Environmental Assessment Registration Document

Name of Project:
Birrette’s East Uniacke Quarry Expansion Project
Location: East Uniacke, Hants County, Nova Scotia
Proponent: Bio Design Earth Products Inc.
   6 Belmont Avenue
   Eastern Passage, Nova Scotia, Canada
   PO Box 89

Report Prepared by:

McCallum Environmental Ltd.

2 Bluewater Road, Suite 115
Bedford, Nova Scotia
B4B 1G7

Date: March 2019
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EXECUTIVE SUMMARY

Bio Design Earth Products Inc. (BDEP) currently owns and operates Birrette’s East Uniacke Quarry, operating under a Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2014-089114). BDEP plans to expand the existing Birrette’s East Uniacke Quarry, which requires a Provincial Environmental Assessment (EA) registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

The current quarry footprint exists within a portion of a property (PID 45405388), owned by BDEP and located 4 km northeast of the community of East Uniacke, Nova Scotia. The current IA encompasses quarry operations within this property. The proposed expansion of the quarry will occur within the same property. Expansion of the quarry will take place within the Development Area over 25-year time period. This Project encompasses a total proposed Development Area of 30.2 ha. A broader 41 ha Study Area was identified for the purposes of the provincial EA process.

Presently, there are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.

Baseline evaluations were completed for each Valued Environmental Component (VEC) over the course of a four-season survey period. The VECs used in the Projects EA include:

- Noise levels;
- Air quality;
- Surficial and bedrock geology;
- Groundwater;
- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat, flora, and lichens;
- Fauna (herpetofauna and mammals);
- Avifauna;
- Species of Conservation Interest (SOCl) and Species at Risk (SAR);
- Socioeconomic conditions;
- Archaeological and heritage resources; and
- Mi’kmaq.

In regard to the atmospheric environment (noise levels and air quality) and as per the current IA for the existing quarry, BDEP monitors all blasts for concussion (air blast) and ground vibration to ensure that the designated limits are not exceeded. To date, no blasts have exceeded concussion (128 dBL) or ground vibration (12.5 mm/s) levels at the nearest off-site structure. NSE has not requested BDEP monitor dust at
the site property boundaries and no issues or complaints related to quarry generated dust have been received by the Proponent to date.

The surficial geology of the Study Area consists of two types of surficial geologic units: Silty Druml (Drumlin Facies) and Silty Till Plain (Ground Moraine), and Drumlins. The Study Area overlies bedrock formations from the Goldenville Group. Acid Rock Drainage (ARD) testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations.

In relation to potential effects to groundwater, a desktop review for wells was conducted. No wells were recorded within the Study Area by the NS Well Logs Database nor were any observed within the Study Area during field studies. In order to determine a more precise location for adjacent residential wells, the Nova Scotia Topographic Database was reviewed to identify buildings within 1 km of the Study Area accompanied by an aerial review. In total two residential receptors (with assumed wells) were identified approximately 930 m north and 1,000 m west of the Study Area, respectively.

Surface water on site is currently directed to a series of settling ponds present in the eastern extent of the Study Area via rock lined ditches. Water passively drains from the settling ponds via a culvert to the east, beyond the Study Area boundary, into ditches adjacent to the gravel access road. Water proceeds to drain northward within the roadside ditch prior to discharging into a previously identified treed swamp. Based on desktop analysis, water drains from this location southward into lower reaches of a field identified watercourse (WC2), prior to connecting to O’Hearn Flowage (~630m east). As quarry expansion progresses, surface water will continue to be directed east and the capacity of settling ponds will increase as per engineered specifications and NSE IA requirements.

Two watercourses (WC1 and WC4) are present within the Study Area. Two additional watercourses (WC2 and WC3) were identified outside of the Study Area. These watercourses encompass the downstream receiving water from the Study Area and were assessed within the Fish Habitat Assessment Area.

- WC1 initiates in WL4 and flows south via a culvert into WL7 where it eventually dissipates. There is only a potential connection to downstream fish resources (through WL7) during periods when the wetland is flooded (i.e. periods of seasonal high flow).
- WC2 exists as an outflow from the eastern extent of WL7. WC2 flows through several unmapped wetlands where the channel becomes less defined, however, it is presumed that during high flow, fish passage could be possible. WC2 eventually discharges into O’Hearn Flowage.
- WC3 is a mapped watercourse that exists as an outflow from the western extent of WL7. WC3 commences as a subterranean channel and flows south and eventually east where it empties into O’Hearn Flowage. Fish access is expected within WC3 (to the point of subterranean flow).
- WC4 initiates in WL16 and flows west into WL18 where it dissipates. There is a lack of continuous surface water flow in WC4 to support resident fish populations, fish access, and there is no direct connectivity to a downstream fish resource.
Electrofishing in WC2 and WC3 found no fish and no fish were observed incidentally during any field surveys, however, fish are known to be present within the O’Hearn system. Herbert River, downstream of O’Hearn Brook is a known Atlantic Salmon – Inner Bay of Fundy Population (*Salmo Salar pop 1; S1*) river.

Nineteen wetlands were identified across the Study Area of which 14 are located within the Development Area (i.e. proposed to be directly altered throughout the lifetime of the proposed quarry expansion). Of the 19 wetlands, the majority (13) exist as isolated features; three are located in a headwater (outflow) position with a drainage outlet (WLs 4 and 17) or a watercourse outlet (WL16); and three exist in a throughflow position (WL1, WL7, and WL18). Treed/Shrub Swamps (11) and Treed/Shrub Bogs (7) are the dominant wetland types on the landscape within the Study Area. WL7 was identified as a Softwood Treed Shrub Fen. All wetlands were in a terrane landscape position, and most of them were identified in basin landforms, except WL17 which was a flat terrace, and WL18 which is sloped.

A total of 117 flora species were identified within the Study Area. One SOCI was observed, Southern Twayblade (*Listera australis, S3*). Thirty lichen species were observed in the Study Area. Two species were determined to be SOCI species which include Appressed Jellyskin Lichen (*Leptogium subtile; S3*) and Pompom-tipped Shadow Lichen (*Phaeophyscia pusilloides; S3*).

Wildlife surveys found signs of Eastern Coyote (*Canis latrans*), North American Porcupine (*Erethizon dorsatum*), Snowshoe Hare (*Lepus americanus*), Short-tailed Weasel (*Mustela ermina*), White Tailed Deer (*Odocoileus virginianus*), American Red Squirrel (*Tamiasciurus hudsonicus*), and White-footed Deer Mouse (*Peromyscus leucopus*). No SAR/SOCI fauna (e.g. Mainland Moose, Wood Turtle, or Snapping Turtle) were observed on within the Study Area, however, during public consultation several residences in the vicinity of the Study Area (~ 1 km) informed MEL staff that they have regularly observed Snapping Turtles (*Chelydra serpintina*).

Bird surveys completed during spring, breeding and fall identified 43 species of birds and activity levels across all seasons studied indicated a healthy population of birds utilizing on-site habitat. Across all survey seasons, a total of four Priority Species (all Species of Conservation Interest [SOCI]) were observed either during dedicated survey periods or incidentally (*Pine Siskin [Cardelius pinus; S2S3], Red-breasted Nuthatch [Sitta canadensis; S3], Ruby-crowned Kinglet [Regulus calendula; S3S4B], and Yellow-bellied Flycatcher [Empidonax flaviventris; S3S4B]). No Species at Risk (SAR) birds were identified.

In regard to socioeconomic conditions, the Development Area is situated away from residential receptors and the land within the Study Area is owned by BDEP. No residual effects to human health are anticipated due of the distance of the Project to residual receptors as well as mitigations and best management practices regarding the hauling of aggregate (e.g. enforcing speed limits, posting signage etc.). The Project will allow for continued employment at the quarry as well as in related industries where
the aggregate material is used (e.g. construction, hauling). Employment and financial gain is expected to occur in the rural communities near the Project and in turn will strengthen the local economy.

No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin. No concerns were received by Mi'kmaq, however the KMKNO recommended further evaluating the landscape for evidence of potential historical Mi'kmaq uses of the land through implementation of a shovel testing program. The Proponent will consider this in the future as and when the quarry expands into undisturbed portions of the Study Area.

Based on the potential for an adverse residual environmental effect the following eight VECs were carried forward to the detailed effects assessment:

- Groundwater;
- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat and vegetation;
- Fauna;
- Birds; and
- SOCI/SAR.

To date, the Birrette’s East Uniacke Quarry has not been observed to interact with the groundwater table (no observed seepages through the exposed rock face of build up of water on the quarry floor) and the intention is to remain above groundwater throughout the expansion process. Implementation of a groundwater monitoring plan in line with NSE requirements will support the determination of where groundwater exists. Quarry expansion will remain beyond 800 m from local residents and to date, there have been no reports of negative effect to residential properties surrounding the existing quarry, however, potential effects as a result of quarrying activity (including blasting) on groundwater, water quantity and water quality are possible. Mitigation including blast monitoring, a water well replacement policy for wells proven to be damaged by quarry activities, and commitments to monitor water quality will be implemented. Based on the distances from surrounding residences, residual environmental effects are expected to not be significant.

Surface water quantity is expected to be affected by the proposed activity as a result of loss of natural catchment areas. A Hydrological Effects Analysis was completed as part of the EA process to determine impacts to the natural flow of surface water from land within the Study Area to downstream aquatic systems. The modeling concluded that that stream flow losses are expected within four watercourses adjacent the Study Area (WC2, WC3, Unnamed Tributary A, and O’Hearn Flowage). However, none of the losses cause a reduction of Ecological Maintenance Flow and as such, flow regimes and water levels will be maintained to sustain ecological functions for fisheries and its habitat. Potential for Acid Rock
Drainage is low as determined from rock sample testing results and mitigation and monitoring is expected to prevent impacts to water quality from sedimentation. Based on the analysis completed and proposed mitigation, residual environmental effects are expected to be not significant.

The two watercourses (WC1 and WC4) identified within the proposed Development Area will be directly impacted by future quarry development. WC1 provides poor fish habitat (and only accessible to fish if the downstream WL7 is flooded), and WC4 does not provide access to fish. As described above, water quantity is predicted to be reduced in four watercourses adjacent the Study Area (WC2 and WC3 provide rearing and foraging habitat), however, Ecological Maintenance Flow will be maintained and as such, serious harm to fish and fish habitat is not expected. Therefore, residual environmental effects to fish and fish habitat post mitigation are expected to be not significant.

Nineteen wetlands were identified across the Study Area of which 14 are proposed to be directly altered throughout the lifetime of the proposed quarry expansion. The majority of the wetlands (n=10) being directly impacted exist as isolated swamps. Wetland alteration permits (and associated wetland compensation) will be obtained for wetlands which require alteration, and unaltered adjacent wetlands will be monitored as per NSE requirements. The extent of wetland alteration as a result of the quarry expansion is small scale at the watershed level and as such, residual environmental effects post mitigation are expected to be not significant.

Habitat, flora, and lichens across the Study Area are common to the regional area and province of Nova Scotia consisting of an intermix between cut blocks and forested land. Wildlife survey results and bird surveys indicate a common assemblage of fauna and birds utilize the Study Area. No SAR flora, lichens, fauna or birds were identified within the Study Area. Based on the degree of disturbance currently within the Study Area, the lack of core habitat within the Study Area, the availability of suitable habitat adjacent the Study Area, and the best management practices that will be implemented as part of the Project Environmental Protection Plan; no significant residual environmental effects are expected for these VECs.

Species at Risk inventories within the Project Study Area revealed that no flora or fauna SAR are present across the Study Area. One flora SOCI, (Southern Twayblade; S3) and two SOCI lichens (Leptogium subtile; S3 and Phaeophyscia pusilloides; S3?) were identified within the Study Area. As described previously, four SOCI birds were also identified. There will be a direct loss of these SOCI lichen and flora species as a result of the Project. Due to the lack of SAR presence, as well as the critical habitat required to support SAR, residual environmental effects are expected to be not significant.

The field data, regulatory consultation, and subsequent conclusions of this assessment indicate that there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response. Residual environmental effects have been determined to be not significant for all identified VECs.
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<td>AMO</td>
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<tr>
<td>NSDNR</td>
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</tr>
<tr>
<td>NSESA</td>
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</tr>
<tr>
<td>NSTB</td>
<td>Nova Scotia Topographic Database</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>O₃</td>
<td>Ozone</td>
</tr>
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<td>Office of Aboriginal Affairs</td>
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<td>PID</td>
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<td>SRank</td>
<td>Status rank</td>
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<td>TSS</td>
<td>Total Suspended Solids</td>
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<td>Universal Transform Mercator</td>
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<td>Valued Environmental Components</td>
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<td>Vegetation Type</td>
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<td>Wetland Ecosystem Services Protocol</td>
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<tr>
<td>WC</td>
<td>Watercourse</td>
</tr>
<tr>
<td>WL</td>
<td>Wetland</td>
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</table>
1 GENERAL INFORMATION

The Project summary is provided below.

Table 1 Project Summary

<table>
<thead>
<tr>
<th>General Project Information</th>
<th>Bio Design Earth Products Inc. (Company # 3230836) intends to expand the existing Birrette’s East Uniacke Quarry (NSE Approval #2014-089114), currently located on Property Identification Number (PID) 45405388.</th>
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</thead>
<tbody>
<tr>
<td>Project Name</td>
<td>Birrette’s East Uniacke Quarry Expansion Project (the &quot;Project&quot;)</td>
</tr>
<tr>
<td>Proponent Name</td>
<td>Bio Design Earth Products Inc. (&quot;BDEP&quot;)</td>
</tr>
</tbody>
</table>
| Proponent Contact Information | 6 Belmont Avenue  
Eastern Passage, Nova Scotia, Canada  
PO Box 89  
Business: (902) 404-8547  
Facsimile: (902) 405-0901 |
| Proponent Project Directors | Brad Hickey  
President  
Bio Design Earth Products Inc.  
Date |
| Project Location           | • The Study Area is located within the boundaries of PID 45405388  
• The Study Area is located approximately 4 km northeast of the community of East Uniacke, Hants County, Nova Scotia.  
• The Study Area is located entirely within Hants County, Nova Scotia.  
• The approximate centre of the Study Area is located at 440974 m E and 4976694 m N. |
<p>| Landowner(s)               | The Study Area is located on freehold (private) land owned by Bio Design Earth Products Inc.                                                                                                             |
| Closest distance from the quarry to a residence | The closest residence is located approximately 930 m north of the Study Area (along East Uniacke Road).                                                                                                 |
| Federal Involvement, Permits and Authorizations | No federal departments or public sources of funding provided. No Canadian Environmental Assessment Act triggers (Section 5, CEAA) occur or are expected. No federal permits or authorizations are anticipated at this time. |</p>
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<thead>
<tr>
<th><strong>Provincial Authorities issuing Approvals</strong></th>
<th><strong>Nova Scotia Environment (NSE)</strong></th>
</tr>
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<tr>
<td><strong>Required Provincial Permits &amp; Authorizations</strong></td>
<td>The following permits, authorizations and/or approvals may be required for this Project which will allow for the construction and operation of the Project</td>
</tr>
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<td>1. <strong>Environmental Assessment Approval.</strong> Approved pursuant to Section 40 of the <em>Environment Act</em> and Section 13 (1)(b) of the <em>Environmental Assessment Regulations</em> in Nova Scotia, Canada;</td>
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<tr>
<td>2. <strong>Industrial Approval</strong> pursuant to Activities Designation Regulations, Division V, Section 13(f)</td>
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<td>3. <strong>Wetland and Watercourse Alterations</strong> Pursuant to Activities Designation Regulations, Division I, Section 5A (2)</td>
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<td><strong>Provincial Regulatory Authorities Consulted during EA and Project Development Process</strong></td>
<td>Nova Scotia Environment (NSE), Environmental Assessment Branch:</td>
</tr>
<tr>
<td></td>
<td>• Candice Quinn, Environmental Assessment Officer</td>
</tr>
<tr>
<td></td>
<td>• Renata Mageste da Silva, Environmental Assessment Officer</td>
</tr>
<tr>
<td></td>
<td>Nova Scotia Department of Lands and Forestry (NSDL&amp;F):</td>
</tr>
<tr>
<td></td>
<td>• Mark Elderkin, Species at Risk Biologist</td>
</tr>
<tr>
<td></td>
<td>• Kimberly George, Regional Biologist</td>
</tr>
<tr>
<td></td>
<td>Office of Aboriginal Affairs (OAA):</td>
</tr>
<tr>
<td></td>
<td>• David Mitchell, Consultation Advisor</td>
</tr>
<tr>
<td><strong>Municipal Authorities</strong></td>
<td>Municipality of East Hants</td>
</tr>
<tr>
<td><strong>Required Municipal Permits &amp; Authorizations</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Environmental Assessment Document Completed By:</strong></td>
<td>Jeff Bonazza, M.Env.Sci.</td>
</tr>
<tr>
<td></td>
<td>Andy Walter, B.Sc.</td>
</tr>
<tr>
<td></td>
<td>Emma Posluns, M.Se.</td>
</tr>
<tr>
<td></td>
<td>John Gallop, B.Sc.</td>
</tr>
<tr>
<td><strong>McCallum Environmental Ltd.</strong></td>
<td>Suite 115, 2 Bluewater Road</td>
</tr>
<tr>
<td></td>
<td>Bedford, NS.</td>
</tr>
<tr>
<td></td>
<td>B4B 1G7</td>
</tr>
</tbody>
</table>
2 PROJECT INFORMATION

The following sections outline the proponent profile, the environmental assessment team, a description of the Project location, and the current quarry operations and proposed future operations.

2.1 Proponent Profile

Bio Design Earth Products Inc. (BDEP) is a Nova Scotian company that manufactures aggregate material for its own use and for supply to other contractors.

BDEP currently owns and operates Birrette’s East Uniacke Quarry, operating under a Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2014-089114). BDEP plans to expand the existing Birrette’s East Uniacke Quarry, which requires a Provincial EA registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

Bio Design Earth Products Inc. Executive Management Team consists of:

• Brad Hickey, President;
• Gerard Birrette, Manager; and
• Greg MacDonald, Engineer.

The Environmental Assessment Project Team consists of:

• Meghan Milloy, MES, McCallum Environmental Ltd;
• Jeff Bonazza, M.Env.Sc., McCallum Environmental Ltd;
• Andy Walter, B.Sc., McCallum Environmental Ltd.;
• Emma Posluns, M.Sc., McCallum Environmental Ltd;
• John Gallop, B.Sc., McCallum Environmental Ltd;
• Amber Stoffer, MREM, McCallum Environmental Ltd;
• Ryan Gardiner, B.Sc., McCallum Environmental Ltd;
• Laura de Boer, Professional Archeologist, Davis McIntyre & Associates; and
• Vanessa McKillop, Intermediate Archaeologist, Davis McIntyre & Associates.

2.2 Project Location

The Birrette’s East Uniacke Quarry Expansion Project Study Area (hereafter Study Area) is located approximately 4 kilometers (km) northeast of the community of East Uniacke, Nova Scotia. The Study Area is approximately 1.45 km south of East Uniacke Road and 1.7 km west of Beaver Bank Road (Figure 1, Appendix A). The quarry is located at the civic address of 1255 East Uniacke Road and the approximate centre of the Study Area is located at UTM 20N 440974 m E 4976694 m N.
The Study Area is located within PID 45405388 (owned by BDEP) and encompasses the existing quarry footprint (approximately 3 ha in size within a permitted maximum 4 ha area) (Figure 2, Appendix A). The Study Area is 41 ha (inclusive of the 3 ha existing quarry). The remainder of the Study Area comprises a combination of intact forest, with evidence of forestry activities (i.e. clear cuts), wetland habitat, watercourses and an access road (Figures 2, Appendix A).

Access to the Birrette’s East Uniacke Quarry is via a private gravel access road (gated) which extends south from East Uniacke Road.

The Study Area is situated in a rural setting. There are approximately two residences within 1 km from the outer edge of the Study Area. The two closest residences to the Study Area are located 930 m and 1,000 m north and west of the Study Area, respectively. Both of these residents are located on East Uniacke Road (Figure 3, Appendix A).

The Study Area is not located in any protected or conservation areas within federal, provincial, or municipal jurisdiction. Figure 4 (Appendix A) shows the Study Area and surrounding significant habitats and conservation areas. The Nova Scotia Provincial Landscape Viewer (NSDL&F, 2019) and desktop review identified the following:

- A mapped Significant Habitat for Wood Turtle (HN291), a Species at Risk is located approximately 2.3 km north of the Study Area, within Moore Lake Brook;
- Critical habitat for Wood Turtle is located approximately 2.3 km north of the Study Area, on Herbert River;
  - Critical habitat are areas identified to have both occupancy and suitable habitat for Wood Turtle (ECCC, 2016)
- The closest NSE Wetland of Special Significance is located 2.7 km northeast of the Study Area;
- Devils Jaw Wilderness Area is located approximately 3.5 km north of the Study Area;
- A mapped Significant Habitat for the Common Loon (HN303), is located approximately 4.5 km northwest of the Study Area;
- Sackville River Nature Reserve is located approximately 6.7 km south of the Study Area;
- Bell Provincial Park is located approximately 8.3 km southwest of the Study Area;
- A mainland moose concentration area is located approximately 8.7 km west of the Study Area; and
- The Southern Bight, Minas Basin Important Bird Area (NS020) is located approximately 26.8 km west of the Study Area;
2.3 **Existing Quarry Operations**

Birrette’s East Uniacke Quarry generates aggregate material for its own projects, as well as to supply external contractors. Currently, the production at the Birrette’s East Uniacke Quarry has averaged approximately 300,000 tonnes of aggregate from the quarry per year, during active periods.

The existing Birrette’s East Uniacke Quarry operations consist of a laydown area on the quarry floor, two aggregate crushers (jaw and cone crusher), aggregate stockpiles, stabilized grubbings and overburden stockpiles, as well as a scale and a scale house. Surface water runoff and drainage occurring on site is controlled by two settling ponds at the eastern extent of the quarry floor. Birrette’s East Uniacke Quarry’s working face is currently located in the western extent of the existing quarry, and the height of the quarry face is approximately 11 m. No fuel storage currently exists on site.

The following sections provide additional information related to the operations and best management practices which are currently followed at Birrette’s East Uniacke Quarry.

2.3.1 **Drilling and Blasting**

Blasting typically occurs at Birrette’s East Uniacke Quarry between two and seven times per year. No residential structures are located within 800 m of the Study Area. Under the *Pit and Quarry Guidelines* (NSDEL 1999), a separation distance of 800 m is required between the working face of the quarry and the base of a structure. BDEP currently monitors all blasts for concussion and ground vibration at the existing quarry through an independent subcontractor. Monitoring occurs at the two nearest off-site structures; 1065 East Uniacke Road and 1071 East Uniacke Road. The independent subcontractor is a qualified blasting company which is sub-contracted to undertake the blasting operations in accordance with the *General Blasting Regulations* contained in the *Nova Scotia Occupational Health and Safety Act* (1996). Monitoring of the blasts is conducted to ensured that concussion and ground vibration levels do not exceed the limits stated within the Industrial Approval (IA).

The qualified blasting company will be responsible for blast design, methods, monitoring and activities consistent with the Nova Scotia Department of Environment and Labour (NSDEL) *Pit and Quarry Guidelines* (NSDEL 1999). Pre-blast surveys will be completed at the two nearest structures (NSDOE 1993).

Weather conditions including high humidity or cloud cover, can cause the levels of overpressure and noise to appear more severe for surrounding residents than on a day when the humidity is low and there is lack of cloud cover. When possible, BDEP and its sub-contractors will avoid blasting when weather conditions include significant temperature inversions, strong winds, foggy, hazy or smoky conditions with little or no wind, or still, cloudy days with a low cloud ceiling.
2.3.2 **Processing Activities**

Specific processing activities including crushing and screening will be determined based on need. Two crushers (jaw and cone crusher) are currently used at the existing Birrette’s East Uniacke Quarry. No washing process takes place on the site. Various aggregate products (e.g. Type I and II rock, clear stone, armour rock, crusher dust, surge and blown rock) are produced based on need and stockpiled in designated areas within the quarry. Aggregate stockpiles, topsoil and overburden piles are located in designated areas within the quarry. Stockpiles are built, and material hauled and moved within the quarry with a front-end loader. An excavator is also used for material handling.

2.3.3 **Water Management**

Currently, the majority of the surface water runoff and drainage occurring on site drains eastward toward the active quarry floor (Figure 5, Appendix A). Rock lined drainage ditches direct water from western portions of the quarry into a series of two settling ponds which are present in the northeastern extent of the existing quarry. Existing settling ponds are rock lined and consist of deeper sections and small geotextile lined berms to detain water flow and enable sediment deposition. Water passively drains from the settling ponds via a culvert to the east, beyond the Study Area boundary, into ditches adjacent to the gravel access road. As indicated in Figure 5 (Appendix A), water drains northward within the roadside ditch prior to discharging into a previously identified treed swamp. Based on desktop analysis, water drains from this location southward into lower reaches of a field identified watercourse (WC2), prior to connecting to O’Hearn Flowage (~630m east). See Section 5.3.5 for additional detail.

The current Project IA (and ongoing communication with the regional NSE office) ensures monitoring requirements associated with surface water exiting the existing quarry are implemented and meet the specified parameters. To date, only one TSS sample (collected monthly since 2015) has exceeded the limit outlined in the current IA.

Additional settling ponds and/or water management methods will be added and modified as needed during quarry expansion to ensure water discharge meets criteria prior to release into the receiving environment. These structures will be approved and implemented in association with Birrette’s East Uniacke Quarry IA Approval.

2.3.4 **Waste Management**

Quarry operations do not result in large quantities of waste material. Overburden is currently stored northwest of the existing quarry area and has been stabilized with hay. This overburden will be re-used during rehabilitation and reclamation during the life of the quarry and at the end of its operational phase.
Other typical small-scale waste will be disposed of off-site via local waste handling facilities operated by the local municipalities. As appropriate, materials suitable for recycling will be separated, reused and/or recycled.

In the case that excess topsoil is prevalent during quarrying, topsoil will be stored at a suitable location within the active quarry area and possibly sold to external customers. Left over topsoil will be used for future reclamation purposes. Prior to future blasting, tree clearing activities will be completed by a third-party contractor who will cut and remove merchantable timber from the quarry site.

2.3.5 Hazardous Waste Management

As previously discussed, no fuel tanks currently exist at Birrette’s East Uniacke Quarry. Additionally, there are no future plans to store additional hazardous materials, chemicals or petroleum products at the quarry site.

Regular maintenance of the equipment (loaders, excavators and crushing equipment) is conducted at the quarry site. Used oil and filters are currently stored in drums and removed from the quarry site and this practice will continue with the proposed expansion. Re-fueling of equipment will continue to be conducted via a contracted fuel truck. Re-fuelling on site will occur on a regular basis at distances greater than 100 m from any surface water feature and the operators will remain with the equipment at all time when re-fueling activities are taking place. Disposed of hazardous material and refuelling procedures will be conducted in line with best management practices described in the Project Environmental Protection Plan (EPP) (which follows the EA registration and approval) and regulatory requirements.

2.3.6 Transportation and Production

Haul trucks leaving Birrette’s East Uniacke Quarry with aggregate comprise a combination of BDEP owned vehicles and third-party customer owned trucks. Once leaving the quarry access road, haul truck traffic will either travel west on East Uniacke Road or east to access the Beaver Bank Road. At Beaver Bank Road trucks either travel north or south to reach the local market for aggregate production and sales.

The planned production rate of Birrette’s East Uniacke Quarry is expected to remain consistent with current rates. The quarry will operate within HRM bylaws and for predominantly 6 days per week. It is possible that the quarry could temporarily operate for 7 days per week during a period of high demand. No blasting will occur on Sunday’s or holidays. The production rate and truck traffic expectations are consistent with current quarry operations but will be market driven.

2.3.7 Noise Management

Sound levels within the quarry are monitored as requested by NSE at the property boundaries of the quarry, in accordance with the NSDEL Pit and Quarry Guidelines (NSDEL, 1999). Blasting accounts for
the predominant source of noise from the quarry. As previously discussed, blasting is monitored and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels, nor will it occur on Sundays or holidays.

Noise from haul truck traffic accessing the quarry will occur during quarry operation. This is consistent with current quarry operations.

2.3.8 Dust Control

Dust emission and particulate matter will be monitored at property boundaries adjacent to the quarry, at the request of NSE, in accordance with the NSDEL Pit and Quarry Guidelines (NSDEL, 1999). All haul truck loads will be covered to minimize dust and to contain aggregate material. Should it be required, dust emissions will be controlled with the application of water.

2.3.9 Viewscape

Birrette’s East Uniacke Quarry is located in a rural location and is not visible from any adjacent public vantage points (i.e. East Uniacke Road) or from the nearest residence, located on East Uniacke Road (930 m north of the Study Area).

2.3.10 Risk Management

A contingency plan for Birrette’s East Uniacke Quarry and its proposed expansion is the responsibility of the Proponent: the quarry owner and operator. The contingency plan will cover notification procedures for emergencies, identification of owner team leaders and contacts, spill prevention, spill procedures, and incident reporting procedures. This plan will be provided to NSE as part of the EPP.

2.4 Future Quarry Operations

In order to continue production and supply aggregate to the local market, BDEP plans to expand the existing Birrette’s East Uniacke Quarry. The proposed quarry expansion is proposed to increase reserves, not increase production. The timing and rate of quarry expansion and development is based on market demand for local aggregate, however, current production rates are expected to remain consistent as the quarry expands. If the local demand for aggregate changes, the proposed development plans could vary.

Presently, there are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.
2.4.1 Development Plan

The predicted expansion timeline of Birrette’s East Uniacke Quarry has been proposed over 25 years (Figure 6, Appendix A). Quarry expansion will occur within the proposed Development Area and will include a combination of quarrying activities, and components that support the quarrying activity (i.e. access roads, stockpile and overburden areas among others).

The following items were considered when determining the extent and location of the Development Area:

- Separation distances from the boundaries of Development Area to public roads: 1000 m;
- Development Area not encroaching within 30 m of an adjacent property boundary; and
- Development Area not encroaching within 30 m of the mapped headwater wetland located on the southern boundary of the Study Area as well as four additional isolated wetlands (Figure 5, Appendix A).

Initially, expansion of the quarry will continue south from the existing quarry footprint before expanding westward into the existing quarry face to access the desirable aggregate (Figure 6, Appendix A). The current quarry floor sits at an elevation of ~147 m above sea level and rises to natural forested land beyond the existing quarry face to the west (~165 m above sea level). Proposed quarry activities will not result in excavation deeper than the existing quarry floor (i.e. a pit), rather, additional carving of the existing quarry face into the side of the incline will occur and groundwater interaction is not expected. As the quarry expands, the quarry floor will be sloped upgradient 1-2% in order to control runoff.

The entirety of the Development Area is within PID 45405388. The rate of expansion has been designed based on the Proponent’s expectation of local aggregate need over the next 25 years. As such, rate of expansion is estimated, and could vary from those defined in this document. The estimated size of the quarry expansion Development Area is 30.2 ha. The estimated rate of production will remain consistent with current levels (i.e. 300,000 tonnes per year).

The majority of the Development Area is forested, however, access roads and historic forestry activity is present. Clearing and grubbing to support quarry expansion will be completed as necessary and will be limited to minimize exposed soil and potential for erosion. Approximately 0.5 ha of quarrying area will be cleared of vegetation at the top of the existing quarry face at any given time. Topsoil and overburden removed during this process will be added to existing stockpiles present in the existing quarry.

Fourteen wetlands and two watercourses have been identified within the proposed Development Area.

2.4.2 Quarry Components

Existing quarry infrastructure will remain in place during expansion within the Development Area including two crushers. No new quarry infrastructure is anticipated. Existing aggregate piles, topsoil piles,
and overburden piles are currently located across the existing quarry limits and may be relocated within the quarry floor as expansion progresses. The scale and the scale house are and will continue to be located adjacent to a paved access road within quarry limits. The existing gravel access road (gated) to the quarry from East Uniacke Road will continue to be used as the entrance and exit to the quarry.

Environmental controls will be upgraded (i.e. settling ponds), and additional measures will be implemented in conjunction with a new IA.

2.5 Decommissioning and Reclamation

Decommissioning will involve the removal of all garbage, equipment and all structures from the quarry property.

Reclamation at Birrette’s East Uniacke Quarry will aim to control erosion and sedimentation, restore soil capability, contour, and revegetate. The end land use objectives are based on pre-development site conditions and the reclaimed site would be capable of supporting a range of land uses similar to the pre-development site conditions (i.e. undeveloped, vegetated land).

Progressive reclamation will occur where practical, to areas where aggregate resources are exhausted (e.g. immediately north and south of the existing quarry footprint). However, the majority of reclamation is planned to occur in conjunction with decommissioning, towards and at the end of the operational window. Reclamation will involve identification of short and long-term goals and options for the site including, but not limited to the spreading of grubbing piles, sloping, surface contouring, establishing drainage, and seeding. Reclamation will be completed in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDEL, 2009) to the satisfaction of NSE and other regulatory departments.

A detailed reclamation plan will be completed at the request of NSE prior to operations ceasing at the quarry (or a portion of the quarry).

2.6 Anticipated Schedule of Activities

The following milestone schedule (see Table 2) outlines the Project schedule.

<table>
<thead>
<tr>
<th>Task</th>
<th>Anticipated Completion Date</th>
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<tr>
<td>Environmental Studies</td>
<td>Winter, Spring, Summer, and Fall 2018</td>
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<tr>
<td>Environmental Assessment</td>
<td>March 2019</td>
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</table>
### Purpose and Need for the Undertaking

The purpose and need of the undertaking is to allow BDEP to expand their existing quarry and to supply the local market with aggregate. Aggregate material is in demand and is required in a wide variety of construction projects (e.g. road construction).

The Project will allow for continued employment at the quarry as well as in related industries where the aggregate material is used (e.g. construction, hauling). Employment and financial gain is expected to occur in the rural communities near the Project and in turn will strengthen the local economy. Additionally, the Project will be an important addition to Nova Scotia’s natural resource sector.

### Consideration of Alternatives

The consideration of alternatives is analyzes different ways in which the Project can be carried out. These include; alternate sites, alternate extraction methods, alternative transportation modes and routes etc.

The proposed expansion is located at the existing Birrette’s East Uniacke Quarry. This area was originally selected in 2014 based on suitable aggregate quality and quantity. BDEP currently owns the land within the proposed Development Area and have completed test pit programs across the land to confirm that suitable aggregate is present. Furthermore, Birrette’s East Uniacke Quarry has an extensive setback from residential dwellings (960 m being the closest from the Development Area boundary) and a proven track record for successfully operating a quarry at this location.

Few alternatives exist for the methods related to aggregate extraction and crushing. The rock type found within the Study Area is hard and mechanical extraction via ripping is unfeasible. The technique currently employed at the existing Birrette’s East Uniacke Quarry includes drilling, blasting, crushing, stockpiling, and hauling of aggregate. These techniques have proven to be effective and will continue to be used during quarry expansion.
The Project is located on East Uniacke Road near its intersection with Beaver Bank Road (Highway 354) which allows for three general transportation routes; west on East Uniacke Road, north on Beaver Bank Road, or south on Beaver Bank Road. Depending on the location of aggregate demand, all options are likely to be used at some point during the life of the expansion. Multiple transportation routes allow for lower traffic on one particular route, over time. Overall, the Project location allows for many distribution options throughout a broad area.

Alternatives for all Project phases have been considered and the methods decided upon represent the best options in regard to minimizing environmental impact balanced with the economics of the Project.

3 ENVIRONMENTAL ASSESSMENT SCOPE

Nova Scotia’s Environmental Act and Environmental Assessment Regulations regulate provincial environmental assessments. The Birrette’s East Uniacke Quarry Expansion Project requires a provincial environmental assessment registration as it is considered a Class I undertaking under Section 9(1) of the Nova Scotia Environmental Assessment Regulations.

3.1 Boundaries of the Assessment- Spatial and Temporal

Spatial boundaries of the EA are defined by the Birrette’s East Uniacke Quarry Expansion Study Area (Study Area) (Figures 2, Appendix A). The Study Area covers the entirety of PID 45405388 and was designed to buffer and surround the proposed expansion area (Development Area) for Birrette’s East Uniacke Quarry. All assessments used this Study Area as the spatial boundary for assessment with the exception of the following, expanded area evaluations:

1. O’Hearn Flowage Local Catchment Area (O’Hearn Flowage LCA): This spatial boundary was developed in support of the Hydrological Effects Analysis and includes the first downstream confluence common to all tributaries that may sustain hydrological effects as a result of the proposed Project (Figure 7, Appendix A, and Sections 4.1.2.4 and 5.5.4);
2. Fish Habitat Assessment Areas were developed to assess fish habitat within the downstream receiving aquatic environment (Figure 8, Appendix A);
   a. Fish habitat assessments
   b. Electrofishing
   c. Water quality
3. The Municipality of East Hants was considered for the purpose of data collection relating to existing socioeconomic conditions and evaluation;
4. Potable wells located within a 1.0 km buffer of the Study Area (Figure 3, Appendix A) were assessed as potential receptors to evaluate groundwater interaction;

The temporal boundaries of the EA include the construction (expansion), operation and maintenance, and decommissioning/reclamation phases of the Project, and associated activities.
3.2 Assessment Scope

The EA planning process allows for the prediction of environmental effects of a proposed Project and identifies measures to minimize and then mitigate potential adverse environmental effects. The EA attempts to predict significant residual adverse environmental effects once mitigation measures are implemented.

The EA focuses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical, socioeconomic, human health, and cultural environments. VECs are important to a local human population and can have a national or even international profile. VECs are important for the evaluation of environmental impacts of a proposed undertaking. The scope of the assessment for this Project included: the selection and assessment of potential VECs; evaluation of the potential VEC interactions with Project activities; identification of environmental effects, if any, for each VEC; and identification of thresholds to determine the significance of residual environmental effects.

4 ENVIRONMENTAL ASSESSMENT METHODOLOGIES

The EA registration document for the Project describes the biophysical, social, and economic environment. All VECs were identified, and the potential for interaction between individual VECs and Project activities were determined. Methods to minimize and mitigate environmental effects resulting from the Project are provided in this chapter.

The Project team, through an evaluation of the VECs, identified Project environmental effects that post-mitigation, have the potential for a residual effect on the environment. The significance of these residual effects was then determined and evaluated (Section 9.2).

This chapter details the following key aspects of the EA methodologies:

1. Biophysical: birds, bats, species at risk, wildlife, vegetation and habitat, lichen, watercourse evaluation, fish habitat assessment, electrofishing, and wetland functional assessment and delineation.

4.1 Biophysical Assessments

In March of 2018, field components of the biophysical EA were initiated. These field components continued through until November 2018 complying with the requirements for a Class I undertaking under Section 9(1) of the Nova Scotia Environmental Assessment Regulations. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the habitats surrounding the Study Area. The field components included:
1. Avian baseline surveys: spring bird migration, breeding bird, fall bird migration, and Common Nighthawk;
2. Botanical surveys (late and early) for Priority Species (including lichens);
3. Opportunistic herpetofauna, mammal and other taxonomic group surveys for Priority Species;
4. Wetland and watercourse identification and evaluation;
5. Fish habitat assessments and electrofishing;
6. Surface water sampling;
7. Habitat surveys;
8. Winter wildlife and bird surveys; and,
9. Archaeological assessments- Phase I (Desktop) and Phase II (Field).

4.1.1 Terrestrial Environment

4.1.1.1 Priority Species

Assessment of wildlife, vegetation, and habitat was completed based on the requirements outlined in the Nova Scotia Environment (NSE) Guide to Addressing Wildlife Species and Habitat in an EA Registration Document, (NSE, 2009). A Priority Species list was created in accordance with this guide as outlined below (NSE, 2009). The purpose of the Priority Species list is to identify a broad list of species which have the potential to be present within the Study Area, and to inform the field programs. The desktop priority list was based on general species habitat requirements and the broad geographic area that individual species are known to occur. The Priority Species list can be found in Appendix C.

Development of a priority list of species for each taxonomic group was completed based on a compilation of listed species from the following sources:

1. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Federal Species-at Risk Act (SARA, 2002). All species listed as Endangered, Threatened, or of Special Concern;
2. Nova Scotia Endangered Species Act (NSESA, 1999). All species listed as Endangered, Threatened, or Vulnerable; and,
3. Conservation Rank: All species designated as S1, S2 or S3 or any combination thereof (i.e. S3S4 is considered a Priority Species) as defined by the Atlantic Canadian Conservation Data Centre (ACCDC).

Collectively, this group of species is known as Priority Species. This umbrella grouping includes species of conservation interest (SOCl) and Species at Risk (SAR). SOCl are not listed species under provincial or federal legislation (COSEWIC species and ACCDC S1, S2, and S3 species or any combination thereof (i.e. S3S4 is considered a Priority Species)), and SAR are listed on SARA or NSESA.
Breeding bird status qualifiers are used to determine whether a species is a Priority Species, based on the time of year in which the species was observed. For instance, Pine Grosbeak has an SRank of S2S3B, S5N. If observed during breeding season, this species would be considered a Priority Species. Outside of breeding season, this species would not be considered a Priority Species.

The priority list of species was first narrowed by broad geographic area. The priority list of species was further narrowed by identifying specific habitat requirements for each species. For example, if a listed species on the Nova Scotia Endangered Species Act (NSESA) required open water lake habitat, and no open water lake habitat is present inside the Study Area footprint, this species was not carried forward to the final list of Priority Species for field assessments within the Study Area.

Data was requested from the ACCDC and the Nova Scotia Communities Culture and Heritage (NSCCH) Environmental Screening Report to obtain records of rare species existing or historically found within the general location of the property. The results of the database search were also reviewed to identify Priority Species that could be potentially located within the Study Area (based on recorded sightings within, or in close proximity to the Study Area, and general geographic and habitat requirements).

The final broad priority list of species used for field assessments is attached in Appendix C. The ACCDC and NSCCH reports are also included as Appendix C.

Targeted SOCI and SAR surveys were completed from March to November 2018, to assess for all identified Priority Species across the Study Area. In addition, incidental Priority Species were noted during all field surveys.

4.1.1.2 Habitat Surveys
The following are the desktop and field survey methodologies used during the habitat survey program.

4.1.1.2.1 Desktop Review
A desktop review was conducted using the available GIS forestry (NSDL&F, 2017) and wetland inventory layer (NSE, 2017). Habitat survey routes targeted major forested habitat types throughout the Study Area. The habitat survey focused on assessing upland habitats, as detailed evaluation of all wetland habitat is completed as part of the wetland assessments. A literature review was also conducted to determine the Ecoregion and Ecodistrict in which the Study Area is within. The purpose of this study is to determine the geological, biological, and climatic characteristics found within the Study Area, coupled with the site specific data gathered during the field habitat surveys.

4.1.1.2.2 Field Survey
A habitat assessment was conducted in conjunction with winter wildlife surveys. The MEL field team walked the Study Area on March 12, 2018, following a meandering transect that reached all major habitat
types expected within the Study Area. The distances between each Habitat Assessment Point (HAP) varied and was a result of the complexity of the forest stands found within the Study Area. The minimum distance between HAPs is 70 m. The Forest Ecosystem Classification for Nova Scotia (FEC) guides (Keys, Neily, Quigley and Stewart, 2010) were used to identify the ecosites and vegetation types present at each habitat survey point throughout the Study Area. The following were described at each habitat survey point:

- Vegetation Type (VT) – was determined using Part 1 of the FEC guide (Neily et al., 2011). Each survey point was classified by overall forest group code and VT using the keys provided in the guide book. Forest Groups are general groupings of VTs. Within each forest group (e.g. open woodland), there are several specific VTs. VTs are recurring and identifiable plant communities which reflect differences in site conditions, natural disturbance regimes, and successional stage. For example, TH4 is a tolerant hardwood forest group dominated by Sugar Maple (*Acer saccharum*) and White Ash (*Fraxinus americana*) VT, while TH6 is a tolerant hardwood (TH) forest group dominated by Red Oak (*Quercus rubra*) and Yellow Birch (*Betula alleghaniensis*) VT.

- Ecosite – was determined using Part 3 of the FEC Guide (Keys et al., 2010). This guide provides keys to identify ecosite using an edatopic grid, which is a two-dimensional diagram used to plot ecosystems and ecosites based on their relative moisture and nutrient regimes. Ecosites are units which represent ecosystems that have developed under a particular nutrient and moisture regimes. A finite range of VTs will naturally grow in any given ecosite.

It is important to note that during these assessments limitations and biases existed and are as follows:

- During the survey snow cover was present and surveys were outside the growing season. The herbaceous layer was sometimes not visible and the VTs in their entirety were not assessed. This limitation is considered to be minimal as the VTs are primarily defined by the woody perennials (i.e. trees and shrubs) present.

- One bias is towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the Study Area will be delineated and described in detail and their function as habitats within the landscape of the Study Area would be captured in the wetland program.

- The second bias is towards forested landscape as opposed to non-forested landscapes. In this context, clear cut lands, or those which have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads, were not assessed during the habitat survey simply because they lack forest cover to be described and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance.
• The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire Study Area is limited. These habitat survey points are meant to describe habitat in ‘snapshots’ of specific locations. The results of the habitat survey are meant to describe the diversity of habitat types present throughout the Study Area and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the Study Area.

4.1.1.3  Avian

A review of the Canada Important Bird Areas database, ACCDC, and Maritime Breeding Bird Atlas (MBBA) square 20MQ47 was completed to support bird survey design and methodology. The ACCDC and MBBA square results are included in Appendix C.

A NSCCH report (Appendix C) for the presence of natural and heritage resources was requested and consulted prior to completion of field surveys.

Avian field monitoring programs were completed by MEL personnel and included the following surveys:
• Spring migration (May 3 and May 17, 2018);
• Breeding bird (June 7 and June 21, 2018);
• Raptor nest (during all biophysical field surveys);
• Common Nighthawk (June 21 and July 3, 2018); and,
• Fall migration (September 5, September 18 and October 1, 2018).

Detailed descriptions of each survey methodology are provided in the following sections.

4.1.1.3.1  Spring Migration

Spring migration surveys were completed by MEL personnel on May 3 and May 17, 2018. Surveys were conducted at twelve-point count stations within the Study Area (Figure 9, Appendix A). The point count locations were placed in representative habitat types within the Study Area. Surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Weather conditions (i.e., precipitation and visibility) were monitored and confirmed to be within the parameters required by monitoring programs such as Environment and Climate Change Canada’s (ECCC) Breeding Bird Survey Guidelines (i.e. good visibility, little or no precipitation, light winds not exceeding 19 km/h. Bird observations were recorded at four distance regimes: within a 50 m radius, 50 to 100 m radius, outside the 100 m radius, and flyovers. A record was made of the start and end time of the observation period and a hand-held GPS unit was used to geo-reference the location for each point count station. General observations including the temperature, visibility, wind speed, and date were also recorded. Species recorded between point counts were recorded as incidentals. Bearings (in degrees) were taken for Priority Species observed both during dedicated survey periods and incidentally.
4.1.1.3.2 Breeding Birds

Surveys for breeding birds were conducted by MEL personnel on June 7 and 21, 2018 at the same twelve (12) point count stations as surveyed in the spring, within the Study Area (Figure 9, Appendix A). Two rounds of surveys for breeding birds were conducted to capture early and late breeding. The surveys were conducted using the same methodology as the spring migration surveys. Early morning point count surveys were conducted from 30-minutes before sunrise till 10:00 a.m. Species and number of birds observed at each point count location were recorded. The point counts are located in a mix of habitat types including: the edge of a cutblock, within a mixedwood forest, the edge of a road, a treed swamp, and along a road in proximity to quarry operations.

4.1.1.3.3 Common Nighthawk

The Common Nighthawk (Chordeiles minor) prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset. Suitable habitat is available for this species within the Study Area (i.e. existing quarry area, cutblocks, and roadside clearings), therefore dedicated surveys for the Common Nighthawk were conducted from the end of June to early July at dawn, one hour before sunrise to 30 minutes after sunrise (Maritimes Breeding Bird Atlas, 2008). Four survey point count locations were surveyed twice by MEL personnel on June 21 and repeated on July 3, 2018 (Figure 9, Appendix A). The point count locations are situated within the Study Area and surrounded by forested, cutblock, or existing quarry habitat. Each point count survey consisted of a three-minute passive surveying period, followed by three minutes of alternating 30-seconds call playback of the conspecific Common Nighthawk call and 30-seconds of silence (passive surveying) as per survey protocol of Saskatchewan Ministry of Environment (2015).

4.1.1.3.4 Fall Migration

The same point count locations surveyed during the spring migration and breeding bird surveys were used for the fall migration surveys (Figure 9, Appendix A). Ten-minute point counts were conducted by MEL personnel on September 5, September 18, and October 1, 2018, during peak migration following the same survey protocol as spring migration. Surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Weather conditions (i.e., precipitation and visibility) were monitored and confirmed to be within the acceptable parameters as discussed previously.

4.1.1.4 Vascular Plant Surveys

The following desktop and field survey methodologies were implemented during the vascular plant survey program.
4.1.1.4.1 Desktop Review

Prior to undertaking the field assessment, a detailed desktop review of known vascular plant observations and potential habitat for rare plants within the Study Area was conducted. The desktop review process involved three components: a review of the ACCDC database results, a review of mapped wetland habitat and a review of the Priority Species List.

4.1.1.4.2 Field Survey

For the purpose of this study, vascular plant surveys focused on identifying general vegetative communities, with particular focus on identifying Priority Species following the guidance of the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE, 2009). Early and Late surveys were completed by John R. Gallop on June 6th, 2018 and Amber Stoffer on September 5th, 2018.

The biologists walked meandering transects and targeted land features with higher rare plant potential such as tolerant hardwood landscapes (if present), seepages, floodplains and wetlands. Every wetland within the Study Area was visited and assessed for vascular plant rarities. A general species list was made of vascular plant species observed. In addition to targeting the aforementioned habitats, disturbed habitats such as clearings and road ditches were assessed as a variety of Priority Species are known to thrive in these habitats (e.g. *Equisetum variegatum* and *Agalinis neoscotica*).

In the event that a specimen could not be identified in the field, specimens were photographed and/or collected and pressed for identification at a later time. All SAR and/or SOCI species observed were georeferenced, counted, photographed, and their habitat was recorded. The following literature was referenced during the surveys and the identification process:

- Roland’s Flora of Nova Scotia (Zinck, 1998);
- Flora of New Brunswick (Hinds M., 2000);
- GoBotany Digital Keys (Go Botany, 2019);

4.1.1.5 Lichen Surveys

The following are the desktop and field survey methodologies implemented during the Lichen survey program.

4.1.1.5.1 Desktop Review

Prior to undertaking the field assessment, a detailed desktop review of known lichen observations and potential habitat for rare lichens within the Study Area was conducted. The desktop review process involved four components: a review of the ACCDC database results; a review of Nova Scotia Department
of Lands and Forestry (NSDL&F) predictive habitat mapping for Boreal Felt Lichen (*Erioderma pedicellatum*); a review of the results of habitat mapping; and a review of mapped wetland habitat.

To develop the predictive habitat maps for Boreal Felt Lichen (BFL), NSDL&F used an algorithm that identifies all forest stands in the provincial forestry database in which Balsam Fir (*Abies balsamea*) is listed as a primary or secondary species, and that occur within 80-metres of a mapped bog or fen. The model further confines the search to only those forest stands located within 30 kilometers of the Atlantic Coast. This database is used to predict areas with a higher potential of locating BFL. This data set was reviewed in advance of field assessment and was uploaded onto the GPS unit prior to conducting the field study. Other habitats identified by the biologist as suitable for rare lichens were surveyed for lichens as well.

### 4.1.1.5.2 Field Survey

While the specific habitat requirements of each of priority lichen species varies, many require mature to over-mature forests; stand age is one of the greatest determinants of the presence of many rare epiphytic lichens (i.e. lichens which grow on other plants) (McMullin et al., 2008).

The Study Area consists of historical forestry activity (i.e. clear cuts and logging roads), and areas of softwood and hardwood stands of variable maturities. Lichen surveys throughout the Study Area were focused on mature stands, particularly those located within mapped wetlands and predicted BFL habitat, as these habitats have elevated potential for identifying associative priority lichen species.

All suitable habitats within the Study Area were surveyed on May 17th, 2018 by John R. Gallop. Mature trees that are appropriate for hosting priority lichen species were visually inspected by focusing on tree trunks, branches and twigs. The following information was collected for any priority lichen species identified during field surveys: site location, date, scientific name, count, size, habitat (host tree and general habitat), location (waypoint in UTM NAD83), height of the specimen, direction that the specimen was facing, along with a photograph and any relevant comments. A general list of common lichens was also recorded with focus on macrolichens (i.e. foliiose, fruticose, squamulose).

In the event that a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified at a later date. If necessary, collected samples were inspected with microscopy and standard chemical spot tests in accordance with Brodo et al. (2001) to identify to the species level. The following literature was referenced during the surveys and identification process:

- *The Macrolichens of New England* (Hinds & Hinds, 2007);
- *Lichens of North America* (Brodo, I.M., Sharnoff, S.D., Sharnoff, S., 2001);
- *Keys to Lichens of North American – Revised and Expanded* (Brodo, Sharnoff, & Sharnoff, 2016);
- *Microlichens of the Pacific Northwest – Volume 1 – Key to The Genera* (McCune, 2009);
4.1.1.6  Bats
A desktop review for known bat hibernaculum nearby and within the Study Area was completed. The NSDL&F (NSDNR, 2017) records of abandoned mine openings (AMOs) were reviewed for the Study Area and within 5km of the Study Area, as AMOs potentially provide bat hibernacula. The ACCDC report, the Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada (Environment Canada, 2015), and the Nova Scotia Museum’s records of bats were also consulted. During habitat surveys within the Study Area, MEL personnel also looked for signs of habitat that could support winter bat hibernation.

4.1.1.7  Herpetofauna Surveys
Habitat survey results within the Study Area indicated that there was limited habitat potential within the Study Area for priority herpetofaunal species (Wood Turtle and Snapping Turtle), therefore, no targeted herpetofauna surveys were undertaken. However, all watercourses were evaluated for wood turtle habitat during wetland and watercourse surveys in 2018 and efforts were made to locate these species including inspection of crevices, fallen logs, and other potential habitats. Incidental observations of herpetofauna across the Study Area were documented during all field surveys completed through 2018.

4.1.1.8  Wildlife Surveys
A winter wildlife survey was completed on March 12, 2018. The survey involved the completion of one transect within and near the Study Area (Figure 9, Appendix A). The transect was walked and all signs of ungulates or Priority Species, including tracks, scat, browse, and hair snags that were observed were recorded. Other mammal signs were noted as well. Any birds that were present or could be heard were also recorded. Locations of observations were geo-referenced with a handheld GPS unit.

Incidental wildlife observations were documented and photographed throughout all other field surveys in 2018.

4.1.2  Aquatic Environment

4.1.2.1  Wetlands
The NS Environment Act defines wetlands as:

> Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions. (Environment Act, 2006)
Wetland functions are the natural processes associated with wetlands and include, but are not limited to water storage, pollutant removal, sediment retention and provision of nesting/breeding habitat. Functions may also include values and benefits associated with these natural processes and include aesthetics/recreation, cultural values, and subsistence production. The discussions of wetlands presented herein primarily uses terminology associated with the Canadian Wetlands Classification System (Warner and Rubec, 1997) or in line with the methodologies adapted by Nova Scotia for wetland delineation and functional assessment.

4.1.2.1 Desktop Review

A desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to aid in determination of wetland habitat in the Study Area. Mapped wetland areas were identified from the NSE Wetland Inventory Database (Figure 2, Appendix A).

4.1.2.2 Field survey

Field surveys to identify wetland habitat were originally initiated by MEL in July 2014 as part of the IA process (quarry <4 ha). Initial surveys were completed in a separate, smaller Study Area than the one assessed as part of the EA. The 2014 surveys followed the same methods used during the 2018 field surveys conducted as part of the EA process, as described below.

The additional field surveys conducted by MEL personnel were completed in June and July of 2018 across the Study Area. Targeted surveys were completed within the Study Area where mapped wetland systems were present to confirm and delineate wetland habitat. Meandering transects were also completed to support efforts to delineate all wetlands present within the Study Area. Wetland delineation was completed in accordance with the Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers, 2011). Wetland delineation was conducted based on micro-topography, observed surface hydrology, vegetation and soils by qualified wetland delineator. Wetland boundaries were documented using an SXBlue II Global Positioning System (GPS) receiver unit capable of sub-metre accuracy with a handheld SXPad field computer. Any inlet and outlet streams or other features associated with each wetland were marked during the delineation process and walked and mapped. Pink flagging tape was used to mark the boundaries of wetlands and blue flagging tape was used to mark the boundaries of watercourses. Observations were made on wetland types, water flow path, dominant vegetation communities (and SAR/ SOCI, if present), fish habitat potential and characterizations, and wetland functions.
4.1.2.1.3 **Wetland Functional Analysis**

Wetland functional assessment was completed for each wetland using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The WESP process involves the completion of three forms; a desktop review portion that examines the landscape level aerial conditions to which the wetland is situated, and two field forms. The process serves as a rapid method for assessing individual wetland functions and values. WESP addresses 17 specific functions which wetlands may provide (Table 3). The specific wetland functions are individually allocated into grouped wetland functions and measured for “functional” and “benefit” scores. Wetland function relates to what a wetland does naturally (i.e., water storage), whereas wetland benefits are benefits of the function, whether it is ecological, social, or economic. The highest functioning wetlands are ones which have both high ‘Function’ and ‘Benefit’ scores for a given function. WESP enables a comparison to be made between individual wetlands within a Province to gain a sense of the importance each has in providing ecosystem services.

**Table 3: Wetland Function Parameters**

<table>
<thead>
<tr>
<th>Grouped Wetland Function</th>
<th>Specific Wetland Functions</th>
</tr>
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<tbody>
<tr>
<td>Hydrologic Function</td>
<td>Surface Water Storage</td>
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<tr>
<td>Aquatic Support</td>
<td>Aquatic Invertebrate Habitat</td>
</tr>
<tr>
<td></td>
<td>Stream Flow Support</td>
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<td></td>
<td>Organic Nutrient Export</td>
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<td></td>
<td>Water Cooling</td>
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<tr>
<td>Water Quality</td>
<td>Sediment Retention &amp; Stabilization</td>
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<td></td>
<td>Phosphorus Retention</td>
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<tr>
<td></td>
<td>Nitrate Removal &amp; Retention</td>
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<tr>
<td></td>
<td>Carbon Sequestration</td>
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<tr>
<td>Aquatic Habitat</td>
<td>Anadromous Fish Habitat</td>
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<td></td>
<td>Resident Fish Habitat</td>
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<tr>
<td></td>
<td>Waterbird Feeding Habitat</td>
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<td></td>
<td>Waterbird Nesting Habitat</td>
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<tr>
<td></td>
<td>Amphibian and Turtle Habitat</td>
</tr>
<tr>
<td>Terrestrial Habitat</td>
<td>Songbird, Raptor, &amp; Mammal Habitat</td>
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<tr>
<td></td>
<td>Pollinator Habitat</td>
</tr>
<tr>
<td></td>
<td>Native Plant Habitat</td>
</tr>
</tbody>
</table>

In addition to the grouped wetland functions above, WESP also measures the following groups, however these are only evaluated by their benefit scores:
  - Wetland Condition; and
  - Wetland Risk.
The following individual functions are assessed to determine the benefit scores associated with these groups:

- Public Use & Recognition;
- Wetland Sensitivity;
- Wetland Ecological Condition; and
- Wetland Stressors.

For each wetland evaluated, the WESP process calculates the overall score for the seven grouped wetland functions and the 17 specific wetland functions listed in Table 3 above. One score each is provided for function and benefit. Scores are ranked as ‘Lower’, ‘Moderate’, or ‘Higher’, allowing for analysis of the wetland as compared to baseline wetland scores in Nova Scotia. A ‘Higher’ WESP score means that wetland has a greater capacity to support those processes as compared to other wetlands in the province. A ‘Higher’ WESP score in both the function and benefits category means the wetland supports the natural ecosystem functions and provides services potentially important to society. For our analysis, MEL weighted the WESP scores to quantitatively compare wetlands. The following weights were applied to scores for grouped wetland functions and specific wetland functions:

- Lower score = 1 point
- Moderate score = 2 points
- Higher score = 3 points

4.1.2.2 Watercourse and Electrofishing Surveys

The NS Environment Act defines a watercourse as:

(i) the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, within the jurisdiction of the Province, whether it contains water or not, and

(ii) all groundwater (Environment Act, 2006)

4.1.2.2.1 Desktop Review

A desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to aid in determination of watercourses in the Study Area. Topographical maps were reviewed (1:50,000, 1:30,000, and 1:10,000) to identify all mapped watercourses. Mapped watercourses were identified from the NS Topographic Database (Figure 2, Appendix A) (Government of Nova Scotia 2015).
4.1.2.2 Watercourse Field Surveys

Field surveys to identify watercourses were originally initiated by MEL in July 2014 as part of the IA process (quarry <4 ha). Initial surveys were completed in a smaller Study Area. These surveys followed the same methods used for the 2018 field surveys conducted as part of the EA process, as described below.

Field surveys were conducted by MEL personnel in June and July 2018 across the Study Area to identify watercourses. Watercourses were documented using an SXBlue GPS unit and SX Pad hand held field computer capable of sub 1 m accuracy. Observations of fish habitat quality and fish habitat potential for each identified watercourse were documented, as well as Wood Turtle and Snapping Turtle habitat potential. Blue flagging tape was used to mark the boundaries of watercourses.

Additional detailed surveys were completed in September 2018 for all watercourses within the Study Area to obtain a detailed characterization of fish habitat. This was also completed for two additional watercourses which are located outside of the Birrette’s East Uniacke Quarry Expansion Study Area, within the Fish Habitat Assessment Area (Figure 8, Appendix A). These watercourses (WC2 and WC3) intersected the gravel access road located east of the existing quarry and were therefore accessible to the Project Team. Land to the west of the Study Area was observed to comprise wetland habitat from the Study Area boundary, but could not be accessed by the Project Team for further evaluation due to it existing on private land.

4.1.2.2.3 Electrofishing

Electrofishing was conducted within watercourses draining through the Fish Habitat Assessment Area (and therefore accessible to the Project Team). The Fish Habitat Assessment Area was defined to encompass the two watercourses which intercept surface water from within the Study Area. Electrofishing was not completed within the Study Area; WC4 was not electrofished due to unsuitable surveying conditions and WC1 was not surveyed because electrofishing was conducted in both downstream receptors (WC2 and WC3), and no fish were observed. Sampling sites of approximately 100 m in length were selected as representative habitats with high potential to support fish along a section of a watercourse. The purpose of the electrofishing surveys was to determine what species of fish are present within watercourses that intercept surface water from the Birrette’s East Uniacke Quarry Expansion Study Area. Two electrofishing sites were selected. These locations are shown on Figure 9, Appendix A. Fishing was completed under Fisheries and Oceans Canada Fishing License # 341208.

Standardized data collection forms developed by the New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006) were adapted for use for field data collection during electrofishing surveys. Field data
collected included the physical and chemical parameters of the electrofishing site, along with electrofishing methods and settings, and results of electrofishing surveys.

The Electrofishing Site Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006) was completed to identify and describe the physical and chemical characteristics of the reach to be sampled. This site description helped the electrofishing team determine the appropriate settings on the electrofishing unit based on physical parameters of the watercourse, conductivity, and species expected to be present. Survey effort (in electrofishing seconds) was recorded on the Electrofishing Site Form as well. Water quality measurements were recorded in the field with a YSI 650 MDS.

Fisheries and Oceans Canada’s Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy. The crew lead is responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.

Fish were sampled within the 100 m sampling areas using a Halltech Battery Backpack Electrofisher (HT-2000) with unpulsed direct current (DC) and a single pass. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into likely fish habitat within the site. A second crew member walked behind the operator to net any stunned fish using a D-frame landing net (1/8” mesh). If fish were captured, they were held in a live well containing ambient stream water, which was kept out of the sun and checked regularly. At the conclusion of each pass, fish in the live well were identified (species confirmation) and measured (total length in mm). Status, sex, and maturity were also recorded for individual fish using the Individual Fish Measurement Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006). After recuperating, all fish were released upstream and outside of the sampling site.

4.1.2.3 Surface Water Quality
Surface water samples were collected by MEL personnel from two mapped watercourses: One sample was collected within WC2 and one sample within an unnamed mapped WC (referred to in this document as Unnamed Tributary B) as indicated on Figure 8 (Appendix A). Water sourcing WC2 predominantly drains from undeveloped, forested land and wetlands within the Study Area. One sample (referred to as WQ2, in Figure 8, Appendix A) was collected on July 3, 2018 adjacent to the existing quarry access road, in a portion of WC2 which is reflective of downstream conditions from the proposed quarry expansion area located west. The other sample (WQ1) is located in Unnamed Tributary B north of the existing quarry and down gradient of the proposed quarry expansion. Due to a topographical divide, this watercourse is located in a different catchment area than the Study Area and is not expected to receive
direct surface water run-off from the proposed quarry Development Area. As a precautionary measure however, baseline water quality was sampled at WQ1 on July 11, 2018 from which future samples can be compared to should it be required. Both watercourses drain into O’Hearn Flowage which is located east of the access road to Birrette’s East Uniacke Quarry.

The samples were collected from the surface of the water column by submerging the sample bottle neck enough so water from the surface filled the bottle. The sample bottles were labelled with the sample location and date. A Chain of Custody (CoC) was filled out for the samples. The surface water samples were kept cool and were transported to Maxxam Analytics, in Bedford, Nova Scotia for processing. The two surface water samples were analysed for Total Suspended Solids (TSS) and RCAp-MS total metals.

The current discharge location from the on-site settling ponds (WQ3) has been sampled extensively throughout the period 2014-2018 for Total Suspended Solids (TSS) and pH. As discussed in Section 2.3.3, water drains from the settling ponds, beneath the gravel access road and via a ditch into off-site wetland habitat. WQ3 will be re-sampled prior to additional quarry development to include baseline RCAp-MS total metals conditions are captured. Sampling will continue at WQ3 throughout the life of the quarry as per future IA requirements.

4.1.2.3.1 Water Quality Measurements

Water quality measurements were collected by MEL personnel for all delineated watercourses on September 28, 2018, using a Horiba U22 Multi-parameter probe for water temperature, salinity, pH, dissolved oxygen, total dissolved solids and conductivity.

4.1.2.4 Hydrological Effects Analysis

The objective of the hydrologic effects analysis is to determine the potential indirect impact of a change in water quantity the proposed quarry expansion may have on three receiving watercourses (WC2, WC3, and Unnamed Tributary A) (Figure 8, Appendix A). In addition, the potential effects on O’Hearn Flowage has also been explored. The following methods were implemented in order to complete this assessment:

1) Landform lines (5 m topographic) obtained from the Nova Scotia Topographic Database (NSTDB) were used in association with elevation data, and water feature data to delineate local catchment areas (LCA).

2) Three LCA’s were identified based on three tributaries that drain to O’Hearn Flowage. An additional LCA, for the contributing area to O’Hearn Flowage was also identified. These local catchment areas were delineated via desktop (Figure 7, Appendix A).
   • Eastern Local Catchment Area (Eastern LCA) contributes to Watercourse 2 (WC2) and is located within the eastern extent of the Study Area. WC2 as an outflow of WL7, beyond the southern Study Area boundary. WC2 was GPS field delineated and is not recorded in the NSTDB.
• Central Local Catchment Area (Central-LCA) contributes to Watercourse 3 (WC-3) and is located in the central portion of the Study Area. WC3 is also an outflow from WL7, located west of WC2. WC3 was partly field delineated, and a watercourse record is present in the NSTDB.

• Western Local Catchment Area (Western-LCA) contributes to the Unnamed Tributary A and is located at the western extent of the Study Area. Unnamed Tributary A is a mapped watercourse in the NSTDB. The Western-LCA is the largest of the three local catchment areas.

• O’Hearn Flowage Local Catchment Area (O’Hearn Flowage - LCA) encompasses the three LCA’s listed above, as well as additional drainage areas which source water to O’Hearn Brook but are located outside of the Study Area.

3) The existing drainage delineation was used to assess the potential change to four local catchment areas as a result of the proposed quarry expansion. Area was calculated for each LCA.

4) A water balance (mass balance) assessment was completed to determine the impact on flow within each watercourse adjacent the quarry. This is a standard methodology to evaluate potential indirect impact to watercourses and their associated fisheries resources.

   a. A water balance assessment can be used to describe the flow of water in and out of a system. A system is described here as a local catchment area. A water balance assessment uses the principals of conservation of mass in a closed system, whereby any water entering a system (i.e. precipitation) must be transferred into either evaporation (or evapotranspiration), surface runoff (eventually streamflow) or storage/infiltration in the ground. The change in drainage area can be used to simplify the assessment of change in streamflow to receiving watercourses based on the following assumptions:

      a. Water Balance Equation represented as:
      
      \[ \text{Precipitation} = \text{Streamflow} + \text{Evapotranspiration} +/\!\!- \text{Change in Storage} \]

      1. Precipitation rates remain constant over time (i.e. will not drastically change over the next 50+ years).
      2. Streamflow rates will be affected by the changes to contributing drainage area only. No modifications to land use or drainage patterns are expected to areas outside the quarry Development Area.
      3. Evapotranspiration rates remain constant over time (i.e. will not drastically change over the next 50+ years).
      4. No additional storage is created or removed from the local catchment areas from baseline conditions to post expansion (i.e. land use type does not change from existing conditions other than the increased quarry footprint).

   b. Therefore, the drainage area method is applicable to this local catchment area assessment because the only change to the water balance calculation is the contributing drainage area. Furthermore, a conservative approach to determining the reduction in streamflow based on contributing drainage changes is to assume...
the ratio change will be equal (i.e. percent change in local catchment area equals percent change in streamflow).

5) Local catchment area lost due to quarry development was calculated by intersecting the Development Area with the local catchment areas.
   a. It should be recognized that LCA-Central loses not only its footprint within the Development Area but also the remaining portion of the upgradient local catchment area (i.e. the portion which extends outside of the Development Area boundary). This is accounted for in the calculations.

Utilizing the methodology discussed above, the following analysis was performed:

1) Reduction of catchment area within each LCA;
2) Potential change in streamflow characteristics within WC2, WC3, the tributary to O’Hearn Lake as a result of the catchment area changes; and,
3) Overall predicted reduction in catchment area and streamflow within the O’Hearn Flowage.

4.2 Archaeological Resource Assessment

Davis MacIntyre and Associates Limited completed an archaeological resource impact assessment for Birrette’s East Uniacke Quarry Expansion Project in 2018. This assessment consisted of two components:

1. Phase I archaeological resource impact assessment
2. Field reconnaissance Phase II archaeological resource impact assessment

The methodologies of these two components are described below.

4.2.1 Phase I

As part of this assessment, a historic background study was conducted. Historical maps, manuscripts and published literature were consulted at Nova Scotia Archives and Records Management in Halifax. In addition, the Maritime Archaeological Resource Inventory was searched to understand prior archaeological research and known archaeological resources within or neighbouring the Study Area.

4.2.2 Phase II

Vanessa McKillop and Laura de Boer conducted a field reconnaissance of the Study Area on May 30, 2018. Transects were completed through the Study Area, in an east-west direction.

GPS tracklogs of all reconnaissance areas were retained for records, and any sites determined to have potential for archaeological resources were recorded with photographs and GPS coordinates. The terrain and vegetation were noted in the interest of recording negative evidence for historic cultural activity.
5 BIOPHYSICAL ENVIRONMENT CONDITIONS

5.1 General Spatial Setting for Project

The proposed Project is located in the Nova Scotia Eastern Ecoregion (400), as defined by the Nova Scotia Department of Natural Resources (Neily et al. 2005).

The Nova Scotia Eastern Ecoregion extends from Bedford Basin to the town of Guysborough. The total area of the Nova Scotia Uplands Ecoregion is 6,427 km² or approximately 11.6% of the province. This ecoregion is diverse in landforms, including rolling till plains, drumlin fields, extensive rock lands and wetlands. The elevation ranges from 0-220m above sea level (Neily et al., 2005).

The Nova Scotia Eastern Ecoregion is further subdivided into ecodistricts. The Project exists in the Eastern Drumlins Ecodistrict (420). This ecodistrict consists of three disjunct areas of drumlins within this ecoregion. This landscape is formed glacial ice movement the drumlins are oriented north to south towards the Atlantic Ocean (Neily et al., 2005). The geology within this ecodistrict consists of the Meguma Group greywacke and slate covered by fine-textured tills.

The well drained drumlins and hummocks in this ecodistrict provide suitable conditions for tolerant hardwoods such as Yellow Birch, Sugar Maple and Beech to thrive (Neily et al., 2005). In other areas of this region, particularly in lower elevations, conifers such as Black Spruce and Red Spruce dominate.
5.1.2 Land Use and Habitat

Table 4 below displays the land use types and area (in hectares) of each type within the Study Area:

**Table 4. Calculations of Land Use**

<table>
<thead>
<tr>
<th>Land Use/Land Type</th>
<th>Area (ha)</th>
<th>% of Study Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland Habitat</td>
<td>5.8</td>
<td>14</td>
</tr>
<tr>
<td>Quarry</td>
<td>3.0</td>
<td>7</td>
</tr>
<tr>
<td>Hardwood Forest</td>
<td>1.5</td>
<td>4</td>
</tr>
<tr>
<td>Softwood Forest</td>
<td>25.7</td>
<td>63</td>
</tr>
<tr>
<td>Mixed wood Forest</td>
<td>3.3</td>
<td>8</td>
</tr>
<tr>
<td>Other Forest Types</td>
<td>0.07</td>
<td>0</td>
</tr>
<tr>
<td>Roads</td>
<td>1.3</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL STUDY AREA</strong></td>
<td><strong>40.6</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

1 For the purposes of this calculation Study Area includes the existing quarry area

Land use within the Study Area is dominated by forested land. The total area of forested habitat accounts for 75% of the Study Area land base. It should be noted that a review of aerial imagery and field surveys have identified areas with timber-harvesting activities present, and these areas are not accounted for in the land use calculations. Wetlands account for the next dominant land use within the Study Area and the existing quarry and roads make up the remaining percentage of land use.

5.2 Atmospheric Environment

5.2.1 Weather and Climate

The Nova Scotia Eastern Ecoregion summers tend to be warmer and the winters longer and cooler than the neighboring region influenced by the Atlantic Ocean (Neily et al., 2005). The average low temperature (based on statistics from 1981-2010; 30 years) was recorded at -10.4 °C in January and the average high temperature was recorded at 23.8 °C in July (recorded at Halifax Stanfield International Airport, NS) located 19 km southeast of the Study Area (Government of Canada, 2010). Average annual precipitation at this location is recorded at 1396.2 mm. Average annual rainfall at this location is recorded at 1196.1 mm with maximum rainfall levels in November (average 139.1 mm in November). Average annual snowfall has been measured at 221.2 cm with the maximum average snowfall occurring in January (58.5 cm) (Government of Canada, 2010).

5.2.2 Air Quality

Measured air quality parameters across Nova Scotia include ground-level ozone (O3), particulate matter (PM2.5), and nitrogen dioxide (NO2), and these values are used to calculate a score in the Air Quality
Health Index (AQHI) (ECCC, 2016a). The AQHI is a scale from 1-10+, representing the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+). The Study Area is located between the monitoring station of Halifax – Lake Major and Kentville, NS. The AQHI at these sites are considered low, when assessed in January 2019 (ECCC, 2016a).

Average air quality data from the two nearest stations in 2018 is provided by National Air Pollution Surveillance (NAPS) Network and is presented in Table 5 below.

**Table 5: 2018 Air Quality Data**

<table>
<thead>
<tr>
<th>Station</th>
<th>SO2 (ppb)</th>
<th>NOX (ppb)</th>
<th>NO (ppb)</th>
<th>NO2 (ppb)</th>
<th>PM2.5 (µg/m³)</th>
<th>O3 (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Major</td>
<td>0.2</td>
<td>1.3</td>
<td>0.2</td>
<td>1.1</td>
<td>4.3</td>
<td>29.1</td>
</tr>
<tr>
<td>Kentville</td>
<td>-</td>
<td>0.9</td>
<td>0</td>
<td>0.8</td>
<td>7.4</td>
<td>30.5</td>
</tr>
</tbody>
</table>

As per the current IA, particulate emissions (dust) must not exceed 70 µg/m³ (annual geometric mean) and 120 µg/m³ (daily average [24 hr.]) at or beyond the site property boundaries, however, dust monitoring has not been requested by NSE (nor completed) during quarry operations to date. Further, no issues or complaints related to quarry generated dust have been received by the Proponent to date.

5.2.3 **Noise**

Quarry operations create noise during periods of blasting, aggregate crushing, equipment use, and haul truck traffic entering and exiting the quarry. The Study Area is located in a rural setting with the closest residential receptor located 930 m to the north.

As per the current IA, BDEP monitors all blasts for concussion (air blast) and ground vibration to ensure that the designated limits are not exceeded. To date, no blasts have exceeded concussion (128 dBL) or ground vibration (12.5 mm/s) levels at the nearest off-site structure.

Noise level monitoring has not been requested by NSE (nor completed) during quarry operations to date. Further, no issues or complaints related to quarry noise have been received by the Proponent to date.

5.3 **Geophysical Environment**

5.3.1 **Topography**

The Study Area is located at a local high point in elevation. Within the Study Area; the eastern extent slopes southeast towards O’Hearn Flowage, the western extent slopes to the west, and the central portion slopes south. In general, the highest elevations present within the Study Area extend along the northern Study Area boundary (~165 m), however, additional areas of higher elevation also exist adjacent (west) of the current quarry wall (approximately 160 m above sea level), and in land, west of Wetland 7. Apart from the existing quarry floor (approximately 147 m above sea level), the southwestern corner of the
Study Area (comprising Wetlands 16, 18 and 17), exist as the lowest point of the Study Area (approximately 150 m below sea level).

5.3.2 Surficial Geology

The surficial geology of the Study Area consists of two types of surficial geologic units: Silty Drumlín (Drumlin Facies) and Silty Till Plain (Ground Moraine), and Drumlins (NSDNR, 2012a).

Silty Till Plain dominates the underlying surficial geology of the Study Area. The plain is derived from silty material from local and distant sources deposited during the Wisconsinan glaciation. The topography of the plain is described as flat to rolling, with few surface boulders and a thickness of 3-30 m, enough to hide the bedrock undulations. Drumlins and Silty Drumlín Facies are derived from silty material deposited by glacial movement with a higher percentage of distant source material, including red clay. The topography of the Drumlín is described as rolling hills. The general area is described as moderate stoniness and drainage, providing good agricultural land. The acid rain buffer capacity of the area is usually moderate to good, due to transported calcareous bedrocks material (NSDNR, 2012a).

5.3.3 Bedrock Geology

The Study Area overlies bedrock formations from the Goldenville Group (NSDNR, 2012b). The Goldenville Group is described as sandstone, minor siltstone and slate (NSDNR, 2012b). Surficial geology and bedrock geology within the Study Area are shown on Figure 10 and Figure 11 (Appendix A).

5.3.3.1 Acid Rock Drainage (ARD)

Exposing and physically disturbing sulphide-bearing rocks can cause acid rock drainage to develop and can negatively impact the environment, human health and infrastructure. Acidic runoff, with pH levels as low as 3, can be harmful for aquatic habitats and can cause fish kills. ARD can contaminate drinking water supplies with increased concentrations of toxic and carcinogenic heavy metals (The Province of Nova Scotia, 2017).

In Nova Scotia, bedrock groups such as the Goldenville Formation and Halifax Formation of the Cambro-Ordovician Meguma Group are more likely to comprise acid producing rock. Based on a higher probability of acid producing bedrock to occur in Southwestern Nova Scotia, NSDL&F has developed an ARD Potential Map for this area. The Study Area does not fall within this mapping layer, nevertheless, the bedrock underlying the Study Area is part of the Goldenville Formation, which has potential for ARD. For this reason, ARD testing was completed in December 2013 by Maritime Testing Ltd (Table 6 below, and Appendix J). Two samples were collected at representative locations along the existing quarry face of Birrette’s East Uniacke Quarry and analyzed using an Eltra C2000 to measure Total sulphur, following ASTM E1915. Acid Producing Potential was calculated assuming a conservative estimation that all
sulphur measured was sulphide sulphur. For both samples, the total sulfur weight proportion was less than 0.001% and the acid producing potential was less than 0.03 kg/t (Table 6).

Table 6  Acid Rock Drainage Testing

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Total Sulfur (Wt. %)</th>
<th>Acid Producing Potential (kg/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample #1</td>
<td>&lt; 0.001</td>
<td>&lt; 0.03</td>
</tr>
<tr>
<td>Sample #2</td>
<td>&lt; 0.001</td>
<td>&lt; 0.03</td>
</tr>
</tbody>
</table>

A sulphur concentration of 0.001% is considered as low sulphur content and does not present potential for ARD (SRK Consulting, 2013).

5.3.4  Groundwater

Water supplies for individual homes surrounding the Study Area are provided by drilled potable wells.

Details associated with individual wells within a 1 km radius of the Study Area were identified through a review of the NS Well Logs Database (NSE, 2016). This database provides information on more than 100,000 water wells in the province, including information on well locations, geology and well construction, well depth and yield. A total of 19 well logs (all drilled) were found within 1 km of the Study Area. Table 7 outlines well characteristics for each of these wells. General conclusions relating to the groundwater resource in the Study Area were derived from this information. Locations of the drilled wells are provided on Figure 3 (Appendix A).

It should be noted that accuracy of location of these wells is ± 707 m and that 18 of the wells are located at the same UTM (20T 440500 m E 4977500 m N). According to the user’s manual of the NS Well Logs Database (NSE, 2016), all of the wells listed in Table 7 were based off of the NS Map Book, therefore, the UTM coordinates are approximated based on a central point from the map reference.

The average depth to bedrock based on drilling data was generally 8.022 m. Wells appeared to be drilled to an average depth of 54.01 m below grade and were constructed with an average 11.62 m depth of casing (casting depth ranges from 6.09 m to 30.45 m). Sixteen of the 19 well logs recorded static water levels of -9999. These numbers were not included in the average but information that was provided from the remaining three wells indicated an average static depth to water of 4.87 m. A general review of water yields for these wells indicated an average yield of approximately 12.14 L/min.
Table 7. Well Characteristics within 1 km of the Study Area

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Address / Community</th>
<th>Date</th>
<th>Depth (m)</th>
<th>Casing (m)</th>
<th>Depth to Bedrock (m)</th>
<th>Static Level (m)</th>
<th>Yield (L/min)</th>
<th>Elevation (m ASL)</th>
<th>Easting</th>
<th>Northing</th>
<th>Accuracy ± (m)</th>
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</thead>
<tbody>
<tr>
<td>851517</td>
<td>East Uniacke</td>
<td>9/17/1985</td>
<td>45.68</td>
<td>27.4</td>
<td>27.4</td>
<td>-9999</td>
<td>2.27</td>
<td>161</td>
<td>440500</td>
<td>4977500</td>
<td>707</td>
</tr>
<tr>
<td>851535</td>
<td>226 Main Ave, Halifax</td>
<td>9/7/1985</td>
<td>85.26</td>
<td>6.09</td>
<td>-9999</td>
<td>-9999</td>
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<td>4977500</td>
<td>707</td>
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<tr>
<td>851861</td>
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<td>25.88</td>
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<td>861599</td>
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<td>4977500</td>
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<td>MacKenzie Road</td>
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<td>63.94</td>
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<td>3.04</td>
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<td>871811</td>
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<td>61.81</td>
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<td>-9999</td>
<td>6.81</td>
<td>161</td>
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<td>872276</td>
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<td>-9999</td>
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<td>872575</td>
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<tr>
<td>880088</td>
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<td>1/30/1988</td>
<td>48.72</td>
<td>12.18</td>
<td>10.66</td>
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<td>2.27</td>
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<tr>
<td>880700</td>
<td>MacKenzie Lane</td>
<td>9/8/1988</td>
<td>36.54</td>
<td>6.09</td>
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<td>-9999</td>
<td>9.08</td>
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<td>440500</td>
<td>4977500</td>
<td>707</td>
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<td>880701</td>
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<td>440500</td>
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<td>-9999</td>
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<td>892421</td>
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<td>440500</td>
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<td>901573</td>
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<td>-9999</td>
<td>9.08</td>
<td>161</td>
<td>440500</td>
<td>4977500</td>
<td>707</td>
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<td>942089</td>
<td>East Uniacke</td>
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<td>45.4</td>
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<td>4977500</td>
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<td>961730</td>
<td>Rankin Road</td>
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<td>-9999</td>
<td>4.54</td>
<td>161</td>
<td>440500</td>
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### Birrette's East Uniacke Quarry Expansion

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Address / Community</th>
<th>Date</th>
<th>Depth (m)</th>
<th>Casing (m)</th>
<th>Depth to Bedrock (m)</th>
<th>Static Level (m)</th>
<th>Yield (L/min)</th>
<th>Elevation (m ASL)</th>
<th>Easting</th>
<th>Northing</th>
<th>Accuracy ± (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>990512</td>
<td>Sunrise Lane</td>
<td>6/23/1999</td>
<td>76.12</td>
<td>9.14</td>
<td>7</td>
<td>-9999</td>
<td>9.08</td>
<td>161</td>
<td>440500</td>
<td>4977500</td>
<td>707</td>
</tr>
<tr>
<td>991812</td>
<td>65 Beamist Road</td>
<td>9/10/1999</td>
<td>68.51</td>
<td>6.09</td>
<td>3.04</td>
<td>-9999</td>
<td>11.35</td>
<td>161</td>
<td>440500</td>
<td>4977500</td>
<td>707</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>N/A</strong></td>
<td></td>
<td><strong>54.01</strong></td>
<td><strong>11.62</strong></td>
<td><strong>8.02</strong></td>
<td><strong>4.87</strong></td>
<td><strong>12.14</strong></td>
<td><strong>161.37</strong></td>
<td><strong>N/A</strong></td>
<td><strong>N/A</strong></td>
<td><strong>N/A</strong></td>
</tr>
</tbody>
</table>

Note = Averages do not include casing, depth to bed rock, or static levels reported as -9999.
No wells were recorded within the Study Area by the NS Well Logs Database nor were any observed within the Study Area during field studies. According to the information available in the NS Well Logs Database, the closest mapped drilled groundwater well used for potable purposes is located 680 m north of the Study Area; however, as previously mentioned, the accuracy for this well within the database is ± 707 m. Additionally, a review of aerial imagery found no structure present at this location which further suggests that this well location is inaccurate.

In order to determine a more precise location for adjacent residential wells, the Nova Scotia Topographic Database (NSTB) was reviewed to identify buildings within 1 km of the Study Area. In total one building was identified within 1 km of the Study Area. An aerial review identified a second building within 1 km of the Study Area. Although the NSE Well Logs Database does not indicate wells at either building, they have been assumed to exist. These residential receptors are located approximately 930 m north and 1,000 m west of the Study Area, respectively (Figure 3, Appendix A).

5.3.5 **Surface Water**

A review of aerial imagery identified no waterbodies within the Study Area. The following mapped watercourses were identified as indicated on Figure 8 (Appendix A):

- One mapped watercourse was identified in the south-central portion of the Study Area as an outflow to a mapped wetland. This mapped watercourse drains south to O’Hearn Flowage and is referred to in this document as WC3;
- O’Hearn Flowage is located approximately 660 m east of the Study Area and connects to Herbert River via O’Hearn Brook and eventually discharges into the Minas Basin;
- A second mapped watercourse was identified north of the Study Area, but based on 5 m topographical contours, has no surficial connection to the Study Area. This watercourse is referred to in this document as Unnamed Tributary B; and
- A third mapped watercourse exists approximately 420 m west of the Study Area boundary and is referred to in this document as Unnamed Tributary A.

The detailed catchment area analysis which was completed to evaluate hydrological effects associated with the Project identified three catchments within the Study Area. These catchments define baseline water flow patterns across the Study Area and indicate that due to the undulating nature of the landscape, surface water flows are as follows:

- Eastward from eastern portions of the Study Area;
- Southward from central portions of the Study Area; and,
- Westward from western portions of the Study Area.
5.3.5.1  *Predicted Water Discharge*
As described in Section 2.3.3, water currently discharges from the quarry via settling ponds eastward (via culverts beneath the quarry gravel access road) into an off-site wetland. Desktop resources including topographical mapping, NSDL&F Flow Accumulation mapping (NSDNR, 2013), and aerial imagery were utilized to predict the flow of water from the current quarry. Future water flows are proposed to discharge via the same system (see Sections 9.2.2 and 9.2.3). Desktop analysis confirmed that water discharging from the quarry drains northward within road side ditching before being culverted into a previously field identified wetland. From this wetland drainage flows south into WC2, approximately 350 m south of the discharge culvert from the quarry. The predicted discharge flow location is identified on Figure 5 (Appendix A).

5.3.5.2  *East Hants Regional Municipal Water Supply Area*
According to the ACCDC report, the East Hants Regional Municipal Water Supply Area is the closest NSE Protected Water Area. The water supply area is located approximately 1.8 km south of the Study Area.

5.4  *Terrestrial Environment*
This section describes the Study Area habitat, avian use, wildlife, and vegetation communities.

5.4.1  *Habitat*
Desktop review and field results for habitat assessments completed within the Study Area are provided in the following sections.

5.4.1.1  *Desktop Results*
Based on the desktop review, the Study Area is within the Eastern Ecoregion and Eastern Drumlin Ecodistrict (420). Please refer to Section 5.1.1 for details.

5.4.1.2  *Field Results*
During the field surveys it was noted that the Study Area consists of cut blocks, access roads, forested landscapes and an existing quarry. In locations where forested landscapes are present, mixedwood (MW), intolerant hardwoods (IH) and Spruce-hemlock (SH) were the prevalent VTs.

Ten HAPs were assessed during the surveys. The vegetative community, which is dominated by Spruce (*Picea sp.*), Balsam Fir (*Abies balsamea*) and Red Maple (*Acer rubrum*) with a prominent ericaceous herbaceous layer is reflective of a poor to medium nutrient regime. These ecosites (AC10 and AC11) were identified within the Study Area during the surveys.

The most prevalent VTs observed during the surveys were the SH (50%) and MW (40%) with the least frequent VT being IH (10%). See Figure 1 (below) for the relative habitat type within the Study Area.
See below for descriptions of the VTs observed during the surveys.

5.4.1.2.1 *Mixedwood Vegetation Types*

The mixedwood VT comprise of 40% (n=4) of the HAPs surveyed with the Balsam Fir – Red Maple/ Wood Sorrel - Goldthread (MW4, n=3) being the most frequent VT of this group within the Study Area. This is an early to mid-successional mixedwood VT dominated by Balsam Fir and Red Maple with an understory of Birch (*Betula sp.*.) and Spruce. The herbaceous layer is sparse and consisting primarily of Star Flower (*Trientalis borealis*) and a moss layer consisting of Schreber’s moss and *Bazzania sp.* The second VT within this group – Red Spruce – Yellow Birch/ Evergreen Woodfern (MW1, n=1). This VT is a late successional mixedwood VT dominated by Yellow Birch with Red Spruce (*Picea rubens*) and Balsam Fir. The understory consists of Red Maple saplings and the herbaceous layer consists of woodferns (*Dryopteris sp.*), and Black Berries. These VTs are scattered across the Study Area.

5.4.1.2.2 *Spruce-hemlock Vegetation Types*

The Spruce-hemlock VTs comprise of 50% (n=5) of the HAPs surveyed and are scattered throughout the Study Area. The only VT within this group observed is the Red Spruce – Balsam Fir/Schreber’s moss (SH5). This VT is mid-successional with Red Spruce and Balsam Fir as the dominant canopy cover. This VT typically has a sparse understory commonly dominated with Red Maple and False Holly.
(Nemopanthus mucronatus). The herbaceous layer across the survey points were dominated by Schreber’s Moss and Bunchberry (Cornus canadensis).

5.4.1.2.3 Intolerant Hardwood Vegetation Types

The intolerant community comprises of 10% (n=1) of the HAPs surveyed within the Study Area. This VT is located in the western portion of the Study Area. These VTs are defined by forests with closed canopies dominated by shade intolerant to intermediate hardwoods (i.e. Red Maple, White Birch [Betula papyrifera], Grey Birch [Betula populifolia], Trembling Aspen [Populus tremuloides], Large-tooth Aspen [Populus grandidentata], Red Oak and White Ash). The herbaceous layer can be quite variable depending on the nutrient regime however, common species found were Wild Sarsaparilla (Aralia nudicaulis), Starflower and ericaceous species (on poorer nutrient sites). The only VT found within this group is the Trembling Aspen/ Wild Raisin/ Bunchberry (IH5). This VT is early successional dominated by Trembling Aspen and Red Maple and usually indicative of stand disturbances (e.g. timber harvesting, forest fires etc.), and usually in soils with a moisture regime of fresh – moist.

5.4.1.3 Habitat Conclusions

In general, the Study Area is dominated by disturbances such as a quarry, access roads and cut blocks. The forest stands are of varying maturity ranging from regenerative to mature stands. As indicative of the vegetation community (i.e. ericaceous shrubs and conifer dominant), the soils in the area are acidic with nutrient regimes of poor to medium richness which is attributed by the Greywacke bedrock present within the Study Area.

5.4.2 Vascular Plants

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.2.1 Desktop Results

One priority vascular plant, Michaux’s Dwarf Birch (Betula michauxii; S2S3) was documented within 5 km of the Study Area in the ACCDC report. No priority plant species were identified in the NSCCH report. The Priority Species List (Appendix C) created for the Project comprised 71 vascular plant species that have potential for being present within the Study Area. This was used as a reference during the field program.

5.4.2.2 Field Results

A total of 117 species were identified within the Study Area. One SOCI was observed, Southern Twayblade (Listera australis, S3). The bedrock within the Study Area consists primarily of Greywacke which supports ericaceous shrubs and conifers which have a tolerance for acidic and nutrient poor soils. The Study Area is disturbed by previous quarry development and forestry activities. Within portions of the Study Area, large wetland fen and bog complexes exist with variable topography providing a variety
of microhabitats with different moisture regimes which has the potential to support vascular plant rarities. Other habitats that often support rarities such as hardwood tolerant forests and floodplains were not observed within the Study Area. A list of all species identified within the Study Area is provided in Appendix D. Further details relating to potential SAR and SOCI flora species are provided in Section 5.6.1.

5.4.3 **Lichens**

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.3.1 **Desktop Results**

No priority lichen species were documented within a 5 km in the ACCDC report. No priority lichens were identified within the NSCCH report. No predicted BFL polygons are present within the Study Area.

5.4.3.2 **Field Results**

During the field Surveys, 30 lichen species were observed. Two species were determined to be SOCI species which include Appressed Jellyskin Lichen (*Leptogium subtile*) and Pompom-tipped Shadow Lichen (*Phaeophyscia pusilloides*). Additional information regarding the Priority Lichen Species is provided in Section 5.6.2.

As a result of historical and current disturbances, the landscape consisted primarily of regenerative canopies (hardwood and softwood) which do not provide the appropriate stand maturity necessary for many of the priority lichen species in Nova Scotia.

No suitable habitat for BFL was observed. Mature Balsam Fir dominated swamps were lacking within the Study Area and as mentioned above, the Study Area was dominated by regenerative stands of both softwood and hardwood species. Aside from the lack of the appropriate stands and landscape types (i.e. treed wetlands) necessary to support BFL, the overall lichen community which is often indicative of BFL habitat was also lacking. No indicator species such as *Coccocarpia palmicola* and *Lobaria spp.* on Balsam Fir were observed.

Although the Study Area is primarily disturbed, there were isolated stands of mature hardwood tree species such as Red Maple and Large-tooth Aspen which did provide suitable habitat for some corticolous species such as *Leptogium subtile* and *Phaeophyscia pusilloides* which were observed during the surveys. See Table 8 (below) for the lichens species observed.

**Table 8: Observed Lichen Species**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>SAR/NSESA</th>
<th>SRank</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Leptogium subtile</em></td>
<td>Appressed Jellyskin Lichen</td>
<td>-</td>
<td>S3</td>
</tr>
<tr>
<td><em>Phaeophyscia pusilloides</em></td>
<td>Pompom-tipped Shadow Lichen</td>
<td>-</td>
<td>S3?</td>
</tr>
</tbody>
</table>
### Scientific Name | Common Name | SAR/NSESA | SRank |
--- | --- | --- | --- |
*Imshaugia aleurites* | Salted Starburst Lichen | - | S4 |
Usnea longissini | Methuselah's Beard Lichen | - | S4 |
*Mycoblastus sanguineroides* | Bloody-heart Lichen | - | --* |
*Tuckermannopsis sp.* | A Lichen | - | --* |
*Peltigera praetextata* | Born-again Pelt Lichen | - | S4S5 |
*Pertusaria amara* | Bitter Wart Lichen | - | --* |
*Bryoria fuscescens* | Pale-footed Horsehair Lichen | - | S4S5 |
*Cladonia macilenta* | Lipstick Powderhorn Lichen | - | S4S5 |
*Stereocaulon tomentosum* | Woolly Foam Lichen | - | S4S5 |
caloplaea flavorubescens | A Lichen | - | --* |
*Hypogymnia incurvoides* | Lattice Tube Lichen | - | S4S5 |
*Hypogymnia krogiae* | Freckled Tube Lichen | - | S5 |
*Lobaria pulmonaria* | Lungwort Lichen | - | S5 |
*Lobaria quercizans* | Smooth Lung Lichen | - | S5 |
*Ropalospora chlorantha* | Comet Spored Lichen | - | --* |
*Cladonia cristatella* | British Soldiers Lichen | - | S5 |
*Cladonia maxima* | Giant Cladonia Lichen | - | S5 |
*Cladonia ochrochlora* | Smooth-footed Powderhorn Lichen | - | S5 |
*Collema subflaccidum* | Tree Tarpaper Lichen | - | S5 |
*Dibaeis baeomyces* | Pink Earth Lichen | - | S5 |
*Hypogymnia physodes* | Monk's Hood Lichen | - | S5 |
*Hypogymnia tubulosa* | Powder-headed Tube Lichen | - | S5 |
*Leptogium cyanescens* | Blue Jellyskin Lichen | - | S5 |
*Platismatia tuckermanii* | Crumpled Rag Lichen | - | S5 |
*Iopadium disciforme* | A Lichen | - | --* |
*Usnea strigose* | Bushy Beard Lichen | - | S5 |
*Cladina arbuscular* | Reindeer Lichen | - | S5 |
*Cladina stellaris* | Star-tipped Reindeer Lichen | - | S5 |
*Cladonia squamosa* | Dragon Lichen | - | S5 |
*Cladonia uncialis* | Thorn Lichen | - | S5 |
*Evernia mesomorpha* | Boreal Oakmoss Lichen | - | S5 |
*Parmelia squarrosa* | Bottlebrush Shield Lichen | - | S5 |
*Buellia erubescens* | Common Button Lichen | - | --* |
*Platismatia glauca* | Varied Rag Lichen | - | S5 |
*Lecanora thysanophora* | a Lichen | - | SNR |

Note: Scientific names used are in accordance to the latest ACCDC species list retrieved in December 2018. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used.

* Species ranking in the province has yet to be determined by the ACCDC

### 5.4.4 Herpetofaunal Species

No herpetofaunal species were observed during field surveys within the Study Area, however, the Study Area provides potential herpetofaunal habitat notably within the wetland habitat identified and
watercourses present. A common assemblage of herpetofaunal species likely to inhabit the Study Area are listed in Table 9 (below).

Table 9. Herpetofaunal Species with an Elevated Potential to Occupy the Study Area.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>ACCDC Prov. Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ambystoma maculatum</em></td>
<td>Yellow-spotted Salamander</td>
<td>S5</td>
</tr>
<tr>
<td><em>Anaxyrus americanus</em></td>
<td>Eastern American Toad</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lithobates clamitans</em></td>
<td>Green Frog</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lithobates palustris</em></td>
<td>Pickerel Frog</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lithobates pipiens</em></td>
<td>Northern Leopard Frog</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lithobates pipiens</em></td>
<td>Mink Frog</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lithobates sylvaticus</em></td>
<td>Wood Frog</td>
<td>S5</td>
</tr>
<tr>
<td><em>Opheodrys vernalis</em></td>
<td>Eastern Smooth Green Snake</td>
<td>S5</td>
</tr>
<tr>
<td><em>Plethodon cinereus</em></td>
<td>Eastern Red-backed Salamander</td>
<td>S5</td>
</tr>
<tr>
<td><em>Pseudacris crucifer</em></td>
<td>Spring Peeper</td>
<td>S5</td>
</tr>
<tr>
<td><em>Thamnophis sirtalis pallidulus</em></td>
<td>Maritime Garter Snake</td>
<td>S5</td>
</tr>
</tbody>
</table>

During field surveys, specific focus was given to identifying Priority Species, especially those identified as having appropriate habitat within the Study Area through the desktop evaluation for Priority Species. Wood Turtles (Threatened under SARA) were observed 5.2 km from the Study Area and Snapping Turtles (Special Concern under SARA) were observed 6.6 km from the Study Area, by the ACCDC. As well, Wood Turtle critical habitat is documented approximately 3.2 km north of the Study Area, along Herbert River. During public consultation several residences in the vicinity of the Study Area (~ 1 km) informed MEL staff that they have observed Snapping Turtles on the shoulder of driveways off East Uniacke Road, in gravel substrate.

No SAR and SOCI herpetofaunal species were identified during field surveys. No breeding or overwintering Wood Turtle or Snapping Turtle habitat was observed throughout the Study Area. Further details relating to potential SAR and SOCI herpetofaunal species are provided in Section 5.6.3.

5.4.5 Wildlife Surveys and Mammals

The closest Mainland Moose Concentration Area is located approximately 50 km north of the Study Area. A winter wildlife survey was completed on March 12, 2018. No Mainland Moose sign were observed.

Incidental observation of mammal species were documented during all field survey activities during 2018 across the Study Area. Specific focus was given to searching for signs of Priority Species identified as having appropriate habitat within the Study Area.
Table 10 lists those species that were confirmed within the Study Area either visually or by sign (scat, tracks, etc.). A discussion of bat usage within the Study Area is provided in Section 5.4.7.

**Table 10. Confirmed Mammalian Species during 2018 Field Surveys.**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>SRank</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Canis latrans</em></td>
<td>Eastern Coyote</td>
<td>S5</td>
</tr>
<tr>
<td><em>Erethizon dorsatum</em></td>
<td>North American Porcupine</td>
<td>S5</td>
</tr>
<tr>
<td><em>Lepus americanus</em></td>
<td>Snowshoe Hare</td>
<td>S5</td>
</tr>
<tr>
<td><em>Mustela erminea</em></td>
<td>Short-tailed Weasel</td>
<td>S5</td>
</tr>
<tr>
<td><em>Odocoileus virginianus</em></td>
<td>White Tailed Deer</td>
<td>S5</td>
</tr>
<tr>
<td><em>Tamiasciurus hudsonicus</em></td>
<td>American Red Squirrel</td>
<td>S5</td>
</tr>
<tr>
<td><em>Peromyscus leucopus</em></td>
<td>White-footed Deermouse</td>
<td>S5</td>
</tr>
</tbody>
</table>

Other common carnivore/omnivore species such as Red Fox (*Vulpes Vulpes*), Northern Raccoon (*Procyon lotor*) and Striped Skunk (*Mephitis mephitis*) are likely to inhabit the Study Area or surrounding areas, at least periodically.

Further details relating to potential SAR and SOCI mammal species are provided in Section 5.6.4. No SAR or SOCI mammals were identified during field surveys.

5.4.6 **Avian**

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.6.1 **Desktop Results**

There are no Important Bird Areas (IBA) within 20 km of the Study Area. (Bird Studies Canada, 2012). The closest IBA, Southern Bight, Minas Basin (NS020), is approximately 38 km northwest of the Study Area.

Southern Bight, Minas Basin (NS020) is located along the Avon River and Minas Basin, Bay of Fundy. The communities of Windsor and Wolfville are found within this IBA. The Southern Bight, Minas Basin IBA is a large tidal embayment, composed largely of intertidal mudflats divided into five sections by river channels. These sections vary in substrate (i.e. sand/silt gradients) and invertebrate assemblage. Kingsport-Medford, Porters Point, Starrs Point, Evangeline Beach, and Avonport make up the five sections. This IBA, and the mud flats within it that become exposed at low tide, are an important staging ground for an estimated 1 to 2 million shorebirds. During late July and early August, shorebirds – including the Semipalmated Sandpiper (*Calidris pusilla*; S3M) – use this area to feed before their southward migration (Bird Studies Canada, 2012).
The habitats provided within this IBA are not consistent with habitat available within the Study Area. The IBA is mainly associated with shorebird and wading species dependant on exposed mudflats and salt marsh for their food sources.

The closest Canada Wildlife Service Migratory Bird Sanctuary (MBS) in Nova Scotia is the Kentville MBS, which is located approximately 90 km northwest of the Study Area. Kentville MBS plays a key role for regional waterfowl populations. Various waterfowl and raptors have been observed within the MBS (Government of Canada, 2017).

The NSCCH report (Appendix C) contained records for the following priority bird species nesting or possibly nesting within or surrounding the Study Area:

- Bank Swallow
- Barn Swallow
- Bay-breasted Warbler
- Blackpoll Warbler
- Bobolink
- Boreal Chickadee
- Chimney Swift
- Common Loon
- Common Nighthawk
- Eastern Kingbird
- Eastern Wood-Peewee
- Golden-Crowned Kinglet
- Gray Jay
- Olive-Sided Flycatcher
- Pine Grosbeak
- Pine Siskin
- Ruby-Crowned Kinglet
- Tree Swallow
- Yellow-bellied Flycatcher

5.4.6.2 Avian Survey Results
Baseline surveys for birds were completed from May to October 2018, by MEL personnel. A total of 888 minutes (14 hours and 48 mins) of surveys were completed over three seasons including time spent on Common Nighthawk surveys. These surveys resulted in the observation of 682 individuals, representing 43 species within or in proximity to the Study Area; this includes one incidentally observed species. Across all survey seasons a total of four priority species were observed during dedicated survey periods, all of which are SOCI according to ranks designated by the ACCDC. These Priority Species are discussed in Section 5.6.5.
Bird species were identified based on functional bird groups to understand how each group of birds is using the Study Area. These functional groups include:

1. **Waterfowl**: Ducks, geese, or other large aquatic birds, especially when regarded as game;
2. **Shorebirds**: Waders, from the Order Charadriiformes;
3. **Other waterbirds**: Includes seabirds (i.e. marine birds), grebes (Order Podicipediformes), loons (Order Gaviiformes), Ciconiiformes (i.e. storks, herons, egrets, ibises, spoonbills, etc.), pelicans (Order Pelecaniformes), flamingos (Order Phoenicopteriformes), Gruiformes (i.e. cranes and rails), kingfishers, gulls and dippers (the only family of passerines considered waterbirds);
4. **Diurnal Raptors**: Birds within the families Accipitridae (i.e. hawks, eagles, buzzards, harriers, kites and old-world vultures), Pandionidae (i.e. Osprey), Sagittariidae (i.e. Secretary bird), Falconidae (i.e. falcons, caracaras, and forest falcons), Cathartidae (i.e. new world vultures), and one species from the Order Strigiformes (i.e. Hawk Owl);
5. **Nocturnal Raptors**: Birds of the Order Strigiformes (i.e. owls; with exception of the Hawk Owl, which is a diurnal species of owl);
6. **Passerines**: Any bird of the Order Passeriformes, which includes more than half of all bird species. This is with exception of the dippers, which are a passerine considered a waterbird; and,
7. **Other Landbirds**: Birds within the Orders Galliformes (i.e. quail, pheasant, and grouse), Columbiformes (i.e. pigeons and doves), Cuculiformes (i.e. cuckoos), Caprimulgiformes (i.e. nighthawks and whip-poor-wills), Apodiformes (i.e. swifts and hummingbirds), and Piciformes (i.e. woodpeckers, flickers and sapsuckers).

The most abundant group observed on site were passerines. The seasonal specific survey results are discussed below:

**5.4.6.2.1 Spring Migration**

Twelve (12) point count locations were surveyed during the spring bird migration period. The spring bird migration survey was conducted on May 3 and May 17, 2018. During spring migration, a total of 314 individuals representing 32 species were observed. With incidental observations removed (those outside of point count locations), 313 individuals, representing 31 species, not including one rooster heard at during the dedicated survey period (see Table 11 below).

No SAR and two SOCI species were observed during the spring migration surveys: Pine Siskin *(Carduelis pinus; S2S3)* and Red-breasted Nuthatch *(Sitta canadensis; S3).*

### Table 11. Spring Migration: Species and Abundance of Birds

<table>
<thead>
<tr>
<th>Species Code</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>#</th>
<th>Points Obs.</th>
<th>Bird Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCR</td>
<td>American Crow</td>
<td><em>Corvus brachyrhynchos</em></td>
<td>9</td>
<td>6, 7, 8, 9, 10, 11</td>
<td>6</td>
</tr>
<tr>
<td>AMGO</td>
<td>American Goldfinch</td>
<td><em>Carduelis tristis</em></td>
<td>3</td>
<td>1, 9, 12</td>
<td>6</td>
</tr>
<tr>
<td>Species Code</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>#</td>
<td>Points Obs.</td>
<td>Bird Group</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------</td>
<td>----------------------------------</td>
<td>----</td>
<td>-------------------</td>
<td>------------</td>
</tr>
<tr>
<td>AMRO</td>
<td>American Robin</td>
<td><em>Turdus migratorius</em></td>
<td>17</td>
<td>2,3,5,6,7,8,9,10</td>
<td>6</td>
</tr>
<tr>
<td>BAWW</td>
<td>Black-and-white Warbler</td>
<td><em>Mniotilta varia</em></td>
<td>9</td>
<td>1,2,3,6,8,11,12</td>
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<tr>
<td>BCH</td>
<td>Black-capped Chickadee</td>
<td><em>Poecile atricapilla</em></td>
<td>25</td>
<td>1,2,3,4,5,6,7,9,10</td>
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<tr>
<td>BHVI</td>
<td>Blue-headed Vireo</td>
<td><em>Vireo solitarius</em></td>
<td>7</td>
<td>1,2,4,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>BLJA</td>
<td>Blue Jay</td>
<td><em>Cyanocitta cristata</em></td>
<td>18</td>
<td>1,2,3,4,5,7,8,9,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>BTNW</td>
<td>Black-throated Green Warbler</td>
<td><em>Dendroica virens</em></td>
<td>18</td>
<td>1,2,3,4,5,6,7,8,9,10,12</td>
<td>6</td>
</tr>
<tr>
<td>CAGO</td>
<td>Canada Goose</td>
<td><em>Branta canadensis</em></td>
<td>6</td>
<td>6,10,11,12</td>
<td>1</td>
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<tr>
<td>COGR</td>
<td>Common Grackle</td>
<td><em>Quiscalus quiscula</em></td>
<td>6</td>
<td>2,3,4,7</td>
<td>6</td>
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<tr>
<td>DEJU</td>
<td>Dark-eyed Junco</td>
<td><em>Junco hyemalis</em></td>
<td>28</td>
<td>1,2,3,4,5,6,7,10,12</td>
<td>6</td>
</tr>
<tr>
<td>GCKI</td>
<td>Golden-crowned Kinglet</td>
<td><em>Regulus satrapa</em></td>
<td>8</td>
<td>4,5,9,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>HAWO</td>
<td>Hairy Woodpecker</td>
<td><em>Picoides viloosus</em></td>
<td>3</td>
<td>5,7</td>
<td>7</td>
</tr>
<tr>
<td>HETH</td>
<td>Hermit Thrush</td>
<td><em>Catharus guttatus</em></td>
<td>33</td>
<td>1,2,3,4,5,6,7,8,9,10,11,12</td>
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</tr>
<tr>
<td>MAWA</td>
<td>Magnolia Warbler</td>
<td><em>Dendroica magnolia</em></td>
<td>4</td>
<td>2,4,9,12</td>
<td>6</td>
</tr>
<tr>
<td>MODO</td>
<td>Mourning Dove</td>
<td><em>Zenaida macroura</em></td>
<td>2</td>
<td>4,10</td>
<td>7</td>
</tr>
<tr>
<td>NAWA</td>
<td>Nashville Warbler</td>
<td><em>Vermivora ruficapilla</em></td>
<td>1</td>
<td>12</td>
<td>6</td>
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<tr>
<td>NOFL</td>
<td>Northern Flicker</td>
<td><em>Colaptes auratus</em></td>
<td>12</td>
<td>2,3,6,8,9,10,11,12</td>
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</tr>
<tr>
<td>NOPA</td>
<td>Northern Parula</td>
<td><em>Parula americana</em></td>
<td>1</td>
<td>8</td>
<td>6</td>
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<tr>
<td>OVEN</td>
<td>Ovenbird</td>
<td><em>Seiurus aurocapilla</em></td>
<td>17</td>
<td>1,2,3,4,5,6,7,8,10,11,12</td>
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<tr>
<td>PAWA</td>
<td>Palm Warbler</td>
<td><em>Dendroica palmarum</em></td>
<td>4</td>
<td>10,12</td>
<td>6</td>
</tr>
<tr>
<td>PISI</td>
<td>Pine Siskin</td>
<td><em>Carduelis pinus</em></td>
<td>2</td>
<td>4,12</td>
<td>6</td>
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<tr>
<td>PUFI</td>
<td>Purple Finch</td>
<td><em>Carpodacus purpureus</em></td>
<td>5</td>
<td>1,6,12</td>
<td>6</td>
</tr>
<tr>
<td>RBNU</td>
<td>Red-breasted Nuthatch</td>
<td><em>Sitta canadensis</em></td>
<td>9</td>
<td>3,4,5,6,8,10</td>
<td>6</td>
</tr>
<tr>
<td>RCKI</td>
<td>Ruby-crowned Kinglet</td>
<td><em>Regulus calendula</em></td>
<td>4</td>
<td>3,4,10,12</td>
<td>6</td>
</tr>
<tr>
<td>REVI</td>
<td>Red-eyed Vireo</td>
<td><em>Vireo olivaceus</em></td>
<td>2</td>
<td>8,10</td>
<td>6</td>
</tr>
<tr>
<td>RTHA</td>
<td>Red-tailed Hawk</td>
<td><em>Buteo jamaicensis</em></td>
<td>1</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>RUGR</td>
<td>Ruffed Grouse</td>
<td><em>Bonasa umbellus</em></td>
<td>2</td>
<td>2,4</td>
<td>7</td>
</tr>
<tr>
<td>SOSP</td>
<td>Song Sparrow</td>
<td><em>Melospiza melodia</em></td>
<td>1</td>
<td>1</td>
<td>6</td>
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<tr>
<td>Unidentified Bird species</td>
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<td>6</td>
<td>1,4,12</td>
<td></td>
</tr>
<tr>
<td>Unidentified Woodpecker species</td>
<td>#N/A</td>
<td></td>
<td>1</td>
<td>4</td>
<td></td>
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<tr>
<td>WTSP</td>
<td>White-throated Sparrow</td>
<td><em>Zonotrichia albicollis</em></td>
<td>37</td>
<td>1,2,3,4,6,7,8,9,10,11,12</td>
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</tr>
<tr>
<td>YRWA</td>
<td>Yellow-rumped Warbler</td>
<td><em>Dendroica coronata</em></td>
<td>12</td>
<td>2,3,5,9,11,12</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Species: 31**  **Total Number: 313**

Notes: Incidental observations during the spring migration surveys are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

The three most commonly observed species were White-throated Sparrow (n=37), Hermit Thrush (n=33), and Black-capped Chickadee (n=25). No obvious concentration of ducks or shorebirds was observed. The majority of observations were of a few individuals, and no large group of birds were observed. The most abundant species group observed on site during the spring migration period was passerines, followed by other landbirds as the next most abundant group on-site.
5.4.6.2.2 Breeding Season

The breeding bird survey consisted of 12 point count stations which were surveyed twice in the month of June, 2018. A total of 172 individuals representing 34 species were observed. With incidental observations removed (i.e. those outside of point count), 171 individuals representing 33 species were observed and are included in the summary below (see Table 12). The only species observed incidentally was a rooster, which was heard crowing at multiple point count locations on June 21, 2018.

During dedicated breeding bird point count surveys, three Priority Species, all of which were SOCI, were observed. Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), and Yellow-bellied Flycatcher (S3S4B) were observed at multiple point count locations.

The breeding status of the bird species observed during breeding bird surveys are noted in Table 12. The surveyor recorded any notes on bird behavior observed, including distraction display, carrying food, and carrying nesting material. The following are the breeding status (MBBA, 2008) observed during the breeding bird surveys:

- Observed- species observed in its breeding season
- Possible- species observed during breeding season in suitable nesting habitat or singing males or breeding calls heard, in suitable nesting habitat during breeding season
- Probable- agitated behavior observed or the occurrence of an adult bird, at the same place, on at least two days a week during breeding season
- Confirmed- adult carrying food or distraction display

**Table 12. Breeding Season Surveys: Species and Abundance of Birds**

<table>
<thead>
<tr>
<th>Species Code</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>#</th>
<th>Points Obs.</th>
<th>Bird Group</th>
<th>Breeding Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALFL</td>
<td>Alder Flycatcher</td>
<td>Empidonax alnorum</td>
<td>9</td>
<td>2,6,7,8,10,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>AMCR</td>
<td>American Crow</td>
<td>Corvus brachyrhynchos</td>
<td>4</td>
<td>3,5,8,11</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>AMGO</td>
<td>American Goldfinch</td>
<td>Carduelis tristis</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>AMRE</td>
<td>American Redstart</td>
<td>Setophaga ruticilla</td>
<td>2</td>
<td>1,7</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>AMRO</td>
<td>American Robin</td>
<td>Turdus migratorius</td>
<td>7</td>
<td>5,9,10,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>BAWW</td>
<td>Black-and-white Warbler</td>
<td>Mniotilta varia</td>
<td>8</td>
<td>1,4,5,7,8,9,11</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>BCCH</td>
<td>Black-capped Chickadee</td>
<td>Poecile atricapilla</td>
<td>8</td>
<td>2,4,7,8,9,10</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>BHVI</td>
<td>Blue-headed Vireo</td>
<td>Vireo solitarius</td>
<td>1</td>
<td>11</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>BLJA</td>
<td>Blue Jay</td>
<td>Cyanocitta cristata</td>
<td>8</td>
<td>3,4,6,8,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>BTNW</td>
<td>Black-throated Green Warbler</td>
<td>Dendroica virens</td>
<td>24</td>
<td>2,3,4,5,6,7,8,9,11</td>
<td>6</td>
<td>Probable</td>
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<tr>
<td>CAGO</td>
<td>Canada Goose</td>
<td>Branta canadensis</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>Observed</td>
</tr>
<tr>
<td>CHSP</td>
<td>Chipping Sparrow</td>
<td>Spizella passerina</td>
<td>1</td>
<td>8</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>Species Code</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>#</td>
<td>Points Obs.</td>
<td>Bird Group</td>
<td>Breeding Status</td>
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<td>--------------------------</td>
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<tr>
<td>COYE</td>
<td>Common Yellowthroat</td>
<td><em>Geothlypis trichas</em></td>
<td>13</td>
<td>1,5,6,7,8,10,11,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>DEJU</td>
<td>Dark-eyed Junco</td>
<td><em>Junco hyemalis</em></td>
<td>6</td>
<td>3,5,7,8,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>GCKI</td>
<td>Golden-crowned Kinglet</td>
<td><em>Regulus satrapa</em></td>
<td>6</td>
<td>3,6,11,12</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>HETH</td>
<td>Hermit Thrush</td>
<td><em>Catharus guttatus</em></td>
<td>8</td>
<td>3,4,5,9,10,11</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>LEFL</td>
<td>Least Flycatcher</td>
<td><em>Empidonax minimus</em></td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>MAWA</td>
<td>Magnolia Warbler</td>
<td><em>Dendroica magnolia</em></td>
<td>6</td>
<td>2,3,4,5,9</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>NAWA</td>
<td>Nashville Warbler</td>
<td><em>Vermivora ruficapilla</em></td>
<td>3</td>
<td>4,5</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>OVEN</td>
<td>Ovenbird</td>
<td><em>Seiurus aurocapilla</em></td>
<td>8</td>
<td>2,3,5,9,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>PAWA</td>
<td>Palm Warbler</td>
<td><em>Dendroica palmarum</em></td>
<td>3</td>
<td>2,10,12</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>RBNU</td>
<td>Red-breasted Nuthatch</td>
<td><em>Sitta canadensis</em></td>
<td>4</td>
<td>4,9,10,12</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>RCKI</td>
<td>Ruby-crowned Kinglet</td>
<td><em>Regulus calendula</em></td>
<td>6</td>
<td>3,4,5,10,12</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>REVI</td>
<td>Red-eyed Vireo</td>
<td><em>Vireo olivaceus</em></td>
<td>2</td>
<td>6,8</td>
<td>6</td>
<td>Probable</td>
</tr>
<tr>
<td>RIPH</td>
<td>Ring-necked Pheasant</td>
<td><em>Phasianus colchicus</em></td>
<td>5</td>
<td>3,5,7,11,12</td>
<td>7</td>
<td>Possible</td>
</tr>
<tr>
<td>RTHA</td>
<td>Red-tailed Hawk</td>
<td><em>Buteo jamaicensis</em></td>
<td>2</td>
<td>5,12</td>
<td>4</td>
<td>Possible</td>
</tr>
<tr>
<td>SOSP</td>
<td>Song Sparrow</td>
<td><em>Melospiza melodia</em></td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>SWSP</td>
<td>Swamp Sparrow</td>
<td><em>Melospiza georgiana</em></td>
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<td>Unknown</td>
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<td>1</td>
<td>9</td>
<td>#N/A</td>
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<tr>
<td>WIWR</td>
<td>Winter Wren</td>
<td><em>Troglodytes</em></td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>WTSP</td>
<td>White-throated Sparrow</td>
<td><em>Zonotrichia albicollis</em></td>
<td>11</td>
<td>1,4,6,8,9,10,12</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>YBFL</td>
<td>Yellow-bellied Flycatcher</td>
<td><em>Empidonax flaviventeris</em></td>
<td>4</td>
<td>6,8,9,10</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>YEWA</td>
<td>Yellow Warbler</td>
<td><em>Dendroica petechia</em></td>
<td>2</td>
<td>2,12</td>
<td>6</td>
<td>Possible</td>
</tr>
<tr>
<td>YRWA</td>
<td>Yellow-rumped Warbler</td>
<td><em>Dendroica coronata</em></td>
<td>2</td>
<td>2,12</td>
<td>6</td>
<td>Possible</td>
</tr>
</tbody>
</table>

Total: 33 Species  | Total Number: 171

Notes: Incidental observations not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

The three most commonly observed species during breeding bird surveys were the Black-throated Green Warbler (n=24), Common Yellowthroat (n=13), followed by the White-throated Sparrow (n=11). No species were noted as confirmed breeders. The remaining probable breeders (n = 14) were observed at the same location on two subsequent breeding season surveys. Those identified as possible breeders were observed during breeding season in suitable nesting habitat (n=19). Since the site surveyed is a relatively small part of the surrounding area, it is not possible to confirm that all species identified were actually nesting within the boundaries of the Study Area. For instance, for an adult bird that was observed singing in suitable nesting habitat (possible breeding evidence), it is reasonable to assume that the bird could be
nesting on an adjacent parcel of land. One species, Canada Goose, breeding status was noted as observed during surveys, however, no suitable nesting habitat is present within the Study Area (i.e. no open water present).

All of the species identified, except Ring-necked Pheasant, are native species in this area of Nova Scotia and the province in general and observed within the typical and common habitat associated with the Study Area and surrounding landscape. The majority of observations comprised one or two individuals. No large flocks of birds were observed during breeding bird surveys. The most abundant species group observed on site during the breeding bird period was passerines, followed by other landbirds.

5.4.6.2.3 Fall Migration

The fall bird migration survey consisted of 12 point count stations and dedicated surveys were conducted three times during the fall migration period; September 5, September 18, and October 1, 2018. During fall migration, a total of 196 individuals representing 26 species were observed. When incidental observations were removed (i.e. those observed outside of Point Count locations), 195 individuals representing 25 species remain, not including a rooster overheard crowing at point count 10 (see Table 13 below).

During dedicated fall migration point count surveys, one SOCI bird was observed. Red-breasted Nuthatch (S3) were observed at multiple point count locations. No SAR were observed during fall migration surveys.

Table 13. Fall Migration Surveys: Species and Abundance of Birds

<table>
<thead>
<tr>
<th>Species Code</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>#</th>
<th>Point Obs.</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCR</td>
<td>American Crow</td>
<td>Corvus brachyrhynchos</td>
<td>33</td>
<td>2,3,4,5,6,7,8,9,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>AMGO</td>
<td>American Goldfinch</td>
<td>Carduelis tristis</td>
<td>8</td>
<td>1,5,6,7,8,9</td>
<td>6</td>
</tr>
<tr>
<td>AMRO</td>
<td>American Robin</td>
<td>Turdus migratorius</td>
<td>12</td>
<td>1,4,5,6,8,9,10,11</td>
<td>6</td>
</tr>
<tr>
<td>BCCH</td>
<td>Black-capped Chickadee</td>
<td>Poecile atricapilla</td>
<td>31</td>
<td>2,3,4,5,6,7,8,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>BLJA</td>
<td>Blue Jay</td>
<td>Cyanocitta cristata</td>
<td>27</td>
<td>1,2,3,4,5,6,7,8,9,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>BTNW</td>
<td>Black-throated Green Warbler</td>
<td>Dendroica virens</td>
<td>2</td>
<td>5,11</td>
<td>6</td>
</tr>
<tr>
<td>COGR</td>
<td>Common Grackle</td>
<td>Quiscalus quiscula</td>
<td>2</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>CORA</td>
<td>Common Raven</td>
<td>Corvus corax</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>COYE</td>
<td>Common Yellowthroat</td>
<td>Geothlypis trichas</td>
<td>3</td>
<td>2,5</td>
<td>6</td>
</tr>
<tr>
<td>DEJU</td>
<td>Dark-eyed Junco</td>
<td>Junco hyemalis</td>
<td>7</td>
<td>2,3,7,8,11,12</td>
<td>6</td>
</tr>
<tr>
<td>GCKI</td>
<td>Golden-crowned Kinglet</td>
<td>Regulus satrapa</td>
<td>7</td>
<td>3,5,8,11,12</td>
<td>6</td>
</tr>
<tr>
<td>HAWO</td>
<td>Hairy Woodpecker</td>
<td>Picoides villosus</td>
<td>1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>MAWA</td>
<td>Magnolia Warbler</td>
<td>Dendroica magnolia</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>MODO</td>
<td>Mourning Dove</td>
<td>Zenaida macroura</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>NOFL</td>
<td>Northern Flicker</td>
<td>Colaptes auratus</td>
<td>10</td>
<td>2,4,7,8,9,10,12</td>
<td>7</td>
</tr>
<tr>
<td>OVEN</td>
<td>Ovenbird</td>
<td>Seiurus aurocapilla</td>
<td>2</td>
<td>6,7</td>
<td>6</td>
</tr>
<tr>
<td>PUEI</td>
<td>Purple Finch</td>
<td>Carpodacus purpureus</td>
<td>23</td>
<td>3,4,5,6,7,8,9,10,11,12</td>
<td>6</td>
</tr>
<tr>
<td>RBNU</td>
<td>Red-breasted Nuthatch</td>
<td>Sitta canadensis</td>
<td>7</td>
<td>4,6,8,11</td>
<td>6</td>
</tr>
</tbody>
</table>
### Birrette’s East Uniacke Quarry Expansion

#### Summary of Bird Surveys

Overall, 682 individuals, representing 43 species within and adjacent to the Study Area were identified, which includes one incidentally observed species. A higher number of birds were observed during the spring migration period, compared to during the fall migration and breeding periods. Two visits were conducted in the spring and three visits in the fall, which further highlights that bird abundance is greater during the early migration period. Recent forestry activities have created edge habitat for foraging activities and have created habitat niches for certain bird species. This edge habitat is also available along an existing access road which bisects the Study Area.

Across all survey seasons a total of four (4) Priority Species, all of which were SOCI: Pine Siskin, Red-breasted Nuthatch, Ruby-crowned Kinglet, and Yellow-bellied Flycatcher. Section 5.6.5 discusses these species in more detail.

<table>
<thead>
<tr>
<th>Species Code</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>#</th>
<th>Point Obs.</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVI</td>
<td>Red-eyed Vireo</td>
<td>Vireo olivaceus</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>RIPH</td>
<td>Ring-necked Pheasant</td>
<td>Phasianus colchicus</td>
<td>3</td>
<td>3, 4, 6</td>
<td>7</td>
</tr>
<tr>
<td>RTHA</td>
<td>Red-tailed Hawk</td>
<td>Buteo jamaicensis</td>
<td>2</td>
<td>3, 7</td>
<td>4</td>
</tr>
<tr>
<td>RUGR</td>
<td>Ruffed Grouse</td>
<td>Bonasa umbellus</td>
<td>1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>SOSP</td>
<td>Song Sparrow</td>
<td>Melospiza melodia</td>
<td>3</td>
<td>1, 10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Unknown Duck</td>
<td></td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unknown Passerine species</td>
<td></td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>WTSP</td>
<td>White-throated Sparrow</td>
<td>Zonotrichia albicollis</td>
<td>2</td>
<td>1, 9</td>
<td>6</td>
</tr>
<tr>
<td>YRWA</td>
<td>Yellow-rumped Warbler</td>
<td>Dendroica coronata</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>AMGO</td>
<td>American Goldfinch</td>
<td>Carduelis tristis</td>
<td>8</td>
<td>1, 5, 6, 7, 8, 9</td>
<td>6</td>
</tr>
<tr>
<td>AMRO</td>
<td>American Robin</td>
<td>Turdus migratorius</td>
<td>12</td>
<td>1, 4, 5, 6, 8, 9, 10, 11</td>
<td>6</td>
</tr>
<tr>
<td>BCCH</td>
<td>Black-capped Chickadee</td>
<td>Poecile atricapilla</td>
<td>31</td>
<td>2, 3, 4, 5, 6, 7, 8, 10, 11, 12</td>
<td>6</td>
</tr>
<tr>
<td><strong>25 Species</strong></td>
<td><strong>Total Number:</strong></td>
<td></td>
<td>195</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Incidental observations not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

The three most commonly observed species during fall migration were American crow (n=33), Black-capped Chickadee (n=31), followed by Blue Jay (n=27). Most observations documented groups of up to four individuals, no large flocks were observed. The most abundant group observed on site during the fall migration period were passerines. Other landbirds were the next most abundant group observed.

#### 5.4.6.2.1 Common Nighthawk Surveys

No Common Nighthawk were observed during either specialized survey at the four point count locations (Figure 9, Appendix A) or incidentally.

#### 5.4.6.3 Summary of Bird Surveys

Across all survey seasons a total of four (4) Priority Species, all of which were SOCI: Pine Siskin, Red-breasted Nuthatch, Ruby-crowned Kinglet, and Yellow-bellied Flycatcher. Section 5.6.5 discusses these species in more detail.
5.4.7  Bat Use

According to the NSCCH Environmental Screening Report (Appendix C), historical presence of bat hibernacula in caves and abandoned mine workings were historically recorded in the general area and none in the direct boundary of the Study Area. Additionally, personal communications with NSDL&F SAR Biologist, Mark Elderkin (Elderkin. M June 27, 2018) confirmed that no NSDL&F known bat sightings or hibernacula are in close proximity to the Study Area. Additionally, the ACCDC reported no known bat hibernaculum within 5 km of the Study Area. The ACCDC report did identify one species of bat recorded within 20 km of the Study Area. At this location (within 14.9 km of the Study Area), thirty-five Little Brown Myotis were observed. Both the NSCCH report and the ACCDC report can be found in Appendix C.

No provincial government records of abandoned mine openings (AMOs) were located within the Study Area (NSDNR, 2017). There are 195 records of AMOs within 5 km of the Study Area. All of these records are west of the Study Area, the majority of which are in a compact group along Uniacke Mines Road (3 -5 km west of the Study Area). One of the 195 records is identified as adit opening type, 25 are considered as open cut opening type, one is considered as pit opening type, 160 are considered as shaft opening type and 8 are considered as trench opening type.

The closest critical habitat for the Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Nova Scotia is approximately 3 km northwest of the Study Area, near the community of Centre Rawdon, NS (Environment Canada, 2018). Critical habitat as defined by Environment Canada (2018) as the habitat necessary for the survival or recovery of the species and is protected by a 100 km² buffer to avoid identification of hibernacula – the 3 km distance cited above was measured from the Study Area to the critical habitat buffer.

No Little Brown Myotis, other bat species, nor suitable habitat was observed within the Study Area during field surveys. Refer to Section 5.6.4 for further information regarding the Little Brown Myotis.

5.4.8  Wildlife Habitat

Habitat across the Study Area is described in detail in Section 5.4.1.2 and characterized by the presence of cut-blocks, access roads, forested landscapes and an existing quarry. In locations where forested landscapes are present, mixedwood (MW), intolerant hardwoods (IH), and Spruce-hemlock (SH) were the prevalent VTs.

Habitat within the Study Area is currently fragmented by the existing quarry, access roads, and historical forestry operations. The extent of habitat fragmentation within the Study Area limits the habitat quality for species that prefer interior, mature, undisturbed habitats, such as Fisher (Pekania pennanti). Habitat within the Study Area is suitable for those wildlife species that thrive in fragmented, diverse landscapes, such as White-tailed Deer, Eastern Coyote, and Snowshoe Hare. This fragmented, diverse landscape
provides edge habitat for foraging, and patches of full canopy coverage for refuge and cover through all
seasons. Wildlife habitat observed was neither unique nor rare in the local or regional landscape context.

5.5 Aquatic Environment

Nineteen wetlands and two watercourses were identified within the Study Area through field surveys (14
wetlands and 2 watercourses are located within the Development Area). The following sections provide
details about the aquatic habitat identified, including the results from the surface water sampling program.

The Study Area lies within the St. Croix River Secondary Watershed (1DE-1; Figure 7, Appendix A)
which discharges into the St. Croix River located approximately 22.5 km west of the Study Area. The St.
Croix River Secondary Watershed is located within the St. Croix River Primary Watershed (1DE). The St.
Croix River drains north into the Bay of Fundy (Atlantic Ocean). The sizes of the secondary watershed
and the primary watershed are 74,671 ha and 134,558 ha, respectively.

The Study Area is located on high undulating land. There are three predominant surface water flows
patterns present within the Study Area. These correspond to the LCA ‘s discussed in Section 4.1.2.4 and
5.5.4 (below). Surface water in eastern portions of the Study Area flows eastward through the existing
quarry, southeastward (and into WC2 and WC3) from central portions of the Study Area and westward
from western portions of the Study Area. All outflows eventually drain into the O’Hearn Flowage which
then drains into the Herbert River. The Herbert River drains into the St. Croix River, which then drains
into the Avon River, then the Minas Basin, and finally drains into the Bay of Fundy (Atlantic Ocean).

5.5.1 Wetlands

A review of the NSE Wetlands Inventory Database identified two wetlands within Birrette’s East Uniacke
Quarry Expansion Study Area (Figure 2, Appendix A). One mapped wetland (0.44 ha and described as a
swamp) is located along the northeastern Study Area boundary. The second mapped wetland is described
in the inventory as a swamp (1.88ha in size), and it extends beyond the southern Study Area boundary.

During field surveys completed across the Study Area, 19 wetlands were identified (Figure 8, Appendix
A).

5.5.1.1 Wetland Characteristics

Most (13) wetlands identified with the Study Area exist as isolated features; three are located in a
headwater (outflow) position with a drainage outlet (WLs 4 and 17) or a watercourse outlet (WL16); and
three exist in a throughflow position (WL1, WL7, and WL18). Treed/Shrub Swamps (11) and
Treed/Shrub Bogs (7) are the dominant wetland types on the landscape within the Study Area. WL7 was
identified as a Softwood Treed Shrub Fen. All wetlands were in a terrene landscape position, and most of
them were identified in basin landforms, except WL17 which was a flat terrace, and WL18 which is
sloped.
A high-water table and saturation at surface as observed in all the wetlands within the Study Area. Surface water was present within Wetlands 1, 6, 7, 11, 14, 15, 16, 17, 18 and 19. With the exception of WL7, the average depth of surface water and cover for all wetlands was between 5-8 cm covering 2-10% of the wetland area. None of these wetlands provide fish habitat based on limited surface water availability and a lack of connection to downstream fisheries resources. Wetland 7 (which comprises two outflow watercourses), was observed to have a wetter hydrological regime. As a result, during the dryer summer months intermittent standing water exists, although not enough to provide a consistent passage for fish. During November, observations indicate that standing water is present across a larger extent of WL7 and provides potential passage for fish through the wetland during that period of time.

The dominant tree species in the overstory layer within the wetlands are Black Spruce (*Picea mariana*), Red Maple (*Acer rubrum*), Balsam Fir (*Abies balsamea*) and Gray Birch (*Betula populifolia*), which are also found in the understory shrub layer. In addition, Mountain Holly (*Ilex mucronata*) and Wild Raisin (*Viburnum nudum*) are also found within the shrub layer. A variety of herbaceous species are found within the ground cover, depending on local hydrology, disturbance regime, and nutrient regime. Three-seeded Sedge (*Carex trisperma*), Cinnamon Fern (*Osmunda cinnamomea*), Sheep Laurel (*Kalmia angustifolia*) and Dewberry (*Rubus pubescens*) are common in the herbaceous layer.

Hydric soil within on-site wetlands is typically indicated by decomposed organic soil either over clay/loam mineral soil or rock. Histosol and depleted mineral soil indicators, such as histic epipedon and hydrogen sulfide, (hydric soil indicators A1, A2 and A4) are present within these wetlands.

Table 14 provides the characteristics for delineated wetlands.
### Table 14: Wetland Characteristics

<table>
<thead>
<tr>
<th>Wetland</th>
<th>Wetland Type</th>
<th>Wetland Size (ha)</th>
<th>Water Flow Path</th>
<th>Landform</th>
<th>Landscape Position</th>
<th>Hydrological Conditions</th>
<th>Dominant Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mixedwood Treed Swamp</td>
<td>0.04</td>
<td>Throughflow via Drainage</td>
<td>Basin</td>
<td>Terrene</td>
<td>Standing water (3% of WL, depth 5cm), wetland saturated within 20cm, groundwater within 30cm</td>
<td>Herbs: Osmunda cinnamomea, Equisetum arvense, Shrubs: Viburnum nudum, Trees: Acer rubrum, Betula populifolia, Abies balsamea</td>
</tr>
<tr>
<td>2</td>
<td>Shrub Bog</td>
<td>0.38</td>
<td>Isolated</td>
<td>Basin</td>
<td>Terrene</td>
<td>Wetland saturated within 20cm, groundwater within 30cm</td>
<td>Herbs: Rubus pubescens, Scirpus cyperinus, Carex stricta, Carex trisperma, Dryopteris cristata, Pogonia ophioglossoides, Shrubs: Myrica gale, Acer rubrum, Trees: Betula populifolia, Picea mariana, Larix Laricina</td>
</tr>
<tr>
<td>3</td>
<td>Shrub Bog</td>
<td>0.02</td>
<td>Isolated</td>
<td>Basin</td>
<td>Terrene</td>
<td>Wetland saturated within 20cm, groundwater within 30cm</td>
<td>Herbs: Osmunda cinnamomea, Kalmia angustifolia, Scirpus cyperinus, Shrubs: Viburnum nudum, Picea mariana, Betula populifolia</td>
</tr>
<tr>
<td>4</td>
<td>Shrub Bog</td>
<td>0.59</td>
<td>Outflow via Drainage (culvert to WC1)</td>
<td>Basin</td>
<td>Terrene</td>
<td>Wetland saturated within 20cm, groundwater within 30cm</td>
<td>Herbs: Osmunda cinnamomea, Rhododendron groenlandicum, Kalmia angustifolia, Shrubs: Viburnum nudum, Picea mariana, Acer rubrum, Ilex mucronata, Tree: Picea mariana</td>
</tr>
<tr>
<td>5</td>
<td>Mixedwood Treed Shrub Bog</td>
<td>0.08</td>
<td>Isolated</td>
<td>Basin</td>
<td>Terrene</td>
<td>Wetland saturated within 20cm, groundwater within 30cm</td>
<td>Herbs: Kalmia angustifolia, Scirpus cyperinus, Vaccinium myrtilloides, Shrubs: Acer rubrum, Betula populifolia, Tree: Picea mariana</td>
</tr>
<tr>
<td>Wetland</td>
<td>Wetland Type</td>
<td>Wetland Size (ha)</td>
<td>Water Flow Path</td>
<td>Landform</td>
<td>Landscape Position</td>
<td>Hydrological Conditions</td>
<td>Dominant Vegetation</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>----------</td>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 6         | Complex: Softwood Treed Bog Swamp along the fringe | 1.04              | Isolated        | Basin    | Terrene            | Standing water (2% of WL, depth 6cm), wetland saturated within 20cm, groundwater within 30cm                                                                                                                                 | Herbs: *Osmunda cinnamonea*, *Cornus canadensis*, *Carex trisperma*, *Gaultheria hispida*, *Kalmia angustifolia*  
Shrubs: *Abies balsamea*, *Picea mariana*, *Acer rubrum*, *Ilex mucronata*  
Tree: *Picea mariana*                                                                                                                                 |
| 7         | Softwood Treed Shrub Fen | 2.15 (Zone delineated, WL continues outside the Study Area) | Throughflow (via WC) | Basin    | Terrene            | Standing water in summer (2% of WL, depth 5cm), wetland saturated within 20cm, groundwater within 30cm. Extensive standing water across wetland during fall and spring.                                                                  | Herbs: *Osmunda cinnamonea*, *Pogonia ophioglossoide*, *Maianthemum trilolium*, *Eriophorum angustifolium*, *Carex magellanica*  
Shrubs: *Betula populifolia*, *Acer rubrum*, *Alnus incana*  
Tree: *Picea mariana*                                                                                                                                  |
| 8         | Shrub Bog                | 0.15              | Isolated        | Basin    | Terrene            | Wetland saturated within 20cm, groundwater within 30cm.                                                                                                                                                                   | Herbs: *Scirpus Cyperinus*, *Maianthemum trilolium*, *Eriophorum angustifolium*, *Pogonia ophioglossoide*, *Kalmia angustifolium*, *Drosera rotundifolia*  
Shrubs: *Picea mariana*, *Acer rubrum*, *Betula populifolia*  
Trees: *Picea mariana*, *Betula populifolia*                                                                                                                                                                 |
| 9         | Mixedwood Treed Swamp    | 0.09              | Isolated        | Basin    | Terrene            | Wetland saturated within 20cm, groundwater within 30cm                                                                                                                                                                  | Herbs: *Osmunda cinnamomea*, *Solidago canadense*, *Cornus canadensis*, *Rubus hispidus*, *Rubus pubescens*, *Onoclea sensibilis*, *Spirea tomentosa*  
Shrubs: *Populus tremuloides*, *Acer rubrum*, *Picea rubens*  
Trees: *Picea rubens*, *Betula papyrifera*, *Abies*                                                                                                                                                                  |
<table>
<thead>
<tr>
<th>Wetland</th>
<th>Wetland Type</th>
<th>Wetland Size (ha)</th>
<th>Water Flow Path</th>
<th>Landform</th>
<th>Landscape Position</th>
<th>Hydrological Conditions</th>
<th>Dominant Vegetation</th>
</tr>
</thead>
</table>
| 10      | Bog          | 0.18             | Isolated        | Basin    | Terrene            | Wetland saturated within 20cm, groundwater within 30cm | Herbs: *Scirpus cyperinus*, *Kalmia angustifolia*, *Lonicera canadensis*, *Rubus pubescens*, *Viola macloskeyi*, *Osmunda cinnamomea*, *Spirea tomentosa*  
 Shrubs: *Betula papyrifera*, *Acer rubrum*, *Salix discolor*, *Picea mariana*  
 Trees: *Acer rubrum*, *Abies balsamea*, *Picea mariana*, *Betula papyrifera* |
| 11      | Mixedwood Treed Swamp | 0.05 | Isolated        | Basin    | Terrene            | Standing water (5% of WL), wetland saturated within 20cm, groundwater within 30cm. | Herbs: *Kalmia angustifolia*, *Cornus canadensis*, *Carex trisperma*, *Vaccinium myrtilloides*, *Gaultheria hispidula*, *Maianthemum canadensis*  
 Shrubs: *Viburnum nudum*, *Picea mariana*, *Abies balsamea*, *Ilex mucronata*  
 Trees: *Acer rubrum*, *Picea mariana*, *Abies balsamea*, *Betula populifolia* |
| 12      | Mixedwood Treed Swamp | 0.13 | Isolated        | Basin    | Terrene            | Wetland saturated within 20cm, groundwater within 30cm. | Herbs: *Kalmia angustifolia*, *Osmunda cinnamomea*, *Vaccinium myrtilloides*, *Trientalis borealis*, *Maianthemum canadensis*, *Carex trisperma*, *Rubus pubescens*  
 Shrubs: *Acer rubrum*, *Picea mariana*, *Ilex mucronata*  
 Trees: *Picea mariana*, *Acer rubrum*, *Betula papyrifera*, *Pinus strobus* |
| 13      | Mixedwood Treed Swamp | 0.70 | Isolated (inferred) – wetland extends off site to the  | Basin    | Terrene            | Wetland saturated within 20cm, groundwater within 30cm. | Herbs: *Osmunda cinnamomea*, *Maianthemum canadensis*, *Carex trisperma*, *Gaultheria hispidula*, *Linnea borealis*, *Cornus canadensis*  
 Shrubs: *Abies balsamea*, *Picea mariana*, *Ilex mucronata* |
<table>
<thead>
<tr>
<th>Wetland</th>
<th>Wetland Type</th>
<th>Wetland Size (ha)</th>
<th>Water Flow Path</th>
<th>Landform</th>
<th>Landscape Position</th>
<th>Hydrological Conditions</th>
<th>Dominant Vegetation</th>
</tr>
</thead>
</table>
| 14      | Mixedwood Treed Swamp | 0.05 | Isolated | Basin | Terrene | Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm. | Trees: Picea mariana, Acer rubrum, Betula papyrifera, Abies balsamea  
Herbs: Glyceria canadensis, Cornus canadensis, Rubus pubescens, Viola macloskeyi, Solidago sp., Trientalis borealis  
Shrubs: Picea mariana  
Trees: Picea mariana, Acer rubrum, Betula papyrifera, Abies balsamea |
| 15      | Mixedwood Treed Swamp | 0.05 | Isolated | Basin | Terrene | Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm. | Herbs: Rubus pubescens, Viola macloskeyi, Solidago canadensis, Juncus effuses, Carex sp.  
Shrubs: Acer rubrum, Betula papyrifera, Prunus virginiana, Spirea tomentosa, Rubus idaeus  
Trees: Picea mariana, Acer rubrum, Betula papyrifera, Abies balsamea |
| 16      | Mixedwood Treed Swamp | 0.91 | Outflow via WC | Basin | Terrene | Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm. | Herbs: Rubus pubescens, Solidago canadensis, Carex sp., Trientalis borealis, Cornus canadensis  
Shrubs: Acer rubrum, Populus tremuloides, Ilex mucronata, Abies balsamea  
Trees: Picea mariana, Betula papyrifera, Abies balsamea |
| 17      | Mixedwood Treed Swamp | 0.15 | Outflow via Drainage | Terrace | Terrene | Standing water (10% of WL), wetland saturated within 20cm, groundwater within 30cm. | Herbs: Cornus canadensis  
Shrubs: Abies balsamea  
Trees: Populus tremuloides, Abies balsamea |
<table>
<thead>
<tr>
<th>Wetland</th>
<th>Wetland Type</th>
<th>Wetland Size (ha)</th>
<th>Water Flow Path</th>
<th>Landform</th>
<th>Landscape Position</th>
<th>Hydrological Conditions</th>
<th>Dominant Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Shrub Swamp</td>
<td>0.40</td>
<td>Throughflow</td>
<td>Sloped</td>
<td>Terrene</td>
<td>Standing water (5% of WL), wetland saturated within 20cm, groundwater within 30cm.</td>
<td>Herbs: Calamagrostis canadensis, Juncus effuses, Rubus idaeus  &lt;br&gt; Shrub: Betula papyrifera, Acer rubrum, Populus tremuloides, Ilex mucronata</td>
</tr>
<tr>
<td>19</td>
<td>Softwood Treed Swamp</td>
<td>0.04</td>
<td>Isolated</td>
<td>Basin</td>
<td>Terrene</td>
<td>Standing water (5% of WL, depth 8cm), wetland saturated within 20cm, groundwater within 30cm.</td>
<td>Herbs: Carex trisperma, Spirea tomentosa, Oxalis montana, Osmunda cinnamomea  &lt;br&gt; Shrub: Viburnum nudum, Abies balsamea, Betula alleghaniensis  &lt;br&gt; Tree: Picea mariana</td>
</tr>
</tbody>
</table>
5.5.1.1 Groundwater Interactions

The determination as to whether a wetland is functioning as a groundwater recharge or a groundwater discharge feature is often not possible by visual inspection alone. A wetland is a groundwater discharge area if groundwater moves upwards from underlying soils towards the land surface, whereas recharge wetlands exhibit groundwater that flows vertically downward from the wetland to underlying mineral soils. Groundwater discharge maintains high water tables and wetland habitat, whereas recharge sites replenish aquifers (Siegela, 1988).

It is likely that wetlands within the Study Area exist as a combination of recharge and discharge features, although as presented in Table 14, 13 of the wetlands identified are isolated, are located in elevated areas (i.e. on high land), and lack restrictive soils or rock which inhibit the movement of water downward. As such, these wetlands are expected to be serving as groundwater recharge wetlands. Conversely, wetlands which have connectivity to outflow watercourses, appear to have wetter hydrological surface characteristics and are located in lower lying land, are more likely to be functioning as groundwater discharge wetlands. One notable wetland within the Study Area that is suspected to act as a groundwater discharge wetland is WL7. This wetland was observed to accumulate surface water during November (i.e. wetter periods of the year), and also comprises two discharge watercourses (WC2 and WC3) further indicating that the capacity for water to infiltrate through the wetland surface and recharge groundwater is inhibited. Wetlands 16 and 18 likely also exist as groundwater discharge wetlands and also drain water from the Study Area to offsite aquatic features (i.e. additional wetlands and possible off-site tributaries).

5.5.1.2 Wetland Functional Analysis

The WESP process calculates the overall scores for seven wetland functional groups including a functional and benefit rating for five of the groups (Hydrologic, Water Purification, Aquatic Support, Aquatic Habitat and Terrestrial Habitat) and only the benefit rating for the Wetland Condition and Wetland Risk groups. The WESP calculator utilized the responses from desktop, field and stressor questions (included in the WESP calculator) to determine whether the functions and benefits for each group are Low, Moderate or High in comparison to baseline wetland scores in Nova Scotia. In order to complete an effective, quantitative comparison of WESP results for wetlands within the Study Area, scores were weighted numerically as follows:

LOW: 1 point
MODERATE: 2 points
HIGH: 3 Points

Table E1 (Appendix E), provides the overall numerically weighted scores for the evaluation of 19 wetlands completed across the Study Area. It should be noted that function scores are not provided for the Wetland Condition and Wetland Risk Functional groups, as the WESP calculator only considers these as benefits. Of the 19 wetlands evaluated, the average accumulated functional score per wetland was 2.1
Birrette’s East Uniacke Quarry Expansion

(M Moderate). Based on the same analysis, the average accumulated benefit score per wetland was 2.1 (Moderate). WESP guidance states that the most valuable wetlands are those that possess high functions and benefits. Benefits relate to the perceived worth of the wetland function to societal needs (Adamus & Verble, 2016). Of the 19 wetlands evaluated, none of the wetlands evaluated scored in the HIGH accumulated range for both functions and benefits – All scored Moderate range for function, and benefits (see Table E1 Appendix E).

Additional analysis was completed on the individual wetland functional groups being provided by the wetlands present within the Study Area. The following sections provide results of this analysis on a per wetland functional group basis.

5.5.1.3 WESP Grouped Wetland Function Results

Hydrologic Group
The hydrological wetland service group evaluates the effectiveness of a wetland to store or delay the downslope movement of surface water. Wetlands that have the highest functions within this group include those that do not have surface water outlets, and instead are isolated from flowing surface water. The model does not account for wetland size, and in turn, does not account for larger wetlands having the ability to store more water than smaller wetlands.

Most wetlands scored Moderate-High in function largely because they exist as isolated wetlands across the landscape, which allow them to store and delay water movement. Five wetlands scored Low (WLs 1, 7, 16, 17 and 18) because of their water outflow that existed either as a watercourse (WLs 7 and 16) or a drainage channel (WLs 1, 17 and 18) and exported water with limited delay. However, it should be noted that some of the high-scoring wetlands are small, which reduces the storage capacity in comparison to other wetlands (although this isn’t considered by WESP).

All wetlands scored Moderate-High in benefit, largely because of their high position in the watershed, which provides storage at the headwaters and better prevent flooding.

Wetlands 3, 9 and 12 scored High for both hydrological functions and benefits.

Water Purification Group
This wetland functional group is compiled from four different functions: Sediment Retention and Stabilization; Phosphorus Retention; Nitrate Removal; and Carbon Sequestration. The main function of this group is to evaluate each wetland’s potential to intercept, retain, and filter sediments, particulates, and organic matter. Similar to the hydrologic group, the wetlands that have the highest functions in this regard include those that do not have a surface water outlet, and instead are isolated from flowing surface water.

Most wetlands scored High in function for the Water Purification Group, demonstrating they are effective
at intercepting, retaining, and filtering suspended sediments, particulates, and organic matter due to their lack of outlet and low topographic gradient. As well, because of their important vegetation cover and wetland type (Bog), many wetlands (WLs 2, 3, 4, 5, 8 and 9) scored High in carbon sequestration function, since the vegetation (tree, shrubs, herbs, *Sphagnum* moss) acts as a carbon sink (see Table E2, Appendix E). Similar to the hydrologic group, wetlands 1, 7, 16, 17 and 18 scored Low for Water Purification Group function because of their water outflow.

All wetlands scored Low-Moderate in benefit, largely because of the isolation of the project from developed areas and the small size of the wetlands compared to their catchment areas, which limits the potential benefits of water purification function.

**Aquatic Support Group**
The aquatic support group comprises four individual functions: Stream Flow Support; Aquatic Invertebrate Habitat; Organic Nutrient Export; and Water Cooling. The main function of this group is to determine the wetlands ability to support ecological stream functions that promote habitat health. Therefore, wetlands lying adjacent to or containing flowing water score higher than those that do not (i.e. isolated wetlands). In addition, headwater wetlands are crucial for supporting stream flow during the dry season by contributing to water flow via groundwater input and storage capacity.

All wetlands scored in the Low-Moderate range for function (except WL1 – High score) because of their restricted association with flowing surface water systems and limited presence of ponded water. Wetlands 1, 16 and 18 scored High for Organic Nutrient Export, due to the presence of water outlet. Wetlands 7, 16 and 18 scored High for Stream Flow Support, due to their association with Watercourses 1 and 4. Also, Wetland 16 scored High for Water cooling (see Table E2, Appendix E).

Most wetlands scored in the Low-Moderate range for benefit however, due to their Moderate-High function scores, wetlands 1, 7, 16, 17 and 18 scored High by providing beneficial aquatic support. It is largely due to the association of surface water features with these wetlands.

**Aquatic Habitat Group**
The aquatic habitat group comprises of five different functions: Anadromous Fish Habitat; Resident Fish Habitat; Amphibian and Turtle Habitat; Waterbird Feeding Habitat; and Waterbird Nesting Habitat. Wetlands that have the highest functions within this group include those that are adjacent to or contain water.

Most of the wetlands scored Moderate for function due to their limited surface water features and absence of fish habitat, while the remaining wetlands scored Low for functions due to their lack of surface water features.
The Wetlands that scored Moderate in functions, all scored High for benefits. The High benefits are due to the lack of ponded water in the region, making the wetlands especially important for amphibian, turtle and waterfowl habitat. The remainders scored Low for benefits – there were no benefits evaluated as possible, considering the Low functional scores of these wetlands.

**Terrestrial Habitat Group**
The terrestrial habitat group comprises of three different functions: Songbird, Raptor, and Mammal Habitat; Native Plant Habitat; and Pollinator Habitat. The main function of the collective group is to evaluate the wetland’s ability to support healthy habitat for birds, mammals, pollinators and native plants.

All wetlands scored Moderate-High for function and benefit for Terrestrial Habitat Group. In general, wetlands within the Study Area provide ideal habitat, which includes downed wood, prevalent ground cover, varied microtopography, tree and shrub cover in and around the wetlands, and naturally vegetated buffer zones. The wetlands have a variety of woody heights and diverse forms, which allows for nesting habitat, perches, and feeding grounds. In addition, the wetlands provide a diverse range of herbaceous vegetation. As such, wetlands within the Study Area generally provide habitat for songbirds, mammals, pollinators and potentially rare plants. *Listera australis* (S3) was observed in Wetland 4, hence its High score on both function and benefit for Terrestrial Habitat Group. Most wetlands had High scores on both function and benefit for Songbird, Raptor, and Mammal Habitat (all except WLs 1, 2, 3, 4, 5, 8, 9 and 12) and WL 4 had High scores on both function and benefit for Pollinator Habitat.

**Wetland Condition**
Wetland Condition refers to the integrity or health of a wetland as defined by its vegetative composition and richness of native species. Scores are derived from the similarity between the wetland being evaluated and reference wetlands of the same type and landscape setting (Adamus, 1996).

Most wetlands scored Moderate-High for Wetland Condition (benefit only) which indicates that currently, wetlands carry healthy vegetative communities. For the wetlands that scored Low (WLs 9, 10, 15, 16 and 18), this is due to the lack of ground irregularities (ground irregularities provide microhabitats for plant species allowing plant species with different habitat requirements to establish themselves within a wetland), and the low plant diversity. None of the wetlands were recorded to have invasive vascular plant species.

**Wetland Risk**
Wetland Risk takes sensitivity and stressors into account by averaging the two. Sensitivity is the lack of intrinsic resistance and resilience of the wetland to human or naturally caused stress (Niemi et al., 1990). The model uses five metrics to measure sensitivity: abiotic resistance, biotic resistance, site fertility, availability of colonizers, and growth rate. Stress relates to the degree to which the wetland is or has recently been altered by humans in a way that degrades its ecological condition. The model applies four stress groups: hydrologic stress, water quality stress, fragmentation stress, and general disturbance stress.
Wetlands that are highly resilient may have lower risk scores despite their exposure to multiple stressors. Additionally, wetlands exposed to fewer threats, but with low resilience may have high risk scores. Wetland resilience is tied to multiple factors, such as size, proximity to natural land cover, and presence of invasive species.

Most wetlands analyzed had Moderate-High risk scores for Wetland Risk benefit, due to their small size, close proximity to roads and high location in the watershed, which is also shown in the High scores of wetlands 1, 2, 4, 6, 11, 12, 19, pertaining Sensitivity. Wetlands 7 and 18 scored Low risk, due to their larger size, presence of water outflow preventing contaminants accumulation and presence of surface water making them less vulnerable to drought event. Wetlands 1 and 15 scored High for Stressor, because of their close proximity of the current quarry (WL1) and road crossing (WL15).

5.5.2 Fish and Fish Habitat

5.5.2.1 Desktop Review

According to the Atlantic Salmon Federation (ASF), Herbert River is a current salmon bearing river (2018). Atlantic Salmon (*Salmo salar pop. 1*) in this system are the Inner Bay of Fundy Population (SARA Endangered, ACCDC S1). Additionally, the Nova Scotia Freshwater Fish Distribution Records identified Brook Trout (*Salvelinus fontinalis*; ACCDC S3), White Sucker (*Catostomus commersonii*), and Ninespine Stickleback (*Pungitius pungitius*) in Moore Lake (Government of Nova Scotia, 2017). Moore Lake is located north of the Study Area and its outflow (Moore Lake Brook) connects to Herbert River, approximately 5 km downstream of its connection with O’Hearn Brook. Both Atlantic Salmon - Inner Bay of Fundy population and Brook Trout were identified within 20 km of the Study Area by the ACCDC.

The ACCDC also identified Striped Bass - Bay of Fundy population (*Morone saxatilis; S1B*) and American Eel (*Anguilla rostrata; S2*) within 20 km of the Study Area. Herzert River eventually feeds into the Minas Basin and Bay of Fundy, therefore although unlikely, it is possible that a Bay of Fundy Striped Bass (COSEWIC; Endangered, ACCDC; S1B) could potentially make its way to the O’Hearn system. This population of Striped Bass has been found within the Shubenacadie River, which is the only confirmed spawning location in the province (COSEWIC 2004). They have also been found in the Saint John River and Annapolis River (DFO, 2016c). According to the ACCDC report, Striped Bass were observed within 13 km of the Study Area, likely within the Shubenacadie River. The Shubenacadie River is located in a separate primary watershed to the Study Area, therefore, it is not expected for Striped Bass to be present in the O’Hearn system. American Eel (COSEWIC; Threatened, ACCDC; S2) were also listed as observed within 20 km of the Study Area.

Personal communications with Jason LeBlanc, Resource Manager for Nova Scotia Fisheries and Aquaculture, confirmed that no other (more recent) fish data in this area is available (Leblanc. J February 25, 2019).
5.5.2.2   **Field Results**
Field surveys found no lakes or areas of open water in the Study Area. Two watercourses were confirmed to be present within the Study Area (WC1 and WC4) and two additional watercourses outside of the Study Area were identified (WC2 and WC3). The additional watercourses encompass the down-stream receiving water from the Study Area and have been assessed within the Fish Habitat Assessment Area (Figure 9, Appendix A).

As indicated through the desktop review, on site watercourses drain into the O’Hearn Flowage system. O’Hearn Flowage connects to Herbert River via O’Hearn Brook. Herbert River discharges into the Minas Basin via the St. Croix River and the Avon River.

Physical characteristics of the watercourses within the Study Area and Fish Assessment Area are described in Table 15. A georeferenced photolog was completed during the fish habitat evaluations and is provided in Appendix I.
Table 15. Physical Characteristics of Watercourses within the Study Area

<table>
<thead>
<tr>
<th>WC</th>
<th>Reference UTMs (Upstream)</th>
<th>Section Length (m)</th>
<th>Velocity</th>
<th>Gradient</th>
<th>Wetted Width (cm)</th>
<th>Bankfull Width (cm)</th>
<th>Average Depth (cm)</th>
<th>Bank Height (cm)</th>
<th>Substrate (%)</th>
<th>Habitat Type (%)</th>
<th>Habitat Type (Sooley et al., 1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>441108 4976630</td>
<td>60</td>
<td>slow</td>
<td>1%</td>
<td>75</td>
<td>75</td>
<td>20</td>
<td>10</td>
<td>SB=10 Co=40 Gr=40</td>
<td>Run=80 Riffle=10 Pool=10</td>
<td>II/IV</td>
</tr>
<tr>
<td>2</td>
<td>441382 4976436</td>
<td>1,300</td>
<td>moderate</td>
<td>3%</td>
<td>50-250</td>
<td>50-250</td>
<td>30</td>
<td>20</td>
<td>Co=25 Ru=30 Gr=20 Mu=10 SB=15</td>
<td>Run=75 Riffle=15 Pool=10</td>
<td>II/IV</td>
</tr>
<tr>
<td>3</td>
<td>441247 4975990</td>
<td>2,300</td>
<td>moderate</td>
<td>2%</td>
<td>100-150</td>
<td>100-150</td>
<td>20</td>
<td>15</td>
<td>SB=60 Co=10 Mu=30</td>
<td>Run=80 Riffle=15 Pool=5</td>
<td>II/IV</td>
</tr>
<tr>
<td>4</td>
<td>440681 4976549</td>
<td>40</td>
<td>slow</td>
<td>1%</td>
<td>50</td>
<td>50</td>
<td>15</td>
<td>10</td>
<td>SB=20 Ru=50 Co=20 Gr=10</td>
<td>Run=60 Riffle=30 Pool=10</td>
<td>N/A- No fish habitat present</td>
</tr>
</tbody>
</table>

SB=Small Boulder, Ru=Rubble, Co=Cobble, Pe=Pebble, Gr=Gravel, Sa=Sand, Si/Mud=Silt/Mud
Watercourse 1 (WC1) is an unmapped watercourse located in the central extent of the Study Area. The watercourse initiates in WL4 and flows south via a culvert into WL7, where it eventually dissipates. This watercourse is impacted by the current access road that bisects the Study Area, which likely sources additional water to the channel via its roadside ditches. Prior to flowing through the culvert under the access road (i.e. north of the access road), WC1 lacks a defined channel. At the outflow of the culvert, a section of WC1 has been anthropogenically straightened and ditched towards WL7 before developing into a natural channel as described in Table 15. WC1 is confined between two wetlands (WL7 and WL4) and there is only a potential connection to downstream fish resources (through WL7) during periods when the wetland is flooded (i.e. periods of seasonal high flow). If fish were to access WC1 their movement would be restricted as far upstream as the southern boundary of WL4.

WC2 is an unmapped watercourse located within the Fish Habitat Assessment Area, southeast of the Study Area. WC2 exists as an outflow from the eastern extent of WL7 and flows southeast before being culverted beneath the gravel quarry access road. This culvert is currently hung (10 cm), which presents a potential barrier to fish passage upstream and into WL7. East of the culvert, WC2 flows through several unmapped wetlands where the channel becomes less defined, however, it is presumed that during high flow, fish passage could be possible. WC2 eventually discharges into O’Hearn Flowage. As discussed in Section 5.3.5, discharge water from the current quarry area drains into WC2 approximately 350 m down stream of the boundary of WL7 (Figure 8, Appendix A).

WC3 is a mapped watercourse that is located within the Fish Habitat Assessment Area, south of the central portion of the Study Area. WC3 is an outflow from the western extent of WL7. The watercourse develops as a subterranean channel from WL7 before developing into a watercourse with defined banks, downstream of WL7. WC3 flows south and eventually east where it empties into O’Hearn Flowage. Fish access is expected within WC3 (to the point of subterranean flow). The field delineated watercourse identified in Figure 8 (Appendix A) illustrates the extent of define channel.

WC4 is an unmapped watercourse located in the west central extent of the Study Area. The watercourse initiates in WL16 and flows west to WL18 where it dissipates. The watercourse continues to drain through the wetland in an undefined channel, especially in the cut block areas, and finally exits the Study Area as drainage. There is a lack of continuous surface water flow in WC4 to support resident fish populations and fish access, and there is no direct connectivity to a downstream fish resource.

The watercourses within the Study Area and the Fish Habitat Assessment Area were evaluated for habitat characterizations based on parameters identified in the Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador (Sooley et al., 1998). As described in the guide, water quality and quantity tolerances of the Atlantic Salmon (Salmo salar) were used as an index of the relative health of the river for fish populations. The Atlantic Salmon were used as the indicator species for several reasons (Sooley et al., 1998);
• Salmon inhabit areas targeted for the assessments (riffles and pool habitat);
• Salmon are sensitive to acidification;
• Salmon are a predatory species at the top of the food chain; and
• Data exists that defines preferred habitat conditions for this species.

WC1 exhibits Type IV fish habitat. WC2 and WC3 contain portions exhibiting Type II and IV fish habitat downgradient of WL7, however, due to the presence of potential barriers – hung culvert in WC2 and subterranean flow within WC3, fish access is limited in these features. Both WC2 and WC3 drain through several alder swamps downstream of the Study Area. In these alder swamps the watercourses lose a defined channel and braid extensively, potentially creating another barrier, especially during seasons with low flow. The description of the fish habitat type found within Type II and IV as described in Sooley et al. (1998) is documented below:

Type II watercourses consists of:
• Good juvenile salmonid rearing habitat with limited spawning capability, usually limited to gravel pockets;
• Good feeding and holding areas in deeper pools;
• Water flows usually is moderate with heavy riffles to light rapids;
• Substrate consist of large cobble/rubble, with large boulders and bedrocks, some gravel pockets;
• General habitat types consist of runs, riffle and pool.

Type IV watercourses consists of:
• Poor juvenile salmonid rearing habitat with no spawning capability;
• Provides shelter and feeding habitat;
• Water flows is sluggish
• Substrate is soft sediment or sand, occasionally large boulders or bedrock and;
• General habitat types consist of flat and pool.

There is no access provided for fish to WC4 as off-site conditions to the west of the Study Area comprise additional wetland habitat with a lack of standing water and no channelization.

The habitat descriptions listed above should be considered in the knowledge that although each watercourse contains portions of suitable fish habitat, these habitats occur intermittently along each channel, and are separated by some of the seasonal barriers discussed above. The georeferenced photolog provided in Appendix I provides the reader an additional insight into these characteristics.

The watercourses within the Fish Habitat Assessment Area (WC2 and WC3) are described in further detail below:
WC2 exhibits moderate waterflow, with medium size rock substrate, providing no spawning capability, but exhibiting some Type II characteristics. The sections with Type IV habitat have slower water running through wetlands and fine substrate. The substrate in WC2 is dominated by rubble, cobbles and gravel co-dominating with small boulders and mud present throughout. WC2 provides potential feeding and rearing habitat only when water depth allows and provides no spawning or overwintering habitat.

WC3 exhibits moderate waterflow, with larger size rock substrate, providing no spawning capability, but exhibiting some Type II characteristics. The substrate is dominated by small boulders co-dominating with mud and cobbles present throughout. WC3 is also shallow (5-30 cm) and exhibits a high proportion of in-stream vegetation, all Type IV characteristics. WC3 provides potential feeding and rearing habitat only when water depth allows and provides no spawning or overwintering habitat.

Brook Trout and Atlantic Salmon are cold water fish species, meaning they require cold water to live and reproduce. The optimal temperature range for these species (growth of juvenile) is 10-20°C (The Stream Steward n.d.) to 16-20°C (DFO 2012) (Brook Trout and Atlantic Salmon, respectively). American Eels have a broader temperature range and can tolerate temperatures from 4 to 25 °C (MIT Sea Grant Coastal Resources, 2006). Temperatures recorded in WC2 and WC3 during electrofishing in September 2018 (Table 23) were 13.2°C and 12.3°C, respectively. These temperatures are within the optimal range for Brook Trout and American Eel but below the optimal range for Atlantic Salmon.

The Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life for Freshwater (FWAL) establish that a range of pH from 6.5 to 9.0 is suitable within freshwater habitat. WC2 and WC3, as measured in September 2018, had pH levels within the range suitable for fish within freshwater habitat (see Table 23). Alternatively, surface water samples taken in July 2018 (Table 22) at WQ2 (in WC2) had a pH of 5.72, below CCME guidelines. Refer to Table 22 for additional CCME FWAL exceedances.

Based on the watercourse characteristics described above, the following comparisons were made with the SAR/SOCI fish species identified as being potentially present within aquatic systems connected to the O’Hearn Flowage (see Section 5.5.2). As stated earlier, Atlantic Salmon (Inner Bay of Fundy Population), Brook Trout, Striped Bass (Bay of Fundy Population), and American Eel have potential to access these watercourses due to their downstream aquatic connections. Tables 16-19 outline the availability of viable habitat within either watercourse as compared to these species’ habitat requirements.
### Table 16. Atlantic Salmon Specific Habitat Characteristics

<table>
<thead>
<tr>
<th>Life Cycle Period</th>
<th>Habitat Requirements</th>
<th>Habitat Provided in WC2?</th>
<th>Habitat Provided in WC3?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>Runs, fast current, gravel/cobble bed, eddies, and in stream protection features (i.e. rocks).</td>
<td>No: lacks water flow characteristics</td>
<td>No: lacks water flow characteristics</td>
</tr>
<tr>
<td>Juvenile/rearing</td>
<td>Same as above</td>
<td>Possible: water depth insufficient except during times of high flow</td>
<td>Possible: water depth insufficient except during times of high flow</td>
</tr>
<tr>
<td>Overwintering</td>
<td>Deep, slow moving pools with sand or small gravel bottoms.</td>
<td>No: lacks sufficient water depth</td>
<td>No: lacks sufficient water depth</td>
</tr>
<tr>
<td>Spawning</td>
<td>Gravel beds, in shallow rapidly moving water (riffles) with rapids and pools. Water temperatures between 15-25 C in summer.</td>
<td>No: lacks critical substrate</td>
<td>No: lacks critical substrate</td>
</tr>
</tbody>
</table>

### Table 17. Brook Trout Specific Habitat Characteristics

<table>
<thead>
<tr>
<th>Life Cycle Period</th>
<th>Habitat Requirements</th>
<th>Habitat Provided in WC2?</th>
<th>Habitat Provided in WC3?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>Well oxygenated, cold, deep-water lakes and perennial streams. Closed canopy, and trees to protect channel from erosion.</td>
<td>No: lacks sufficient water depth</td>
<td>No: lacks sufficient water depth</td>
</tr>
<tr>
<td>Juvenile/rearing</td>
<td>Nursery habitat includes littoral and sublittoral zones in lakes and ponds, where submerged aquatic vegetation and macroalgal beds provide important nursery habitat. Juveniles rely on several different</td>
<td>Possible: water depth insufficient except during times of high flow</td>
<td>Possible: water depth insufficient except during times of high flow</td>
</tr>
</tbody>
</table>

---

1. Table 16
2. Table 17
### Table 18. Bay of Fundy Striped Bass Specific Habitat Characteristics

<table>
<thead>
<tr>
<th>Life Cycle Period</th>
<th>Habitat Requirements</th>
<th>Habitat Provided in WC2?</th>
<th>Habitat Provided in WC3?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>Connectivity to spawning or overwintering areas</td>
<td>Unlikely: watercourse not connected to Shubenacadie River but does drain to Minas Basin.</td>
<td>Unlikely: watercourse not connected to Shubenacadie River but does drain to Minas Basin.</td>
</tr>
<tr>
<td>Juvenile/rearing</td>
<td>Nursery habitat includes areas of submerged aquatic vegetation, especially eelgrass. Shorelines and intertidal zones.</td>
<td>No: habitat types not present.</td>
<td>No: habitat types not present.</td>
</tr>
<tr>
<td>Overwintering</td>
<td>Overwinter in Grand Lake, via Shubenacadie River</td>
<td>No: unsuitable geographical location</td>
<td>No: unsuitable geographical location</td>
</tr>
<tr>
<td>Spawning</td>
<td>Freshwater environments near the fresh-saltwater transition zone.</td>
<td>No: distant from saltwater habitat</td>
<td>No: distant from saltwater habitat</td>
</tr>
</tbody>
</table>

### Brook Trout

<table>
<thead>
<tr>
<th>Life Cycle Period</th>
<th>Habitat Requirements</th>
<th>Habitat Provided in WC2?</th>
<th>Habitat Provided in WC3?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overwintering</td>
<td>Pools beneath cover (overhanging vegetation, rocks, logs etc.) and close to point sources of groundwater discharge. Undercut banks.</td>
<td>No: lacks sufficient water depth</td>
<td>No: lacks sufficient water depth</td>
</tr>
<tr>
<td>Spawning</td>
<td>Gravel substrate in lake or perennial stream. Groundwater upwellings and spring seeps.</td>
<td>No: lacks critical substrate</td>
<td>No: lacks critical substrate</td>
</tr>
</tbody>
</table>

**Table 18. Bay of Fundy Striped Bass Specific Habitat Characteristics**

- **Migration**: Connectivity to spawning or overwintering areas. Unlikely: watercourse not connected to Shubenacadie River but does drain to Minas Basin.
- **Juvenile/rearing**: Nursery habitat includes areas of submerged aquatic vegetation, especially eelgrass. No: habitat types not present.
- **Overwintering**: Overwinter in Grand Lake, via Shubenacadie River. No: unsuitable geographical location.
- **Spawning**: Freshwater environments near the fresh-saltwater transition zone. No: distant from saltwater habitat.
Table 19. American Eel Specific Habitat Characteristics

<table>
<thead>
<tr>
<th>Life Cycle Period</th>
<th>Habitat Requirements</th>
<th>Habitat Provided in WC2?</th>
<th>Habitat Provided in WC3?</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Eel1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migration</td>
<td>Connectivity to other bodies of water</td>
<td>Possible: connected to other, larger bodies of water downstream</td>
<td>Possible: connected to other, larger bodies of water downstream</td>
</tr>
<tr>
<td>Juvenile/rearing</td>
<td>Rock, sand, mud substrate, bottom debris and submerged vegetation for protection and cover</td>
<td>Possible: water depth insufficient except during times of high flow</td>
<td>Possible: water depth insufficient except during times of high flow</td>
</tr>
<tr>
<td>Overwintering</td>
<td>Fresh and saltwater in lakes, rivers, bays, estuaries. Also uses shallow, protected waters with mud substrates.</td>
<td>Possible: lacks critical substrate, but provides shallow, protected waters</td>
<td>Possible: lacks critical substrate, but provides shallow, protected waters</td>
</tr>
<tr>
<td>Spawning</td>
<td>Sargasso Sea</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

1 References: Department of Fisheries and Oceans (2016)
2 References: Whitewater to Bluewater Partnership (unknown date)
3 References: COSEWIC (2004)
4 References: COSEWIC (2006)

5.5.2.2.1 Electrofishing Results

Two watercourses within the Fish Habitat Assessment Area were electrofished following the methods outlined in Section 4.1.2.2.3. No fish were caught nor observed at the two electrofishing locations. The electrofishing effort within the Fish Habitat Assessment Area (Figure 9, Appendix A) is described in Table 20 (below).

Table 20: Electrofishing Effort

<table>
<thead>
<tr>
<th>Watercourse</th>
<th>Section Length</th>
<th>Survey Effort</th>
<th>Voltage</th>
<th>Frequency</th>
<th>Water Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC 2</td>
<td>93m</td>
<td>533 sec.</td>
<td>450V</td>
<td>160Hz</td>
<td>13.0°C</td>
</tr>
<tr>
<td>WC 3</td>
<td>42m</td>
<td>603 sec.</td>
<td>450V</td>
<td>60Hz</td>
<td>12.6°C</td>
</tr>
</tbody>
</table>

5.5.3 Water Quality

Water sampling and water quality field measurements were collected within WC2 and WC3 to establish current conditions. As discussed in Section 4.1.2.3.1, TSS samples have been collected and analyzed on
an ongoing basis by the Proponent since 2015 at WQ2 and WQ3. WQ3 will also be sampled for baseline RCAp-MS Total Metals in Water prior to future quarry expansion.

5.5.3.1 Surface Water Sampling

Two surface water samples were collected (Figure 8, Appendix A) as discussed in Section 4.1.2.3.1. The samples were analysed at Maxxam Analytics in Bedford, Nova Scotia for TSS and RCAp-MS Total Metals in Water. Table 21 (below) provides the locations of the two surface water samples.

Table 21. Surface Water Samples Locations

<table>
<thead>
<tr>
<th>Sample ID as per Figure 8</th>
<th>Sample Location Description</th>
<th>Sample Location (UTM; 20T)</th>
<th>Date Sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>WQ1</td>
<td>Unnamed Tributary B, north of Study Area boundary</td>
<td>441741m E 4977192m N</td>
<td>July 11, 2018</td>
</tr>
<tr>
<td>WQ2</td>
<td>WC2 downstream of WL7, south of Study Area boundary</td>
<td>441520m E 4976336m N</td>
<td>July 3, 2018</td>
</tr>
</tbody>
</table>

The surface water sample results were compared to the CCME FWAL guidelines. The results for these samples and the CCME guidelines are provided in Appendix F.

TSS and RCAp-MS Total Metals in Water were analysed to establish a baseline for comparison of surface water quality. Sample results recorded at WQ1 and WQ2 meet all but 5 (WQ1) and 3 (WQ2) applicable CCME FWAL water quality guidelines. Table 22 provides a comparison of the CCME FWAL exceedances at WQ1 and WQ2 (highlighted grey cells).

Table 22: CCME FWAL Guideline Exceedances

<table>
<thead>
<tr>
<th>Sample Parameter</th>
<th>CCME FWAL Guideline</th>
<th>WQ1 Results</th>
<th>WQ2 Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 to 9.0</td>
<td>5.52</td>
<td>5.72</td>
</tr>
<tr>
<td>Total Aluminum</td>
<td>Variable</td>
<td>840 ug/L</td>
<td>560 ug/L</td>
</tr>
<tr>
<td>Total Chromium</td>
<td>1 ug/L (for Cr VI) or 8.9 ug/L (for Cr III)</td>
<td>2.5 ug/L</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Total Iron</td>
<td>300 ug/L</td>
<td>1500ug/L</td>
<td>2000ug/L</td>
</tr>
<tr>
<td>Total Lead</td>
<td>1 ug/L</td>
<td>1.2 ug/L</td>
<td>0.77</td>
</tr>
</tbody>
</table>

TSS sample results recorded at each location were as follows:

WQ1 (July 3, 2018) – 1.4 mg/L
WQ2 (July 11, 2018) – <1 mg/L
WQ3 (September 12, 2018) – 1.2 mg/L
As discussed in Section 4.1.2.3.1, WQ1 is located in Unnamed Tributary B (a mapped WC). The majority of water sourced to Unnamed Tributary B is via run-off from natural forested land and wetlands located beyond (north) of the Study Area. Based on topography, and as described in Section 4.1.2.4, this WC is in an adjacent catchment area to the Study Area and as such, surface water run-off from the Study Area into Unnamed Tributary B is not expected to occur. Due to the inaccuracies in topographical mapping however, and proximity of Unnamed Tributary B to the Study Area boundary, water quality measurements were collected within this feature for the purposes of future comparison.

WQ2 is located in WC2, downstream of WL7 and the Study Area. As indicated on Figure 8 (Appendix A), the southern portion of the existing quarry footprint extends to within 150 m of WC2, and 200 m of WQ1 location. However, WC2 does not currently receive direct surface water inflow from the existing quarry area and as such WQ2 represents natural, baseline conditions.

Sample results WQ1 and WQ2 indicate some exceedances in comparison with CCME FWAL guidelines. At this time, the cause of the exceedances in water quality measurements is unknown, but water quality samples are reflective of natural conditions, sourced from undeveloped areas of the Study Area. Acidic water conditions (pH < 6.5) and the presence of wetlands in the catchment area might explain the higher metal concentration due to acidic leaching from rock.

Concerning chromium concentration, the Environmental Protection Agency (EPA) states:

"Chromium occurs in the environment predominantly in one of two valence states: trivalent chromium (Cr III), which occurs naturally and is an essential nutrient, and hexavalent chromium (Cr VI), which, along with the less common metallic chromium (Cr 0), is most commonly produced by industrial processes. The most important industrial sources of chromium are those related to ferrochrome production. Ore refining, chemical and refractory processing, cement-producing plants, automobile brake lining and catalytic converters for automobiles, leather tanneries, and chrome pigments"

Chromium VI is more toxic than Chromium III, hence the lower CCME FWAL concentration guideline (1 ug/L vs 8.9 ug/L) was used as a comparative to on-site conditions. Given the absence of such industrial process in the area, our assumptions is that the Chromium concentrations present are from the trivalent state.

Other factors such as preceding precipitation volumes, seasonal water flow variances, and up-stream conditions can affect water quality results.

5.5.3.2 Water Quality Measurements

Water quality measurements were recorded during field surveys on September 28, 2018 at WC1-4. Table 23 provides results collected by the Horiba U22 Multi-parameter probe.
Table 23: Water Quality Measurements

<table>
<thead>
<tr>
<th>Sample Parameter</th>
<th>WC1 Results</th>
<th>WC2 Results</th>
<th>WC3 Results</th>
<th>WC4 Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Location (UTM; 20T)</td>
<td>441108m E; 4976630m N</td>
<td>441529m E; 4976334m N</td>
<td>441468 m E; 4975657 m N</td>
<td>440681 m E; 4976548 m N</td>
</tr>
<tr>
<td>pH</td>
<td>6.47</td>
<td>7.98</td>
<td>7.45</td>
<td>5.90</td>
</tr>
<tr>
<td>Salinity (ppt)</td>
<td>NA</td>
<td>0.02</td>
<td>0.03</td>
<td>NA</td>
</tr>
<tr>
<td>Total Dissolved Solids (mg/L)</td>
<td>42.9</td>
<td>34.45</td>
<td>39.00</td>
<td>51.35</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td>4.8</td>
<td>8.82</td>
<td>5.67</td>
<td>4.32</td>
</tr>
<tr>
<td>Conductivity (mmHg)</td>
<td>750.0</td>
<td>747.9</td>
<td>749.3</td>
<td>750.4</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>12.3</td>
<td>13.2</td>
<td>12.3</td>
<td>12.5</td>
</tr>
</tbody>
</table>

5.5.4 Hydrological Effects Analysis

Three LCA’s (Eastern - LCA, Central - LCA and Western - LCA) divide the surface water drainage characteristics across the Development Area (Figure 7, Appendix A). An additional LCA, the O’Hearn Flowage - LCA, encompasses the three LCA’s listed above, as well as additional drainage areas which source water to O’Hearn Brook, but are located outside of the Study Area. Current area values for each of these local catchments and the area lost due to proposed quarry development are presented in Table 24.

Table 24: Local Catchment Area Lost from Project Development

<table>
<thead>
<tr>
<th>Local Catchment Area</th>
<th>Total Area (m²)</th>
<th>Total Area Lost (m²) Post Quarry Expansion</th>
<th>% Lost Post Quarry Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern LCA</td>
<td>423,962</td>
<td>63,546</td>
<td>15.0</td>
</tr>
<tr>
<td>Central LCA</td>
<td>650,556</td>
<td>102,784</td>
<td>15.8</td>
</tr>
<tr>
<td>Western LCA</td>
<td>3,822,757</td>
<td>136,434</td>
<td>3.6</td>
</tr>
<tr>
<td>O’Hearn Flowage LCA</td>
<td>14,552,777</td>
<td>301,729</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The following summary of results should be evaluated in consultation with the methodologies and assumptions (i.e. precipitation and evapotranspiration remain constant and no additional storage is created or removed from the local catchment areas from baseline conditions to post expansion) stated in the Hydrological Effects Analysis Methods (Section 4.1.2.4).

The Eastern LCA, the smallest LCA analyzed, encompasses an area of 423,962 m² of which 63,546 m² is located within the Development Area and lost as a result of future quarry expansion. As per the methodology for this assessment, this reduction in contributing drainage area to WC2 equates to a 15.0% predicted reduction in streamflow.
The Central LCA is 650,556 m² and this LCA will lose 102,784 m² due to quarry expansion. As a percentage lost, the reduction in Central LCA is the greatest of the three LCA’s that are located within the Development Area. The loss of the Central LCA is 15.8% which will result in a 15.8% decrease in predicted streamflow of WC3.

The Western LCA is the largest of the three LCA’s within the Development Area. This LCA includes 3,822,757 m². The Western LCA will lose 136,434 m² of its area through future quarry expansion which represents a 3.6% predicted reduction in streamflow within Unnamed Tributary A. As expected, given the large area of the Western LCA, the predicted reduction of streamflow within the Western LCA represents the least potential effect of all altered tributaries to O’Hearn Flowage (WC2, WC3, and Unnamed Tributary A).

When accounting for the entire Development Area, overall, within the O’Hearn Flowage LCA, there is a predicted reduction in streamflow of 2.1%. This potential hydrological effect exists between Unnamed Tributary A, upstream of O’Hearn Lake, to the confluence of WC2 and O’Hearn Flowage. This is based on the loss of the entire Development Area (301,729 m²) over the 14,552,777 m² area of the O’Hearn Flowage LCA.

5.6  SAR and SOCI

A SAR is a species which is legally protected under the federal Species at Risk Act (SARA) or the provincial Nova Scotia Endangered Species Act (NSESA), while a SOCI is a species that is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or one which is classified as S1 to S3 by the ACCDC.

A review of ACCDC and NSCCH report confirms the presence of several Priority Species in proximity to the Study Area (Figure 12, Appendix A). The ACCDC identified the following records of SAR, SOCI and Special Areas within 5 km of the Study Area including:

• 1 record of 1 vascular flora,
• no records of nonvascular flora,
• 58 records of 26 vertebrate,
• no records of invertebrates,
• 1 managed area,
• no biologically significant sites, and
• no location sensitive species.

Of these identified records, six SAR, of which none were observed during field surveys, were identified within 5 km of Study Area:

• Barn Swallow (NSESA Endangered, SARA Threatened, COSEWIC Threatened).
• Canada Warbler (NSESA Endangered, SARA Threatened, COSEWIC Threatened).
Birrette's East Uniacke Quarry Expansion

- Common Nighthawk (NSESA Threatened, SARA Threatened, COSEWIC Special Concern).
- Eastern Wood Pewee (NSESA Vulnerable, SARA Special Concern, COSEWIC Special Concern).
- Olive-sided Flycatcher (NSESA Threatened, SARA Threatened, COSEWIC Special Concern).
- Rusty Blackbird (NSESA Endangered, SARA Special Concern, COSEWIC Special Concern).

The managed area that was identified by ACCDC within 5 km of the Study Area is the East Hants Regional Municipal Water Supply.

No location sensitive species were identified within 5 km of the Study Area and none were observed during field surveys within the Study Area. No suitable bat hibernaculum was encountered within the Study Area during field surveys. Additional information regarding bat hibernacula and potential effect to bats associated with blasting activities is discussed in Section 5.4.7.

A summary of federally and provincially protected species identified within 20 km of the Study Area is provided below (Table 25). For avifaunal Priority Species, breeding status as documented in the Maritime Breeding Bird Atlas square summary (square 20MQ47) is also included. If the species was observed during atlas surveys, with no breeding evidence noted, this is indicated below as well.

**Table 25. Summary of ACCDC observations of federally and provincially protected species within 20 km of the Study Area.**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>COSEWIC</th>
<th>SARA</th>
<th>NSESA</th>
<th>S Rank</th>
<th>Distance</th>
<th>MBBA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flora and Lichens</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fraxinus nigra</em></td>
<td>Black Ash</td>
<td></td>
<td></td>
<td>Threatened</td>
<td>S1S2</td>
<td>14.2 ± 0.0</td>
<td>NA</td>
</tr>
<tr>
<td><em>Juglans cinerea</em></td>
<td>Butternut</td>
<td></td>
<td></td>
<td>Endangered</td>
<td>SNA</td>
<td>16.5 ± 0.0</td>
<td>NA</td>
</tr>
<tr>
<td><em>Thuja occidentalis</em></td>
<td>Eastern White Cedar</td>
<td></td>
<td>Vulnerable</td>
<td>S1</td>
<td>21.0 ± 1.0</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td><em>Sclerophora peronella</em> <em>(Nova Scotia pop.)</em></td>
<td>Frosted Glass-whiskers Lichen - Nova Scotia pop.</td>
<td>Special Concern</td>
<td>Special Concern</td>
<td>S1?</td>
<td>11.2 ± 0.0</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td><em>Cypripedium arietinum</em></td>
<td>Ram's-Head Lady's-Slipper</td>
<td></td>
<td></td>
<td>Endangered</td>
<td>S1</td>
<td>20.3 ± 2.0</td>
<td>NA</td>
</tr>
<tr>
<td>Scientific Name</td>
<td>Common Name</td>
<td>COSEWIC</td>
<td>SARA</td>
<td>NSESA</td>
<td>S Rank</td>
<td>Distance</td>
<td>MBBA</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>--------------</td>
<td>------------</td>
<td>--------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>Herpetofauna</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyptemys insculpta</td>
<td>Wood Turtle</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Threatened</td>
<td>S2</td>
<td>5.2 ± 0.0</td>
<td>NA</td>
</tr>
<tr>
<td>Chelydra serpentina</td>
<td>Snapping Turtle</td>
<td>Special Concern</td>
<td>Special Concern</td>
<td>Vulnerable</td>
<td>S3</td>
<td>6.6 ± 10.0</td>
<td>NA</td>
</tr>
<tr>
<td>Mammals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myotis lucifugus</td>
<td>Little Brown Myotis</td>
<td>Endangered</td>
<td>Endangered</td>
<td>Endangered</td>
<td>S1</td>
<td>14.9 ± 0.0</td>
<td>NA</td>
</tr>
<tr>
<td>Avian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antrostomus vociferus</td>
<td>Eastern Whip-Poor-Will</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Threatened</td>
<td>S1?B</td>
<td>12.1 ± 7.0</td>
<td>NA</td>
</tr>
<tr>
<td>Chordeiles minor</td>
<td>Common Nighthawk</td>
<td>Special Concern</td>
<td>Threatened</td>
<td>Threatened</td>
<td>S2B</td>
<td>3.9 ± 7.0</td>
<td>Probable</td>
</tr>
<tr>
<td>Contopus cooperi</td>
<td>Olive-sided Flycatcher</td>
<td>Special Concern</td>
<td>Threatened</td>
<td>Threatened</td>
<td>S2B</td>
<td>3.9 ± 7.0</td>
<td>Probable</td>
</tr>
<tr>
<td>Chaetura pelagica</td>
<td>Chimney Swift</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Endangered</td>
<td>S2B, S1M</td>
<td>10.6 ± 7.0</td>
<td>Possible</td>
</tr>
<tr>
<td>Riparia riparia</td>
<td>Bank Swallow</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Endangered</td>
<td>S2S3B</td>
<td>9.2 ± 7.0</td>
<td>NA</td>
</tr>
<tr>
<td>Hirundo rustica</td>
<td>Barn Swallow</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Endangered</td>
<td>S2S3B</td>
<td>3.9 ± 7.0</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Wilsonia canadensis</td>
<td>Canada Warbler</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Endangered</td>
<td>S3B</td>
<td>3.9 ± 7.0</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Dolichonyx oryzivorus</td>
<td>Bobolink</td>
<td>Threatened</td>
<td>Threatened</td>
<td>Vulnerable</td>
<td>S3S4B</td>
<td>9.2 ± 7.0</td>
<td>NA</td>
</tr>
<tr>
<td>Hylocichla mustelina</td>
<td>Wood Thrush</td>
<td>Threatened</td>
<td>Threatened</td>
<td>NA</td>
<td>SUB</td>
<td>18.8 ± 7.0</td>
<td>NA</td>
</tr>
<tr>
<td>Euphagus carolinus</td>
<td>Rusty Blackbird</td>
<td>Special Concern</td>
<td>Special Concern</td>
<td>Endangered</td>
<td>S2B</td>
<td>4.1 ± 0.0</td>
<td>Possible</td>
</tr>
<tr>
<td>Contopus virens</td>
<td>Eastern Wood-Pewee</td>
<td>Special Concern</td>
<td>Special Concern</td>
<td>Vulnerable</td>
<td>S3S4B</td>
<td>2.7 ± 0.0</td>
<td>Probable</td>
</tr>
<tr>
<td>Coccodroma vespertinus</td>
<td>Evening Grosbeak</td>
<td>Special Concern</td>
<td>NA</td>
<td>Vulnerable</td>
<td>S3S4B, S3N</td>
<td>3.9 ± 7.0</td>
<td>Possible</td>
</tr>
<tr>
<td>Invertebrates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Danaus plexippus</td>
<td>Monarch</td>
<td>Endangered</td>
<td>Special Concern</td>
<td>Endangered</td>
<td>S2B</td>
<td>9.1 ± 0.0</td>
<td>NA</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmo salar pop. 1</td>
<td>Atlantic</td>
<td>Endangered</td>
<td>Endangered</td>
<td>NA</td>
<td>S1</td>
<td>11.5 ± 0.0</td>
<td>NA</td>
</tr>
</tbody>
</table>
Vascular Plants

According to the ACCDC report, one observation of Michaux’s Dwarf Birch (*Betula michauxii*; S2S3) was observed 2.5 km from the Study Area. During the vascular plant surveys in June and September 2018 one SOCI, Southern Twayblade (*Listera australis*) was observed. See below for information regarding the Southern Twayblade observation.

**Southern Twayblade (*Listera australis*)**
The Southern Twayblade which is a member of the Orchidaceae family, is a diminutive orchid, with reflexed sepals and a forked labellum (resembling that of a snake’s tongue). This species is often inconspicuous and found on the toe of hummocks in bogs and fens which often have variable topography and microhabitats. This species is often associated with undisturbed wetland complexes and is dependent on mycorrhizal relationships and is part of the Atlantic Coastal Plain Flora (ACPF) (Hill, 2018). This species is listed as Vulnerable (S3) by the ACCDC. Within the Study Area, one specimen in flower was observed on the toe of a hummock in a large bog (WL 4).

Lichens

No rare lichen species were documented within a 5 km in the ACCDC report. No predicted BFL polygons are present within the Study Area. During the Lichen Surveys in May and June (as incidentals) two SOCI lichen species were observed. The species are Appressed Jellyskin Lichen and Pompom-tipped Shadow Lichen. See below for descriptions and locations of the SOCI lichen species observed.

**Appressed Jellyskin Lichen**
Appressed Jellyskin Lichen is a small inconspicuous cyanolichen often associated with mature hardwood trees in close proximity to streams and wetlands (Hinds & Hinds, 2007). Typically, this species is found near the base of trees where it receives a considerable amount of moisture from the forest floor/wetland. The ACCDC has this species listed as Vulnerable (S3) in Nova Scotia.

Two locations and two individuals of Appressed Jellyskin Lichen were observed in the Study Area and both of which were associated with a mature Large-tooth Aspen and a Trembling Aspen. One location was found on the base of a Trembling Aspen in a wet-mesic isolated tree patch just south of the main access road going west to east. The other specimen was found further east in a similar habitat at the base of a Large-tooth Aspen.
Pompom-tipped Shadow Lichen

Pompom-tipped Shadow Lichen is a lichen species with a green-algae as the photobiont, often forming small rosettes and with conspicuous black-rhizines (Nash, 2004). This species is distinguished from the other similar species by the soralia that is often capitate (appearing like pom-poms). This species is often growing on hardwood species such as Poplars (*Populus* spp.) which can be found in wetlands and upland. Within the Study Area, one thallus was observed on a Trembling Aspen in a mesic isolated tree patch north of the main access road going east-west. This species is ranked as Vulnerable (S3?) by the ACCDC.

5.6.3 Herpetofauna

No priority herpetofauna species were observed during field surveys. According to the ACCDC, two SAR were identified within 20 km of the Study Area. Wood Turtle and Snapping Turtle were identified approximately 5.2 km and 6.6 km from the Study Area, respectively.

Wood Turtle

Wood Turtles are listed Threatened under SARA, COSEWIC and NSESA. The species live along permanent streams but may roam, during summer, overland and can be found in a variety of terrestrial habitat. Wood Turtle nest on sand or gravel-sand beaches and banks. This species prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate. They overwinter in numerous microhabitat types, which include burrowing in mud, under overhanging bank or in the bottoms of stream pools (Environment Canada, 2016). No overwintering or nesting habitat for the Wood Turtle was identified within the Study Area. WC2 substrate is co-dominated by small boulders, rubbles, cobbles, gravel and mud, and WC3 is dominated by small boulders, cobbles and mud. The potential for the Wood Turtle to nest in these watercourses are low. However, Wood Turtles could use the watercourses for passage to other habitats beyond the Study Area limits. WC1 and WC4 were too intermittent to provide potential Wood Turtle habitat.

Snapping Turtle

Snapping Turtles are listed as Vulnerable under the NSESA and Special Concern under SARA and COSEWIC. Snapping Turtles use a variety of habitats; however, the preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. They overwinter in aquatic environments which will not freeze to the bottom (ECCC, 2016b). No soft muddy bottom and dense aquatic vegetation conditions are described for the watercourses or wetlands located within the Study Area therefore suitable overwintering or nesting habitats for the Snapping Turtle are not present. It should be noted, however, that a resident communicated to MEL staff during public consultation that Snapping Turtles had been observed on the shoulder of driveways off East Uniacke Road, approximately 1 km from the Study Area.
5.6.4 Mammals

No priority mammal species were observed during field surveys. According to the ACCDC report, one SAR was identified within 20 km of the Study Area, the Little Brown Myotis. Mainland Moose were identified approximately 39.6 km from the Study Area.

**Little Brown Myotis**

The Little Brown Myotis require a variety of habitats depending on the season. For overwintering habitat, they need hibernacula which include caves, abandoned mines, and wells, summer habitat include roosting habitat and foraging habitat and they need swarming habitat in late summer and early fall for mating and socializing. The Little Brown Myotis uses building and other anthropogenic structures to roost, tree cavities, tree bark, and crevices on cliffs. They feed on insects and spiders and are associated with open habitats, ponds, road, and open canopy forests. Foraging habitat for the Little Brown Myotis is provided within the Study Area. Minimal roosting habitat is provided within the Study Area (Environment Canada, 2015). Further information regarding bat usage is provided in Section 5.4.7.

**Mainland Moose**

Mainland Moose (*Alces americanus*) is listed as Endangered under the NSESA and ranked as S1 by the ACCDC. The habitat requirements for Mainland Moose are mixed wood habitats, where its food source, twigs, stems and foliage of young deciduous trees and shrubs are abundant. In mainland Nova Scotia, it is estimated that less than 1,000 Mainland Moose individuals are present (MTRI, 2015). The Study Area is not located within a Mainland Moose Concentration Area and no observations of Mainland Moose were recorded during dedicated surveys or incidentally during field assessments, however, suitable habitat is provided within the Study Area.

5.6.5 Avian

Four (4) SOCI birds (Table 26) were identified within or surrounding the Study Area during field surveys. No SAR birds were observed.

**Table 26. SOCI observed during dedicated survey periods**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>SARA</th>
<th>COSEWIC</th>
<th>NSESA</th>
<th>SRank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Siskin</td>
<td><em>Cardelius pinus</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>S2S3</td>
</tr>
<tr>
<td>Red-breasted Nuthatch</td>
<td><em>Sitta canadensis</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>S3</td>
</tr>
<tr>
<td>Ruby-crowned Kinglet</td>
<td><em>Regulus calendula</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>S3S4B</td>
</tr>
<tr>
<td>Yellow-bellied Flycatcher</td>
<td><em>Empidonax flaviventris</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>S3S4B</td>
</tr>
</tbody>
</table>

The potential for these species to be impacted by this Project is evaluated below. Potential effects of the Project on these species, as well as proposed mitigation measures, are discussed in more detail in Section

**Pine Siskin**
Two Pine Siskins were observed during the spring migration surveys at PC4 and PC12. Preferred habitat for the Pine Siskin consists of coniferous or mixed wood forest with open canopies. They nest within conifer trees (Cornell University, 2015). Potential breeding habitat is scattered throughout the Study Area.

Red-breasted Nuthatch
Nine Red-breasted Nuthatches were observed during spring migration (PC3, PC4, PC5, PC6, PC8 and PC10), 4 during breeding season (PC4, PC9, PC10 and PC12) and 7 during fall migration (PC4, PC6, PC8 and PC11). Possible breeding evidence was observed during the breeding bird survey. Red-breasted Nuthatches preferred habitat is mainly in coniferous forests of spruce, fir, pine, hemlock, and larch (Cornell University, 2015). Potential breeding habitat is scattered throughout the Study Area.

Ruby-crowned Kinglet
Four Ruby-crowned Kinglets were observed during spring migration (PC3, PC4, PC10 and PC12) and 6 during the breeding season (PC3, PC4, PC5, PC10, PC12). Probable breeding evidence was observed during the breeding bird survey. Ruby-crowned Kinglets build their nests high on a conifer tree within conifer dominant or mixed wood forests. They also use isolated trees in meadows and floodplain forests (Cornell University, 2015). Potential breeding habitat is scattered throughout the Study Area.

Yellow-bellied Flycatcher
Four Yellow-bellied Flycatchers were observed during the breeding season (PC6, PC8, PC9, PC10). Possible breeding evidence was observed during the breeding bird survey. Yellow-bellied Flycatchers build their nest on or near the ground in moist coniferous forests, bogs, swamps, and peatlands (Cornell University, 2015). Potential breeding habitat is scattered throughout the Study Area, especially in relation to the numerous wetlands observed in the Study Area.

5.6.6 Invertebrates
According to the ACCDC report, no SAR/SOCI invertebrates were identified within 5 km from the Study Area. One (1) SAR species was reported to be within 20 km from the Study Area: Monarch (*Danaus plexippus*; NSESA Endangered, SARA Special Concern, COSEWIC Endangered, S2B).

Monarch
Monarch butterflies use a variety of habitats; however, they require habitats with milkweed species (Audubon, 1981). No Monarch butterflies were observed within the Study Area. No milkweed species were identified during field surveys, therefore, habitat for the Monarch is not present within the Study Area.
5.6.7 Fish

No priority fish species were identified during field surveys, electrofishing, or by ACCDC (within 5 km of the Study Area). Atlantic Salmon - Inner Bay of Fundy population (*Salmo salar* pop 1, S1), Striped Bass - Bay of Fundy population (*Morone saxatilis*; S1B), American Eel (*Anguilla rostrata*; S2) and Brook Trout (*Salvelinus fontinalis*; S3) were reported to be within 20 km of the Study Area by the ACCDC.

The Study Area is present within the St. Croix River Secondary Watershed. The St.Croix and Herbert River, in which O’Hearn Flowage connects to, is an Atlantic Salmon (*Salmo salar*) river (Inner Bay of Fundy population; COSEWIC Endangered, SARA Endangered, S1) system. This population is found in rivers that drain to the Bay of Fundy from the Pereaux River in mainland Nova Scotia to the Mispec River in New Brunswick (DFO, 2018).

No direct impacts to either Watercourse 2 or 3 (which both receive water from the Development Area) will occur as a result of future quarrying, however as described in Section 5.5.4, possible indirect effects related to flow of water into these systems may occur. As such, potential effects as a result of this scenario for the species discussed below is further evaluated in Section 9.2.3 (effects assessment).

The following describes habitat provision for the Priority Fish Species discussed above in the watercourses evaluated. It should be noted however, that each of these watercourses presents possible barriers to fish passage (notably during periods of low flow), and the habitat characteristics described are intermittent along the channel extent surveyed within each of the Fish Habitat Assessment Areas. Refer to Tables 16 – 19 in Section 5.5.2.2 for further details related to priority fish habitat provisions.
Atlantic Salmon
Atlantic Salmon spawn in fresh water, generally in the same river where they were born. Juveniles spend one to eight years in fresh water before migrating to salt water in the North Atlantic. After remaining within salt water for one to four years, adult salmon will return to fresh water to spawn. Salmon rivers or streams are generally clear and cool, with gravel, cobble and boulder river beds (DFO, 2016b). WC2 and WC3 are first order streams located in the upper reaches of the St. Croix River Secondary Watershed. As discussed in Section 5.5.2, WC2 and WC3 provides potential feeding, and rearing habitats as far as Wetland 7, at which point watercourses dissipate, and a lack of flowing water was observed for extended periods of time. The portion downstream of WL7, for both watercourses is considered Type II/IV fish habitat. No Atlantic Salmon were observed during field surveys in 2018 (including electrofishing).

Striped Bass - Bay of Fundy population
Striped Bass are usually associated with estuaries and coastal waters. They can be found on the east coast of North America, from the St. Lawrence Estuary to the northeast of Florida. They spawn in freshwater and brackish water and following hatching will undergo a slow migration downstream to saltwater. The Canadian population is known to overwinter in freshwater. The Striped Bass - Bay of Fundy population is currently limited to spawning in the Shubenacadie River, other residence occurring in the Saint John and the Annapolis River (DFO, 2016c). None of these systems are connected to the St. Croix River Watershed, hence this species would not be present within the aquatic system that drains from the Study Area.

American Eel
American Eel is found in the Atlantic Ocean from Iceland to the Caribbean Sea. They spawn in the Sargasso Sea, situated on the West side of the Atlantic Ocean, southeast of Nova Scotia. American Eel can be found in all waters that are connected to the Atlantic Ocean (DFO, 2016a). The watercourses that drain out of the Study Areas, specifically WC2 and WC3, are connected to the Atlantic Ocean via the Minas Basin. Both watercourses drain in the Herbert River, a known fish bearing-river, hence the potential of American Eel habitat.

Brook Trout
Brook Trout require cool water habitat. Spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with a gravel substrate (Whitewater to Bluewater Partnership, n.d.). No spawning habitat was identified within the Study Area and Fish Habitat Assessment Area for Brook Trout, however potential for juvenile/rearing is possible when water levels are high enough.

No SAR or SOCI fish were identified within the Study Area or Fish Habitat Assessment Area.
6 SOCIOECONOMIC CONDITIONS

The Project is located approximately 4km northeast of East Uniacke in the Municipality of the District of East Hants, Hants County, Nova Scotia. Background on the regional area including nearby centres are summarized below.

6.1 Mi’kmaq

The Project is located within the Mi’kmaq district of Sipekni’katik meaning "wild potato area"; there are several geographic locations surrounding Study Area that have Mi’kmaq names. In the region, several isolated finds and encampment sites from the precontact period were largely found along river systems and lakes outlining the importance of waterways for Mi’kmaq (Davis MacIntyre & Associates Limited, 2018). Neither a background study nor field survey completed by Davis MacIntyre & Associates Limited revealed evidence of significant historic or precontact land use by Mi’kmaq or European settlers within the Study Area. There is no traditional land use sites within a 1 km radius of the Study Area (Davis MacIntyre & Associates Limited, 2018 [KMKNO, pers. comm., 2018]). The nearest First Nations communities are Sipekne’katik First Nations (approximately 25 km), Glooscap (approximately 40 km) and Millbrook (approximately 55 km).

6.2 Population and Demographics

East Uniacke is located in Hants County, Nova Scotia.

Hants County, the 7th most populous county in Nova Scotia, had a total census population of 42,558 in 2016, approximately 4.6 per cent of the provincial population. From 2011 to 2016, the county population increased 0.6 per cent while the population for the entire province increased by 0.2 per cent. Statistics on the population and demographics of Hants County and Nova Scotia are presented in Table 27. The largest population centre in Hants County is the community of Windsor. Other population centres near the Study Area are Mount Uniacke and Beaver Bank.

Table 27: Population and Demographics for Hants County and Nova Scotia.

<table>
<thead>
<tr>
<th></th>
<th>Hants County</th>
<th>Nova Scotia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population in 2016</td>
<td>42,558</td>
<td>923,598</td>
</tr>
<tr>
<td>Population in 2011</td>
<td>42,304</td>
<td>921,727</td>
</tr>
<tr>
<td>2011-2016 Population Change (%)</td>
<td>0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Total private dwellings (2016)</td>
<td>19,202</td>
<td>458,568</td>
</tr>
<tr>
<td>Total number of households (2016)</td>
<td>17,439</td>
<td>401,990</td>
</tr>
<tr>
<td>Population density per square km (2016)</td>
<td>13.9</td>
<td>17.4</td>
</tr>
<tr>
<td>Land area (square km) (2016)</td>
<td>3,051.9</td>
<td>52,942.3</td>
</tr>
<tr>
<td>Median Age of the Population (2016)</td>
<td>44.8</td>
<td>45.5</td>
</tr>
</tbody>
</table>
The population of Hants County has a median age of 44.8 years, nearly one year younger than that of the entire province, which has a median age of 45.5. The population by age cohort in Hants County is presented in Figure 2 (below).

![Figure 2. Population by Age Cohort, Hants County](image)

Source: Statistics Canada 2016 Census of Population Community Profiles

Median income in Hants County (2015) for persons 15 years and older with income was $32,670. Employment income accounted for 70.2% of income, while 15.4% came from Government Transfers.

### 6.3 Economy

Historically, Hants County has relied on resource-based industries to drive the economy; these included agriculture, mining and forestry. Today the economy relies heavily on health care and social assistance, construction and retail trade, which make up 12.1%, 11.5% and 11.4% respectively. The labour force by industry is outlined in Table 28, below.

**Table 28: Labour Force by Industry, Hants County**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care and social assistance</td>
<td>2590</td>
<td>12.1%</td>
</tr>
<tr>
<td>Construction</td>
<td>2475</td>
<td>11.5%</td>
</tr>
<tr>
<td>Retail trade</td>
<td>2435</td>
<td>11.4%</td>
</tr>
</tbody>
</table>
### Industry Labor Force Data

<table>
<thead>
<tr>
<th>Industry</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care and social assistance</td>
<td>2590</td>
<td>12.1%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1660</td>
<td>7.7%</td>
</tr>
<tr>
<td>Public administration</td>
<td>1595</td>
<td>7.4%</td>
</tr>
<tr>
<td>Transportation and warehousing</td>
<td>1425</td>
<td>6.6%</td>
</tr>
<tr>
<td>Educational services</td>
<td>1415</td>
<td>6.6%</td>
</tr>
<tr>
<td>Accommodation and food services</td>
<td>1260</td>
<td>5.9%</td>
</tr>
<tr>
<td>Administrative and support; waste management and remediation services</td>
<td>1160</td>
<td>5.4%</td>
</tr>
<tr>
<td>Professional; scientific and technical services</td>
<td>1145</td>
<td>5.3%</td>
</tr>
<tr>
<td>Other services (except public administration)</td>
<td>950</td>
<td>4.4%</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>770</td>
<td>3.6%</td>
</tr>
<tr>
<td>Agriculture; forestry; fishing and hunting</td>
<td>670</td>
<td>3.1%</td>
</tr>
<tr>
<td>Finance and insurance</td>
<td>580</td>
<td>2.7%</td>
</tr>
<tr>
<td>Arts; entertainment and recreation</td>
<td>365</td>
<td>1.7%</td>
</tr>
<tr>
<td>Real estate and rental and leasing</td>
<td>285</td>
<td>1.3%</td>
</tr>
<tr>
<td>Information and cultural industries</td>
<td>285</td>
<td>1.3%</td>
</tr>
<tr>
<td>Mining; quarrying; and oil and gas extraction</td>
<td>220</td>
<td>1.0%</td>
</tr>
<tr>
<td>Utilities</td>
<td>120</td>
<td>0.6%</td>
</tr>
<tr>
<td>Management of companies and enterprises</td>
<td>15</td>
<td>0.07%</td>
</tr>
</tbody>
</table>

Source: Statistics Canada 2016 National Household Survey

About 52.3% of the experienced labour force in Hants County is female. The participation rate (i.e., the percentage of working age population in the labour force) in 2016 for the county was 62.2%, slightly higher than the provincial average of 61.3%. The unemployment rate for Hants County in 2016 was 8.7%, slightly lower than the provincial average of 10.0%.

Economic activity within 5 km of the Study Area includes forestry, quarrying a wind energy complex, and construction among others. Historical land use within the Study Area and vicinity is dominated by timber harvesting and commercial activity from the active quarry in the eastern extent.

### 6.4 Recreation and Tourism

There is a wide variety of recreational activities within Hants County, these include skiing at Martock, the Shubenacadie River tidal bore rafting, fishing, hunting, hiking, ATVing, and many others. In the East Uniacke area, activities mostly include ATVing and hiking.
The closest Provincial Parks is Bell Provincial Park located, approximately 8.3 km southwest of the Study Area. Bell Provincial Park is a day-use park with a system of trails giving access to the West Lake and providing outdoor activities, such as hiking, cross-country skiing and snowshoeing.

Uniacke Estate Museum Park is located approximately 9 km southwest of the Study Area and offers walking trails and lake access through the country estate of Attorney-General Richard John Uniacke (1753-1830).

Tourism in Nova Scotia is an important and growing industry; between 2010 and 2016 it increased by 28% in the province. Tourism in summer is playing an increasingly vital role in many local economies in Nova Scotia. Hants County is part of the Bay of Fundy and Annapolis Valley touristic region. The Bay of Fundy is known for its impressive tides, aquatic activities, and seafood, while the Annapolis Valley is known for its wineries, farmland and food-oriented attractions. The nearest tourism destination to the Project is Mount Uniacke, which is over 9km away. Both Bell Park and Uniacke Estate Museum Park comprise the largest draw for tourism for the local area.

Shubenacadie Provincial Wildlife Park is located approximately 35 km northeast of the Study Area, in Shubenacadie, NS. The park offers interactive exhibits of native and exotic animal species in a natural woodland setting.

There are no known recreational uses within the Study Area. Apart from the woods access road which intersects the length of the Study Area from east to west, there are no ATV trails, walking trails or public access to the Study Area. No hunting or fishing within the Study Area is known to occur.

7 ARCHAEOLOGICAL RESOURCES

Two phases of the archaeological resource impact assessment were completed for the Project. The first, Phase I, was a historical assessment of the potential for archaeological resources to be present within the Study Area. The second, Phase II, was the field reconnaissance program within the Study Area. The results described below are taken directly from the assessment completed by Davis McIntyre & Associates (Appendix G).

7.1 Phase I

A historic background study was conducted in March 2018, which included consultation of historic maps and manuscripts and published literature. The Maritime Archaeological Resource Inventory, a database of known archaeological resources in the Maritime region, was searched in an effort to understand prior archaeological research and known archaeological resources neighbouring the Study Area. No archaeological sites were identified within 5km of the Study Area through this process. The nearest site is located 8.5 kilometers along a direct route southwest of the quarry representing the historic period as part
of the Uniacke Estate in Mount Uniacke. Though no sites have been reported within a 5 km radius of the Study Area, there have been over 30 recorded isolated finds and encampment sites covering all precontact temporal periods reported along several navigable waterways within a 20-kilometer radius. This indicates an important reliance on the waterways neighbouring the Study Area by the Mi’kmaq people and their ancestors.

Staff at the Archaeology Research Division of Kwilmu’kw Maw-klusuaqn (KMKNO-ARD) were contacted in May 2018 to inquire whether their records contained any information regarding past or traditional land use in or near the Study Area. They had indicated that there are no recorded traditional use sites within a 1 km radius of the proposed Study Area. Furthermore, there are no recorded Mi’kmaw archaeological sites within a 5 km radius of the Study Area. However, their records do indicate that in 1865, Silas T. Rand had visited Mi’kmaq at nearby Mount Uniacke.

A review of historical air photos and satellite imagery prove to be inconclusive for archaeological resources.

7.2 Phase II

An archaeological field reconnaissance was conducted in May 2018 within the Study Area. The assessment was directed by Vanessa McKillop and Laura de Boer of Davis MacIntyre & Associates Limited.

The field reconnaissance of the Study Area has revealed very little evidence of cultural landscape alteration or areas of elevated archeological potential and has been determined to be of low potential for archaeological resources, of either First Nations or European-descended origin.

The 2018 report is provided in Appendix G.

8 ENGAGEMENT SUMMARY

The Birrette’s East Uniacke Quarry has been in operation since 2014 and the Quarry Manger (Mr. Gerrard Birrette) has actively engaged the public and local residents throughout. These activities have included responding to concerns or questions, actively monitoring the speed of truck traffic entering and exiting the quarry and advising local residents of the proposed expansion associated with this EA registration document. In addition to this regular engagement the Project Team have also implemented the following engagement efforts to support the EA process.

8.1 Public Engagement

Public engagement was completed for the Project via an information session. In addition, a Project Description letter was developed and sent to stakeholders and Mi’kmaq representatives.
One community information session was held for the Project in December 2018.

On December 4, 2018 and in advance of the information session, 300 flyers were distributed via Canada Post to residents within the rural route encompassing the Study Area (RR#2), which included the communities from Lewis Lake to Long Lake (Appendix H). The flyers announced the information session date and location, a general description of the quarry location, as well as opened the line of communication directly with BDEP. If people had questions, comments or concerns about the Project, the flyer provided contact information for the local BDEP representative.

In addition to the flyers, a notice providing the same information was advertised in The Chronicle Herald, on December 1, 2018 (Appendix H).

Project Description letters, along with an invitation to the information session were also sent to local representatives, including:

- David Mitchell, NS Office of Aboriginal Affairs (NS OAA);
- Chief Gerald Gloade, Millbrook First Nation;
- Melissa Nevin, Kwilmu’kw Maw-klusuaqn Negotiation Office (KMKNO);
- Twila Gaudet, KMKNO;
- Jennifer Copage, Sipekne’katik First Nation;
- Michael Cox, Sipekne’katik First Nation;
- Margaret Miller, MLA;
- Scott Brison, MP;
- Kimberly George, NSDL&F;
- Elie Moussa, District 9 (South-East Uniacke) Councilor;
- Bridget Tutty, NSE; and
- Candace Quinn, NSE.

On December 12, 2018, BDEP hosted the Information Session at the Beaver Bank Kinsac Community Centre in Beaver Bank (5:00-8:00 pm). This provided residents, community members and other interested parties an opportunity to view and discuss with BDEP representatives (two in attendance) information on the Project. The Project was introduced to the community through a series of poster boards and three consultants from MEL (Jeff Bonazza, Andy Walter, and Emma Posluns) were present to describe the Project, the EA process, and proposed and expected timelines of the Project.

- Sixteen (16) people attended the Information Session (according to signatures on the sign in sheet provided at the front door);
- Attendees were encouraged to fill out comment cards. Four (4) comment cards were received.
During the information session event, BDEP and the consultants discussed the Project with local residents and members of the public. The following concerns were relayed to the Project team regarding the Project:

- Concern was noted from residents on East Uniacke Road regarding an increase in noise from blasting and other quarrying activities as expansion progresses. Two of these local residents explained that they currently do not hear quarry related noise from Birrette’s East Uniacke Quarry, only the horn that sounds prior to blasting (see comment cards). The Project Team advised these individuals that the frequency of blasting will not increase above current levels, that monitoring of blasting activity will continue to occur to ensure compliance with IA requirements, and that future blasting associated with the expansion will remain beyond 800 m from their property. Effects and mitigation related to Project noise is provided in Section 9.1.

- Concern was raised by three local residents regarding haul truck traffic and speed on East Uniacke Road and Beaver Bank Road. Two of these individuals reside on East Uniacke Road, west of the Study Area, and were concerned about the speed of haul trucks and the safety of their children. The Proponent has committed to reinforcing safe operation of haul trucks and increase driver awareness to speed limits and safe driving procedures. No increase in haul truck traffic is expected with the expansion of Birrette’s East Uniacke Quarry. Truck traffic potential effects and mitigation are discussed further in (Table 29), Section 9.1.

- An additional concern regarding East Uniacke Road and Beaver Bank Road was raised by a local resident. The concern communicated was specific to the future wear and tear of these roads from haul truck activity. The Project Team explained that there is no anticipated increase in haul truck traffic but that quarry expansion, if approved, will occur over a long duration (approximately 25 years).

- One resident expressed concern regarding the potential effects to groundwater wells as a result of blasting at the quarry (see comment card). The Project Team advised the individual that the frequency of blasting will not increase above current levels, that monitoring of blasting activity will continue to occur to ensure compliance with IA requirements, and that future blasting associated with the expansion will remain at minimum 800 m from their property. In the unlikely event that blasting is proven to affect a resident’s groundwater well, the Proponent has committed to re-drilling or re-digging their well. Potential effect to groundwater and building foundations are discussed further in Sections 5.3.4 and 9.2.1.

8.2 Mi’kmaq Engagement & Traditional Use

The Project Description letter and an invitation to the December 12, 2018 information session were submitted to the KMKNO, Millbrook First Nation, Sipekne’katik First Nation, and the NS OAA on July
Birrette’s East Uniacke Quarry Expansion

25, 2018 and December 4, 2018, respectively. To date, confirmation of receipt was provided by KMKNO and OAA, however no other responses have been received and no representatives from KMKNO, Millbrook First Nation, Sipekne’katik First Nation, or the NS OAA were present at the information session.

Alyson Vandergrift (Jr. Consultation Researcher, KMKNO) met with MEL consultants, Jeff Bonazza and Andy Walter, on January 24, 2018 to discuss the proposed expansion of Birrette’s East Uniacke Quarry. At this meeting the KMKNO requested the Proponent complete an assessment within the Study Area to further evaluate the landscape for evidence of potential historical Mi’kmaq uses of the land. It was recommended that the Proponent engage the KMKNO to assist in the design and implementation of a shovel testing program to achieve this. The Proponent will consider this in the future as and when the quarry expands into undisturbed portions of the Study Area.
9 DISCUSSION OF IMPACTS

9.1 Valued Environmental Component (VEC) Selection

The scope, methodology and baseline environmental conditions for the Project have been described in detail in Sections 3 through 8 in this registration document. Each potential VEC, as identified and defined in the NSE Guide to Preparing an Environmental Assessment Registration Document for Pit and Quarry Developments in Nova Scotia, revised September 2009, has been described and baseline environmental work has been completed to evaluate each VEC based on the site-specific conditions relating to Birrette’s East Uniacke Quarry.

The thresholds for determination of significant of adverse residual environmental effects for each VEC are defined in the table below.

Table 29. VECs Threshold for Determination of Significance

<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Threshold for Determination of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Levels</td>
<td>An exceedance of the maximum allowable noise (128 dBA) or vibration limit (12.5 mm/s) at the nearest off-site structure, as regulated by NSE.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>An exceedance of the parameters defined by NSE in the current IA (as described in section 5.2.2) beyond the site property boundaries.</td>
</tr>
<tr>
<td>Surficial and Bedrock Geology</td>
<td>There are no regulated or proposed thresholds for geology for the Project but processing of aggregate and disturbance to surficial geology can impact water quality (i.e. dissolved solids, metals, and sediments). Refer to the threshold for determination of significance for surface water.</td>
</tr>
<tr>
<td>Groundwater</td>
<td>A proven negative effect to surrounding water supplies (i.e. water drawdown at adjacent drilled/dug wells).</td>
</tr>
</tbody>
</table>
| Surface Water                         | A repeated or sustained exceedance of the CCME FWAL criteria, Tier 1 EQS criteria or confirmed background concentrations for TSS, pH and metals.  
And/or  
A reduction of Ecological Maintenance Flow >25% of the median flow during the seasons that the predicted loss is taking place. |
<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Threshold for Determination of Significance</th>
</tr>
</thead>
</table>
| Fish and Fish Habitat                  | An effect that is likely to cause serious harm to fish, as defined by the Government of Canada (1985, Section 2(1)):
   “serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat,” with fish habitat defined as “spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.” |
| Wetlands                               | An effect to wetlands that is likely to cause an adverse change in watershed health (water quality or quantity) in the O’Hearn Flowage LCA, directly affected by the Project. |
| Habitat/ Vegetation                    | An effect that is likely to cause a permanent alteration to any flora species distribution, abundance or habitat, where similar habitat is not currently available at the local/regional level. |
| Fauna (Herpetofauna Species and Mammals) | An effect that is likely to cause a permanent alteration to any fauna species distribution or abundance, or alteration of core habitat. |
| Birds (Avifauna)                       | An effect that is likely to cause a permanent alteration to any bird species distribution or abundance, or alteration of core habitat. |
| Species of Conservation Interest (SOCI) and Species at Risk (SAR) | An effect that is likely to cause a permanent alteration to a priority species’ distribution or abundance, or alteration of critical habitat. Sedentary species such as flora and lichens do not have the opportunity to move to avoid direct or indirect impact. For these taxa, the loss of a population of SAR, is considered significant. |
| Socioeconomic Conditions               | An effect by the Project likely to cause long term decreases in economic activity, human health, recreational use, land use, and tourism. |
| Archaeological and Heritage Resources   | Any disturbance to or destruction of any archaeological or heritage resource of importance. |
| Mi’kmaq                               | Any disturbance to or destruction of any Mi’kmaw archaeological or heritage resource of importance. |

Evaluation, based on the environmental baseline work completed for each VEC over the course of a four-season survey period, and the expertise of the various members of the EA Project Team, has been completed to determine which VECs could have potential residual effects once planned mitigation has
been completed. Potential effect and mitigation for each VEC is provided in Table 29 and VECs with potential Project interactions and potential residual effects are indicated. All VECs with potential residual effects have been carried forward (in Section 9.2) for further discussion.
Table 30. Valued Environmental Component (VEC) Evaluation

<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
</table>
| Noise Levels                          | • Quarry related noise as a result of blasting.  
• Quarry related noise as a result of quarry operations.  
• Noise related to haul truck traffic | • There are no anticipated changes to the current frequency of blasting, the operating hours of the quarry, production rates or truck traffic; therefore, noise levels are expected to remain consistent with current conditions.  
• Noise levels will be monitored in accordance with NSE IA Conditions.  
• Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels.  
• Blasting will not occur on Sundays or holidays.  
• A Project EPP will be developed and will include site specific measures to reduce and mitigate noise levels during operations if and as required. | No | Description of VEC Section 5.2.3 |
| Air Quality                           | • Continued generation of dust during construction and operation activities.  
• Continued current usage of quarry equipment resulting in ongoing air emissions during construction, operation and decommissioning. | • Project-related air emissions and dust are expected to be minimal, localized in nature and to remain consistent with current levels produced at Birrette’s East Uniacke Quarry.  
• Quarrying production is not expected to increase from current levels therefore dust emissions are not expected to increase.  
• Dust emission and particulate matter will be monitored at the property boundary of the quarry at the request of NSE.  
• Should it be required, dust emissions will be controlled with the application of water. | No | Description of VEC Section 5.2 |
<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
</table>
| **Surficial and Bedrock Geology**     | • Disturbance of surficial soils leading to increased potential for sediment and erosion and sedimentation in waterbodies and wetlands.  
• Negligible potential for Acid Rock Drainage based on sample results. | • Sediment (e.g. settlement pond and sediment fencing) and erosion control (e.g. armor stone) will be implemented.  
• A Project EPP will be developed and will include site specific measures to prevent sedimentation and erosion. | No | Description of VEC: Section 5.3.2 and 5.3.3 |
| **Groundwater**                       | • The closest residence is ~1,300 m from the current quarry footprint.  
• Approximately two residences are within a 1 km radius from the EA Study Area boundary. Both residences are anticipated to have domestic drilled wells.  
• Potential damage from blasting activities to potable groundwater wells.  
• Potential interaction with groundwater via blasting or quarrying activities.  
• Potential interaction with adjacent wetlands and watercourses as a result of blasting. | Due to the potential residual effects on groundwater once mitigation efforts are employed, this VEC has been considered for further assessment.  
• Detailed effects and mitigation measures are discussed in Section 9.2.1 | Yes – potential residual effects of blasting on local groundwater. | Description of VEC: Section 5.3.4  
Effects Assessment and Mitigation: Section 9.2.1 |
## Birrette’s East Uniacke Quarry Expansion

### Valued Environmental Components (VECs)

<table>
<thead>
<tr>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Water</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two watercourses in the Development Area may be directly impacted by quarry development.</td>
<td>Due to the potential residual effects on surface water once mitigation efforts are employed, this VEC has been considered for further assessment.</td>
<td>Yes</td>
<td>Description of VEC Section 5.5 Effects Assessment and Mitigation: Section 9.2.2</td>
</tr>
<tr>
<td>Potential indirect impacts in surface water quality and quantity to downstream watercourses.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible impacts as a result of adjacent blasting.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential susceptibility to sediment and erosion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fish and Fish Habitat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No watercourses within the Development Area are considered to provide fish habitat.</td>
<td>Due to the potential residual effects on watercourses once mitigation efforts are employed, this VEC has been considered for further assessment.</td>
<td>Yes</td>
<td>Description of VEC: Section 5.5.2 Effects Assessment and Mitigation: Section 9.2.3</td>
</tr>
<tr>
<td>Potential water quality/quantity impacts to downgradient watercourses (WC-1, 2, and 3).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible impacts as a result of adjacent blasting.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential susceptibility to sediment and erosion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valued Environmental Components (VECs)</td>
<td>Description of Potential Impacts</td>
<td>Mitigation</td>
<td>Residual Effects (Section 9.2)</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------------------</td>
<td>------------</td>
<td>-------------------------------</td>
</tr>
</tbody>
</table>
| **Wetlands**                          | • Direct impact to wetlands by quarry development.  
• Potential indirect impacts from sediment and erosion.  
• Potential indirect hydrological impacts due to adjacent blasting/quarrying.  
• Change in water quality/quantity entering downgradient wetlands from quarry Development Area. | Due to the potential residual effects on wetlands once mitigation efforts are employed, this VEC has been considered for further assessment.  
Detailed effects and mitigation measures are discussed in Section 9.2.4 | Yes | Description of VEC:  
Section 5.5.1  
Effects Assessment And Mitigation:  
Section 9.2.4 |
| **Habitat, Flora, and Lichens**       | • Loss of vegetation due to clearing activities to support quarry expansion.  
• Habitat fragmentation.  
• Introduction of invasive species.  
• Dust from quarry activities. | Due to the potential residual effects on Habitat and Vegetation once mitigation efforts are employed, this VEC has been considered for further assessment.  
• Detailed effects and mitigation measures are discussed in Section 9.2.5 | Yes | Description of VEC:  
Section 5.4  
Effects Assessment And Mitigation:  
Section 9.2.5 |
| **Fauna** (Herpetofauna Species and Mammals) | • Sensory disturbance to fauna.  
• Potential mortality of fauna species due to clearing and construction activities.  
• Loss of habitat.  
• Habitat fragmentation. | Due to the potential residual effects on fauna once mitigation efforts are employed, this VEC has been considered for further assessment.  
• Detailed effects and mitigation measures are discussed in Section 9.2.6 | Yes | Description of VEC:  
Section 5.4.4 and 5.4.5  
Effects Assessment And Mitigation:  
Section 9.2.6 |
### Valued Environmental Components (VECs)

<table>
<thead>
<tr>
<th>Birds (Avifauna)</th>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Habitat loss and alteration.</td>
<td>Due to the potential residual effects on birds once mitigation efforts are employed, this VEC has been considered for further assessment.</td>
<td>Yes</td>
<td>Description of VEC: Section 5.4.6</td>
</tr>
<tr>
<td></td>
<td>Sensory disturbance (lighting and noise).</td>
<td>Detailed effects and mitigation measures are discussed in Section 9.2.7</td>
<td></td>
<td>Effects Assessment and Mitigation: Section 9.2.7</td>
</tr>
</tbody>
</table>

### Species of Conservation Interest (SOCI) and Species at Risk (SAR)

<table>
<thead>
<tr>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential effect to Priority Species identified during baseline evaluations:</td>
<td>Due to the potential residual effects on SOCI/SAR once mitigation efforts are employed, this VEC has been considered for further assessment.</td>
<td>Yes</td>
<td>Description of VEC: Section 5.6</td>
</tr>
<tr>
<td>SOCI flora (Southern Twayblade)</td>
<td>Detailed effects and mitigation measures are discussed in Section 9.2.8</td>
<td></td>
<td>Effects Assessment and Mitigation: Section 9.2.8</td>
</tr>
<tr>
<td>SOCI lichens (<em>Leptogium subtile</em> and <em>Phaeophyscia pusilloides</em>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOCI birds (Pine Siskin, Red-breasted Nuthatch, Ruby-crowned Kinglet, Yellow-bellied Flycatcher)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other priority taxa not observed during field surveys.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential concerns for these species include:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory disturbance resulting in area avoidance or behaviour changes.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential direct mortality during quarry expansion.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alteration or loss of habitat/habitat fragmentation.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Socioeconomic Conditions

<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use/Property Values</td>
<td>Potential loss of land value for adjacent properties as a result of expanding quarry. Impacts to existing land use (human and natural) occurring within and adjacent to the Study Area.</td>
<td>Land Use/Property Values The proposed expansion area is bounded by undeveloped, privately owned land situated away from residential areas. Therefore, impacts to adjacent property land values is not expected. Land within the Study Area is privately owned (BDEP), therefore, public land use will be unaffected.</td>
<td>No – there is an expected positive effect to the local economy from the Project</td>
<td>Description of VEC Section 6.2-6.4</td>
</tr>
<tr>
<td>Human Health</td>
<td>Potential safety hazards within quarry area. Potential air (dust) and noise (blasting and equipment) impacts as a result of active quarrying (see above). Potential truck traffic hazards within residential areas.</td>
<td>Human Health No public access to the quarry permitted. Access is gated and locked outside of operational hours. See Air and Noise Mitigation (above). The Proponent has committed to implementing signage within the truck routes to increase driver awareness to perform safe driving practices when visiting the quarry. The Proponent will monitor truck traffic to ensure these practices are being carried out.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>The Study Area is on privately owned land and does not support public recreation areas: No negative impacts expected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>There are no tourism resources in close proximity to the Study Area: No impacts expected.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No – there is an expected positive effect to the local economy from the Project.
<table>
<thead>
<tr>
<th>Valued Environmental Components (VECs)</th>
<th>Description of Potential Impacts</th>
<th>Mitigation</th>
<th>Residual Effects (Section 9.2)</th>
<th>Applicable Section of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Economy</td>
<td>The Project will continue to support the local economy and local jobs within Hants County. BDEP will employ, whenever possible, local contractors to complete Project tasks.</td>
<td>None required.</td>
<td>No</td>
<td>Description of VEC Section 6.2-6.4</td>
</tr>
<tr>
<td>Archaeological and Heritage Resources</td>
<td>Field reconnaissance of the Study Area revealed very little evidence of cultural landscape alteration or areas of elevated archaeological potential (Davis &amp; MacIntyre, 2018). Study Area was Determined to be of low potential for archeological resources of either First Nations or European-descended origin (Davis &amp; MacIntyre, 2018).</td>
<td>None required.</td>
<td>No</td>
<td>Description of VEC Section 7</td>
</tr>
<tr>
<td>Valued Environmental Components (VECs)</td>
<td>Description of Potential Impacts</td>
<td>Mitigation</td>
<td>Residual Effects (Section 9.2)</td>
<td>Applicable Section of Report</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------------------</td>
<td>------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Mi'kmaq</td>
<td>Study Area was Determined to be of low potential for archeological resources of either First Nations or European-descended origin (Davis &amp; MacIntyre, 2018).</td>
<td>None required.</td>
<td>No</td>
<td>Description of VEC Section 6.1 and 8.2</td>
</tr>
</tbody>
</table>
As indicated in Table 29, the following eight VECs have been carried forward to the detailed effects assessment:

- Groundwater;
- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat and vegetation;
- Fauna;
- Birds; and
- SOCI/SAR.

### 9.2 Effects Assessment

Effects assessment involves the following steps:

1. Identification of potential Project interactions on selected VEC;
2. Identification of potential effects;
3. Description of recommended mitigation;
4. Identification of expected residual effects (post mitigation);
5. Evaluation of significance of residual effects; and,
6. Description of recommended follow up and monitoring.

Project interactions and potential effects for each identified VEC are discussed and evaluated in the following sections to determine specific mitigation requirements, expected significance of residual effects, and any monitoring and follow up requirements.

#### 9.2.1 Groundwater

Table 31 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with groundwater. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to groundwater as a result of quarrying, and potable wells surrounding the Study Area has been analysed as part of the review.

### Table 31. Project- VEC Interactions by Project Phase on Groundwater

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interaction with Groundwater</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
</tbody>
</table>

1. Identification of potential Project interactions on selected VEC;
2. Identification of potential effects;
3. Description of recommended mitigation;
4. Identification of expected residual effects (post mitigation);
5. Evaluation of significance of residual effects; and,
6. Description of recommended follow up and monitoring.
Birrette’s East Uniacke Quarry Expansion Project

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interaction with Groundwater</td>
</tr>
<tr>
<td>Site preparation/clearing</td>
<td>X</td>
</tr>
<tr>
<td>Grubbing</td>
<td></td>
</tr>
<tr>
<td>Watercourse/wetland alteration</td>
<td>X</td>
</tr>
<tr>
<td>Removal of overburden</td>
<td></td>
</tr>
<tr>
<td>Waste management</td>
<td></td>
</tr>
<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
<td></td>
</tr>
</tbody>
</table>

### Operation and Maintenance

- Rock Blasting
- Rock Transfer
- Sorting and Crushing
- Management of surface water
- Trucking/Transport of product

### Decommissioning

- Re-grading of rock face
- Reclamation/re-vegetation

### Accidents, Malfunctions and Unplanned Events

- Erosion and sediment control failure
- Fuel spill from machinery/trucks
- Fire

Groundwater impacts as a result of quarrying can be variable and depend on conditions such as underlying geological conditions, natural groundwater characteristics and the quarrying activities taking place.

Groundwater flow interference occurs in instances where quarrying interacts with groundwater or disrupts groundwater flows in the quarry area. Dewatering (pumping) is often required in these situations to facilitate the quarrying activity, and as a result lowers the water table (drawdown) and has the potential to change groundwater flow direction. This can have an impact to water yields within surrounding potable wells and/or groundwater inputs provided to natural aquatic features such as watercourses and wetlands. Furthermore, although groundwater has not been observed to date during quarrying activities, it is possible interaction with the groundwater table will occur as quarrying advances in the future. Localized groundwater levels have a symbiotic relationship with surface water. As stated in "Ground Water and Surface Water A Single Resource", surface-water features (streams, lakes, reservoirs, wetlands, and estuaries) interact with groundwater and their interactions take many forms. Surface water bodies can accept water and solutes from groundwater systems and surface water can also act as a source of groundwater recharge to groundwater quality (Winter et al, 1998). Potential impacts to surface water systems are further discussed in Section 9.2.2. The Development Area comprises multiple areas of wetland habitat which are located at higher elevations and in general, lack surface water connections to...
downgradient features (i.e. isolated). As such, it is likely that these features act as groundwater recharge wetlands, and their alteration as a result of future quarrying has the potential to impact local groundwater levels.

Blasting associated with quarry activities also has the potential to impact groundwater quantity due to potential alterations in groundwater flow via newly created fractures and discharge points.

Groundwater quality effects are possible within surrounding potable wells and to the health and sustainability of local ecological systems. By nature, blasting can increase the turbidity of groundwater as a result of increase silt as a by product of the process. Turbidity is typically an effect which is seen in close proximity to blasting locations but could be evident within potable water supply wells or natural aquatic features. Ammonia nitrate used as part of the blasting process have also been identified as a potential contaminant to groundwater which has the potential to enter drinking water when in close proximity to potable wells. Processing of aggregate and rock at a quarry (notably crushing and exposure of rock to water and oxygen), can create dissolved solids and metals which can enter groundwater and surrounding potable wells and/or aquatic features. Effects to surrounding groundwater wells are unlikely because the closest wells are located approximately 1 km from the Development Area.

9.2.1.1 Mitigation
Birrette’s East Uniacke Quarry has been in operation since 2014 and no interaction of groundwater has occurred (including seepages through exposed rock quarry face or build up of water on the quarry floor) based on visual observations. As quarry development continues, the quarry floor will be sloped upgradient 1-2% in order to control runoff and ensure the potential for interaction with groundwater is limited. As discussed in the previous section, quarrying is not expected to interact with groundwater in the future and the Proponent is committed to operating the quarry to meet this objective. However, it is also acknowledged that groundwater levels can rise with topography, and intersection with groundwater in bedrock can be difficult to determine visually. As such, a groundwater monitoring program in line with NSE standards can be implemented to assess the water table location and groundwater flow conditions are well understood as the quarry expands. Should it be determined as a result of the groundwater monitoring program that future quarrying is likely to intercept groundwater, the Proponent will adhere to NSE requirements for undertaking this activity.

The closest residential receptor assumed to comprise a potable well is located ~ 930 m from the northern extent of the Study Area or 960 m from the Development Area (Figure 3, Appendix A). Only one other residential property (assumed to comprise potable drilled wells) exists within 1 km of the Study Area boundary. Birrette’s East Uniacke Quarry is an existing quarry that has had no issues regarding interactions with residents drilled wells. Quarry practices are expected to remain consistent (i.e. blasting frequency), therefore impacts are not expected at the closest residences. As quarrying expansion progresses west, the active quarry face will advance closer to residential receptors and assumed potable wells located on East Uniacke Road, however, the distances cited above will remain between quarry development and wells. It should be noted that the 18 wells identified on Figure 3 (Appendix A) do not
accurately represent actual well locations. As well, a domestic well replacement strategy will be in place committing to the replacement of potable wells should any be confirmed to be damaged by blasting occurring at Birrette’s East Uniacke Quarry.

BDEP will continue to monitor blasting at the two nearest residents as currently conducted under the IA. Furthermore, if residents request to be a part of the blasting communication plan, the Proponent commits to implementing this plan which includes a forum for open and honest information exchange related to blasting as well as notification prior to blasting activities occurring.

BDEP currently does not store fuel on site and fuel will not be stored on site in the future. Following best management practices as well as having spill kits on site and site workers trained in their use, the likelihood of a spill release that has the potential to contaminate groundwater is significantly reduced.

Potential effects to groundwater quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.

As part of the groundwater monitoring program, the Proponent will perform baseline water chemistry sampling in order for future results to be compared to. This will be completed as per NSE requirements in association with the IA process and will ensure the quarry is not causing adverse effects to groundwater quality conditions as a result of dissolved solids and metals or other deleterious substances.

Based on the proposed activity, its consistent approach with current operations, and the distance from the Development Area to the nearest drilled wells, there are no expected significant residual environmental effects on groundwater resulting from the proposed expansion of Birrette’s East Uniacke Quarry once all appropriate mitigation and monitoring has been implemented and completed.

9.2.1.2 Residual Effects and Significance
The predicted residual environmental effects of the Project on groundwater are assessed to be adverse, but not significant, after mitigation measures have been implemented. No negative effect to surrounding water supplies (i.e. drilled or dug residential wells) are anticipated based on no known interactions with groundwater from operations at the existing quarry, to date.

9.2.2 Surface Water
Table 32 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with surface water. As discussed in Sections 3.1 and 4.1.2.4, potential effects to surface water have been evaluated within the Development Area as well as the aquatic features within the O’Hearn Flowage LCA. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC
Birrette’s East Uniacke Quarry Expansion Project

interactions. Interaction and potential effects to groundwater as a result of quarrying, and potable wells surrounding the Study Area has been analysed as part of the review.

Table 32. Project- VEC Interactions by Project Phase on Surface Water

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Changes in Water Quality</td>
</tr>
<tr>
<td>Construction</td>
<td>X</td>
</tr>
<tr>
<td>Site preparation/clearing</td>
<td></td>
</tr>
<tr>
<td>Grubbing</td>
<td>X</td>
</tr>
<tr>
<td>Watercourse/wetland alteration</td>
<td>X</td>
</tr>
<tr>
<td>Removal of overburden</td>
<td></td>
</tr>
<tr>
<td>Waste management</td>
<td></td>
</tr>
<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
<td></td>
</tr>
<tr>
<td>Operation and Maintenance</td>
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<td>Rock Blasting</td>
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<td>Rock Transfer</td>
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<td>Sorting and Crushing</td>
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<tr>
<td>Management of surface water</td>
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<tr>
<td>Decommission</td>
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<tr>
<td>Re-grading of rock face</td>
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<tr>
<td>Erosion and sediment control failure</td>
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<tr>
<td>Fuel spill from machinery/trucks</td>
<td>X</td>
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<tr>
<td>Fire</td>
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</tbody>
</table>

Potential surface water effects can be divided into two components (i) water quantity effects and (ii) water quality effects. These are discussed below:

Water Quantity
Surface water impacts as a result of quarrying can be caused by direct or indirect alterations to watercourses and wetlands and/or disturbance to surface water runoff characteristics across the natural landscape. Both of these instances can cause subsequent water quantity impacts to connected surface water features.

Direct alteration to surface water systems as a result of quarry operations will occur as a result of Birrette’s East Uniacke Quarry. As quarry expansion progresses, the baseline flow of surface water from on-site wetlands and watercourses proposed to be altered has the potential to impact downstream receiving habitats. As well, due to the likely interaction between on site wetlands and groundwater (i.e.
recharge wetlands), alteration of wetlands has the potential to impact localized groundwater and adjacent aquatic features. These impacts are variable and depend on the extent of alteration, type of aquatic feature being altered and the characteristics of the landscape being altered (i.e. wetland type and function, or infiltration characteristics of bedrock etc).

Within the Development Area a direct loss of WC4 and indirect of WC1 as well as the direct loss of 14 wetlands is anticipated as quarry expansion continues. Alterations will require approval from NSE (wetland and watercourse alteration applications). Additional details regarding watercourse and wetland loss is provided in Sections 9.2.3 and 9.2.4 respectively. As well as the connection between on-site and off-site wetlands and watercourses, water quantity is expected to be affected in downgradient aquatic receivers as a result of reduced surface water run-off from within the Development Area. As quarry development advances west, on site surface water will continue to be directed eastwards towards the current sedimentation pond location (Figure 6, Appendix A). As such, there is a potential loss of water being provided to downstream receiving features which should be considered. As defined in Section 4.1.2.4, these potential aquatic effects have been evaluated within the O’Hearn LCA and includes a specific assessment of Watercourses 2 and 3 Unnamed Tributary A.

As per the results of the Hydrological Effects Analysis (Section 5.5.4) three LCA’s (LCA-East, Central and West) divide the Development Area (Figure 7). The three watercourse systems associated with these LCA’s constitute the potentially effected systems from the predicted loss of catchment as a result of future quarrying. These watercourses drain from the Development Area and are all tributaries to the greater O’Hearn system.

A water balance assessment was completed to determine the impact on flow within Watercourses 2 and 3 and Unnamed Tributary A, within each respective LCA. In addition, the predicted reduction in streamflow within O’Hearn Flowage LCA was assessed and accounted for the entire quarry development (i.e. catchment area loss for all proposed future quarrying area). As indicated in the methods (Section 4.1.2.4) a water balance assessment uses the principals of conservation of mass in a closed system, whereby any water entering a system (i.e. precipitation) must be transferred into either evaporation (or evapotranspiration), surface runoff (eventually streamflow) or storage/infiltration in the ground. The change in drainage area can be used to simplify the assessment of change in streamflow to receiving watercourses based on the assumptions that precipitation and evapotranspiration rates remain constant, and no additional storage is gained or removed.

The areas of these local catchments, and the area lost due to quarry development are presented in Table 24 (Section 5.5.4). Eastern, Central, and Western LCA are predicted to lose 15.0%, 15.8%, and 3.6% of their catchment areas respectively, and the overall loss of catchment (and potential streamflow) into the O’Hearn Flowage LCA was predicted at 2.1%.

For the purposes of determining potential effect as a result of these losses, a comparison was made between predicted losses within each LCA and the Ecological Maintenance Flow (EMF).
Ecological Maintenance Flow (EMF) is defined as:

*The flow regimes and water levels required to maintain the ecological functions that sustain fisheries associated with that water body and its habitat.* (NSE 2016)

The EMF requirement is determined to be a reduction of <25% of the median flow during the seasons that the predicted loss (due to catchment loss) is taking place (NSE 2016).

The losses predicted as part of the Hydrological Effects Analysis are within the requirements as determined by EMF.

**Water Quality**
Quarrying has the ability to impact surface water quality as a result of blasting, and the physical processing of aggregate and rock. Water quality has the potential to be altered from issues with erosion and sedimentation which can increase the amount of total suspended solids. Similar to that discussed in Section 9.2.1 (Groundwater), surface water quality is also at potential risk as a result of receiving dissolved solids and metals and/or experiencing turbidity issues. As discussed in Section 5.5.3, baseline water quality samples for TSS and Total metals have been obtained at two locations (WC2) and Unnamed Tributary B initiating to the north of the Study Area. Water quality analysis indicates that CCME Environmental Quality Guidelines for Freshwater Aquatic Life are exceeded even though water drains from natural, undeveloped lands.

Mitigations listed in Section 9.2.2.1 will reduce the likelihood of issues related to erosion and sedimentation and subsequent water quality issues.

Samples were collected to determine potential for ARD. For both samples, the total sulfur weight proportion was less than 0.001% and the acid producing potential was less than 0.03 kg/t (Table 6, Section 5.3.3.1). A sulphur concentration of 0.001% is considered as low sulphur content and therefore does not present a potential for ARD.

9.2.2.1 Mitigation

**Water Quantity**
As discussed in Section 2.3.3, currently Birrette’s East Uniacke Quarry comprises a system of drainage ditches and a series of two settling ponds located at the northeastern extent of the Study Area. Surface water runoff and drainage is directed eastward from the active quarrying areas through the ditching within the quarry floor and into the settling ponds. (Figure 5, Appendix A). Capacity of settling ponds exceeds current IA requirements, and TSS samples collected in the outflow ditches of the settling pond since 2015 has indicated no exceedances to date.
Surface water will continue to be directed eastward during the lifetime of the Birrette’s East Uniacke Quarry. An increase in surface water runoff entering the settling pond is expected during expansion, therefore the capacity of the settling ponds will increase as per engineered specifications and NSE IA requirements as the quarry expands. Additionally, this system will be designed to ensure that discharge rates and water quantities are protective of the receiving environment (i.e., offsite treed swamp habitat and eventually O’Hearn Flowage). This will involve the design of a settling pond designed to accommodate 1:20 year flows.

Additional mitigation measures related to water quantity effects associated with fish habitat (receiving watercourses) and wetlands are provided in Sections 9.2.3 and 9.2.4.

**Water Quality**

BDEP will implement necessary measures (as determined by NSE via the IA process) to ensure the water quality leaving the quarry is not negatively impacting off-site receptors. Ongoing water quality monitoring will occur as per IA requirements to ensure that quarry operations are not impacting water quality conditions within aquatic features that discharge from the site, and as well to evaluate the surface water features which may be sourced to groundwater. As discussed above, water will be directed from the quarry area into the on-site settling ponds. The design of these ponds will be done so in accordance with IA requirements and allow for suitable water detention period prior to it draining off-site. This will enable suspended sediments to settle and manage water quality conditions prior to discharge. The future water quality monitoring plan will also include monitoring at the discharge location of the settling ponds (as this will act as the main discharge point from the quarry Development Area).

BDEP will use erosion and sediment control structures (e.g., sediment fence, rip rap, check dams etc.) as needed to minimize the potential for sediment release into surface water. A particular instance where this is proposed is along the boundaries of off-site aquatic features that could convey water to downstream environments (i.e., WL7). Rock lined ditches currently direct surface water runoff to a series of settling ponds present in the eastern extent of the Study Area and keep surface water runoff away from disturbed areas. This system will continue to be used as quarry expansion progresses. All erosion and sediment control structures will be regularly inspected and repaired.

Stockpiles of material with a potential to cause sedimentation issues will be setback from surface water systems and will be stabilized to reduce the likelihood of erosion and sedimentation.

Potential effects to water quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.

BDEP currently does not store fuel on site and will not store fuel on site in the future. Following best management practices as well as having spill kits on site and site workers trained in their use, the
likelihood of a spill release that has the potential to contaminate surface water is significantly reduced. Refueling and maintenance of vehicles and equipment will occur in areas 100 m from a watercourse.

9.2.2.2 Residual Effects and Significance

The predicted residual environmental effects of the Project on surface water are assessed to be adverse, but not significant, after mitigation measures have been implemented. EMF will be maintained in downstream watercourses during quarry expansion and a surface water monitoring program will be implemented to ensure water quality meets the appropriate guidelines (i.e. no exceedance of CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals).

9.2.3 Fish and Fish Habitat

Quarry development can affect fish and fish habitat through direct and indirect activities associated with quarrying practices. Activities such as clearing, grubbing, blasting and expansion of the quarry can lead to a direct loss of a watercourse from the landscape, or access of equipment across watercourses would require installation of drainage structures such as culverts or bridges. Indirect effects to fish and fish habitat include potential changes in water quality conditions draining from the Development Area into aquatic receivers, and water quantity changes due to loss of catchment area and re-direction of surface water flows.

Table 33 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with fish and fish habitat. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Potential effects to fish and fish habitat have been divided into water quality and water quantity effects. The discussion following the table provides an analysis of key Project-VEC interactions.

**Table 33. Project- VEC Interactions by Project Phase on Fish and Fish Habitat**

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
<th>Change in Water Quantity</th>
<th>Change in Water Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Site preparation/clearing</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Watercourse/Wetland Alteration</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Removal of overburden</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Waste management</td>
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<td>X</td>
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<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
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<td>X</td>
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<tr>
<td><strong>Operation and Maintenance</strong></td>
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Birrette’s East Uniacke Quarry Expansion Project

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
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<tr>
<td></td>
<td>Change in Water Quantity</td>
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<td>Fire</td>
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</table>

The highest likelihood of Project interactions with watercourses will occur during the construction/expansion phase during clearing, grubbing, and removal of overburden. On-going interactions with adjacent watercourse habitat surrounding the quarry during operations of the quarry are possible if surface water discharge is not well managed and erosion and sediment control measures are not well implemented, or during an accident, malfunction or unplanned event.

**Direct Impacts**

Field surveys identified two watercourses (WC1 and WC4) within the Study Area (Section 5.5.2), both of which would be directly impacted by future quarry development. WC1 and WC4 are located in the central and western portions of the Study Area, respectively. As discussed in Section 5.5.2, in WC1 (~60m length) there is only a potential connection to downstream fish resources (through WL7) during periods when the wetland is completely flooded (i.e. periods of seasonal high flow). If fish were to access WC1 their movement would be restricted as far upstream as the southern boundary of WL4. WC4 (~40m of length) does not exhibit fish habitat because of a lack of connectivity to a downstream fish resource.

Quarrying activity is intended to avoid WC1, however, all of the surface water that sources it will be eliminated through quarry expansion. Future quarry expansion will result in the loss of WC4. Watercourse alteration for both watercourses requires a provincial permit through NSE regional offices. A watercourse alteration permit application will be submitted to NSE and approval granted prior to commencement of alteration of watercourses to support quarry expansion. Due to the lack of viable fish habitat in WC1, and inability for fish to access WC4, no residual effects are expected to fish and fish habitat.
Indirect Effects
Initially, the evaluation of potential indirect effect as a result in reduced water quantities draining from the Development Area was based on the LCA-O’Hearn Flowage (Figure 7, Appendix A). It was determined that as a result of potential reduced water quantities flowing from the Development Area, the following aquatic features located within the LCA-O’Hearn Flowage could be affected:

- WC2;
- WC3;
- Unnamed Tributary A; and
- The extent of O’Hearn Flowage in between WC3 and WC2. NOTE: Predicted Discharge Flow From the Development Area rejoins lower reaches of WC2 prior to WC draining into O’Hearn Flowage as indicated in Figure 8 (Appendix A).

As described in Section 5.5.4 (Hydrological Effects Analysis) and Section 9.2.2 (Surface Water Effects), as quarry development progresses the LCA’s located within the Development Area (LCA-West, Central, and East) will reduce in size which in turn corresponds with a direct loss of water quantity to the respective watercourses listed above. A reduction in flow can reduce the availability of suitable fish habitat by altering the water characteristics (e.g. water temperature) and changing habitat types (e.g. runs or riffles). Furthermore, managing the local drainage of surface water flows across the landscape (i.e. through use of settling ponds) has the potential to alter natural flow regimes entering downstream aquatic resources. Quantifying potential effects as a result altered flow is challenging however; a literature review was completed by the Faculty of Environmental Sciences, Griffith University, Queensland, Australia in 2002 to identify potential threats to aquatic biodiversity as a result of altered flows (Bunn and Arthington 2002). The study identified four potential effects to aquatic biodiversity which can interrelate resulting in varying levels of effect. These include:

1. Physical stream habitat effects (i.e. riffles, pools, substrate, vegetation cover), flooding, scouring, changes in velocity and frequency of flow, pulsing of flow etc.;
2. Effects to aquatic species (i.e. changes in flow regime have the ability to alter aquatic species (i.e. recruitment, growth, and establishment of aquatic vegetation, and critical life cycle events for fish and insects including emergence and populations);
3. Changes in Longitudinal and Lateral Connectivity’s (i.e. barriers for movement of aquatic life into adjacent floodplain wetlands should they become drier or wetter; and
4. Introduction of exotic and introduced species (i.e. modified flow could introduce invading fish and/or exotic plants.

As described in the Hydrological Effects Analysis (Section 5.5.4) and the effects assessment for surface water (Section 9.2.2); Eastern, Central, and Western LCA are predicted to lose the following loss of flow as a result of their catchment areas losses:

- WC2 (i.e. Eastern LCA): 15.0% loss at the point of confluence of WC2 and O’Hearn Flowage;
• WC3; (i.e. Central LCA): 15.8% loss at the point of confluence of WC3 and O’Hearn Flowage; and
• Unnamed Tributary A (i.e. Western LCA): 3.6% loss at the point of confluence of Unnamed Tributary A and O’Hearn Flowage.

Furthermore, an additional LCA, the O’Hearn Flowage LCA, was analysed for potential loss of flow due to quarry development. The O’Hearn Flowage LCA encompasses the three LCA’s listed above, as well as additional drainage areas which source water to O’Hearn Brook but are located outside of the Study Area. Overall, within the O’Hearn Flowage LCA, there is a predicted reduction in streamflow of 2.1%. This potential hydrological effect exists between Unnamed Tributary A, upstream of O’Hearn Lake, to the confluence of WC2 and O’Hearn Flowage.

For the purposes of evaluating potential effect to fish and fish habitat however, the losses pertaining to Birrette’s East Uniacke Quarry have been compared to EMF which determine that less than 25% of the median flow during the driest month is required to sustain fisheries resources. All modeled losses are within the requirements as determined by EMF and will occur gradually over the lifespan of the expansion, it should also be noted that water draining from Birrette’s East Uniacke Quarry will be directed eastward through the on-site settling ponds and via the existing discharge route identified as the Predicted Discharge Route on Figure 5 (Appendix A). As such, water loss from WC2 (15.0%) is expected to be replenished ~360m downstream from WL7 within WC2.

Since EMF is being maintained in the downstream receiving environment, the potential impacts outlined above by Bunn and Arthington (2002) are not anticipated, therefore, no effect to fish and fish habitat is expected.

In-direct impacts to watercourses are also possible during quarry expansion in the form of accidents, erosion and sediment control failure or unplanned events. Indirect effects to off-site watercourses could include siltation from quarry operations (i.e. run-off from exposed surfaces, crushing activities, and lack of vegetation), and water quality issues associated with the blasting and quarrying practices (i.e. chemical composition of water, increase in dissolved metals etc.). Regarding ARD, samples were collected, and it was determined that they do not hold a potential for ARD (see Section 5.3.3.1).

Furthermore, baseline water quality results (Table 22) highlights exceedances in CCME FWAL guidelines. Monitoring, as described below, will ensure discharge is within the parameters outlined in the IA.

9.2.3.1 Mitigation

In order to reduce the potential effects on fish and fish habitat the following mitigation will be employed:

• Monitoring of water quality discharged from the quarry area will be completed as per NSE IA requirements and as discussed in Section 9.2.2.1. A surface water monitoring plan will be
Birrette’s East Uniacke Quarry Expansion Project

developed for the Project which will include the methods and implementation schedule associated with gathering water quality data.

- In addition, monitoring for siltation at the discharge points from the active quarry will continue to be undertaken as part of the existing Project IA.
- Erosion and sediment control systems will be monitored regularly to ensure they are in working order and effectively managing site run off.
- An Environmental Protection Plan (EPP) will be developed for the Project outlining the monitoring and mitigation methods to be employed for the Project;
- Surface water will continue to be directed eastward during the lifetime of the Birrette’s East Uniacke Quarry. The capacity of the settling ponds will increase as per engineered specifications and NSE IA requirements as the quarry expands. Additionally, this system will be designed to ensure that discharge rates and water quantities are protective of the receiving environment (i.e. offsite treed swamp habitat and eventually O’Hearn Flowage). This will involve the design of a settling pond designed to accommodate 1:20 year flows and have discharge mimic seasonal flows, wherever possible.

9.2.3.2 Residual Effects and Significance
The predicted residual environmental effects of the Project on fish and fish habitat are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the Project maintaining EMF, the lack of significant fish habitat, and no evidence of fish; no serious harm to fish is expected from Project development.

9.2.4 Wetlands
Quarry expansion will cause direct and indirect impacts to wetlands. Direct impacts will be associated with clearing, grubbing, and the removal of wetlands as a result of quarrying activity. Indirect impacts are a by-product of adjacent quarrying activities including potential changes in the volume of water discharging to wetlands. Table 34 provides a summary of the potential project interactions and environmental effects resulting from the Project-VEC interactions with wetlands. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events) and describes when direct and indirect wetland impacts are expected to occur. The discussion following the table provides an analysis of key Project-VEC interactions.
Table 34. Project- VEC Interactions by Project Phase on Wetlands

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
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<tr>
<td></td>
<td>Direct wetland impacts</td>
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<tr>
<td><strong>Construction</strong></td>
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<tr>
<td>Site preparation/clearing</td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td>X</td>
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<tr>
<td>Watercourse/Wetland Alteration</td>
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<tr>
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<td>Fire</td>
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**Direct Impact**

Potential direct impact extent as a result of quarry expansion during the temporal lifetime of the Project are described in Table 32 below.

Table 35: Estimated Direct Impact Area to Wetlands

<table>
<thead>
<tr>
<th>Wetland #</th>
<th>Wetland Area (m²)</th>
<th>Estimated Direct Impact Area (m²)</th>
<th>Direct Impact Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>364</td>
<td>364</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>221</td>
<td>221</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>5,989</td>
<td>5,989</td>
<td>C</td>
</tr>
<tr>
<td>5</td>
<td>778</td>
<td>778</td>
<td>C</td>
</tr>
<tr>
<td>6</td>
<td>10,448</td>
<td>10,448</td>
<td>C</td>
</tr>
<tr>
<td>8</td>
<td>1,470</td>
<td>1,321</td>
<td>P</td>
</tr>
</tbody>
</table>
In total, 14 wetlands are proposed for alteration over the lifetime of the quarry expansion. As quarry expansion progresses through the Development Area, wetlands located in the western extent will be further considered for avoidance. These wetlands include several that are located along the Development Area boundary (WL9, 13, 17, and 18). WL2, 7, 9, 13, and 17 will be completely avoided from quarry development. As a worst-case scenario, a total of 35,121 m² (3.9 ha) of wetland habitat could be lost due to quarry activities. It should be noted that this loss would be gradual and would take place over the expected 25-year life of the quarry expansion.

**Indirect Impacts**
Potential for downgradient, indirect wetland impacts can be expected as a result of up-gradient hydrological alteration. Primarily, the alteration of hydrological conditions in connected up-gradient wetlands and watercourses will affect natural outflows and hydroperiod characteristics in contiguous wetland systems. As quarry expansion progresses, site drainage will be collected and directed eastward, and away from its natural flow path. In addition, where up-gradient alteration is occurring potential exists for indirect impacts to downgradient water quality (e.g. siltation, dissolved metals etc.) and quantity conditions (e.g. altered hydrology and hydroperiod).

Wetlands within the Study Area are comprised of a combination of groundwater recharge and groundwater discharge systems. Of the 14 wetlands proposed for alteration over the lifetime of the quarry, 10 are isolated features located on higher land across the Development Area (WL’s 3, 5, 6, 8, 10, 11, 12, 14, 15 and 19). Due to their lack of surface water connectivity to other aquatic features, potential for
indirect impacts to adjacent surface water features is reduced. However, loss of these isolated wetlands has the potential to reduce groundwater recharge and could lead to some localized changes in groundwater level. These smaller isolated wetlands have the ability to hold water for longer and allow penetration of surface water into the relatively impermeable bedrock geology. Removal of recharge wetlands form the landscape reduces the ability for water to be collected, stored, and fed into underlying aquifers. Many of these wetlands across the Development Area however, are of a small size (ranging from 221m² to 10,448m²) and provide a limited source of water (precipitation and surface runoff), to groundwater at the landscape level.

Areas with a heightened risk of indirect impacts associated with the quarry expansion includes WL7, WL16 and WL18. As discussed in Section 5.5.1.1, these wetlands likely exist as groundwater discharge features and are largely dependant on their hydrological inputs from upstream aquatic features and surface water run-off from the upstream catchment areas. This has been evident during field observations in wet seasons where the wetlands were observed to be intermittently flooded at surface, and then dry at surface during summer months. All three wetlands are permanently saturated throughout the year however and extend beyond the Study Area boundary. It is unclear at this stage whether potential indirect effects as a result of adjacent quarrying (and removal of their associated catchment areas) will occur in these wetlands, however since quarrying is expected over such a long-time frame, these systems may adapt concurrent to the quarry expansion phases. As it relates to confirming indirect alteration to these adjacent wetlands, it must be evident that the functional characteristics have been altered, which is typically determined through evaluating changes in hydrological, soil and/or vegetative conditions. If wetlands become dryer, organic soils can subside (Tiner, 2005) and plants may become stressed. Most plants, however, can survive dry conditions and reproduce under altered hydrologic conditions (Tiner, 2005).

Similarly, to fish and fish habitat, a comparison can be been made between the modelled loss of water to adjacent wetlands as a result of catchment area loss, and the EMF. In this case, at the end of quarry life, the EMF is still present. As well, the resilience to seasonal hydrological conditions and water level fluctuations within these adjacent wetlands suggest that a reduction of water inputs to them is not likely to have an adverse effect on wetland function.

Potential exists for water quality effects in wetlands adjacent to, and downstream of quarrying activities. These effects include siltation, dissolved solids and metals and ARD. In addition, accidents and malfunctions or unplanned events could affect the water quality conditions in these features.

9.2.4.1 Mitigation

In order to mitigate and reduce overall loss of function of wetland habitat, the following actions will be implemented within wetlands where direct impacts and potential indirect impacts to wetland habitat are expected:

- Acquire and adhere to wetland alteration permits;
Birrette’s East Uniacke Quarry Expansion Project

- Engage in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process;
  - On-the-ground restoration opportunities to meet a 2:1 ratio and to be completed in a watershed near the Project area to the extent possible;
- Monitor wetlands as directed in regulatory approvals;
- A wetland monitoring plan will be developed for the Project. The plan will include methods and implementation schedule associated with monitoring the health of adjacent, unaffected wetlands during quarry expansion;
- Maintain a 30 m buffer around WL2, 7, 9, 13, and 17;
- Complete pre-construction site meeting for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance;
- Ensure all wetlands are visually delineated (e.g. flagged);
- Implement methods to reduce the potential to drain or flood surrounding wetlands;
- Direct runoff through natural vegetation, wherever practicable;
- Implement erosion and sediment control; and
- Re-vegetate and progressively reclaim the quarry.

9.2.4.2 Residual Effect and Significance
The predicted residual environmental effects of the Project on wetlands are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the Project maintaining EMF and the implementation of a water quality monitoring program; no significant residual environmental effect is expected to watershed health (water quality and quantity) within the O’Hearn Flowage LCA.

9.2.5 Terrestrial Environment (Habitat, Flora, and Lichens)
Table 34 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with habitat and flora. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects has been divided into direct and indirect impacts to habitat and flora. The discussion following the table provides an analysis of key Project-VEC interactions.
Table 36. Project- VEC Interactions by Project Phase on Habitat, Flora and Lichens

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
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<tbody>
<tr>
<td></td>
<td>Direct Impact</td>
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<tr>
<td><strong>Construction</strong></td>
<td></td>
</tr>
<tr>
<td>Site preparation/clearing</td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td>X</td>
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<tr>
<td>Watercourse/Wetland Alteration</td>
<td>X</td>
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<tr>
<td>Removal of overburden</td>
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<tr>
<td>Waste management</td>
<td></td>
</tr>
<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
<td>X</td>
</tr>
<tr>
<td><strong>Operation and Maintenance</strong></td>
<td></td>
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<tr>
<td>Rock Blasting</td>
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<td>Rock Transfer</td>
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<tr>
<td>Sorting and Crushing</td>
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<tr>
<td>Management of surface water</td>
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<tr>
<td>Trucking/Transport of product</td>
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<tr>
<td><strong>Decommissioning</strong></td>
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<tr>
<td>Re-grading of rock face</td>
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<tr>
<td>Reclamation/re-vegetation</td>
<td></td>
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<tr>
<td><strong>Accidents, Malfunctions and Unplanned Events</strong></td>
<td></td>
</tr>
<tr>
<td>Erosion and sediment control failure</td>
<td>X</td>
</tr>
<tr>
<td>Fuel spill from machinery/trucks</td>
<td>X</td>
</tr>
<tr>
<td>Fire</td>
<td>X</td>
</tr>
</tbody>
</table>

Quarry expansion will cause direct impacts to habitat and flora (vascular and non-vascular plants), within upland, wetland, and aquatic habitats. This will occur within the construction phase of the Project through activities such as clearing and grubbing. Habitat within the Study Area and surrounding landscape currently exhibits fragmented conditions based on the footprint of the existing quarry, recent/historic forestry activity and an existing road. Portions of the Development Area will require little clearing due to historical tree harvesting. Overall, Project activities will result in an increase in habitat fragmentation and a decrease in habitat quality (i.e. loss of habitat).

The most likely potential effect of the Project on habitat and flora is the direct loss of flora from construction activities. One SOCI flora; Southern Twayblade (S3), and two SOCI lichens; Appressed Jellyskin Lichen (S3) and Pompon-tipped Shadow Lichen (S3?) were identified within the Study Area. All the identified priority flora and lichen species are expected to be lost due to quarry expansion. Aside from these priority species, the vegetation identified within the Study Area was determined to be locally and regionally common.
There were no unique habitats identified within the Study Area, and habitat within and immediately adjacent WL2, 7, 9, 13, and 17 will be avoided from quarry activities. In addition, limited impact will be experienced within the historically harvested area (northwestern extent of the Study Area).

Project activities have the ability to indirectly affect flora in the construction, operational, and decommissioning phases of the Project. Indirect impacts may include altered hydrology as a result of alterations to surface water flow, erosion and sedimentation from Project activities, dust accumulation on vegetation smothering and stressing plants, or accidental spills involving deposition of a deleterious substance.

Blasting, crushing, and hauling aggregate may result in deposition of dust on vegetation within close proximity of the Study Area, especially when conditions are dry. This affects flora through the deposition of dust on leaves, which temporarily reduces evapotranspiration and photosynthesis. Over time this may reduce overall growth rates.

Additional indirect impacts to native plant communities include the potential for introduction of invasive species. Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers (footwear and clothing) into adjacent habitat during construction and operational activities. Introduction of invasive species can occur when equipment or people enter vascular plant communities, or indirectly via runoff or dust from the roads. Invasive species, such as purple loosestrife (*Lythrum salicaria*), can severely degrade habitat quality and outcompete many native species, particularly along roadsides. No purple loosestrife was noted during field surveys.

Decommissioning of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

9.2.5.1 Mitigation

BDEP is committed to the development of a Project Environmental Protection Plan (EPP) which among other commitments will specify best management practices and mitigation methods associated with vegetation removal, dust suppression, progressive reclamation and re-vegetation of the quarry and a vegetation management plan. Mitigations that will be outlined in the EPP will include:

- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Dust suppressants (e.g. water trucks) will be used when normal precipitation levels are not effective in controlling dust;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- A wetland alteration application will be approved prior to wetland alteration;
- Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval;
• Employ measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles); and
• Implement reclamation program to re-establish native vegetation communities.

9.2.5.2 Residual Effect and Significance
The predicted residual environmental effects of the Project on habitat and flora are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the degree of disturbance currently within the Study Area and the best management practices that will be implemented as part of the Project EPP; no significant residual environmental effects are expected.

9.2.6 Terrestrial Environment (Fauna)
Table 36 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with Fauna. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality to fauna, habitat alteration, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 37. Project- VEC Interactions by Project Phase on Fauna

<table>
<thead>
<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
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<tr>
<td></td>
<td>Direct Mortality</td>
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<tr>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>Site preparation/clearing</td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td>X</td>
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<tr>
<td>Watercourse/Wetland Alteration</td>
<td>X</td>
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<tr>
<td>Removal of overburden</td>
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<tr>
<td>Waste management</td>
<td>X</td>
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<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
<td>X</td>
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<tr>
<td>Operation and Maintenance</td>
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<tr>
<td>Rock Blasting</td>
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<td>Rock Transfer</td>
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<td>Sorting and Crushing</td>
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<td>Management of surface water</td>
<td>X</td>
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<td>Trucking/Transport of product</td>
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<td>Decommission</td>
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<td>Re-grading of rock face</td>
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<td>Reclamion/re-vegetation</td>
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<tr>
<td>Accidents, Malfunctions and Unplanned Events</td>
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<td>Erosion and sediment control failure</td>
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</table>
Quarry development will cause direct impacts to habitat used by terrestrial fauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project. Habitat within the Study Area and surrounding landscape currently exhibits fragmented conditions based on recent/historic forestry activity and an existing road. Quarry expansion will result in increased habitat fragmentation and a decrease in habitat quality for fauna. The increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat within and immediately adjacent the Study Area, as discussed.

Wildlife evidence (Table 9) within the Study Area was low during field evaluations, likely as a result of current quarrying activity and no priority fauna species were identified. Wildlife habitat directly within the footprint of the expansion area will be eliminated gradually over the expansion timeframe. Expansion will be slow and incremental over 25 years, therefore effects (sensory disturbance) are likely to minimized in the western extent of the Study Area until expansion of the quarry progresses to that location (Figure 6; year 12-25). Clearing and grubbing for site preparation will remove vegetation, reducing the quantity of terrestrial habitat, and will affect the quality of already marginal habitat. The Project will result in an increase in edge area, which may act as a barrier for some animal movements, and could increase predation on small mammals, but also has potential benefits related to habitat creation and food availability (e.g. regenerating trees for White-tailed Deer).

Change in wildlife habitat quality includes the potential fragmentation of habitat during construction. Habitat fragmentation can adversely affect local populations of wildlife living adjacent to the Study Area. However, the size of this Project (Development Area 30.2 ha) and the current level of fragmentation in the surrounding landscape suggests that the significance of this impact would be low.

Sensory disturbance to fauna is expected to occur throughout all Project phases and would result from activities such as rock blasting, clearing and grubbing, and the sorting and crushing of aggregate. This will likely result in the localized wildlife avoidance of the Study Area. Overall, Project activities will likely cause a change in usage of the Study Area by wildlife, with some species tending to avoid the area, while others may be attracted to the increased activity, including opportunistic species such as Eastern Coyote, Northern Raccoon, Striped Skunk, or American Black Bear (*Ursus americanus*).
Noise is the type of sensory disturbance that is most likely to affect fauna within the Study Area. Although the auditory capabilities of fauna species vary (Shannon et al. 2016) and fauna behavior in response to noise is largely related to perceived threats not noise intensity (Bowles, 1995) changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna. Noise can affect behavioral patterns (Patthey et al. 2008), stress fauna (Knight and Swaddle, 2011), cause avoidance behavior (Ware et al. 2015), and reduce the ability for communication and hunting success (Barber et al. 2009). Combined, these effects can negatively impact the overall population health of a particular species (Ware et al. 2015).

Fauna affected may temporarily move out of the range of disturbance throughout the life of the quarry. Similar habitat to that identified within the Study Area is present in surrounding lands. This provides an alternate habitat resource for all wildlife during quarry expansion. There were no unique habitats identified within the Study Area, and habitat within and immediately adjacent WL2, 7, 9, 13, and 17 will be avoided from quarry activities. In addition, limited impact will be experienced within the historically harvested area (northwestern extent of the Study Area).

Light is another sensory disturbance that can impact fauna by potentially causing disorientation or by causing attraction or avoidance behaviour (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum et al. 2016). The current quarry comprises one spotlight (located at the scale house) which remains on during the night for safety purposes. This will remain the only source of light throughout the proposed expansion of the quarry.

Direct mortality of fauna species could result from Project activities, particularly from wildlife vehicle collisions. There is no expected increase in traffic as a result of quarry expansion, therefore, wildlife vehicle collisions remain unlikely. Accidents such as fuel spills have the potential to cause indirect mortality to fauna due to exposure of contaminants.

Decommissioning of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

9.2.6.1 Mitigation
BDEP is committed to the development of a Project Environmental Protection Plan (EPP) which among other commitments will specify best management practices and mitigation methods associated with vegetation removal, dust suppression, progressive reclamation and re-vegetation of the quarry and a Wildlife Management Plan. The Project EPP will include methods by which the Project can take place while minimizing interactions with wildlife, these include:

- Implementation of wildlife best management practices;
- Provide wildlife awareness training to site personnel;
- Awareness to wildlife on roads especially for Project traffic;
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- Install signage where specific wildlife concerns have been identified;
- Follow Pit and Quarry Guidelines to reduce impact of noise and vibration on wildlife;
- Limit the use of lighting to the current spotlight located at the scale house and shine it downward to reduce attraction to birds;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Dust suppressants (e.g. water trucks) will be used when normal precipitation levels are not effective in controlling dust;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- A wetland alteration application will be approved prior to wetland alteration;
- Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval; and
- Implement reclamation program to re-establish habitat to support fauna habitat.

9.2.6.2 Residual Effect and Significance
The predicted residual environmental effects of the Project on fauna are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the degree of disturbance currently within the Study Area, the lack of core habitat within the Study Area, the availability of suitable habitat adjacent the Study Area, and the best management practices that will be implemented as part of the Project EPP; no significant residual environmental effects are expected.

9.2.7 Terrestrial Environment (Birds)
Table 38 provides a summary of the potential environmental effects resulting from the Project-VEC interactions with birds. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfuctions, and Unplanned Events). Interaction and potential effects has been divided into direct mortality of birds, alteration to habitat, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 38. Project-VEC Interactions by Project Phase on Birds

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<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
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<td></td>
<td>Direct Mortality</td>
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<tr>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>Site preparation/clearing</td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td>X</td>
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<tr>
<td>Watercourse/Wetland Alteration</td>
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</tbody>
</table>
Quarry development will cause direct impacts to habitat used by avifauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project. Habitat within the Study Area and surrounding landscape currently exhibits fragmented conditions based on recent and historic forestry activity and an existing road. Recent forestry activities have created edge habitat for foraging activities and has created habitat niches for certain bird species. This edge habitat is also available along an existing access road which bisects the Study Area. Quarry expansion will result in increased habitat fragmentation and a decrease in habitat quality for avifauna. The increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat within and immediately adjacent the Study Area, as discussed.

Bird surveys (Section 5.4.6) identified 682 individuals representing 43 species within and adjacent to the Study Area (Tables 10-12). Across all survey seasons a total of four Priority Species, all of which were SOCI, were observed during dedicated survey periods: Pine Siskin, Red-breasted Nuthatch, Ruby-crowned Kinglet, and Yellow-bellied Flycatcher.

Avifauna habitat directly within the Development Area will be eliminated gradually over the expansion timeframe. Expansion will be slow and incremental over 25 years, therefore effects (sensory disturbance) are likely to minimized in the western extent of the Study Area until expansion of the quarry progresses to that location (Figure 6, Appendix A; year 12-25). Clearing and grubbing for site preparation will remove vegetation, reducing the quantity of avifauna habitat, and will affect the quality of already marginal
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habitat. The Project will result in an increase in edge area which could increase predation on birds, but also has potential benefits related to habitat creation (edge nesting birds), and food availability (near edge and ditches).

Change in wildlife habitat quality includes the potential fragmentation of habitat during construction. Habitat fragmentation can adversely affect local populations of avifauna living adjacent to the Study Area. However, the size of this Project (Development Area 30.2 ha) and the current level of fragmentation in the surrounding landscape suggests that the significance of this impact would be low.

Bird species that currently use the habitat within the direct area of the quarry expansion will be displaced during the initial stages of construction. This could potentially cause direct mortality of species if individuals are unable to relocate to alternate suitable habitat. However, as previously noted, there are areas of suitable nesting habitat in adjacent lands and the regional area in general.

Construction, in particular site preparation, during the breeding season for birds has the potential to cause direct mortality, abandonment of nests, the destruction of nest contents, which could include species designated as SAR or SOCI (see Section 9.2.8). If adjacent suitable habitat is not available, birds that have been displaced will not likely nest until nearby habitat becomes available, as most birds return to the same general area from year to year. This may result in a higher non-breeding population.

The environmental effects of clearing and grubbing are most severe when these activities are conducted during the period when most bird species are breeding (May to end of August). Clearing and grubbing at this time could result in the direct mortality of eggs and unfledged nestlings. The killing of birds or the destruction of their nests, eggs, or young is an offence under the Migratory Birds Convention Act. The construction phase (i.e. clearing, grubbing, vegetation removal) of the Project will be planned to take place outside of the nesting season for most birds (May-August), where practicable. If this is not possible, pre-nest surveys will be completed to prevent disturbance to nesting birds. Similarly, stockpiles of soil within the quarry area can attract the nesting of some birds (i.e. Bank Swallows). Utilization of nesting birds within stockpiles typically occurs until chicks can fly.

Sensory disturbance to avifauna would result from rock blasting, clearing and grubbing, and aggregate crushing. These project components will likely result in the localized avifauna avoidance of the Study Area. Overall, project activities will likely cause a change in usage of the Study Area by avifauna, with some species tending to avoid the area, while others may be attracted to the increased activity or disturbed site.

Sensory disturbance related to Project activities include changes to noise and light levels. Changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect birds by influencing migration and behavioral patterns. A literature review conducted by Shannon et al. (2016) found that birds have the potential to exhibit changes in song characteristics, reproduction, abundance, stress levels, and species richness at levels greater than 45 dBA. Avifauna may be displaced
from areas adjacent to the Project as a result of construction and/or operations-related noise. This potential environmental effect would be prolonged over the lifetime of the Project.

Light can impact birds by potentially causing disorientation or by causing attraction or avoidance (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum et al. 2016).

Direct mortality of avifauna could result from Project activities, particularly from wildlife vehicle collisions or, as discussed above, from clearing and grubbing during the nesting period. Specific to wildlife vehicle collisions, there is no expected increase in traffic through quarry expansion, therefore, wildlife vehicle collisions remain unlikely. Accidents such as fuel spills have the potential to cause indirect mortality to avifauna due to exposure of contaminants.

Decommissioning of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

9.2.7.1 Mitigation

BDEP is committed to the development of an EPP which among other commitments will specify best management practices associated with birds utilizing the Development Area, mitigation methods and contingency plans associated with vegetation removal, dust suppression, progressive reclamation and re-vegetation of the quarry. The Project EPP will include methods by which the Project can take place while minimizing interactions with avifauna, these include:

- Avoid construction/disturbances on native vegetation during the breeding bird season for migratory birds, where practicable;
- Discourage ground-nesting species (e.g. Common Nighthawk, Bank Swallow) by limiting large piles or patches of bare soil during the breeding season, where practicable;
- Should any ground- or burrow-nesting species initiate breeding activities within stockpiles or exposed areas, the Proponent will avoid disturbance to these areas until chicks can fly and the nesting areas are no longer being utilized;
- Implement dust suppressants (e.g. water trucks) when normal precipitation levels are not effective in controlling dust;
- Limit lighting to the one spotlight at the weigh scale, where practicable;
- Install downward-facing lights on site infrastructure to reduce attraction to birds;
- Implement wildlife best management plans;
- Provide wildlife awareness training to site personnel;
- Vehicles will yield to wildlife on roads;
- Install signage where specific wildlife concerns have been identified;
- Follow Pit and Quarry Guidelines to reduce impact of noise and vibration on avifauna;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
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- Implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- A wetland alteration application will be approved prior to wetland alteration;
- Compensation for permanent loss of wetland function will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval; and
- Implement reclamation program to re-establish habitat to support reintroduction of birds post quarry life.

Should site activities during active nesting periods be unavoidable, additional mitigative measures such as pre-disturbance nest searches and avoidance and setbacks from active nests will be applied. These will be developed in consultation with Environment and Climate Change Canada (ECC). The Project is committed to use of limited lighting during construction and operations.

Clearing of vegetation associated with quarrying will be limited to active areas (i.e. 0.5 ha in advance of quarrying) in order to maintain intact habitat elsewhere across the unquarried portions of the site.

9.2.7.2 Residual Effect and Significance
The predicted residual environmental effects of the Project on birds are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the degree of disturbance currently within the Study Area, the lack of core habitat within the Study Area, the regional availability of alternate suitable habitat, and the best management practices that will be implemented as part of the Project EPP; no significant residual environmental effects are expected.

9.2.8 Species of Conservation Interest and Species at Risk
The following SAR/SOCI (and/or their habitat) were identified within the Study Area:

- One SOCI flora (Southern Twayblade; S3);
- Two SOCI lichens (*Leptogium subtile*; S3 and *Phaeophyscia pusilloides*; S3?);
- No priority herpetofauna species were observed, although potential habitat to support non-nesting and non-overwintering Snapping Turtle (SARA/COSEWIC SC, NSESA Vulnerable, ACCDC S3) and the Wood Turtle (SARA/COSWEIC/NSESA Threatened, ACCDC S2) are present in WC2 and WC3;
- No priority mammals were observed, but potential habitat is present for Mainland Moose (NSESA Endangered);
- Four SOCI birds (Pine Siskin; S2S3, Red-breasted Nuthatch; S3, Ruby-crowned Kinglet; S3S4B, and Yellow-bellied Flycatcher; S3S4B);
- No priority invertebrates were observed; and
- No priority fish species were observed, but potential access for Atlantic Salmon – Inner Bay of Fundy Population (SARA/COSEWIC Endangered, ACCDC S1), American Eel (S2), and
Brook Trout (S3) is provided within WC2 and WC3. It should be noted however that neither features provide significant habitat provision for these species.

Potential effects to SAR and SOCI are similar to those discussed for habitat and flora (Section 9.2.5), fauna (Section 9.2.6) and birds (Section 9.2.7) including:

- Sensory disturbance resulting in area avoidance or behaviour changes; and,
- Alteration or loss of habitat/habitat fragmentation.

Table 37 provides a summary of the potential environmental effects resulting from the Project-VEC interactions on SOCI and SAR. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality, alteration to habitat and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 39. Project-VEC Interactions by Project Phase on Potential SAR/SOCI

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<tr>
<th>Project Activities and Physical Works</th>
<th>Potential Project Interactions and Environmental Effect</th>
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<td></td>
<td>Direct Mortality</td>
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<td><strong>Construction</strong></td>
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<tr>
<td>Site preparation/clearing</td>
<td>X</td>
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<tr>
<td>Grubbing</td>
<td>X</td>
</tr>
<tr>
<td>Watercourse Alteration</td>
<td></td>
</tr>
<tr>
<td>Removal of overburden</td>
<td>X</td>
</tr>
<tr>
<td>Waste management</td>
<td>X</td>
</tr>
<tr>
<td>Expansion of storage areas for grubbings and overburden soils</td>
<td>X</td>
</tr>
<tr>
<td><strong>Operation and Maintenance</strong></td>
<td></td>
</tr>
<tr>
<td>Rock Blasting</td>
<td>X</td>
</tr>
<tr>
<td>Rock Transfer</td>
<td>X</td>
</tr>
<tr>
<td>Sorting and Crushing</td>
<td></td>
</tr>
<tr>
<td>Management of surface water</td>
<td></td>
</tr>
<tr>
<td>Trucking/Transport of product</td>
<td>X</td>
</tr>
<tr>
<td><strong>Decommissioning</strong></td>
<td></td>
</tr>
<tr>
<td>Re-grading of rock face</td>
<td></td>
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<tr>
<td>Reclamation/re-vegetation</td>
<td>X</td>
</tr>
<tr>
<td><strong>Accidents, Malfunctions and Unplanned Events</strong></td>
<td></td>
</tr>
<tr>
<td>Erosion and sediment control failure</td>
<td>X</td>
</tr>
<tr>
<td>Fuel spill from machinery/trucks</td>
<td>X</td>
</tr>
<tr>
<td>Fire</td>
<td>X</td>
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</tbody>
</table>

Potential effects to SAR/SOCI are consistent with those discussed for habitat and flora, fauna and birds. The SOCI species identified during field evaluations are dominated by birds (4 species). No critical
Birrette’s East Uniacke Quarry Expansion Project

habitat for these species was identified within the Study Area, and suitable habitat is present in surrounding lands and the region in general.

The one SOCI flora identified (Southern Twayblade) is designated by ACCDC as S3 and was located on the toe of a hummock in WL4. It is anticipated that quarry development will cause direct removal/destruction of the species.

Two SOCI lichens, *Leptogium subtile* and *Phaeophyscia pussiloides*, were identified within the Study Area. Two individual *Leptogium subtile* were observed in two locations, both of which are just south of the access road in the central and western portions of the Study Area. *Phaeophyscia pussiloides* was observed south of WL10. It is anticipated that quarry development will cause the direct removal/destruction of all individuals.

No critical habitat was identified within the Study Area for remaining mammalian and herpetofauna SAR and SOCI, and alternate habitat resource for these species is available during the construction and operational phase of this Project in surrounding areas.

Progressive decommissioning of the quarried areas will result in a positive effect on the habitat available for SAR/SOCI, involving the re-grading of the rock face, reclamation of land and vegetation across the Study Area, and reduction in overall habitat fragmentation associated with the Project.

Fire events, fuel losses, or erosion/sediment control failure during any phase of the Project could remove/destroy/flood significant amounts of vegetation, thereby having an environmental effect on habitat for wildlife including SAR and SOCI and potentially result in their displacement or mortality.

9.2.8.1 Mitigation
Mitigation of effects to SAR/SOCI are consistent with habitat and flora, fauna and birds (Sections 9.2.5, 9.2.6, and 9.2.7). However, the Project EPP will raise awareness of the specific SOCI identified and potential SAR that could be present to site personnel and provide recommendations for protective measures to be in place.

9.2.8.2 Residual Effects and Significance
The predicted residual environmental effects of the Project on SAR/SOCI are assessed to be adverse, but not significant, after mitigation measures have been implemented. Based on the lack of critical habitat (for BFL, priority birds, or priority fauna), no loss of known SAR flora or lichens, the regional availability of alternate suitable habitat (for priority birds and fauna), and the best management practices that will be implemented as part of the Project EPP; no significant residual environmental effects are expected.
10 CONCLUSIONS

Bio Design Earth Products Inc. (BDEP) currently owns and operates Birrette’s East Uniacke Quarry, operating under a Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2014-089114). BDEP plans to expand the existing Birrette’s East Uniacke Quarry, which requires a Provincial Environmental Assessment (EA) registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

The current quarry footprint exists within a portion of a property (PID 45405388), owned by BDEP and located 4 km northeast of the community of East Uniacke, Nova Scotia. The current IA encompasses quarry operations within this property. The proposed expansion of the quarry will occur within the same property. Expansion of the quarry will take place within the Development Area over 25-year time period. This Project encompasses a total proposed Development Area of 30.2 ha. A broader 41 ha Study Area was identified for the purposes of the provincial EA process.

Presently, there are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.

Baseline evaluations were completed for each Valued Environmental Component (VEC) over the course of a four-season survey period. The VECs used in the Projects EA include:

- Noise levels;
- Air quality;
- Surficial and bedrock geology;
- Groundwater;
- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat, flora, and lichens;
- Fauna (herpetofauna and mammals);
- Avifauna;
- Species of Conservation Interest (SOCl) and Species at Risk (SAR);
- Socioeconomic conditions;
- Archaeological and heritage resources; and
- Mi’kmaq.

In regard to the atmospheric environment (noise levels and air quality) and as per the current IA for the existing quarry, BDEP monitors all blasts for concussion (air blast) and ground vibration to ensure that the designated limits are not exceeded. To date, no blasts have exceeded concussion (128 dBL) or ground vibration (12.5 mm/s) levels at the nearest off-site structures. NSE has not requested BDEP monitor dust
at the site property boundaries and no issues or complaints related to quarry generated dust have been received by the Proponent to date.

The surficial geology of the Study Area consists of two types of surficial geologic units: Silty Drumlins (Drumlin Facies) and Silty Till Plain (Ground Moraine), and Drumlins. The Study Area overlies bedrock formations from the Goldenville Group. Acid Rock Drainage (ARD) testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations.

In relation to potential effects to groundwater, a desktop review for wells was conducted. No wells were recorded within the Study Area by the NS Well Logs Database nor were any observed within the Study Area during field studies. In order to determine a more precise location for adjacent residential wells, the Nova Scotia Topographic Database was reviewed to identify buildings within 1 km of the Study Area accompanied by an aerial review. In total two residential receptors (with assumed wells) were identified approximately 930 m north and 1,000 m west of the Study Area, respectively.

Surface water on site is currently directed to a series of settling ponds present in the eastern extent of the Study Area via rock lined ditches. Water passively drains from the settling ponds via a culvert to the east, beyond the Study Area boundary, into ditches adjacent to the gravel access road. Water proceeds to drain northward within the roadside ditch prior to discharging into a previously identified treed swamp. Based on desktop analysis, water drains from this location southward into lower reaches of a field identified watercourse (WC2), prior to connecting to O’Hearn Flowage (~630m east). As quarry expansion progresses, surface water will continue to be directed east and the capacity of settling ponds will increase as per engineered specifications and NSE IA requirements.

Two watercourses (WC1 and WC4) are present within the Study Area. Two additional watercourses (WC2 and WC3) were identified outside of the Study Area. These watercourses encompass the downstream receiving water from the Study Area and were assessed within the Fish Habitat Assessment Area.

- WC1 initiates in WL4 and flows south via a culvert into WL7 where it eventually dissipates. There is only a potential connection to downstream fish resources (through WL7) during periods when the wetland is flooded (i.e. periods of seasonal high flow).
- WC2 exists as an outflow from the eastern extent of WL7. WC2 flows through several unmapped wetlands where the channel becomes less defined, however, it is presumed that during high flow, fish passage could be possible. WC2 eventually discharges into O’Hearn Flowage.
- WC3 is a mapped watercourse that exists as an outflow from the western extent of WL7. WC3 commences as a subterranean channel and flows south and eventually east where it empties into O’Hearn Flowage. Fish access is expected within WC3 (to the point of subterranean flow).
- WC4 initiates in WL16 and flows west into WL18 where it dissipates. There is a lack of continuous surface water flow in WC4 to support resident fish populations, fish access, and there is no direct connectivity to a downstream fish resource.
Electrofishing in WC2 and WC3 found no fish and no fish were observed incidentally during any field surveys, however, fish are known to be present within the O’Hearn system. Herbert River, downstream of O’Hearn Brook is a known Atlantic Salmon – Inner Bay of Fundy Population (*Salmo Salar pop 1; S1*) river.

Nineteen wetlands were identified across the Study Area of which 14 are located within the Development Area (i.e. proposed to be directly altered throughout the lifetime of the proposed quarry expansion). Of the 19 wetlands, the majority (13) exist as isolated features; three are located in a headwater (outflow) position with a drainage outlet (WLs 4 and 17) or a watercourse outlet (WL16); and three exist in a throughflow position (WL1, WL7, and WL18). Treed/Shrub Swamps (11) and Treed/Shrub Bogs (7) are the dominant wetland types on the landscape within the Study Area. WL7 was identified as a Softwood Treed Shrub Fen. All wetlands were in a terrene landscape position, and most of them were identified in basin landforms, except WL17 which was a flat terrace, and WL18 which is sloped. A total of 117 flora species were identified within the Study Area. One SOCI was observed, Southern Twayblade (*Listera australis*, S3). Thirty lichen species were observed in the Study Area. Two species were determined to be SOCI species which include Appressed Jellyskin Lichen (*Leptogium subtile; S3*) and Pompom-tipped Shadow Lichen (*Phaeophyscia pusilloides; S3?).

Wildlife surveys found signs of Eastern Coyote (*Canis latrans*), North American Porcupine (*Erethizon dorsatum*), Snowshoe Hare (*Lepus americanus*), Short-tailed Weasel (*Mustela ermina*), White Tailed Deer (*Odocoileus virginianus*), American Red Squirrel (*Tamiasciurus hudsonicus*), and White-footed Deermouse (*Peromyscus leucopus*). No SAR/SOCI fauna (e.g. Mainland Moose, Wood Turtle, or Snapping Turtle) were observed on within the Study Area, however, during public consultation several residences in the vicinity of the Study Area (~ 1 km) informed MEL staff that they have regularly observed Snapping Turtles (*Chelydra serpintina*).

Bird surveys completed during spring, breeding and fall identified 43 species of birds and activity levels across all seasons studied indicated a healthy population of birds utilizing on-site habitat. Across all survey seasons, a total of four Priority Species (all Species of Conservation Interest [SOCI]) were observed either during dedicated survey periods or incidentally (Pine Siskin [*Cardelius pinus; S2S3*], Red-breasted Nuthatch [*Sitta canadensis; S3*], Ruby-crowned Kinglet [*Regulus calendula; S3S4B*], and Yellow-bellied Flycatcher [*Empidonax flaviventris; S3S4B*]). No Species at Risk (SAR) birds were identified.

In regard to socioeconomic conditions, the Development Area is situated away from residential receptors and the land within the Study Area is owned by BDEP. No residual effects to human health are anticipated due of the distance of the Project to residual receptors as well as mitigations and best management practices regarding the hauling of aggregate (e.g. enforcing speed limits, posting signage etc.). The Project will allow for continued employment at the quarry as well as in related industries where the aggregate material is used (e.g. construction, hauling). Employment and financial gain is expected to occur in the rural communities near the Project and in turn will strengthen the local economy.
No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin. No concerns were received by Mi’kmaq, however the KMKNO recommended further evaluating the landscape for evidence of potential historical Mi’kmaq uses of the land through implementation of a shovel testing program. The Proponent will consider this in the future as and when the quarry expands into undisturbed portions of the Study Area.

Based on the potential for an adverse residual environmental effect the following eight VECs were carried forward to the detailed effects assessment:

- Groundwater;
- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat and vegetation;
- Fauna;
- Birds; and
- SOCI/SAR.

To date, the Birrette’s East Uniacke Quarry has not been observed to interact with the groundwater table (no observed seepages through the exposed rock face of build up of water on the quarry floor) and the intention is to remain above groundwater throughout the expansion process. Implementation of a groundwater monitoring plan in line with NSE requirements will support the determination of where groundwater exists. Quarry expansion will remain beyond 800 m from local residents and to date, there have been no reports of negative effect to residential properties surrounding the existing quarry, however, potential effects as a result of quarrying activity (including blasting) on groundwater, water quantity and water quality are possible. Mitigation including blast monitoring, a water well replacement policy for wells proven to be damaged by quarry activities, and commitments to monitor water quality will be implemented. Based on the distances from surrounding residences, residual environmental effects are expected to not be significant.

Surface water quantity is expected to be affected by the proposed activity as a result of loss of natural catchment areas. A Hydrological Effects Analysis was completed as part of the EA process to determine impacts to the natural flow of surface water from land within the Study Area to downstream aquatic systems. The modeling concluded that that stream flow losses are expected within four watercourses adjacent the Study Area (WC2, WC3, Unnamed Tributary A, and O’Hearn Flowage). However, none of the losses cause a reduction of Ecological Maintenance Flow and as such, flow regimes and water levels will be maintained to sustain ecological functions for fisheries and its habitat. Potential for Acid Rock Drainage is low as determined from rock sample testing results and mitigation and monitoring is expected to prevent impacts to water quality from sedimentation. Based on the analysis completed and proposed mitigation, residual environmental effects are expected to be not significant.
The two watercourses (WC1 and WC4) identified within the proposed Development Area will be directly impacted by future quarry development. WC1 provides poor fish habitat (and only accessible to fish if the downstream WL7 is flooded), and WC4 does not provide access to fish. As described above, water quantity is predicted to be reduced in four watercourses adjacent the Study Area (WC2 and WC3 provide rearing and foraging habitat), however, Ecological Maintenance Flow will be maintained and as such, serious harm to fish and fish habitat is not expected. Therefore, residual environmental effects to fish and fish habitat post mitigation are expected to be not significant.

Nineteen wetlands were identified across the Study Area of which 14 are proposed to be directly altered throughout the lifetime of the proposed quarry expansion. The majority of the wetlands (n=10) being directly impacted exist as isolated swamps. Wetland alteration permits (and associated wetland compensation) will be obtained for wetlands which require alteration, and unaltered adjacent wetlands will be monitored as per NSE requirements. The extent of wetland alteration as a result of the quarry expansion is small scale at the watershed level and as such, residual environmental effects post mitigation are expected to be not significant.

Habitat, flora, and lichens across the Study Area are common to the regional area and province of Nova Scotia consisting of an intermix between cut blocks and forested land. Wildlife survey results and bird surveys indicate a common assemblage of fauna and birds utilize the Study Area. No SAR flora, lichens, fauna or birds were identified within the Study Area. Based on the degree of disturbance currently within the Study Area, the lack of core habitat within the Study Area, the availability of suitable habitat adjacent the Study Area, and the best management practices that will be implemented as part of the Project Environmental Protection Plan; no significant residual environmental effects are expected for these VECs.

Species at Risk inventories within the Project Study Area revealed that no flora or fauna SAR are present across the Study Area. One flora SOCI, (Southern Twayblade; S3) and two SOCI lichens (Leptogium subtile; S3 and Phaeophyscia pusilloides; S3?) were identified within the Study Area. As described previously, four SOCI birds were also identified. There will be a direct loss of these SOCI lichen and flora species as a result of the Project. Due to the lack of SAR presence, as well as the critical habitat required to support SAR, residual environmental effects are expected to be not significant.

The field data, regulatory consultation, and subsequent conclusions of this assessment indicate that there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response. Residual environmental effects have been determined to be not significant for all identified VECs.

11 LIMITATIONS

Constraints Analysis
On some maps, land use or land cover is defined everywhere to form a complete mosaic of polygons. On topographic maps landuse/landcover is depicted only in certain areas. The source data in some cases may need to be conditioned to allow the second type of depiction if it is a mosaic, and certain constraints will operate differently in each case, and,

Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.

Limitations incurred at the time of the assessment include:

- McCallum Environmental Ltd. has relied in good faith upon the evaluation and conclusions in all third-party assessments. MEL relies upon these representations and information provided but can make no warranty as to accuracy of information provided;
- There are a potentially infinite number of methods in which human activity can influence wildlife behaviors and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors;
- The EA provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions;
- Effects of impacts separated in time and space that may affect the areas in question, have not been included in this assessment; and
- Limitations associated with the seasonality of Habitat Surveys are described in Section 4.1.1.2.2.

General Limitations incurred include:

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (i.e., vegetation concentrations, and wildlife usage) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors; and
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.
12 REFERENCES


Birrette’s East Uniacke Quarry Expansion Project


Birrette’s East Uniacke Quarry Expansion Project


Ware, H., McClure, C., Carlisle, J., and Barber., J. 2015. A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. PNAS. 112 (39). 12105-12109. https://doi.org/10.1073/pnas.1504710112


13 CERTIFICATION

This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written, combined, and referenced the report accordingly.

Jeff Bonazza, M.Env.Sci
Intermediate Environmental Scientist
McCallum Environmental Ltd.

Andy Walter, B.Sc.
Senior Project Manager
McCallum Environmental Ltd.