5.0 VALUED ENVIRONMENTAL/SOCIO-ECONOMIC COMPONENTS (VEC/VSC) AND EFFECTS MANAGEMENT

5.1 Air Quality

Air Quality has been selected as a VEC because of its intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. Air is an important pathway that could transfer contaminants to freshwater, terrestrial and human environments. Air quality, with specific regard to dust emissions, was raised as an issue of concern during public and stakeholder consultation. Air quality will be assessed in the context of Project-related emissions and ground-level concentrations for particulate matter (PM; total suspended particulate (TSP); dust).

5.1.1 Description of Existing Environment

The air quality of Nova Scotia is generally considered to be good due to the lack of significant emission sources in most areas. In certain industrial areas, and in larger urban areas, such as the Halifax-Dartmouth-Bedford area, there is some evidence of the effect of anthropogenic sources; however, exceedances of provincial standards are very rare, even in these areas.

NSEL monitors air quality at ten stations across Nova Scotia. The criteria air pollutants that are monitored regularly are sulphur dioxide (SO_2), particulate matter (PM), fine particulate matter (PM2.5), carbon monoxide (CO), ground level ozone (O_3), nitrogen dioxide (NO_2), and hydrogen sulphide (H_2S). The closest NSEL monitoring site to the Sovereign Resources quarry is located in downtown Halifax, approximately 15 km from the quarry site. In 1997, the province began continuous reporting of an air quality index for the Halifax – Dartmouth region. Since reporting began, air quality has been predominantly in the "Good" category (NSDOE 1998).

It is noted that NSDEL monitors PM2.5 at Lake Major. Unfortunately this data was unavailable at the time of report preparation. It is recognized that PM2.5 will be regulated under Canada Wide Standards, specifically 30 ug/m^3. PM2.5 is predominantly a combustion source pollutant, rather than a pollutant produced by mechanical crushing or abrasion processes. Table 11.12.2-3 from US EPA AP-42 (Compilation of Emission Factors) shows typical particle size distributions for various aggregate handling operations. These indicate that PM2.5 is from 1/4th to 1/20th of the total particulate emissions from aggregate processing operations, therefore it is likely that meeting the 120 ug/m^3 for total particulate is indicative that the Canada Wide Standard for PM2.5 is also met.

More specific to the study area is air quality monitoring that has been conducted for the Municipal Enterprises quarry. Jacques Whitford, on behalf of Municipal Enterprises, monitors TSP to fulfill NSEL

approval conditions for the operation of the quarry. The monitoring locations were determined in consultation with NSEL with the objective of locating the stations as close as possible to public areas outside the property line of the quarry.

The two sampling locations most commonly used are Ambassador Motorhomes, immediately northeast of the quarry site, and Fraserway RV Centre Ltd., west of the quarry entrance. These monitoring locations are within approximately 0.5 km of the Municipal Enterprises quarry (refer to Figure 5.1)

These sites are downwind of the Municipal Enterprises quarry when the wind direction is from the southeast (about 14% of the time). Figure 5.2 shows a joint wind speed-direction frequency distribution ("wind-rose") based on data from the Meteorological Services Canada station at the Halifax International Airport. The wind is more frequently from the southwest through northwest; however, there are often strong winds from the eastern quarter. Although the wind direction more frequently has a western component, it is difficult to sample under these conditions since the nearest public areas with electrical power for the hi-volume samplers are three to four kilometres away, and would be subject to additional contribution sources of TSP outside of Municipal Enterprises' operations.

The most recent monitoring was performed in August of 2004. In accordance with Environment Canada methodologies, TSP samples were taken over 24 hours at two stations for five 24-hour periods. The results are contained in Table 5.1

Table 5.1 Ambient Air Quality – Municipal Enterprises Rocky Lake Quarry, August 2004

Location	Date	Avg. Wind Dir./Speed (kph)	TSP (μg/m^3)
Ambassador Motorhomes	August 4, 2004	W/10	59.4
	August 10, 2004	SW/8	82.2
	August 11, 2004	S/10	82.4
	August 17, 2004	NW/8	90.3
	August 19, 2004	S/14	77.6
Fraserway RV Centre Ltd	August 4, 2004	W/10	72.0
	August 10, 2004	SW/8	99.1
	August 11, 2004	S/10	85.2
	August 17, 2004	NW/8	61.5
	August 19, 2004	S/14	54.8
NSEL Regulated Limit for TSP 120 μg/m^3			

This data represents a small sample of the monitoring results gathered from the Municipal Enterprises quarry over the years of the monitoring program. However, this sample is typical of all measurements that have been taken. The TSP results were all within the 24-hour NSEL limit of 120 μg/m^3. These results show the effects of several influences, including the traffic on Rocky Lake Road, cement plants, and landscaping businesses in addition to the influences of the nearby quarries. To date, there have been no recorded instances of exceedances that can be directly attributed to work within the Municipal Enterprises quarry.

Sovereign Resources Quarry Modification Project Environmental Assessment

Figure 5.1

Air and Noise Monitoring Locations

Second Lake
Three Mile Lake
Spriggs Lake
Skerry Pond
Powder Mill Lake
First Lake
Rocky Lake
Lake William
Leonard Lake
Highway 118
Highway 102
Buffer Zone
Anderson Lake
CN Rail
Enchanted Lake
Juniper Lake
Lake Charles

Nova Scotia
Windsor
Mount Uniacke
Elmsdale
Enfield
Sackville
Bedford
Dartmouth
Halifax
Hubbards
Site Location
Key Map
0 5 10 15 20
Kilometres

Monitoring Locations

- Sovereign Resources Ambiant Noise Monitoring Locations
- Municipal Enterprises Air and Noise Monitoring Locations
- Historic Tidewater Air and Noise Monitoring Locations

Project Features

- Proposed Sovereign Resources Quarry Modification Area
- Approved Sovereign Resources Quarry
- Existing Quarry

Topographic Features

- Elevation Contour (m)
- Stream
- Waterbody
- Property Boundary

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Scale 1:30,000

0 500 1000 1500
Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

Jacques Whitford

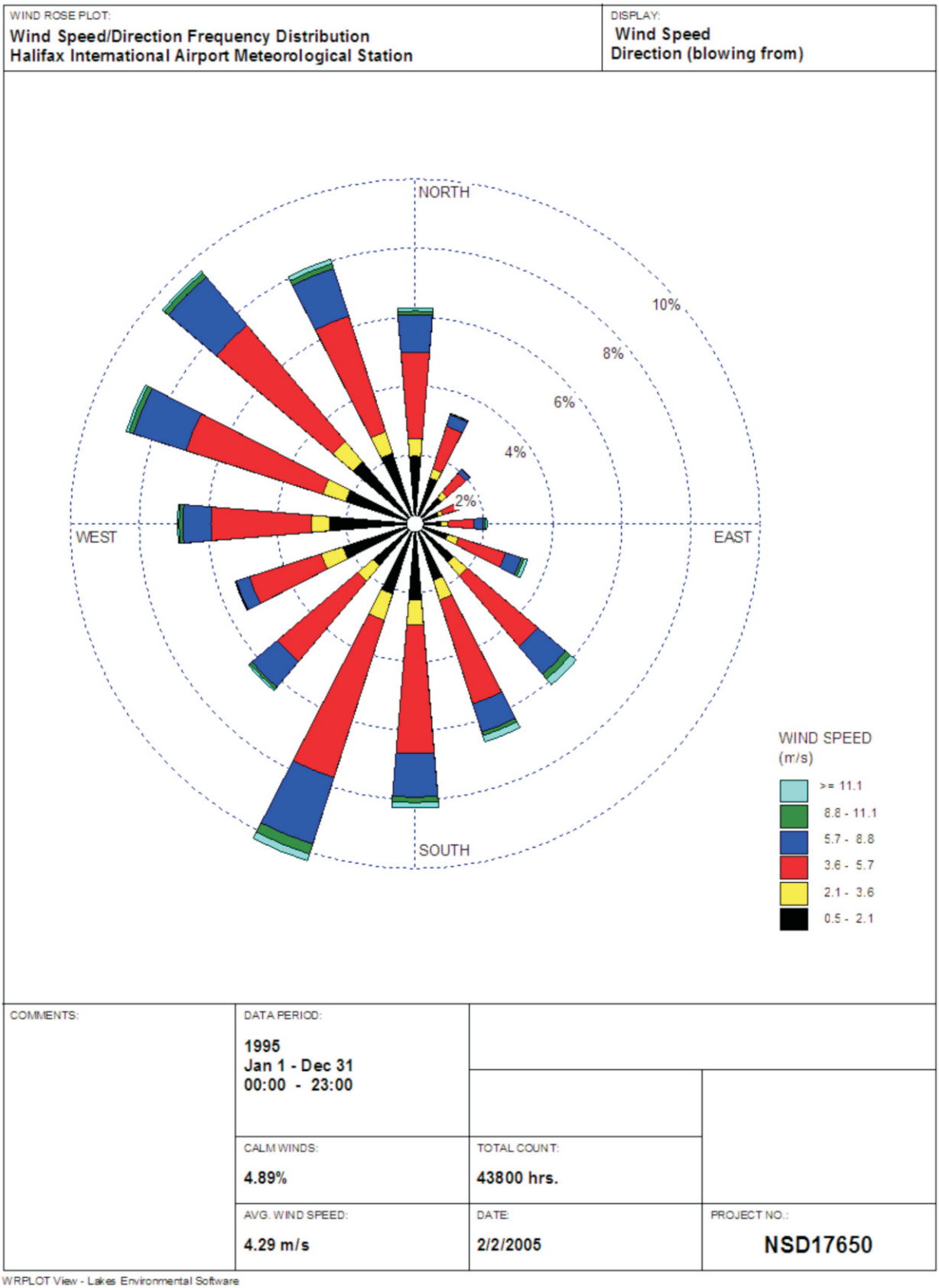

Figure 5.2

Joint Wind Speed-Direction Frequency Distribution (Wind-Rose) for the Halifax International Airport

A review of air quality monitoring data for the former Tidewater Quarry (also conducted by Jacques Whitford and submitted to NSEL) indicates that the Tidewater facility also operated consistently within the regulatory limits (maximum 120 $\mu g/m^3$ daily average (24-hour)) for TSP (Tidewater 1999). One of the differences in the Tidewater air quality monitoring program was the inclusion of arsenic due to concerns expressed by the public. The limit in the operating permit was 25 $\mu g/m^3$. Nova Scotia does not have a specific limit for arsenic in the Air Quality Regulations; however, Newfoundland and Labrador's Air Pollution Control Regulations (Schedule A) specify ambient air quality standards for arsenic of 0.3 $\mu g/m^3$. Air quality measurements recorded from Albernie Trailer Sales, Atlantic Explosives and the Waverley Fire Hall showed levels consistently lower than 0.01$\mu g/m^3$ (Tidewater 1999) which is approximately 1/30th of the Newfoundland and Labrador standard.

It is important to note that these measurements obtained during monitoring programs for Municipal and Tidewater are useful indicators for conditions at the receptor sites but are not presented as predictors of performance of future operations of quarries (*e.g.*, Sovereign Resources quarry) in the area.

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

There are several operations within a quarry that can be responsible for the generation of particulate matter. As per the conditions of the existing Sovereign Resources Industrial Approval and the Pit and Quarry Guidelines, particulate emissions will not exceed the following limits at the site property boundaries:

- Annual Geometric Mean 70 $\mu g/m^3$
- Daily Average (24 hrs) 120 $\mu g/m^3$

Blasting can result in a concentrated plume of particulate matter, but the volume and time duration of such plumes are quite constrained. Even when blasts result in a visible plume, the contribution to 24-hour averages, as in the Air Quality Regulations, will be negligible. Much of the material in the initial plume is larger than the aerodynamic diameter of particles that can remain suspended in the air, and deposit within a relatively short distance (*e.g.*, 100 m) of the blast site. Nevertheless, a visible plume is often unacceptable to the public and regulators, and control is appropriate. Proper controlled blasting techniques are effective in reduction of the visible plume and other more serious potential effects. Blasting energy that is expended in generating visible plumes is wasted energy, therefore it is also the objective of the operators to reduce these impacts. Blast design, including controlled timing, limiting charge size, and blasting during meteorological conditions that minimize the offsite transport of the blast dust and noise, are mitigation methods that will be used.

Crushing and stockpiling are activities that can result in the generation of particulate matter. The source, in both cases, is often the vertical drop off the end of the conveyor on the crusher or stacker. As the fine

material passes through the air, the finest material may become windblown and travel downwind. There will be no crushing activity at the Sovereign Resources quarry; this activity will be undertaken at the Municipal Enterprises quarry.

As the quarry working face moves farther from the Municipal Enterprises crusher and stockpiles, there will be more trucking onsite. Several measures will be taken to minimize dust generated by truck movement on site:

- Onsite speed will be strictly controlled.
- Trucks will be loaded such to avoid excessive loss of material from the truck on the road.
- Onsite roads will be maintained to reduce dust generation by routine application of dust suppressant, such as calcium chloride, and/or routine application of water spray, particularly during summer dry periods. In the event that either calcium chloride or magnesium chloride is considered for use as a dust suppressant, it will only be used in accordance with "Best Practices for the Use and Storage of Chloride-based Dust Suppressants" (Environment Canada 2004).
- Onsite roads will be constructed with stable material and will be maintained with timely repair of ruts and bumps that could otherwise cause trucks to lose part of their load.
- Onsite road design and quarry rehabilitation planning will consider use of windscreens (*e.g.*, berms, tree planting) to minimize off-site transport of dust.

Trucks moving off-site can also impact air quality by transporting mud and material on their tires that is deposited on public roads, where it can become airborne through the mechanical action of passing vehicles and the wind. A large portion of trucks hauling material off-site are independent haulers who are members of the Nova Scotia Trucking Association and are not under the direct control of Sovereign Resources or Municipal Enterprises. However, Sovereign Resources will cooperate and support efforts of the Municipal Enterprises quarry to continue to reduce dust generation and share the burden of the costs for such controls.

The final major source of particulate matter is the erosion of vulnerable material by the wind. Stockpiles of material are particularly vulnerable to wind erosion and, for this reason, stockpiles of crushed aggregate will not be placed within the proposed Project area. Wind erosion is also important on areas of the quarry that have been mined, or have been cleared for other purposes. These areas can serve as ongoing sources of particulate matter during windy times and provide no restriction to the wind. Water applications will be used to minimize dust during particularly dry conditions. Also, trees, brush, and grasses are effective in both stabilizing the surface and reducing the wind speed at the surface. Rehabilitation of inactive areas of the quarry is an important part of dust mitigation. Progressive rehabilitation of lands no longer required for quarry activities will reduce the exposed surfaces and prevent wind erosion effects. Additional information on progressive rehabilitation is contained in Section 2.7.

One of the main concerns raised during public consultation was the off-site transport of dust from the Sovereign Resources quarry, particularly given the proposed changes to the topography and the increased proximity to residential development compared to the Municipal Enterprises quarry. The change in topography may cause slight changes in the emissions of particulate matter from the quarry, because it may cause slight changes in the wind. The removal of trees will tend to reduce the friction of the earth on the moving air, increasing the speed of the wind, and increasing the potential of dust emissions. As the air moves downwind, if trees are encountered, the decrease in windspeed and contact with the vegetation will tend to remove some of the particulate matter from the air. It is difficult to quantify air quality effects attributable to the reduction in the elevation of the terrain, however the change in elevation is unlikely to cause perceptible changes in wind direction or wind speed outside the property boundaries. Retention of the vegetation cover and/or rehabilitation of the site will minimize these changes and provide the additional benefit of a reduction in particulate material transported off-site.

Progressive reclamation will also address the concern that there could be a significant increase in dust emissions as a result of a potentially larger quarry operation. Modification of the permitted boundaries will not necessarily result in a net increase in exposed working area and/or dust emissions since reclamation of the exposed areas will be conducted as those areas become inactive.

Subject to Project approval, Sovereign Resources has committed to setting aside the undeveloped forested lands between the quarry and Lake William as a buffer zone for the duration of quarry operation on Sovereign Resources Land. This buffer zone will also serve as a wind screen and assist in reducing transport of particulate matter.

Another dust-related concern raised during public consultation was the potential for and risk associated with transmission of arsenic in TSP. As noted above, the Tidewater air quality monitoring program included testing for arsenic levels, with results consistently lower than 0.01µg/m^3. Observed levels of arsenic in rock at the quarry ranges from 3-20 ppm. Even at the upper end of this range (*i.e.*, 20 ppm), the TSP level would have to be over 100 times the allowable limit before the arsenic level would reach 25 µg/m^3 (limit specified in the Tidewater approval). Monitoring of TSP and periodic (*e.g.*, quarterly) sampling of arsenic content of the rock will be implemented, which will help ensure these limits are not exceeded.

Additional detail related to particulate monitoring will be presented in the Quarry Development Plan. The location of the monitoring stations will be determined in consultation with NSEL and the Monitoring Board and will likely include, but not necessarily be limited to, the Silversides area east of Lake William, the Lakeview area west of the quarry, and a location northeast of the quarry on the west side of Lake William if a power supply becomes available. It is proposed that monitoring occur at each station for five 24-hour periods during spring, summer and autumn seasons during quarry operations. Sovereign Resources will also consider use of hand-held monitoring devices to provide immediate feedback regarding dust migration off-site and adequacy of mitigation measures.

Sovereign Resources will implement a complaint resolution program whereby public concerns communicated to the quarry are tracked and resolved in a suitable and timely manner. Where appropriate, monitoring programs (*e.g.*, dust, noise) will be modified to address specific concerns. For example, the dust monitoring program could address concerns that deposits in a specific area are related to quarry activities. In such cases, it may be possible to determine the source of the deposit and, if not attributed to Sovereign Resources, it would not warrant ongoing monitoring.

GHG emissions resulting from vehicle emissions (*e.g.*, CO, CO_2, NO_x, SO_2) will be reduced through proper equipment maintenance and reduction of vehicle idling.

In summary, assuming appropriate dust suppression and GHG emission reduction measures are undertaken, no significant adverse residual effects on air quality are likely to occur as a result of the Project.

5.2 Noise and Vibration

Noise and vibration have been selected as a VEC due to concern with potential Project-related noise emissions and ground vibrations. Noise is defined as unwanted sound. Noise is measured in the same way as any sound, as a sound pressure level (SPL) in units of decibels. To reflect the sensitivity of the human ear across the audio spectrum, the SPL readings are given in what is termed as the "A-scale" and are denoted as dBA. Ground vibration is included due to the potential for ground vibration from blasting to cause concern to landowners/residents or damage to structures in the vicinity of the activity.

Humans live in a broad range of sound pressure levels. A level of 0 dBA is the least perceptible sound by a human. A change of 3 dBA represents a physical doubling of the sound pressure levels, but is barely perceptible as a change, whereas most persons clearly notice a change of 5 dBA and perceive a change of 10 dBA as a doubling of the sound level (USEPA 1974). Typically, conversation occurs in the range of 50 to 60 dBA. Loud equipment or trucks passing by on a busy road, are responsible for noise levels of about 85 dBA, the threshold for which hearing protection may be required in the workplace. Very quiet environments, such as a still night in a remote environment may fall below 40 dBA, but only below 30 dBA in exceptionally quiet environments.

The acoustic environment can be degraded by the presence of unwanted sound. For the most part, noise is a nuisance that detracts from the enjoyment of a quiet acoustic environment. In severe cases, noise can cause sleep disturbance, anxiety, and consequent health effects. It can damage the natural environment by alarming wildlife, inhibiting reproduction, and spoiling habitat.

Noise from blasting, truck movements, rock crushing and other quarry activities, as well as ground vibration from blasting were identified as issues of concern during public consultation.

5.2.1 Description of Existing Environment

The assessment of noise in Nova Scotia is established through the Guideline for Environmental Noise Measurement and Assessment (Noise Guideline) (NSDOE 1989) as follows:

Day	(07:00 to 19:00)	65 dBA
Evening	(19:00 to 23:00)	60 dBA
Night	(23:00 to 07:00)	55 dBA

These limits are consistent with the limits provided in the Pit and Quarry Guidelines (NSDOE 1999), have been incorporated in typical operating permits for quarries in Nova Scotia, and are often used as criteria for impact assessments.

Jacques Whitford, on behalf of Municipal Enterprises, monitors noise levels to satisfy NSEL approval conditions for the operation of Rocky Lake quarry. The most recent monitoring was performed in August of 2004. Noise monitoring was performed during daytime hours at the sites of Ambassador Motorhomes, immediately northeast of the quarry site, and Fraserway RV Centre Ltd., west of the quarry entrance, as well as one station inside the quarry property to provide a site reference (Figure 5.1). Monitoring is in accordance with the Noise Guideline (NSDOE 1989).

The measurements taken off the quarry property were within the daytime recommended limit (refer to Table 5.2). The limit does not apply to the onsite readings. The major source of noise at Ambassador Motorhomes and Fraserway RV Centre Ltd. measurement locations was traffic on Rocky Lake Road.

Table 5.2 Ambient Noise Levels – Rocky Lake Quarry, August 2004

Location	Date	Time	Leq/Sources
Ambassador Motorhomes	August 27	1:00 PM	56.2 dBA / traffic
Fraserway RV Centre Ltd.	August 27	2:10 PM	58.3 dBA / traffic
Within the quarry	August 27	3:25 PM	72.1 dBA/ crusher and haulage trucks
Noise Guideline Limit			65.0 dBA

These results are typical noise levels in the area where the noise of traffic on Rocky Lake Drive is dominant. There may be some contribution to the total noise levels from normal quarry operation, but it is not sufficient to cause exceedance of the guidelines and is not perceptible to a listener exposed to the traffic noise levels.

Baseline noise monitoring for this Project was conducted on February 7-8 and 13-14, 2005. SPL measurements were taken at three locations (refer to Figure 5.1) which were considered representative of residential receptors in the Rocky Lake Road, Lakeview, and Silversides areas. Larson Davis System 824 Type 2 sound level meters were used to record sound levels at each of the three locations for

approximately 24 hours. Due to power supply difficulties related to the cold weather, data was collected over two 24-hour periods and aggregated to illustrate the diurnal variation. The results, shown in Table 5.3, are expressed in terms of L_{eq}, L_{10}, and L_{90}. L_{eq} is the one-hour "average" of the sound energy. L_{10} is the level exceeded 10% of the time, and typically reflects intermittent noises such as vehicle passages. L_{90} is the level exceeded 90% of the time, and is often taken as representative of the steady state background noise. Table 5.3 also includes the Noise Guideline limits for comparative purposes.

Table 5.3 SPL Background Measurements (Feb. 2005)

Time of Day[1]	Lakeview			Rolling Hills			Rocky Lake			Noise Guideline Limits (NSDOE 1989)
	L_{eq} (dBA)	L_{10}[2] (dBA)	L_{90}[3] (dBA)	L_{eq} (dBA)	L_{10} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{10} (dBA)	L_{90} (dBA)	(dBA)
0:00	41	46	30	49	51	41	47	48	31	55
1:00	46	50	29	45	48	41	39	44	27	55
2:00	42	46	28	47	51	41	56	46	27	55
3:00	47	49	29	47	51	41	54	48	28	55
4:00	46	47	34	44	47	40	42	45	37	55
5:00	46	49	39	46	49	41	42	44	35	55
6:00	49	52	40	52	55	47	49	51	39	55
7:00	52	54	47	52	54	49	49	52	44	65
8:00	51	52	43	52	54	49	50	53	46	65
9:00	45	48	40	50	52	43	See Note 4.			65
10:00	47	47	37	45	48	38				65
11:00	44	45	38	42	44	36				65
12:00	45	46	33	44	46	33				65
13:00	42	45	31	45	48	31				65
14:00	44	40	32	41	42	31	49	53	40	65
15:00	41	44	32	40	42	31	51	54	39	65
16:00	44	45	32	54	44	33	50	54	39	65
17:00	53	52	43	48	51	43	47	52	38	65
18:00	48	49	42	46	49	41	46	50	36	65
19:00	54	47	39	46	48	41	47	49	36	60
20:00	49	47	38	46	49	39	49	51	38	60
21:00	55	50	40	46	49	42	49	50	38	60
22:00	53	51	40	48	50	42	47	48	36	60
23:00	48	48	36	45	47	40	45	46	33	60

Notes:
1. Results are aggregates of measures taken on February 7, 8, 13, and 14, 2005
2. L_{10} is the sound pressure level that is exceeded 10% of the time (i.e., reflects influences of noise above background)
3. L_{90} is the sound pressure level that is exceed 90% of the time (i.e., represents background noise)
4. Due to equipment malfunction, no measurements were captured from this location between 09:00 and 13:00.

The results show overnight noise levels tend to be in the mid-40 dBA range. At about 06:00, there is a marked increase at each site to about 48-52 dBA with the onset of morning traffic. The traffic noise decreases during the day, rising again near 16:00. The levels are all within the Noise Guideline limits except for two readings in the early hours at the Rocky Lake Road site. Examination of the raw data indicated that the averages were raised by a few high readings due to short-term intense noises, which were most likely attributed to animals.

These measurements were obtained during the winter season in which there is limited activity at the Municipal Enterprises quarry. It is proposed that baseline noise monitoring for the Sovereign Resources quarry Project be conducted again in the spring/summer season once the Municipal Enterprises quarry is in full operation to provide an accurate representation of existing pre-Project noise levels in these areas during the rest of the year.

In addition to the noise limits provided above, the Pit and Quarry Guidelines (NSDOE 1999) also prescribe limits for blasting noise (concussion) and ground vibration as follows:

Concussion (Air Blast): 128 dBA	Within seven metres of the nearest structure not located on the property where the blasting operations occur, or other locations as directed by the Minister or Administrator.
Ground Vibration: 0.5 in/sc (12.5 mm/s) Peak Particle Velocity	Measured below grade or less than one metre above grade in any part of the nearest structure not located on the property where the blasting occurs, or other locations as directed by the Minister or Administrator.

Vibration monitoring (with seismographs) has been undertaken for all blasts carried out at the adjacent Municipal Enterprises quarry at four locations. A review of vibration monitoring data collected over the past three years indicates that all readings have been well below the regulated safe levels.

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

Sources of Project-related noise include blasting, onsite truck traffic (*e.g.*, engines, back-up alarms), and operation of other heavy machinery (*e.g.*, loaders). To a limited extent, these noise sources are currently present at the approved Sovereign Resources quarry. The proposed Project will increase the frequency and time period over which these activities and resulting noise emissions occur.

Typical short term maximum noise levels for trucks, loaders and other heavy equipment are up to 85 dBA at 15 m from the source. Noise levels decrease about 6 dBA for every doubling of the distance from the source of the noise (*e.g.*, 85 dBA at 15 m would attenuate to approximately 79 dBA at 30 m).

Line of sight barriers (*e.g.*, rim of quarry) would further reduce received sound levels by providing at least 5 dBA attenuation of noise levels at the source. A higher barrier increases the attenuation up to as much as 15-20 dBA. Distance from the source and topographic features work together to logarithmically reduce received noise levels.

As shown on Figure 5.9 (land use), the closest residential areas from the Sovereign Resources quarry modification area in order of proximity are Waverley on Rocky Lake Drive (generally more than 1 km), Lakeview (generally more than 1 km, with the nearest residence 730 m away and already within the 800 m setback distance of the existing quarry), and residential development across Lake William (> 1.5 km). At any of these potential noise receptors, the noise levels due to quarry operations are likely to be lower than the current background levels at those locations; the potential for the public to perceive them will depend on the nature and orientation of background levels. For example, an arterial road between the receiver and the quarry could partially mask any noise emissions from the quarry.

The following mitigative measures will be implemented to minimize noise off-site from Project-related activities:

- Routine maintenance of Project vehicles (particularly exhaust systems);
- Minimization of travel distances and enforcement of maximum speed limits to reduce the total noise emission of onsite traffic;
- Optimization of travel to minimize reverse gearing so that back-up alarms are minimized and/or investigation of alternative safety features such as lights or sonar;
- Concentrating intense activity during the times of day when background noise sources are active, and minimizing activity during those times when background sources are low (*e.g.*, minimize trucking activity at night); and
- Maintaining a line-of-sight berm between the quarry operations and potential receivers, particularly between the quarry area and Lakeview.

In addition, routine monitoring of noise at the property boundaries and at the nearest receptors will be undertaken to identify the levels and the proportion contributed by the quarry. Sovereign Resources will undertake to investigate exceedances of the noise guidelines attributed to Project activities and attempt to reduce them to acceptable levels (*i.e.*, according to the Noise Guidelines).

The above discussion and mitigative measures mainly address noise emissions from onsite machinery. Blasting is another Project activity that generates noise, and more noticeably, vibration. It is common for ground borne vibration to be mistakenly interpreted by receiving sources (*e.g.*, residents) as airborne noise.

All structures experience stresses from wind, live loads, settlement, moisture, thermal expansion and shrinkage, *etc*. Such stresses can result in cracks. In addition to these normal environmental stresses, ground vibration associated with anthropogenic activities such as blasting can also cause stress on structures resulting in damage.

Blasting noise and vibration is limited by the use of proper blasting techniques, and by constraining the activity to days when atmospheric conditions will not cause enhanced effects through reflection of the noise by a thermal inversion layer. Blasts will be timed/limited to minimize the times during the day when the public might notice the noise, and also to use the time when atmospheric inversion height is a maximum, therefore reducing the reflection problem.

A qualified company will conduct all blasting. The blasting sub-contractor is responsible for blast designs and methods in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* and the Pit and Quarry Guidelines (NSDOE 1999). A blast design will be prepared and submitted to NSEL. A pre-blast survey of all residences and wells within 800 m of the quarry will be undertaken, if required.

As the quarry advances closer to the community of Waverley, noise and vibration levels could increase. As part of the Quarry Development Plan, Sovereign Resources will, through the use of alternative technologies, develop an enhanced blast noise management strategy that directly assesses the impulse noise of blasting as the quarry advances closer to the Community of Waverley. The program will provide documentation of the blasting noise monitoring levels and will address the relative impacts off site of airborne noise and ground borne vibration. Monitoring locations will be determined in consultation with NSEL and the Monitoring Board as the locations may change as the quarry develops.

In summary, assuming appropriate noise control measures are undertaken, no significant adverse residual effects on noise and vibration are likely to occur as a result of the Project.

5.3 Groundwater Resources

Groundwater, an integral component of the hydrologic cycle, originates from percolation of rain, snowmelt, or surface water into the ground. The infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures developed in consolidated materials. The upper surface of the saturated zone is called the water table. The water table intersects the surface at springs, lakes, and streams where interaction between the groundwater and the surface water environment can occur. Groundwater flows through soil and bedrock from areas of high elevation (recharge area) to areas of low elevation (discharge areas) where it exits the sub-surface as springs, streams, and lakes. There is a dynamic interaction between groundwater resources and surface water resources in Nova Scotia. Groundwater generally sustains the base flow of springs, streams, and wetlands during dry periods of the year. More rarely, surface water bodies can contribute to groundwater storage under specific hydrogeological conditions.

Groundwater yield to dug or drilled wells can vary greatly, depending on the hydraulic properties of overburden or bedrock aquifers. An aquifer is a formation or group of formations that can store or yield

useable volumes of groundwater to wells or springs. Natural groundwater quality is directly influenced by the geochemical composition of the aquifer materials through which it passes, and the length of time the water resides within the material.

Groundwater has been selected as a VEC because of its potential importance to the water supply of residents and because of its relationship with surface water conditions. Public consultation revealed concerns regarding potential damage to domestic wells as a result of blasting and the potential transport of contaminants through groundwater systems. Groundwater Resources will be assessed in the context of potential Project-related effects on groundwater quality and quantity.

5.3.1 Description of Existing Environment

Bedrock Geology

The bedrock geology in the vicinity of the proposed quarry area consists of Cambrian-Ordovician aged meta-sandstone (*i.e.*, meta-quartzarenite, quartzite and meta-greywacke with minor slate and meta-siltstone) of the Goldenville Formation of the Meguma Group, as shown on Figure 5.3 (Keppie 2000). The Goldenville Formation bedrock is not generally considered to be acid generating, although it is possible within mineralized zones. Mineralization within the Goldenville Formation generally occurs as (Sangster 1990):

- concordant deposits within the Goldenville-Halifax Formation Transition Zone;
- structurally controlled vein deposits of hydrothermal origin along anticline structures; or
- as deposits that are spatially and genetically related to Acadian plutons.

The proposed quarry is located on a syncline and is not immediately adjacent to either the Halifax Formation contact or an Acadian Pluton (MacDonald and Horne 1987). Therefore, mineralized zones and associated risk of acid generating bedrock are not expected to be encountered within the proposed quarry area.

The occurrence of natural arsenic, in the form of arsenopyrite, in the Goldenville Formation bedrock is well known and documented in Nova Scotia (Grantham 1976, Grantham and Jones 1977). In fact, Waverley was the "Type Section" for several studies of arsenic in groundwater, exhibiting some of the highest concentrations. With respect to groundwater resources, arsenic risk areas (*e.g.*, dissolved arsenic in groundwater) are typically associated with Gold-Bearing Districts throughout the Meguma Terrain of Southern Nova Scotia.

Sovereign Resources
Quarry Modification Project
Environmental Assessment

Figure 5.3

Site Geology

N

Second Lake
Three Mile Lake
Powder Mill Lake
Rocky Lake
Lake William
Leonard Lake
Highway 102
Highway 118
Lily Lake
Anderson Lake
Lake Charles

Project Features
Proposed Sovereign Resources Quarry Modification Boundaries

Bedrock Geology
Goldenville Formation
- Cambrian-Ordovician aged meta-sandstone and minor slate

Surficial Geology
Thin Veneer of Till & Exposed Bedrock
Quartzite Till
Lawrencetown Till (Drumlin Faces)
Lawrencetown Till

Topographic Features
Elevation Contour (m)
Stream
Waterbody
Property Boundary

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Keppie. J.D. (compiler) 2000: Geological Map of the Province of Nova Scotia: Nova Scotia Department of Natural Resources. Minerals and Energy Branch. Map ME2000-1 scale 1:500,000

Scale 1:25,000

0 400 800 1200

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

Jacques Whitford

Surficial Geology

The majority of the surficial geology in the vicinity of the proposed quarry area consists of a thin veneer of glacial till surrounding areas of exposed bedrock outcrops. However, as shown on Figure 5.3, an area of quartzite till, approximately one to ten metres thick, is present along Rocky Lake Road. The quartzite till consists of a light blueish-gray, loose matrix of angular clasts comprised of approximately 80% sand, 15% silt and 5% clay with large cobbles (Stea and Fowler 1981).

Groundwater Flow

The nearest communities, Waverley and Lakeview, are located approximately 850 m north (Rocky Lake Drive) and approximately 700 m west of the proposed quarry areas, respectively. The proposed Sovereign Resources quarry area is bounded on the north by a forested area which includes storage sheds, to the east by a forested area which includes a rail line, to the south by Municipal's quarry and to the west by forested areas and Rocky Lake Drive.

Approximate groundwater flow directions at the proposed quarry area are interpreted based on topography. According to the hydrological assessment for the quarry (Appendix D), which is based on topography, 71% of the proposed quarry area currently flows to Lake William, 18% to Rocky Lake and 11% to Powder Mill Lake. The groundwater flow direction is assumed to mirror the topography.

Water Wells

Domestic water supply in the immediate vicinity of the proposed quarry area (along Rocky Lake Road) would be derived from individual dug or drilled water wells. Water supply for the Lakeview area, across Rocky Lake, is mainly provided by the Halifax Regional Water Commission. However, there is one home with a dug well located on Lakeview Drive within the 800 m buffer zone for the proposed quarry area. The water well closest to the proposed Sovereign Resources boundaries is located on Rocky Lake Road approximately 460 m southwest of the current approved Sovereign Resources quarry, as shown on Figure 5.4. This well is not a residential water well and is located on lands owned by Municipal Enterprises. Other wells or assumed wells within 800 m of the proposed quarry area are also shown on Figure 5.4. The nearest existing residential well is approximately 730 m from the proposed quarry boundary, across Rocky Lake. It should be noted that all observed or suspected wells located within 800 m of the proposed quarry area are already located within 800 m of the currently approved quarry area (*i.e.*, existing Sovereign Resources quarry boundary). Therefore, no new domestic water supply wells are identified within the 800 m of the proposed modified quarry area.

Sovereign Resources
Quarry Modification Project
Environmental Assessment

Figure 5.4

Water Well Locations

N

Powder Mill Lake

Rocky Lake Road

Waverley Road

Silversides Subdivision

Rocky Lake

Lakeview INSET

Lakeview Road

Lake William

Buffer Zone

Highway 102

Municipal Quarry

PID: 40238181
228 Lakeview Road

PID: 40207094
246 Lakeview Road

PID: 40237182
585 Rocky Lake Road

PID: 00368522
548 Rocky Lake Road

PID: 40237182
533 Rocky Lake Road

INSET
0 100 200 300
Metres

Drinking Water Wells

- Dug Well
- Confirmed Well (Unknown Type)
- Suspected Well (Unknown Type)

Project Features

- Proposed Sovereign Resources Quarry 800m Buffer
- Approved Sovereign Resources Quarry 800m Buffer
- Proposed Sovereign Resources Quarry Modification Area
- Approved Sovereign Resources Quarry
- Approved Municipal Quarry
- Exisitng Quarry

Topographic Features

- Elevation Contour (m)
- Stream
- Waterbody
- Property Boundary

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Scale 1:20,000

0 250 500 750 1000
Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

Jacques Whitford

A review of available NSEL well records provides information for thirty-eight driller well logs for wells that are reportedly located along Rocky Lake Drive or Lakeview in vicinity of the 800 m setback distance for the proposed quarry area (NSEL 1940-2004). Most of these wells are reported to have been constructed in either quartzite or slate (*i.e.*, Goldenville Formation). While individual water wells have not been field-verified for the assessment, these records provide an indication of likely drilled well conditions in the vicinity of the proposed quarry area. The well construction details for these bedrock wells are summarized in Table 5.4. The wells average 64 m in depth and have an average of 12 m of casing. The well yields range from nil to 36.4 litres per minute (L/min), with a median yield of 4.5 L/min. Depth to the water table averages 6 m below grade and the average overburden thickness is 5.6 m.

Table 5.4 Summary of Local Domestic Water Wells Completed in Goldenville Formation for 38 Wells Reported Along Rocky Lake Drive and Lakeview within Study Area

	Well Depth (m)	Casing Length (m)	Well Diameter (mm)	Estimated Yield (L/min)	Water Level (m)	Overburden Thickness (m)
Minimum	5.8	4.6	152.4	0.0	1.8	0.0
Maximum	121.9	20.1	914.4	36.4	12.2	18.3
Average	63.9	12.0	190.5	7.9	6.0	5.6
Median	61.0	12.2	152.4	4.5	5.2	5.2
Number	38.0	36.0	20.0	33.0	9.0	31.0

Source: NSEL Well Driller Logs (1940-2004)

Water Quality

The water quality from wells constructed in the Goldenville Formation is expected to be good, with most parameters meeting the Canadian Drinking Water Guidelines (Health Canada 2003). Arsenic in excess of the drinking water guidelines is a possible naturally-occurring water quality issue, especially near anticline axis or gold districts. The proposed quarry site is not known to be located on an anticline axis; it is approximately 1 km south of Waverley which is known to be a gold district (Sangster 1990). As indicated above, water in the Waverley area is known to contain elevated levels of arsenic (HRM 1989b). Other potential aesthetic problems such as iron, manganese and moderate hardness have occasionally been reported.

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

Generally, the potential environmental effects on groundwater resources from a quarry operation include groundwater level lowering, temporary siltation of nearby wells due to intermittent blasting, decrease in well yield, and possible water quality deterioration of down-gradient wells from accidental releases of deleterious substances within the quarry area or acidic drainage production. Potential impacts to domestic water wells are a function of distance, location of a well with respect to groundwater flow directions, intensity and frequency of blasting, and individual well construction methods.

As the proposed quarry develops, it is expected that it will encounter increased groundwater seepage from perched groundwater. Water will collect on the quarry floor and/or be directed to flow retention/siltation structures. Development will not occur below the elevation of the surrounding lakes (*i.e.*, excavation will remain at or above 50 m ASL). As such, the deep water table is not expected to be encountered and therefore dewatering of the quarry is not likely to be required.

In the unlikely event that the water level were to be lowered by the Project resulting in a decline in well levels, the degree of water level decline at a domestic well would be proportional to the distance between the well and the edge of the quarry, decreasing exponentially with distance. In consideration of the distance between the quarry and the nearest existing residential well (*i.e.*, 730 m), the likelihood that its source of groundwater is obtained from depths below the proposed quarry floor, the inferred low yields of local drilled wells in fractured quartzite bedrock (*i.e.*, 4.5 L/min), and the close proximity of Rocky Lake, loss of yield at the existing residential wells is not anticipated.

Wells located on the east side of Lake William (between Highway 118 and the Lake) are recharged from groundwater flow from the east (*i.e.*, groundwater flows toward the Lake). Given the distance from the quarry, the difference in elevation, the average depth of drilled wells in the area, and particularly the groundwater flow direction, wells east of Lake William are not likely to be affected by the Project.

Changes in water quality may theoretically occur as a result of excavations in the recharge area of the wells. Wells located down-gradient of the quarry are more likely to be affected in this manner than wells located across Rocky Lake (*i.e.* Lakeview). Potential impacts include: temporary siltation from blasting; oil and nitrate contamination from blasting operations; lubricant compounds; and other chemical releases within the quarry area. Again, due to distance, significant impacts are not anticipated due to natural attenuation primarily by dilution and dispersion along the groundwater pathways.

A possible long term impact of well water quality is decreased pH or increased dissolved solids from attenuation of acidic drainage from exposed sulfide-rich bedrock. As noted in Section 5.3.1, the potential for acid drainage production in this area is low. Monitoring for potential acid drainage production will be conducted at the request of NSEL and DFO.

Mitigation of short-term turbidity impacts caused by blasting vibration would likely involve temporary provision of bottled water to affected residents, or provision of an in-line dirt filter. In the unlikely event of persisting long-term degraded water quality, or a well yield loss event, Sovereign Resources will replace or repair any water supply well found to be adversely affected by their quarry operation to the satisfaction of the owner.

Groundwater monitoring wells will be installed within the proposed quarry area at locations between the quarry and domestic wells or the lakes. These wells should be drilled to a depth of three to five metres below the proposed quarry floor and can be used for monitoring groundwater depths on a regular basis. This data could be used to monitor the elevation of the groundwater table across the proposed quarry area, and the hydraulic connection between the quarry and the nearby watercourses. Furthermore, hydraulic testing of these wells could be used to predict groundwater inflow to the quarry and outflow to the lakes. Further details regarding the location of wells and monitoring parameters and frequency will be developed as part of the Quarry Development Plan. To establish baseline conditions (*i.e.*, pre-expansion), groundwater will be tested for general chemistry and metals once the wells are installed.

In summary, there is not likely to be any significant adverse environmental effects on groundwater resources as a result of the Project.

5.4 Surface Water and Hydrology

Surface water and groundwater hydrology were selected as a VEC because of potential interactions between Project activities and the physical aquatic environment and because of the relationship between surface water conditions and the health of fish and fish habitat. Surface water is also a VEC due to public concerns about potential Project effects on Lake William, Rocky Lake and Powder Mill Lake, which contain fish and fish habitat. Lake William is also valued for recreational purposes and some landowners also draw drinking water from the lake.

In the context of this VEC, surface and groundwater are defined as the chemical, physical and biological attributes of surface water including, but not limited to, suspended sediments, temperature, flow regime, water quality and water quantity. Surface water includes any flowing or free-standing water in lakes, reservoirs, ponds, rivers, streams or other watercourses. Groundwater includes the hydrogeological characteristics of sub-surface waters which support surface water features. Groundwater Resources is a VEC discussed in Section 5.3 of this report. Fish and fish habitat is also considered and is defined by the federal *Fisheries Act* as spawning, rearing, nursery, food supply, overwintering, migration corridors and any other area on which fish depend directly or indirectly in order to carry out their life processes.

Description of Existing Environment

Information used to assess surface water was obtained through field surveys, a hydrological assessment (Appendix D), a review of existing published data, and map and aerial photograph interpretation.

The proposed Sovereign Resources quarry modification area lies within the subwatershed of Lake William. Lake William is one of the headwater lakes for the Shubenacadie Canal System, receiving water from seven inlets along the south and west shores including Lake Charles, Rocky Lake, Powder Mill Lake,

First Lake, Second Lake, Third Lake, Three Mile Lake, Spriggs Lake, Willis Lake, Marshall Brook, Toddy Brook and three small unnamed streams. The proposed quarry area presently drains into three lakes: Rocky Lake, Powder Mill Lake, and Lake William (Figure 5.5).

There are no watercourses within the proposed quarry area. However, just outside the proposed boundaries, there are five watercourses which may be affected, to varying degrees, due to changes in the flow regime that will occur as a result of the proposed project (refer to Figure 5.5). Two of the watercourses are small unnamed drainages (referred to herein as Streams A and C); Toddy Brook (Stream B) drains a large wetland and associated pond; Marshall Brook (Stream D) is an extensive watercourse that includes MacGregor Brook in its catchment area; and Stream E (a tributary to Powder Mill Lake) which currently receives drainage from the existing Sovereign Resources quarry (former Tidewater Quarry). Streams A through D drain to Lake William, while Stream E drains to Powder Mill Lake.

All of these watercourses, as well as Rocky Lake and Powder Mill Lake, are within approximately 500 m of the proposed quarry boundary.

Fish and Fish Habitat

Aquatic biologists surveyed the proposed quarry area and surrounding lands in May and June 2004 and again in May 2005 to confirm the presence of watercourses and assess their suitability as fish habitat. Watercourses in and adjacent to the proposed quarry area were identified and delineated with the aid of aerial photography and 1:15,000 mapping. The 2004 surveys were carried out on Streams A and B and three small ponds that were identified within the proposed quarry area. In 2005, aquatic biologists re-visited Streams A and B and also assessed Streams C, D and E for their suitability as fish habitat. Streams A, B, C, D are crossed by a railway to the east of the proposed quarry area. Even though none of the streams are within the proposed quarry area, it is important to assess them as much of their surface source water originates from within the proposed quarry area.

The three ponds within the proposed quarry area are isolated. No water flows in or out of these ponds through defined channels. Since none of those processes defined by DFO as fish habitat (*e.g.*, areas for spawning, rearing, nursery, food supply, overwintering, migration corridors, *etc*.) occur in these ponds, the ponds are not considered to be fish habitat. The ponds were found to be associated with wetland habitat. The substrate in these ponds is composed of decomposing organic material. A description of the vegetation within and surrounding these ponds is provided in Section 5.5 of this report.

Sovereign Resources Quarry Modification Project Environmental Assessment

Figure 5.5

Watershed Delineation for Pre-development Conditions

N

Fall River

Waverley

Sackville

Bedford

Burnside

Powder Mill Lake Watershed

Rocky Lake Watershed

Lake William Watershed

HRM Boundary

Stream E

Stream A

Stream B (Toddy Bk)

Stream C

Stream D (Marshall Bk)

Sovereign Resources Quarry

Outlet from Municipal Enterprises Quarry

Duck Lake
Beaver Pond
Third Lake
Second Lake
First Lake
Three Mile Lake
Powder Mill Lake
Rocky Lake
Lake Thomas
Perry Lake
Willis Lake
Springs Lake
Skerry Pond
Lake William
Round Lake
Leonard Lake
Spider Lake
Lily Lake
Jack Lake
Anderson Lake
Bedford Basin
Paper Mill Lake
Webb Pond
Enchanted Lake
Juniper Lake
Lake Charles

Watersheds
- Watershed Boundary

Sub-Watersheds
- Lake William Sub -Watershed
- Powder Mill Lake Sub-Watershed
- Rocky Lake Sub-Watershed
- Runoff Flow Direction
- Connection Between Bodies of Water

Designated Sites
- Mine Tailings
- Waste Mine Rock

Project Features
- Approved Sovereign Resources Quarry
- Proposed Sovereign Resources Quarry Modification Boundary
- Existing Quarry

Topographic Features
- Elevation Contour (m)
- Stream
- Lake
- Property Boundary

Scale 1:40,000

0 500 1000 1500 2000

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: February 2005
Project: NSD17650

Jacques Whitford

Stream A (unnamed) did not contain water during the 2004 survey. However, flowing water was observed downstream of the railway crossing only, in May 2005. It is important to note that at the time of the 2005 survey, water levels in the region were exceptionally high due to record-breaking precipitation levels in May. Therefore, it is probable that Stream A does not contain water for the majority of the year. Furthermore, the stream channel upstream of the railway crossing is poorly defined suggesting that water is present only immediately after heavy rains and during snowmelt. Downstream of the railway crossing to Lake William, Stream A is less than 0.5 m wide and no more than 10 cm deep. The stream runs underground in several places along this reach. No culvert associated with this stream was observed on either side of the railway track, thus blocking fish movement. Upstream of the railway, the channel is poorly defined and crosses areas of steep terrain. A few pools of standing water were observed between boulders in flat areas. Due to its small size, ephemeral nature and the lack of a culvert under the railway track, Stream A is not considered to be fish habitat.

Portions of Stream B (Toddy Brook) contained water during both the 2004 and 2005 surveys. The headwaters of the stream are composed of numerous channels which run both above and underground. A wetland (Wetland 11) occurs at the headwaters of this stream and is described in Section 5.5 of this report. Downstream of the wetland, the stream channel remains well-defined for approximately 100 m before flowing underground. From this point downstream to the railway crossing, the stream channel runs in and out of the ground through quartzite-Graywacke boulder fields with a few large pools of water. The bottom substrate of these pools is composed primarily of silt and detritus. In several areas, the stream splits into several smaller channels. The only section of riffles was observed downstream of the railway. A culvert installed under the railway allows for flow of water. Approximately 20 m before discharging into Lake William, the stream cascades and disappears through a boulder field before flowing out and over a large boulder (height of approximately 50 cm). These barriers would effectively prevent any fish migration up this stream from Lake William, likely rendering the majority of Stream B inaccessible to fish. According to DFO, Stream B is considered fish habitat and impacts to the watercourse as a result of the proposed Project would require Authorization pursuant to Section 35(2) of the federal *Fisheries Act* (J. Crocker, pers. comm. 2005).

Stream C (unnamed) was assessed during the 2005 survey. At the time of survey, the stream did not contain flowing water; only a few pools of standing water were observed on the downstream side of the railway crossing. There was no culvert observed under the railway. There was no clearly defined channel observed. The presumed streambed was identified in the field by wet areas in low-lying regions and quartzite-Graywacke boulder fields along steeper sections. Stream C may contain flowing water after periods of heavy rain and during snowmelt; however, it is likely dry and undistinguishable from the forest floor for the majority of the year. Given these characteristics, Stream C does not likely provide fish habitat.

MacGregor Brook (Stream D) is a tributary to Marshall Brook. MacGregor Brook was assessed during the 2005 survey. MacGregor Brook contained flowing water at the time of survey; however, given the shallow depth of the stream after heavy rains in May, it is likely that this stream dries up or at least is significantly reduced during the summer months. Stream morphology is characterized by a series of pools and runs. Riparian vegetation consisted of mixed mature forest and alders in marshy areas, providing a high degree of overhead cover. The channel was rather poorly defined and was typified by quartzite-Graywacke boulder fields. In several areas, the stream flowed under and through these boulder fields, disappearing and re-emerging along its course. Most pools were shallow with silt and detritus bottoms while runs were no deeper than 10 cm and flowed over moss covered boulders. The stream channel was generally less than one metre and diverged into multiple smaller channels in several areas. Approximately 250 m from MacGregor Brook's outlet into Marshall Brook, there was an area of steep topography with a number of cascades over large boulders. These natural barriers likely prevent fish from accessing the upper reaches of MacGregor Brook. There were no sand or gravel deposits observed in this stream, a typical physical feature of suitable salmonid habitat. Given its small size and lack of suitable habitat, it is unlikely that MacGregor Brook is used routinely by any fish species. According to DFO, Stream D is considered fish habitat and impacts to the watercourse as a result of the proposed Project would require Authorization pursuant to Section 35(2) of the federal *Fisheries Act* (J. Crocker, pers. comm. 2005).

The upper reaches of Marshall Brook (*i.e.*, upstream of the confluence with MacGregor Brook) were not surveyed as this section of brook is located a considerable distance from the project area and the majority of source water does not originate from within the proposed quarry area. However, the section downstream of MacGregor Brook was assessed for its suitability as fish habitat. From its outlet into Lake William to approximately 2,500 m upstream, Marshall Brook is characterized by a broad, meandering channel. Shrubby swamp habitat surrounds the stream channel. The water is relatively slow flowing and shallow allowing hydrophytes such as *Nuphar* spp. to root in the soft bottom sediments. The water surface is exposed along these lower reaches as there is no overhead cover. Two culverts, approximately 50 m apart, have been installed under the railway. At the time of the survey, Marshall Brook meandered downstream and mostly flowed through the southern most culvert. Downstream of the railway crossing was a 40 m section of fast-flowing stream. This segment was characterized by several deep pools and riffle areas and was about two metres wide. The northern most culvert was perched on the downstream end.

There are no historical records of fish or fisheries in either Marshall or MacGregor Brooks. An electrofishing survey of various habitats along Marshall Brook in June and July 1993 documented creek chub (*Semolitus atromaculatus*) and American eel (*Anguilla rostrata*) (JWEL 1993). However, during the 2005 survey, large numbers of gaspereau (*Alosa pseudoharengus*) were observed to be moving from Lake William into Marshall Brook. Individuals were observed to be using the southern most culvert under the railway track to access reaches of the brook upstream from the railway. Gaspereau were

observed both upstream and downstream of the railway crossing, with large numbers (estimated at several hundred) congregated in the 40 m section of stream flowing from the southern most culvert.

Stream E was assessed during the 2005 survey. Stream E is a tributary to Powder Mill Lake and presently receives drainage from the existing Sovereign Resources quarry. At the time of survey, along its first 85 m from Powder Mill Lake, there was no defined channel, rather Stream E was characterized by a wetland dominated by alder. At 85 m upstream from Powder Mill Lake, the stream became well defined and was characterized by alternating run/riffle morphology. The average depth of water in the channel was approximately 25 cm and the average width of the channel was approximately 1.5 m. At about 95 m upstream from Powder Mill Lake, a gravel road has been built over the stream. A culvert has been installed; however, it is perched above the surface of the stream on the downstream side, thus blocking fish passage. Upstream of the gravel road, the stream is characterized by a continuous slow moving run with a soft bottom. At about 250 m, Stream E dissipates into a small marshy area. This area is fed by several narrow channels (which were dry at the time of survey) originating from ditches along Rocky Lake Road. The stream does not provide suitable spawning or rearing habitat for brook trout (*Salvelinus fontinalis*) (Tidewater 1999) and it is unlikely that it is used extensively by any fish species.

Fish species censused from Lake William (Anderson 1972) included white sucker (*Catostomus commersoni*), white perch (*Morone Americana*), brook trout, smallmouth bass (*Micropterus dolomieui*), American eel, gaspereau and Atlantic salmon (*Salmo salar*). A 1993 fish resources survey found the same species, plus striped bass (*Morone saxatilis*) (JWEL 1993). Documented fish species in Powder Mill Lake include white perch, brook trout, white sucker, smallmouth bass, American eel and gaspereau.

Water Quality

Historic Conditions

Gold mining activity in the Waverley/Montague area occurred between 1861 and 1939. These operations generated approximately 168,000 tons of mine waste and approximately 134,000 tons of mill tailings. Nearby lakes and watercourses were used as disposal sites, waste rock was used for road and railway bed construction (Figure 5.5). Subsequent disturbance of mining areas caused by urban development have resulted in wide spread contamination. Elevated mercury and arsenic in the Waverley area lakes have been a long-standing concern, especially with respect to groundwater quality. Gold-mining activities (explosives and gold processing) as well as the natural geology have resulted in releases of arsenic and mercury into the area. As indicated in Section 5.2.1, arsenic naturally occurs in gold bearing ore; mercury is generated through natural sources and anthropogenic activities. The source of mercury in some of the area lakes may also be linked to atmospheric deposition direct to the lakes and their watersheds (Harrison and Klaverkamp 1990, Weiner 1987, Lee and Hultberg 1990).

In 1976, the Provincial Government appointed the Grantham and Jones Task Force to study the arsenic problem in the Waverley area. The study revealed that sediments in Muddy Pond, Powder Mill Lake, Lake William, Lake Thomas and Lake Fletcher contained elevated levels of arsenic and mercury (Murdoch and Sandilands 1978, Shubenacadie-Stewiacke River Basin Board 1981).

A joint federal-provincial study group was formed in 1982 to evaluate the sources and degree of contamination in the Waverley area (Murdoch and Clair 1985). In 1983, sediment samples were taken from Muddy Pond, Three Mile Lake, Lake Thomas and Powder Mill Lake for contamination characterization (Murdoch 1985) and compared with a larger sampling program in 1977. Muddy Pond, appropriately named, was the tailings pond for the Waverley gold mines and hence had the highest arsenic concentration in its sediment. Powder Mill Lake had the highest mercury levels in its sediment.

Lake water samples were analyzed from Lake Thomas, Lake Fletcher, Powder Mill Lake, Third Lake, Parry Lake and Muddy Pond and the interconnecting watercourses between Lake William to Lake Thomas, Lake Thomas to Lake Fletcher, Muddy Pond to Lake Thomas, Three Mile Lake to Powder Mill Lake, Powder Mill Lake to Lake William and Muddy Pond to Lake Thomas. Mercury was undetectable and arsenic was below the standards for drinking water and aquatic life protection (Clair 1985). This is a typical finding as metals tend to be associated with suspended particulate matter which eventually settles and is incorporated into the sediment matrix.

Mercury and arsenic levels were analysed in fish tissue from Powder Mill Lake, Lake William, Lake Thomas and Muddy Pond (Eaton and Clair 1985). Arsenic levels in fish were elevated in Powder Mill Lake and Lake Thomas compared with Lake William. The overall average was 0.04 mg/kg. The average arsenic concentration for white perch was 0.037 mg/kg, 0.052 mg/kg for white sucker, and 0.028 mg/kg for smallmouth bass. Mercury concentrations in fish from Powder Mill Lake and Lake Thomas were higher than fish from Lake William and Muddy Pond. The highest levels were in white perch from Powder Mill Lake and in white suckers from Lake Thomas; these fish exceeded the 0.5 mg/kg limit for human consumption (Eaton and Clair 1985).

Lake William, Powder Mill Lake, and Rocky Lake

Water quality data of Lake William was collected in 1971 (MAPC 1972), 1974 (NSDOF), 1980 (BIO), 1983 (NSDOF), 1990 (Scott *et al*. 1991) and 1993 (JWEL 1993). Comparison of the data shows little change in the water chemistry from watershed development. The lake water exhibits nutrient values that categorize it as oligotrophic (low productivity, nutrient poor), normal pH levels fluctuate between 6.2 and 7.3, and some influence from road salting is reflected in elevated sodium and chloride levels. Heavy metal concentrations of mercury, cadmium, lead, zinc, chromium and copper in the surface water were below their detection limits. Arsenic was detected at 2 µg/L.

Historical use of explosives by the Acadia Powder Mill Company in the Powder Mill Lake and Rocky Lake catchment areas has resulted in elevated levels of mercury in the area, particularly in Powder Mill Lake sediments (Kay 1985). Other potential sources of mercury may originate from releases during the gold amalgamation process and natural weathering. The sediments of Powder Mill Lake contained elevated arsenic, mercury and other metals (Kay 1985); this condition likely remains although with sedimentation over time, these metals become less biologically available.

Surface water discharge from the Municipal Enterprises quarry and former Tidewater quarry are subjected to regular water quality monitoring as dictated in the industrial waste permits issued by NSEL.

Three sites at the Municipal Enterprises quarry were monitored routinely between 1998 and 2004. Two of the sample areas are located on the property and the third site is off Rocky Lake road prior to discharge into Rocky Lake. This third sampling location had consistently detectable levels of total arsenic (As) on 95 of the 285 sampling days; values ranged from 0.002 mg As/L to 0.018 mg As/L. Arsenic concentrations tended to be higher in early January and August of most years.

Since 1994, surface water from the Sovereign Resources quarry (former Tidewater Quarry) has been collected and analyzed on a monthly basis with results provided to NSEL. Arsenic levels in the surface water have been monitored within the Rocky Lake outlet watercourse to Powder Mill Lake below the quarry effluent ditch on a monthly basis. With a few exceptions, the concentrations have been less than the detectable limit of 0.002 mg As/L. Detectable levels were low (*i.e.*, no more than 0.005 mg As/L).

Lake William and Powder Mill Lake Tributaries

During the 2004 survey, a water sample was obtained from Stream B only. During the 2005 survey, water samples were obtained from Streams A, B, D, and E. Water sampling was also undertaken in 1990 by the Centre for Water Resource Studies (Scott *et al*. 1991) at the outlets of Streams A and B in May and November of that year; subsequent sampling attempts from June through to September were not possible due to lack of flow. Water quality parameters of the streams were compared against guidelines set forth by the Canadian Council of the Ministers of Environment (CCME). The CCME issues strict water quality guidelines to prevent degradation of aquatic habitats from anthropogenic sources, such as chemical inputs or alteration of physical components. The following is a description of water quality for each stream. Laboratory results from the 2004 and 2005 surveys are provided in Appendix F.

Characteristics of the water flowing through the surveyed streams are largely dictated by the local metamorphic geology which is highly resistant to erosion, and thus unable to yield substantial quantities of minerals and nutrients essential to aquatic primary productivity. In Streams A and B, alkalinity, conductivity and hardness levels were low. The pH level in Stream B was 6.1 in 2004 and 6.26 in 2005. The pH level in Stream A was more basic, with a pH of 7.28 at the time of the 2005 survey. Total

dissolved solids or ion sum levels were low, another indication of the lack of weathering of the surrounding geology. Water temperature in Stream B at the time of the 2004 survey was 13.8ºC and was 12.3ºC in 2005. Water in Stream A was 12.9ºC at the time of the 2005 survey.

Water samples from Stream D also showed low alkalinity, conductivity and hardness. The waters of Stream D are tea-stained from tannic and humic acids derived from vegetation and wetland drainage. It is likely that the low buffering capacity of this stream has resulted in a relatively acidic pH of 5.38. Total dissolved solids or ion sum levels were also low. The stream waters are aptly described as soft, corrosive and poorly buffered, consequently minimizing their potential as salmonid habitat. Water temperature at the time of the 2005 survey was 12.1ºC.

Water samples collected from Stream E were anomalous when compared to the other streams. Water collected from Stream E during the 2005 survey had higher levels of alkalinity, conductivity and hardness. Additionally, total dissolved solids or ion sum levels were high. Given that source water of Stream E at least partially originates from ditches along Rocky Lake Road, it is likely that the aforementioned water parameters in the stream are affected by run-off from the road (*i.e.*, road salt). Water temperature at the time of the 2005 survey was 13.1ºC.

Most total metal levels in Streams A, B, D and E were below the detection limit of the laboratory. Concentrations of cadmium, chromium, copper, iron, molybdenum, nickel, selenium, silver, thallium and zinc were below the CCME Guidelines for the protection of aquatic life in both the 2004 and 2005 surveys (CCME 2004). In Stream B in 2004, concentrations of lead were slightly above CCME guidelines while levels of aluminum were well above CCME guidelines in all surveyed streams during both the 2004 and 2005 surveys. Nitrite levels were below CCME guidelines in all surveyed streams. All other nutrient levels were low, further suggesting relatively unproductive aquatic environments. Total suspended solids were low in all streams except Stream A; however, it is likely that the sample contained debris as the stream water appeared clear at the time of the 2005 survey.

Hydrology

The proposed quarry area presently drains into three lakes (Figure 5.5). The largest drainage area (approximately 71% of the proposed quarry area) presently drains east toward Lake William primarily by way of a number of watercourses, namely Stream A (unnamed), Stream B (Toddy Brook), Stream C (unnamed), and Stream D (Marshall Brook). A smaller drainage area, located in the northwest corner of the property (representing approximately 18% of the proposed quarry area) flows west directly into Rocky Lake. The smallest drainage area (representing approximately 11% of the proposed expansion area), located in the north corner of the property, flows north toward Powder Mill Lake by way of Stream E (unnamed) and includes the former Tidewater quarry. A delineation of the three subwatersheds and their hydraulic connection as well as the direction of surface runoff is illustrated in Figure 5.5. The

drainage area of Lake William (22 km^2) is substantially larger than that of Powder Mill Lake (10.9 km^2) which is substantially larger than that of Rocky Lake (5.11 km^2).

In addition to the above mentioned streams and lakes, there are 26 wetlands located within or adjacent to the proposed quarry area. A complete description of these wetlands is provided is Section 5.5.

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

Potential Project-related effects on surface water and groundwater hydrology include:

- loss of fish habitat from a reduction in groundwater baseflow;
- reduced water quality from sedimentation/siltation, deposition of fines and acid drainage;
- heavy metal contamination;
- introduction of contaminants (*e.g.*, nitrate) from blasting operations; and
- petroleum hydrocarbons and other chemical releases from with the quarry area.

Impacts to Fish and Fish Habitat

DFO developed the Policy for the Management of Fish Habitat (1986) which applies to all projects and activities, large or small, in or near water that could alter, disrupt or destroy fish habitats by chemical, physical or biological means. The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. The policy is regulated by Sections 20 to 42 of the federal *Fisheries Act*.

As previously indicated, there are no streams within the proposed quarry area. As such, there is no direct physical impact on fish habitat as a result of the proposed Project.

Blasting in and adjacent to watercourses can cause direct deleterious effects on fish health, death or damage to fish eggs and larvae, excessive dust deposited in streams, disturbance to the habitat, and introduction of acidic drainage if the bedrock contains sulphide mineralization. Given that there are no watercourses within the proposed quarry area, the potential for this effect is minimal. Blasting shall be conducted in accordance with the Pit and Quarry Guidelines and the Guidelines for use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998), including consultation with DFO, as required.

In addition, blasting may result in chemical impacts on fish (*e.g.*, release of ammonia). Although ammonia is a nutrient required for life, ammonia is toxic in its ionic form, which occurs in high pH environments. Experiments have shown that the lethal concentration for a variety of fish species ranges from 0.2 to 2.0 mg/l. At present, Environment Canada has not identified a buffer zone between an area

in which ammonia-based explosives are used and a freshwater system. Most of the studies to date have looked at the effects of ammonia discharge from wastewater, fertilizer, and pulp and paper activities directly into a freshwater system. Due to the significant distance between the discharge of surface water from the Sovereign Resources quarry and any receiving water body and the nature of ammonia uptake in neutral pH environments, chemical impacts on the fish in the surrounding lakes as a result of blasting are not likely to occur.

The hydrology of Streams A through E will be altered by the Project (see below). The change in hydrology will occur gradually over the life of the Project (*i.e.*, 50 years). As noted in the hydrological assessment (Appendix D), flows to Streams A and B will be reduced by 31% and 65%, respectively; however, Stream A is intermittent, flowing only in the winter, spring and fall periods of seasonally frequent precipitation events. Approximately 20 m before discharging into Lake William, Stream B has barriers which would effectively prevent any fish migration up this stream from Lake William, likely rendering the majority of Stream B inaccessible to fish. Notwithstanding this, DFO has characterized Stream B as fish habitat and impacts to the water regime of this watercourse would require Authorization pursuant to the *Fisheries Act*.

Stream C will be reduced by an insignificant amount (7%). This watercourse does not likely support fish based on the water quality of adjacent watercourses and lack of suitable substrate for spawning and rearing. The surficial terrain and lack of topsoil create streams that flow subterranean around boulders.

Stream D, Marshall Brook, will be reduced by 12% at the outlet to Lake William as a result of the Project. Marshall Brook will also likely experience cumulative effects from the adjacent Municipal Enterprises quarry. MacGregor Brook, which drains to Marshall Brook, will not likely be affected. Since fish in this stream are mainly restricted to the open channel in the lower reaches of Marshall Brook, fish habitat may be affected and DFO has advised that impacts to the stream would require an Authorization under the *Fisheries Act*.

Although some of the flow from these tributaries will be redirected away from Lake William, overall, the flow into Lake William is expected to increase by 3%. The flow that is redirected will drain to Rocky Lake which drains to Powder Mill Lake, and then back into Lake William. The overall increase in flow to Lake William is primarily due to evapotranspiration and increased runoff (see hydrology discussion below). This small volume is not anticipated to have a significant adverse effect upon the water quantity in Lake William; hence fish habitat will not be significantly affected.

Stream E will be reduced by 41% at the outlet to Powder Mill Lake; however, this stream does not provide suitable spawning or rearing habitat for brook trout (Tidewater 1999). As such, impact on habitat is not considered to be significant.

To ensure appropriate mitigation of potential effects of project activities on fish habitat in the Lake William Watershed, baseline conditions must be established and an environmental effects monitoring program be put in place. Baseline conditions of the fish habitat should be established prior to project activities within the Lake William Watershed boundary in which Streams A through D reside. Baseline information could include monitoring groundwater temperature and volume, identification of groundwater upwelling sites within the stream channels and the shore of Lake William, and monitoring of spawning activity. This data could be collected over a period of a few years to establish average conditions. DFO has advised that a baseline monitoring program will be required prior to initiating quarry activities within the proposed expanded area of the Sovereign Resources quarry.

Once project activities begin within the Lake William Watershed, a monitoring program will be in place and will include regular measurements of groundwater temperature, velocity and volume at upwelling sites using piezometers as well as site visits to monitor spawning habitat along the lake shore and at Streams B and D.

Details of the monitoring program will be developed in consultation with DFO, after the Environmental Assessment for the Project is approved by NSEL and prior to initiating quarry activities in the expanded area of the Sovereign Resources quarry. This will include, but not necessarily be limited to, the establishment of monitoring locations, frequency of monitoring, and reporting requirements.

As part of the monitoring program, an adaptive management strategy will be developed which could include setting acceptable threshold limits on groundwater flow in consideration of the baseline results and developing options or alternatives for project activities and development. This will enable the proponent to identify changes in the baseline conditions well enough in advance to allow for implementation of appropriate mitigation or, if required, authorizations to harmfully alter, disrupt or destroy fish habitat from the Minister of Fisheries and Oceans Canada under Section 35(2) of the *Fisheries Act*. This strategy will be developed once baseline results are obtained in consultation with DFO. The environmental effects monitoring plan and adaptive management strategy will be incorporated as an element of the overall quarry development plan which will indicate a variety of environmental management activities to coincide with progressive phases of quarry development.

Water Quality Effects

The dispersion and settling of fine particulate matter in the streams and lakes from blasting or discharge of water from the quarry site, may over the life of the Project, result in an alteration of water quality and stream and lake substrates. As illustrated in Figure 5.1, the wind is more frequently from the southwest through northwest; however, there are often strong winds from the eastern quarter. TSP levels in air are regulated through the provincial Air Quality Regulations as well as the Pit and Quarry Guidelines (NSDOE 1999). Compliance with these levels should be sufficient to control the introduction of

excessive fines into Lake William. Subject to EA approval, Sovereign Resources has committed to setting aside a large parcel of undeveloped forested land between the Sovereign Resources quarry and Lake William. This buffer zone will also serve as a wind screen and assist in reducing transport of particulate matter.

As indicated in Section 5.1, a dust monitoring program will be implemented with monitoring parameters and locations determined in consultation with NSEL and the Monitoring Board. Potential impacts to the water quality of the surrounding lakes will be considered when determining the appropriate monitoring locations. It is recommended that monitoring occur to the northeast of the proposed quarry area to reflect the (predominantly) downwind transport of any particulate matter generated onsite.

Clearing, grubbing, and topsoil stripping activities can increase the potential for sediment erosion and deposition downgradient, particularly during periods of heavy rainfall or snowmelt. These activities will also result in a reduction of evapotranspiration and a corresponding increase in surface runoff, which, in turn, increases potential for sediment erosion and deposition. As the quarry (generally) advances west to east, surface runoff will be directed to the quarry floor and/or to flow retention structures. Ultimately, surface runoff from the Sovereign Resources quarry will be discharged into Rocky Lake, through the Municipal Enterprises quarry (potential impacts from settling of particulate and subsequent runoff into Lake William are discussed above). At a minimum, the surface runoff leaving the quarry must meet the Pit and Quarry Guidelines for total suspended solids and mitigate impacts to fish and fish habitat in Rocky Lake. Mitigative measures to prevent and/or minimize erosion and subsequent sedimentation include:

- provide suitable area for settling ponds and an appropriate time period for the settling of suspended materials prior to discharge form the quarry site;
- direct clean surface water away from exposed/disturbed areas, to the extent practical;
- direct surface runoff within the quarry to low areas/depressions on the quarry floor or to properly sized flow retention structures;
- placement of free-draining material (*i.e.*, blasted rock) over disturbed work areas;
- stabilization of stockpiled overburden and topsoil with hydroseed and/or mulch for future use during reclamation; and
- implement a progressive rehabilitation plan to ensure inactive/depleted areas are reclaimed and stabilized/revegetated.

The hydrologic assessment (Appendix D) provides a peak flow and volume for the recommended flow retention structures for the quarry. The design peak flow was estimated to be 15.1 m^3/s and the retention capacity was estimated to be 83,600 m^3. These estimates are based on one centrally located retention/siltation structure at the outlet of the proposed quarry area and assume full development of the entire area with no progressive rehabilitation (*i.e.*, worse-case scenario). The use of a number of

retention/siltation structures upstream of the final outlet of the quarry would reduce the peak flow requirements of the retention/siltation structures. Progressive reclamation using revegetation of quarry sections that are no longer actively mined would also reduce the hydraulic requirements of these retention/siltation structures. These retention/siltation structures must be properly sized based on their location within the proposed quarry and the maximum impacted area within the proposed new quarry area.

As indicated in Section 2.7, a development plan for the quarry will be prepared. Due to the large area and lifespan of the Project, it is anticipated that the development plan will be prepared in stages and updated as necessary. Specific details related to the size and location of erosion control structures and other mitigative measures will be described in this plan.

A possible long term impact on water quality is decreased pH or increased dissolved solids and metals from acidic drainage production from exposed sulfide-rich bedrock. As noted in Section 5.3, the potential for acid drainage production in this area is low. Monitoring for potential acid drainage production will be conducted at the request of NSEL and DFO.

Mercury and arsenic contamination of waterbodies was an issue of concern raised during public consultation. Section 5.4.1 discussed existing mercury and arsenic levels in water and fish tissue from local waterbodies.

Arsenic in the water and sediment is accumulated in the biota and does not appear to biomagnify (Eaton and Clair 1985). There is no clear correlation between fish morphology and tissue concentration. As indicated in Section 5.2.2, observed levels of arsenic in rock at the quarry ranges from 3-20 ppm. Low levels of arsenic are detected in settling pond effluent waters from the existing quarries on rare occasions (three times over 10 years). These concentrations are bound to the suspended particles in the water column and will settle into the sediment matrix. Baseline monitoring of area watercourses has not been undertaken for comparison. However, the discharge data compares with levels found in upstream lakes in the 1983 survey. Therefore, with stringent adherence to settling pond operating procedures, the arsenic releases will be controlled to ambient levels.

High grade metamorphic rock (*e.g.*, gneiss) coupled with oligotrophic lake conditions (*i.e.*, alkalinity as $CaCO_3$ < 30 ppm and pH < 7) create conditions favourable for inorganic mercury to become soluble in water. The rock type within the existing and proposed quarry area is meta-sandstone and is not a producer of mercury (and arsenic) to the extent that quartzite ores can be. Alkalinity in area lakes tends to be low due to surrounding igneous and metamorphic geology which are resistant to weathering and contain little carbonate. The quarry rock is not considered to be a producer of mercury; therefore, mercury levels are not anticipated to increase above what presently exists in the sediments and fish as a result a mining.

The proposed Project is not expected to result in increased levels of mercury and arsenic in area lakes. Any hazardous material spilled onsite will be contained within the quarry boundaries and handled in accordance with the Company's Hazardous Materials Response and Contingency Plans. Surface water within the quarry will be collected on the quarry floor or a flow retention/siltation structure. The Company's Hazardous Materials Response Plan will provide procedures for fuelling of equipment and handling/storage of hazardous material on site to prevent contamination of the environment. Timely and effective cleanup of such material will mitigate any potential downstream effect. Also, due to distance, significant impacts are not anticipated due to natural attenuation primarily by dilution and dispersion along the groundwater pathways.

Surface runoff generated at the quarry will be monitored as it leaves the Sovereign Resources quarry and enters the Municipal Enterprises quarry site. It is anticipated that monitoring of the discharge into Rocky Lake will continue over the life of both projects. Monitoring (*i.e.*, parameters and frequency) will be conducted in accordance with approval conditions.

Hydrological Effects

Quarrying is expected to generally progress in west to east. As the rock face advances into the catchment areas of the watercourses, groundwater base flow and surface runoff will be redirected and will flow west towards the working quarry floor (Figure 5.6). As previously indicated, flow will collect in low areas on the quarry floor or to flow retention structures for treatment of suspended solids and control of water quantity.

The hydrological assessment (Appendix D) conducted in support of this Project estimates the change in the drainage area for each of the potentially impacted waterbodies as well as the change in annual runoff volume (Table 5.5). It is important to note that the estimates summarized in Table 5.5 are considered to be a worse-case scenario as they are based on complete development of the quarry area with no progressive rehabilitation.

Table 5.5 Estimated Change in Drainage Areas and Annual Runoff Volumes

Watershed/ Subwatersheds	Drainage Areas (km^2)			Annual Runoff Volumes * (x1000 m^3)		
	Pre-Dev.	Ultimate Dev.	% Change	Pre-Dev.	Ultimate Dev.	% Change
Rocky Lake	5.11	6.94	+36	5,130	7,400	+45
Outlet from Municipal Enterprises quarry	1.59	3.82	+140	1,780	4,460	+150
Powder Mill Lake	10.9	12.5	+15	10,700	12,700	+19
Stream E	0.635	0.386	-39	623	367	-41
Lake William	22.0	22.0	0	21,200	21,700	+3
Stream A	0.410	0.282	-31	390	268	-31
Stream B (Toddy Brook)	1.62	0.57	-65	1,540	542	-65
Stream C	0.357	0.332	-7	340	316	-7
Stream D (Marshall Brook)	3.10	2.72	-12	2,950	2,590	-12

Sovereign Resources
Quarry Modification Project
Environmental Assessment

Figure 5.6

Watershed Delineations for Ultimate Development Conditions

N

Fall River
Waverley
Sackville
Bedford
Burnside

Powder Mill Lake Watershed
Rocky Lake Watershed
Lake William Watershed

HRM Boundary

Duck Lake
Beaver Pond
Lake Thomas
Perry Lake
Willis Lake
Third Lake
Mudley Pond
Spriggs Lake
Skerry Pond
Second Lake
Three Mile Lake
Powder Mill Lake
Stream E
First Lake
Rocky Lake
Lake William
Stream A
Round Lake
Leonard Lake
Spider Lake
Runoff directed into Municipal Enterprises Quarry
Stream B (Roddy Bk)
Stream C
Sovereign Resources Quarry
Outlet from Municipal Enterprises Quarry
Stream D (Marshall Bk)
Lily Lake
Jack Lake
Anderson Lake
Enchanted Lake
Juniper Lake
Lake Charles

Watersheds
- Watershed Boundary

Sub-Watersheds
- Lake William Sub -Watershed
- Powder Mill Lake Sub-Watershed
- Rocky Lake Sub-Watershed

- Runoff Flow Direction
- Connection Between Bodies of Water

Project Features
- Approved Sovereign Resources Quarry
- Proposed Sovereign Resources Quarry Modification Boundary
- Existing Quarry

Topographic Features
- Elevation Contour (m)
- Stream
- Lake
- Property Boundary

Scale 1:40,000

0 500 1000 1500 2000

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: February 2005
Project: NSD17650

Jacques Whitford

The estimates for annual runoff volumes provided in Table 5.5 are considered to be a worse-case scenario. The analysis was conducted assuming no mitigative measures were employed. Sovereign Resources will design and implement a Stormwater Management Plan in conjunction with the objectives of meeting pre-determined conditions.

The potential effects of the increases in mean annual runoff and design peak flow following full quarry development, with no mitigation, include potential impacts on downstream drainage infrastructure and erosion of channels and banks of receiving waterbodies. Remedial measures can, however, be implemented within the proposed Sovereign Resources quarry and/or upstream of the outlet of the Municipal Enterprises quarry to mitigate these increases in peak flows. These remedial measures include properly-sized retention structures and reclamation of inactive quarry areas with vegetation. Retention structures can be sized to attenuate peak flows to pre-development conditions. Reclamation activities will also reduce peak rates and volumes of surface runoff. Either practice or a combination of both (*i.e.*, retention and reclamation) can mitigate the potential impact on downstream flows. The quarry development plan (Section 2.7) will incorporate the detailed information regarding quarry development and reclamation required to properly size and locate the flow retention structures and other measures to ensure the potential effects are mitigated.

Potential environmental effects on fish habitat as a result of hydrologic effects are discussed above.

Summary

There is no fish habitat within the proposed quarry area. Five streams outside the quarry area will be indirectly affected by hydrological changes (reduced flows) to varying degrees. According to DFO, Streams B and D are considered fish habitat (J. Crocker, pers. comm.2005). Collection of baseline data and implementation of an environmental effects monitoring plan and adaptive management strategy will address DFO concerns by limiting the potential for environmental effects on fish and fish habitat in the Lake William Watershed. While it is not anticipated that fish habitat will be affected during the early years of quarry development, monitoring activities implemented according to the monitoring plan, will identify requirements, if any, to obtain authorizations to harmfully alter, disrupt or destroy fish habitat from the Minister of Fisheries and Oceans Canada under Section 35(2) of the *Fisheries Act*, if required.

Historic activities have resulted in impacted lake sediments in the Lake William watershed; however, the Project is not anticipated to contribute to further reductions in sediment quality or reduced water quality. The Project will adhere to monitoring requirements (liquid effluent and air quality) provided in the Pit and Quarry Guidelines to ensure that water quality is not adversely affected. Erosion and sediment control measures including design and location of flow retention structures will be specified in the Quarry Development Plan.

Assuming implementation of mitigation, monitoring and *Fisheries Act* Authorizations, if required, there is not likely to be a significant adverse environmental effect on surface water and hydrology.

5.5 Wetlands

Wetlands were selected as a VEC because they are an important feature of the landscape, performing many biological, hydrological, social/cultural, and economic production functions. Wetlands provide habitat for plant and animal species, many of which depend on wetland habitats for their survival. Hydrological functions of wetlands include erosion and flood control, contaminant reduction, and groundwater recharge and discharge. Wetlands support various forms of recreational activity, as well as subsistence production, such as harvesting of wildlife and plants, and commercial production, such as cranberry bogs, forestry, and peat extraction. Wetlands are protected under the Nova Scotia *Environment Act* generally and specifically according to the provincial Wetlands Directive.

5.5.1 Description of Existing Environment

Twenty-six wetlands are within or adjacent to the proposed quarry area. Wetland surveys were conducted on August 12, and September 2, 3, and 29, 2004, with information supplemented by earlier visits as part of wildlife and vegetation surveys. The locations of these wetlands are mapped on Figure 5.7. All wetlands were evaluated according to either the NSEL ten-step evaluation process (wetlands less than 2 ha) or the North American Wetlands Conservation Council (Canada) wetland evaluation technique (wetlands greater than 2 ha). A listing of the wetlands and the findings of wetland evaluations are summarized in Table 5.6; complete wetland evaluations are presented in Appendix G.

Powder Mill Lake
Rocky Lake
Lake William
Lily Lake
Anderson Lake
Buffer Zone
WL-1 0.4ha
WL-22 1.6ha
WL-2 0.5ha
WL-3 0.8ha
WL-4 1.3ha
WL-5 2.2ha
WL-6 0.3ha
WL-8 0.04ha
WL-14 0.3ha
WL-15 0.2ha
WL-9 0.9ha
WL-10 0.1ha
WL-11 4.6ha
WL-23 0.1ha
WL-16 0.2ha
WL-12 0.6ha
WL-21 0.1ha
WL-17 0.5ha
WL-24 1.3ha
WL-7 0.1ha
WL-13 0.3ha
WL-20 0.4ha
WL-25 0.1ha
WL-18 0.8ha
WL-19
WL-26 3.9ha
N

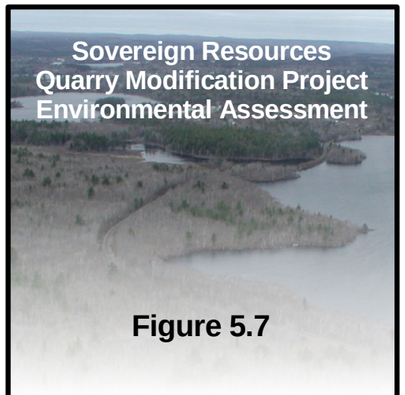

Figure 5.7

Wetland Habitat

Wetlands

WL-1 0.4ha — Surveyed Wetland (Labeled by identifier and area in hectares)

Plants

✱ *Aster Borealis* population

Project Features

- Proposed Sovereign Resources Quarry Modification Area
- Approved Sovereign Resources Quarry
- Existing Quarry
- Approved Municipal Quarry

Topographic Features

- Elevation Contour (m)
- Stream
- Waterbody
- Property Boundary

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Scale 1:20,000

0 250 500 750 1000

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

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Table 5.6 Wetlands Found Within or Immediately Adjacent to the Proposed Quarry Boundaries

Wetland No.	Type	Size (ha)	Area to be Lost to Quarry Operations (ha)	Wetland Evaluation Process	Results of Evaluation
1	Low shrub dominated basin bog	0.40	0.40	NSEL 10 step	Not significant
2	Wetland complex consisting of mixedwood treed basin swamp and graminoid dominated basin fen	0.46	0.46	NSEL 10 step	Not significant
3	Coniferous treed basin bog	0.82	0.82	NSEL 10 step	Not significant
4	Wetland complex composed of tall shrub dominated basin swamp, low shrub dominated shore bog, coniferous treed basin bog, coniferous treed basin swamp, and open water wetland	1.33	1.33	NSEL 10 step	Not significant
5	Wetland complex composed of coniferous treed basin swamp, tall shrub dominated basin swamp, coniferous treed basin bog, basin bog, and open water wetland	2.21	2.21	North American Wetlands Conservation Council	Not significant
6	Mixed wood treed basin swamp	0.34	0.34	NSEL 10 step	Not significant
7	Low shrub dominated basin bog	0.13	0.13	NSEL 10 step	Not significant
8	Tall shrub dominated basin swamp	0.04	0.04	NSEL 10 step	Not significant
9	Deciduous treed basin swamp	0.86	0	NSEL 10 step	Not significant
10	Deciduous treed stream swamp	0.13	0	NSEL 10 step	Not significant
11	Wetland complex composed of low shrub dominated basin bog, floating bog, open water wetland, mixedwood treed stream swamp, and deciduous treed stream swamp	4.60	0	North American Wetlands Conservation Council	No critical factors identified.
12	Wetland complex composed of deciduous treed basin swamp and graminoid dominated basin bog	0.59	0.59	NSEL 10 step	Not significant
13	Deciduous treed basin swamp	0.32	0.32	NSEL 10 step	Not significant
14	Deciduous treed basin swamp	0.29	0.29	NSEL 10 step	Not significant
15	Deciduous treed basin swamp	0.24	0.24	NSEL 10 step	Not significant
16	Deciduous treed basin swamp	0.21	0.21	NSEL 10 step	Not significant
17	Mixedwood treed basin swamp	0.51	0.51	NSEL 10 step	Not significant
18	Mixed treed basin swamp	0.77	0.77	NSEL 10 step	Not significant
19	Low shrub dominated basin bog	0.41	0.41	NSEL 10 step	Not significant
20	Low shrub dominated basin bog	0.36	0.36	NSEL 10 step	Not significant
21	Mixedwood treed basin bog	0.08	0.08	NSEL 10 step	Not significant
22	Wetland complex composed of immature deciduous treed stream swamp, tall shrub dominated flat bog, tall shrub dominated stream swamp	1.61	0	NSEL 10 step	Wetland contains one critical value, providing habitat for an S2?/undetermined listed plant species (*Aster borealis*). Species may be more widespread in the province than originally understood. Wetland will be avoided but hydrological changes may affect habitat.
23	Low shrub dominated basin bog	0.07	0.07	NSEL 10 step	Not significant
24	Low shrub dominated basin bog	1.34	1.34	NSEL 10 step	Not significant
25	Low shrub dominated basin bog	0.13	0.13	NSEL 10 step	Not significant
26	Wetland complex composed of mixedwood treed stream swamp, deciduous treed stream swamp, low shrub dominated stream swamp, low shrub dominated shore bog, and open water wetland	3.90	0.00	North American Wetlands Conservation Council	The wetland will not be directly affected. There is some potential for changes to hydrology to the wetland.

These wetlands can be grouped according to wetland types. Three types of wetland are found within the Project boundaries: bog, fen, and swamp. Most wetlands are relatively small (under one hectare), and comprised of a single wetland type.

Bogs are peatlands that have the water table at or near the peat surface. The bog surface is virtually unaffected by nutrient enriched groundwater from the surrounding mineral soils. As such, bogs are typically acidic and nutrient deficient. The dominant substrates of bogs are weakly to moderately decomposed sphagnum and woody peat that may occasionally be underlain by peat derived from sedges. Bogs may be treed or treeless and are usually occupied by various species of sphagnum moss and ericaceous shrubs (National Wetlands Working Group 1987).

Most of the bogs in the study area are low shrub dominated basin bogs. Basin bogs occur in topographically defined basins where the water is derived locally but may be augmented by drainage from other parts of the watershed. The shrub layer is typically dominated by leatherleaf (*Chamaedaphne calyculata*) sheep-laurel (*Kalmia angustifolia*), rhodora (*Rhododendron canadense*), black huckleberry (*Gaylussacia baccata*) and/or sweet bayberry (*Myrica gale*). Coniferous treed bog is also present and typically contains a tree layer composed of black spruce (*Picea mariana*), with white pine (*Pinus strobus*) and larch (*Larix laricina*), and a shrub layer similar to the low shrub dominated basin bogs. Only a few basin bogs have no or sparse tree and/or shrub layer.

A floating bog forms part of Wetland 11 and also has no trees and few shrubs. These open bogs typically have a ground vegetation layer dominated by sphagnum moss, with graminoids and typical bog plants such as pitcher-plant (*Sarracenia purpurea*), and spoon-leaved sundew (*Drosera intermedia*). Floating bogs develop around the margins of water bodies. These bogs consist of a mat of vegetation and peat floating on water or a loose slurry of peat. The surface of the floating bog is sufficiently elevated for the rooting zone to be free from contact with the mineral-enriched surface water on which it floats.

Wetland 22, located outside of the proposed quarry area, includes a tall-shrub flat bog component, that differs from the other shrub-dominated bogs by containing speckled alder (*Alnus incana*) and gray birch (*Betula populifolia*), along with black holly (*Ilex verticillata*), red maple (*Acer rubrum*) and possum-haw viburnum (*Viburnum nudum*). Flat bogs are characterized by a flat featureless surface and occur in broad, poorly defined depressions. Peat depths in flat bogs are generally uniform.

Fens are peatlands in which the water table is located at or just below the surface. The waters are generally nutrient and mineral enriched and derived from groundwater (National Wetlands Working Group 1987). The vegetation of fens is characterized by the presence of sedges, grasses, reeds and brown mosses. A sparse cover of shrubs and occasionally trees may also be present. Wetland 2 includes a graminoid dominated basin fen which is seasonally flooded and forms the vernal pool. This fen contains a sparse shrub layer of leatherleaf, meadow-sweet (*Spiraea alba*), hardhack spiraea (*Spiraea*

tomentosa) and rhodora. The ground vegetation contains various mosses as well as graminoids including blue-joint reedgrass (*Calamagrostis canadensis*) and black-girdle bulrush (*Scirpus cyperinus*).

Swamps are mineral wetlands or peatlands with standing water or water flowing slowly through pools or channels (National Wetlands Working Group 1987). The water table is generally at or near the surface of the swamp. There is internal water movement from the margin of the swamp or from other sources of mineral enriched waters. If peat is present, it consists mainly of well-decomposed wood, underlain at times by sedge peat. The vegetation typically consists of a dense cover of trees or shrubs, herbs and some mosses.

Basin swamps occur in topographically defined basins where the water is derived locally but may be augmented by drainage from other parts of the watershed. Stream swamps occur on the banks of permanent or semi-permanent streams. The high water table is maintained by the level of water in the stream. The swamp is seasonally flooded, with subsequent sediment deposition. Swamps in the study area can be further subdivided based on the dominant vegetation.

Four types of basin swamp are present including: mixedwood treed basin swamp; coniferous treed basin swamp; deciduous treed basin swamp; and tall shrub dominated basin swamp. Mixedwood treed basin swamps in the study area are characterized by a tree canopy dominated by a variety of species including black spruce, red maple, balsam fir (*Abies balsamea*) and birch (*Betula* spp.). The shrub understory of this wetland type includes black holly *(Ilex verticillata*) and may contain mountain holly (*Nemopanthus mucronata*), speckled alder (*Alnus incana*) and/or leatherleaf. Coniferous treed basin swamps in the study area are associated with wetland complexes, and typically have a tree layer composed largely of black spruce, larch, white pine and red maple. The shrub understory is similar in species composition to mixedwood treed basin swamp. Deciduous treed basin swamps are characterized by a tree canopy composed of red maple and white ash (*Fraxinus americana*), and may contain paper birch (*Betula papyrifera*) and/or northern red oak (*Quercus rubra*), as well as a minor coniferous component. The shrub layer typically includes a mixture of speckled alder and black holly, and other shrub species in more diverse wetlands. The tall shrub dominated basin swamps typically have a diffuse tree canopy composed largely of red maple, black spruce and/or white pine under which is a relatively dense shrub layer consisting of tall mountain holly, with low-shrubs including rhodora and sheep-laurel.

Four types of stream swamp may be affected by the Project, including mixedwood treed stream swamp, deciduous treed stream swamp, tall shrub dominated stream swamp, and low shrub dominated stream swamp**.** Mixedwood treed stream swamp is characterized by a tree canopy composed of a mixture of red maple and larch. The shrub understory is moderately dense and is composed mainly of black holly, dwarf huckleberry and possum-haw viburnum. Deciduous treed stream swamp typically has a tree canopy containing red maple and white ash, and may contain yellow birch, and a minor conifer component. The shrub layer cover is typically low, consisting mainly of speckled alder, and may contain black holly and possum-haw viburnum. Tall shrub dominated stream swamp (in Wetland 22)

has no tree layer, but a dense shrub layer consisting of mostly speckled alder with black holly. Low shrub dominated stream swamp is characterized by a shrub layer composed mainly of sweet bayberry, narrow-leaved meadow-sweet, red maple, rhodora, speckled alder, and sheep laurel. Sphagnum moss dominates the groundcover but also has tussock sedge and bristly dewberry as co-dominants. Scattered bog goldenrod is also present.

Only three wetlands were larger than 2 ha, and the largest was only 4.6 ha. Even the largest wetland (Wetland 11) is believed to play a minimal role on surface water flow regulation, having a relatively small storage capacity.

The wetland evaluations indicated that one of the wetlands (Wetland 22) provides habitat for *Aster borealis*, a rare plant species (ACCDC status S2? and NSDNR status "undetermined"; see discussion in Section 5.6).

Four-toed salamander was the only listed wildlife species (ACCDC status S3, and NSDNR status "yellow"; see Section 5.7 for discussion) recorded in the wetlands. This species was found in Wetlands 3 and 9 and is likely to be found in Wetland 26, which is just outside the Project boundary. Four-toed salamanders nest in sphagnum moss hummocks at the edges of pools or sluggish streams. Local herpetologists believe that this species is more widespread and abundant than previously thought. A recent study (JWEL 1999) corroborates this belief. The study found four-toed salamander nest sites in 25 of 46 locations tested with a total of 79 nests found in the 25 sites where the species was present. Nests were found in a variety of natural and anthropogenic sites including ditches and wheel ruts. Jacques Whitford has encountered four-toed salamanders at a wide variety of locations in Nova Scotia and a number of these sites are present in the Halifax area. Given these findings, the presence of a four-toed salamander nest in the wetland is not considered to be a significant environmental constraint.

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

Given the extent of wetlands in the study area, total avoidance of wetlands would render most of the property unusable and would therefore not be feasible for this Project. As demonstrated by the wetland evaluations, none of the wetlands within the Project area are considered to be significant; only Wetland 22, which is located outside of the proposed quarry area, contains one critical value, providing habitat for a rare plant species. However, given the intrinsic value and regulatory significance of wetlands, and the predicted cumulative loss of wetlands within the proposed quarry area, Sovereign Resources explored options to minimize residual effects on wetland habitat including avoidance. Based on the wetland evaluations and field study results, the study team identified two wetlands which demonstrated a slightly higher relative value than the rest of the wetlands in the study area and were provided special consideration for protection: Wetlands 22 and 9. These wetlands were within the original boundaries of the quarry modification area but are now excluded (refer to Figure 2.2).

Wetland 9 provides suitable nesting habitat for three bird species which have been identified by the Canadian Wildlife Service as "target species" since they have undergone some historic declines. It also provides habitat for four-toed salamander, an uncommon amphibian species in Nova Scotia. Wetland 9 was buffered coincident with the redesign of the quarry boundary in that area to the 50 m contour to reduce potential visual impacts. This also resulted in avoidance of Wetlands 10, 11 and 12. Wetland 26, which is just outside the proposed boundaries, will also be avoided. Wetland 22 was excluded from the quarry boundary, in part, to protect a rare plant species.

The hydrological assessment (Appendix D) estimates that approximately 83% of the surface drainage to Wetland 22 and 43% for Wetland 9 will be redirected following complete quarry development. However, based on the hydrogeological conditions in the area, it is possible that these wetlands (and the remaining wetlands in the Project area) are largely associated with perched water conditions, caused mainly by rainfall. An example can be noted with the close proximity of Wetland 2 to the existing working face. The buffer zones established by the revised boundary (*i.e.*, 30 m for Wetland 22 and approximately 60 m for Wetland 9) may be sufficient to maintain the overall function/value of the wetlands. A 30 m buffer zone is consistent with the Pit and Quarry Guidelines' recommended separation distance of an active quarry from a watercourse or high water mark.

Sovereign Resources will maintain a buffer zone around Wetlands 9 and 22, within which no quarrying activity will be undertaken. Multi-level monitoring wells will also be installed prior to quarry excavation in these areas to allow monitoring of wetland outfalls before and during quarry excavation.

In recognition of the loss of remaining wetland habitat, a specific mitigation program will be developed in consultation with NSDNR and NSEL. Application of this program will mitigate the loss of habitat based on function and relative value.

In summary, assuming the application of proposed mitigation measures, there are not likely to be any significant adverse environmental effects on wetlands.

5.6 Rare and Sensitive Flora

Rare and Sensitive Flora was selected as a VEC because it is a rare element of indigenous biodiversity and is often indicative of rare habitats that harbour unique assemblages of plants and animals. Preserving rare plant species often ensure that rare habitats and their unique assemblages of species are preserved. Rare and Sensitive Flora are designated in the following ways:

- being listed as a species at risk at the national level by COSEWIC (COSEWIC 2004) or *SARA*; and/or
- being listed as a rare species in Nova Scotia (Pronych and Wilson 1993, NSDNR 2003b).

This VEC is closely related to the Wetland VEC (Section 5.5).

5.6.1 Description of Existing Environment

Plant Communities

The study area is composed of a variety of terrestrial and wetland plant communities. Most of the area is forested. The types of forest present are the result of a combination of poor stony soils and varying degrees of fire related disturbance. Upland areas that have not been recently burned support three different stand types including red pine/paper birch forest, northern red oak/paper birch forest, red spruce/eastern white pine forest, and black spruce/red maple forest.

Red pine/paper birch forest is largely restricted to dry areas at the northwestern edge of the study area. This community is dominated by a mixture of red pine (*Pinus resinosa*), paper birch (*Betula papyrifera*) and eastern white pine (*Pinus strobus*). The shrub understory is moderately dense and consists mainly of black huckleberry (*Gaylussacia baccata*), sheep-laurel (*Kalmia angustifolia*), late lowbush blueberry (*Vaccinium angustifolium*) and possum-haw viburnum (*Viburnum nudum*).

Northern red oak/paper birch forest is found in hilly terrain in the center of the study area. This plant community is dominated by a mixture of northern red oak (*Quercus rubra*), paper birch, red maple (*Acer rubrum*), and white pine. The shrub understory is dense and composed of the same species as found in the red pine/paper birch forest type.

Red spruce/eastern white pine forest is found in mesic areas in between parallel ridges in the center of the study area. The dominant tree species of this community are red spruce (*Picea rubens*), eastern white pine, paper birch, and red maple. A dense shrub understory is also present in this plant community.

Black spruce/red maple forest is found in poorly drained hollows between ridges. Most stands of this type are found in the central portion of the study area. Black spruce (*Picea mariana*), red maple and balsam fir (*Abies balsamea*) are the dominant tree species of this plant community. The shrub understory is generally more sparse than in other forest stands in the area and consists mainly of sheep-laurel, rhodora (*Rhododendron canadense*) and possum-haw viburnum.

The southern portion of the study area has been burned more frequently with the last fire occurring in the 1960s. These burned areas support two distinct plant communities including paper birch/red maple forest and semi-barrens.

Paper birch/red maple forest covers most of the southern third of the study area. This plant community is dominated by a mixture of paper birch, red maple, large-tooth aspen (*Populus grandidentata*), and

northern red oak. The shrub understory is very dense and is composed of black huckleberry, sheep-laurel, late lowbush blueberry and possum-haw viburnum.

The semi-barrens plant community occurs on a number of bedrock ridges in the study area as well as the areas most heavily disturbed by fires. In these areas tree regeneration has been impeded by dense stands of black huckleberry, late lowbush blueberry, sheep-laurel, and possum-haw viburnum. An open tree cover has developed which is composed mainly of paper birch, eastern white pine, and jack pine (*Pinus banksiana*).

Disturbed areas are found along woods roads and the existing quarry site. These areas are characterized by a sparse ground cover composed mainly of introduced weeds and forage grasses. Some species present in this habitat type include poverty oat-grass (*Danthonia spicata*), downy goldenrod (*Solidago puberula*), rough bentgrass (*Agrostis hyemalis*), and New Belgium American-aster (*Aster novi-belgii*). Twenty-six wetlands are found on the property. These habitats are discussed in more detail in Section 5.5.

Rare Vascular Plants

Vascular plant surveys were conducted by Jacques Whitford at the site on June 4, 14, and September 2 and 3, 2004. The survey focussed on natural habitats located within the proposed quarry boundaries. Prior to conducting vascular plant surveys, the Atlas of Rare Vascular Plants in Nova Scotia (Pronych and Wilson 1993) was reviewed to determine if any rare vascular plant species had been recorded in the vicinity of the study area. This data was later supplemented with the results of a data request to the Atlantic Canada Conservation Data Centre (ACCDC) Data was compiled for the 10 km X 10 km atlas square within which the study area is situated. NSDNR has also required information from all of the atlas squares adjacent to the primary atlas square. Table 5.7 lists the nine rare species, including phenology and habitat preferences, which have been recorded within the 900 km^2 encompassed by the nine atlas squares surrounding the study area.

Table 5.7 Phenology and Habitat Preferences of Rare Vascular Plant Species Found in and Near the Study Area

Binomial	Flowering Period/ Ease of Identification	Preferred Habitat	NSDNR Status
Arenaria groenlandica (Mountain Sandwort)	June to August	Granitic ledges and gravel on coasts at higher elevations	Yellow
Aster undulatus (Waxy-leaved Aster)	August and September; can be identified by vegetative characteristics	Old fields and edges of thickets	Yellow
Eleocharis flavescens (Capitate Spikerush)	June to October; inflorescence and seeds required for identification	Peaty muck in bogs, wet sandy shores, and swales	Yellow
Elymus wiegandii (Wiegand's Wild Rye)	July and August; spikelets required for identification	Streambanks and meadows	Red
Empetrum rubrum var. eamesii (Purple Crowberry)	July to November; can be identified by vegetative characteristics	Exposed headlands, on top of lichen covered rocks with thin soils	Yellow

Table 5.7 Phenology and Habitat Preferences of Rare Vascular Plant Species Found in and Near the Study Area

Binomial	Flowering Period/ Ease of Identification	Preferred Habitat	NSDNR Status
Equisetum variegatum (Variegated Horsetail)	Sporangia are present year-round; readily identified by vegetative characteristics	Ditches, quarries, mine tailings, stream banks, bogs, and wet thickets	Green
Euthamia tenuifolia (Grass-leaved Goldenrod)	August and September; inflorescence required for identification	Dry sandy soils and beaches	Yellow
Polygala sanguinea (Field Milkwort)	Late June to October; flowers required for positive identification	Poor or acidic fields, damp slopes, edges of woods roads, and open woods or brush	Yellow
Thuja occidentalis (Northern White Cedar)	Easily identified by vegetative characteristics; feral and native populations are difficult to distinguish apart	Lakesides, and swamps, or old pastures	Red

NSDNR Status Key

- Green (Secure) - Species that are not believed to be at risk, or sensitive.
- Yellow (Sensitive) - Species that are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.
- Red (At Risk or Maybe at Risk) - Species for which a formal detailed risk assessment has been completed (COSEWIC assessment or a provincial equivalent) and that have been determined to be at risk of extirpation or extinction. Species that maybe at risk of immediate extirpation or extinction and are therefore candidates for interim conservation action and detailed risk assessment by COSEWIC or the Province.

Suitable habitat is present in the study area for six of the nine species. The species that would have a very low probability of being present are Wiegand's wild rye, purple crowberry and northern white cedar. Wiegand's wild rye is typically found growing on rich soils, which are not present in the study area. Purple crowberry is typically found on exposed coastal headlands. The study area is far enough from the coast that this species is unlikely to be present. Native populations of northern white cedar have been recorded in Digby, Cumberland and Annapolis Counties. Other populations are considered to be introductions.

All of the rare species recorded in the general vicinity of the study area can be readily identified in June and early September, when the rare plant surveys were conducted. It is therefore believed that the surveys conducted on June 4, June 14, September 2 and September 3 would have been sufficient to allow the detection of rare vascular plant species expected in the general area.

All species of vascular plant encountered during the surveys were identified and their population status in Nova Scotia were determined through a review of the General Status of Species in Nova Scotia (NSDNR 2003a), the list of species contained in the Nova Scotia *Endangered Species Act* (NSDNR 2003b), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004). A list of the vascular plant species found in the study area is presented in Appendix H.

One of the species encountered during the field survey, boreal aster (*Aster borealis*) is listed as status undetermined (NSDNR 2003a) indicating that little is known regarding its distribution and abundance in Nova Scotia. ACCDC lists this species as S2? indicating that it is believed to be rare but the status of the population is not well understood. There are 14 recorded locations for this species in Nova Scotia

(Zinck 1998) and Jacques Whitford has identified this species at another two locations in addition to the population found in the study area for a total of 16 known populations in the province. The two sites recorded by Jacques Whitford are near Shelburne, Shelburne County, and Beaverbank, HRM. In the study area, boreal aster was found in Wetland 22 located at the northern end of study area near the existing approved Sovereign Resources quarry (Figure 5.7).

Wetland 22 is a wetland complex composed of immature deciduous treed stream swamp, tall shrub dominated flat bog and tall shrub dominated stream swamp. Boreal aster was found in the tall shrub dominated flat bog plant community. This species was found growing in poorly vegetated areas of the bog in sphagnum moss mats. Species associated with boreal aster at this site included bristly dewberry (*Rubus hispidus*), tawny cotton-grass (*Eriophorum virginicum*), Canada manna-grass (*Glyceria canadensis*), and three-seed sedge (*Carex trisperma*). A total of four boreal aster were found in the wetland although more are likely to be present. None of the other vascular plant species recorded during the surveys are considered to be uncommon or rare in Nova Scotia (NSDNR 2003a; NSDNR 2003b) or in Canada (COSEWIC 2004).

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

Potential effects on rare flora from quarrying activity includes loss of specimens due to clearing and grubbing prior to blasting as well as alteration of hydrology potentially affecting habitat. Other potential effects include introduction of invasive plant species during revegetation.

As noted in Section 5.6.1, a vascular plant survey identified only one occurrence of a listed plant (*Aster borealis*) in Wetland 22. The status of this species in Nova Scotia is considered not well understood. As noted in Section 5.5, Wetland 22 was excluded from the area to be quarried in part to protect this listed plant species. It is possible however that as the quarry area is developed, the hydrology of the wetland may be affected which, in turn, could affect the population. Given that it will likely be a number of years (*i.e.*, 10-15 years or more) before this potential effect could occur, and the undetermined status of the species, it is recommended that prior to quarry development in this subwatershed, the status of this species be re-evaluated. Based on the results of this re-evaluation, additional studies to confirm the population may be required and additional monitoring of the species may be recommended.

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

In summary, provided the recommended mitigation and monitoring activities are applied, no significant residual adverse environmental effects on rare or uncommon flora are predicted to occur as a result of this Project.

5.7 Wildlife

Wildlife was selected as a VEC because of its ecological importance and regulatory protection. In particular, this VEC addresses migratory birds and raptors, mammals, and herpetiles (amphibians and reptiles) with an emphasis on rare or sensitive species. Bird species in Canada are protected by the *Migratory Birds Convention Act*. Wildlife, including non-game bird species are protected in Nova Scotia by the *Wildlife Act* and Regulations. The Nova Scotia *Endangered Species Act* and *SARA* offer legal protection to some rare species that have been proclaimed endangered, rare or vulnerable under the Acts.

5.7.1 Description of Existing Environment

Birds

Breeding bird surveys were conducted at the site on May 20, June 4 and June 14, 2004. Additional bird observations were recorded during the vegetation surveys conducted on September 2 and 3 as well as during a site reconnaissance survey conducted on May 7. The area within the property boundaries was surveyed. The surveys were conducted between the hours of 05:00 and 12:00. During the surveys, representative habitats on the property were visited by two survey teams and all birds heard or observed were recorded. The breeding status of each species recorded was determined using the methodology employed by the Atlas of Breeding Birds of the Maritimes program (Erskine 1992). Species identified but not exhibiting signs of breeding (such as flyovers) were classified as non-breeders. Species observed or heard singing in suitable nesting habitat were classified as possible breeders. Species exhibiting the following behaviors were classed as probable breeders:

- courtship behaviour between a male and female;
- birds visiting a probable nesting site;
- birds displaying agitated behaviour; and
- male and female observed together in suitable nesting habitat.

Species were confirmed as breeding if any of the following items or activities were observed:

- nest building or adults carrying nesting material;
- distraction display or injury feigning;
- recently fledged young;

- occupied nest located; and
- adult observed carrying food or faecal sac for young.

The population status of each species was determined from existing literature. Lists of provincially rare or sensitive birds were derived from the General Status of Wildlife in Nova Scotia (NSDNR 2003a), Species at Risk in Nova Scotia (NSDNR 2003b), and ACCDC database (ACCDC 2004) while nationally rare species were derived from COSEWIC (2004) and *SARA*.

Appendix I contains a list of bird species recorded during the survey. A total of 626 birds representing 55 species were recorded during the breeding bird survey. The most abundant species in descending order of abundance were Ovenbird (10.2% of all birds recorded), Common Yellowthroat (8.9%), Black-throated Green Warbler (8.1%), Black-and-white Warbler (5.4%), Hermit Thrush (5.3%), and Dark-eyed Junco (5.0%). Together these species accounted for 43% of the total number of birds recorded during the survey. Eleven species were confirmed as breeding on the site, 11 were listed as probable breeders, 25 were listed as possible breeders, and no evidence of breeding activities was found for eight species (Table 2 in Appendix I). The habitat type in which the largest number of birds was encountered was mature mixed-wood forest. Fifty percent of all bird observations were made in this habitat type. Other habitats which supported relatively large numbers of birds included mature hardwood forest and immature hardwood forest. These habitats provide good feeding and nesting habitat for a wide range of species and therefore attract high densities of birds. These habitats also supported the greatest bird species richness.

None of the bird species recorded during the breeding bird surveys is considered to be rare or uncommon in Nova Scotia by the ACCDC (2004) or at risk by NSDNR (2003a); however, species encountered that may be sensitive to human activities of natural events (ranked "yellow") include Common Loon and Northern Goshawk (S4, "yellow"). Common Loon was only identified as a flyover. There is no suitable nesting or foraging habitat within the study area. This species is known to breed in Rocky Lake and Miller Lake. Suitable nesting habitat is also present on Lake William. The bird observed flying over the study area was probably transiting between Rocky Lake and Lake William.

A Northern Goshawk was identified at the northern extent of the proposed quarry area, near Wetland 22 in the vicinity of the existing quarry. This species was observed in this area on two occasions suggesting that a nest might be present. Despite some efforts to locate a nest in suitable habitat where the bird was observed, none was found. Suitable nesting habitat is also located to the northeast of the property, towards Lake William.

The Canadian Wildlife Service (CWS) has identified a number of "target" species that include species currently common (*e.g.*, ranked S4 or S5 by ACCDC) and not currently assessed as sensitive or at risk

by NSDNR ("green"), but whose population trends indicate a decline in the populations. Target species encountered during the bird surveys included Olive-sided Flycatcher, Canada Warbler and Purple Finch.

Olive-sided Flycatchers are characteristically found in open woodlands and other places where scattered trees remain (Erskine 1992). Only one individual was recorded, located in Wetland 9, a small (<1 ha) deciduous treed basin swamp dominated by red maple (35% cover) with a sphagnum moss (*Sphagnum* spp.) and cinnamon fern (*Osmunda cinnamomea*) dominated ground vegetation. The Olive-sided Flycatcher observed at this location was observed carrying nesting material indicating that was nesting in or near the wetland. Historically there has been a good population of Olive-sided Flycatchers immediately to the northeast of the project near the rail line near Lake William (F. Lavender, pers. comm. 2004)

Canada Warblers are usually found in dense understory vegetation of mature to mid-age mixed forests, most closely associated with broad-leafed trees and shrubs, but with conifers usually present too (Erskine 1992). They were recorded in both mature mixedwood forest, as well as in five wetlands which included deciduous treed swamp, tall shrub swamp, and low shrub swamp. Wetlands containing Canada Warbler included Wetlands 8, 9, 10, 11, and 22.

Purple Finch are known to build their nests in conifers; however, they frequent open mixed woodland and well-treed gardens, as well as spruce/fir forests (Erskine 1992). Purple finch were found in mature mixedwood, mature hardwood, and immature hardwood in the Project area, and were as abundant as Red-eyed Vireo and Yellow-rumped Warblers.

Additional information regarding use of the area by bird species of concern was derived from a review of the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992) as well as through an ACCDC data request. Nine rare, uncommon or sensitive bird species have been recorded within a 10 km radius of the study area including Common Tern, Bobolink, Horned Lark, Great-crested Flycatcher, Northern Mockingbird, Scarlet Tanager, Boreal Chickadee, and Rusty Blackbird.

Common Tern and Bobolink are considered to be sensitive to human activities and natural events ("yellow" listed) by NSDNR (NSDNR 2003a). ACCDC considers both of these species to be uncommon in Nova Scotia. Common Tern populations in Nova Scotia are adversely affected by disturbance at nesting colony sites, predation of eggs and young by gulls and loss of prime nesting sites to gulls, which typically begin nesting earlier than terns. Common Terns generally nest on coastal islands, sand spits, beaches and occasionally salt marshes. They sometimes nest on small islands in lakes. No suitable nesting or feeding habitat is present within the study area. The nearest suitable habitat would be on some of the small islands on Lake William.

Bobolinks generally nest in hay fields and pastures. The Bobolink population in Nova Scotia has decreased substantially in recent years. The causes of this decline are not well understood but may relate to changes in agricultural practices such as the use of insecticides, changes in management of hay fields, loss of hay fields to other land uses, and the practice of spring burning and mowing. There is no agricultural land in the study area, so Bobolinks are not expected in the study area.

The remaining seven species are considered to have secure populations in Nova Scotia (NSDNR 2003a) but are listed as rare or uncommon species by ACCDC. ACCDC considers two of the species, Horned Lark and Whip-poor-will to be rare (S2) in Nova Scotia. Horned Larks prefer to nest in open grasslands with large areas of short or sparse grass cover. Most nesting records in the Maritime Provinces are associated with airfields, which provide this habitat. The Halifax International Airport provides this habitat type and the Horned Lark records for the atlas square come from the airport. The study area does not contain any grassland habitat that would be suitable breeding habitat for this species.

In Nova Scotia, Whip-poor-will are typically associated with dry deciduous forest. Suitable habitat is present throughout much of the study area. Whip-poor-will have been reported from identical habitat in the vicinity of Burnside Industrial Park in the 1980s. Since then, there have been no records of this species in the area. Whip-poor-wills are nocturnal and are best detected by their calls. Whip-poor-wills call at night but will also vocalize at dawn and dusk. The study area was visited on the night of May 20, 2004 at which time no Whip-poor-will were heard. Surveys conducted on June 4 and 14 were begun at sunrise. No Whip-poor-wills were heard during either of these surveys. It is possible that Whip-poor-wills may be present near the southern end of the study area which could not be safely accessed at night due to lack of access routes and difficult terrain.

ACCDC lists Great-crested Flycatcher as rare to uncommon (S2S3) in Nova Scotia. Great-crested Flycatchers nest in tree cavities in open hardwood forests. Habitat of this type is present in the central and eastern portions of the study area. This area was surveyed extensively by birders familiar with the vocalizations of Great-crested Flycatchers but none were heard or observed during the three surveys.

Scarlet Tanager and Northern Mockingbird are listed as uncommon (S3) in Nova Scotia by ACCDC. Scarlet Tanagers typically nest in mature hardwood forest. The mature hardwood forest found in the center and eastern areas of the study area may provide suitable nesting habitat. The birders who surveyed the study area are familiar with the songs and call of Scarlet Tanagers. No Scarlet Tanagers were observed or heard during the three bird surveys conducted in the study area.

In Nova Scotia, Northern Mockingbirds typically nest in urban and suburban areas in gardens and vacant lots. No habitat of this type is present in the study area so it is unlikely that this species would nest there.

Two species listed as uncommon to common (S3S4), Boreal Chickadee and Rusty Blackbird, have been recorded in the general vicinity of the study area. Boreal Chickadees nest in coniferous forest, particularly stands dominated by black spruce and balsam fir. Stands of this type are present in the study area but are rather small. These areas were surveyed and no Boreal Chickadees were detected.

Rusty Blackbirds are typically associated with swamps along sluggish streams or stillwaters. They are most abundant in the interior of the province and are generally found in areas remote from human settlement. Wetland 11, located at the eastern edge of the study area, was the only area that provided suitable habitat for this species. No Rusty Blackbirds were observed or heard in this area.

Mammals

Information regarding the presence of rare mammals and sensitive mammal habitat within the study area was derived from field surveys, a review of data collected in nearby areas and a review of Nova Scotia significant habitat mapping data base (NSDNR 2003c). Field surveys were conducted concurrently with vegetation, wetland and bird surveys.

The species recorded in the study area are generally typical of woodland habitats. Species recorded during the field survey included varying hare, eastern chipmunk, American red squirrel, meadow vole, porcupine, coyote, red fox, raccoon, bobcat, and white-tailed deer. Other species that have been recorded in adjacent areas include woodchuck, deer mouse, red-backed vole, meadow jumping mouse, American black bear, and ermine. Table 5.8 provides a complete list of mammals that were recorded or would be expected to be present in the area.

Table 5.8 Mammal Species Recorded in the Study Area and/or Expected to be Present in the Study Area

Common Name	Scientific Name
*Smoky Shrew	*Sorex fumeus*
*Cinerous Shrew	*Sorex cinereus*
*Short-tailed Shrew	*Blarina brevicauda*
*Star-nosed Mole	*Condylura cristata*
*Little Brown Bat	*Myotis lucifugus*
Woodchuck	*Marmota monax*
Varying Hare	*Lepus americanus*
Eastern Chipmunk	*Tamias striatus*
American Red Squirrel	*Tamiasciurus hudsonicus*
*Northern Flying Squirrel	*Glaucomys sabrinus*
Deer Mouse	*Peromyscus maniculatus*
Red-backed Vole	*Chethrionomys gapperi*
Meadow Vole	*Microtus pennsylvanicus*
Meadow Jumping Mouse	*Zapus hudsonius*
*Woodland Jumping Vole	*Napaeozapus insignis*
Porcupine	*Erithizon dorsatum*
American Black Bear	*Ursus americana*

Table 5.8 Mammal Species Recorded in the Study Area and/or Expected to be Present in the Study Area	
Common Name	**Scientific Name**
Coyote	*Canis latrans*
Red Fox	*Vulpes vulpes*
Raccoon	*Procyon lotor*
Ermine	*Mustela erminea*
*Striped Skunk	*Mephitis mephitis*
Bobcat	*Lynx rufus*
White-tailed Deer	*Odocoileus virginianus*
* = Species not observed during field survey but expected to be present in the study area.	

None of the species recorded in the study area or expected to occur in the study area are considered to be rare in Nova Scotia (ACCDC 2004) or Canada (COSEWIC 2004). NSDNR lists little brown bat as a species sensitive to anthropogenic activities or natural events. Little brown bats are common in Nova Scotia; however, they are sensitive to human activities due to the fact that they congregate in large numbers at a few sites during the late fall, winter and early spring to hibernate. Hibernation occurs in natural caves or mine shafts. Destruction of these structures can result in large scale mortality of bats and/or loss of suitable hibernation habitat, which may be a limiting factor for bat numbers depending on the availability of hibernacula. Disturbance of bats in their hibernacula by noise stimuli such as blasting can result in the bats arousing themselves from their torpor, which requires the expenditure of energy. Repeated disturbance events can result in depletion of fat reserves resulting in increased bat mortality.

The study area is not found in an area where caves normally form and there are no abandoned mine shafts nearby that might provide hibernation sites. As such, it is unlikely that little brown bats are present in or near the study area during the period from November to May when they are hibernating. Little brown bats are likely to be present in the study area during the period from May to November. At this time, they are widely dispersed and local populations are unlikely to be seriously adversely affected by activities associated with operation of the quarry.

A review of the NSDNR significant habitat mapping data base (NSDNR 2003c) did not reveal the presence of any rare or sensitive mammal species in the vicinity of the study area or critical habitat such as deer wintering areas. All of the habitats present in the study area are commonly encountered throughout the province and are unlikely to provide habitat for rare small mammal species.

Herpetiles

Information regarding amphibians and reptiles and their habitat within the study area was derived during the various spring and summer surveys. Eight amphibian and two reptile species were encountered during the surveys (refer to Table 5.9). Most of the herpetiles were observed in wetlands or in forested areas within the study area.

Table 5.9 Herpetile Species Recorded in the Study Area and/or Expected to be Present in the Study Area	
Common Name	**Scientific Name**
Northern spring peeper	*Pseudocaris crucifer crucifer*
Bullfrog	*Rana catesbiana*
Green frog	*Rana clamitans melanota*
Pickerel frog	*Rana palustris*
Wood frog	*Rana sylvatica*
Yellow-spotted salamander	*Ambystoma maculatum*
Four-toed salamander	*Hemidactylium scutatum*
Eastern redback salamander	*Plethodon cinereus*
*Red-spotted newts	*Notopthalmus viridescens viriescens*
Northern redbelly snake	*Storeria occipitomaculata occipitomaculata*
Maritime garter snake	*Thamnophis sirtali pallidula*
*Northern ringneck snake	*Diadophis punctatu edwardsi*
*Eastern smooth green snake	*Liochlorophis vernalis borealis*
* = Species not observed during field survey but expected to be present in the study area.	

The terrain on the property is greywacke rock ridge and swale type habitat. The underlying geology supports a diversity of terrestrial habitats, some relatively open and others more shaded, from forests to shrub barrens and exposed rock outcrops. Wetlands of varying size and nature are plentiful and several larger ponds and many small, often intermittent streams are also present in the landscape. Such environments provide good habitat for a variety of native amphibians and reptiles.

With the exception of the four-toed salamander, none of these species are considered to be rare or sensitive to disturbance. Four-toed salamanders, listed as S3 (ACCDC 2004) and yellow-listed by NSDNR (2003a), were noted from two wetlands (3 and 9) on the site and excellent habitat for this species was noted from Wetland 26. Local herpetologists believe that this species is more widespread and abundant than previously thought. A recent study has demonstrated that they are relatively widespread and make use of a variety of habitats including human-made ditches and wheel ruts so long as sphagnum moss hummocks are present in close proximity to pools or sluggish streams. Four-toed salamanders found in Wetlands 3 and 9 were found along small pools in treed swamp, and primarily in root craters created from past wind throw events. This basic habitat was present in many of the wetlands present in the study area.

It is possible that both eastern painted turtles (*Chrysemys picta picta*) and common snapping turtles (*Chelydra serpentia serpentina*) might be resident in some of the larger waterbodies of the general area like the large pond in Wetland 26. Although none were noted, these turtle species are both cryptic and can be difficult to detect. Neither of these species are considered to be rare.

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

Potential Project-related effects on wildlife include loss of habitat, direct mortality and disturbance from noise and other stimuli.

None of the bird species recorded during the breeding bird surveys is listed under the Nova Scotia *Endangered Species Act* or *SARA.* Species considered to be rare in Nova Scotia (Erskine 1992), or particularly sensitive to anthropogenic activities (NSDNR 2003a) that may be nesting on the property included Northern Goshawk. Despite some effort searching in suitable habitat near the sighting, a nest was not found. As this species is generally resident, and will reuse nests, a survey conducted in late winter/early spring 2005 could be conducted in the northeastern corner of the site to determine the presence/absence of a nest. If an active nest is found, a buffer zone having a 200 m radius will be established around the nest. The status of the nest will be monitored every two years to determine if the nest remains occupied. If the nest is abandoned for more than two years, the buffer can be eliminated.

Migratory birds are protected under the *Migratory Birds Convention Act.* It is illegal to kill migratory bird species not listed as game birds or destroy their eggs or young. Other bird species not protected under the federal act such as raptors are protected under the provincial *Wildlife Act.* Clearing and grubbing of areas to be used as quarry sites will be conducted outside of the breeding season for most bird species (April 1 to August 1) so that the eggs and flightless young of birds are not inadvertently destroyed.

No critical areas for mammals such as deer wintering areas are known to exist in the study area. The species recorded in the study area are generally typical of woodland habitats. The field survey and a review of existing records (NSDNR 2003c) did not reveal the presence of any rare mammal species in the vicinity of the study area. The habitats present in the study area are commonly encountered throughout the province and are unlikely to provide habitat for rare small mammal species.

Other than four-toed salamanders, no amphibian or reptile species of provincial or national concern was encountered or is expected to be present on the site. Four-toed salamanders were found in Wetlands 3, 9 with suitable habitat in Wetland 26. Wetlands 9 and 26 will be avoided during quarry operations. Furthermore, evidence suggests that four-toed salamanders are adaptable and more widespread and abundant than previous records would indicate. Neither the Provincial population nor local populations of four-toed salamander are likely to be significantly adversely affected by Project activities.

In summary, assuming recommended mitigative measures are applied (*e.g.*, clearing outside bird breeding season), significant Project-related effects on wildlife are not likely to occur.

5.8 Land Use

Land use is a VSC because there will be Project interactions with current land use in the immediate vicinity of the Project. Although commercial, industrial, residential, institutional, and recreational land uses occur within the vicinity of the Project and are described under existing environment, the analysis of potential effects focuses on residential and recreational land uses due to stakeholder concerns. Environmental effects resulting from the Project on this VSC are defined by interruptions or disruptions to current land use by Project activities such that present land use activities are restricted and/or degraded and/or cannot continue at present levels.

5.8.1 Description of Existing Environment

Information used in support of assessing land use issues was obtained from public and stakeholder consultations, mapping data and a windshield reconnaissance survey within the study area.

Land Use Zoning

The quarry is located on Rocky Lake Drive, north of the Town of Bedford and south of Waverley in the HRM. The quarry falls within the HRM Plan Area of Shubenacadie Lakes (Planning Districts 14 and 17). HRM has prepared a Land Use By-Law (LUB) and Municipal Planning Strategy (MPS) for this Plan Area (HRM 1989a, 1989b). This Plan Area consists of approximately 339 km^2 bordering the Town of Bedford and the City of Dartmouth in the south and Hants County in the north. The Plan Area is at the periphery of the Halifax-Dartmouth metropolitan region. The quarry area is at the periphery of the Shubenacadie Lakes Plan Area, bordered by the Bedford and Dartmouth Plan Areas.

Although the predominant form of development throughout the Plan Area over the past few decades has been residential, land use closer to the quarry is mainly industrial. This is representative of the larger Plan Area, where industrial uses are generally located in close proximity to rail systems or in relation to the exploitation of a resource (*e.g.*, quarry). Large parts of the Plan Area are not generally accessible from the public road network. Much of this land has served as a resource base for many primary industries such as forestry or quarry operations (HRM 1989b).

Current land use zoning and generalized future land use for the study area are shown on Figure 5.8. The existing Sovereign Resources quarry is zoned I-3 (Light Industrial). The proposed modification area is zoned I-3 and R-7 (Rural Estate). Permitted uses in an I-3 zone include, but are not limited to, warehousing, building materials outlets, light manufacturing, greenhouses and composting. Permitted uses in an R-7 zone include but are not limited to, various residential uses, institutional uses, open space uses, forestry uses, and agricultural uses. Applicability of the zoning to quarry operations is discussed in Section 5.8.2.

Sovereign Resources
Quarry Modification Project
Environmental Assessment

Figure 5.8

Land Use Zoning and Generalized Future Land Use

Project Features

- Proposed Sovereign Resources Quarry Modification Boundary
- Existing Quarry

Districts and Zoning

R-7 Municipal Planning Strategy, Planning Districts and Zoning

- R-1a - Single Unit Dwelling
- R-1b - Suburban Residential
- R-6 - Rural Residential
- R-7 - Rural Estate
- H-1 - Hazard
- I-3 - Light Industrial
- RR - Residential Reserved

Generalized Future Landuse

- Community Centre
- Hazard
- Light Industrial
- Resource
- Future Residential

Data Source: Municipality of the County of Halifax Department of Planning and Development Policy Division. Planning Districts 14 & 17 Municipal Planning Strategy Generalized Future Land Use and Zoning maps (1989). Town of Bedford Generalized Future Land Use and Zoning Maps (1996).

Topographic Features

- Elevation Contour (m)
- Stream
- Waterbody

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Scale 1:25,000

0 400 800 1200

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

Jacques Whitford

The generalized future land use designation for these lands are “Light Industrial” and “Resource”. The intention of the Resource Designation is to recognize and provide for continued traditional resource activities, including quarrying, while also recognizing that these backlands provide the land base for future growth and development within the Plan Area (HRM 1989b).

Industrial Land Use

As shown on Figure 5.8, adjacent lands to the north of the Project are zoned H-1 (Hazard) and R-7. The Hazard zone was designated to account for explosive storage facilities. A portion of these lands was formerly owned by the Acadia Powder Works. In the late 1800s, black powder and nitroglycerine were manufactured on these lands. Around 1915, production ceased and most of the structures were removed. However, the site is still occupied by several explosives magazines (HRM 1989b). Given the previous history and the current use of these lands, the site is specially zoned to allow only explosives storage and related uses, and would require careful attention to decontamination prior to the development of any other use (HRM 1989b). In December 2004, Sovereign Resources Inc. purchased the parcel of property immediately north of the proposed quarry modification area, bordering Lake William. Upon Project approval, it is intended that this land be preserved as an undeveloped buffer zone (refer to Figure 5.9).

The predominant land use within the immediate area along Rocky Lake Drive is light industrial and commercial, including a mobile home commercial business, bulk tank farm, recreational vehicle (RV) sales and rental business, and a concrete batch plant. CN Rail lines parallel and cross Rocky Lake Drive. Another CN Rail line follows the western shore of Lake William and down through the approved Municipal Quarry area. A Nova Scotia Power Inc. right-of-way (RoW) traverses the proposed quarry area, through the existing approved quarry area, paralleling Rocky Lake Drive, into the Town of Bedford.

Sovereign Resources
Quarry Modification Project
Environmental Assessment

Figure 5.9

Land Use Features

Frame Subdivision
Silversides Subdivision
Silversides Beach
Silversides R.d.
Waverley Road
Rolling Hills
Elmsdale
Beechcrest
Stonemount Subdivision
Lakeview Road
Lakeview
Powder Mill Lake
Rocky Lake
Lake William
Trailer
Abandoned Dilapitated Magazine
Unfinished Structure
Buffer Zone
Closest Residential Building
Ambassador RV
Mobile Ready Mix Cement Plant
Alpha Chemicals
Duke Street
Concrete Plant
Concrete Plant
Lily Lake
CN Rail
N

Project Features

- Proposed Sovereign Resources Quarry 800m Buffer
- Approved Sovereign Resources Quarry 800m Buffer
- Proposed Sovereign Resources Quarry Modification Area
- Approved Sovereign Resources Quarry
- Approved Municipal Quarry
- Exisitng Quarry

Land Use Features

- Powder Mill Park
- Storage Container and/or Stone Magazine

Topographic Features

- Building
- Elevation Contour (m)
- Stream
- Waterbody
- Property Boundary

Topographic Data Source: Nova Scotia Digital Topographic Database (NSTDB) from Service Nova Scotia. Elevation contour data is at 5 metre intervals

Scale 1:20,000

0 250 500 750 1000

Metres

Map Parameters
Projection: 3° MTM
Datum: ATS77
Zone: 5
Date: March 2005
Project: NSD17650

Jacques Whitford

Residential Land Use

Residential land use in the immediate vicinity (*i.e.*, within one kilometre) of the quarry is limited. For the most part, residential development in the study area is dominated by subdivision patterns or village style, rather than linear development along existing roads. The closest residential areas from the Sovereign Resources quarry modification area in order of proximity are Waverley on Rocky Lake Drive (generally more than one kilometre), Lakeview (generally more than one kilometre, with the nearest residence 730 m away and already within the 800 m setback distance of the existing quarry), and residential development across Lake William (> 1.5 km). No additional residences are located within the 800 m setback distance as a result of the Modification Project. Based on Nova Scotia Topographic Database information from Service Nova Scotia there are eight buildings within 500 m of the quarry boundary (none residential and all located on lands owned by the Municipal Group of Companies); 36 buildings within one kilometre (17 residential, 16 of which are between 800 m and one kilometre); 148 buildings within 1.5 km (125 residences) and 522 buildings within two kilometres (484 residential)**.** Figure 5.9 shows the residential areas and location of structures relative to the proposed quarry boundaries.

Institutional Land Use

Due to public concerns raised at the public open house session for this Project, institutional land use is considered in this EA with specific regard to the Waverley Memorial-LC Skerry Schools. These elementary schools are located approximately 1.2 km from the proposed Sovereign Resources quarry area. Some version of these schools have been in operation at this site since the 1880s. The school population is approximately 300 for the last twenty years and serves the three main areas of the Waverley core, Waverley Road/Montague/Spider Lake, and Lakeview.

Recreational Land Use

Forested lands north of the proposed expansion area contain a few, unmaintained, walking trails which are informally used for hiking and dog-walking (A. Bone pers. comm. 2004).

Farther north along Rocky Lake Drive, approximately 1.2 km from the existing Sovereign Resources quarry, there is a small roadside rest stop on Powder Mill Lake called Powder Mill Park (Figure 5.9). Although this land is privately owned, the park is maintained by the Waverley Ratepayers Association. Another recreational land use in the area is Silverside Beach which is a private beach for residents of Silverside Subdivision, located along the eastern side of Lake William, near the northern entrance of the subdivision (Figure 5.9).

The Shubenacadie Canal Commission, in association with Canoe to Sea, is proposing to extend the Shubenacadie trail system which currently ends at Lake Charles (A. Bone pers. comm. 2004, A. Billard pers. comm. 2005). Over the next three to four years, the Commission is proposing to build a trail system from Lake Charles to Waverley. This trail project includes an extension of the existing trail at Lake Charles north, along the west side of Lake William ending at the village of Waverley on Rocky Lake Drive (OCL 2004). The trail will be approximately 6 km and is intended to serve as a hiking/recreational use trail. At various locations along the route, three to five side trails (total distance of 1.8 km) will be constructed to the ends of small peninsulae and other sites to provide access and visual perspectives of Lake William (OCL 2004). Construction is proposed to begin in 2005, with the full Lake William Trail tentatively scheduled to be officially opened in July 2006. The majority of this trail is proposed to be located between the proposed Project and Lake William on lands owned by Sovereign Resources which are designated to be undeveloped buffer lands for the duration of quarry operations if EA approval is granted.

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

Land Use Zoning

The MPS (HRM 1989b) recognizes the value of aggregate operations, but raises concerns with the location of these uses close to rapidly growing residential areas. Municipalities do not have the authority, under the *Municipal Government Act*, to control the location of pits and quarries. However, within the MPS, Policies 134 to 136 state the intent of Council to control the locations of aggregate operations should the Province empower the Municipality to regulate the location of pits and quarries (HRM 1989b). Specifically, the MPS states that additional exploitation of deposits in the southern area of the Plan Area will create severe long-term conflicts with the expanding residential communities (P-134), and that if empowered, Council would permit the development of new pits and quarries only in those portions of the Resource Designation located in the vicinity of Oldham and Goffs Roads and east of the Halifax International Airport (P-135). Discussions with HRM planning staff confirmed that the intent of these policies was to control expansion of the Tidewater Quarry (currently owned by Sovereign Resources Inc.).

Although it would appear from these policies, that the municipality, if empowered, would prohibit the proposed Project in this location, it is important to note that the proposed Sovereign Resources quarry Modification Project is unique in that crushing of blasted rock and hauling of rock aggregate will be conducted at/from the Municipal Enterprises quarry and the Project it is not expected to result in an increase in aggregate production rates and trucking volumes at the existing adjacent Municipal Enterprises quarry. These two aspects of the Sovereign Resources proposal (*i.e.*, no net increase in production/trucking and crushing at the Municipal Enterprises quarry) differentiate it from the previous Tidewater proposal that the HRM policies were intended to prevent.

Impacts on Land Use

An analysis of the potential effects of the Project on land use must consider those activities that have the potential to impact the use and enjoyment of property from an individual landowner as well as a community perspective. For example, it is important to consider compatibility with existing land uses, taking into consideration specific Project activities, including, but not limited to, blasting operations.

Since the Project involves continuation and expansion of an existing quarry, these Project activities already co-exist with existing land uses in surrounding communities. As per the Pit and Quarry Guidelines (NSDOE 1999), a separation distance of 800 m must be in place from the working face (*i.e.*, blasting point) to the foundation or base of a structure located off site. This distance can be reduced with written consent from all individuals owning structures within 800 m. There are several structures located within 800 m of the existing approved Sovereign Resources quarry and the Municipal Enterprises quarry. As shown on Figure 5.9, the buffer zone associated with the proposed expansion area includes an additional three existing structures not already contained within the existing buffer zones. All of these structures are storage containers and magazines. There are no residential structures within 800 m of the proposed boundary that are not already within 800 m of the existing approved Sovereign Resources quarry boundaries.

Blasting operations associated with the proposed expansion will be conducted in accordance with the Pit and Quarry Guidelines (NSDOE 1999). Blasting will be conducted in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act*. A pre-blast survey will be conducted, if required, in accordance with the NSEL Procedure for Conducting a Pre-Blast Survey. It is understood that additional blast monitoring activities and/or reporting may be required by NSEL.

There will be no crushing equipment on site. All crushing of aggregate from the Sovereign Resources quarry will be conducted at the approved Municipal Enterprises quarry. This element of the Project design greatly reduces potential dust emissions. Also, since trucks hauling aggregate will exit to Rocky Lake Drive via the Municipal Enterprises quarry, the potential for effects on adjacent land uses related to dust emissions is further reduced. Section 5.1 contains additional information on the potential air quality issues and Section 5.2 contains additional information on potential noise issues.

There is not likely to be any adverse effects on the Waverley Memorial/LC Skerry Schools since the schools have successfully co-existed with quarrying activity in the past, the school site is located approximately 1.2 km from the proposed quarry area (approximately 600 m closer than previous quarry activity), blasting will be conducted at mid-day and in accordance with applicable regulatory requirements, quarry traffic volume and routes are not proposed to change from current conditions experienced at the Municipal Enterprises quarry, and there will be no crushing activity at the Sovereign

Resources quarry. Therefore, there are no predicted significant adverse environmental effects on institutional land use in the study area.

Since the Project is located in an industrial area, the few residential properties within 800 m of the proposed quarry boundary are already located within 800 m of the approved quarry boundary, and the volume of trucks and location of crushing operations is not proposed to change from existing (Municipal Enterprises) operations, there are not likely to be any significant adverse environmental effects on existing residential, industrial and commercial land use.

Property Values

A particular concern that has been raised by residents in the Waverley area is the predicted effect on property values. There are many factors, particularly the general demand for residential properties, which can affect the value of properties. Property values can therefore never be guaranteed. The general area has included various forms of industrial activity including quarrying, for many years. The proposed quarry modification will not appreciably change the overall level of industrial activity or proximity of much of that activity (*e.g.*, crushing, trucking) compared with current levels. The working face of the quarry will come closer to some residential areas over the course of many years as compared with the quarry working face today at the approved Sovereign Resources quarry. However, all residential areas currently beyond the 800 m setback will continue to remain well beyond that setback. In addition, upon Project approval, Sovereign Resources has set aside additional land as an undeveloped buffer zone to quarry activities that will further protect residential areas from Project-related effects (refer to Figure 5.9).

A review of literature examining case studies of properties within proximity to sand and gravel quarries in the United States made the following conclusions:

- Properties adjacent to quarry operations that are buffered by 100+ feet have no difference in value compared to properties removed from the operation. In some instances values near a quarry are higher since market often prefers open space versus neighbors on all sides (McKown 1995).
- Properties next to a service road with quarry traffic and with a 100+ foot buffer reflect no difference in value compared to similar properties located away from the road (McKown 1995).
- Properties next to a service road with quarry traffic to and from a quarry with no buffer reflect values from 0%-11% less than similar properties not having the unbuffered traffic influence. If there is already a volume of heavy truck traffic and/or large vehicles from sources other than the quarry, the value difference is 0%-5% (McKown 1995).
- If a quarry is properly developed there were no positive or negative impacts on the value of housing adjacent to the operation. Some homeowners suggested there is a benefit of being near a quarry because of the open space and wooded areas used to buffer operations (Rabianski and Carn 1987).

Studies have shown that consumer satisfaction and resultant housing values are strongly affected by positive and negative externalities. Where quarries are properly developed with control measures in place to reduce or eliminate negative externalities (*e.g.*, air quality, noise, vibration, visual qualities), there are no significant adverse impacts on the values of homes (Rabianski and Carn 1987).

Recreational Land Use

The Project is not predicted to have an adverse impact on recreation and tourism in the area. Lands within the proposed quarry area are not currently used for recreation and the Project does not affect continued use of adjacent lands for dog-walking or proposed trail development.

The EIA for the Lake William Trail project acknowledges the proposed modification of the Sovereign Resources quarry and states an 800 m buffer zone would provide adequate separation of the trail from future quarry operations (OCL 2004, p. 22). It is likely that portions of the proposed trail will fall within the 800 m buffer zone. However, this buffer is intended to protect structures from potential quarry activities and infringement of the trail on this buffer is not predicted to result in any adverse effects. The Project may actually have a potential positive effect on recreational land use given the designation of the undeveloped forested land between the proposed Project area and Lake William as a buffer zone. It is likely that this land may have otherwise been developed in the absence of the Project.

Summary

In summary, due to implementation of proposed mitigation and monitoring and Project design (*i.e.*, use of existing Municipal Enterprises quarry for crushing and trucking activities and designation of additional buffer lands), there is not likely to be any significant adverse effects to existing land use as a result of the Project.

5.9 Visual Environment

Visual environment was identified as a VSC for this assessment primarily due to concerns raised during public and stakeholder consultations. The proposed Project will result in changes to the existing visual landscape which is considered to be a valued resource, particularly to residents living in the Waverley area. To address some of these concerns, a visual impact assessment has been conducted to estimate, in perspective view, the potential visual effect of proposed quarry operations on the scenic landscape. Appendix J contains the graphic presentation of the visual impact assessment.

5.9.1 Description of Existing Environment

Some residences, particularly along Waverley Road and in Silversides and Frame Subdivisions, have been designed to take advantage of the view of Lake William. Appendix K contains photographs taken from various vantage points in Waverley, looking across Lake William. Currently, from a Waverley viewing perspective, a gently sloping forested hill serves as the backdrop of a virtually undeveloped, Lake William. These elevated lands across Lake William to the west and southwest are currently owned by Sovereign Resources.

The current viewscape is regarded by many local residents as a valued resource which contributes to the enjoyment of their property and community. Although the view of Lake William and lands to the west is not visible from all residential properties in Waverley, local residents and commuters are also able to enjoy the current view while travelling along the Waverley Road through the community. These viewscapes, as with most viewplanes in Nova Scotia, are not protected by legislation.

Sovereign Resources recently acquired the parcel of land between the proposed quarry area and Lake William, in part, to protect the viewscape of Waverley area residents.

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

Visual impacts relate to changes in views of the landscape and the effects of those changes on people. They arise from changes in land use, development of buildings and structures, changes in land management, and less commonly, changes in production process and emissions (Zhang *et al.* 2000).

In general, the visual impact assessment of a proposed development addresses three types of issues:

- *spatial issues* include from where the development is visible or to what or to whom it is visible;
- *quantitative issues* include how much of the development is visible, how much of the surrounding area is affected and to what degree; and
- *qualitative issues* include the visual character of the development and its compatibility with its surroundings (Kaliampakos and Menegaki undated).

Viewer sensitivity (*i.e.*, concern for scenic quality and response to change in visual resources that make up the view) is regarded as relatively high in Waverley. Approximately 39% of respondents present at the public open house indicated potential visual impacts of the Project as a concern, with the majority of this subset of respondents residing in Silversides Subdivision. The two main concerns raised by these respondents included potential visual exposure of the Sovereign Resources quarry (or adjacent Municipal Enterprises quarry) and lowering of the horizon along the western shore of Lake William as a result of quarrying activity toward the northeastern boundary.

There are currently no guidelines for visual impact assessment in Canada or Nova Scotia. The Province of British Columbia has published a Visual Impact Assessment Guidebook (Government of British Columbia 2001) as part of their Forest Practices Code. This Guidebook applies specifically to forest harvesting and planning and is not particularly relevant to visual impact assessment of industrial developments. To help address spatial and quantitative issues, the EA Study Team used Geographic Information System (GIS) modelling tools to create projective and reflective mapping, supported by ground-truthing (*i.e.*, windshield reconnaissance, photography from select viewpoints).

In recognition of the high level of expressed community concern regarding potential visual impacts, the EA Study Team undertook and extensive visual impact assessment modelling exercise for this Project.

Using provincial topography and groundcover data, a spatial model was created using computer modelling software (ESRI ArcGIS and ESRI Spatial Analyst). The following assumptions were built into the model:

- vegetative cover remains in currently vegetated areas outside the proposed quarry boundaries;
- all vegetative cover within the proposed quarry boundaries is removed;
- where vegetation is present, it is assumed to be a height of eight metres;
- total quarry development including Sovereign Resources quarry and adjacent Municipal Enterprises' Rocky Lake quarry down to an elevation of 50 m ASL; and
- no progressive reclamation of either quarry.

Using these assumptions, the model is considered to be a worse-case scenario, since in most vegetated areas, particularly around Lake William, the vegetation is very dense and considerably taller than eight metres. Also, while it is likely that the Municipal Enterprises quarry will develop in a northeast direction, joining the Sovereign Resources quarry, there will never be total development of both quarries without progressive reclamation at both sites. Therefore, the model assumes a larger excavated footprint than what would actually be present at any given time.

Projective mapping was initiated from viewpoints within the development (inside looking out) to reveal the potential extent of visibility of the development to its surroundings and therefore, inferring from where the quarry is potentially visible. A preliminary analysis at a small scale (*i.e.*, 1:45,000) revealed that residential areas most potentially affected include residential developments in Fall River, Lakeview, and Waverley. Subsequent ground-truthing from Fall River revealed that in many cases, actual forest cover obstructs the view in question. However, regardless of forest cover, these areas are located more than five kilometres away from the quarry site; therefore while the quarry could be potentially visible, it would be so at such a distance that it does not comprise a significant portion of a resident's view.

A subsequent analysis was then conducted at a larger scale (1:20,000) with greater accuracy (one metre), concentrating on Lakeview and Waverley areas (refer to Figure 1 Appendix J). Areas shaded in green denote potential areas from which the Sovereign Resources quarry may be visible. Based on these results, it was predicted that approximately ten homes along the eastern side of Lake William (including but not limited to Frame Subdivision, Silversides Subdivision) would be visible from the Sovereign Resources quarry (and likewise, the quarry would be visible from these homes). A similar analysis was conducted projecting from the Municipal Enterprises quarry only, assuming total development of both quarries (*i.e.*, a cumulative effect). From viewpoints within the Municipal Enterprises quarry, an additional 13 homes were identified as being within view of the quarry. It is therefore predicted that a portion of either quarry will be visible from approximately 23 homes along the eastern side of Lake William (Waverley). Based on an approximate count of 309 homes in this area (Figure 1), approximately 7.4% of residences will have some view of a quarry. As noted, the view of a quarry is based on several worse-case scenario assumptions and the views from the 23 homes occurs at a distance of approximately two to three kilometres and may be partially obscured by existing vegetation.

Considering the Lakeview area between Rocky Lake and Cobequid Road, it is predicted that the Sovereign Resources quarry will be visible from approximately 15 homes. Approximately 42 homes within this same area would have some view of the Municipal Enterprises quarry. It is worth noting however, that approximately 39 of these homes currently have a view of the Municipal Enterprises quarry. Therefore, since it appears that the Project (*i.e.*, development of the Sovereign Resources quarry) does not appreciably increase the number of homes with a view of the Municipal Enterprises quarry in the Lakeview area, visibility of the Municipal Enterprises quarry is not considered further for this area. Based on an approximate count of 516 homes in this area, approximately 2.9% of residences will have some view of the Sovereign Resources quarry.

This projective mapping exercise, completed in response to public feedback on preliminary viewshed analysis results presented at the open house, helped to validate the scope of the visual impact assessment (*i.e.*, geographic areas within visual reference of the Project) and confirm appropriate viewpoint locations for reflective mapping. Reflective mapping, initiated from viewpoints in the surrounding landscape (outside looking in) was then conducted from various locations to help confirm whether, and to what extent, the quarry development would be visible from its surroundings. Figures 2 to 6 in Appendix J present reflective mapping from specific viewpoints deemed to be most potentially visually affected by the quarry development, as determined by Figure 1.

The reflective mapping presented in Appendix J is more refined than that presented at the public open house in December 2004 as it was conducted at a one metre level of accuracy, and used more specific viewpoints instead of “blending” data. Viewpoints were taken from residences rather than roads since it was noted during ground-truthing that many homes are elevated several metres above or below road level (particularly along Waverley Road, and several locations within Silversides Subdivision).

Figure 2 in Appendix J predicts the view from an elevated location on Beechcrest Drive in Frame Subdivision, approximately 2.2 km from the Sovereign Resources quarry proposed boundary. Although the mapping does not reflect the current extent of Beechcrest or the recent development of Brookfalls Court, the ground-truthing exercise identified the most appropriate (*i.e.*, potentially affected) viewpoint for this analysis. As shown on Figure 2, there will be small areas of the Municipal Enterprises quarry that will eventually be visible from the selected viewpoint (cumulative effect). The distance to the closest visible point from the viewpoint is 4.3 km. No portions of the proposed Sovereign Resources quarry area are predicted to be visible.

Figure 3 predicts the view from a point on Elmsridge Drive in Silversides Subdivision, approximately 2.1 km from the proposed boundary. Although this road is at a relatively high elevation, the existing vegetation surrounding the houses obscure the view of Lake William such that, even without leaf cover, only an outline of the existing horizon is partially visible. Figure 3 predicts that neither the Municipal Enterprises or Sovereign Resources quarry will be visible from this viewpoint.

Figures 4 and 5 present views from various viewpoints on Rolling Hills Drive (approximately 1.9 km and 1.8 km respectively from the Sovereign Resources quarry proposed boundary). The first viewpoint (Figure 4) is located near the beginning of Rolling Hills Drive and predicts little of the Sovereign Resources quarry will be visible, but a larger extent of the Municipal Enterprises quarry will be visible. The distance to the closest visible point from this viewpoint is 2.9 km. Figure 5 shows viewpoints from the two highest and relatively exposed residences along Rolling Hills Drive. From these residences, it is predicted that some portion of the Municipal Enterprises quarry and the Sovereign Resources quarry may be visible. The distance to the closest visible point from this viewpoint is 2.7 km. These viewing locations are predicted to be the most affected residences in Silversides with respect to viewshed effects.

Figure 6 shows a viewpoint in the Lakeview area, just north of Highway 102, approximately 1.9 km from the Sovereign Resources quarry proposed boundary. This viewpoint was selected due to its high elevation and was identified during the ground-truthing exercise as an area potentially affected by visual effects. Although the mapping does not reflect current development in this area, the viewpoint selected is located in a residentially developed area. The distance to the closest visible point from this viewpoint is 2.2 km. It is noted that the existing Municipal Enterprises quarry is currently visible from this viewpoint though the view of the quarry will be increased as quarry footprints expand. Residences in this area also currently have a view of the four-lane Highway 102 as it runs relatively close to these homes.

As noted above, approximately 23 homes in the Lake William area will experience some visibility of either the Sovereign Resources or Municipal Enterprises quarry and approximately 15 homes in the Lakeview area will experience some visibility of the Sovereign Resources quarry. The extent of the visibility varies depending on the viewpoint. Distances to the closest visible point ranges from 2.2 km

(Lakeview) to 4.3 km (Beechcrest). These results are based on the worse-case scenario modelling assumptions listed above (*e.g.*, no progressive reclamation, total quarry development of both quarries) and assume no mitigation. It should be noted that the actual extent of these visibility effects are further based on the quarry development plan which will be developed in the future. However, it can be assumed that visibility effects will be experienced gradually over a 50 year time period with the final results predicted as shown on Figures 2 to 6 (assuming no mitigation and/or progressive reclamation).

The primary form of mitigation for visibility effects is implementation of a progressive reclamation plan (Section 2.7) which will include sloping and revegetation of areas of the quarry no longer needed for quarry activities. In addition to progressive reclamation, Sovereign Resources will investigate the feasibility of planting relatively taller species of trees along some portions of the quarry boundary to further screen views into the quarry. Also, since there will be no crushing at the Sovereign Resources quarry, there will be less infrastructure and lighting that would otherwise be present and potentially visible. As noted in Section 2.2, the importance of views was noted during the public and stakeholder consultations and significant design modifications were made in order to reduce visual impacts at the expense of land with potential to be quarried (*i.e.*, to maintain the 50 m contour). Other aspects of the Project which will also protect views from east of Lake William include the commitment by Sovereign Resources, upon Project approval, to maintain a significant buffer zone of undeveloped lands to be protected from future development and associated visual impacts.

The projective and reflective mapping results address the first concern regarding visual exposure of the quarry, but do not directly address the concern regarding the lowering of the horizon.

A three-dimensional model was used to demonstrate the existing elevation levels in the proposed quarry modification area as well as the predicted level of change in the horizon given total development of the quarry to 50 m ASL.

As the current topography varies, the resulting differences in the horizon post-quarry development will also fluctuate, depending on location. The model indicated that, depending on location, the percentage of vertical horizon change will range from less than a 15% change to a 40% change. The area most affected with regard to horizon change (35 to 40% change) are elevated areas with an unobstructed view between the viewpoint 1 and viewpoint 2, in Silversides Subdivision (refer to Figures 4 and 5 in Appendix J).

Horizon change effects may be perceived to be secondary to quarry visibility effects since the visual integrity of the landscape does not change (*i.e.*, landscape remains intact, without encroachment of anthropogenic features). As with visibility effects, the change in horizon will occur at a distance of several kilometres.

While the lowering of the horizon for some views will be difficult to mitigate completely, it is assumed that the mitigative measures for visibility effects (*e.g.*, revegetation, possible tree screening, 50 m contour, undeveloped buffer zone) will also help to mitigate horizon effects and/or reduce overall visual impacts.

In summary, the proposed Project will result in adverse environmental effects on the visual environment. However, these effects are not considered to be significant given the fact that they will occur gradually over a long time period (*e.g.*, 50 years) and, in the case of quarry visibility, will affect a relatively small percentage of the communities. In the case of horizon change effects, a greater portion of the community will be affected, however, the effects are gradual and visual integrity of the viewshed will not be affected (*e.g.*, the vegetated viewscape will be maintained). As discussed above, mitigation including, but not limited to, progressive reclamation of both quarries and maintenance of the undeveloped buffer lands, will help to minimize visual effects.

5.10 Archaeological and Heritage Resources

Archaeological and Heritage Resources is a VSC in recognition of stakeholder interest in ensuring the effective management of these resources. For the purposes of this assessment, archaeological and heritage resources are defined as any physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. These resources may be from the earliest prehistoric times of human occupation of the study area, up to the relatively recent past and include both built and depositional resources.

5.10.1 Description of Existing Environment

In October of 2004, Jacques Whitford conducted an archaeological impact assessment of the proposed modification area. The object of the assessment was to identify any archaeological resources within the study area and determine the nature and extent of any impacts the resources may receive from the proposed project.

Background research was followed by a field survey of the proposed quarry area. The background research included reviews of existing impact assessment documents, research at the Public Archives of Nova Scotia and the Nova Scotia Museum (NSM). The fieldwork consisted of a pedestrian survey of the proposed quarry area.

Historical Background Research

Mi'kmaq Period

There are no Aboriginal archaeology sites recorded within the study area according to the NSM archaeological sites database. However, the study area is close to three identified pre-Contact archaeological sites, recorded in the Maritime Archaeological Resource Inventory (MARI) database at the NSM; none fall within the study area. Two of the three sites lay at the northern end of Lake William, near where the river empties between that lake and Fish Lake. The third site is at the southern end of Lake William. There do not appear to be any resources located within the study area that would have attracted the Mi'kmaq. There are no major watercourses running through the area, for example. It seems evident that the majority of resources for the Mi'kmaq would have been along the Shubenacadie river system, which includes Lake William.

Contacts have been made with the Union of Nova Scotia Indians (UNSI), the Confederacy of Mainland Mi'kmaq (CMM) and the Treaty and Aboriginal Rights Research Centre (TARR Centre) to ascertain whether current Mi'kmaq knowledge might indicate as yet undetected archaeological resources in the study area. At the time of writing no response has been received. The Millbrook Band Council was also consulted regarding the Project. As evidenced by the letter of correspondence from Chief Lawrence Paul (Appendix L), Millbrook First Nation does not foresee any conflict with this Project.

Historic Period

The first grantees of the land covered by the study area appeared in the eighteenth-century. The grantees names included George and Joseph Scott (the major landholders in the area), Alex Stephane and F.S. Coombs. The Sackville area, in the eighteenth-century was used largely for farming (Harvey 2002). As such, the few structures that were to be found in the area at that time were likely close to the few roads in the area (*e.g.*, the Road to Windsor and the Old Cobequid Road). Neither of these roads pass through or near the study area. A search of maps dating from the first quarter of the nineteenth-century has yielded no evidence for structures in the study area, save for one "potential structure" recorded on the A.F. Church Map (1864). The point that appears in the northernmost corner of the study area bears no label, unlike the many other points on Church's maps, so this "potential structure" may simply be a mapping imperfection.

Between the time of the original land grants and A.F. Church's map, a canal from Bedford Basin to Lake William was proposed. It was never completed, but the map that was built to accompany the proposal (Gill 1814) covers the edge of the Bedford Basin through to Lake William and past to Fish Lake (then known as Gaspereau Lake), Rocky Lake and Lily Lake (then known as Pace's Pond). Therefore, this early nineteenth-century map may represent the landscape and its development at that

time. A label on the 1814 map refers to the study area as simply "Rocky Barren Land". This seems to indicate that the study area was not likely used for farming.

The adjacent area was the location of the Acadia Powder Company, a black powder and dynamite manufacturing company that was established in 1862. The company expanded into the Rocky Lake area in 1885 where dynamite was manufactured. In 1910, the company was acquired by Canadian Explosives Ltd., which was renamed Canadian Industrials Ltd. (C-I-L) in 1927. One stone structure relating to the Acadian Powder Company, believed to be a powder magazine, is located within the proposed boundary modification area. This site is discussed in more detail below.

Geological survey maps from the turn of the century (1897 – 1909) by Fletcher and Faribault show no structures in the study area, though two appear between the northern tip of Lake William and the northeastern corner of Rocky Lake. It is unclear when these structures appeared or how far from them the general human activity associated with them might have occurred. The research completed in the archival holdings of Nova Scotia Archives and Records Management (NSARM) suggests that the potential for historic European-descendent resources in the study area is low.

Archaeological Potential

Mi'kmaq Potential

Background research indicated that there was a low potential for the study area containing any archaeological resources associated with the Mi'kmaq period.

Historic Potential

Background research indicated that there is a low potential for the study area containing any archaeological resources associated with the historic period.

Field Survey

Methodology

The field portion of the archaeological impact assessment consisted of a pedestrian survey by two archaeologists within the study area. The survey began at a point off Rocky Lake drive that was the northeast corner of the study area. The objective of the survey was to locate an apparent north-south running powerline cut that basically bisected the study area. It was felt, given the low potential of the area as determined by the background research, that following this line would give a good indication of the validity of that potential. The site of the old powder magazine was also examined.

The powder magazine is located approximately 100 m southwest of the road that leads into the powerline (Photos 1 and 2 in Appendix M). The building is stone construction with a wooden framed roof. It is in poor condition and the roof is very unstable. The stone walls are intact, however, and appear stable.

In the search for the powerline, a well-traveled north-south running trail was discovered where the powerline was approximately located. It was determined during the survey that this path ran roughly parallel to the powerline, which had been abandoned and the poles cut down. The re-growth of the vegetation had obscured the old line cut. During the survey along the path, no major body of water was encountered. The forest is mixed hardwood and softwood and the land is dominated by outcroppings of bedrock. Travel through these woods a couple of hundred years ago would have been extremely difficult. The obvious and easiest means of travel would have been along the nearby lakes and rivers outside the study area.

There were no potential archaeological resources observed during the survey. It was noted that the path was very well-maintained and in places had been levelled and supported using rocks. There is every reason to believe that this trail likely dates to the first building of the power/telegraph line. The trail was surveyed for a total of two kilometers, when it became very obscure. At the end of the survey it was concluded that the area did indeed have low potential for containing archaeological resources of any kind.

The results of this field survey were consistent with findings of a previous survey conducted on behalf of Tidewater in 1984 where the archaeologist (S. Davis) stated that he believed the entire development area is free of any cultural resources (Davis 1984). However, the past proposed Tidewater development area boundaries fall within, but do not cover, the entire area proposed by Sovereign Resources.

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

The Project will result in surficial or subsurface disturbance which could affect archaeological and heritage resource sites, if present. These disturbances, if unmitigated, could result in the loss of the resource and the potential knowledge to be gained from its interpretation. As noted in Section 5.10.1, the only historic resource identified within the study area was the late nineteenth century powder magazine.

While the walls of the structure appear stable enough, the roof may collapse as a result of vibrations associated with nearby blasting at the quarry. However, this structure is in close proximity to Wetland 22 which will be protected by a minimum 30 m buffer zone, so the building will be afforded some protection from blasting and other quarry activity. It is also worth noting that this structure is

located approximately 170 m from the existing quarry on the Sovereign Resources site (*i.e.*, former Tidewater quarry).

The remaining area has low potential for containing archaeological resources. No significant adverse residual environmental effects on archaeological and heritage resources from this Project.

5.11 Other Undertakings in the Area

Other undertakings in the area with which the proposed Project could interact to create cumulative environmental and socio-economic effects include the Municipal Enterprises Rocky Lake quarry, an asphalt plant, and Envirosoil (remediation plant) on adjacent property owned by the Municipal Group, the former explosives storage on adjacent properties, a bulk tank farm (Alpha Chemical Limited) and the Conrad Bros. Ltd. quarry.

Sovereign Resources, through its Project design, has taken measures to minimize cumulative effects of its proposed Project. Modification of the Sovereign Resources quarry is not expected to result in an increase in aggregate production and trucking at the existing adjacent Municipal Enterprises quarry. That is, the volume of aggregate produced, and hence the volume of truck traffic on Rocky Lake Drive, will not increase as a result of the Project. Furthermore, all truck traffic associated with the removal of rock aggregate from the Sovereign Resources quarry will enter and exit through the Municipal Enterprises quarry. Cumulative effects, therefore are limited to the cumulative loss of habitat that will occur over several years as the footprints of the quarries increase. It is important to note, however, that this loss of habitat will slowly occur over several years (*e.g.*, > 50 years) and both quarries will undergo progressive reclamation so the amount of exposed quarry will be limited in area at any given time. Sovereign Resources has also undertaken to maintain undeveloped lands surrounding the quarry as buffer zone which will serve to preserve habitat within these lands.

Land northwest of the Sovereign Resources quarry, that currently house explosive magazines are in the process of being remediated. There are no predicted cumulative effects associated with this activity.

Alpha Chemical Limited recently (December 14, 2004) received EA approval for a bulk tank farm, blending, packaging and storing facility on Rocky Lake Drive. This facility is to be located at 533 Rocky Lake Drive directly in front (roadside) of the Municipal Enterprises quarry, across the road from Rocky Lake. The purpose of this project is to construct a bulk storage, handling, blending and packaging facility for products sold to the offshore oil and gas sector. Once the facility is in operation and ready for handling the bulk material, there will be an estimated traffic volume of 5-10 trucks/day leaving the facility. Potential environmental effects of this undertaking include air emissions (*e.g.*, vapour release during transfer, storage and blending of volatile liquids), water withdrawal and release from/to an onsite pond, and in the case of an accidental uncontrolled release of product, potential land

and water contamination. The EA Registration document and addendum filed by the proponent and conditions of approval contain various mitigation and monitoring controls to minimize potential environmental effects of this undertaking. The proposed Sovereign Resources quarry is not predicted to interact cumulatively with this undertaking and result in any significant cumulative adverse environmental effect.

Conrad Bros. Ltd. operates a quarry approximately two kilometres south of Lake William, in the Portobello area. This quarry has been in operation since 1956 and is one of the largest rock quarries in Nova Scotia. Since 1995, the Conrad Group has operated SRT Soils Remediation Technologies Ltd., a hydrocarbon contaminated soil treatment facility, and Conrad Transport, a container transport company, from this location as well. Cumulative effects with the Sovereign Resources quarry include air emissions (*e.g.*, dust) and noise.

Other proposed undertakings in the area include the proposed Sackville Expressway, and proposed relocation of the Brightwood Golf Course to Anderson Lake. These projects are at various stages of planning, but neither have received approvals to proceed at the time of EA Report preparation.

6.0 EFFECTS OF THE PROJECT ON THE ENVIRONMENT

Section 5 discusses the potential effects of the Project on the ecological and socio-economic environment. Table 6.1 summarizes the predicted effects and proposed mitigation, monitoring and follow up.

Table 6.1 Summary of Environmental Effects, Mitigation and Monitoring

VEC/VSC	Potential Effects	Mitigation, Monitoring and Follow-up	Residual Environmental Effect
Air Quality	• Particulate emissions	• Dust control measures • Reduction of CO_2, SO_2 and NO_x emissions through proper equipment maintenance and reduction of idling • Dust monitoring program • Complaint Resolution Program	Not Significant
Noise and Vibration	• Noise emissions • Structural damage from blasting	• Blasting in accordance with Pit and Quarry Guidelines (including 800 m buffer zone) • Maintain undeveloped buffer lands • Regular blasting schedule (*i.e.*, mid-day) • Avoidance of blasting during temperature inversion conditions • Minimization of activity at night • Consideration of berms, plantings during quarry development and reclamation to minimize noise transmission • Complaint Resolution Program • Noise and vibration monitoring program	Not Significant
Groundwater Resources	• Impacts to groundwater quality and quantity	• Blasting in accordance with Pit and Quarry Guidelines (including 800 m buffer zone) • Pre-Blast Survey • Monitoring wells • Complaint Resolution Program • Provision of drinking water and well repair/replacement as required	Not Significant
Surface Water and Hydrology	• Reduced water quality from sedimentation/siltation, deposition of fines and acid drainage • Heavy metal contamination • Introduction of contaminants (*e.g.*, nitrate) from blasting operations • Introduction of petroleum hydrocarbons and other chemical releases from within the quarry area • A reduction in groundwater base flow • Alteration of flow regime	• Liquid effluent and air quality monitoring as required by Pit and Quarry Guidelines • Quarry Development Plan specifying design and location of flow retention structures • Erosion and sediment control measures • Establishment of baseline conditions and ongoing monitoring program for fish and fish habitat.	Not Significant

Table 6.1 Summary of Environmental Effects, Mitigation and Monitoring			
VEC/VSC	**Potential Effects**	**Mitigation, Monitoring and Follow-up**	**Residual Environmental Effect**
Wetlands	• Loss of wetland habitat	• Avoidance of Wetlands 9 and 22 • Monitoring of hydrologic effects at some wetlands • Wetland Mitigation Program	Not Significant
Rare and Sensitive Flora	• Mortality • Loss of habitat • Introduction of invasive species	• Avoidance of Wetland 22 • Rare plant re-evaluation prior to quarrying in subwatershed • Reclamation Plan using native species	Not Significant
Wildlife	• Mortality • Noise disturbance • Habitat loss	• Clearing outside bird breeding season • Follow-up survey for Northern Goshawk nest and establishment of buffer zone if required • Avoidance of Wetlands 9 and 26	Not Significant
Land Use	• Noise disturbance • Particulate emissions	• Separation distance for blasting of 800 m from structures • Maintaining undeveloped buffer lands • No crushing on site • No trucking offsite from Sovereign Resources quarry	Not Significant
Visual Environment	• Change in view • Visibility of quarry • Changes to horizon	• Modification of quarry boundary to 50 m contour • Progressive reclamation • Consideration of berms and tree plantings to help provide line of sight barriers	Not Significant
Archaeological and Heritage Resources	• Disturbance and/or loss of resources	• > 30 m buffer zone from identified stone structure	Not Significant

Implementation of the proposed mitigation, monitoring and follow-up studies, and adherence to the applicable regulations and approvals will reduce or eliminate any adverse environmental effects. No significant adverse residual environmental effects are therefore likely to occur as a result of this Project. Continued operation of the quarry will result in economic benefits, including continued employment and ongoing business opportunities.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The definition of an environmental effect often includes any change to the project that may be caused by the environment. In the case of a quarry operation, potential effects of the environment on the Project are limited to climate and meteorological conditions, specifically precipitation. Precipitation and runoff may cause temporary delays in quarry construction, operation, and rehabilitation activities.

On a national basis, Canada shows a warming and cooling pattern with a higher overall warming trend of approximately 1.1 ºC since 1895. The Atlantic Region, however, shows a warming trend from 1895 which peaked in the mid-1950s followed by a cooling trend in the 1990s. The overall warming trend of 0.4 ºC in Atlantic Canada since 1895 is not statistically significant. With respect to precipitation, the Atlantic Region shows an overall increasing trend in precipitation since 1948, with an increasing trend in the number of daily precipitation events above 20 mm and a very slightly increasing trend in the number of daily snowfall events above 15 cm (Lewis 1997).

There are a number of planning, design and construction strategies intended to minimize the potential effects of the environment on the Project so that the risk of damage to the Project or interruption of service can be reduced to acceptable levels. Mitigation measures include, but are not limited to, designing and installing erosion and sediment control structures to accommodate appropriate levels of precipitation, and consideration of weather conditions when scheduling activities, including scheduling of activities to accommodate weather interruptions. All Project activities will be taking place out-of-doors and thus weather has been and will be factored into all Project activities. For example, blasting will not be conducted between December and April. Between May and November, blasting activities will also be influenced by atmospheric conditions; blasting will be avoided during conditions of temperature inversions in order to help avoid downward reflection of blasting noise over a larger area.

Although activities may be limited, Sovereign Resources proposes that the quarry remain open year-round, weather depending, and will consider severe winter weather conditions when planning activities. Heavy snowfalls and significant snow accumulation will have an impact on the quarry's ability to remain open.

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

8.0 OTHER APPROVALS REQUIRED

As stated in Section 2.0, the Proponent is required to register this project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. Sovereign Resources will also submit an application for an Industrial (Division V) Approval pursuant to the Activities Designation Regulations and the Approvals Procedure Regulations to reflect the proposed changes to the existing operation and replace the existing approval. A separate (Division VI) approval may also be required for working in wetlands. After a number of years of quarry activities, the Project will approach the Lake William Watershed boundary which includes streams considered to be fish habitat by DFO. At that time, should monitoring determine that fish habitat is affected by Project activities (Section 5.4), an authorization to harmfully alter, disrupt or destroy fish habitat from the Minister of Fisheries and Oceans Canada under Section 35(2) of the *Fisheries Act* may be required.

9.0 FUNDING

The proposed Project will be 100 percent privately funded.

10.0 ADDITIONAL INFORMATION

No additional information is provided in support of this document.

11.0 REFERENCES

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