might be affected by the Quarry Extension. **To address the concerns of the Wildlife Division, the footprint has been reduced and modified to avoid removal of topsoil / overburden, drilling, blasting, and excavation in areas of high potential for rare plants, where practicable, and a commitment has been made to prepare a Rare Plant Mitigation Plan.**

4.3 Issues Scoping

General concerns as expressed by public stakeholders with respect to the Quarry Extension, as well as where these issues have been addressed in the Environmental Assessment Registration are presented in Table 4.2.

Table 4.2 Concordance of Registration with Identified Issues

Issue	Location in Environmental Assessment Registration
Rare Plants	Section 7.3
Dust and related issues	Section 5.3, 7.1
Alternatives	Section 3
Communication	Section 4.0
Support of Communities	Sections 4.0,
Water / Water Supply Issues	Section 5.5, 7.2
Blasting	Section 5.4, 7.1, Appendix I
Wildlife / Habitat	Section 5.6, 5.7
Shipping / Ocean	Not within scope of Quarry Extension
Loss of Land Use	Section 5.10
Tourism	Section 5.9
Closure Plan	Section 2.6
Cutting of Trees	Section 7.4
Traffic	Section 7.1
Employment	Section 2.7, 5.9, 7.4

5.0 ENVIRONMENTAL SETTING

5.1 Physiography, Surface Water and Drainage

The Port au Port Peninsula is located within the West Coast Lowlands, and is characterized by a low-lying coastal plain that is bounded by various upland regions in the north, east, and south (JWEL 2008). The interior of the peninsula is semi-mountainous, with elevations rising upwards to 350 m above sea level in the White Hills area. Coastal areas are relatively even and slope gently to the coast, but become more rugged with coastal cliffs and rocky beaches along the western and southern sides of the peninsula.

The existing quarry operations and proposed extension areas straddle the Peninsula's interior upland region, which is defined by the eastern extension of the White Hills, and adjacent unnamed northeast-trending ridges to the east. The majority of the existing quarry operation, as well as several of the proposed Quarry Extension components (i.e. the new access road, the laydown area, the fuel supply station, the quarry lunch building and the garage) are situated on the south-facing flank of the White Hills and slope moderately down to the south towards the waters of Bay St. George. The three existing quarries (High-Cal, Dolomite #1, and Dolomite #2) are located in the northern portion of the property at the crest of the ridge at peak elevations ranging between 140 and 160 m above sea level. The dewatering discharge system for the High-Cal quarry is located along the north boundary of the quarry on the opposite side of the ridge and slopes gently-to-moderately to the north towards the waters of West Bay. The proposed Quarry Extension area and associated dewatering drainage system will also be situated along the north-facing side of the White Hills at elevations ranging from 180 to 220 m above sea level. Topography in this area slopes moderately to the north towards the waters of West Bay.

The existing quarries and proposed extension areas are located in the headwaters of the Harry Brook drainage system, which in the extension area is defined by Goose Pond and Duck Pond as well as a number of unnamed small tributary streams and brooks. Harry Brook flows from the headwater region underlying the Quarry Extension area towards the waters of West Bay, located approximately 8 km north of the site. No other substantial surface water drainage systems are present in the vicinity of the site.

At its closest point, the proposed Quarry Extension is located approximately 1 km away from the Victors Brook drainage system, which is an approximately 22 km² watershed that serves as the municipal water supply for the communities of Lourdes and West Bay. **The Quarry Extension area is not considered hydraulically connected to the Lourdes-West Bay Water Supply, with a small unnamed tributary to Harry Brook located down-gradient in a low-lying area approximately 151 m north of the proposed extension area, at its closest point**, expected to act as a drainage divide between the Quarry Extension area and the Victors Brook watershed.

Three other smaller public surface water supplies are present on the peninsula, including Port au Port West / Aguathuna / Felix Cove – Jim Rowe's Brook, Cape St. George – Rouzes Brook, Mainland – Caribou Brook, and Piccadilly Head – Unnamed Brook, as well as the Sheaves Cove Falls Brook unprotected water supply. **The Quarry Extension area is not considered hydraulically connected to any of these surface water supplies given the distance (i.e., ranging from approximately 2.5 km for the Sheaves Cove Falls Brook unprotected water supply to 12 km for the Mainland-Caribou Brook water supply)** and the number of intervening topographic and hydraulic drainage divides that separate the Quarry Extension area from these surface water systems. The locations of these various surface water and drainage features, as well as the protected boundaries and locations of intakes for the municipal water supply are shown in Figure 7-2, and are based on information provided in the NLDEC-WRD Water Resources Portal (available online at http://maps.gov.nl.ca/water/) and the Newfoundland and Labrador Department of Natural Resources Online Geoscience Atlas (available online at http://gis.geosurv.gov.nl.ca/).

In addition to public surface water supplies, two groundwater supplies (Lower Cove and Sheaves Cove) are also present on the peninsula, as well as a number of private dug and drilled water wells. A further discussion of these is provided in Section 5.5.

5.2 Regional Geology

Based on the available surficial geology mapping for the area by Batterson (2001a, 2001b 2001c), as well as descriptions of surficial geology provided in Greenlee and Heringa (1984) and Hender (1989), till deposits are widespread throughout the Port au Port Peninsula, occurring as both thin veneer less than 2 m thick, and more extensive deposits with local thicknesses up to 20 m. The till compositions are bedrock-controlled, but generally consists of stony, silt loam to loam sand derived from dolomite, limestone and minor siliciclastic sedimentary rocks. The veneer and moraine tills are locally eroded along stream and river channels. Also, a small isolated area of sand and gravel deposits of glacial outwash and fluvial origin is also present on the peninsula, and occurs along the unnamed pond and brook system that flows into Lower Cove, located approximately 5 km south east of the Quarry Extension. Along with glacial units, the peninsula also contains areas of organic soils overlying either till or bedrock. In large portions of the peninsula's interior upland region, including in the White Hills area, bedrock is exposed within the till and various other surficial deposits. These bedrock outcrops may be partially or fully concealed by a thin mat of vegetation and sparse forest.

Regional 1:250,000-scale compilation bedrock geology mapping by Colman-Sadd and Crisby-Whittle (2005), as well as a description of bedrock geology provided in Boyce, et al. (2000) and Knight, et al. (2008), indicates that the Port au Port Peninsula lies within the Humber (Tectonostratigraphic) Zone and is underlain by Late Precambrian siliciclastic basinal rift sedimentary rocks, Cambrian to Late Ordovician shallow marine sedimentary rocks, overthrusted Precambrian to Ordovician deepwater basinal sedimentary rocks, melange and ophilitic rocks, and Late Silurian to Carboniferous sedimentary cover rocks. The majority of the peninsula,

including the Quarry Extension area is underlain by a succession of Middle Cambrian to Late Ordovician carbonate platformal sedimentary rocks belonging to the Labrador Group, Port au Port Group, St. George's Group, Table Head Group, and Goose Tickle Group. This sedimentary sequence typically referred to as the Humber Arm autochthon (non-transported) sequence is structurally overlain by an allochthon (transported) complex of deep water sedimentary, igneous and metamorphic rocks (Humber Arm Allochthon intermediate structural slices, and Humber Arm Allochthon low structural slices) present north of the Quarry Extension area between the communities of Tea Cove and Boswarlos. Locally on the peninsula, an overlap sequence of Late Silurian to Carboniferous sedimentary rocks comprising siliciclastic and minor carbonate and evaporitic sedimentary rocks and coal beds unconformably overlie the Cambrian to Ordovican rocks of the Humber Zone.

The allochthonous and autochonous rocks of the Humber Zone, including bedrock underlying the Quarry Extension area have undergone complex, multiphase deformation associated with Ordovician Taconic and Devonian Acadian orogenesis, and are characterized by northeast-trending folds with a penetrative crenulation cleavage, as well as thrust faulting, and faulting with dextral strike-slip movement. The Round Head Thrust, which resulted in structural thickening of the Humber Arm autochthonous sequence, is located in the northern portion of the peninsula approximately 10 km north of the Quarry Extension area.

Locally, the Quarry Extension area is overlaid by thin, discontinuous, till veneer (typically less than 2 m thick) with localized areas of organic soils (bog). Beneath the overburden, or exposed at surface in areas of higher elevation, the bedrock consists of massive to well-bedded, grey to beige limestone and dolostone belonging to the lower Ordovician-aged St. George Group (Catoche Formation and Aquathuna Formation). The productive units mined at the existing quarries belong to the older Catoche Formation, and include the upper, massive and chemically-pure Costa Bay Member limestone (mined in the High-Cal Quarry), the middle Catoche Dolomite (mined in the Dolomite #1 and Dolomite #2 quarries), and the lower Catoche Limestone (previously mined in the former Pigeon Head quarry). Quarry mapping and exploration drilling completed by AML in support of both existing quarry and proposed Quarry Extension indicates that stratigraphic bedding is near horizontal in the area, with bedding angles ranging from 5° to 15° and dipping to the north. The Quarry Extension area occurs along strike of the existing High Cal Quarry and will produce from the Costa Bay Member Limestone. The youngest rocks in the Quarry Extension area are light brown to grey dolomitic limestone belonging to the Aquathuna Formation and overlie the Costa Bay Member Limestone (Catoche Formation) in the northern portion of the site.

A number of high-angle northeast-southwest-trending faults are present in the Quarry Extension area due to regional orogenic processes and are defined by locally intense shearing and fracturing in the limestones and dolostones, respectively. In the Quarry Extension area, these are represented surficially as well-defined topographic lineaments.

5.3 Atmospheric Environment

The Quarry Extension location falls within the Southwestern Newfoundland Ecoregion. This region covers the west coast of Newfoundland, south of the Northern Peninsula and west of the southern Long Range Mountains and the Buchans Plateau. This ecoregion is characterized by cool summers and long snowy winters. The average annual temperature for this ecoregion is approximately 4°C, with an average of 12°C in the summer and -3.5°C in the winter time. The southwestern region of Newfoundland receives between 1,000 and 1,200 mm of precipitation annually (Newfoundland Labrador Heritage 2002).

Air quality in communities across the island of Newfoundland is generally considered to be good as ambient air quality standards are rarely exceeded for the pollutants being measured. According to the 2011 Ambient Air Monitoring Report produced by NLDEC (2012) any exceedances tend to be at industrial property boundaries. The nearest National Air Pollution Surveillance Network site is located in Corner Brook and monitors the ambient levels of sulphur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO)), ozone, and particulate matter (PM) on a continuous basis. None of the measured pollutants, with the exception of ozone, exceeded ambient air standards in 2011. The 8-hour ozone standard was exceeded on 29 occasions in 2011 (NLDEC 2012).

The dominant winds on the Port au Port Peninsula prevail from the west, west-southwest, east-northeast, and east. With the exception of extreme weather events, these winds tend to average between 10 and 30 km/hr (Stantec 2015). In the summer, winds are generally blowing from the south and southwest, while in the winter the winds are in a west to northwest direction (LGL 2007). In rural areas such as those within which the Quarry Extension is located, the acoustic environment is dominated by the sound of wind in the trees and vegetation, the sound of running water in the vicinity of streams and rivers, and wildlife sounds (e.g., bird calls).

5.4 Aquatic Environment

Surface water quality on the Port au Port Peninsula is generally considered good to excellent, based on water chemistry. A study was conducted by the NLDEC Water Resources Management Division (NLDEC-WRMD) on five public surface water supplies, including one supply at Sheaves Cove. When comparing samples against the Canadian Drinking Water Quality Guidelines, the Water Quality Index returned results between 90 and 100 (considered very good to excellent) (JWEL 2008). Based on ion chemistry, the water on the Peninsula is moderate to very hard, basic, and of moderate alkalinity. Iron, turbidity, and manganese have been detected in the water supplies around the Port au Port Peninsula. These are aesthetic objectives and do not pose any direct health risks to the drinking water. However, aesthetic issues may develop such as foul taste, deposition, or staining.

With regards to fish and fish habitat on the Port au Port Peninsula, there are 59 identified watersheds along the Peninsula (LGL 2007). Many of these watersheds are first order streams that

do not have any direct inflow from streams or rivers, and rely on their inflow of water from drainage of marshes or bogs or groundwater. As a result of this, many of these watersheds do not contain fish or provide suitable fishing habitat due to their intermittent water flows. A study was conducted by JWEL in 1997 for the current AML operations to determine the presence of fish in Goose Pond, which was a water body adjacent to the existing quarry operations. Electrofishing and gillnetting operations were carried out; no salmonids were observed during any of the surveys. The result of the study showed that the pond provided low quality fish habitat due to lack of spawning substrate, and its low flow of water from a lack of inflowing streams (JWEL 1997).

5.5 Groundwater

The Quarry Extension area is inferred to be underlain by an unconfined aquifer system contained within the underlying shallow carbonate bedrock. The movement of groundwater within the bedrock is expected to mainly occur within secondary openings, such as fractures, joints, and dissolution partings and will be variable depending on the frequency and interconnection of these structural features. Groundwater is thought to be recharging along the topographic high along the north boundary of the Quarry Extension area, which is located close to a natural drainage divide that separates sub-catchment drainage areas. The direction of groundwater flow in the Quarry Extension area is assumed to follow local topography, which would be south-southwest towards the waters of Bay St. George. **There are no substantial streams or surface water bodies in the Quarry Extension area, so regional discharge is expected to be directed to the coast area.** The headwaters of the Harry Brook drainage system is located along the northern boundary of the site and flows north towards the north shore of the Port au Port Peninsula. Depth to groundwater is not known; however, based on water level measurements collected from five water wells located at the site, groundwater levels range from approximately 5 m below ground surface (mbgs) to greater than 90 mbgs. The large range in depth to water table is attributed to the karstic nature of the underlying carbonate bedrock.

The area lies within a bedrock hydrostratigraphic unit referred to as Unit 3 in the 2008 NLDEC-Water Resources report on the hydrogeology of Western Newfoundland (AMEC 2008). This bedrock unit is reported to have potential for moderate groundwater yields. Based on a total of 557 well records, yields are reported to range from 0 to 789 L/min, with a mean yield of 37 L/min. Well depths supporting such yields range from 7.3 to 154 m, with an average depth of 36 m. Results of aquifer testing completed on 37 wells in Unit 3 support the average yield estimate from the water well records, indicating an average estimated safe yield of 54 L/min with a range of 1 to 250 L/min. Seven of the 557 water well records defining the hydrogeological characteristics of Unit 3 are located in the adjacent communities of Sheaves Cove and Lower Cove and were drilled from 1985 to 1998. Based on information provided in the Drilled Water Well Database (NLDEC 2008), wells completed in Unit 3 in the Sheaves Cove and Lower Cove area appear to have similar well yields for this hydrostratigraphic unit, with a reported average yield of 35.7 L/min and an average reported well depth of 72.3 m. Based on the results of a recent reconnaissance water well survey, there are reportedly five existing water wells at the site, ranging in depth from

61 to 137.2 mbgs; however, the estimated well yield was only reported for one of the wells, at 45.5 L/min.

Based on 101 available analysis' from eight different source waters in other areas of Hydrostratigraphic Unit 3, the groundwater in this unit can be classified as a calcium-bicarbonate type water, and is expected to have very good to excellent water quality (AMEC 2008). Results of chemical analysis of water samples collected from the site water wells during the recent water well survey showed similar results and would be classified as calcium-bicarbonate type water. However, the chemical results also showed elevated concentrations of iron, lead and manganese in some water samples that exceeded the applicable Canadian Drinking Water Quality Guidelines. **These elevated concentrations are naturally occurring and not a result of AML quarry activities.** Water used from onsite wells are for non-potable and industrial uses only. As mentioned in previous sections AML uses bottled water as a potable water supply.

5.6 Vegetation

The Port au Port Peninsula is located within the Southwestern Newfoundland ecoregion, which is considered to have some of the best growing conditions in the province, and vegetation is dominated by stands of balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*). The Port au Port is located in its own subregion of the Southwestern ecoregion: the Port au Port subregion. This area is dominated by wind exposed limestone barrens, bedrock and shallow soils, and is home to a number of rare plant species in the province. Mosses, shrubs, and other calciphile plants are common on the Port au Port Peninsula, as these plants have adapted to shallow soil conditions and can survive on the limestone barrens (NLDEC 2008).

Forest cover on the Port au Port Peninsula consists mainly of balsam fir, with a floor covering of mosses and light ferns. These forest stands are typically restricted to rocky slope areas throughout the Peninsula. Black spruce is sparsely located throughout the region, mainly in poorly drained areas or areas with exposed bedrock. Yellow birch (*Betula alleghaniensis*) has also been known to exist in some parts of the Peninsula, and the species reaches its northern limit in this ecoregion (NLDEC 2008).

Swamps and wetlands also occur on the Port au Port Peninsula, and are described as being Atlantic plateau bogs and slope fens. Atlantic plateau bogs are characterized as plateaus with their surface raised above the surrounding terrain, and are often consisting of large scattered pools. Slope fens are meadow-like pools in the forest areas that have been developed on poorly draining land and receiving nutrient-rich waters from seepages in the surrounding soil. On the Peninsula, wetlands seem to be classified as plateau bogs on the coastal lowlands, and smaller nutrient rich slope ferns in forested areas (LGL 2007).

5.7 Wildlife

Mammals such as snowshoe hare (*Lepus americanus*), fox (*Vulpes vulpes*), mink (*Mustela vison*), black bears (*Ursus americanus*), moose (*Alces alces*), caribou (*Rangifer tarandus*), lynx (*Lynx canadensis*), beaver (*Castor canadensis*), and muskrat (*Ondatra zibethicus*) can all occur on the Peninsula. Other small mammals include chipmunks, bats, shrews and red squirrels (*Tamiasciurus hudsonicus*) (LGL 2007; NLDEC 2008). Although wildlife sightings are not frequent, moose and fox have been seen by AML staff near the existing quarry operations; caribou have not been observed in the vicinity of the existing quarry operations.

In forested areas, warbler species such as blackpoll (*Setophaga striata*), black and white (*Mniotilta varia*), and yellow (*Setophaga petechia*) warblers are known to occur. In other habitat types such as shrub lands and marshes, song sparrows (*Melospiza melodia*), savannah sparrows (*Passerculus sandwichensis*), mourning warblers (*Geothlypis philadelphia*), and northern flickers (*Colaptes auratus*) can be found. Sandy and coastal areas around the Peninsula serve as a stopover point for a variety of shorebirds during their annual migration patterns. Some of these species include ruddy turnstone (*Arenaria interpres*), semipalmated sandpiper (*Calidris pusilla*), and killdeer (*Charadrius vociferus*) (LGL 2007; NLDEC 2008).

5.8 Historic Resources

Multiple recorded archaeological sites exist on the Port au Port Peninsula that provide evidence of early European, Palaeoeskimo, and Recent Indian presence (JWEL 2006; LGL 2007). These known sites are located along the coast, as well as on an island off the west coast of the peninsula (LGL 2007).

If there was to be an accidental discovery of a historic resource during construction or operation, appropriate mitigation measures will be taken to reduce the impact to the historic resource wherever feasible. Procedures to be followed in the event of an accidental discovery will be outlined in the EPP.

5.9 Socio-Economic Environment

The Port au Port Peninsula (Census Subdivision 4E, Lourdes, Cape St. George, and Port au Port West-Aguathuna-Felix Cove) is characterized by a declining population, high unemployment, and low participation rates relative to other areas of the Province. **The main employers in the area are AML and the local schools**. Due to a lack of education opportunities, a large majority of Port au Port's young adults are leaving the area for post-secondary studies, and many are not returning. For those who do return, they often become part of the 'fly in-fly out' community, travelling back and forth between the peninsula and other areas such as St. John's and Alberta for work (Strengthening Rural Canada, no date).

The population of the Port au Port Peninsula was 3,901 in 2011, a 0.6 percent decrease from the 2006 population of 3,924. The trend towards a declining population is evident in both Census Subdivisions 4E and the town of Lourdes, which had declines of 5.8 and 3.3 percent, respectively, between 2006 and 2011. However, Cape St. George experienced a population increase of 6.3 percent, and Port au Port West-Aguathuna-Felix Cove experienced a 15.8 percent increase in the same time frame. Demographic and labour force characteristics for the Port au Port Peninsula, as compared to the Province as a whole is provided in Table 5.1 (Statistics Canada 2012, 2013).

Table 5.1 Demographic and Labour Force Characteristics

Geography	Total Population 2011	Total Population 2006	Change in Population (%)	Labour Force	Participation Rate (%)	Employment Rate (%)	Unemployment Rate (%)
Port au Port Peninsula	3,901	3,924	-0.6	1,200	41.0	28.5	**29.6**
Newfoundland and Labrador	514,536	505,469	+1.7	255,890	59.4	50.7	**14.6**

Source: Statistics Canada 2012, 2013
Note: The Port au Port Peninsula includes Census Subdivision 4D, 4E, Lourdes, Cape St. George, and Port au Port West-Aguathuna-Felix Cove
Note: Due to data or confidentiality reasons, labour force data for Port au Port West-Aguathuna-Felix Cove has been suppressed and is unavailable to the public.
Note: Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Statistics Canada. Totals may not necessarily add up as a result of rounding.

In 2011, the labour force participation rate on the Port au Port Peninsula was 41percent, substantially lower than the provincial participation rate of 59.4 percent (Statistics Canada 2012, 2013). Other labour force indicators were also considerably lower for the Port au Port Peninsula than the Province as a whole. **The provincial employment and unemployment rates were 50.7 and 14.6 percent, respectively, compared with 28.5 and 29.6 percent, respectively, on the Port au Port Peninsula (Statistics Canada 2012, 2013)**.

Public services, including educational services, health care, and social assistance, accounted for approximately 23 percent of employment on the peninsula in 2011. However, primary industries continued to be an important component to the area economy, with approximately 22 percent of the labour force active in harvesting activities (fishing, hunting, and forestry) or natural resource extraction (oil and gas, mining, and quarrying).

Educational attainment on the Port au Port Peninsula is low in comparison to the Province as a whole. In 2011, 20.9 percent of the provincial population aged 25 to 64 years had attained a high school diploma or equivalent, while 18 percent of the population had the same level of education on the Port au Port Peninsula. Additionally, 52 percent of the population on the peninsula had no certificate, diploma, or degree, compared with 20.3 percent provincially.

Within the Port au Port Peninsula and nearby Bay St. George, commercial fishing remains the most important economic base for many communities. Between 2000 and 2007, the number of active fishers remained relatively stable, ranging between 214 and 229 over the period (Intervale Associates Inc. 2010). Within western Newfoundland and southern Labrador, the Bay St. George / Port au Port area was responsible for 25 percent of the total value for all fisheries, with a landed value of approximately $11.6 million (Intervale Associates Inc. 2010).

Oil and gas was discovered on the Port au Port Peninsula in 1995. There is currently one active offshore Exploration License adjacent to the Peninsula (License 1070 – Shoal Point Energy Ltd.) (Canada-Newfoundland and Labrador Offshore Petroleum Board 2015).

5.10 Land Use

Land on the Port au Port Peninsula is used for subsistence, recreation, industry, and commerce. Due to its geological composition and setting, much of the interior of the Peninsula has been staked for mineral claims by mineral exploration and quarrying companies. The high concentrations of dolomitic and limestone deposits on the interior make this the primary activity in that area.

The Port au Port Peninsula represents Moose and Black Bear Management Area #43. The hunting season for moose is from September 10 through December 10 each year. There is no caribou management area on the Port au Port Peninsula (LGL 2007). Minor agricultural activity is undertaken on the Port au Port Peninsula (LGL 2007).

There are no federal or provincial parks in the vicinity of the Quarry Extension; there are two private parks, one east and one west of the Quarry Extension, and lookouts on the Peninsula.

The provincial Wildlife Division has designated the interior of the Peninsula as a Sensitive Wildlife Area, although it is not identified on the Newfoundland and Labrador Crown Land Atlas. There are no special areas on the Port au Port Peninsula that are protected by either federal or provincial legislation.

5.11 Future Environment without the Quarry Extension

Without the Quarry Extension, there will likely be no quarrying operation past 2020 and hence there would be a loss of the local and regional employment and business that has been present in the region since the quarry started operations more than 25 years ago.

As of July 2015, the quarry directly employed approximately 150 workers, making it the largest private employer on the Port au Port Peninsula. If the Quarry Extension does not proceed, the existing work force will no longer be required. In an AML workforce survey conducted in August 2015, **43 percent of the respondents self-identified as Qalipu**, **and there is a large francophone component of the quarry workforce.** This direct employment generates substantial but undocumented amounts of indirect and induced employment, as company expenditures percolate through the economy of the Port au Port and Bay St. George area. **The quarry makes a major contribution to the economy of an area that has traditionally high unemployment rates and is experiencing population decline and out-migration.**

The AML operation also purchases a wide range of supplies and services from companies on the Port au Port Peninsula, Stephenville and Corner Brook areas. These benefits to the local and regional economy would also be lost, as of 2020, without the Quarry Extension.

If the Quarry Extension does not proceed, the existing quarries and the process area will be decommissioned, as described in Section 2.6.

6.0 ENVIRONMENTAL EFFECTS METHODS

A standard approach is used where environmental and socio-economic effects of the Quarry Extension are assessed for issues that have been identified of concern by government agencies and community stakeholders.

6.1 Scope of Assessment

See Section 2.2 for a description of the components included as part of the Quarry Extension being assessed.

An overview of applicable regulations and policies is described for each Valued Environmental Component (VEC) in Sections 7.1 to 7.4, as are the boundaries used for the environmental assessment. The spatial boundaries for each VEC reflect the geographic range over which potential environmental or socio-economic effects may occur, whereas temporal boundaries identify when an environmental or socio-economic effect may occur throughout all phases of the Quarry Extension. For the purposes of this assessment, environmental effect includes both biophysical and socio-economic effects. The spatial boundaries are defined as follows:

Project Development Area (PDA): The PDA is the immediate area within which Quarry Extension activities and features will occur, and within which direct physical disturbance associated with the Quarry Extension will occur. The PDA is the same for all VECs and is illustrated on Figure 6-1. It includes only those components applicable to the Quarry Extension and associated infrastructure. Total ground disturbance will be approximately 160 ha.

Figure 6-1 Project Development Area

Local Assessment Area (LAA): The LAA is the PDA and adjacent areas where environmental effects may be reasonably expected to occur. It may be defined differently for each VEC.

Regional Assessment Area (RAA): The RAA is the area within which residual environmental effects may interact cumulatively with the residual environmental effects of other Extensions. It may be defined differently for each VEC and is large enough to include AML's existing operations.

6.2 Valued Environmental Components

VECs are environmental or socio-economic attributes that may be affected by the Quarry Extension and are of value because they have been identified to be of concern to regulatory agencies, key stakeholders, and/or the general public. Consistent with international best practice, the environmental assessment has been focused by considering the Quarry Extension's adverse environmental effects on each of the VECs. The selection of VECs was conducted in consideration of the following:

- Issues raised by NLDEC in meetings with AML
- Issues raised by regulatory agencies and community stakeholders
- The importance of the existing Lower Cove Quarry operation for the local economy

As described in Section 4, issues were identified through consultation conducted by AML with communities on the Port au Port Peninsula and adjacent areas, and with government agencies. The identified issues informed the VEC selection and have been addressed in Sections 7.1 to 7.4 (Tables 4.1 and 4.2).

The following VECs were selected to facilitate a focused review of identified issues:

- Atmospheric Environment
- Groundwater Resources
- Rare Plants
- Employment and Business

6.3 Existing Conditions

An overview of existing environmental conditions including regional geology, atmospheric environment, aquatic environment, groundwater, vegetation, wildlife, historic resources, socio-economic environment, and land use is provided in Section 5. Existing conditions for each of the four VECs are presented in Sections 7.1 to 7.4 to characterize the receiving environment, facilitate the selection of mitigation measures, and support the analysis of residual environmental effects and their associated significance. Where appropriate, site-specific baseline information was collected to augment existing information sources. For example, two

rare plant surveys were conducted to identify the relative locations of species at risk (SAR) and species of conservation concern (SOCC) within and adjacent to the PDA.

6.4 Preliminary Identification of Likely Quarry Extension Environment Interactions

Potential interactions between Quarry Extension activities and each VEC are presented in tabular format in Sections 7.1 to 7.4. Further assessment is conducted where an interaction occurs between a Quarry Extension activity and the VEC; the effect is characterized, mitigation measures are proposed to reduce the effect, a determination of significance is made, and monitoring is recommended if appropriate.

6.5 Environmental Effects Analysis

For each VEC, mitigation measures are proposed where the VEC and Quarry Extension interact. For example, screening and processing will likely result in an interaction with the Atmospheric Environment resulting from dust. Mitigation measures such as enclosed conveyors and dust suppression spraying systems are proposed to reduce dust levels. The environmental effects remaining after the application of the mitigation measures (i.e., the residual environmental effects) are then characterized using standard descriptors (magnitude, geographic extent, duration, frequency, reversibility, and context) defined for each VEC. The significance of the effect to each VEC is determined using the descriptors and based on a pre-determined definition of significance.

6.6 Cumulative Environmental Effects Analysis

Cumulative environmental effects are assessed in Section 8. The assessment of cumulative environmental effects is carried out where residual environmental effects of the Quarry Extension overlap with residual environmental effects from other projects or activities. Other projects and activities that may result in cumulative environmental effects with the Quarry Extension are ongoing quarrying activities by AML, a petroleum well north of Cape St. George, mineral exploration, and other quarries (Figure 6-2). There are no known future development projects on the Port au Port Peninsula.

The potential for interactions between other projects and the VECs are shown in Table 6.1.

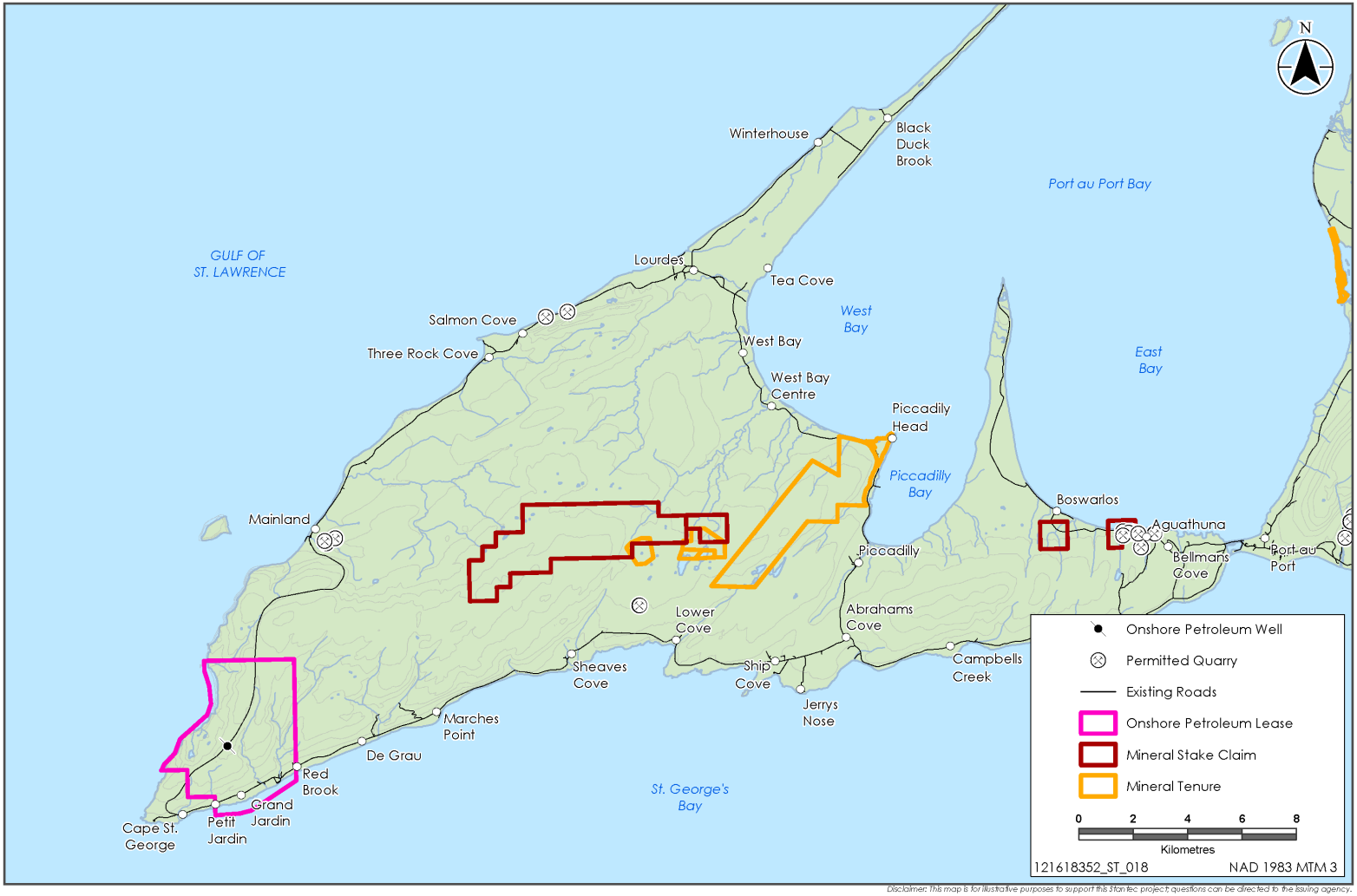


Figure 6-2 Cumulative Environmental Effects Activity on the Port au Port Peninsula

Table 6.1 Potential Interactions between Other Projects and the VECs

VEC	Ongoing AML Activities	Garden Hill South Petroleum Well	Mineral Exploration	Quarries
Atmospheric Environment	✓	-	✓	-
Rare Plants	✓	-	✓	✓
Groundwater	✓	-	-	-
Economy and Business	✓	✓	✓	✓

6.7 Accidents and Malfunctions

The environmental effects of plausible accidents and malfunctions are assessed in Section 9. Potential accidental events are described, interactions with VECs are identified, mitigation measures are proposed, and the potential environmental effects are assessed.

6.8 Monitoring

Where applicable, monitoring programs are identified for each VEC to determine the effectiveness of mitigation measures and compliance with conditions of release.

7.0 ENVIRONMENTAL EFFECTS ASSESSMENT

7.1 Atmospheric Environment

Atmospheric Environment includes air quality, acoustics and greenhouse gases (GHGs). These components constitute a Valued Environmental Component due to:

- Provisions under the Air Pollution Control Regulations of the Newfoundland and Labrador *Environmental Protection Act* (NLEPA)
- The function of the atmosphere as a pathway for the transport of air contaminants to the freshwater, marine, terrestrial and human environments
- Health Canada guidelines for noise emissions and their potential impact on community health
- The possible aesthetic degradation of the environment from air contaminants and noise
- Emissions of GHG and their accumulation in the atmosphere contributing to the greenhouse effect believed to influence climate
- The atmosphere has an intrinsic natural value, in that its constituents are needed to sustain life and maintain the health and well-being of humans, wildlife, vegetation and other biota

7.1.1 Scope of Assessment

The scope of this assessment is to determine the potential environmental effects that the Quarry Extension could have on the atmospheric environment, including air quality, the acoustic environment and GHG emissions. This section provides a discussion of information on air quality, GHGs and noise policies, regulatory requirements and assessment boundaries.

The overall approach to assessing the potential environmental effects that the Quarry Extension could have on the atmospheric environment is to characterize the existing conditions, evaluate potential Quarry Extension related effects and compare Quarry Extension related changes to applicable regulatory standards.

7.1.1.1 Regulatory and Policy Setting

Air Quality

The Government of Newfoundland and Labrador has established *Air Pollution Control Regulations, 2004* under the *Environmental Protection Act*. The Newfoundland and Labrador *Air Pollution Control Regulations* for specified criteria air contaminants (CACs) are presented in Table 7.1.

Table 7.1 Criteria Air Contaminants in the Newfoundland and Labrador *Air Pollution Control Regulations*

Pollutant and Units (alternative units in brackets)	Averaging Time Period	Newfoundland and Labrador *Air Pollution Control Regulations*
Nitrogen Dioxide (NO_2) (µg/m³)	1 hour	400
	24 hour	200
	Annual	100
SO_2 (µg/m³)	1 hour	900
	3 hour	600
	24 hour	300
	Annual	60
PM (µg/m³)	24 hour	120
	Annual	60
PM ≤2.5 Microns ($PM_{2.5}$) (µg/m³)	24 hour	25
	Annual	-
PM ≤10 Microns (PM_{10}) (µg/m³)	24 hour	50
CO (mg/m³)	1 hour	35,000
	8 hour	15,000

Greenhouse Gases

The Government of Newfoundland and Labrador developed a Climate Change Action Plan in 2011, which outlines the Province's commitments for action over a five year period. The plan highlights four goals (Government of Newfoundland and Labrador 2011), including:

- Enhance NL's resilience to impacts from climate change
- Reduce provincial emissions of GHGs
- Demonstrate government leadership on climate change
- Collaborate with other governments to advance action on climate change

The targets set forth in goal two, reducing provincial GHG emissions, follow those of the Conference of New England Governors and Eastern Canadian Premiers and are on a provincial basis (10% below 1990 levels by 2020 and 75 to 85% below 2001 levels by 2050).

Environment Canada, under the Greenhouse Gas Emissions Reporting Program, has also set GHG emissions reporting thresholds that are applicable to all industry in Canada. The reporting threshold is 50 kt CO_{2e}/year. Each year facilities are responsible for calculating their GHG emissions, determining if they meet the reporting threshold, and report under the Environment Canada's online reporting system, if the threshold is met.

In addition to the above, the Canadian Environmental Agency suggests that when emissions are determined to be medium or high, preparation of a GHG Management Plan is required.

Acoustics

There are no regulations regarding acoustic, or noise, emissions in Newfoundland and Labrador, but noise limits may be stipulated in permits on a case-by-case basis. Health Canada has published *Useful Information for Environmental Assessments* (Health Canada 2010), which provides objectives for noise levels based on day-night average sound levels and annoyance. While Health Canada has not published regulations pertaining to noise, their publications provide guidance on assessing effects on the acoustic environment related to human health risk. Health Canada advocates that assessment of changes to the acoustic environment use the concept of annoyance first derived by the United States Environmental Protection Agency (US EPA) in the investigation of community responses to perceived noise issues (US EPA 1974). Annoyance is calculated via a response function relating daytime and weighted nighttime sound pressure levels to a percentage of the population which is highly annoyed (%HA). Heath Canada recommends that the %HA at sensitive receptors not increase by more than 6.5 percent due to noise emissions from Quarry Extension operations. Health Canada also recommends that absolute sound pressure levels not exceed 75 A-weighted decibels (dBA) at any receptor (Health Canada 2010).

7.1.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Section 4 (Consultation and Issues Scoping), AML has consulted with local community leadership and provincial and federal governments. Local concerns on effects of dust and blasting were identified as an issue during engagement, and was noted as a requirement for further assessment.

7.1.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The Quarry Extension has potential to interact with the atmospheric environment to result in adverse effects to air quality (including increased GHG emissions) and increased noise levels, as well as public concern for effects from dust and blasting.

Taking the above into consideration, the assessment of Quarry Extension-related environmental effects on the atmospheric environment is focused on the following potential environmental effects:

- Change in air quality
- Change in acoustic environment

The measurable parameters used for the assessment of the environmental effects presented above, and the effect pathway, are provided in Table 7.2.

Table 7.2 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Atmospheric Environment

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Air Quality	• Interactions between Quarry Extension activities and the environment that result in direct effects to the quality of air	• Emissions and ambient concentrations of CACs and non-CACs (including GHGs).
Change in Acoustic Environment	• Interactions between Quarry Extension activities and the environment that result in changes to the acoustic environment	• Changes in ambient sound levels.

7.1.1.4 Boundaries

Spatial Boundaries

The spatial boundaries for the environmental effects assessment for the Atmospheric Environment VEC are defined below.

PDA: This is the immediate area within which Quarry Extension activities and features will be present, and within which direct physical disturbance associated with those activities will occur. The PDA is the same for all VECs and is illustrated on Figure 6-1. It includes only those components applicable to the Quarry Extension and its associated infrastructure. Total ground disturbance will be 160 ha.

LAA: The LAA is the maximum area within which Quarry Extension-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the PDA and any adjacent areas where Quarry Extension-related environmental effects may reasonably be expected to occur. For Atmospheric Environment, the LAA is defined as an area that extends approximately 2.5 km from the PDA, incorporating the towns of Lower Cove and Sheaves Cove.

RAA: The RAA is the area within which cumulative environmental effects for the Atmospheric Environment might occur, depending on physical and biological conditions and the type and location of other past, present and reasonably foreseeable projects, and within which the significance of Quarry Extension effects is predicted. For this assessment the LAA and the RAA are the same.

Temporal Boundaries

The temporal boundaries are the construction phase (Year 1 to Year 2), the operation phase (Year 2 to Year 25) and the decommissioning (Year 25 to 27).

7.1.1.5 Residual Environmental Effects Description Criteria

The descriptors used to characterize residual environmental effects on the Atmospheric Environment are defined in Table 7.3.

Table 7.3 Characterization of Residual Environmental Effects on Atmospheric Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an environmental effect that moves measurable parameters in a direction beneficial to Atmospheric Environment relative to baseline. **Adverse**—an environmental effect that moves measurable parameters in a direction detrimental to Atmospheric Environment relative to baseline. **Neutral**—no net change in measureable parameters for the Atmospheric Environment relative to baseline.
Magnitude	The amount of change in measurable parameters or the VEC relative to existing conditions	**Negligible**—no measurable adverse environmental effect anticipated **Low**—environmental effect occurs that is detectable but is within normal variability of baseline conditions **Moderate**—environmental effect occurs that would cause an increase with regard to baseline but is within regulatory limits and objectives **High**— environmental effect occurs that would singly or as a substantial contribution in combination with other sources cause exceedances of objectives or standards beyond the Quarry Extension boundaries
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual environmental effects are restricted to the PDA **LAA**—residual environmental effects extend into the LAA **RAA**—residual environmental effects interact with those of other Projects in the RAA
Frequency	Identifies when the residual environmental effect occurs and how often during the Quarry Extension or in a specific phase	**Single event** – occurs once **Multiple irregular event**— occurs at sporadic intervals **Multiple regular event**— occurs on a regular basis and at regular intervals **Continuous**— occurs continuously

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter or the VEC returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual environmental effect restricted to less than two years **Medium-term**—residual environmental effect extends between 2 and 25 years **Long-term**—residual environmental effect extends beyond the life of the Quarry Extension
Reversibility	Pertains to whether a measurable parameter or the VEC can return to its existing condition after the Quarry Extension activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation **Irreversible**—the effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity **Disturbed**—area has been substantially previously disturbed by human development or human development is still present

7.1.1.6 Significance Definition

The significance criteria for environmental effects on Atmospheric Environment are described below.

For air quality, a significant adverse residual environmental effect is defined as a Quarry Extension-related environmental effect that degrades the quality of the ambient air such that the maximum Quarry Extension-related ground-level concentration exceeds the respective air quality objective, guideline or standard.

In terms of emissions of GHGs, 'the contribution of an individual Project to climate change cannot be measured' (CEA Agency 2003). Thus, instead of setting a specific residual environmental effects significance criterion for environmental effects on climate change and determining whether and how it can be met, evaluation of Quarry Extension residual effects, resulting from emissions of GHG, is considered by: conducting a preliminary scoping of GHG emissions; determining jurisdictional considerations (including GHG policies or plans); determining the industry profile (where possible); and by considering the magnitude, intensity, and duration of Quarry Extension emissions as directed by the CEA Agency guidance (CEA Agency 2003). The Quarry Extension-related GHG emissions are compared to similar Extensions, and to provincial, national, and global GHG emissions. Three categories are described in the CEA Agency guidance: low, medium, and high. In this EIS these are attributed to numerical values (on a tonnes CO_{2eq} per annum basis) of less than 10^5, greater than 10^5 and less than 10^6, and greater than 10^6, for low, medium, and high categories, respectively.

For the acoustic environment, a significant adverse residual environmental effect is defined as a Quarry Extension-related environmental effect that results in sound pressure levels at the nearest residential receptors or sensitive receptors (i.e., daycares, schools, hospitals, places of worship) that cause a change in the existing acoustic environment such that Health Canada criteria would be exceeded.

7.1.2 Existing Conditions for Atmospheric Environment

The Lower Cove Quarry is located on the Port au Port Peninsula along Route 460, between the communities of Lower Cove and Sheaves Cove. The existing quarry and primary processing areas are located on the north side of Route 460 and the secondary processing on the south side. The existing quarry and proposed Quarry Extension areas are located approximately 4 to 5 km north of the primary processing area.

Descriptions of the existing ambient air quality and acoustic environment in and around the Quarry Extension are provided below.

The primary data sources used to characterize existing conditions include:

- Environment Canada's National Pollutant Release Inventory
- Alberta Energy Regulator, Directive 038: Noise Control (in the absence of site specific data)

7.1.2.1 Air Quality

Existing ambient air quality in and surrounding the Quarry Extension could be characterized by the emissions of PM, combustion gases and GHGs from the activities currently taking place on-site (i.e., blasting, material handling, conveying, crushing, screening, trucking, and ship loading).

A summary of the emissions of CACs from the operation of the existing quarry, as reported to the National Pollutant Release Inventory for the 2014 reporting year, are provided in Table 7.4.

Table 7.4 AML On-Site Releases to Air, 2014 (tonnes/year)

Substance	Source (tonnes/year)						
	Stack / Point	Storage / Handling	Fugitive	Spills	Road Dust	Other	Total
CO	102	-	30	-	-	-	132
NOX (expressed as NO2)	215	-	7	-	-	-	222
PM	0	6.3	123	-	452	-	582
PM10 - PM ≤10 Microns	16	3	58	-	128	-	205
PM2.5 - PM ≤2.5 Microns	0	0.449	4	0	13	0	17
Source: Environment Canada 2014							

Facility GHG emissions were calculated for 2014, based on the consumption of diesel and gasoline fuel. The estimated emissions of GHGs were 9,213 tonnes CO_{2eq}, well below Environment Canada's reporting threshold of 50 kt CO_{2eq} per year. The estimate includes emissions from the operation of light duty trucks, generators, heavy duty trucks, haul trucks, excavators, graders, drills, and other plant and crusher equipment using fuel.

7.1.2.2 Acoustic Environment

The existing Lower Cove Quarry is located on the Port au Port Peninsula along Route 460 at an elevation approximately 60 to 105 m above that of the two adjacent communities, Lower Cove and Sheaves Cove. This general area would be considered rural, with the existing acoustic environment likely dominated by:

- Vehicle traffic on Route 460
- Sounds from the operation of the existing quarry and associated activities

Directive 38 in Alberta (Alberta Energy Regulator 2007) (field verified by Stantec in a number of locations in Nova Scotia and Newfoundland and Labrador), provides for default values of baseline sound levels of 35 dBA at night and 45 dBA during the day. The daytime increase is due to the increase in wind sounds, animal sounds, and the remote sounds of human activity. In areas where there is a substantial housing density or adjacent to a well-travelled road, the levels tend to be increased by 5 dB or more (Alberta Energy Regulator 2007).

Within the PDA, the existing sound levels would likely be higher than the above default values on any given day, depending on the activities taking place at the existing quarry. The existing acoustic environment within the LAA (in particular the communities of Lower Cove and Sheaves Cove) could likely be characterized by the default levels (35 dBA at night and 45 dBA during the day) increased by 5 dBA to account for the vehicle traffic along Route 460 and the noise from the operation of the existing Lower Cove Quarry.

7.1.3 Quarry Extension Interactions with Atmospheric Environment

A list of the Quarry Extension physical activities that might interact with the Atmospheric Environment to result in an environmental effect on air quality and the acoustic environment is listed in Table 7.5. These interactions are indicated by check marks, and are discussed in detail in the following sections in the context of effects pathways, standard and Quarry Extension-specific mitigation / enhancement, and residual environmental effects. A justification is provided for non-interactions (no check marks).

Table 7.5 Potential Quarry Extension-Environment Interactions and Effects on the Atmospheric Environment

Quarry Extension Components and Physical Activities	Potential Environmental Effects	
	Change in Air Quality	Change in Acoustic Environment
Construction		
Clearing and grubbing	-	-
Construction of on-site road	-	-
Excavation of quarry	-	-
Water management (construction of sump and water line)	-	-
Wastes and emissions[1]	✓	✓
Employment	-	-
Expenditures	-	-
Operation		
Drilling and blasting	-	-
On-site haulage	-	-
Crushing and screening	-	-
Water management	-	-
Wastes and emissions[1]	✓	✓
Employment	-	-
Expenditures	-	-
Decommissioning		
Re-contouring	-	-
Re-vegetation	-	-
Wastes and emissions[1]	✓	✓
Employment	-	-
Expenditures	-	-

NOTES:
✓ = Potential interactions that might cause an effect.
– = Interactions between the Quarry Extension and the VEC are not expected.
[1] Covers all Quarry Extension components that could result in a change in air quality and acoustic environment

As the majority of the activities associated with the construction, operation, and decommissioning of the Quarry Extension have the potential to interact with the Atmospheric

Environment to result in a change in air quality and/or acoustic environment, the Quarry Extension component and physical activity identified as Wastes and Emissions has been check marked in the above table. This category is used to generally refer to all those activities that could result in emissions of CACs and increased sound pressure levels due to the construction, operation, and decommissioning of the Quarry Extension.

The other Quarry Extension components and physical activities are not anticipated to interact with the Atmospheric Environment during any other phase, to result in an environmental effect and therefore have not been checked marked in Table 7.5.

As the decommissioning activities for the Quarry Extension will be similar in nature to construction activities with respect to interactions with the Atmospheric Environment, they have not been further assessed. Accordingly, the assessment of residual environmental effects presented below focuses on the construction and operation of the Quarry Extension.

7.1.4 Assessment of Residual Environmental Effects on Atmospheric Environment

7.1.4.1 Analytical Assessment Techniques

In this section, the change in air quality and change in acoustic environment are assessed on the basis of existing information (Section 7.1.2) and details regarding the proposed Quarry Extension. Based on the discussion of Quarry Extension interactions with the Atmospheric Environment, only those interactions identified with a check mark in Table 7.5 are further considered in this assessment.

It is important to note that with the Quarry Extension, production levels are expected to remain the same. Extension of the existing quarry involves only the development of a new area, 140 ha in size, to extract resources from and the subsequent processing of the extracted material, and supporting infrastructure, with a total area of 160 ha. This is a temporal extension of the current operation.

7.1.4.2 Assessment of Change in Air Quality

Pathways for Change in Air Quality

Construction

Construction of the Quarry Extension will result in emissions of air contaminants and GHGs from site preparation, excavation of the quarry and the construction of a new on-site access road. Site preparation activities will involve site clearing and grading by earth-moving and excavating equipment.

These emissions will likely include particulate matter (total particulate matter (TPM; particulate matter ≤30 microns in diameter), PM_{10}, and $PM_{2.5}$), combustion gases (CO, NO_X, SO_2) and GHGs

through the combustion of fuel in construction equipment and emissions of PM, or dust (TPM, PM_{10}, and $PM_{2.5}$) through the operation of heavy earth-moving equipment handling overburden and traveling on unpaved roads. These will be normal emissions for this type of construction activity.

Operation

During the process of extracting and crushing stone, air emission sources are generally categorized as process or fugitive dust sources. Process sources include those where particulate emissions are subsequently controlled. Fugitive dust sources include those that are exposed to the ambient air and re-entrainment of settled particles can occur due to wind or machine movement. Process sources can be considered fugitive dust sources when there is no collection or control means (Australian Government 2014).

Fugitive dust is PM released to the atmosphere from open sources, instead of being discharged to the atmosphere via a confined flow stream, and is created from the mechanical disturbance of granular material. PM generally consists of three size ranges:

- TPM
- PM_{10}
- $PM_{2.5}$

At particle diameters greater than those of TPM, the dust settles by gravity within a short distance of the emission source (US EPA 1995).

Fugitive releases of PM at the Lower Cove Quarry occur from the following activities:

- Drilling and blasting
- Truck loading and unloading
- Crushing
- Screening
- Conveying and conveyor transfer points
- Stockpiles
- Ship loading
- Travel on unpaved roads

The amounts of dust created from the above activities can vary depending on a number of factors including, but not limited to, the size of the matter being disturbed, local climatic conditions including wind speed and direction and precipitation, frequency of disturbance, the moisture and silt content of the material being disturbed, as well as mechanical stresses, including factors like material drop height and vehicle speed on unpaved roads. The typical distance that dust travels from its source is mostly dependent on the size of the matter being disturbed and the local climatic conditions. In general, larger PM will tend to be deposited closer to the source of the emissions than finer particulate.

Air emissions during the operation of the Quarry Extension will also result from the combustion of diesel and gasoline fuel in the quarry equipment, haul trucks, light vehicles, and generators, which produces emissions of PM (TPM, PM_{10}, $PM_{2.5}$), combustion gases (SO_2, CO, NO_X) and GHGs. Blasting operations will also result in emissions of combustion gases, including SO_2, CO, and NO_X.

A change in air quality could therefore potentially occur as a result of construction activities including site preparation and the construction of an access road. During operation, drilling and blasting activities, truck travel on unpaved roads, material processing and handling and the combustion of fuel in heavy trucks light vehicles, quarry equipment and generators will be responsible for pollutant releases. The interactions of these activities with the environment could result in a change in air quality that may exceed acceptable levels without the implementation of Quarry Extension-specific mitigation.

Mitigation for Change in Air Quality

Construction

AML will continue to use its current measures to mitigate air contaminant emissions during construction and these include:

- Implementation and enforcement of those sections of the Dust Control Plan relevant to construction type activities (i.e., site clearing, blasting)
- Adherence to a comprehensive equipment preventative maintenance program to achieve maximum fuel efficiency and vehicle performance
- Implementation of an idling policy
- Adhering to any relevant permits issued by the Forestry and Agrifoods Agency for site clearing
- Reduce haul route distance to and from the Quarry Extension where possible

Operation

The majority of the air emissions related to operation will consist of fugitive releases of dust due to material extraction, handling, haul truck and light vehicle travel on unpaved roads, conveyance on conveyor systems, processing and stockpiling.

Dust emissions during operation will be mitigated through the implementation of a facility Dust Control Plan (see Appendix A). The Dust Control Plan uses a phased approach in reducing on-site emissions of dust. Phase I identifies industry best management practices (BMP)s; Phase II involves evaluating the effectiveness of Phase I, and Phase III provides additional control measures that could be implemented, if further reduction is needed.

AML has taken an adaptive management approach to controlling dust emissions from all quarry operations. Adaptive management is a systematic application of monitoring programs to learn optimum procedures for reducing exposure from air contaminants. For example, dust generation from haul roads is a function of several factors, including moisture in the roadway and speed of

the vehicle. Through adaptive management, an operator / supervisor can gain immediate reductions in dust emissions through speed reductions, while watering trucks may be deployed as a more long-term control that does not compromise productivity. Adaptive management therefore implies willingness to continually monitor conditions on-site and respond in a timely way to changing environmental conditions to achieve control efficiencies.

In addition to the implementation of the Dust Control Plan, operations at the Lower Cove Quarry make use of a specialized wet suppression system. The wet suppression system emits a dust-trapping mist into the atmosphere enabling particulate matter to settle out versus being carried offsite. The wet suppression system is a mobile unit that can be used to mitigate dust emissions at various locations, on an as needed basis. The Lower Cove Quarry has taken an adaptive management approach to the use of the wet suppression system, moving the unit to different process areas depending on, for example, the type of material being processed on any given day and local meteorological conditions. The Lower Cove Quarry has installed a number of water sprays, consisting of multiple nozzles per spray at dust generating locations.

Mitigation measures related to blasting and drilling operations are covered within the Dust Control Plan (Appendix A). Drilling and blasting activities occur within the quarries, which are located approximately 4 to 5 km north of the processing facilities, these activities are naturally mitigated from the surrounding communities by distance, and the quarry face as quarry development progresses.

The majority of the GHG emissions during operation will result from the combustion of fuel in quarry equipment; mitigation can therefore be accomplished through adherence to a comprehensive equipment preventative maintenance program to maintain the vehicles and improve fuel efficiency, and by enforcing the idling policy.

Residual Environmental Effect for Change in Air Quality

Construction

The construction of the Quarry Extension will affect the same general area as the existing quarries, but will be temporary and short-term. The distances to the nearest communities (approximately 5 km south of the Quarry Extension area) is sufficient to limit potential effects within Lower Cove and Sheaves Cove. Therefore, the residual environmental effect of construction on change in air quality is predicted to be low in magnitude, restricted to the PDA, short-term in duration, and will occur regularly.

Operation

This assessment on change in air quality is based on emissions of Quarry Extension-related CACs and GHGs due to the operation of the Quarry Extension. As the Quarry Extension does not anticipate an increase in the amount of material being processed or new activities, annual emissions of these air contaminants, as presented in Section 7.1.2.1, are not anticipated to increase.

By adhering to and enforcing the use of the Dust Control Plan during the Quarry Extension of the existing Lower Cove Quarry, and due to the fact that the proposed Quarry Extension will not involve an increase in the amount of material being extracted, handled, or processed, the residual environmental effects for a change in air quality during Quarry Extension operation are expected to be negligible to low in magnitude. Emissions of CACs will be limited to the PDA, long-term in duration, occur regularly, are reversible, and are not anticipated to exceed provincial regulatory guidelines beyond the Quarry Extension boundaries.

Releases of GHGs to the atmosphere are recognized to contribute to changes in local and global climate conditions. However, the environmental effect of the GHG emissions from any specific facility on global climate change cannot be measured (see Section 7.1.1.1) (CEA Agency 2003). To assess GHG emissions due to the operation of the Quarry Extension, Quarry Extension GHG emissions were quantified (see Section 7.1.2.1) and placed in context with jurisdictional (provincial, national, global) and industry-wide emissions. Based on this methodology the operation of the Lower Cove Quarry would be considered to be a low emitter. The emissions represent approximately 0.2% of the total GHG emissions from Newfoundland and Labrador in 2013 (as reported from nine facilities under the GHGRP as 4,479,091 tonnes CO_{2eq}), or 0.004% of Canada's total GHG emissions (comprising 565 reporting facilities with a national total of 260,693,327 tonnes CO_{2eq}) (Environment Canada 2013). A summary of Canada's estimated GHG emissions by Sector from 2005 through to 2011 is provided in Table 7.6. The Lower Cove Quarry represents about 0.1% of the national mineral products total in 2011.

Table 7.6 Summary of Canada's Estimated GHG Emissions 2005 – 2011 (Mt CO_{2eq})

GHG Emission Categories	2005	2006	2007	2008	2009	2010	2011
Energy	599	585	611	591	560	562	572
Stationary Combustion	124	117	126	114	98	101	313
Transport	193	192	196	194	187	195	199
Fugitive Sources	63	65	63	62	59	59	60
Industrial Processes	60	60	59	59	51	52	54
Mineral Products	9.9	9.9	9.8	9	7	8	8
Chemical Industry	9.3	8.1	7.9	9.4	7	6.5	7
Metal Production	19.7	20.3	19.2	18.8	15.6	15.5	16.6
Production and Consumption of Halocarbons and SF6	5.5	5.3	5.7	5.8	6.5	7.3	7.7
Other & Undifferentiated Production	15	17	17	15	15	16	15
Solvent & Other Product Use	0.38	0.33	0.33	0.34	0.26	0.24	0.25
Agriculture	58	57	57	58	56	56	54

GHG Emission Categories	2005	2006	2007	2008	2009	2010	2011
Waste	22	23	23	22	22	22	22
Total	740	726	751	731	690	692	702
Notes: * Sources include coal mining, oil, natural gas, venting and flaring. Summarized from Environment Canada 2014 , Canada's 6th National Report on Climate Change.							

7.1.4.3 Assessment of Change in Acoustic Environment

Pathways for Change in Acoustic Environment

Construction

Construction may result in temporary changes in the acoustic environment from quarry excavation and site preparation activities (including clearing and grubbing, quarry excavation, material haulage, ditching, and stockpiling), and through the construction of an on-site access road.

The areas of the Quarry Extension that will require site preparation includes the proposed quarry area, the new on-site quarry access road and new lunchroom trailer. Site preparation activities will involve site clearing and grading with earth-moving and excavating equipment. Most of the acoustic impact will be at the site of the proposed Quarry Extension area, approximately 5 km north of Route 460, and therefore buffered by distance from the surrounding communities.

The interactions of these activities with a change in the acoustic environment may exceed acceptable levels without the implementation of Quarry Extension-specific mitigation.

Operation

During operation, acoustic emissions will result from material extraction from the quarry, material processing, material transport, conveyance, and vessel loading. Acoustic emissions due to Quarry Extension operation activities include noise due to the operation of mobile and fixed equipment. Blasting and drilling activities will be limited to the area proposed for the Quarry Extension. However, as the volume of material produced annually may not increase over the life of the Quarry Extension, these acoustic emissions may not be greater than acoustic emissions currently occurring at the existing quarry and processing sites.

The interactions of these activities with the environment may result in a change in the acoustic environment that may exceed acceptable levels without the implementation of Quarry Extension-specific mitigation.

Mitigation for Change in Acoustic Environment

Construction and Operation

Mitigation measures for noise have been incorporated into the design of the Quarry Extension. The primary design feature is the separation distance from the communities of Lower Cove and Sheaves Cove, which are located 2.5 and 2 km from the site, respectively, and approximately 5 km from the Quarry Extension area.

Much of the noise generating equipment is enclosed affording the opportunity to also attenuate the noise levels. Blasting and drilling occurs only during daytime hours and are mitigated naturally through distance to the surrounding communities.

Residual Environmental Effects for Change in Acoustic Environment

Construction

Construction will affect the acoustic environment in the same areas currently affected by operation of the existing quarry, but will be temporary and short-term. The distances to sensitive receptors are sufficient that individual sound is unlikely to be distinguished, but an industrial hum may be perceived by the closest receptors.

Therefore, the residual environmental effect of construction on the acoustic environment will be low in magnitude, limited to the PDA in geographic extent, short-term in duration, regular in frequency during the construction of the Quarry Extension, reversible and not likely result in an exceedance of the Health Canada guidelines for construction noise.

Operation

The proposed Quarry Extension will be similar to the existing operations at the Lower Cove Quarry, with the main difference being location. It is not anticipated that the Quarry Extension will result in an increase in the amount of material being processed or new activities being generated at the Lower Cove Quarry. Therefore, the residual environmental effect of the operation of the Quarry Extension on the acoustic environment will be negligible to low in magnitude, limited to the LAA in extent, long-term in duration, and regular in frequency.

7.1.4.4 Summary of Residual Environmental Effects

The residual environmental effects of the Quarry Extension on the Atmospheric Environment are summarized in Table 7.7.

Table 7.7 Summary of Residual Environmental Effects on Atmospheric Environment

Residual Effect	Residual Environmental Effects Characterization							
	Quarry Extension Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Air Quality	C / D	A	L	PDA	ST	R	R	U
	O	A	L	PDA	LT	R	R	U
Change in Acoustic Environment	C / D	A	L	PDA	ST	R	R	U
	O	A	L	LAA	LT	R	R	U

KEY

See Table 7.3 for detailed definitions

Quarry Extension Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed
R: Resilient
NR: Not resilient

7.1.5 Determination of Significance

7.1.5.1 Change in Air Quality

Construction will result in emissions of CACs (PM, combustion gases) and GHGs from operation of heavy equipment and vehicle travel on unpaved roads. Such emissions will be localized to the PDA and will be temporary. The residual effects during decommissioning are likely to be the same as residual effects during construction.

Operation will result in emissions of CACs and GHGs from drill units, light vehicles, haul trucks, excavators, and generators. Fugitive releases of PM will occur through quarry material handling, conveying, crushing and screening, vehicle and haul truck travel on unpaved roads, wind erosion of overburden and product stockpiles, and the loading of product onto vessels. The residual environmental effects will include a negligible to slight increase in CACs and GHGs above current conditions. With the implementation of a Dust Control Plan (Appendix A) levels

are likely to be within provincial regulatory limits at property boundaries and will be restricted to the PDA.

In summary, with implementation of the proposed mitigation, the residual environmental effects of all phases of the Quarry Extension on a change in air quality are not anticipated to be significant.

7.1.5.2 Change in Acoustic Environment

Construction will result in increased ambient noise levels in the PDA from operation of heavy equipment. Construction noise emissions will be localized and temporary and are not anticipated to increase sound levels substantially beyond current site conditions. The residual effects during decommissioning are likely to be the same as residual effects during construction.

Operation will result in noise emissions from vehicles and trucks involved in the quarrying process, drilling and blasting activities, material handling, crushing and screening, and material movement to stockpiles and vessels. Sound pressure levels are not expected to result in an exceedance of noise levels recommended by Health Canada (<75 dBA and change in %HA <6.5). Any increase in sound levels should be localized to the PDA.

In summary, the residual environmental effects all phases of the Quarry Extension on change in the acoustic environment are not anticipated to be significant.

7.1.6 Follow-up and Monitoring

The proposed follow-up and monitoring for each environmental effect is described in the following sections.

7.1.6.1 Change in Air Quality

Fugitive emissions of dust at the site level will continue to be monitored and a dust complaint procedure implemented as necessary and according the Dust Control Plan. CACs will be reported to regulators as required.

7.1.6.2 Change in Acoustic Environment

Acoustic monitoring will be conducted by measuring sound pressure levels in specific noise-sensitive areas and/or along the site perimeter as the Quarry Extension proceeds, if deemed necessary. A noise complaint procedure will be developed and implemented.

7.2 Groundwater Resources

Groundwater Resources include domestic, commercial, and industrial groundwater-source water supplies, and the groundwater component of freshwater ecosystems. Groundwater is

defined as the water held beneath the Earth's surface in the pores, fractures, crevasses, and seams of bedrock and overlying surficial materials. Groundwater originates from the percolation of rain, snowmelt, or surface water into the ground, flowing from areas of high elevation (i.e., recharge areas) to areas of low elevation (i.e., discharge areas), where it exits the sub-surface as springs, streams, lakes, and wetlands. The infiltrating water fills voids between individual grains in unconsolidated materials (collectively referred to as overburden), and fills fractures, pores, and voids developed in consolidated materials such as bedrock. The upper surface of the saturated zone is called the water table. An aquifer is defined as a saturated formation or group of formations that can store or transmit useable volumes of groundwater to wells or springs.

Groundwater Resources refer specifically to the value and function of groundwater in supplying freshwater for human and light industrial or commercial uses and in maintaining stream flow for ecological habitat. Groundwater availability for ecological and human uses and its susceptibility to chemical degradation or depletion by human activities is determined by the hydrogeological and hydrochemical properties of the surficial and bedrock geology in which it is found.

Groundwater Resources has been selected as a VEC because of potential effects to private domestic wells, and both public groundwater and surface water supplies, were identified as an issue of concern during public consultation, and because groundwater monitoring was identified as a requirement by NLDEC. The interaction of greatest concern is considered to be dewatering activities associated with Quarry Extension operations. The dewatering activities required for the operation of the quarry will potentially be measureable in groundwater flows over a certain radius from it, and as such, can affect the yield of groundwater supply wells, groundwater flow pathways, and surface water baseflow within the zone of influence. The resulting potential for disruption to potable water supplies for both the quarry operations and nearby residents therefore requires assessment.

An aim of the assessment of Groundwater Resources is to develop a site characterization of both the quality and quantity of the groundwater in the vicinity of the Quarry Extension. The water levels, topographically-inferred flow directions and patterns, and the hydraulic properties of overburden and bedrock have been considered for an understanding of groundwater interactions with the Quarry Extension, and how it might interact with the natural hydrogeological-hydrologic cycle.

This assessment primarily involved a desktop review of published geological and hydrogeological reports and maps for the Quarry Extension area, and available exploration drilling information provided by AML from previous 2014 and 2015 exploration drilling programs at the site. In addition, several field programs recently conducted on the property, including a reconnaissance water well survey completed from September 29 to October 1, 2015, to obtain details for five existing water wells on the property as part of a Site Water Assessment, and drilling of one borehole completed as a monitor well for environmental groundwater monitoring in the

former Pigeon Head Quarry, provides additional supplementary information with respect to the geological and hydrogeological conditions in the Quarry Extension area.

7.2.1 Scope of Assessment

7.2.1.1 Regulatory and Policy Setting

The *Water Resources Act* SNL SNL2002 Chapter W-4.01 gives the NLDEC-WRMD the responsibility and legislative power for the management and protection of water resources in the province, including groundwater. Groundwater use authorizations are required from NLDEC under the *Water Resources Act*.

Water supply well construction for various Quarry Extension components is regulated under the *Well Drilling Regulations, 2003*, under the *Water Resources Act*. New water supply wells, if required, must be constructed by licensed well drilling contractors in compliance with the Regulation. Water well abandonment is regulated under Section 18 (3) of the *Well Drilling Regulations*.

Groundwater resources for potable usage are generally regulated by NLDEC with respect to the Guidelines for Canadian Drinking Water Quality (Health Canada 2014), which specifies maximum acceptable concentrations for health-based parameters and Interim Maximum Acceptable Guidelines for non-health or aesthetic parameters. Other guidelines respecting groundwater quality, specifically from a discharge perspective, include Canadian Council of Ministers of the Environment Water Quality Guidelines for the Protection of Freshwater Aquatic Life (1999, updated 2012); and Newfoundland and Labrador *Environmental Control Water and Sewage Regulations*, Schedule A (2003, amended 2009).

7.2.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Section 4 (Consultation and Issues Scoping), AML has consulted with local community leadership, and provincial and federal governments. Public concerns regarding effects of the Quarry Extension on groundwater supplies was identified as an issue during engagement, and was noted as a requirement for monitoring by the NLDEC.

7.2.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The Quarry Extension and associated activities, has the potential to interact with Groundwater Resources. The assessment of Quarry Extension-related environmental effects on Groundwater Resources is focused on the following potential environmental effects:

- Change in groundwater quantity
- Change in groundwater quality

The measurable parameters used for the assessment of the environmental effects presented above, and the effect pathway, are provided in Table 7.8.

Table 7.8 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Groundwater Resource

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Groundwater Quantity	• Dewatering of the quarry may potentially divert the natural groundwater flow directions inward towards the quarry, and lower groundwater levels in overburden and bedrock some distance out from the quarry. • Decline in water table elevations can result in loss of yield to dug or drilled wells, or reduction in drought-period baseflow to nearby surface water bodies that contribute to surface water supplies in the area.	• Relative changes in shallow water table and deep (piezometric pressure) groundwater elevation measured in monitoring wells adjacent to and at distance from the quarry.
Change in Groundwater Quality	• Potential changes in water quality, including turbidity levels, in groundwater due to blasting and quarry operations	• Relative changes in physical parameters (turbidity) and other water quality indicators, including analytes outlined in the existing quarry operation Certificate of Approval, analyzed during routine monitoring.

7.2.1.4 Boundaries

Spatial Boundaries

The spatial boundaries for the assessment of Groundwater Resources are based on a combination of the locations of the known aquifers relative to the Quarry Extension, aquifer hydraulic properties, expected groundwater flow directions, and the distance between the quarry and wells that may be affected by quarry activities.

The spatial boundaries for the environmental effects assessment of Groundwater Resources are defined below.

PDA: The PDA is the immediate area within which Quarry Extension activities and features will occur, and within which direct physical disturbance associated with the Quarry Extension will occur. The PDA is the same for all VECs and is illustrated on Figure 6-1. It includes only those

components applicable to the Quarry Extension and associated infrastructure. Total ground disturbance will be approximately 160 ha.

LAA: The LAA is the maximum area within which Quarry Extension-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The Groundwater Resources LAA includes the PDA and adjacent areas where Quarry Extension-related environmental effects may reasonably be expected to occur, including a 100 m buffer adjacent to the haulage / access roads that connect the Quarry Extension area to the processing area in the south, as well as a 100 m buffer around the planned area for the proposed new fueling station, quarry dry building and garage, and future laydown area (Figure 7-1).

In consideration of expected groundwater flow directions, the LAA would include the PDA and those areas between the PDA and expected discharge boundaries for groundwater flow. Based on available topography maps, the Groundwater Resources LAA is contained within the Harry Brook watershed. This topography-controlled watershed results in relatively short run-off and groundwater travel paths between the Quarry Extension area and the closest receiving water discharge environment. Based on expected groundwater flow pathways, the LAA would generally include the hydraulically down gradient areas north of the Quarry Extension area within the Harry Brook watershed.

RAA: The RAA is the area within which cumulative environmental effects on Groundwater Resources may occur, and within which the significance of Quarry Extension effects is predicted. The RAA for the assessment of Groundwater Resources is based on watershed areas potentially affected by groundwater flow from the Quarry Extension. For purposes of discussion of potential interaction of the Quarry Extension with both public and private water supplies in the region, the RAA is extended to include the entire peninsula east of Provincial Highway Route 463.

Temporal Boundaries

The temporal boundaries considered in the environmental effects assessment for Groundwater Resources include all phases of the Quarry Extension.

The temporal boundaries are the construction phase (Year 1 to Year 2), the operations phase (Year 2 to Year 25), and the decommissioning phase (Year 25 to 27).

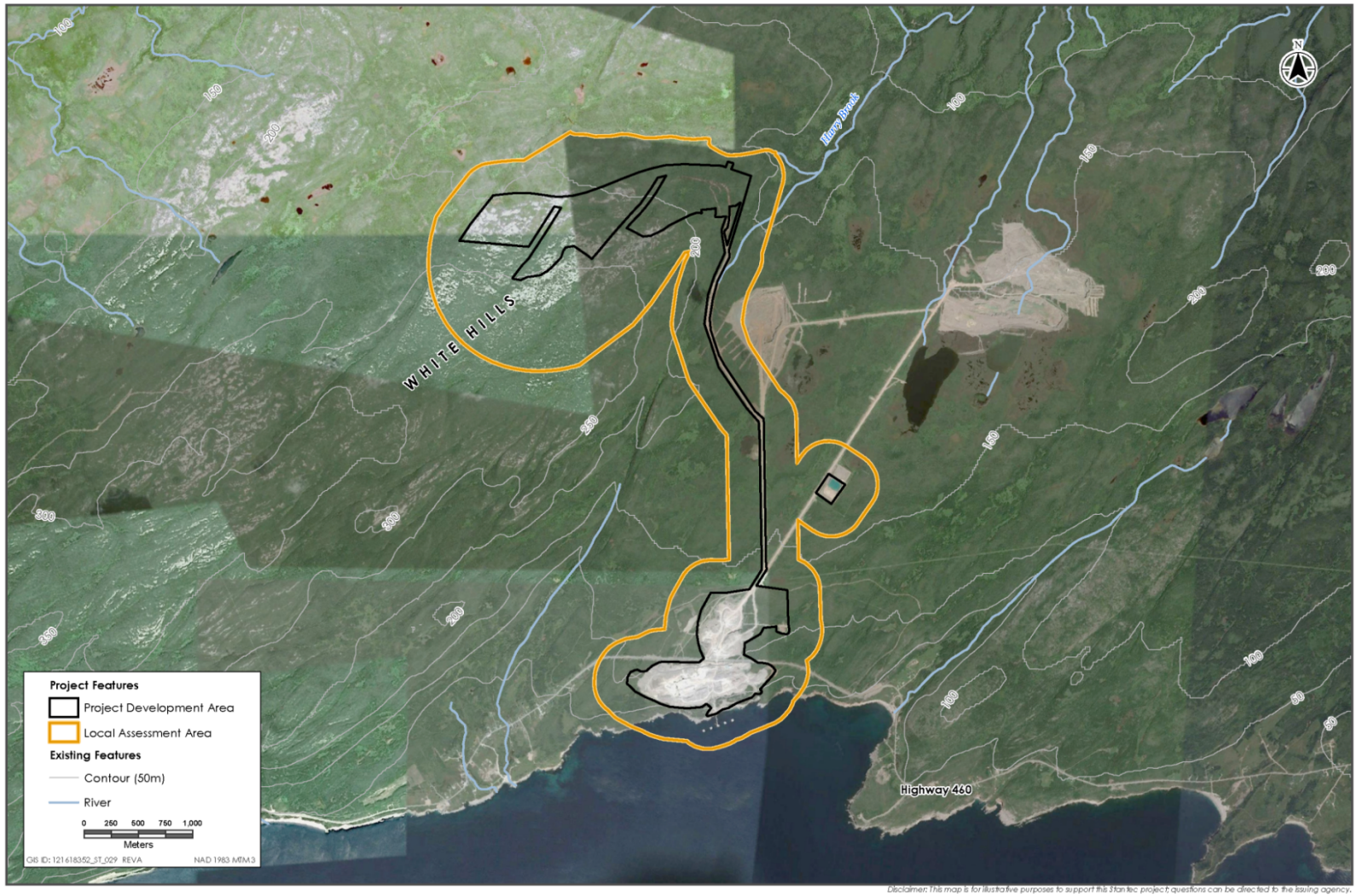


Figure 7-1 Project Development Area and Local Assessment Area for Groundwater Resources

7.2.1.5 Residual Environmental Effects Description Criteria

The descriptors used to characterize residual environmental effects on Groundwater Resources are defined in Table 7.9.

Table.7.9 Characterization of Residual Environmental Effects on Groundwater Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to Groundwater Resources relative to baseline. In general, an increase in static water level, well yield or water quality improvement in comparison to baseline conditions and trends **Adverse**— an effect that moves measurable parameters in a direction detrimental to Groundwater Resources relative to baseline. In general, a decrease in static water level, well yield or water quality in comparison to baseline conditions and trends **Neutral**—no net change in measureable parameters for Groundwater Resources relative to baseline. In general, no net change in annual water levels, well yields or water chemistry in comparison to baseline conditions and trends
Magnitude	The amount of change in measurable parameters relative to existing conditions	**Negligible**— no measurable adverse effect anticipated **Low**— effect occurs that is detectable, but is within normal variability of baseline conditions **Moderate**— effect occurs that would cause an increase (or decrease) with regard to baseline, but is within regulatory limits and objectives **High**— effect occurs that would cause exceedances of objectives or standards within the Quarry Extension boundaries
Geographic Extent	The geographic area in which an environmental, effect occurs	**PDA**—residual effects are restricted to the PDA **LAA**—residual effects extend into the LAA **RAA** – residual effects interact with those of other projects in the RAA
Frequency	Identifies when the residual effect occurs and how often during the Quarry Extension or in a specific phase	**Single event**-occurs once during the life of the Quarry Extension (e.g., clearing) **Multiple irregular event** –occurs sporadically, at irregular intervals, without any predictable pattern during the life of the Quarry Extension **Multiple regular event**— occurs on a regular basis and at regular intervals **Continuous**—occurs continuously throughout the Quarry Extension life

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter for Groundwater Resources returns to its existing condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to less than 2 years **Medium-term**—residual effect extends between 2 and 25 years **Long-term**—residual effect extends beyond the life of the Quarry Extension
Reversibility	Pertains to whether a measurable parameter for Groundwater Resources can return to its existing condition after the Quarry Extension activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation **Irreversible**—the effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed**—area is relatively undisturbed or not adversely affected by human activity **Disturbed**—area has been substantially previously disturbed by human development or human development is still present

7.2.1.6 Significance Definition

A significant residual adverse environmental effect is a persistent degradation in the quantity or quality of groundwater after application of mitigation and remedial measures. The determination of significance considers the following thresholds:

- Changes in groundwater quantity such that the yield from an otherwise adequate water supply well or spring decreases to the point where it is inadequate for intended use
- Changes in groundwater quality such that the quality of groundwater from an otherwise adequate water supply well or spring that meets guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2014)
- Physically or chemically altering the aquifer to the extent that interactions with local surface water results in stream flow or surface water chemistry changes that adversely affects aquatic life or a down-stream surface water supply

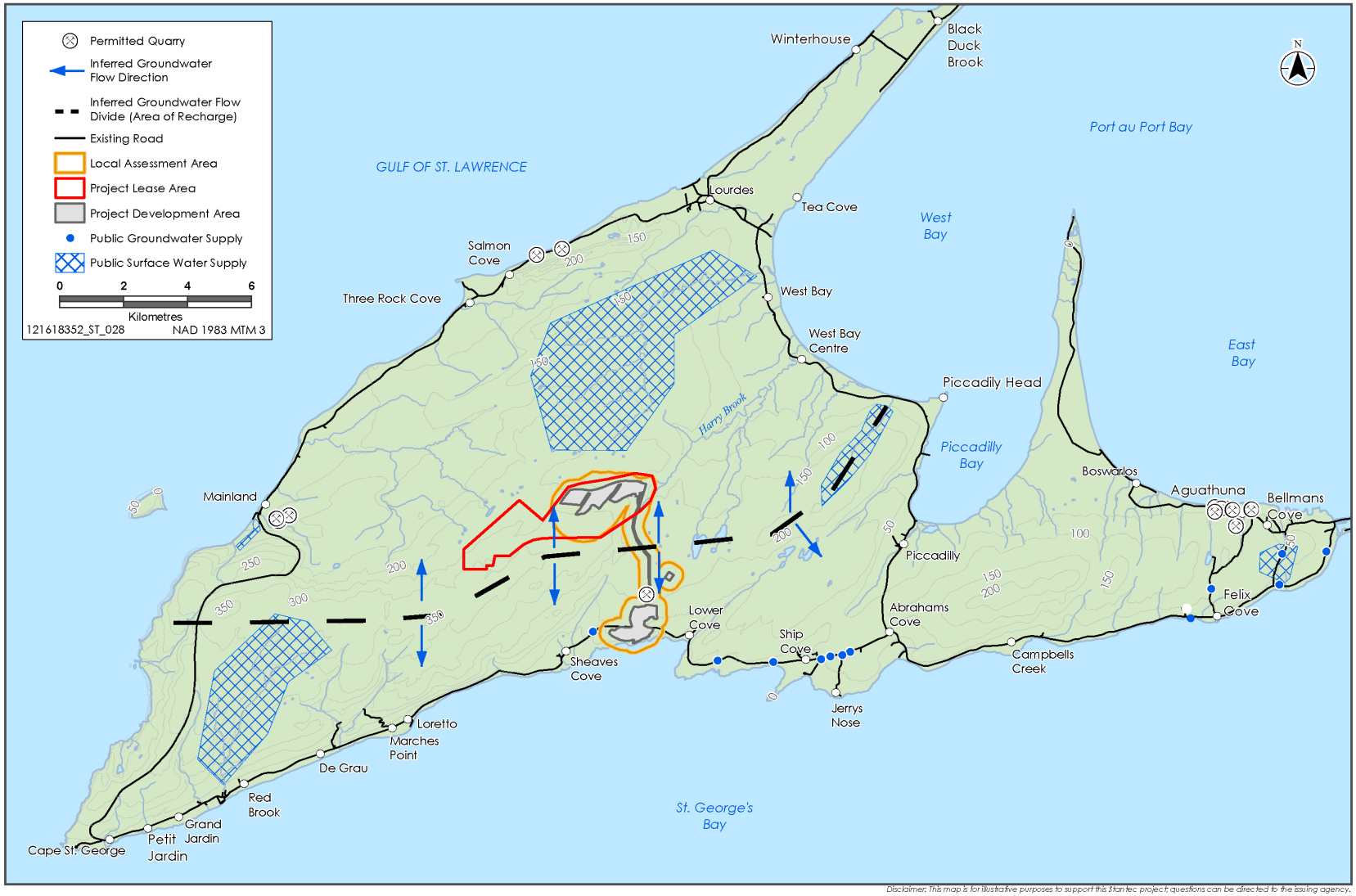
7.2.2 Existing Conditions for Groundwater Resources

Based on information for existing on-site water wells, in addition to field observations during a recent borehole drilling and monitor well installation program on the property in November 2015, the Quarry Extension area is inferred to be underlain by an unconfined aquifer system contained within the underlying carbonate bedrock. The movement of groundwater within the bedrock is expected to mainly occur within secondary openings, such as fractures, joints, and dissolution

partings and will be variable depending on the frequency and interconnection of these structural features. The topographically inferred groundwater flow regime across the Quarry Extension area is illustrated in Figure 7-2, showing the inferred groundwater flow divides and areas of recharge and discharge associated with the groundwater system. Groundwater is thought to be recharging along the topographic high defined by the eastern Quarry Extension of the White Hills, which is located immediately south of the existing quarries (High-Cal, Dolomite #1 and Dolomite #2) and proposed Quarry Extension area, and acts as a natural drainage divide across the site. **The direction of groundwater flow in the Quarry Extension area is expected to follow topography and surface water flow, which would be south towards the waters of Bay St. George in the area of the existing crushing and processing operations, as well as new Quarry Extension components**. This includes the laydown area, fuel supply station, and quarry lunch building and the garage; and north towards the waters of West Bay in the vicinity of the three existing quarries and proposed Quarry Extension area. With the exception of Harry Brook, there are no substantial streams or surface water bodies in the Quarry Extension area and regional groundwater discharge is expect to be directly to the coast area. The headwaters of the Harry Brook drainage system is located along the north boundary of the site and is expected to act as a local discharge area for shallow groundwater flow in the vicinity of the Quarry Extension area. Harry Brook flows north towards the north shore of the Port au Port Peninsula.

The depth to groundwater in the LAA is not known; however, based on water level measurements collected from five water wells located at the site, as well as a recent monitor well installed in November 2015 in the former Pigeon Head Quarry for environmental groundwater monitoring, groundwater levels range from approximately 5 mbgs to greater than 90 mbgs. The large range in depth to water table is possibly attributed to the karstic nature of the underling carbonate bedrock.

The LAA lies within a bedrock hydrostratigraphic unit referred to as Unit 3 in the 2008 NLDEC Water Resources report on the hydrogeology of Western Newfoundland (AMEC 2008). This bedrock unit is reported to have potential for moderate groundwater yields. Based on a total of 557 well records, yields are reported to range from 0 L/min to 789 L/min, with a mean yield of 37 L/min. Well depths supporting such yields range from 7.3 to 154 m, with an average depth of 36 m. Results of aquifer testing completed on 37 wells in Unit 3 support the average yield estimate from the water well records indicating an average estimated safe yield of 54 L/min, with a range of 1 to 250 L/min. Seven of the 557 water well records defining the hydrogeological characteristics of Unit 3 are located in the adjacent communities of Sheaves Cove and Lower Cove and were drilled from 1985 to 1998. Based on information provided in the Drilled Water Well Database (AMEC 2008), wells completed in Unit 3 in the Sheaves Cove and Lower Cove area appear to have similar well yields for this hydrostratigraphic unit, with a reported average yield of 35.7 L/min and an average reported well depth of 72.3 m. Based on the results of the recent reconnaissance water well survey, there are reportedly five existing water wells at the site ranging in depth from 61 to 137.2 mbgs; however, the estimated well yield was only reported for one of the wells, at 45.5 L/min.



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

Figure 7-2 Topographically Inferred Groundwater Flow Regime

Based on 101 available analyses from eight different source waters in other areas of hydrostratigraphic Unit 3, the groundwater in this unit can be classified as a calcium-bicarbonate type water, and is expected to have very good to excellent water quality (AMEC 2008). Results of chemical analysis of water samples collected from the site water wells during the recent reconnaissance water well survey showed similar results and would be classified as calcium-bicarbonate type water. However, the chemical results also showed elevated concentrations of iron, lead, and manganese in some water samples that exceeded the applicable Canadian Drinking Water Quality Guidelines.

Two groundwater supplies (Lower Cove and Sheaves Cove) are present on the peninsula, as well as a number of private dug and drilled water wells located in various coastal communities throughout the peninsula. The groundwater supplies for Sheaves Cove and Lower Cove, as well as private water wells in these communities, are located approximately 6 km away from the Quarry Extension area, and approximately 2 km away from new infrastructure components. The locations of these groundwater supplies are shown on Figure 7-2, and are based on information provided in the NLDEC-WRMD Water Resources Portal (available online at http://maps.gov.nl.ca/water/) and the Newfoundland and Labrador Department of Natural Resources Online Geoscience Atlas (available online at http://gis.geosurv.gov.nl.ca/).

7.2.3 Interactions with Groundwater Resources

The Quarry Extension physical activities that might interact with Groundwater Resources for each potential effect are identified in Table 7.10. These interactions are indicated by check marks, and are discussed in detail in Section 7.2.4 in the context of effects pathways, standard and Quarry Extension-specific mitigation, and residual environmental effects. A justification is also provided for non-interactions (dash marks).

Table.7.10 Potential Quarry Extension-Environment Interactions and Effects on Groundwater Resources

Quarry Extension Components and Physical Activities	Potential Environmental Effects	
	Change in Groundwater Level	Change in Groundwater Quality
Construction		
Clearing and grubbing	✓	✓
Construction of on-site road	–	–
Excavation of quarry	✓	✓
Construction of Site Buildings and Associated Infrastructure	✓	✓
Water management (construction of sump and water line)	✓	✓
Wastes and emissions	–	–

Quarry Extension Components and Physical Activities	Potential Environmental Effects	
	Change in Groundwater Level	Change in Groundwater Quality
Employment	–	–
Expenditures	–	–
Operation		
Drilling and blasting	✓	✓
On-site haulage	–	–
Crushing and screening	–	–
Water management	✓	✓
Wastes and emissions	–	–
Employment	–	–
Expenditures	–	–
Decommissioning		
Re-contouring	–	–
Re-vegetation	–	–
Wastes and emissions	–	–
Employment	–	–
Expenditures	–	–

NOTES:
✓ Potential interactions that might cause an effect.
– Interactions between the Quarry Extension and the VEC are not expected.

Activities that are classified by a dash mark (-) are not expected to interact with the quantity or quality of Groundwater Resources. These activities include those associated with construction of haulage / access roads, wastes and emissions, and employment and expenditure.

The primary Quarry Extension-related effects on Groundwater Resources will include potential dewatering of groundwater during operation of the quarry resulting in possible changes in PDA and LAA water levels and flow directions predominantly during the operation phase; and potential localized changes to groundwater quality in the vicinity of the quarry, and septic disposal field associated with the quarry lunch trailer during the operation phase.

There are no groundwater supply users identified in the area of expected groundwater influence from quarry dewatering, or along the haulage road and other Quarry Extension components in existing portions of the site. Further, in the unlikely event that the water level were to be lowered by the Quarry Extension resulting in a decline in well levels, the degree of water level decline at a domestic well would be proportional to the distance between the well and the edge of the

quarry, decreasing exponentially with distance. In consideration of the distance between the quarry and the nearest existing down-gradient residential well along the north shore of the peninsula (i.e., 6 km to the community of West Bay), **the loss of yield at the existing wells in areas down-gradient of the site is not anticipated.**

Further, as discussed previously, wells located on the south side of the peninsula near the site (i.e., Sheaves Cove and Lower Cove) are located approximately 6 km away from the Quarry Extension area, and approximately 2 km away from new infrastructure components. Given the distance from the Quarry Extension, and the location of these groundwater supplies in a separate drainage catchment area that flows south from the White Hills upland area, **wells in the communities of Sheaves Cove and Lower Cove are not expected to be affected by the Quarry Extension.**

7.2.4 Assessment of Residual Environmental Effects on Groundwater

This section describes the potential effects of Quarry Extension activities on Groundwater Resources, with emphasis on groundwater levels (i.e., groundwater quantity). There is no user of Groundwater Resources (i.e., domestic, commercial, municipal, or industrial groundwater supply wells) identified within several kilometres of the Quarry Extension. Therefore, the following assessment is focused on local Groundwater Resources, including that which may be used by future groundwater supply wells to be developed for Quarry Extension components, and hydrological interactions with the Harry Brook drainage system.

7.2.4.1 Analytical Assessment Techniques

The Groundwater Resources assessment primarily involved a desktop review of published geological and hydrogeological reports and maps for the Quarry Extension area, and available exploration drilling information provided by AML (2014 and 2015). In addition, several field programs recently conducted on the property, including a reconnaissance water well survey completed from September 29 to October 1, 2015, to obtain details for five existing water wells on the property as part of a Site Water Study, and drilling of one borehole completed as a monitor well for environmental groundwater monitoring in the former Pigeon Head Quarry, provides additional supplementary information with respect to the geological and hydrogeological conditions in the Quarry Extension area. This information was compiled into electronic databases, GIS mapping, figures, and tables, and used to generate a conceptual understanding of the groundwater flow conditions and baseline groundwater chemistry throughout the PDA and LAA.

7.2.4.2 Assessment of Change in Groundwater Quantity

Pathways for Change in Groundwater Quantity

As indicated in Table 7.10, there are a number of activities during construction (i.e., clearing / grubbing, initial excavation in the quarry to accommodate the dewatering sump system,

component construction, installation of buried infrastructure, and pipelines) that could potentially interact with local Groundwater Resources. Short-term interactions with shallow overburden groundwater levels may occur during initial grubbing and site preparation; however, the effects are likely to be local and limited to the immediate vicinity of the PDA and will likely not extend to the down-gradient Harry Brook tributary to the north. Further, there is potential for temporary diversion of shallow groundwater flow and lowering of the water table near major excavations for buildings and sub-surface infrastructure. The expected water table levels in the Quarry Extension area range from 5 to 90 mbgs. Excavation and dewatering during site preparation has the potential to interact with groundwater in areas of low elevation where groundwater may be close to surface. The effects are expected to be temporary in nature and the water levels are anticipated to return to normal after completion of the excavation or construction.

The most substantive interaction with Groundwater Resources associated with the Quarry Extension is dewatering activities during the operation phase. No groundwater depth measurements are available for the local area of the Quarry Extension, and it is possible that as the quarry develops to its maximum bench depth of 45 mbgs, it will encounter increased groundwater seepage, and dewatering demands that could potentially divert the natural groundwater flow directions inward towards the quarry and cause local changes in groundwater recharge, water table elevation, and flow directions. Resulting potential groundwater quantity effects include reduction in water levels and yield capacity in water supply wells within the drawdown radius of influence of the quarry, and reduction in groundwater contribution to baseflow to the nearby Harry Brook tributary. This loss of groundwater contribution to baseflow has the potential to dry up the section of the tributary down-gradient of the site, particularly during periods of drought. However, this loss of groundwater contribution to baseflow to the down gradient Harry Brook tributary is expected to be at least partially off-set in lower sections of the stream by discharge water from the quarry's discharge drainage system, and therefore is not likely to go dry.

In addition, during the operation phase there is potential for temporary diversion of shallow groundwater flow and lowering of the water table associated with the operation of water supply pumping wells in the Quarry Extension area. The water level drawdown effects from the operation of future on-site water supply wells are expected to be limited to a few hundred metres from a pumping well in local bedrock, and water level effects on off-site water wells are therefore considered to be unlikely.

As indicated in Table 7.10, interactions between the Quarry Extension and Groundwater Resources are not likely during decommissioning. Immediately upon the cessation of quarry operations, the quarry would begin to flood with a combination of rainwater and groundwater seepage. During this period, the local groundwater movement would continue to be towards the quarry; however, as the water level rises in the quarry, the magnitude of drawdown at points distant from the quarry will gradually recover to pre-operation levels. Once the quarry has flooded to equilibrium, the local groundwater flow system should return to approximate pre-

development conditions. No further effects on groundwater levels or water quality are anticipated.

The effect on overall regional groundwater patterns in the area associated with the Quarry Extension is not expected to occur, with the Harry Brook tributary to the north expected to provide a hydraulic boundary for any Quarry Extension-driven groundwater seepages or water level dewatering down-gradient of the site. Further, the extension area is located along the upper north-facing slope of the White Hills, the crest of which is located approximately 1 km to the south. The majority of groundwater inflow into the quarry would be expected to originate from this up-gradient recharge area. However, given the relatively small area of the Quarry Extension relative to this regional upland area, dewatering activities associated with quarry development would not be expected to substantively influence natural groundwater flow directions associated with this groundwater divide, and thus the upland White Hills area is considered to represent a hydraulic boundary for any Quarry Extension-driven groundwater effects along the south boundary of the Quarry Extension area. Because of these defined drainage patterns and the expected short groundwater travel distances between points of recharge and points of discharge in the hydrogeological environment of the LAA, effects on Groundwater Resource associated with the Quarry Extension are anticipated to be limited to the PDA and LAA, and not extend into the RAA. In particular, the Quarry Extension area is considered remote with respect to groundwater and surface water supplies in the region, and not considered to be hydraulically connected given the number of intervening topographic and hydraulic drainage divides that separate the Quarry Extension area from these public and private water supply sources.

Mitigation for Change in Groundwater Quantity

The following mitigation measures are proposed to avoid or reduce Quarry Extension-related effects on Groundwater Resources quantity during the construction phase:

- Construction of diversion ditches to manage surface run-off and drainage
- Designing ditches, culverts, and settling ponds for a 1-in-25 year storm event (as a minimum)
- Excavation drainage water control using a settling pond

The following mitigation measure is proposed to avoid or reduce Quarry Extension-related effects on Groundwater Resources quantity during the operations phase:

- The quarry walls will be regularly monitored for measurable groundwater inflows, with a contingency plan for management of anomalous joint-related groundwater inflows from quarry walls using interception, depressurization techniques, and/or other groundwater inflow management strategies

A Water Management Plan will be developed to deal with the major components of water inflow, namely: rainfall; overland run-off; and groundwater seepage. This plan will outline water

management in and around the main Quarry Extension component areas (i.e., quarry, roads, and various Quarry Extension infrastructure).

Residual Environmental Effect for Change in Groundwater Quantity

Clearing, grubbing, and excavation activities during site preparation has the potential to adversely affect Groundwater Resources quantity in some areas of the PDA and LAA. The dewatering of the quarry and resulting gradual decrease in groundwater levels and adverse effect on Groundwater Resources is expected to be of medium to high magnitude in the area immediately surrounding the quarry (PDA / LAA) and occur continuously throughout the construction and operation phases of the Quarry Extension (i.e., medium term duration), but is considered reversible with gradual recovery in water levels as the quarry floods during decommissioning. The closest public water supply to the Quarry Extension is Lourdes, which is a surface water supply, and is hydraulically separated from the Quarry Extension area by a drainage divide defined by the headwaters of Harry Brook. The nearest potential groundwater supply (i.e., water well users in the communities of Sheaves Cove and Lower Cove) are located approximately 6 km away from the Quarry Extension area, and approximately 2 km away from new infrastructure components. Given the distance from the Quarry Extension, and the location of these groundwater supplies in a separate drainage catchment area that flows south from the White Hills upland area, wells in the communities of Sheaves Cove and Lower Cove are not expected to be affected by the Quarry Extension. Since there are no known Groundwater Resources users located within 6 km of the quarry, no residual adverse effects on Groundwater Resource users are anticipated.

Dewatering of the quarry during the construction and operation phases has the potential to affect baseflow to the nearby Harry Brook tributary. This effect has the potential to adversely affect the section of the tributary down-gradient of the site, be of low to moderate magnitude, and occur over multiple regular events (i.e., occur during periods of summer drought). However, the loss of groundwater contribution to baseflow to the down gradient Harry Brook tributary is expected to be at least partially off-set in lower sections of the stream by discharge water from the quarry's discharge drainage system, and recover to Quarry Extension stream flow and stage conditions during decommissioning.

Interactions between the Quarry Extension and Groundwater Resources are not likely during decommissioning.

7.2.4.3 Assessment of Change in Groundwater Quality

Pathways for Change in Groundwater Quality

The groundwater quality changes associated with site preparation, quarry drilling and blasting, and on-site sewerage septic systems are expected to be measurable. Subsurface breakage of bedrock associated with blasting may result in increased turbidity in groundwater derived from a

bedrock well and be associated with elevated metals and other water quality parameters. Turbidity caused by blasting activities is most often temporary and limited to within 500 m.

Releases of inorganic chemicals and bacteria from on-site septic field systems can have an adverse effect on local groundwater resources in the area.

Mitigation for Change in Groundwater Quality

The effects to groundwater quality will be localized and can be mitigated with best management practices, including:

- The location and operation of water supply wells will be implemented in accordance with the sustainability of the host aquifer, as determined by individual constant rate pumping tests performed on each new supply well. Monitoring of supply wells for water quality, water level, and nearby aquifer water level (observation wells), will promote safe abstraction rates that do not adversely affect aquifer water levels at adjacent wells or stream base flows
- On-site sewage from the Quarry Extension infrastructure will be disposed by on-site septic disposal systems. If required, septic fields will be constructed in accordance with relevant provincial regulations to reduce interaction between the system and Groundwater Resources

Residual Environmental Effects for Change in Groundwater Quality

The potential for effects on Groundwater Resource users is low because there are no identified groundwater supply well users in the area that would be potentially affected by the Quarry Extension. Water supply wells installed for the quarry operation itself are the main receptors of effects on Groundwater Resources.

Potential groundwater quality changes have been identified associated with site preparation, quarry drilling and blasting activities, and use of on-site sewage systems. However, because seepages will be intercepted by the drainage system, and in consideration of the expected seepage chemistry, the short groundwater flow pathways and the hydrological isolation of the site from existing groundwater users, effects are considered negligible to low, limited in extent to the PDA, and are expected to be restored to pre-development conditions following decommissioning. Since no residential water supply wells are known to be located within 6 km of the quarry, water quality of residential wells is not likely to be affected as a result of the Quarry Extension. Effects, if any, are more likely to be experienced by on-site wells, which can be readily remediated by the Proponent through provision of particulate filters, monitoring, maintenance, rehabilitation, or replacement, as applicable.

7.2.4.4 Summary of Residual Environmental Effects

The residual environmental effects of the Quarry Extension on Groundwater Resources are summarized in Table 7.11.

Table.7.11 Summary of Residual Environmental Effects on Groundwater Resources

Residual Effect	Residual Environmental Effects Characterization							
	Quarry Extension Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in groundwater quantity	C-O	A	M-H	PDA/LAA	MT	C	R	U
	D	N	NA	NA	NA	NA	NA	NA
Change in groundwater quality	C-O	A	M-H	PDA	ST-MT	R-C	R	U
	D	N	NA	NA	NA	NA	NA	NA

KEY

The descriptors used to characterize residual environmental effects on Groundwater Resources are defined in Table 7.9.

N/A – not applicable

Quarry Extension Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local assessment area
RAA: Regional assessment area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed
R: Resilient
NR: Not resilient

7.2.5 Determination of Significance

7.2.5.1 Significance of Residual Environmental Effects

With the proposed mitigation measures, the adverse residual environmental effects of the Quarry Extension on Groundwater Resources during the construction and operation phases from routine activities are likely to be not significant.

Interactions between the Quarry Extension and Groundwater Resources are not likely during decommissioning.

7.2.6 Follow-up and Monitoring

Monitoring plans will be developed upon release of the Quarry Extension from the EA process, and will be reported to authorities as required. The following monitoring plans will be considered to address Groundwater Resources for the Quarry Extension:

- Monitoring of groundwater levels and groundwater chemistry in the Quarry Extension area, as well as overall down-gradient areas of the property to detect changes in groundwater chemistry and inform mitigation measures during the construction, operation, and decommissioning phases of the Quarry Extension
- Precipitation will be monitored so that the proportions of rainfall and groundwater seepage in the total quarry discharge can be differentiated

7.3 Rare Plants

A species is rare because it has relatively few individuals, it is uncommon or scarce, or it occurs within a limited geographical range, existing only in certain patches of habitat scattered across an area. The rarity of a plant species may also be a matter of scale, meaning that a species may not be rare in Canada but may be considered regionally rare in the respective province or territory in which it occurs. The rarest species are those with small geographic ranges, few occurrences and few individuals in each occurrence.

Rare Plants were selected as a VEC because of the potential for the Quarry Extension to affect SAR and SOCC, the sensitivity of many of these plants to disturbance, and because of the intrinsic value of these plants and their habitats (vegetation communities) for biodiversity. This VEC focuses on SAR and SOCC (as defined below), within the vicinity of the Quarry Extension.

7.3.1 Scope of Assessment

The scope of this assessment is to determine the potential environmental effects that the Quarry Extension will have on rare plants, including SAR and SOCC. This section provides information on regulatory requirements and assessment boundaries.

The overall approach to assessing the potential environmental effects that the Quarry Extension could have on rare plants is to characterize the existing conditions, and evaluate potential Quarry Extension related effects within a local and regional scale, as described below.

7.3.1.1 Regulatory and Policy Setting

Although an understanding of rare plant species and their protection is important for a variety of reasons, the protection of the rarest such species is also a legal requirement under the federal *Species at Risk Act* (SARA) and the Newfoundland and Labrador *Endangered Species Act* (NLESA). In Newfoundland and Labrador, there are presently a number of plant species designated or listed under the federal and/or provincial legislation.

SARA is designed to protect endangered or threatened organisms and their habitats and also assist in managing habitats that are potentially in jeopardy. SAR include those species listed as *extirpated*, *endangered* or *threatened* under the NL ESA (Government of Newfoundland and Labrador 2001), the federal SARA (Government of Canada 2002), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

For the purpose of this assessment, SOCC include those plant species recommended for listing by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as *endangered*, *threatened*, or *special concern* (COSEWIC 2015) or the Species Status Advisory Committee as *endangered*, *threatened*, or *vulnerable*, but not yet listed under SARA or NLESA, respectively. In addition to those listed by Atlantic Canada Conservation Data Centre (AC CDC 2010) as *S1* (*critically imperiled*), *S2* (*imperiled*), *S3* (*vulnerable*)[1], or combinations thereof (e.g., *S1/S2*)[2].

Unlike SAR, SOCC are not afforded protection by either federal or provincial legislation, but are included as a precautionary measure, reflecting observations and trends in their provincial population status. SOCC may be important indicators of ecosystem health and regional biodiversity, thus their presence in a particular area might warrant mitigation, given their rarity or importance. They are also often indicators of the presence of unusual and/or sensitive habitat, and their protection as umbrella species can confer protection on their associated unusual habitats and co-existing species.

Federal Legislation

SARA is a federally-legislated commitment to prevent wildlife species from becoming extirpated or extinct. SARA is intended to secure the necessary actions for recovery of listed species and to encourage the management of other species in order to prevent them from becoming endangered or threatened. It provides for the legal protection of certain wildlife species and the conservation of their biological diversity.

The status of plant species is assessed and designated by COSEWIC, which then recommends a designation for legal protection by being officially listed under SARA. One of the key considerations under SARA for protection of listed SAR is protection of the species' habitat.

SARA is one part of a three-part Government of Canada strategy for the protection of plant SAR, and applies to all extirpated, endangered or threatened species listed as being at risk and their critical habitat. SARA-listed species designated as special concern are not protected by the prohibitions of Sections 32-36 of SARA; however; they do require that provincial or regional management plans are developed to protect the species. The other two parts of this strategy include commitments under the Accord for the Protection of Species at Risk and activities under the Habitat Stewardship Program for SAR, which protect SAR on federal land.

[1] While S3 species are of concern from a provincial biodiversity perspective, they are often not included, as their populations are considered less sensitive. This determination is typically at the discretion of the NLDEC Wildlife Division.
[2] The first rank indicates the rarity status given current documentation, and the second rank indicates the rarity status that will most likely be assigned after all historical data and likely habitats have been checked.

There are three main prohibitions in SARA relevant to *extirpated*, *endangered* or *threatened* plant SAR and their critical habitat:

- Section 32, which prohibits killing, harming, or taking SAR
- Section 33, which prohibits damage or destruction of residences of SAR
- Subsection 58(1), which prohibits destruction of critical habitat of SAR

Definitions of COSEWIC and SARA wildlife species status categories are summarized in Appendix B: Rare Plant Surveys and Habitat Characterization Baseline Report.

Provincial Legislation

In Newfoundland and Labrador, a vascular plant SAR is protected under the NLESA (Government of Newfoundland and Labrador 2001). Designation under the Act follows the recommendations of the Species Status Advisory Committee on the appropriate assessment of a species and referring concerns about the status of species to COSEWIC, where the species is of national importance.

The purpose of the NLESA is to:

- Prevent listed species from being extirpated from Newfoundland and Labrador
- Provide for the recovery of species listed as *extirpated*, *endangered*, or *threatened* as a result of human activity
- Conserve species listed as special concern to prevent them from becoming *endangered* or *threatened*

Prohibitions of NLESA include Section 16, which states "*a person shall not disturb, harass, injure, or kill an individual of a species designated as threatened, endangered or extirpated*". The associated *Prohibitions Regulation* identifies those species to which Section 28 applies, and includes eight vascular plant species. Section 29 states that an area or site designated by regulation as survival habitat or recovery habitat may be identified by a description or plan of the specific boundaries or features of the area or site.

A Permit to Engage in an Economic Activity under Section 19 of the NLESA, SNL 2001 C.E.-10.1 would be required. The purpose of the permit is to allow economic and administrative activities to co-exist harmoniously with environmental planning and biodiversity stewardship. The permit provides assurance that the activities of a proponent comply with the necessary requirements. Under this permit a proponent must adhere to all commitments made under the permit including surveys, conducting monitoring work, and regular reporting. The Quarry Extension may not proceed without this permit.

7.3.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Section 4 (Consultation and Issues Scoping), AML has consulted with local community leadership and the provincial government. Concerns related to effects on rare plants was identified as an issue during engagement, and was noted as a requirement for further assessment by the NLDEC EA Division.

Through AML's consultation process, NLDEC Wildlife Division identified uncertainties about the extent to which SAR, and more specifically, Lindley's aster *(Symphyotrichum ciliolatum*), might be affected by the Quarry Extension. To address the concerns of the Wildlife Division, the footprint has been reduced and modified to avoid removal of topsoil / overburden, drilling, blasting, and excavation in areas of high potential for rare plants, where practicable. The alternative reduced Quarry Extension footprint:

- Is approximately 80 percent (decrease from approximately 761 ha lease area to 140 ha Quarry Extension footprint) smaller than the original footprint
- Avoids the area identified by the Wildlife Division as posing the greatest concern for SAR
- Avoids the areas identified as having the highest rare plant density (e.g., incised, sheltered valleys, gullies, and ravines associated with fault zones intersecting the PDA and LAA)
- Results in an expected reduction of Lindley's aster relocations based on previous surveys of the Quarry Extension site; the actual number of relocations will depend on where SAR are encountered at pre-construction

7.3.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

The Lower Cove Quarry Extension and associated activities have the potential to interact with Rare Plants and their habitats. The assessment of Quarry Extension-related environmental effects on rare plants is focused on the following potential environmental effect:

- Change in rare plant species abundance and distribution

The measurable parameter used for the assessment of the environmental effect presented above, and the effect pathway, are provided in Table 7.12.

Table 7.12 Potential Environmental Effects, Effects Pathways and Measurable Parameters for Rare Plants

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Rare Plant Species Abundance and Distribution	• Direct loss of individual plants or loss / alteration of habitat resulting from vegetation clearing and ground disturbance related to construction and operations phases	• Relative number and location (individuals or populations) of occurrences of vascular plant SAR or SOCC

The abundance and distribution of rare plant species may change due to activities that cause physical disturbance.

7.3.1.4 Boundaries

Spatial Boundaries

The spatial boundaries for the environmental effects assessment for Rare Plants are defined below and shown in Figure 7-3.

PDA: The PDA is the immediate area within which Quarry Extension activities and features will occur, and within which direct physical disturbance associated with the Quarry Extension will occur. The PDA is the same for all VECs and is illustrated on Figure 6-1. It includes only those components applicable to the Quarry Extension and associated infrastructure.

LAA: The LAA is the maximum area within which Quarry Extension-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence.

The LAA includes the PDA and any adjacent areas where Quarry Extension-related environmental effects may reasonably be expected to occur. For Rare Plants, the LAA is defined as the area that will be directly affected by surface disturbance activities (i.e., the Quarry Extension footprint), in addition to an approximately 200 m buffer surrounding these components (Figure 7-3).

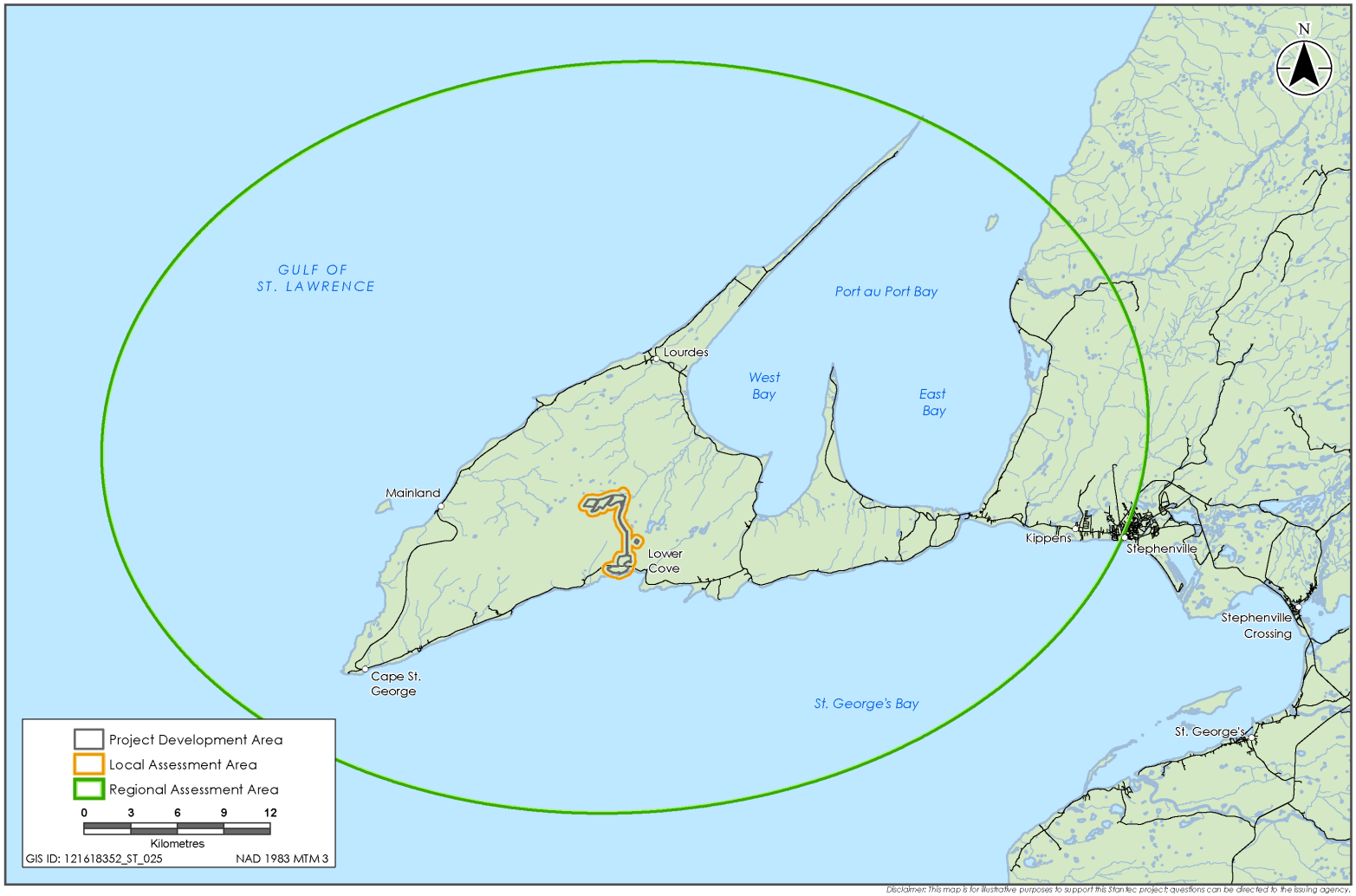


Figure 7-3 Local and Regional Assessment Areas for Species at Risk and Species of Conservation Concern

RAA: The RAA is the area within which cumulative environmental effects for Rare Plants might occur, depending on physical and biological conditions and the type and location of other past, present, and reasonably foreseeable Projects, and within which the significance of Extension effects is predicted. The RAA also accommodates a wider geographic area for ecological context (Figure 7-3). It includes an area that incorporates the Port au Port Peninsula, in addition to portions of the Table Mountain or Pine Tree area, a ridge that extends in a north-easterly direction a distance of approximately 16 km along the shoreline of East Bay. These encompassing regions were included in the RAA because these areas represent environments (e.g., calcareous substrates) similar to those in the LAA and PDA, and provide relevant comparisons with vegetation populations and communities in the greater landscape.

Temporal Boundaries

The temporal boundaries considered in the environmental effects assessment for Rare Plants include all phases of the Quarry Extension. Activities such as site preparation and quarry excavation will cause the majority of Quarry Extension effects to Rare Plants. Decommissioning will take place following the useful service life of the Quarry Extension and will be carried out in accordance with regulations in place at that time. The temporal boundaries are the construction phase, the operations phase and the decommissioning phase after exhaustion of the ore body.

7.3.1.5 Residual Environmental Effects Description Criteria

The descriptors used to characterize residual environmental effects on Rare Plants are defined in Table 7.13.

Table 7.13 Characterization of Residual Environmental Effects on Rare Plants

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect	**Positive** - an environmental effect that moves measurable parameters in a direction beneficial to rare plants or population status relative to baseline **Adverse** - an environmental effect that moves measurable parameters in a direction detrimental to rare plants or population status relative to baseline **Neutral** - no net change in measureable parameters for the rare plants or population status relative to baseline

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the VEC relative to existing conditions	**Negligible** - no detectable change from baseline conditions, or so small as to be immeasurable **Low** - effect occurs that is detectable but is near the low end of observed natural variability. No measurable adverse environmental effect anticipated **Moderate** - effect occurs that is detectable and is at the high end of observed natural variability. A measurable adverse environmental effect is anticipated and may alter species abundance and distributions, and reduce diversity **High** – environmental effect occurs that would alter species abundance and distributions greater than the observed natural variability, with a loss of diversity
Geographic Extent	The geographic area in which an environmental effect occurs	**PDA** - residual environmental effects are restricted to the PDA **LAA** - residual environmental effects extend into the LAA **RAA** - residual environmental effects interact with those of other projects in the RAA
Frequency	Identifies how often the environmental effect during the Quarry Extension or in a specific phase	**Single event** – occurs once **Multiple irregular event** - occurs at sporadic intervals **Multiple regular event** - occurs on a regular basis and at regular intervals **Continuous** - occurs continuously
Duration	The period of time required until the measurable parameter or the VEC returns to its existing condition, or the environmental effect can no longer be measured or otherwise perceived	**Short-term** - residual environmental effect is restricted to less than two years **Medium-term** - residual environmental effect extends between 2 and 25 years **Long-term** - residual environmental effect extends beyond the life of the Quarry Extension
Reversibility	Pertains to whether a measurable parameter or the VEC can return to its existing condition after the Quarry Extension activity ceases	**Reversible** - the environmental effect is likely to be reversed after activity completion and reclamation **Irreversible** - the environmental effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where environmental effects occur	**Undisturbed** - area is relatively undisturbed or not adversely affected by human activity **Disturbed** - area has been substantially previously disturbed by human development or human development is still present

7.3.1.6 Significance Definition

For a change in rare plant species abundance and distribution, a significant adverse residual environmental effect is defined as a Quarry Extension-related environmental effect that:

- Results in a non-permitted contravention of any of the prohibitions stated in Sections 32-36 of SARA, or in contravention of any of the prohibitions stated in Section 15 of NLESA
- Results in the direct mortality of individuals or populations of SAR and/or SOCC such that the likelihood of the long-term survival within the region is compromised as a result
- Alters the terrestrial habitat within the LAA physically, chemically, or biologically, in quality or extent, in such a way as to cause a change or decline in the abundance or distribution of a viable plant population that is dependent upon that habitat such that the likelihood of long-term survival within the province is compromised as a result

7.3.2 Existing Conditions for Rare Plants

The Lower Cove Quarry is located on the Port Au Port Peninsula along Route 460, between the communities of Lower Cove and Sheaves Cove. The existing quarry and primary processing areas are located on the north side of Route 460 and the secondary processing on the south side. The existing quarry and proposed Quarry Extension area is located approximately 4 to 5 km north of the primary processing area (see Figure 1-1).

7.3.2.1 Methods and Information Sources Used to Characterize Existing Conditions

This section identifies those information sources used to establish baseline conditions and to describe existing conditions related to rare plants and their habitats in the PDA, LAA, and RAA.

Information to support the identification of rare plants, including SAR and SOCC, characterize the LAA, and identify data to be collected during field surveys was obtained from a variety of sources. The primary sources used to characterize existing conditions include:

- Google Earth® and Bing® imagery (2015)
- Government databases that include information on rare plant species (e.g., SARA Public Registry (COSEWIC 2015), AC CDC database (AC CDC 2015)) and which may be used in identifying previously documented occurrences of SAR and/or SOCC in the vicinity of the PDA and LAA
- Technical manuals and regional floras (e.g. Atlas of the Vascular Plants of the Island of Newfoundland and of the Island of Saint-Pierre-et-Miquelon (Rouleau and Lamoureux 1992), Gray's Manual of Botany (Fernald 1950), Flora of Canada (Scoggan 1978) and available volumes of the Flora of North America) for familiarization of all identifying characteristics of rare species that could be encountered
- Information from other published literature, including peer-reviewed academic journals, research reports, government publications, and current federal legislation and regulations

- Third-party baseline studies (e.g., PDI Production Inc. Garden Hill Seismic Exploration Program 2007)
- Field surveys to assess rare plant presence and potential

The SARA Public Registry was reviewed to identify vascular plant SAR with potential to occur in the RAA. Based on this review, there are no federally listed SAR with potential to occur in the RAA.

The AC CDC database was also queried for a list of vascular plant SAR and/or SOCC within a 5 km radius of the PDA. These databases, supported by a review of existing information sources on the known habitat preferences for a list of species, were used to identify occurrences of SAR and SOCC intersected by the Quarry Extension and with potential to occur in the PDA.

Information provided by NLDEC – Wildlife Division staff was also used to identify occurrences of SAR and SOCC species with potential to occur in the PDA through personal communications with Claudia Hanel (Provincial Botanist).

In coordination with AML and NLDEC Wildlife Division, a plan for executing a well-timed vascular plant survey was developed that called for multiple visits (i.e., late spring and mid to late summer) throughout the PDA. Emphasis was placed on accessing as many high priority sites as possible and based on the phenology (timing of germination, flowering, maturity) of those rare plants with the potential of being encountered.

Early season surveys were planned for and executed during the week of June 16 to 19, 2015, with late season surveys taking place between July 27 to August 4, 2015, and coinciding with the period when the probabilities of encountering a majority of target species was highest (e.g., flowering periods for both cool and warm season perennials), and detectability of the majority of species maximized. Search effort focused on inspecting as many fine-scale biotic habitats, unusual plant communities, and biophysical features as possible. Surveys were comprehensive over the entire site, and floristic in nature (floristic habitat sampling), including those areas that will be directly or indirectly affected by the Quarry Extension. Floristic habitat sampling, in the context of this study, focused survey effort on those vegetation communities with elevated potential to harbour *endangered*, *threatened*, rare, or otherwise unusual plant species, the results of which provide information on the distribution and abundance of these species within the area surveyed.

Detailed descriptions of the assessment methodology are provided in Appendix B: 2015 Rare Plant Survey and Habitat Characterization Report. Rare plant surveys to date have confirmed the presence of some vascular plant SAR and SOCC. The following section summarizes information on SAR and SOCC observed during field surveys of the PDA and LAA.

7.3.2.2 Rare Plants and Habitat Characterization

A single plant *species at risk*, Lindley's aster, listed as *endangered* under the NLESA, was recorded in the AC CDC database as occurring within 5 km of the PDA. Additionally, six provincially tracked vascular plant species have also been identified. Along with their respective designations and/or conservation rankings, they include: western thread-leaf pondweed (*Stuckenia filiformis* subsp. *occidentalis*; *S1*; *may be at risk*), giant bur-reed (*Sparganium eurycarpum*; *S2*; *may be at risk*), northern holly fern (*Polystichum lonchitis*; *S2*; *may be at risk*), pulvinate pussytoes (*Antennaria rosea* subsp. *pulvinata*; *S2*; *unranked*), forest bluegrass (*Poa saltuensis*; *S2/S3*; *sensitive*), and limestone oak fern (*Gymnocarpium robertianum*; *S2/S3*; *sensitive*).

Native Vegetation Communities

Eight general plant community types or subtypes were identified in the PDA and LAA. They include: weathered rock barrens; dry to moist / wet rock crevices; dwarf shrub heath; mesic scrub woodland (low tuckamoor); fresh meadows; incised sheltered valleys / gullies; upland conifer forest; and coniferous treed fen.

Weathered Rock Barrens

The weathered rock barrens community is characterized by Arctic alpine-like climatic conditions, although typically occurring at lower elevations. The characteristic exposed limestone bedrock-pavement was formed when horizontally or gently inclined bedded sheets of limestone were exposed by glaciation and then chemically weathered by rain. The result is a distinctive level surface dissected into blocks and ridges by a series of eroded cracks. The exposed limestone bedrock is covered with a shallow layer of turfy peat or exposed bedrock.

The vegetation adjacent to the exposed, horizontally-bedded limestone outcrops and their immediate environs can vary from high-elevation weathered rock barrens to mesic scrub woodland, dwarf shrub heath, and open wet meadow. Where the bedrock is covered with a layer of peat it is common to have abrupt ecotones between ericaceous heath and peaty (peatland) vegetation types to pockets of highly calcicolous heath and open wet meadow. Where limestone outcrops emerge from under the soil there can be interesting mixtures of vegetation with shrubs such as sheep laurel (*Kalmia angustifolia*), bearberry (*Arctostaphylos uva-ursi*), alpine bearberry (*Arctous alpina*) and crowberry (*Empetrum nigrum*) growing together with calcicolous, Arctic-alpine-like species such as rock willow (*Salix vestita*), entireleaf mountain-avens (*Dryas integrifolia*), and kidney-leaf violet (*Viola renifolia*). These natural communities provide the highest quality habitat for the rare flora of the PDA known to date.

Dry to Moist / Wet Rock Crevices

A subtype of the weathered rock barren plant community, it includes dry to moist / wet cracks, crevasses, fissures, and sinkholes created by the dissolution of soluble limestone, dolomite, and gypsumn bedrock. Deep pockets of damp humus and soil can accumulate in these crevices

and contrast starkly with the dry surface cracks and well-drained surrounding ecotones. At the openings of these features, and clinging to the rock face or growing directly out of cracks, crevices and fissures are green spleenwort (*Asplenium virde*), limestone oak fern, bladder fern (*Cystopteris* sp.), male fern (*Dryopteris filix-mas*), hemlock parsley (*Conioselinum chinense*), harebell (*Campanula gieseckeana*), hyssop-leaf fleabane (*Erigeron hyssopifolius*), kidney-leaf violet, and northern hollyfern.

Alternatively, in the dark, moist recesses of numerous rock crevices, fissures, and sinkholes, acidic organic matter collects, and under the influence of prolonged snow cover and neutral seepage water, results in the establishment of such shrub species as bog birch, shrubby cinquefoil, alderleaf buckthorn (*Rhamnus alnifolia*) and squashberry (*Viburnum edule*). Characteristic herbaceous species included cow parsnip (*Heracleum maximum*), New York aster (*Symphyotrichum novi-belgii*), bottlebrush (*Sanguisorba canadensis*), yellow clintonia (*Clintonia borealis*), northern holly fern, northern beech fern (*Phegopteris connectilis*), red baneberry (*Actaea rubra*), and bluejoint reed grass (*Calamagrostis canadensis*).

Dwarf Shrub Heath

Dwarf shrub heath types are infertile, moist to dry sites typically exposed to desiccating winter winds that may also remove the protective snow cover during winter, and this is expressed in the sparse vegetation community that occurs. They occupy areas of hummocky terrain and thin poor soils with exposed bedrock. Tree cover is very low and stunted with low frequency of occurrence, comprised of small patches of prostrate balsam fir, black spruce, and tamarack, growing in sheltered microsites. The tall shrub layer is also very poorly represented by bog birch (*Betula pumila*) and alpine blueberry (*Vaccinium uliginosum*). Low shrubs such as bearberry, alpine bearberry and crowberry have generally higher coverage. The herb layer is also quite sparse and the most important herb species are entireleaf mountain-avens and running club moss (*Lycopodium clavatum*), although cover is generally low. Red-stemmed feathermoss (*Pleurozium schreberi*) has the highest coverage of any moss species.

Mesic Scrub Woodland

The mesic scrub woodland (or low tuckamoor) plant community is composed primarily of stunted conifers, often found at the high elevation (alpine) treeline ecotone. The mesic scrub woodland occurs in the protected lee of ridgelines that are oriented perpendicular to the prevailing onshore winds. It is usually dominated by prostrate forms of balsam fir and black spruce, and scattered tamarack is also sometimes found. Throughout the region, mesic scrub woodland types provide shelter for a variety of other shrubs and herbaceous plants to grow beneath them, resulting in a diverse herbaceous understorey. Ericaceous species and other shrubs, particularly sheep laurel, mountain holly (*Ilex mucronata*), northern wild raisin (*Viburnum cassinoides*), alderleaf buckthorn, ground juniper (*Juniperus communis* var. depressa), Canada yew (*Taxus canadensis*), bog laurel (*Kalmia polifolia*), bearberry and creeping snowberry (*Gaultheria hispidula*) were also prevalent. Its protected understorey almost always includes large-leaf goldenrod (*Solidago macrophylla*), bottlebrush, yellow clintonia, bunchberry (*Cornus*

canadensis), starflower (*Trientalis borealis*), wild lily-of-the-valley (*Maianthemum canadense*) and running clubmoss (*Lycopdodium clavatum*), as well as occasional species such as northern comandra (*Geocaulon lividum*). Several orchids, including the provincially tracked Hooker's orchid (*Platanthera hookeri*), with a habitat affinity for moist meadows, are found throughout the area either as small patches in mesic scrub woodland or as larger successional types associated with valleys and are also present. The moss layer reflects an important component of this community and includes red-stemmed feathermoss, plume moss (*Ptilium crista-castrensis*), stairstep moss (*Hylocomium splendens*), common hair-cap moss (*Polytrichum commune*), shaggy moss (*Rhytidiadelphus triquetrus*) and broom mosses (*Dicranum* spp.).

Fresh Meadows

Small fresh meadows distributed across the landscape, especially among expanses of mesic scrub woodland, are characterized by a complex of fresh meadow and/or marginal shallow peatland (folisols) communities. This subtype of the mesic scrub woodland association is limited in extent, typically less than 10 m^2, with a diffuse or patchy distribution across the PDA and LAA. Fresh meadows are found at higher elevations, and often in the frost pockets of valley bottoms and late snow areas, where wet and cold conditions preclude the establishment of tree species. The fresh meadow subtype is characterized by moist to saturated soils, with standing water present for only brief to moderate periods during the growing season. Vegetation includes a wide variety of herbaceous species, from forbs and grasses to sedges and rushes. Woody vegetation, if present, accounts for less than 20 percent of the total cover. The forbs and grasses of these meadows tend to be less competitive, more nutrient demanding, and often shorter-lived species. This community typically has increased snowpack and increased moisture availability in spring and early summer, and remains moist to partially dry throughout the summer. Meadow vegetation is a mosaic of wet meadow and dwarf shrub heath, bordering mesic scrub woodland. Balsam fir, black spruce, sweet gale (*Myrica gale*), and shrubby cinquefoil, are the dominant shrubs on the edges of these openings. Beneath the edges of the shrubs is a lush understorey of herbs and grasses, many of which are shared with the adjacent wet meadow association. Some of the more distinctive herbaceous species associated with the wet meadow type are bottlebrush, bog goldenrod (*Solidago uliginosa*), Hooker's orchid, small tofieldia (*Tofieldia pusilla*), Mistassini primrose (*Primula mistassinica*), common butterwort (*Pinguicula vulgaris*), deergrass (*Trichophorum cespitosum*), single-spike sedge (*Carex scirpoidea*), golden sedge (*Carex aurea*), and sheathed sedge (*Carex vaginata*). It is in or rather on the periphery of these open meadows, within the 'tucks' of balsam fir and black spruce, that the listed vascular plant Lindley's Aster is most likely to be encountered.

Incised Sheltered Valleys / Gullies

The entire site, including a majority of the limestone barren, dwarf shrub heath, and mesic scrub woodland habitat types described above, is dissected by numerous incised, sheltered gullies and ravines (oriented northeast-southwest across the LAA) and depressed areas. Vegetation cover in these areas is among the most floristically diverse of those habitats observed. Unlike the dwarf shrub heath and scrub forest habitats previously described, climatic conditions are

somewhat less severe in these habitats. In many cases, snow accumulates in north-facing gullies, or below north-facing cliffs, and where present provides an insulating layer to the ground surface, facilitating the establishment of diverse snow bed (chionophilic) plant communities. The snow pack in this community lasts longer into the spring and early summer than surrounding vegetation, creating a short growing season but alternatively, conditions to facilitate increased plant growth (e.g., shelter from desiccating winds, increased soil moisture, storage of organic matter) (South 1983). Stunted balsam fir are usually fairly dense along the valley walls, but because of the moist understorey and relatively sunny meadow valley bottom location, there is a well-developed herbaceous and graminoid layer. Many herbs are shared with the dwarf shrub heath and meadow associations, but several species are characteristic. These include: showy mountain ash (*Sorbus decora*), Canada yew, clasping-leaf twisted-stalk (*Streptopus amplexifolius*), northern holly fern, tall meadow rue (*Thalictrum pubescens*), swamp thistle (*Cirsium muticum*), cow parsnip, dewberry (*Rubus pubescens*), and leafy white orchid (*Platanthera dilatata* var. *dilatata*). Lindley's aster is also likely to be regularly encountered in these areas. Clearly, these mesic to hygric snow bed associations are dependent on the reliable, late-persisting snow cover found there.

Upland Conifer Forest

Upland conifer forest habitat is also quite limited in its distribution in the PDA, primarily occurring on sloping terrain in association with valley features along the northern edge of the LAA. This habitat type is composed of stands ranging in age from recently harvested (domestic cutting) to mature, with the majority of stands approximately 40 to 50 years old. The overstorey is dominated by balsam fir and black spruce, with some white (paper) birch (*Betula papyrifera*). The woody understory , depending on the age and openness is typically dominated by regenerating balsam fir, black spruce, and some paper birch with choke cherry (*Prunus virginiana*), sheep laurel, mountain holly and wild red raspberry (*Rubus idaeus* subsp. *strigosus*. The herbaceous ground layer is dominated by wood ferns (primarily evergreen wood fern (*Dryopteris intermedia*), and mountain wood fern (*Dryopteris campyloptera*), spinulose wood fern (*Dryopteris carthusiana*), wild sarsaparilla (*Aralia nudicaulis*), pink ladyslipper (*Cypripedium acaule*), trailing arbutus (*Epigaea repens*), bunchberry, wild lily-of-the-valley, and bluejoint reed grass. The moss layer reflects a substantive component of this community and includes red-stemmed feathermoss, knight's plume (*Ptilium crista-castrensis*), stairstep moss, common hair-cap moss, shaggy moss and broom mosses.

Coniferous Treed Fen

Coniferous treed fen habitat has a restricted distribution in the PDA and LSA, having a forest cover dominated by tamarack and black spruce, with lesser components of balsam fir. The understorey is dominated by ericaceous shrubs including northern wild raisin, sheep laurel, velvetleaf blueberry (*Vaccinium myrtilloides*), and twinflower (*Linnaea borealis*), with an herbaceous layer of cinnamon fern (*Osmundastrum cinnamomeum*), bunchberry, Virginia strawberry (*Fragaria virginiana*), wild lily-of-the-valley, three-fruit sedge (*Carex trisperma*), silvery

sedge (*Carex canescens*), roughleaf mountain ricegrass (*Oryzopsis asperifolia*), as well as sphagnum mosses (*Sphagnum spp*.).

Rare Plant Species – Results of Surveys

This section summarizes information on SAR and SOCC that was observed during field surveys of the PDA and LAA.

The 2015 rare plant survey (both early and late season surveys) resulted in a list of approximately 230 vascular plant species, distributed into 135 genera and 52 families, with the *Cyperaceae* (32 species) and *Asteraceae* (24 species) as the largest families represented. Of the 230 vascular plant species, 12 (5 percent) are considered rare (S-Rank of *S1*, *S2*, *S3*, or combinations thereof (e.g., *S1/S2*, *S2/S3*)) or SAR / SOCC (Appendix B: Rare Plant Surveys and Habitat Characterization Baseline Report).

No SARA-listed species were found during the survey. However, one species, Lindley's aster, listed by the province (NLESA 2007) in Schedule A of the *Endangered Species List Regulations* and ranked *S1*, was observed during surveys of the PDA, LAA and RAA.

Eleven species within the PDA are considered provincially rare. One species, umbellate sedge (*Carex umbellata*) is ranked *S1S2*; seven are ranked *S2*, including Hooker's orchid, northern holly fern, Laurentian bladder fern (*Cystopteris laurentiana*), New England sedge (*Carex novae-angliae*), beautiful sedge (*Carex concinna*), blunt sweet-cicely (*Osmorhiza depauperata*), wood valerian (*Valeriana* dioica var. *sylvatica*); and the remaining three - forest bluegrass, limestone oak fern, and dwarf white birch (*Betula minor*) - are ranked *S2S3*.

The number of observations of SAR and SOCC within the PDA, LAA, and RAA are presented in Table 7.14. The relative locations of SOCCs within the PDA and LAA are presented in Figure 7-4, and the locations of SAR within the RAA are presented in Figure 7-5.

Details on distribution and abundance are summarized in Section 2.1 of Appendix B: 2015 Rare Plant Survey and Habitat Characterization Report, with a description of their preferred habitat requirements and known occurrences nationally, as well as within the regional landscape.

Table 7.14 Rare Plant Species Observations within the PDA, LAA and RAA

Scientific Name	Common Name	G Rank1	N Rank2	SRank3	General Status	Number of Observations			Observed Plant Community Types
						PDA	LAA	RAA	
Symphyotrichum ciliolatum (Lindley) (Lindl.) Á. Löve & D. Löve	Lindley's aster	G5	N5	S1	*may be at risk*	22	44	172	In various conifer-dominated woodland habitats throughout the PDA, LAA, and RAA; on subhygric soils; calcareous or basic substrates (calciphile)
Carex umbellata Schkuhr ex Willd.	umbellate sedge	G5	N5	S1S2	*sensitive*	3	3	5	Moist to wet open woodlands and meadows
Carex concinna R. Br.	low northern sedge	G5	N5	S2	*may be at risk*	0	0	1	Moderately open, dry woods on outcrops; on exposed calcareous or basic substrates (calciphile)
Carex novae-angliae Schwein.	New England sedge	G5	N5	S2	*sensitive*	0	2	2	Moderately shaded forest edges, paths, and dirt roads through forests and woodlands; rarely in wetter habitats. Thickets and open forest sites near the coast (Bouchard et al. 1991)
Cystopteris laurentiana (Weath.) Blasdell	Laurentian bladder fern	G3	N3	S2	*may be at risk*	1	2	2	Bare rock and narrow cracks and crevasses on shaded vertical surfaces of cliffs, ledges and bedrock fractures; on high pH substrates
Osmorhiza depauperata Philippi	blunt sweet cicely	G5	N5	S2	*may be at risk*	3	3	4	Moist, coniferous spruce-fir forest, woodland and scrub habitats, elsewhere from mixed forests and riparian thickets adjacent to small rivers and stream; in seepage areas, on subhygric soils
Platanthera hookeri (Torr. ex A.Gray) Lindl.	Hooker's orchid	G4	NNR	S2	*may be at risk*	14	20	30	Open mesic scrub woodland and open heath types; calcareous or basic substrates (calciphile)

Scientific Name	Common Name	G Rank1	N Rank2	SRank3	General Status	Number of Observations			Observed Plant Community Types
						PDA	LAA	RAA	
Polystichum lonchitis (L.) Roth	northern holly fern	G5	NNR	S2	*may be at risk*	12	28	63	Moist to wet numerous large crevasses, cracks, fissures, sinkholes, gullies, and ravines; calcareous or basic substrates (calciphile)
Valeriana dioica subsp. *sylvatica* (S.Watson) F.G.Mey.	wood valerian	G5T4T5	N4N5	S2	-	2	2	3	Bogs, mossy woods and brooksides on limestone and calcareous or basic substrates (calciphiles) (Bouchard et al. 1991)
Betula minor (Tuck.) Fernald	dwarf white birch	G4Q	N4	S2S3	*secure*	0	1	4	Fairly exposed windy ridges; in the dry / mesic heath of alpine communities, at the edge of tuckamoor
Gymnocarpium robertianum (Hoffm.) Newman	limestone oak fern	G5	N3	S2S3	*sensitive*	2	3	14	Moist to wet cliff face; on exposed calcareous or basic substrates (calciphile)
Poa saltuensis Fernald & Wiegand	forest bluegrass	G5	N4?	S2S3	*sensitive*	3	8	25	Semi-shaded to open, dry or rocky habitat; on well-drained soil ranging from slightly acidic to slightly calcareous

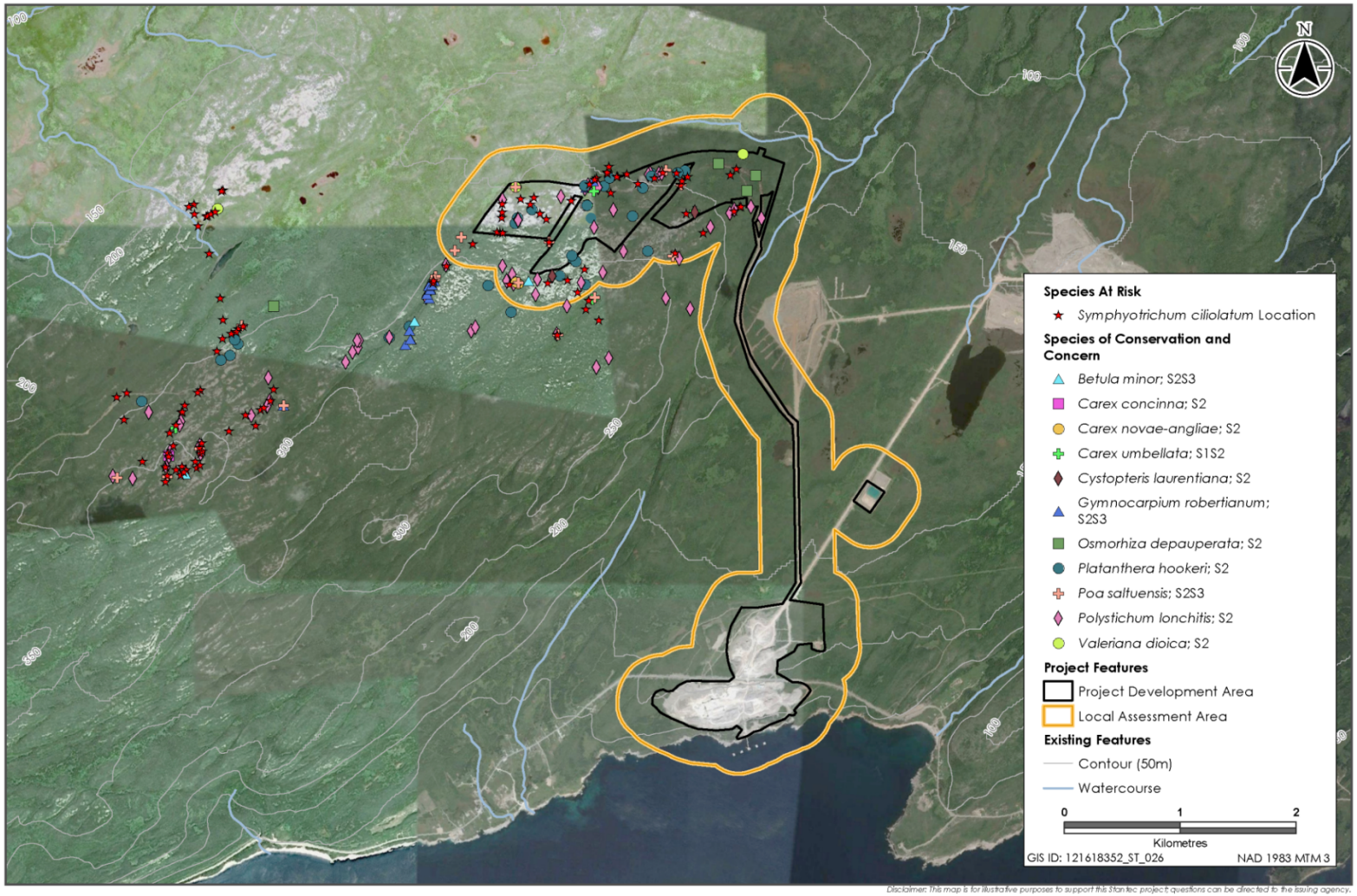


Figure 7-4 Species at Risk and Species of Conservation Concern in the PDA and LAA

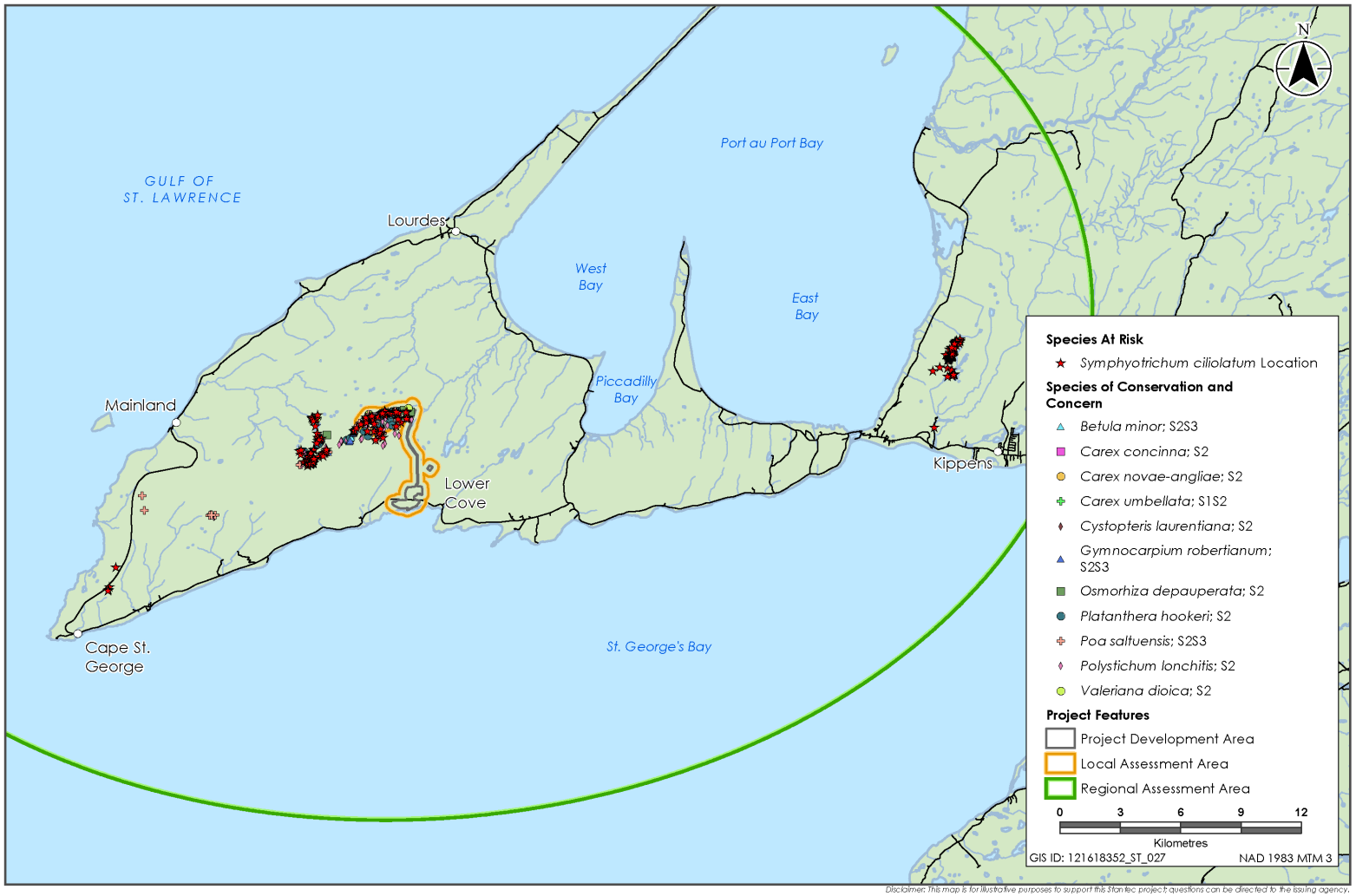


Figure 7-5 Species at Risk and Species of Conservation Concern in the RAA

An additional 10 species, presently ranked S3, were also recorded from within the PDA and LAA. Requests for consultation with NLDEC Wildlife Division have been submitted to determine those potentially deemed of conservation concern to the Province. They include: bristleleaf sedge (*Carex eburnea*); golden sedge; roughleaf mountain ricegrass; kidney-leaf violet, checkered rattlesnake plantain (*Goodyera tesselata*); green adder's mouth (*Malaxis unifolia*); Sitka ground-cedar (*Diphasiastrum sitchense*); trailing arbutus; Canada yew; and dwarf white birch.

A comprehensive list of all vascular plant species observed in the PDA and LAA is provided in Appendix B: 2015 Rare Plant Survey and Habitat Characterization Report.

7.3.3 Quarry Extension Interactions with Rare Plants

The Quarry Extension physical activities that might interact with the VEC are listed in Table 7.15. These interactions are indicated by check marks, and are discussed in detail in Section 7.3.4 in the context of effects pathways, standard and Quarry Extension-specific mitigation, and residual effects. A justification is also provided for non-interactions (no check marks).

Table 7.15 Quarry Extension Interactions with Rare Plants

Quarry Extension Components and Physical Activities	Change in Rare Plant Species Abundance and Distribution
Construction	
Clearing and grubbing	✓
Construction of on-site road	✓
Excavation of the quarry	✓
Construction of Site Buildings and Associated Infrastructure	✓
Water management (construction of sump and water line)	✓
Wastes and emissions	-
Employment	-
Expenditures	-
Operation	
Drilling and blasting	✓
On-site haulage	✓
Crushing and screening	✓
Water management	✓
Wastes and emissions	-
Employment	-
Expenditures	-

Quarry Extension Components and Physical Activities	Change in Rare Plant Species Abundance and Distribution
Decommissioning	
Re-contouring	✓
Re-vegetation	✓
Wastes and emissions	-
Employment	-
Expenditures	-
NOTES: ✓ = Potential interactions that might cause an effect. – = Interactions between the Quarry Extension and the VEC are not expected.	

The following activities during both the construction and operation phases of the Quarry Extension are not anticipated to interact with Rare Plants to result in an environmental effect:

- Wastes and emissions
- Expenditures
- Employment

7.3.4 Assessment of Residual Environmental Effects on Rare Plants

7.3.4.1 Analytical Assessment Techniques

In this section, change in rare plant species abundance and distribution is assessed on the basis of existing information (Section 7.3.2) and information regarding the Quarry Extension. Based on the discussion of Quarry Extension interactions with rare plants, only those interactions with a check mark in Table 7.15 are further considered in this assessment.

As there is some level of uncertainty regarding the actual abundance of SAR (in particular Lindley's aster) and SOCC in the RAA and beyond, AML has conducted reconnaissance-level rare plant surveys outside the PDA in 2015, focusing on regional historic occurrences of Lindley's aster, in addition to those habitats with a high potential of harboring rare plant taxa in the RAA.

7.3.4.2 Assessment of Change in Rare Plant Species Abundance and Distribution

In this section, the potential changes in rare plant species abundance and distribution within the PDA, LAA and RAA are assessed on the basis of baseline data, existing inventories and available biological information. The pathways, mitigation measures and characterization of potential residual environmental effects are described in the following sections.

Pathways for Change in Rare Plant Species Abundance and Distribution

Construction

During construction of the Quarry Extension, native vegetation will be disturbed and a change in rare plant species abundance and distribution will occur as a result of Quarry Extension activities. The following Quarry Extension-related activities have the potential to affect rare plants:

- Site preparation (clearing and grubbing)
- Construction of on-site roads and buildings (e.g., quarry buildings, lunchroom trailer)
- Excavation of the quarry (drilling and blasting)
- Water management (construction of sump and water line)

The assessment assumes that most of the vegetation within the Quarry Extension footprint will have to be removed (e.g., clearing and grubbing) as a result of site preparation. Clearing and grubbing during site preparation, including removal of topsoil / overburden, drilling, blasting, excavation, and/or infilling, will remove or alter native vegetation and will result in the permanent loss of vascular plant SAR or SOCC where those plants are located within directly disturbed areas of the PDA. Clearing and grubbing will eliminate vegetation from the area and removing topsoil and overburden will remove the native seed bank.

Quarry Extension effects on SARA-listed *endangered* or *threatened* plant species during the construction phase are not expected since these species were not found during field surveys and are not expected to occur within the habitats encompassed by the Quarry Extension.

One provincially-listed SAR species, Lindley's aster, was observed within the PDA, occupying the White Hills production area (see Figure 7-4). Additionally, 11 plant species ranked as being of provincial conservation concern (i.e., *S1*, *S2,* or *S2/S3*) were recorded in the PDA during extensive field studies in 2015. Eight of the eleven species identified as being SOCC were recorded in the PDA and it is likely that clearing and grubbing of the site will directly affect these species (see Figure 7-3). They include umbellate sedge, forest bluegrass, Hooker's orchid, northern holly fern, limestone oak fern, Laurentian bladder fern, blunt sweet-cicely and wood valerian. Most of these species are either generally widespread or widespread in their preferred habitat.

Operation

Quarry Extension effects on rare plants, including SAR and SOCC, will result primarily if not exclusively from Quarry Extension and surface disturbance.

Activities associated with the operations phase of the Quarry Extension that have the potential to interact with rare plant species and a resulting change in species abundance and distribution include drilling and blasting[3], on-site haulage (vehicle / heavy equipment use), waste rock

[3] The environmental effects of drilling and blasting are addressed fully in the operations phase. Acknowledging the staged Quarry Extension of the White Hills production area, a conservative approach is taken to the assessment of the complete footprint for the Quarry Extension.

disposal on surface, and water management (treatment and discharge), including quarry water and surface water runoff. These activities will result in the loss of approximately 160 ha of vegetation within the footprint of and adjacent to the Quarry Extension, including the White Hills production area, processing plant site, all new and upgraded on-site roads, and ancillary infrastructure such as buildings, drainage infrastructure, fuel storage, and sewage treatment units.

Decommissioning

Vegetation and soil in the 140 ha area are to be removed through excavation of the quarry and will be converted to some combination of upland and open water habitat types at decommissioning, when the site is re-vegetated.

A RCP will be developed in accordance with the applicable regulations at the time of decommissioning. The RCP will specify the procedures that will be followed with respect to the decommissioning, removal, and disposal of site equipment and structures, and for site remediation, where required. Potential environmental effects of decommissioning activities will also be managed following the Quarry Extension-specific EPP.

Mitigation for Change in Rare Plant Species Abundance and Distribution

Quarry Extension planning, design, and the application of known and proven mitigation measures will be carried out as part of the Quarry Extension with the goal of avoiding or reducing environmental effects on Rare Plants, including SAR and SOCC. Mitigation measures are based on applicable legislation, standards, guidelines, best practices, and experience.

Through AML's consultation process, NLDEC Wildlife Division identified uncertainties about the extent to which SAR, and more specifically Lindley's aster, might be affected by the Quarry Extension. To address the concerns of Wildlife Division, the footprint has been reduced and modified to avoid removal of topsoil / overburden, drilling, blasting, and excavation in areas of high potential for rare plants, where practicable. The Quarry Extension footprint has been reduced from approximately 761 ha (license area) to 140 ha (quarry footprint), now avoids a large proportion of the area identified by Wildlife Division as posing the greatest concern for SAR and areas identified as having the highest rare plant density (e.g., incised, sheltered valleys, gullies, and ravines associated with fault zones intersecting the PDA and LAA). The reduced Quarry Extension footprint results in an expected reduction of Lindley's aster relocations based on previous surveys of the site. Alterations to the final Quarry Extension footprint will avoid, to the extent practicable, key habitats for SAR and SOCC identified within the LAA, thereby reducing the effects to Rare Plants.

Final siting of ancillary infrastructure, including buildings, drainage infrastructure, fuel storage, and sewage treatment units, will avoid locations of SAR and SOCC, where practicable and feasible. A pre-construction rare plant survey within the final Quarry Extension footprint will be conducted when design details are available. Should a new SAR or SOCC be encountered

during the pre-construction survey, Wildlife Division will be consulted and the mitigation measures described below will be applied.

Should a new SAR or SOCC be encountered during construction or operation, the following actions will occur:

- The species will be protected from immediate harm by ceasing / modifying the construction activity
- Regulatory agencies will be advised of the discovery as it relates to SAR in particular

If warranted, further permitting may be required under the NLESA.

Proposed general measures that will be implemented to mitigate the environmental effects of the Quarry Extension on SAR and SOCC include:

- Adherence to all relevant federal, provincial and municipal regulations
- Compliance with all commitments made under the Permit to Engage in Economic Activity, including surveys, conducting monitoring work and regular reporting
- Development of a Rare Plant Mitigation Plan
- Identification of species specific mitigation measures (i.e., rare plant translocation program)
- Implementation of an EPP

Relevant and applicable federal and provincial guidance documents will be used throughout the Quarry Extension so that proper protocols are applied to manage and mitigate potential effects of the Quarry Extension on SAR and SOCC identified within the PDA.

AML will, prior to site preparation and in consultation with NLDEC Wildlife Division, confirm the distribution of rare plant species in the PDA. Where SAR and SOCC are located, AML will, following consultation with appropriate regulatory agencies, take action to mitigate the potential loss of SAR and SOCC, in particular the provincially listed Lindley's aster.

AML will prepare and submit a Rare Plant Mitigation Plan to NLDEC Wildlife Division, addressing SAR and SOCC species and/or their critical habitats affected by the Quarry Extension. In consultation with Wildlife Division, the Plan will be developed on the basis of estimates of SAR and/or SOCC lost, and the extent of their remaining habitat in the PDA, LSA and RAA, with the intent of monitoring and mitigating potential adverse effects to SAR and SOCC. The Plan will present general and species-specific mitigation and habitat restoration measures (where applicable) to be implemented, including: relevant commitments; new mitigation measures, if applicable, resulting from supplementary botanical surveys; criteria that describes the circumstances under which each measure will be applied; and measurable goals for evaluating mitigation success.

Examples of mitigation options for a SAR or SOCC that will be adversely affected by the Quarry Extension may include translocation, rare plant seedbank salvage / seed collection, and the re-establishment of suitable habitat.

Proposed site-specific measures that will be implemented to mitigate the environmental effects of the proposed Quarry Extension on SAR and SOCC during construction and operation are:

- Limit the construction footprint (i.e., the PDA) to the extent feasible and restrict construction activities to the PDA
- Avoid unnecessary vegetation clearing or disturbance and preserve existing habitat conditions wherever possible
- Scheduling construction in potentially sensitive rare plant habitats (e.g., wetlands, riparian areas) to occur during seasonally dry or frozen ground conditions (i.e., negligible risk of ground disturbance / compaction), if practicable and feasible
- Quarry Extension activities will be located outside those areas having been identified as containing plant SAR and SOCC, to the extent practicable. If a SAR or SOCC is confirmed to be located within the PDA, a rare plant specialist will be consulted to establish the process for salvage and translocation
- Limit and monitor access and manage human activity in the LAA through signage and rare plant awareness training
- Clear flagging of work avoidance zones to protect known SAR or SOCC and their habitats, where practicable
- Implement plans to minimize access routes to and at the site, where possible. Rehabilitate access routes no longer needed during construction and operations phases
- Installation of appropriate erosion and sediment controls prior to ground disturbance (e.g., silt fencing, vegetation cover, erosion control blankets, straw bales, check dams, siltation ponds, rock riprap)
- Implement dust control measures, including dust suppressants (e.g., water) at the quarry, and along the haul route (refer to Appendix A: Dust Control Plan)
- Retain the humus layer and vegetative root mat, where practicable
- To preserve the seed source, available topsoil will be stripped and stored separately (from the overburden), where practicable
- Restore temporarily disturbed areas to pre-construction conditions. Allow for natural regeneration when possible, and when not possible, use a native seed mix for revegetation
- Consider developing rare plant translocation trials for Lindley's aster in association with the RCP being developed for AML's existing quarry operations
- In the event of the discovery of an unknown occurrence, or where a potential occurrence has been identified, additional measures may be required (use of exclusion fencing at specific locations until verified by a rare plant specialist);
- The quarry will be progressively reclaimed throughout the operational life of the Quarry Extension (25 years)
- Discourage ATV access through signage, where possible

- Although planning for Rare Plant mitigation is both species- and site-specific, effort will be made to incorporate SAR and SOCC into the progressive reclamation process, where practicable. This may include a combination of the collection and sowing of rare plant seeds and/or transplant of rare vascular plant species to suitable habitats
- With respect to SOCC, their reintroduction or translocation may be considered, upon consultation with NLDEC Wildlife Division
- Use of seed mixtures free of non-native and invasive species weeds and use of native species (where available) during site remediation

Decommissioning

- A RCP will be developed in coordination with provincial regulators, and implemented, where practical, to limit potential effects of the Quarry Extension

All Phases

- Assign an on-site environmental coordinator to oversee implementation of proposed mitigation measures

In exceptional circumstances (i.e., surveys do not result in the identification of additional rare plant species populations in the RAA), rare plant translocation may be required if avoidance of listed species in the PDA is not feasible. Based on observations of historic populations of Lindley's aster from within the RAA (i.e., Table Mountain), the re-establishment of Lindley's aster through natural recovery in heavily disturbed habitats also exists as a viable alternative, where suitable habitat exists. Implementation of any rare plant translocation program will be developed in consultation with the NLDEC Wildlife Division, under the supervision of a rare plant botanist, and in accordance with the Permit to Engage in Economic Activity as per the NLESA and established protocols (e.g., Guidelines for Translocation of Plant Species at Risk (Maslovat 2009)).

In summary, AML will construct the Quarry Extension in accordance with applicable provincial and federal guidance documents, using accepted and proven best practices and procedures, where possible. Mitigation measures will be employed to reduce the potential environmental effects of Quarry Extension construction on SAR and SOCC within the PDA and LAA, wherever possible. This includes the use of appropriate measures to limit activities resulting in disturbance to ground vegetation, to the extent practical. Reclamation plans, developed by AML in coordination with regulators, will be implemented, where practical, to limit potential Quarry Extension effects.

Disturbance related to these activities will be localized (occurring primarily within the PDA). This area of loss or change is likely conservative, as no Quarry Extension activities are anticipated in the LAA. No lowlands (wetlands) exist within the PDA for the Quarry Extension and wetland plant communities in LAA and RAA are unlikely to be lost or changed.

Proposed mitigation measures have been shown to be effective for similar projects in Newfoundland and Labrador.

Residual Environmental Effect to Rare Plant Species Abundance and Distribution

During construction and operation, the Quarry Extension will result in the direct loss of rare plants, including SAR and SOCC within the PDA, due primarily to a loss or change in habitat. The extent of this loss will be limited to the footprint of the Quarry Extension (i.e., the PDA) and adjacent areas that may be indirectly influenced by extension activities (i.e., the LAA).

It is important to note that production levels are expected to remain the same with the extension of the existing Lower Cove Quarry.

Change in Rare Plant species abundance and distribution will be for the life of the Quarry Extension, and likely several years following reclamation activities, until the re-vegetated growth implemented for site reclamation has achieved the established success criteria.

With planned mitigation in place, residual adverse environmental effects on Rare Plants during construction and operation will be moderate in magnitude, as there will be an anticipated loss of SAR (i.e., Lindley's aster) and SOCC from the PDA. Adverse residual environmental effects are mostly localized to the PDA and in the habitats immediately surrounding it, with certain interactions (e.g., dust) extending out into the LAA. Most relevant environmental effects will be for the medium to long-term and will occur continuously during the construction and operations phases.

Owing to the nature of the Quarry Extension, restoration of the footprint upon decommissioning is unlikely to result in complete reversal of a number of the environmental effects associated with the Quarry Extension; however, the site will be re-vegetated using plant species native to the RAA, thereby partially restoring vegetation communities. With mitigation, the Quarry Extension environmental effects during the decommissioning phase are neutral to adverse in direction, low in magnitude, short- to medium-term in duration, site-specific, occur once, and are reversible.

Standard mitigation measures to protect rare plant species and/or their habitats from direct disturbance will be sufficient to effectively reduce or eliminate residual environmental effects. Additional pre-construction mitigation will be developed in consultation with regulatory agencies for those species of highest conservation concern (i.e., provincially listed Lindley's aster) where these species exist within the PDA. With application of the proposed rare plant management plan and special mitigations residual effects on rare plant species abundance and distribution predicted to arise as a result of the Quarry Extension will be further reduced.

Many of the identified rare plants noted have an affinity for the calcareous substrates and nutrient-poor conditions, which occur throughout the PDA and beyond; therefore, plant communities will remain available in the surrounding landscape.

7.3.4.3 Summary of Residual Environmental Effects

The residual environmental effects of the Quarry Extension on Rare Plants are summarized in Table 7.16.

Table 7.16 Summary of Residual Environmental Effects on Rare Plants

Residual Effect	Residual Environmental Effects Characterization							
	Quarry Extension Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Rare Plant Species Abundance and Distribution	C	A	M	PDA	LT	C	R	D
	O	A	M	PDA	LT	C	R	D
	D	P	L	LAA	ST-MT	S	R	D

KEY

See Table 7.13 for detailed definitions

Quarry Extension Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed
R: Resilient
NR: Not resilient

7.3.5 Determination of Significance

7.3.5.1 Change in Rare Plant Species Abundance and Distribution

The construction and operation phases of the Quarry Extension will result in both short-term and long-term disturbance to Rare Plants, including SAR and SOCC, within the PDA. A profile of species observations suggests that a majority of SAR and SOCC within the PDA are calciphiles, preferring limestone dominated substrates that were observed throughout the LAA and RAA, where they were considered abundant. A number of these species are also found in the adjacent transitional communities, albeit at decreased densities. As these transitional communities grade to upland forest, or alternatively wetland community types, there is an apparent decline in the abundance of SAR and SOCC.

A change in rare plant species abundance and distribution will result primarily from site preparation (clearing and grubbing), construction of on-site roads and buildings, excavation of the quarry (drilling and blasting), water management (construction of sump and water line), and other related construction activities. The Quarry Extension will not result in a change or decline in the distribution or abundance of species such that the likelihood of their long-term survival within the LAA is substantially reduced as a result.

Although rare plants, including SAR and SOCC, will be lost as a result of the Quarry Extension, adverse residual environmental effects will not be significant because:

- No SARA-listed SAR are present in the PDA, and potential effects to NLESA-listed SAR will occur primarily, but not entirely, within the PDA
- The extent of the loss will not adversely affect SAR and SOCC populations in the LAA and RAA (see Table 7.14), potentially suitable habitat exists throughout the RAA where there exists potential for previously unidentified species occurrences and the likelihood of long-term survival within Newfoundland and Labrador of any plant species will not be substantially reduced
- The mitigation measures identified above in conjunction with subsequent NLESA permitting requirements usually provide practical means to effectively manage or otherwise reduce the relevant effects
- Development of a rare plant mitigation plan that addresses the specific habitat requirements for at risk species prior to construction, and coupled with future extensions, in addition to the decommissioning of AML's existing quarries
- Mechanisms to evaluate monitoring results and provide for subsequent / additional mitigation or Quarry Extension modification (adaptive management) will be implemented, as necessary

The decommissioning phase of the Quarry Extension will result in negligible changes to rare plant abundance and distribution because there will be no new physical disturbance associated with that phase, and therefore, the adverse residual environmental effects to Rare Plants will not be significant.

In summary, with proposed mitigation, the adverse residual environmental effects on Rare Plants during all phases of the Quarry Extension are predicted to be not significant. The assessment takes into account the occupied habitat and known population areas of SAR and SOCC in proximity to the Quarry Extension. Of note, SAR and SOCC observed in the PDA were also recorded elsewhere in the LAA and RAA, and their viability in the RAA would not be threatened by Quarry Extension effects. This prediction is made with a high level of confidence.

7.3.6 Follow-up and Monitoring

Prior to Quarry Extension start-up, AML will consult and evaluate the need for monitoring to verify predicted environmental effects and to monitor the effectiveness of mitigation measures for SAR and SOCC, and associated habitat.

The following monitoring strategies may be considered:

- Monitoring of construction activities to confirm that vegetation is cleared only from designated areas
- Monitoring of Quarry Extension-related activities, particularly during construction and operation, to verify that mitigation has been implemented and is effective (i.e., SAR and/or SOCC are protected)
- Periodic monitoring of the known occurrences of SAR and/or SOCC in the LAA, where necessary
- Rehabilitation monitoring to assess whether Quarry Extension objectives (e.g., positive recovery) are being or have been achieved, or alternatively indications of rehabilitation failure

The success of rehabilitation will be monitored annually for the first three years after progressive reclamation or until re-vegetation is deemed successful.

AML is committed to the use of adaptive management strategies to support the success of its mitigation measures, and which will be incorporated into the Rare Plant Mitigation Plan. Elements of the Plan may vary somewhat depending on the species involved but will generally consist of:

- Surveys of the features and functions in the affected areas of habitat to better understand needs for creation of new habitat
- Reviewing information on best practices from other jurisdictions
- Monitoring and reporting on the success of practices and modifying mitigation approaches as necessary

7.4 Employment and Business

Employment and Business is selected as a VEC because the Quarry Extension will be a continued source of income for local residents and businesses.

7.4.1 Scope of Assessment

7.4.1.1 Regulatory and Policy Setting

The Quarry Extension is not a designated Project under CEAA, 2012; therefore, AML is not required to submit an EA to the Canadian Environmental Assessment Agency. Environmental

Assessment Registration application is required for the Quarry Extension under the NLDEC requirements.

7.4.1.2 The Influence of Consultation and Engagement on the Assessment

As outlined in Section 4 (Consultation and Issues Scoping), AML has consulted with local community leadership and provincial and federal governments. A list of issues to be addressed has been identified.

7.4.1.3 Potential Environmental Effects, Pathways and Measurable Parameters

Potential effects on Employment and Business associated with the Quarry Extension derive from changes in demand for labour and Quarry Extension expenditures on goods and services. Quarry Extension demands for labour and goods and services have the potential to result in both beneficial and adverse effects.

Beneficial effects may not be evenly distributed among populations, with some residents in a more advantageous position to receive economic benefits than others. Adverse effects are related to increased demand for skilled labour and changes in labour supply.

Potential environmental effects, effect pathways, and measurable parameter(s) and units of measurement are provided in Table 7.17.

Table 7.17 Potential Environmental Effects, Effects Pathways, and Measurable Parameters for Employment and Business

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Employment and Business	Quarry Extension-associated demand for labour (direct, indirect, and induced) and goods and services will create employment and business opportunities within the LAA and RAA and will generate revenue for area business.	• Direct employment • Quarry Extension expenditures on goods and services

7.4.1.4 Boundaries

Spatial Boundaries

PDA: The PDA is the immediate area within which Quarry Extension activities and features will occur, and within which direct physical disturbance associated with the Quarry Extension will occur. The PDA is the same for all VECs and is illustrated on Figure 6-1. It includes only those components applicable to the Quarry Extension and associated infrastructure. Total ground disturbance will be 160 ha.

LAA and RAA: The LAA and RAA encompass the communities that will potentially experience effects and cumulative effects related to Quarry Extension requirements for labour, goods, and services (see Figure 6-1). The LAA includes the PDA and the Port au Port Peninsula (Census Subdivision 4E, Lourdes, Cape St. George, and Port au Port West-Aguathuna-Felix Cove).

Temporal Boundaries

The temporal boundaries are the construction phase, the operation phase and the decommissioning phase.

7.4.1.5 Residual Environmental Effects Description Criteria

The descriptors used to characterize residual environmental effects on the Employment and Business are defined in Table 7.18.

Table 7.18 Characterization of Residual Environmental Effects on Employment and Business

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual environmental effect	**Positive**—an effect that moves measurable parameters in a direction beneficial to socio-economic conditions relative to baseline **Adverse**—an effect that moves measurable parameters in a direction detrimental to socio-economic conditions relative to baseline **Neutral**—no net change in measureable parameters for the socio-economic conditions relative to baseline
Magnitude	The amount of change in measurable parameters or the VEC relative to existing conditions	**Negligible**—no measurable change **Low**— but within the normal range of variability; cannot be distinguished from baseline conditions **Moderate**—measurable change but unlikely to pose a serious risk or benefit to the VEC or to represent a management challenge **High**—measurable change that is likely to pose a serious risk to the selected VEC and, if negative, represents a management challenge
Geographic Extent	The geographic area in which an environmental effect occurs	**PDA**—residual effects are restricted to the PDA **LAA**—residual effects extend into the LAA **RAA**—residual effects interact with those of other projects in the RAA
Frequency	Identifies when the residual effect occurs and how often during the Quarry Extension or in a specific phase	**Single event**—occurs once **Multiple irregular event**—occurs at no set schedule **Multiple regular event**—occurs at regular intervals **Continuous**— occurs continuously

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the measurable parameter or the VEC returns to its existing condition, or the environmental effect can no longer be measured or otherwise perceived	**Short-term**—residual effect restricted to the duration of the construction period or less **Medium-term**—residual effect extends through the construction period but less than the life of the Quarry Extension **Long-term**—residual effect extends beyond the life of the Quarry Extension
Reversibility	Pertains to whether a measurable parameter or the VEC can return to its existing condition after the Quarry Extension activity ceases	**Reversible**—the effect is likely to be reversed after activity completion and reclamation **Irreversible**—the effect is unlikely to be reversed
Socio-economic Context	Existing condition and trends in the area where environmental effects occur	**Low Socio-economic Resiliency**—Sparsely populated region with relatively few service centres **Medium Socio-economic Resiliency**—A mix of sparsely populated areas along with more populated, urban centres **High Socio-economic Resiliency**—Densely populated area with several urban centres

7.4.1.6 Significance Definition

The following definition is used to determine significance thresholds for residual adverse environmental effects on Employment and Business for this assessment:

- A significant residual environmental effect is one that is adverse, of high magnitude, is distinguishable from normal variability, and cannot be managed with current or anticipated programs, policies, or mitigation measures

The Quarry Extension will also benefit Employment and Business, these effects are also described and quantified, where possible, but their significance is not determined.

7.4.2 Existing Conditions for Employment and Business

The Port au Port Peninsula (Census Subdivision 4E, Lourdes, Cape St. George, and Port au Port West-Aguathuna-Felix Cove) is characterized by a declining population, high unemployment, and low participation rates relative to the rest of the Province. The region is characterized by small coastal communities, most of which are populated by fewer than 1,000 residents (Intervale Associates Inc. 2010).

The main employers in the area are AML and the local schools. Due to a lack of post-secondary education opportunities, a large majority of Port-au-Port's young adults are leaving the area. Those who do return often become part of the 'fly in / fly out' community, travelling back and

forth between the peninsula and other areas such as St. John's and Alberta for work (Strengthening Rural Canada, no date).

The population of the Port au Port Peninsula was 3, 901 in 2011, a 0.6 percent decrease from the 2006 population of 3,924. The trend towards a declining population is evident in both Census Subdivisions 4E and the town of Lourdes, which had declines of 5.8 and 3.3 percent, respectively, between 2006 and 2011. Cape St. George experienced a population increase of 6.3 percent, and Port au Port West-Aguathuna-Felix Cove experienced a 15.8 percent increase in the same time frame. Demographic and labour force characteristics for the Port au Port Peninsula, as compared to the Province as a whole is provided in Table 7.19 (Statistics Canada 2012, 2013).

Table 7.19 Demographic and Labour Force Characteristics in the LAA

Geography	Total Population 2011	Total Population 2006	Change in Population (%)	Labour Force	Participation Rate (%)	Employment Rate (%)	Unemployment Rate (%)
Port au Port Peninsula	3,901	3,924	-0.6	1,200	41.0	28.5	29.6
Newfoundland and Labrador	514,536	505,469	+1.7	255,890	59.4	50.7	14.6

Source: Statistics Canada 2012, 2013
Note: The Port au Port Peninsula includes Census Subdivision 4D, 4E, Lourdes, Cape St. George, and Port au Port West-Aguathuna-Felix Cove
Note: Due to data or confidentiality reasons, labour force data for Port au Port West-Aguathuna-Felix Cove has been suppressed and is unavailable to the public.
Note: Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Statistics Canada. Totals may not necessarily add up as a result of rounding.

In 2011, the labour force participation rate on the Port au Port Peninsula was 41 percent, substantially lower than the provincial participation rate of 59.4 percent (Statistics Canada 2012, 2013). Other labour force indicators were also considerably lower for the Port au Port Peninsula than the Province as a whole. The provincial employment and unemployment rates were 50.7 and 14.6 percent, respectively, compared with **28.5 and 29.6** percent on the Port au Port Peninsula (Statistics Canada 2012, 2013).

Public services, including educational services, health care, and social assistance, accounted for approximately 23 percent of employment on the Peninsula in 2011. However, primary industries continued to be an important component to the area economy, with approximately 22 percent of the labour force active in resource harvesting activities (fishing, hunting, and forestry), or natural resource extraction (oil and gas, mining, and quarrying). A breakdown of

each industry by its contribution to area employment is provided in Table 7.20 (Statistics Canada 2012, 2013).

Table 7.20 Total Labour Force Aged 15 Years and Over by Industry, Port au Port Peninsula, 2011

Industry	% of Active Labour Force*
Educational services	12.2
Health care and social assistance	10.5
Construction	9.2
Agriculture; forestry; fishing and hunting	14.0
Retail trade	4.4
Accommodation and food services	6.1
Public administration	5.7
Mining; quarrying; and oil and gas extraction	7.9
Transportation and warehousing	5.2
Manufacturing	7.0
Other services (except public administration)	4.4
Administrative and support; waste management and remediation services	3.9
Professional; scientific and technical services	1.7
Wholesale trade	0.9

Source: Statistics Canada 2012, 2013
Note: Due to data or confidentiality reasons, labour force data for Port au Port West-Aguathuna-Felix Cove has been suppressed and is unavailable to the public.
Note: Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Statistics Canada. Totals may not necessarily add up as a result of rounding.
Note: Active labour force is calculated as the total labour force, less unemployed individuals 15 years and older who have never worked for pay or in self-employment, or had not worked prior to January 1st, 2010, reported in the National Household Survey as "Industry-Not Applicable".

Educational attainment on the Port au Port Peninsula is low in comparison to the Province as a whole (Table 7.21). In 2011, 20.9 percent of the provincial population aged 25 to 64 years had attained a high school diploma or equivalent, while 18percent of the population had the same level of attainment on the Port au Port Peninsula. Additionally, 52percent of the population on the Peninsula had no certificate, diploma, or degree, compared with 20.3 percent provincially.

Within the Port au Port Peninsula and nearby Bay St. George, commercial fishing remains the economic base for many communities. Between 2000 and 2007, the number of active fishers remained relatively stable, ranging between 214 and 229 over the period (Intervale Associates Inc. 2010). Within western Newfoundland and southern Labrador, the Bay St. George / Port au

Port area was responsible for 25 percent of the total value for all fisheries, with a landed value of approximately $11.6 million (Intervale Associates Inc. 2010).

Oil and gas was discovered on the Port au Port Peninsula in 1995. There is currently one active Exploration License adjacent to the Peninsula (License 1070 – Shoal Point Energy Ltd) (Canada-Newfoundland and Labrador Offshore Petroleum Board 2015). There are currently no active onshore petroleum licences on the Port au Port Peninsula, although the area has been the focus of onshore exploration in the past.

Table 7.21 Total Population Aged 25 to 64 Years by Highest Certificate, Diploma or Degree, 2011

Level of Educational Attainment	Port au Port Peninsula	Newfoundland and Labrador
No certificate; diploma or degree	52.3%	20.3%
High school diploma or equivalent	18.1%	20.9%
Postsecondary certificate; diploma or degree	29.5%	58.7%
Apprenticeship or trades certificate or diploma	12.8%	15.1%
College; CEGEP or other non-university certificate or diploma	9.4%	24.0%
University certificate or diploma below bachelor level	1.9%	3.2%
University certificate; diploma or degree at bachelor level or above	4.9%	16.4%
Bachelor's degree	4.3%	10.7%
University certificate; diploma or degree above bachelor level	0.5%	5.7%

Source: Statistics Canada 2012, 2013
Note: Due to data or confidentiality reasons, education data for Port au Port West-Aguathuna-Felix Cove has been suppressed and is unavailable to the public.
Note: Numbers are rounded by Statistics Canada and are reported herein exactly as they are reported by Statistics Statistics Canada. Totals may not necessarily add up as a result of rounding.

7.4.3 Quarry Extension Interactions with Employment and Business

The Quarry Extension physical activities that might interact with the VEC to result in the identified environmental effect are identified in Table 7.22. These interactions are indicated by check marks, and are discussed in detail in below in the context of effects pathways, standard and Quarry Extension-specific mitigation / enhancement, and residual environmental effects. A justification is also provided for non-interactions (no check marks).

Table 7.22 Potential Quarry Extension-Environment Interactions and Effects on Employment and Business

Quarry Extension Components and Physical Activities	Potential Environmental Effects	
	Change in Employment	Change in Business
Construction		
Clearing and grubbing	–	–
Construction of on-site road	–	–
Excavation of quarry	–	–
Construction of Site Buildings and Associated Infrastructure	–	–
Water management (construction of sump and water line)	–	–
Wastes and emissions	–	–
Employment	✓	✓
Expenditures	✓	✓
Operation		
Drilling and blasting	–	–
On-site haulage	–	–
Crushing and screening	–	–
Water management	–	–
Wastes and emissions	–	–
Employment	✓	✓
Expenditures	✓	✓
Decommissioning		
Re-contouring	–	–
Re-vegetation	–	–
Wastes and emissions	–	–
Employment	✓	✓
Expenditures	✓	✓

NOTES:
✓ = Potential interactions that might cause an effect.
– = Interactions between the Quarry Extension and the VEC are not expected.

While all of the Quarry Extension activities for each extension phase will have labour requirements that could affect Employment and Business, it is not possible to isolate the effects of individual activities and so these effects are addressed cumulatively as part of employment and expenditures activities.

The Quarry Extension has the potential to result in effects on Employment and Business through the expenditures on supplies and services and the employment that are involved in all of the Quarry Extension activities and works. The direct, indirect, and induced effects of Quarry Extension expenditures and employment, together with proponent and other Quarry Extension related taxes and royalties, will also contribute to the local economy. These effects are addressed further in the following sections.

During Quarry Extension decommissioning, the scale of employment will be smaller and of shorter duration than construction and operation; therefore, further assessment for this phase is not considered necessary.

7.4.4 Assessment of Residual Environmental Effects on Employment and Business

7.4.4.1 Analytical Assessment Techniques

The assessment of economic conditions considers both positive and adverse effects; however, as stated in Section 7.4.1, significance is determined only for the adverse residual environmental effects of the Quarry Extension. Because the Quarry Extension will also beneficially affect employment and business, these beneficial effects are also described and quantified, where possible.

Quarry Extension-related effects on Employment and Business during construction and operation phases are determined using estimated requirements for Quarry Extension labour by skill category and goods and services.

7.4.4.2 Assessment of Employment and Business

Pathways for Employment and Business

The demand for labour (direct, indirect, and induced) and goods and services as a result of the Quarry Expansion will create employment and business opportunities within the LAA and RAA and will generate revenue for governments. AML has been providing employment to residents of the Port au Port Peninsula for more than 20 years. Upon initiation of the Quarry Extension, work will be undertaken by the existing AML workforce, with some additional contract workers hired during the construction phase. Future labour requirements will be for replacement workers as a result of retirements and other regular turnover. The Quarry Extension will allow continued employment for an additional 25 years. Without the Quarry Extension, there will be no viable quarrying operation past 2020 and hence, there would be a loss of the local and regional employment and business that has been present in the region since the quarry started operations more than 20 years ago.

As of July 2015, the quarry directly employed approximately 150 workers, making it the largest private employer on the Port au Port Peninsula. This direct employment generates substantial but

undocumented amounts of indirect and induced employment, as company expenditures percolate through the economy of the Port au Port and Bay St. George area. As such, the quarry makes a major contribution to the economy of an area that has generally high unemployment rates and is experiencing population decline and out-migration.

Currently, women comprise 3.3 percent of the AML workforce and nearly 43 percent of recent AML employee survey respondents self-identify as Qalipu. As part of its commitment to gender equity and diversity, AML encourages equal opportunity in hiring and provides a supportive workplace for members of these groups. This document fulfills the provincial government's requirement for AML to provide a gender equity and diversity plan for its undertaking.

The AML operation also purchases a wide range of supplies and services from companies on the Peninsula and in the Stephenville and Corner Brook areas. These benefits to the local economy would also be lost, as of 2020, without the Quarry Extension. The main Quarry Extension-specific activities and contracts will be for goods and services required during the construction phase. These are:

- Access road construction
- Tree cutting
- Overburden removal
- Drilling and blasting
- Provision of fuel
- Purchase of pumps for dewatering
- Purchase of pipe for dewatering
- Engineering and environmental services
- Accommodations and catering
- Repair and maintenance parts and services

Most of these construction requirements, and all of those for the operation phase, are consistent with ongoing needs and will very likely be met by companies that are already contractors of AML. Most of these companies are located in western Newfoundland.

Quarry Extension expenditures on goods and services during construction and operation could generate positive economic effects through contracts with local companies in the LAA and RAA. The Quarry Extension will also contribute to government revenue through increased tax revenue.

Mitigation and Management for Employment and Business

Quarry Extension effects on Employment and Business are anticipated to be largely beneficial because employment and business opportunities will be created within the LAA and RAA during all Quarry Extension phases; this in conjunction with taxes paid to government. Where the Quarry Extension competes for skilled labour and goods and services potential exists for increased labour costs and price inflation. Since anticipated Quarry Extension demands for labour and

goods and services are small and short-term, the magnitude of potential adverse environmental effects on labour costs and price inflation are anticipated to be low. Mitigation and management measures, therefore, work to enhance beneficial effects of the Quarry Extension.

AML commits to the following mitigation and management measures related to Employment and Business:

- Develop and implement a strategy to encourage local content in staffing and spending. The strategy will inform local residents, and businesses of job and procurement opportunities and will encourage a hire-local first approach

Residual Environmental Effect for Employment and Business

Due to the relatively small number of new jobs created during construction and regional expenditures on goods and services, along with the low rate of employment in the LAA and RAA, the Quarry Extension is not anticipated to result in labour shortages or affect the supply of goods and services such that wage or price inflation occurs. Residual environmental effects on Employment and Business during Quarry Extension construction are expected to be positive in direction, moderate in magnitude, to extend throughout the LAA and RAA, to be short-term in duration occurring continuously within low socio-economic resiliency, and to be reversible following Quarry Extension decommissioning.

Although Quarry Extension operations are not anticipated to require any additional employment and expenditures beyond AML's current levels, it will extend the life of the current workforce by 25 years. Residual environmental effects during this phase are expected to be positive in direction, low in magnitude, to extend throughout the LAA and RAA, to be long-term in duration occurring continuously within low socio-economic resiliency, and to be reversible following Quarry Extension decommissioning.

The residual environmental effects of the Quarry Extension on the Employment and Business are summarized in Table 7.23.

Table 7.23 Summary of Residual Environmental Effects on Employment and Business

Residual Effect	Residual Environmental Effects Characterization							
	Quarry Extension Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Socio-economic Context
Change in Employment and Business	C	P	M	LAA/RAA	ST	C	R	L
	O	P	M	LAA/RAA	LT	C	R	L
	D	P	L	LAA/RAA	ST	C	R	L

KEY

See Table 7.18 for detailed definitions

Quarry Extension Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term;
MT: Medium-term
LT: Long-term
P: Permanent

NA: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Socio-Economic Context:
L: Low Socio-economic Resiliency
M: Medium Socio-economic Resiliency
H: High Socio-economic Resiliency

7.4.5 Determination of Significance

7.4.5.1 Change in Employment and Business

Quarry Extension residual environmental effects on Employment and Business are largely anticipated to be beneficial, creating and maintaining employment and business opportunities within the LAA and RAA for 25 years. Residual adverse environmental effects on Employment and Business are anticipated to be not significant.

7.4.6 Follow-up and Monitoring

Follow-up and monitoring programs are not required.

8.0 CUMULATIVE ENVIRONMENTAL EFFECTS

8.1 Context for Cumulative Environmental Effects

The existing Lower Cove quarry operation is the primary resource development activity on the Peninsula, and is the largest private employer in Port Au Port. The Port au Port Peninsula has limited resource development, including mineral exploration, quarries, and a petroleum well north of Cape St. George at Garden Hill (Section 6.6).

8.2 Assessment of Cumulative Environmental Effects

While mineral exploration, quarrying operations, and the Garden Hill petroleum well are likely to continue on the Port au Port Peninsula, the residual effects of the projects are not likely to result in significant cumulative environmental effects to Atmospheric Environment, Groundwater Resources, or Rare Plants because:

- The environmental effects will not overlap spatially with environmental effects of the Quarry Extension (for the Garden Hills petroleum well and other quarries)
- Mitigation measures by AML and other project proponents will be implemented for all projects
- Current regulatory requirements will be applied to all projects

The existing AML quarries will be rehabilitated and, with the exception of ground disturbance, will therefore not interact with the proposed Quarry Extension. Given the mitigation proposed by AML and the nature of the effect (i.e., physical disturbance is the primary interaction), significant cumulative environmental effects to groundwater are not expected. Mitigation measures, including progressive rehabilitation of the existing quarries with associated translocation of identified SAR (i.e., Lindley's aster), are also proposed for those Quarry Extension activities that may result in adverse environmental effects to Rare Plants, including SAR and SOCC. Given the mitigation proposed by AML, and the occurrence and distribution of native rare plant populations throughout the RAA, significant cumulative environmental effects to Rare Plants are not likely.

Effects of other projects and activities on Atmospheric Environment are not likely to overlap with effects of the Quarry Extension, and therefore cumulative environmental effects on Atmospheric Environment are not expected. Effects of other projects and activities may overlap with Quarry Extension effects to Economy and Business, which will be positive.

For the reasons listed above, along with the limited spatial scale of Quarry Extension activities, it is not likely that Quarry Extension activities will have significant adverse cumulative environmental effects on any of the VECs.

9.0 ACCIDENTS AND MALFUNCTIONS

Possible accidental events and malfunctions include vehicle collisions, spills and leaks, fires, and failure of sedimentation ponds or erosion control measures.

Vehicle collisions involving mine equipment or haulage trucks may result in the release of fuel and hazardous materials. Failure of the storage and handling systems for diesel and hazardous materials would result in the release of petroleum-related products and hazardous materials into the environment. A fire may result in the destruction of vegetation and natural features surrounding the PDA, and the release of smoke, combustion gases, and ash into the atmospheric environment.

Extreme weather events, depending on their severity, could result in the failure of sedimentation ponds or erosion control measures. However, the likelihood of a settling pond overflowing is low, as settling basins are being designed to contain run-off associated with extreme precipitation events (1-in-25-year storm event). In the unlikely event of an overflow, water containing unsettled particulate matter (elevated levels of total suspended solids) would be released into the receiving environment.

An EPP is being developed to address potential environmental concerns associated with routine daily activities on-site, as well as provide direction and guidance for the management of accidental events. The implementation of best management practices (e.g., preventative maintenance, material handling procedures) will help reduce the likelihood of accidents and malfunctions, and procedures outlined in the EPP (contingency plan) will reduce the magnitude and geographic extent of adverse effects.

9.1 Atmospheric Environment

Although unlikely, Quarry Extension activities involving the use of heat or flame could result in a fire, which could lead to air emissions and affect air quality. The extent and duration of a fire would be dependent on response efforts and meteorological conditions. AML or the contractor will take the precautions necessary to prevent fire when working at the site. Environmental protection procedures in the event of a fire will be outlined in the EPP and include making the proper firefighting equipment available on-site and training personnel to use such equipment.

If a hydrocarbon fuel spill was to occur within the PDA, releases of volatiles to the atmosphere and increased noise levels as a result of the operation of clean-up equipment could occur. The EPP will outline procedures for dealing with a fuel or hazardous material spill. A contingency plan is also available to address hydrocarbon and hazardous materials spills on water, land, and ice. Reasonable attempts will be made to stop the leakage and contain the flow of the material. Spill response equipment is available on-site and staff are trained on procedures to follow in the event of a spill. Containment and clean-up procedures will:

- Reduce danger to workers and public;
- Protect water supplies;
- Reduce pollution of watercourses;
- Reduce the area affected by the spill; and,
- Reduce the degree of disturbance to the area and watercourses during clean-up.

Changes to acoustics would be low to moderate in magnitude, local in extent, short-term in duration and will cease at the conclusion of the fire suppression response. Depending on the extent and duration of a fire, and depending on weather conditions and time of year, changes to air quality could range in magnitude (low to high) and extent (beyond the LAA), for a short-term basis. Therefore, an accident or malfunction will not result in significant environmental effects to Atmospheric Environment.

9.2 Groundwater Resources

Groundwater quality may be adversely affected by failure at the fueling station and the consequent release of petroleum hydrocarbons. A major fuel spill could result in the movement of free petroleum hydrocarbon product into the subsurface, thereby affecting the quality of the underlying groundwater. An accidental event will not interact with groundwater quantity.

The EPP and contingency plan will outline procedures for dealing with a fuel or hazardous material spill. Reasonable attempts will be made to stop the leakage and contain the flow of the material. Spill response equipment is available on-site and staff are trained on procedures to follow in the event of a spill.

The environmental effects of accidental events on groundwater quality are predicted to be adverse, but localized. Substantial fuel spills are unlikely to occur, and with appropriate mitigation, the magnitude of the environmental effects is likely to be low to moderate. There are no other groundwater users that would be affected in the event of a hydrocarbon or hazardous material spill. Therefore, an accidental release of hydrocarbon or hazardous materials will not result in significant environmental effects to Groundwater Resources.

9.3 Rare Plants

A fuel spill could affect rare plants and their habitat inside and outside the PDA, depending on the location and extent of the spill. Similarly, failure of sedimentation ponds or erosion control measures could result in the movement of solids-bearing water into rare plant habitat outside the PDA. A forest fire could alter habitat, consume vegetation, and lead to direct mortality of rare plants, depending on its extent.

The EPP and contingency plan will outline procedures for dealing with a fuel or hazardous material spill. Reasonable attempts will be made to stop the leakage and contain the flow of the material. Spill response equipment is available on-site and staff are trained on procedures to

follow in the event of a spill. Firefighting equipment is available on-site and staff are trained to prevent and control fires. The likelihood of a settling pond overflow is low and a contingency plan is being developed to deal with such an event.

The environmental effects of accidental events on Rare Plants are predicted to be adverse, but temporary. With appropriate mitigation, the magnitude of the environmental effects is likely to be low; under a potentially worst case scenario, the magnitude could be moderate. Reversibility of the environmental effects will depend on the specific habitat involved, the proportion of habitat affected, and the potential for the habitat to be used by Rare Plant species. Population-level effects are not anticipated, and therefore accidental events are not likely to result in significant environmental effects to Rare Plants.

9.4 Employment and Business

Accidental events would have limited effects on Employment and Business, in that they are not likely to have effects on the measureable parameters (e.g., employment, GDP, business contracts, and government revenues). To the extent that an accidental event could lead to short-term disruption of Quarry Extension activities, there could also be a short-term disruption in positive economic benefits from the Quarry Extension, but this would not cause an adverse economic effect (i.e., there would not be a reduction in the measureable parameters compared to baseline economic conditions).

Accidental events, such as a forest fire, could disrupt the Quarry Extension and other economic activity in the RAA. However, any necessary repair, reclamation, and restoration work could result in some additional expenditure and employment, resulting in short-term or medium-term positive effects on Employment and Business.

Quarry Extension-related accidents and malfunctions are unlikely, as AML has mitigation measures in place to reduce their likelihood. Quarry Extension personnel will also be trained to prevent and manage potential accidental events. However, should an accidental event occur, AML's response measures will address any adverse effects of such events on Employment and Business. Accidental events are not likely to result in significant effects to Employment and Business.

10.0 FUNDING

No government funding has been provided to AML. The cost of the Quarry Extension will be funded privately by AML.

11.0 QUARRY EXTENSION RELATED DOCUMENTS

The following documents will accompany this submission as appendices:

- Dust Control Plan (Appendix A)
- 2015 Rare Plant Survey and Habitat Characterization Report, Atlantic Minerals Limited Lower Cove Quarry Extension (Appendix B)
- 1992 Certificate of Approval C.A. #AA92-023996, issued to previous owners (Appendix C)
- Environmental Assessment Registration for a quarry, submitted in 1999, File #208.12.008 (Appendix D)
- Fish and Fish Habitat Study of Goose Pond adjacent to AML quarry (JWEL 1997) (Appendix E)
- Permanent Water Use License #97-12-4802 (Appendix F)
- Environmental Protection Plan Table of Contents (Appendix G)
- Initial Blast Monitoring (Appendix H)
- 2014 Certificate of Approval C.A. #AA14-035590 for existing operations (Appendix I)
- Stormwater Management Design Brief (Appendix J)

12.0 CONCLUSION

AML is proposing to extend existing quarrying activities into the White Hills area over a 25-year duration, based on an annual total production rate of approximately three million tonnes. AML is committed to the protection of the environment, providing employment to residents of local communities, and working with neighbours in a respectful environment to address as many concerns as possible.

Without the Quarry Extension, there will likely be no quarrying operation past 2020 and hence, there would be a loss of the local and regional employment (approximately 150 workers) and business that has been present in the region since the quarry started operations more than 20 years ago.

To support corporate commitments, AML has undertaken a number of environmental initiatives:

- Development of Environmental Protection Plan (including an updated Contingency Plan)
- Avifauna management
- Wildlife protection measures
- Rare plant surveys
- Dust control
- Blast monitoring
- Stormwater management design
- Potable and process site water supply and treatment design
- Water well condition survey
- Water quality compliance monitoring
- Update of Reclamation and Closure Plan
- Education of staff

AML has also engaged community leaders and government agencies, providing an overview of the proposed Quarry Extension and identifying concerns and associated mitigation measures. Issues and concerns have been addressed through the environmental effects analyses. **With the application of mitigation measures, the Quarry Extension is not likely to result in significant adverse environmental effects.**

13.0 SIGNATURE

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President

May 4, 2016
Date

Jamie Goosney, P. Eng.
General Manager, Quarry Operations

MAY 4, 2016
Date

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