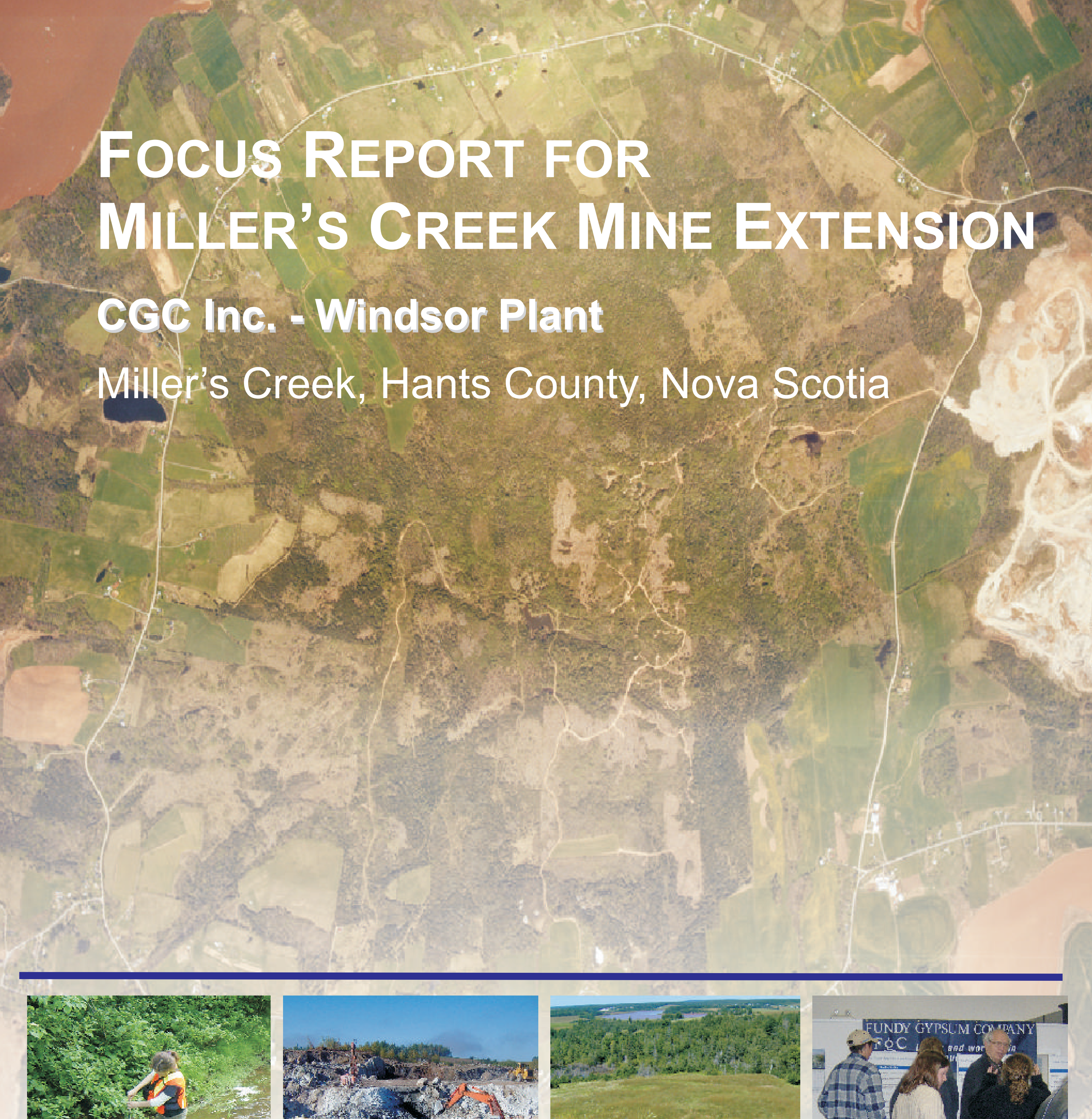

Focus Report for Miller's Creek Mine Extension

CGC Inc. - Windsor Plant

Miller's Creek, Hants County, Nova Scotia

October 2009
Ref No. 820677 (9)

CONESTOGA-ROVERS & ASSOCIATES

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

CGC Inc. - Windsor Plant (CGC) (www.cgcinc.com) has prepared this guide to assist all parties with the review of the Focus Report for the Miller's Creek Mine Extension Project. CGC would first like to thank you for taking time to review the information, and more importantly, contributing to a Project that we feel has been designed with the utmost care and prudence and is a better Project because of the input received from the public through the last four years. We appreciate the time you've taken to date and any more that you may spend in the future to help us have a Project that we can all be proud of.

By way of important background, CGC submitted an Environmental Assessment Registration Document (EARD) on February 21, 2008. This EARD provided Project details and requested that an Environmental Assessment Approval be granted. A review of the EARD was completed by the public and regulators over a 25 day period and a Minister's decision was issued on March 17, 2008. The Minister of Environment and Labour informed CGC by letter that a Focus Report was required to provide additional details on certain aspects of the Project. A copy of this letter has been provided in Appendix A. This letter outlined the fact that a Terms of Reference (TOR) for the Focus Report would be issued detailing the additional information CGC was requested to provide. The TOR is provided in Appendix A as well. It is important to note that the Province felt that only certain aspects of the Miller's Creek Mine Extension Project required additional details. CGC has provided these details and has provided a Concordance Table between the Terms of Reference and Focus Report (Table 1) that shows how CGC has addressed the requirements of Nova Scotia Environment (NSE).

CGC has, since Project inception, felt that public involvement is a key aspect that helps to build a better Project through combining technical, social and environmental aspects of design. CGC has continued on this proactive public consultation path through the development of the Environmental Assessment Registration Document and met with many interested groups and individuals over the past four years specifically on this Project.

BEFORE YOU READ THE FOCUS REPORT – WE STRONGLY ENCOURAGE YOU TO READ THE ENVIRONMENTAL ASSESSMENT REGISTRATION DOCUMENT.

IF YOU DID NOT READ THE ENVIRONMENTAL ASSESSMENT REGISTRATION DOCUMENT DURING THE FEBRUARY-MARCH 2008 REVIEW PERIOD, PLEASE READ THE EARD PROVIDED BEFORE READING THE FOCUS REPORT.

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

Important Points to Keep in Mind

- This document is provided for public review at this location and others as outlined in the Public Notice.
- Please do not write in or otherwise deface this document.
- Please use a reasonable amount of time to review this document if others are waiting to review it also.
- Staff at this facility DO NOT have the authority to answer any questions you may have regarding this document or its contents.
- Comments are important; please provide them according to the NSE instruction.

Organization of the Focus Report

Section 1 provides an introduction to the Focus Report. Section 2 contains the Project Description, including information on the Project site and boundaries, the location of the proposed Project in relation to the existing Miller's Creek Mine, and Project assumptions. Section 3 discusses alternative methods for carrying out the undertaking. Section 4 provides additional information on groundwater, surface water, species-at risk, wetlands, fish and fish habitat, and reclamation. Section 5 provides summaries and conclusions for the issues discussed in Section 4.

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

Table 1: Concordance Table between Terms of Reference and Focus Report

Focus Report Requirement (by section)	Section where Requirement is Specifically Addressed in this Focus Report	Location of Additional Information Related to the Requirement
1.0 INTRODUCTION		
2.0 PROJECT DESCRIPTION		
• Project Site Location	Section 2.2 Figure 2.1	EARD Section 2.2
• Project Site Boundaries	Section 2.2, Figures 2.1, 2.2	
• Location of Proposed Project in Relation to Existing Miller's Creek Mine	Section 2.3 Figure 2.2, 2.2a, 2.2b	
• Project Assumptions	Section 2.4	
3.0 OTHER METHODS FOR CARRYING OUT THE UNDERTAKING		
• Alternative Methods	Section 3.1	EARD Section 3.1.2
• Alternative Methods Considered for This Project Plan showing alternate mine layouts considered	Section 3.2 Figure 3.1	
4.0 ADDITIONAL INFORMATION		
Groundwater	Section 4.1	EARD Section 6.3
• Location and Number of Off-site Wells within Various Radii to 3 km	Figure 4.1-1	
• Cross-section of Proposed Pit Showing Existing and Predicted Water Tables	Figure 4.1-2	
• Groundwater Model for Proposed Pit and Surrounding Area.	Section 4.1.1 Appendix B1 Conceptual Appendix B2 Numerical	
• Predicted Groundwater Flow Rate to Proposed Pit	Section 4.1.2	
• Predicted Extent of Groundwater Cone of Depression due to Proposed Pit Dewatering Operations.	Section 4.1.3	
• Number and Location of Water Wells Lying Within the Predicted Cone of Depression	Section 4.1.4	
• Potential for Salt Water intrusions	Section 4.1.5	
• Potential Baseflow Reduction to Surface Water Courses and Wetlands	Section 4.1.6	
• Predicted Drawdown in Proposed Conservation Areas and Potential Habitat Effects	Section 4.1.7	
• Post-Mining Groundwater Rebound Period	Section 4.1.8	
• Mitigative Measures to Prevent Water Well Problems Off-site	Section 4.1.9	

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

Table 1: Concordance Table between Terms of Reference and Focus Report

Focus Report Requirement (by section)	Section where Requirement is Specifically Addressed in this Focus Report	Location of Additional Information Related to the Requirement
<u>Surface Water</u>	Section 4.2, Appendix C	EARD Section 6.2
• Avoidance and Protection of Surface Water Resources	Section 4.2.1	
• Potential Extent of Surface Water Impacts	Section 4.2.2	
• Shaw Brook Protection and Monitoring Plans	Section 4.2.3	
• Potential Impacts from the Proposed Project and Protection of Local Water Supply Ponds	Section 4.2.4	
• Plans Showing Property Boundaries	Section 4.2.5 Figure 4.2-2	
• Surface Water Sampling Methods and Protocols	Section 4.2.6	
• Cumulative Affects Assessment of Proposed Project to Streams and Wetlands within the Area	Section 4.2.7	
• Baseline Surface Water Quantity Monitoring Results	Section 4.2.8	
• Baseline Surface Water Quality Monitoring Results	Section 4.2.9	
• Framework of Water Quality and Quantity Monitoring Plans	Section 4.2.10	
• Assessment of Time period Required for Lakes Proposed in Reclamation Plan to Flood and Provide Water to Downstream Users	Section 4.2.11 Section 4.2.12	
• Stormwater Management Plan	Section 4.2.13	
• Settling Pond Design and Operation	Section 4.2.14	
• Relevant Existing Environmental Approvals	Appendix D	
• Depiction of Final Proposed Project	Section 4.2.15 Figures 2.1, 2.2, 2.2a, Figures 4.2-2, 4.2-3	
• Contingency Plans for Accidental Spills to Ensure Protection of Water Resources	Section 4.2.16	

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

Table 1: Concordance Table between Terms of Reference and Focus Report

Focus Report Requirement (by section)	Section where Requirement is Specifically Addressed in this Focus Report	Location of Additional Information Related to the Requirement
<u>Species at Risk</u> • Ecological Integrity of the Conservation Area • Protection Plan for Species at Risk • Location of Species at Risk, Wetlands, Watercourses, and Proposed Conservation Area Relative to the Mine Footprint • Ecological Significance of the Proposed Project Site • Areal Extent of the Conservation Area • Framework of Species at Risk and Habitat Conservation, Research, and Monitoring Plan • Framework of Operations Management Plan • Framework of Reclamation Plan to Protect Significant Habitats and Species at Risk, Including Proposed Reclamation Monitoring • Potential for Private Land Conservation on Neighbouring Properties	Section 4.3, Appendix E Section 4.3.1 Section 4.3.2 Section 4.3.3, Figure 4.3-1 Section 4.3.4, Appendix E Section 4.3.5 Figures 4.3-1, 4.3-2, 4.3-3 Section 4.3.6, Appendix E-1 Section 4.3.7 Sections 4.3.8, 5.6 Figure 4.3-4 Section 4.3.9	EARD Sections 6.5, 6.6
<u>Wetlands</u> • Additional Modeling to Ensure Species at Risk Survival in Wetland 12 • Quantitative Assessment of the Proposed Project's Impacts to Surface and Ground Water Inputs to Streams and Wetlands • Mitigative Options to Maintain Natural Annual and Interannual Hydroperiods for Streams and Wetlands • Monitoring Protocols to Assess Adequacy of Mitigative Options • Application of the Mitigative Sequence for Wetland Conservation to Each Wetland Identified Within the Project Area. • Analysis of Avoidance Options and Associated Impacts to Ecosystems and Project Viability	Section 4.4, Figure 4.4-1 Section 4.4.1 Section 4.4.2 Section 4.4.3 Section 4.4.4 Appendix G Section 4.4.5 Section 4.4.6	EARD Section 6.4

READER'S GUIDE FOR PUBLIC VIEWING LOCATIONS

Table 1: Concordance Table between Terms of Reference and Focus Report

Focus Report Requirement (by section)	Section where Requirement is Specifically Addressed in this Focus Report	Location of Additional Information Related to the Requirement
Fish and Fish Habitat • Assessment of Potentially Affected Streams and Ponds for Possible Fish Habitat • Description of Stream Habitats • Presence of Fish in Streams • Location of Assessment Points.	Section 4.5, Appendix F Section 4.5 Section 4.5 Section 4.5 Figures 4.5-1 to 4.5-6	EARD Section 6.7
Reclamation • Detailed Site Reclamation Plan	Section 4.6 Section 4.6, Figure 4.6-1	EARD Section 5.6.3
5.0 FOCUS REPORT SUMMARY AND CONCLUSIONS		
• Groundwater • Surface Water • Species at Risk • Wetlands • Fish and Fish Habitat • Reclamation	Section 5.1 Section 5.2 Section 5.3 Section 5.4 Section 5.5, Appendix F Section 5.6	

ENVIRONMENTAL ASSESSMENT FOCUS REPORT FOR THE MILLER'S CREEK MINE EXTENSION

MILLERS CREEK, HANTS COUNTY, NOVA SCOTIA

Prepared For:
CGC Inc. – Windsor Plant

OCTOBER 2009
REF. NO. 820677K (9)
This report is printed on recycled paper.

EXECUTIVE SUMMARY

CGC Inc. – Windsor Plant requires an extension of the existing gypsum mine at it's Miller's Creek site to continue its operations in the area beyond the next 10 years when gypsum resources will be depleted in the Bailey Quarry. The Project is located on the Avon Peninsula in Hants County, Nova Scotia. CGC proposes to gradually replace the existing surface gypsum mine at Miller's Creek through the development of a deposit, and the construction of associated, limited infrastructure, adjacent to the existing operations, west of Ferry Road.

The Miller's Creek Mine Extension Project (the Project) will include a gypsum extraction area, rock and overburden stockpiles, roads, a Conservation Area, earthen berms, settling ponds, a power distribution system, mine dewatering equipment and some small service buildings. The maximum proposed surface footprint of the site is approximately 347 hectares (ha) west of Ferry Road. An additional area of 46 ha is designated for conservation of species-at-risk. CGC currently owns approximately 486 ha within the Project site. The Project was registered for environmental assessment (EA) as a Class 1 Undertaking pursuant to the Environment Act on February 21, 2008. The Project was reviewed and on March 17, 2008 the Minister of Environment and Labour, now Nova Scotia Environment (NSE), decided that a Focus Report was required. Specifically, a more complete examination of the potential impacts of the proposed mine on groundwater, surface water, species-at-risk, wetlands and fish and fish habitat was requested via a Terms of Reference (TOR) for the Focus Report.

To assess the environmental feasibility of the Project, CGC completed a number of baseline studies and consultations, and gathered a variety of inputs about the 50 years of operations of the existing site. The results are summarized in the EA Registration Document (EARD) (Feb 2008) and have been further expanded in this Focus Report. Assessment of the environmental impacts for the various options available leads to the following conclusions:

- The development of a large (46 ha) Conservation Area that maintains habitat for sensitive and rare flora
- Avoidance, where possible, of wetlands and a compensation strategy for those that are removed
- Progressive and continuous reclamation strategy

Groundwater

The comprehensive groundwater work completed at the site and the modeling report indicate that the mine can operate without significant adverse effects to local domestic wells or to the groundwater regime such that significant impacts to soil moisture, surface water or wetlands will not occur. In many cases the predicted impacts are within the normal annual fluctuations recorded within the bedrock aquifer on the Avon Peninsula. Post-mining, the groundwater regime will return to conditions similar to pre-mining conditions. A comprehensive monitoring program will be in place to determine if predicted impacts found in the groundwater modeling report will occur.

Surface Water

Results of the surface water quantity modeling effort indicated that seven out of the sixteen watercourses will be affected by the proposed mine footprint over the life of the Project. Minor changes to the overall hydrologic budget for the area are also expected. Impacts to water quantity are predicted for Shaw Brook and associated catchments, within which the majority of the pit development will take place. Based on the groundwater model, baseflow in four streams will decrease over the mine life. Although surface water flow will be affected by baseflow reductions, this component of flow represents only a small fraction of total flow in Shaw Brook. In order to ensure continued water supply to the downstream reaches of impacted catchments, rainfall and runoff intercepted by the extraction and stockpile areas will be collected and treated in stormwater ponds followed by controlled release back to the watershed. Following reclamation, a system of lakes in the headwaters of the peninsula would ensure continued supply of water downstream. Proper stormwater management and other mine management best practices will also be employed to protect water quality for all discharges from the site. Monitoring programs will be developed on a watershed by watershed basis as the mine progresses.

Species-at-Risk

The proposed Conservation Area is a large (46 ha), continuous expanse of calcareous habitat, which supports considerable populations of vascular plant and cyanolichen species of concern. The Conservation Area contains a cross-section of the habitat types found within the Project footprint, including wetlands, streams, mature forests, karst topography, and gypsum outcrops and cliffs. It is also known to support specimens of all of the listed vascular plant species known from the Project site, and to contain additional suitable habitat for these species. None of the environmental parameters within the Conservation Area are expected to be significantly adversely affected by the proposed Project.

The Conservation Area will be undisturbed by the proposed Project, and will be protected by CGC to ensure it remains undisturbed. It will never be logged, nor will further anthropogenic disturbances be permitted, unless required to protect species at risk and this would only be completed with NSDNR knowledge and input. The Conservation Area will support detailed monitoring plans and/or research plans on species-at-risk occurring within its boundaries.

Wetlands

Sixteen wetlands were identified within the Project footprint of which twelve wetlands of various size and function would be removed by Project activities. Two additional wetlands excluded from the EARD due to their anthropogenic origins and geomorphological characteristics have been reassessed and included in the Focus Report. CGC, in consultation with NSDNR and NSE, completed several design modifications to the proposed extraction and stockpile areas to avoid impacts on wetlands, where possible, without compromised Project viability. In summary, 13 wetlands (total area of 6.18 ha) will be unavoidably removed by Project activities and five (5) wetlands (total area of 3.29 ha) will be avoided. The loss of wetlands will be compensated using "wetland banking". Wetland banking involves creating wetlands in advance of the removal of wetlands and allows for determining the success of created wetlands to replace the form and function of removed wetlands. Mitigation measures to maintain hydrological inputs to wetlands will be implemented. The outline of a monitoring plan has been developed to assess the adequacy of mitigative options. The monitoring plan will be long-term, adaptable and statistically rigorous, and will be based on a measure of ecological integrity and wetland condition.

Fish and Fish Habitat

The catchment areas of five watercourses to be altered by the Project were surveyed for fish and fish habitat: Shaw Brook, Fish Brook and three unnamed tributaries to the Avon and St. Croix Rivers. All of the watercourse reaches on the Avon Peninsula that may be removed by the proposed mine operations or covered by stockpiles are headwaters of streams that only carry surface runoff during rainfall events and snowmelt. These ephemeral reaches are dry in between these events as there is no groundwater baseflow and as a result they do not provide fish habitat and subsequently support fish. This conclusion is supported by Fisheries and Oceans Canada surveys.

Reclamation

CGC recognizes the importance of progressive reclamation as an element of overall mine planning. Final reclamation plans will be developed in consultation with NSDNR and NSE, with input from stakeholders, including the community. CGC has a history of returning previously mined lands back to a stable, naturalized state, and will continue to do so for the Miller's Creek Mine Extension Project.

TABLE OF CONTENTS

Page

LIST OF FIGURES
(Following Text)

LIST OF TABLES
(Following Text)

<u>LIST OF APPENDICES</u>

1.0 INTRODUCTION

1.1 FOCUS REPORT ORGANIZATION

This Focus Report is organized to respond directly to items outlined in the Terms of Reference (TOR) issued by Nova Scotia Environment (NSE). The TOR is provided in Appendix A for reference but in summary has the following Sections:

1. Introduction
2. Project Description
3. The Methods of Carrying Out the Undertaking
4. Additional Information
    - 4.1 Groundwater
    - 4.2 Surface Water
    - 4.3 Species-at-Risk
    - 4.4 Wetlands
    - 4.5 Fish and Fish Habitat
    - 4.6 Reclamation Plan
5. Focus Report Summary and Conclusions

Table 1 (found in the Readers Guide) provides the specific sections in this Focus Report that correspond with the TOR requested information. In some cases, the Concordance Table will refer the reader to a section of the Environmental Assessment Registration Document (EARD) that was submitted in February 2008. It is important that the reader review that information when a reference is provided.

1.2 PROJECT HISTORY

The Miller's Creek Mine Extension Project, proposed by CGC Inc. – Windsor Plant (CGC) was registered for environmental assessment (EA) as a Class 1 Undertaking pursuant to the Environment Act on February 21, 2008. The project was reviewed and on March 17, 2008 the Minister of Environment and Labour, now Nova Scotia Environment (NSE), decided that a focus report was required. Specifically, a more complete examination of the potential impacts of the proposed mine on surface water, groundwater, species-at-risk, wetlands, and fish and fish habitat was requested via a TOR for the Focus Report.

CGC was required to submit the information within one year of receipt of the TOR. CGC requested from NSE and received a submission extension until October 16, 2009. The rationale for the extension was to allow for a longer data collection period to capture seasonal variations of several key aspects of the requested additional information. CGC has worked diligently over the past 18 months to gather, compile and evaluate additional data and is pleased to present this information in this Focus Report. Upon receipt of the Focus Report, NSE coordinates a 30 day public review period and then has a 25 day period to review public and regulator comments and provide a Report and Recommendations to the Minister. The Minister of Environment has three decision options:

1. the undertaking is approved subject to specified terms and conditions;
2. an environmental assessment report is required; or
3. the undertaking is rejected.

CGC feels that the significant body of work completed over the past 4 years that has been presented in the February 2008 EA document and this Focus Report presents a project that provides significant benefit to the Province and that has carefully considered social, environmental and technical issues. CGC has a 50 year history in the Belmont, Avondale, and Poplar Grove area, and over 100 years in this area of Hants County and looks forward to many more with continued production from this proposed mine.

2.0 PROJECT DESCRIPTION

CGC requires an extension of the existing Miller's Creek site to continue it's operations in the area beyond the next 10 years when gypsum resources will be depleted in the Bailey Quarry. The continued operation of the Miller's Creek site is essential for the on-going operation of all three CGC facilities in the area.

As the reserves at the existing Miller's Creek Quarry become depleted, CGC proposes to develop a new mine and associated, Limited infrastructure to the west of Ferry Road. The Project is within the area included in the current Non-Mineral Registration No. 002 (1042 ha) issued by Nova Scotia Department of Natural Resources (NSDNR) (Figure 2.1). The Project will include a gypsum extraction area, rock and overburden stockpiles, roads, a Conservation Area (EARD Section 6.5.2.2, Figure 6.5-1, CRA, January 2008), earthen berms, settling ponds, power distribution system, mine dewatering equipment, and some small service buildings.

CGC currently owns 486 hectares within the Project site. Negotiations for additional property acquisitions are ongoing. The maximum Project footprint will consist of:

- Extraction Area 155 ha
- Stockpiles, Roads, Settling Ponds, etc 192 ha

A proposed Conservation Area (46 ha), subject to monitoring and other investigations over the mine life will also be part of the project and represents the total area that may be impacted over the life of the project (up to 70 years). The actual disturbed area at any one time during the life cycle of the mine will be much smaller as CGC will seek to minimize the disturbed area at any one time. These areas have been revised from those presented in the EARD due to avoidance options in the Focus Report stage. Progressive reclamation and partial backfilling of areas depleted of gypsum within the mine boundaries may limit the actual Project footprint.

Mine activities will include drilling, blasting, loading, and hauling. The rock mined for production will be transported by off-highway, haulage trucks to existing crushing and screening facilities. A level crossing with a controlled access at Ferry Road will be constructed. Overburden and direct mine waste associated with the deposit will be stockpiled around the perimeter of the mine. A new power distribution system will be installed to provide electricity for the mine de-watering pumps, service buildings, and miscellaneous uses. There is no requirement for a tailings treatment facility characteristic of base metal mines. There is no chemical process effluent associated with gypsum mining.

Initial production is estimated at 50,000 to 100,000 tons per annum increasing to a production rate of between 1.5 and 2 million tons per annum. The production life of the mine extension is estimated at approximately 30 to 50 years. Proven reserves remaining in Miller's Creek plus the proven and probable reserves in the mine extension area can sustain 35 years of production at the planned extraction rate. Additional gypsum may be recoverable if the waste to gypsum ratio decreases or core drilling delineates additional reserves which could extend the life of the mine an additional 15 years. Therefore the mine could be operating for up to 70 years.

2.1 PROJECT SITE LOCATION

The Project site is located on the Avon Peninsula in Hants County, Nova Scotia (Figure 2.1). The proposed extension of the existing surface mining operation is bound by Avondale, Belmont and Ferry Roads**.** The Avon Peninsula is defined by three rivers: the Kennetcook River to the north, the St. Croix River to the south, and the Avon River to the west.

The Project site is located within topography which is generally higher than that of the surrounding areas. Salt marshes along the river banks give way to gently undulating plains further inland. Surface elevations across the site range from approximately 20 to 75 metres above sea level (masl) and slopes range from 1 to 3%, with some local grades of up to 10%. The site is characterized by a series of low rolling hills (described as knobs or knolls), with moderately incised drainages and valleys. The topography of the area has been influenced by the underlying bedrock, exhibiting karst features and numerous pits and excavations, with evidence of gypsum extraction dating back to the mid-19th century in some instances. Some sinkholes support small ponds, and a former spoil area is now a small lake created by a beaver dam.

The Avon Peninsula is occupied by approximately 34% forested stands, 6% cleared or partially cleared forest, 39% agricultural use, 10% previously mined areas, and approximately 3% developed (residential, industrial, commercial). The remaining 8% consists of wetlands/scrub lands and transportation/power corridors.

Residential development in the immediate vicinity of the Project is relatively low, with the closest public road located approximately 395 metres (1300 feet) away. There are approximately 300 residences/structures within a three kilometre radius from the centre of the surface mine extension. The nearest communities are Avondale, Belmont, Poplar Grove, the Village of Brooklyn, and the Town of Windsor.

2.2 PROJECT BOUNDARIES

Figure 2.1 depicts the project boundaries.

2.3 LOCATION OF PROPOSED PROJECT IN RELATION TO EXISTING MILLER'S CREEK MINE

Figures 2.2, 2.2a, and 2.2b show the project boundaries with respect to the existing mine. The aerial photography was flown in May 2006.

2.4 PROJECT ASSUMPTIONS – THE DESIGN PROCESS

The Project design process involves several phases as shown in Figure 2.3. Development scenarios are typically first evaluated for technical merit. Feasible schemes are then assessed on an economic basis (*e.g.* Can we do this technically?, Can we do this at a profit?). Finally, social and environmental impacts of the Project plan are carefully considered as this information is gathered through environmental baseline study, and public and First Nations Consultation programs.

At each stage, an unsatisfactory result may cause the previous basis to be re-evaluated. For example, a technically feasible plan may prove uneconomic causing a new approach to be adopted. Similarly, an environmental impact may have an economic impact or require mitigation which can be addressed through modifying the technical plan. The iterative nature of the process ensures that issues are considered in the context of the entire Project and not in isolation.

Technical and economic evaluation occurs prior to addressing environmental and social issues because without a practical, economic plan there is no investment, no reason for development, and no impact. Just as important, however, is the fact that sustainable projects which can meet their environmental and social obligations must have a sound economic basis.

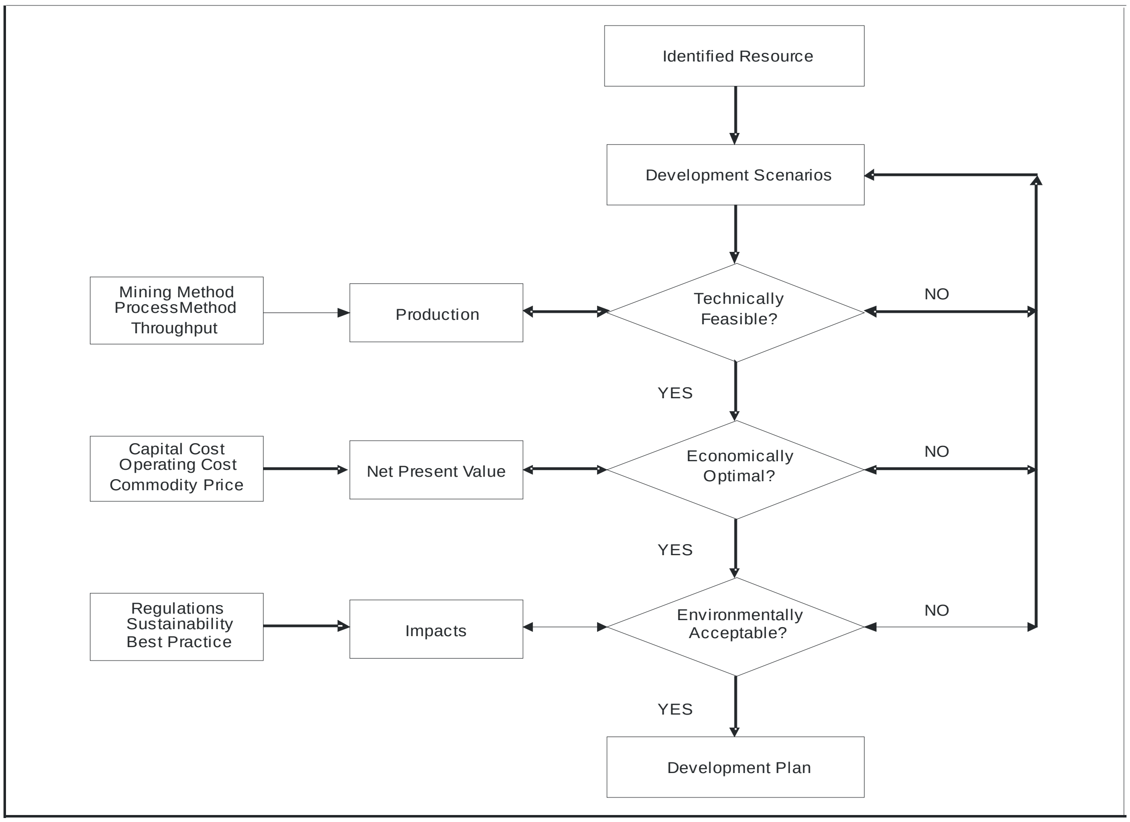

Figure 2.3 Project Design Decision Process

2.4.1 DESIGN STANDARDS

The design of the Miller's Creek Mine Extension Project is based on internationally, nationally and provincially accepted standards and criteria. The Project will be developed and operated in accordance with all applicable national, provincial and municipal legislation for mining projects in Nova Scotia. In particular, the General Safety Regulations pursuant to the *Occupation Health and Safety Act*, the *Nova Scotia Environment Act* and Regulations, the National Building Code, Nova Scotia codes and the Nova Scotia Environment Sediment and Erosion Control Handbook have been used in the design and will continue to be used throughout the duration of the Project. All development activities will be completed under the supervision of qualified staff with the appropriate credentials for work in Nova Scotia.

In order to assess the economic and environmental feasibility of mining the resources west of Ferry Road, the proponent has completed a variety of studies and assessments.

In addition, the proponent has gathered a variety of inputs about the general biophysical location as a result of operating the existing site east of Ferry Road for over 50 years. The following items were completed and in some cases continue to collect data. These inputs will be used in the design and assessment of the proposed gypsum mine extension:

- Review of existing baseline information on surface water, groundwater, soils, and sediment.
- Groundwater assessment was completed, including a desktop review of wells in the area as per the NS Well Log Database, installation of 10 wells in bedrock and overburden in 2006 within and adjacent to the extension, and water level and water quality monitoring. Additional wells were installed in 2009 that were tested for water quality and hydraulic conductivity.
- Groundwater modeling was completed using the data from the above noted groundwater assessments and a Conceptual Site Model report was developed.
- Terrestrial ecology evaluation.
- Environmental screening (desktop assessment of cultural and natural heritage resources in the area) completed by the Nova Scotia Museum (NSM) in 2004.
- Compilation and review of published information on the local site and region related to biophysical and socio-economic considerations.
- Botanical field investigations were undertaken within the study area starting in late summer and fall of 2005 focusing on priority species of risk. Additional detailed investigations conducted during spring and early summer of 2006, spring 2007 and summer of 2008.
- Initial aquatic habitat assessment was completed in autumn of 2005. Additional aquatic habitat surveys were conducted in 2006, 2007, and 2008.
- Breeding birds and amphibians surveys were conducted in 2006 and 2007.
- Assessment of wetland habitat within the study area was completed in 2006 and 2007.
- Surface water sampling program underway since late 2004 at five locations where watercourses leave the Project site, and increased to six locations in November 2005.
- Noise monitoring related to blasting is ongoing and baseline data collection is completed for the extension project.

- Collection of baseline data for suspended particulates (dust) in 2007.
- Core drilling program within the proposed areas has been conducted under existing approvals from NSDNR to assist in development of detailed mining plan.
- Archaeological background study of the proposed site has been completed, including a Heritage Research Permit application, desk top review and initial site visit, and a detailed field reconnaissance program was undertaken in 2006.
- First Nations study of Mi'kmaq Land and Resource Use was completed by Confederacy of Mainland Mi'kmaq (CMM) to determine likelihood of Mi'kmaq interests and site knowledge.
- A two-day formal public information session was completed April 2007 in Belmont for the CGC mine extension project. Approximately 140 people were in attendance.
- Ongoing discussions with elected officials and staff of Municipal and Provincial governments about proposed extension to the west of Ferry Road, including One Window Committee meetings on October 25th, 2005, May 4th, 2006, and April 2008 for Focus Report.
- Aerial photographs and Light Detection and Ranging (LiDAR) – flight survey completed in May 2006 to provide current photographs and very detailed topographical information.
- 3D mine modeling software used for mine design and volume calculations.

2.4.2 TECHNICAL AND ECONOMICAL ASSESSMENT

Historically, gypsum mining has occurred in the area of the proposed project since the early 1800s until the 1920s. (EARD 5.1) CGC has owned gypsum rights in the mine extension area since the turn of the 20th century. Based on the historical mining activity and exploratory core drilling carried out in the past and recent years, it is a known gypsum deposit. CGC also owns surface rights to a large block of land in the project area. It is adjacent to CGC owned rock processing and train loading infrastructure as well as associated employee and maintenance facilities.

CGC currently mines gypsum at Miller's Creek and nearby Wentworth Creek; and anhydrite at the Wentworth Creek site only, producing close to one quarter of the gypsum produced in Nova Scotia and a fifth of the gypsum mined in Canada. The Miller's Creek site operates a drill, blast, haul, crush and screen operation. The rock is transported by rail (~ 15 km), operated by Windsor Hantsport Railway Company, from

Miller Creek and shipped out of its ocean terminal in Hantsport. The existing processing plant will be maintained in its current location throughout the life of the proposed project.

CGC has been operation in this area of Hants County for over 100 years, and at the existing mine east of the proposed project site for over 50 years. It makes practical and financial sense that the company would seek to continue mining in as close proximity as possible to the existing site. Mining in another remote location would be cost prohibitive and result in a much larger area of land disturbance.

The extension to the Miller's Creek site is necessary to maintain the long term viability of the company in the area.

2.4.2.1 MINING METHOD

In mining, there is no distinction between site preparation, operational and reclamation phases as they are all part of the same mining activity. This phase of Project design focuses on the most practical, economical and safest way to extract the commodity. This project can only be accomplished by surface mining methods. Underground mining is not economically feasible and technically unsound due to the presence or potential of karst topography. There is no other location where the project can be developed because it is dependant on the location of an economical grade and volume of gypsum. The deposit is fixed in location. Other factors taken into consideration include distance to the existing infrastructure for processing and shipping, and property and resource rights ownership. Moving or extending these would be decidedly uneconomical to the proposed project.

2.4.2.2 OPERATIONAL METHOD

The mining equipment and accessories used in the operations will vary slightly through the life of the project. The expected types of equipment and accessories that may be used for overburden removal, drilling and blasting, loading and hauling have been discussed in the EARD (Section 5.6.2.1). It is anticipated that the current methodologies used at the Miller's Creek mine will be used at the Extension project. New technologies or mining methods that emerge will be considered through the life of the project. Existing facilities for processing and shipping the gypsum are planned to be used during the operational life of the project.

2.4.2.3 CAPITAL COST

Capital cost is the initial investment required to bring the Project into production. Capital investment has been made at the existing mine for the last 50 years in equipment and mining expertise. Over the last decade, significant capital cost ($30 million) has been incurred in upgrading processing equipment and associated infrastructure, and a continuous supply of gypsum is required to sustain the processing plant and for a return on investment.

Operating costs are well known by CGC and will be similar to the existing Miller's Creek Mine.

2.4.3 ENVIRONMENTAL ASSESSMENT

2.4.3.1 ASSESSMENT PROCESS

Once a technically feasible and economically attractive development plan has been identified, the design process assesses the impact on valued environmental components (VECs) on the Project site and in the surrounding area. These elements are identified as:

- Aesthetics: Noise and Visual impact
- Air and Water Quality
- Recreational Value and Wilderness Experience
- Flora/ Fauna and associated Habitat
- Access and Community

The design process assesses the impact of the development on each of these elements in the context of (1) regulatory standards, (2) best practice, and (3) sustainability. For example, noise from operations would be considered in terms of:

- Does it meet applicable standards?
- Is the proposed operating plan the best way to manage potential impacts from this development?
- Is the proposed operating plan sustainable (as opposed to one which results in ongoing, cumulative impact)?

The VECs have been discussed in detail in the EARD (Feb. 2008) and have been further expanded in this Focus Report.

2.4.3.2 IMPACT MANAGEMENT

Impact is qualitatively described in terms of none, low, moderate, and high. The goal of the Project design process is to formulate a development plan which minimizes impact. Impact can be minimized through design, mitigation, or compensation.

Design offers the opportunity to eliminate impact by designing facilities, processes, and procedures which eliminate the opportunity for impact to occur. For example, the mine is sited to minimize disturbance of fish habitat and impacts to wetlands.

Mitigation includes all measures which are designed to limit or nullify a potential, unavoidable impact. As an example, water from the site will be collected in settling ponds prior to its release to the environment.

Compensation entails payment for or replacement of VECs which are unavoidably impacted by development or due to a failure of operating safeguards. An example of compensation for an unavoidable impact would be the replacement of wetlands removed during mine development concurrent reclamation of the site will be performed wherever possible during the operational phase of mining.

2.4.4 PROJECT DESIGN REVIEW

The technical and economic assessment has concluded that the only development plan for the Miller's Creek Mine Extension Project is a surface mine. The project development scheme is dictated by the physical nature of the deposit in terms of size, location, geology, and grade. Except for the development of waste and overburden stockpiles, settling ponds, and haulage roads, the associated infrastructure (processing plant, shipping facilities) would remain unchanged.

The implications of these factors on the adopted development plan can be summarized as follows:

- Sustainable economic benefit to the community through jobs and services required.
- Existing infrastructure (plant, rail, and shipping) can be utilized without added cost implications.

The results of the Project design review with respect to the environmental assessment are summarized in the EARD (Feb 2008) and have been further expanded in this Focus Report. Assessment of the environmental impacts for the various options available leads to the following conclusions:

- The development of a large (46 ha) Conservation Area that maintains habitat for sensitive and rare flora.
- Avoidance, where possible, of wetlands and a compensation strategy for those that are removed.
- Progressive and continuous reclamation strategy.

3.0 THE METHODS OF CARRYING OUT THE UNDERTAKING

The location of the gypsum deposit is fixed. Historically, mining has taken place in the proposed extension area. Extensive drilling of this area has revealed an economic deposit that can be mined using conventional surface mining methods. CGC has examined other areas for possible development, but no other area offers the combination of favourable geology, physiography and proximity to existing infrastructure to allow for economic extraction of resources. The need for stockpiles was examined as well and the project economics were found to require some permanent stockpiles around the perimeter of the site, but allow for progressive reclamation principles to be incorporated into the project design.

3.1 ALTERNATIVE METHODS

The two alternatives to this project are surface or underground mining. Underground mining is not economically feasible and technically unsound due to the presence or potential of karst topography. Some underground mining has been done in the past but at such a small scale that it could be done relatively safely. The size of the proposed operation and the nature of the geology does not warrant underground methods.

Trucking the mined gypsum to the existing processing facility is the only viable method of conveyance. Building a conveyor system is cost prohibitive to the project as the mobile equipment fleet and associated maintenance facilities are already in place for the existing site. Also, crushing facilities would have to be located within the proposed mine, as it would not be possible to convey run-of-mine rock without primary size reduction. The construction of additional crushing and conveying systems would require a large investment in power transmission and add to the demand on the provincial power supply company.

3.2 ALTERNATIVE MEANS CONSIDERED FOR THIS PROJECT

Mine design is an iterative process from initial concept

The **Conceptual Layout 1** depicted in Figure 3.1 shows the initial overall mine footprint and proposed extraction area. It takes into consideration gypsum rights, property ownership, as well as estimated reserves, which was based on original exploratory core drilling carried out in the 1960s and 1990s.

Layout 2 (Figure 3.1) shows a refinement of the conceptual footprint, based on core drilling programs carried out in 2005 and 2006, with a clearer distinction of which area would be extraction and which would be stockpiles and other disturbances such as roads, settling ponds, etc. It also shows changes to the extraction area as a result of avoidance of provincially red-listed vascular plant species (proposed Conservation Area concept). This plan also avoids Wetlands 11, 13, and 14 on the western end of the project.

Layout 3 (Figure 3.1) shows the planned outline of proposed stockpiles around the perimeter of the extraction area. The locations are based on topography, drainage, view planes around the site, and estimated volume of unsuitable material from the mine to be stockpiled.

Layout 4 (Figure 3.1) shows revisions to the proposed stockpiles and extraction areas due to avoidance of Wetlands 15 and 16. The avoidance of Wetlands 16 also prevents disturbance to the habitat of black ash, a yellow-listed species.

Layout 5 (Figure 2.1, Figure 3.1) is the current proposed project layout. This design shows a further reduction in the area proposed for extraction. On the southeastern portion of the site, a significant block of reserves was removed to avoid the upper reach of the eastern tributary of Shaw Brook. Two stickleback fish were detected in this area of the brook during the electrofishing surveys conducted in June 2008. The extraction area was also reduced on the southern portion of the site to completely avoid Wetland 12. This increases the area proposed for conservation by approximately 3 ha to 46 ha.

4.0 ADDITIONAL INFORMATION

4.1 GROUNDWATER

Groundwater resources were identified as Valued Environmental Components (VECs) in the EARD due to the interaction of the project with bedrock and surface water which are part of the hydrogeological make-up of the area. The proponent identified early in the project planning and Environmental Baseline Studies that groundwater issues would be important to address and a concern for local residents and regulators. All residential water supplies within the project vicinity use groundwater resources to meet human and farm animal needs. The proponent put forth significant efforts to better detail the hydrogeology of the Avondale Peninsula and used this collected data for impact prediction and the design of mitigation programs, monitoring program and contingency plans.

The site hydrogeology was characterized in the EARD. Further details to support the development of a Conceptual Site Model (CSM) report (Appendix C1) were collected and compiled since the EARD. The CSM report provides an overview of all background information compiled, all field programs completed specifically for the Miller's Creek Extension Project and published data on the area. This information was used to develop a numerical groundwater model that assisted in impact prediction for the proposed surface mine, see Groundwater Modeling Report (Appendix C2). The report provides the TOR specified elements including a description of the model, grid design, boundary conditions, model input data and calibration results. The digital model files have been submitted to NSE as per the TOR requirements.

As per the TOR, additional details regarding groundwater resource impacts from the proposed project, mitigation measures, monitoring programs, and management plans, are included here. Figure 4.1-1 shows the approximate locations of off-site wells located at various radii (e.g. 500 m, 1,000 m, 1,500 m and 3,000 m from the proposed surface mine extraction limits. Figure 4.1-2 provides a cross-section view of the proposed extraction areas and the existing water table (bedrock) and the predicted water table after mine development (full mine life).

As the impact predictions in the Groundwater Modeling Report are based on the CSM report, it is important that the public and regulatory agency reviewers read the CSM report in full prior to going to the Groundwater Modeling report for the details on model development, calibration and impact prediction.

4.1.1 GROUNDWATER MODEL FOR PROPOSED PIT AND SURROUNDING AREA

The Groundwater Modeling Report is provided as Appendix B2. The methods used, assumptions made and conclusions reached are presented in this report. The proponent meet with NSE staff prior to the development of the model to discuss the specific TOR requirements relative to the data collection program and the types of models that could be used. A second meeting was held during the data collection program to provide preliminary results and further refine the expectations of NSE prior to completion of the model development .

4.1.2 PREDICTED GROUNDWATER FLOW RATE TO PROPOSED PIT

The Groundwater Modeling Report provides the predicted groundwater flow rate to the proposed pit in Section 7 of that report, (Appendix B2). As the mine design includes various stages each with different depths and aerial extent, the rates vary, at the end of Year 20 it is predicted as 3.1 L/sec, at the end of Year 40 it is predicted to be 5.7 L/sec, at the end of mine life (approximately 70 years) it is predicted at 19.5 L/sec.

4.1.3 PREDICTED EXTENT OF GROUNDWATER CONE OF DEPRESSION DUE TO PROPOSED PIT DEWATERING OPERATIONS

The mine dewatering operations have been planned so as to only remove water when needed by the surface water courses as outlined in Section 3, or as needed for mine development. Water will enter the extraction areas either by overland flow (which will be minimized through properly placed ditches to encourage run-off to stay in its pre-development catchment), precipitation (the mining operation has no effect on this) or by groundwater entry (discussed above). The model has taken this operations scenario into account for the impact predictions that are discussed below in Section 4.1.4.

4.1.4 NUMBER AND LOCATION OF WATER WELLS LYING WITHIN THE PREDICTED CONE OF DEPRESSION

The groundwater modeling report provides this information. Figure 4.1-1 identifies the number and location of known domestic water wells lying within the predicted cone of depression.

The groundwater model results are presented in Appendix B.2. The Focus Report TOR noted a requirement to provide the approximate locations of off-site wells within 3 kilometres of the proposed surface mine and to identify the number of wells located within various radial distances (500m, 1000m and 1500m) of the proposed surface mine. This requirement has been met by the provision of Figure 4.1-1. This figure and those provided in the Groundwater Modeling Report also address the requirement to provide a graphic showing the proposed surface mine's existing water table (Figure B.2.2) shows this) and the predicted water table after pit development (Figure 4.1-2 shows this).

The above noted figures were used to determine the number of domestic wells within various predicted drawdown intervals at various times (20 years, 40 years and full mine life). In summary, there are no predicted impacts (an impact for a bedrock well is defined as a predicted drawdown of more than 1 metre from pre-development conditions) on any existing domestic wells associated with the first 20 years of mine life. By the end of 40 years of mining there are potentially 30 domestic wells within a 1m drawdown zone and 5 wells in the 2m or greater drawdown zone. As earlier noted, the dug wells will experience no impacts; the predicted impacts are in bedrock only; and therefore, only a portion of the domestic well locations are potentially impacted.

Within the first 20 years, as there are no predicted impacts it will be important to have a groundwater monitoring program that is limited in number of points but has broad geographic coverage. It is envisioned that the groundwater monitoring program (EARD, Section 6.3, Feb 2008) that will be developed for the IA application, should the EA be granted for this project, will use the existing monitoring wells. They will be supplemented by domestic wells and possibly other strategically placed monitoring wells. The collected data will be used to update and refine the groundwater model at regular intervals, thus allowing for future predictions to be based on the fullest data set and most current information. These refined predictions will in turn be used to determine the monitoring program elements going forward. At the end of the first 20 years, the groundwater model will be used to plan the monitoring program for the next 20 years by updating the model predictions and reviewing all collected data.

Within the first 40 years, using data collected to date, there are limited predicted impacts of 1m drawdown for roughly 30 current domestic wells and more than 2 m drawdown for 5 domestic wells. As noted above, the dug wells will experience no impacts, the predicted impacts are in bedrock only and therefore only a portion of the domestic well locations are potentially impacted. These predicted impacts highlight the need for a more geographically focused monitoring approach to supplement what will be completed for the first 20 years. At the end of the first 40 years the groundwater model will be used to plan the monitoring program for the period to end of mine life (roughly 30 years) by updating the model predictions and reviewing all collected data.

From 40 years to end of mine life, based on no reclamation and current data, the extent of predicted drawdown in bedrock is significant and widespread. These predictions highlight the need to refine the model prior to this mining period using collected data as the predictions may not occur. This stage of the gypsum extraction would need to proceed with a refined and comprehensive monitoring program and potential implementation of some of the noted mitigation measures. As described in Section 4.6, some reclamation would be completed in the eastern portions at this stage of the extraction and the benefits of this in terms of less drawdown will be quantified through the monitoring program.

4.1.5 POTENTIAL FOR SALT WATER INTRUSION

Based on the groundwater modeling, there are no known existing domestic water wells in an area where they are at risk of saltwater intrusion, resulting in affects to well water quality. Salt water intrusion occurs when the pumping level in a well is below sea level in proximity to marine environments and the salt water is drawn into the freshwater aquifer. Typically, in low permeability aquifers, saltwater intrusion is gradual and easily detected in early stages with proper water quality monitoring.

Model predictions indicate that there are no areas where predicted groundwater elevation contours are below sea level; however, it is also necessary to examine whether there are existing wells with water levels where pumping may cause the level to drop below sea level. Data from the domestic well survey was used as the information source for this analysis. Measured water levels from domestic wells (noted on Table B1.2-3), along with GPS elevation data, were reviewed and compared to the end of mine life (worst case) groundwater elevation and drawdown predictions.

For the Year 1 to 20 and Year 21 to 40 mine phases, there are no areas where saltwater intrusion potential is predicted. The necessary combination of groundwater drawdown, groundwater elevations, and locations of domestic wells does not occur. There is one area (in the extreme western end of the Peninsula where domestic water levels were calculated as being between 10 and 16 metres above sea level and the predicted drawdown at end of mine life is between 5 and 10 metres. Therefore some wells in this area, if pumped below sea level for an extended period of time have the potential for saltwater intrusion. These wells are located up to 500 metres away from the Avon River.

This situation highlights the need for the groundwater monitoring program from Year 40 onward to include several of the domestic wells where potential exists, but no requirement exists prior to that based on the groundwater model. CGC will review this situation with any model re-calibrations and monitoring data that suggests otherwise, and revise the groundwater monitoring program if necessary.

4.1.6 POTENTIAL BASEFLOW REDUCTION TO SURFACE WATER COURSES AND WETLANDS

The groundwater modeling report provides information on the predicted baseflow reductions as percentages as requested in the TOR. Specific discussions on the implications of the predicted reduction for surface water are presented in Section 4.2.2 and 4.2.7. Specific discussions on the implications of the predicted baseflow reductions on wetlands are presented in Section 4.4. Appendices C, F and G provide additional information on the impacts, mitigation, and monitoring of the surface water and wetlands.

It should be noted that the site groundwater, surface water and wetlands assessment programs were extensive, and provided an abundance of information showing that the wetlands systems were essentially unconnected to the groundwater system. The tight clay till blanket over the site creates a situation where wetland development occurs in areas where localized depressions having the right combination of catchment area size and topography promote wetland development. Therefore, changes in the groundwater level in the bedrock system will have no impact on the surface runoff and precipitation dependent wetlands. This is discussed in more detail in the previously noted Section and shown graphically on Figures 4.1-2, 4.1-3, 4.3-2, and 4.4-2.

4.1.7 PREDICTED DRAWDOWN IN PROPOSED CONSERVATION AREAS AND POTENTIAL HABITAT EFFECTS

The groundwater modeling report indicates that there are predicted reductions in groundwater level below the Conservation Area. As outlined above and in the referenced Sections, there are no predicted impacts to the ecology of the Conservation Area due to the lowering of the groundwater level during the extraction period of the mine life.

The model predicts a rise in the groundwater level from the current (pre-mining) level after the reclamation phase of pit backfilling is complete, which may have implications on the Conservation Area. A full assessment of this has not been completed at this stage, as the predictions would have a high level of uncertainty. The assessment of potential impacts to the Conservation Area after pit backfilling should be completed using the first 20 years of mine operation data and the surface water model and groundwater model.

4.1.8 POST-MINING GROUNDWATER REBOUND PERIOD

The groundwater model report in Appendix B.2 provides information on the predictions of the timeframe for groundwater levels to rebound to premining conditions once dewatering has stopped (Section 7.4 and Table B.7.5). These predictions are based on the reclamation scenario presented in Section 4.6. In summary, the time for the West Lake to re-fill is 47 years and for the East Lake is 24 years. After the lakes have re-filled, groundwater inputs will continue; and therefore, there is residual groundwater drawdown after the pits have refilled as outlined on Figure B.7.8. It is important to note that surface watercourses needing water will be given priority over pit re-filling during the post-mining phase and; therefore, the pit re-filling times may be increased over those predicted currently. The monitoring program will identity the surface water courses needing water and the operations staff can direct water as required.

As with other predictions being made in this Focus Report, it will be important for the surface water and groundwater models that have been developed to use actual data collected from the site during mining operations to make better predictions for future scenarios, and for future IA stipulations to take this into account.

4.1.9 MITIGATIVE MEASURES TO PREVENT WATER WELL PROBLEMS OFF-SITE

The EARD (Feb. 2008) contained information on a number of well established and comprehensive mitigative measures that have been successfully employed on construction, highway and mining projects in Nova Scotia. See Section 6.3 of the EARD. CGC has a long history of operating a mining operation in close proximity to domestic water supplies with minimal situations requiring action. The project as planned is a slow progression from an area (eastern side of Avondale Peninsula) where there are no wells predicted to be impacted to an area (western portion of the Avondale Peninsula) where there are a greater number potentially impacted over a period currently estimated at 70 years. This mining plan; therefore has a number of advantage:

- allows time for monitoring data to be used instead of predictions;
- homeowners and CGC to engage in discussions;
- willing host domestic well locations to be chosen to assist CGC's overall monitoring program;
- CLC involvement in refinements to the monitoring program; and
- new methods, and techniques that may prove helpful to be developed.

It should be re-iterated that the groundwater modeling report predicts that none of the dug wells are at risk throughout the life of the project, and that no impacts to wells within bedrock are predicted for the first 20 to 30 years of the project. The approach is to rely heavily on actual data collected from the time extraction begins to refine the predictions. This will allow for the proper combination of mitigative measures to be implemented and for future IA stipulations to take this into account.

4.2 SURFACE WATER

Surface water resources were identified as a Valued Environmental Component (VEC) in the EARD due to the interaction of the Project with local surface water elements. A significant concern for local residents and regulators is the potential impact of the Project on runoff and water quantity in existing streams, some of which are used for water supply in farming operations. As per the TOR, additional details regarding surface water resource impacts from the proposed project, mitigation measures, monitoring programs, and stormwater management plans, are included here.

Throughout this discussion, streams will be numbered based on their monitoring designation, *e.g.* SW-01 is located on Stream 1 (Figure 4.2-2).

4.2.1 AVOIDANCE AND PROTECTION OF SURFACE WATER RESOURCES

As indicated in the TOR, the headwaters of six watercourses were within the proposed mine footprint. In order to address the subject of avoidance of watercourses, CGC Inc. has modified the mine footprint to exclude the headwaters of the northeastern branch of

Shaw Brook. The progression of refinement of the footprint is shown on Figure 3.1 while the final footprint is depicted on Figure 2.1. No other avoidance options for watercourses were feasible due to the availability of gypsum resources. For an analysis of wetland avoidance options, please refer to Section 4.4.

Vegetated buffers will be maintained around all of the streams excluded from the mine and stockpile footprints in order to reduce the effects of erosion and maintain water quality by reducing the amount of non-point source contaminants. Buffers will be a minimum of 30 m in width and will be designed with best management practices in mind. Specifics of vegetated buffer designs will be further developed at the Industrial Approval stage.

A hydrologic model was developed to assess potential surface water impacts from the proposed Project. These surface water runoff impacts are described below.

To address reductions in the total quantity of surface water runoff, water will be discharged in a controlled manner from stormwater settling/treatment ponds to the streams affected by the mine development. Runoff from the stockpiles will be redirected towards the stormwater management ponds while water collected in the pit will be pre-treated in the pit, and if water quality is acceptable, directed to the catchment directly or pumped to the ponds if additional settling time or treatment is needed. Additional details regarding the surface water management plan and the stormwater pond design and operation are included in Sections 4.2.12 and 4.2.13.

4.2.2 POTENTIAL EXTENT OF SURFACE WATER IMPACTS

The hydrology of the CGC Inc. property (Site), located in Hants County, Nova Scotia, has been studied using state-of-the art computer modeling as described in Appendix C1. The hydrologic project had the objective of determining any potential effect of creating a surface mine on the total quantity of surface water runoff within the study area.

A hydrologic model was assembled and used to complete this preliminary estimate of total runoff from the Site and adjacent areas. Although the model calculates peak discharge in each watershed within the study area, under a range of possible conditions, the emphasis of the analysis is on the total volume of runoff generated by the various watersheds that make up the Site.

In addition to hydrologic modeling, groundwater modeling was used to generate baseflow changes due to mine development and dewatering. The groundwater model is included in Appendix B.2.

Results of the modeling efforts will be briefly discussed below. Please refer to Appendices B.2 and C.1 for detailed reports of groundwater and hydrologic model inputs, assumptions, methodology, mine staging scenarios, and overall results.

The area of interest in the hydrologic model was divided into six watersheds, 41 subcatchments, and 16 outlets (Figure C.3 of Appendix C.1). It should be noted that these 41 watershed subcatchments are different from subcatchments previously defined in the EARD. The EARD watershed subcatchment map boundary had been arbitrarily based on the surrounding roads (Belmont Road, Avondale Road and the Ferry Road loop). The hydrologic study boundary for this focus report was based on the hydrologic boundary of the three rivers and the height-of-land to the east.

In addition to the subcatchment map defined in the surface water model (Figure C.3), another map was developed to facilitate aerial disturbance analysis. Several of the subcatchments, which drained to a single outlet, were grouped into larger catchments to reduce the number of subcatchments analyzed for disturbance from 41 to 10. The comparison between the catchments based on the aerial disturbance analysis and subcatchments used in this hydrologic study are illustrated in Figure 4.2-1 and in Figure C.4 of Appendix C.1. Throughout the remainder of this report, the 10 grouped catchments shown in Figure C.4 will be referred to as "CGC catchments" while the 41 subcatchments defined in the hydrologic model will be referred to as "CRA subcatchments".

A summary of projected surface water impacts is provided in Tables 4.2-1 to 4.2-3 for 20-year, 40-year, and 70-year projected development, respectively.

Note: The final mine phase (after full development and during final remediation) is not described. To describe this phase with any certainty will require the groundwater and surface water data from the first 40 years of operation to be used in model re-runs and data analysis.

Based on the hydrologic model, the majority (nine) of the outlets are not affected by the mine development, while seven of the outlets are projected to be affected. Figure C.14 shows that the intercepted volume is linear (log plot) with return period, so the implication is that the difference (percent of the volume intercepted) does not vary with return period. For example, Outlet O6-2, which has the largest percent volume intercepted, shows interception percentages of 9.5%, 9.7,%, 9.8%, 9.9%, 9.9% and 9.9% at the level of the 2-, 5-, 10-, 25-, 50- and 100-year return periods), respectively, for the 20-year development extent. Thus, any return period is representative of the percent volume intercepted, at a point of development.

Based on the groundwater modeling results (Appendix B.2), baseflow contributes to total flow at four of the 19 flow monitoring locations, *i.e.* at SW-01, SW-11, SW-17 and SW-18.

An existing baseflow of 2.21 L/s was modeled at location SW-01, which is known as Shaw Brook. At 20, 40 and 70-year development stages, the baseflow at SW-01 is expected to be 0.58 L/s, 0 L/s, and 0 L/s. The groundwater modeling for SW-01 shows that groundwater contributes only to a very minor extent to the water quantity in Shaw Brook. The water flow in Shaw Brook is predominantly surface water runoff from precipitation and snowmelt. During the flow monitoring conducted from 2005 to 2009, the lowest flow observed in Shaw Brook was 6 L/s while the largest flow observed was 325 L/s, *i.e.* baseflow represents less than 50% of smallest measured flow at SW-01.

At SW-11, baseflow changes do not exceed 23% at any given time. The baseflow change at the 70-year stage amounts to 0.07 L/s based on a modeled existing baseflow of 0.30 L/s.

An existing baseflow of 3.0 L/s was modeled at location SW-17. At the 20, 40 and 70-year development stages, the baseflow at SW-17 is expected to be 2.36 L/s, 1.78 L/s, and 1.70 L/s. Flows measured at SW-17 ranged from non-measurable to 125 L/s. That being said, flow in Stream 17 is predominantly surface water runoff; however, in periods of drought, flow is barely measurable and likely sustained by baseflow.

At location SW-18, an existing baseflow of 0.63 L/s was modeled. At the 20, 40 and 70-year development stages, the baseflow at SW-18 is expected to be 0.36 L/s, 0.36 L/s, and 0.36 L/s. Flows measured at SW-18 ranged from non-measurable to 81 L/s. That being said, flow in Stream 18 is predominantly surface water runoff; however, in periods of drought, flow is barely measurable and likely sustained by baseflow.

Mitigation measures to account for baseflow reductions will be discussed in Section 4.2.12.

Development over time may not impact a watershed to the same degree. For example, outlet O3-1 is affected at the 20-year point, by about 9%, and is not affected any greater amount by later developments. Outlet O5-3 is affected by 8% at the 40-year point and by 25% at the 70-year point. Similarly, baseflow in Shaw Brook is projected to be reduced by 74% at the 20-year point while 100% reduction is projected at the 40-year mark.

Therefore, it is to be expected that planning for any compensating measures will be done on a watershed-by-watershed basis and with time as the development proceeds. Compensating measures will likely involve the controlled release of water from stormwater retention ponds. The stormwater management plan is discussed in Section 4.2.12.

In order to confirm surface water predictions, it would be useful to collect data:

1. for continuous discharge, or stream water level elevations that could be converted to discharge, for all the outlets projected to be affected by the proposed development;

2. for continuous discharge, or stream water level elevations that could be converted to discharge, for outlets projected to be *not* affected by the proposed development, as a check on the data above;

3. detailed surveys of the slopes of the creeks

4. field verification of the flow linkages derived from the digital elevation model (DEM), which themselves are a derived product;

5. soil borings as a check on the assumed soils and infiltration values.

In addition, sites this small are subject to wide variations in the extent and intensity of localized storm events that often fall outside expected wide-area averages. It would be useful to install continuously recording rain gauges, as part of the continuous stream data recording. As well, such on-site gauges would allow determining the timing of the rain events and the timing of the catchment response, further improving the calibration and predictive capability of this Site modeling tool that has been assembled. The framework for additional monitoring is discussed in Section 4.2.10.

4.2.3 SHAW BROOK PROTECTION AND MONITORING PLANS

In the TOR, concern was expressed in regards to the magnitude of impacts from the proposed project on Shaw Brook. Shaw Brook, also referred to as Stream 1 in this document and the EARD, flows continually throughout the year and at higher flow rates than the other streams in the area. In addition, Shaw Brook serves as an agricultural water supply in the vicinity of Avondale Road (not for irrigation purposes but as a livestock water supply). It was apparent in the EARD that the Shaw Brook catchment had the highest aerial disturbance due to the mine footprint and that its headwaters were located within the footprint.

In order to address this problem, the mine footprint was revised by CGC Inc. to exclude the northern branch of Shaw Brook. In addition, groundwater and surface water modeling were completed to confirm the extents of baseflow and surface water runoff flow impacts. As described in Section 4.2.2, the catchment map was revised to define catchments based on the hydrologic boundary of the three rivers and the height-of-land to the east rather than the surrounding roads (Belmont Road, Avondale Road and the Ferry Road loop).

Based on the revised footprint and catchment map, the Shaw Brook catchment (CGC subcatchment 66) has the highest aerial disturbance due to the Miller's Creek Mine extension (see Aerial Catchment Disturbance tables and graphs in Appendix C.6). Based on the hydrologic model, the hydrologic disturbance for this catchment is also greater than for any other catchment, at any point during the mine life. The extent of baseflow and surface water runoff flow impacts are discussed below.

The groundwater model was used to simulate stream baseflow at the different flow monitoring stations along the peninsula. The following mining stages were simulated with the model: end of 20-year extraction (Figure B.7.1 in Appendix B.2), end of 40-year extraction (Figure B.7.3 in Appendix B.2), end of mine life (about 70 years) (Figure B.7.5 in Appendix B.2), and proposed full rehabilitation (Figure B.7.7 in Appendix B.2).

The simulated stream baseflow at Stream 1 for existing conditions is 2.2 L/s. At the end of 20-year extraction, 40-year extraction, mine life, and full rehabilitation, the simulated baseflows are 0.6 L/s (73.6% reduction), 0 L/s (99.6% - effectively 100% reduction), 0 L/s (100.0% reduction), and 2.8 L/s (26.2% increase), respectively. Baseflow changes are presented in Tables B.7.1, B.7.2, B.7.3, and B.7.4 of Appendix B.2. Refer to Appendix B.2 for additional details.

The hydrologic model was used to generate stormwater runoff volumes (excluding groundwater baseflow contributions) at the major outlets to St. Croix River, Avon River, and Kennetcook River. The detailed surface water modeling report is included in Appendix C.1.

In the hydrologic model, the same mine staging scenarios discussed above were simulated, with the exception of the full rehabilitation scenario, which was not generated due to reasons outlined earlier. Catchment maps and mine staging figures are included in Figures C.3, C.5, C.6, and C.7 of Appendix C.1. As shown in Figure C.3, Shaw Brook drains to a single outlet, O6-2. The total volumes of water generated at outlet O6-2 for the various mine staging scenarios are summarized in Table C.14 of Appendix C1.

As discussed in Section 4.2.2, the intercepted volume is linear (log plot) with return period, so the implication is that the difference (percent of the volume intercepted) does not vary with return period (Figure C.20 of Appendix C.1). Outlet O6-2, which has the largest percent volume intercepted, shows interception percentages of 9.5%, 9.6,%, 9.9%, 9.7%, 9.9% and 9.8% at the level of the 2-, 5-, 10-, 25-, 50- and 100-year return periods for the 20-year development extent, *i.e.* 10%. The percentage volume intercepted at O6-2 is about 26% for the 40-year development and approximately 45% at end of mine life.

Loss of some economic viability from the project would have been incurred if the footprint was altered to reduce volume interception at O6-2. To ensure the continued use of Shaw Brook as a water resource and maintain pre-development flows, surface water will be released from stormwater treatment ponds in a controlled manner. One year prior to overburden removal, the following monitoring plan for Shaw Brook will be implemented to ensure that long-term pre-operating conditions are well defined so that appropriate volumes of water are discharged to the stream once mining operations have begun:

- Continue monitoring water level and flow at SW-01; and
- Continuously monitor flow at outlet O6-2. This can be achieved by installing an instream flow monitoring structure or by developing a stage-discharge curve and continuously monitoring the water level.

For details regarding the stormwater management plan and the design and operation of stormwater management structures, refer to Sections 4.2.12 and 4.2.13.

4.2.4 POTENTIAL IMPACTS FROM THE PROPOSED PROJECT AND PROTECTION OF LOCAL WATER SUPPLY PONDS

As noted in the TOR, certain water bodies that were discussed or mentioned in the EARD were not depicted on any figures. Highfield Pond, a fire department water supply, (page 62 of EARD) and Allison's Pond (page 63 of EARD) are depicted on Figure 4.2-2. Reference is not specifically made to Bailey Quarry because it is part of the existing Miller's Creek Mine, not the proposed project, and; therefore, does not appear on any EARD or Focus Report figures. The potential impacts from the proposed project on Allison's Pond and the large pond used by the fire department (Highfield Pond) are assessed below.

Allison's Pond is located at the top of a hill, just outside of the northern boundary of the proposed mine footprint. The pond will not be removed as a result of the proposed mining operations. Since the pond is located at a high point and has no obvious inflow or outflow channels, it is assumed that it is fed by precipitation only; therefore, the dewatering and excavation of the mine are not expected to impact the pond. The bottom is sealed with local materials, which have a low permeability, so seepage is unlikely. Since Allison's Pond has no particular ecological significance or human use, no mitigation measures will be implemented.

Highfield Pond, which is located just west of Belmont Road, is fed by Stream 11 (Figure 4.2-2). Stream 11 and Highfield Pond are located in CRA subcatchment 44 (Figure C.4 of Appendix C.1). Both baseflow and surface water runoff contribute to flow in Stream 11. Total flows measured in Stream 11 from 2006 to 2009 ranged from negligible to 1.1 L/s (Table C.3.1 of Appendix C.3). The following photos depict existing conditions at monitoring location SW-11 on Stream 11. As shown in photos 4.2.1 to 4.2.6, flows in Stream 11 are minimal.

Photo 4.2.1: Flow conditions at SW-11 culvert inlet (June 6, 2006)

Photo 4.2.2: Flow conditions at SW-11 culvert inlet (November 3, 2006)

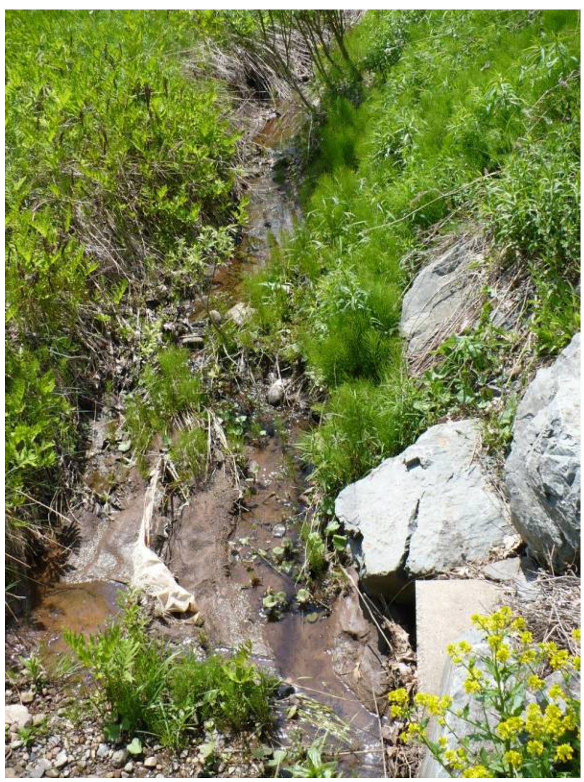

Photo 4.2.3: Flow conditions at SW-11 culvert inlet (May 29, 2008)

Photo 4.2.4: Flow conditions at SW-11 culvert inlet (July 23, 2008)

Photo 4.2.5: Flow conditions at SW-11 culvert inlet (September 16, 2008)

Photo 4.2.6: Flow conditions at SW-11 culvert inlet (June 11, 2009)

Using the groundwater model, a total of five scenarios were evaluated for baseflow changes: existing, 20 years, 40 years, mine life (~70 years), and full rehabilitation conditions. A baseflow rate of 0.3 L/s for existing site conditions at Stream 11 was simulated using the groundwater model (Table B.6.2 of Appendix B.2). Simulated baseflow changes are presented in Tables B.7.1 to B.7.4 of Appendix B.2. Changes in baseflow for the respective scenarios are -0.8%, -4.2%, -23.3%, and -5.6%.

Baseflow reductions within the first 40 years of development are not cause for much concern since they are below 5%, *i.e.* 0.015 L/s. Typically, changes of 5% or less are not considered an impact by several regulating agencies and is within measurement error for surface water monitoring. After 40 years, greater baseflow reductions due to drawdown could be offset by discharging treated water from the surface water management pond into Stream 11, and ultimately into Highfield Pond. A continuous water level monitoring station will be installed in Highfield Pond a year prior to work commencing in the Pond's catchment area to capture baseline conditions and seasonal variations in water level. This baseline information will enable CGC Inc. to maintain water levels at pre-extension conditions, if and when baseflow changes occur.

Based on the hydrologic model results, CRA subcatchment 44 will not be significantly impacted by the mine development. Tables C.6d, C.7d, C.8d, and C.9d of Appendix C.1 show that there will be no change in the volume of water generated by various storm events at any point during the mine life. That being said, the proposed mining activities are not expected to impact surface water runoff volumes or patterns in CRA subcatchment 44.

Based on the results of the groundwater and hydrologic models, only baseflow changes are expected to impact Stream 11, and subsequently Highfield Pond. Existing flow in the stream is already negligible so the changes in baseflow will not likely be measurable in the stream itself. The water level in the pond will be monitored and if changes in water level warrant it, flow from the surface water management ponds will be discharged to the stream.

4.2.5 PROPERTY BOUNDARY MAP

A map showing CGC Inc. property boundaries in relation to the proposed project location is included as Figure 4.2-2. This map was used for the selection of monitoring stations, which are discussed in Section 4.2.10.

4.2.6 SURFACE WATER SAMPLING METHODS AND PROTOCOLS

To address TOR comments regarding the surface water quality and quantity monitoring protocols, CRA has prepared a monitoring protocol document, which is included in Appendix C.2. Sampling/monitoring methodology, equipment, QA/QC methods, and preservation measures are discussed in the afore-mentioned document.

QA/QC sampling for the period of November 2004 to April 2009 consisted of three duplicate water samples out of a total 289 samples collected at locations S1 to S6, which equates to approximately 1% of samples submitted for analyses. Although few duplicate samples were collected, the intent of this limited QA/QC program was to evaluate the reliability of the sampling and testing.

Laboratory replicate analyses were conducted on 11 samples from November 2004 to April 2009, by Maxxam Analytical Services, Bedford, Nova Scotia. Maxxam is an accredited by the Standards Council of Canada laboratory and has in-house QA/QC programs to govern sample analysis.

CRA measured water levels using two different methods in Streams 1, 17 and 18. Pressure transducers were installed in the streams while manual measurements were taken during flow monitoring events to cross-check water elevation data. A table comparing staff gauge measurements to transducer data is included in Appendix C.4.4 for Stream 1, which is the stream in which water level measurements were taken for the longest period of time.

4.2.7 CUMULATIVE EFFECTS ASSESSMENT OF PROPOSED PROJECT TO STREAMS AND WETLANDS WITHIN THE PROJECT AREA

Based on the Cumulative Effects Assessment Practitioners' Guide (Hegmann et. al., 1999), "cumulative effects may occur if local effects on VECs occur as a result of the action under review and/or those VECs are affected by other actions." The concept of cumulative effects also recognizes that the environmental effects of different human activities can combine and interact with each other to cause cumulative effects that may be different in nature or extent from the effects of individual activities. As defined in the EARD, surface water and wetland resources were identified as VECs. VECs in this context refer to surface water and wetland quality and quantity within the project site and downstream. Accordingly, the role of the proposed project in the cumulative effects assessment (CEA) on streams and wetlands within the project area is discussed below.

In the EARD, a project-based CEA was conducted, which determined that no cumulative or adverse effects to surface water and wetland VECs were expected as long as proper stormwater management plans and other mine management best practices are employed to protect water quantity and quality for all discharges from the site. To complement the results of the project-based CEA, a simplified regional-based CEA is completed herein.

Spatial boundaries for the CEA of surface water and wetland VECs cover an area many times the site property, extending to shorelines on the north, east and south and to a height of land some distance to the east of the existing mine. The CEA boundaries correspond to the ones defined in the groundwater and hydrologic models. Runoff from the six independent watersheds within the hydrologic boundaries drains to the St. Croix River, Avon River, and Kennetcook River.

Temporal boundaries for the surface water and wetland resources CEA were set to existing conditions (baseline) and the end of operational life of the project (i.e. approximately 70 years). Although VECs will not likely return to pre-activity conditions within the operational life of the project since full rehabilitation will not be achieved at that time, CEA projections beyond a seventy-year timeline are difficult to establish. The "past" boundary was set to existing baseline conditions due to a lack of historical surface water and wetland resource information.

Known existing, past and future activities that have or may have had cumulative effects on the surface water and wetland VECs include logging, residential construction, power line installation, road and railway construction, agricultural land use, historical mining activities, and off-road vehicle use. One of the main identified uses of the surface water supply on the peninsula is for agricultural purposes (*e.g.* livestock watering and irrigation). There are no known water withdrawal approvals or permits in place for any agricultural users. Water withdrawal permits and approvals are generally issued by NSE for large quantity users. It appears that water use for agriculture is limited to the larger streams such as Shaw Brook, where catchment areas are large enough to provide sufficient and regular (*i.e.* non-ephemeral) runoff volumes. Water has been historically withdrawn by agricultural users on an as-needed basis. As previously mentioned, it is difficult to assess the impacts of historical activities based on a lack of data. The data collected for this study encompasses existing conditions that include water withdrawal by other users. Provided that this volume remains consistent, the cumulative effect for water drawdown from mining is anticipated to be insignificant with applied mitigation to maintain water flow.

Future activities are based on the degree of certainty. A local resident operates a sand pit operation just west of the Belmont Road and Ferry Road intersection. To the best of CRA's knowledge, no other projects, industrial, agricultural, or otherwise are proposed, approved, or currently under review for the spatial boundaries set. That being said, no other future projects fall into the certain category for the boundaries defined.

Judging by the activities that have recently been observed within the spatial boundaries, such as logging, off-road vehicle use, agricultural land use, residential development, and water use for agricultural purposes, one may hypothesize that these activities will occur sporadically or continuously over the course of the mine's operational life.

The spatial and temporal overlap between the mine extension project and water use for agricultural purposes in Shaw Brook shows that there is a strong interaction between the two activities. In fact, water quantity and quality changes associated with the mine development will occur with minimal to no impact to the downstream users. The water quality and quantity will be maintained in the middle and lower reaches by controlled release of stormwater runoff from the mine site and stockpiles. Therefore, predicted changes in water flow and quantity resulting from the Project are manageable with proper mitigation and monitoring methods.

Logging activities on lands not owned by CGC, existing and/or potentially occurring over mine life will contribute cumulative effects to water quantity and quality since catchment characteristics such as runoff coefficients, longest flow paths and interception capacity will change. Logging activities are expected to increase surface water runoff that discharges to the streams since there will be less vegetative interception. In addition, water quality is expected to be affected by sediment entrained from the logged areas. Since logging is not as closely regulated as mining, no contingency or stormwater management plans are required for this type of activity; therefore, potential logging will contribute to surface water VEC cumulative effects.

Current agricultural practices and farming operations will also contribute to the cumulative effects on stream and wetland quantity and quality. Nutrient overloading due to agricultural activities is expected in the downstream reaches. In addition, water used for livestock and irrigation purposes without a permit will add to the cumulative effects on surface water VECs. Since agriculture is not as closely regulated as mining, no contingency or stormwater management plans are required for this type of activity; therefore, existing and potential agricultural activities will contribute to surface water and wetland VECs cumulative effects. That being said, the stormwater management plan for the mine will be reviewed and approved by NSE and they will specify requirements for monitoring of quality and quantity.

Therefore, as long as proper stormwater management plans and other mine management best practices are employed to protect water quantity and quality for all discharges from the site, there is no anticipated significant adverse cumulative effect to surface water VECs within the study area associated with the mining operation. Significant adverse effects are expected to occur through the removal of wetlands (see Section 4.4.5); however, only Wetlands 1 and 4 are hydrologically connected to surface water resources outside of the mine footprint. Provided mitigation measures designed to reduce or eliminate adverse impacts to wetlands are successfully applied (see Section 4.4.5), the cumulative effects of the Project on wetlands will be minimal. As previously described in 4.2.2, predictions for surface water and groundwater and therefore wetlands, for the period after full development will require data from the first 40 years of operation. For that reason, the predicted cumulative effects of the Project on the peninsula from a wetlands perspective for removals are expected to be minimal given the wetland areas to be removed represent 1.6% of the Project footprint. Cumulative effects from potential activities such as logging and surface water withdrawals can be mitigated if proper regulations and guidelines are instated and enforced.

4.2.8 BASELINE SURFACE WATER QUANTITY MONITORING RESULTS

In order to address NSE's concerns regarding the frequency and quality of surface water flow monitoring data, CRA conducted nine additional monthly monitoring events from

May, 2008 to September, 2008 and from March, 2009 to June, 2009, respectively. Monitoring locations are depicted in Figure 4.2-2.

In addition to the nine monitoring events conducted, CRA installed pressure transducers in three streams: Shaw Brook (Stream 1), Fish Brook (Stream 17), and stream 18. The transducers were set to record water levels on an hourly basis or every two minutes during the proposed pumping test. Data collection occurred from May 2008 to June 2009 in Stream 1, from February 2009 to June 2009 in Stream 18 and from April 2009 to June 2009 in Stream 17. In addition, manual water level measurements were collected at these locations using a water level meter and/or a staff gauge during the flow monitoring events.

An updated flow monitoring table that includes precipitation data up to two days prior to the monitoring events is included in Appendix C.3. As indicated in Table C.3.1, the monitoring event conducted in June 2006 is not representative of dry condition baseline data since data collection occurred after a significant precipitation event.

Appendix C.4 also includes tables and water level graphs for Streams 1, 17 and 18. A table comparing staff gauge measurements to transducer data is included for stream 1. Based on the comparative table, the absolute difference between manual measurements and transducer records ranges from 0.001 m to 0.018 m. For the level of accuracy required, this margin of error is acceptable. This small margin of error indicates that the stream instrumentation is in proper working order and that the data records can be trusted. The errors observed were most likely due to manual measurement readings and/or slight transducer elevation changes due to snags in the nylon twine, etc.

Although the existing stream flow monitoring, which consists of spot measurements on a monthly basis, does not capture all possible seasonal variations, it does present an overall acceptable representation of current runoff conditions on the peninsula. In fact, with the exception of Shaw Brook, which flows continually, all the other streams had zero or near zero flows, which could not be measured with a Marsh-McBirney flow meter or the bucket-stopwatch method, at least once during the monitoring period (refer to Appendix C.2 for flow monitoring protocols).

Refer to Section 4.2.10 for the water quantity monitoring plan framework. The plan outlines additional baseline monitoring needed to capture seasonal variations and fine-tune the hydrologic model, as well as measures to confirm EA predictions and assess the success of the mitigation measures.

4.2.9 BASELINE SURFACE WATER QUALITY MONITORING RESULTS

CRA has revised baseline data surface water quality data tables to include sampling dates, units, and comparisons to CCME Fresh Water Aquatic Life Guideline 2007 (FWAL). CGC Inc. has collected monthly surface water samples at five locations (S1-S5) around the peninsula since November 2004. A sixth location (S6) was added in November 2005 (Figure 4.2-2). These samples were analyzed by Maxxam Analytical Services for general inorganic chemistry, nutrients, suspended solids, and metals. The updated data tables for each sampling station are included in Appendix C.5. All concentrations are total values for unfiltered samples.

Four inorganic nutrients were measured: ammonia, nitrite, nitrate and phosphorus. Nitrate and ammonia did not exceed the CCME guidelines for Freshwater Aquatic Life (FWAL) at sampling stations S1-S6. Nitrite concentrations exceeding the CCME FWAL guideline (0.060 μg/L) were observed at the following locations: S2 in March 2005, April 2005, September 2006 and March 2007; S3 in February 2005, March 2005 and April 2005; at S4 in March 2005; and at S5 in April 2005. The phosphorus concentrations at all six locations were high on occasion at levels ranging from 100 to 2000 μg/L. However, the lab detection limit is too high to adequately determine nutrient loading. It is likely that phosphorus limits are at eutrophic levels. The source of this nutrient loading is agricultural related. The sampling locations are downstream of local livestock farms and fields.

Conductivity, total dissolved solids, major anion (sodium, calcium, magnesium and potassium) and major cation (sulfate and chloride) concentrations are high due to dissolved minerals in the area geology rendering the water very hard. Dissolved ions are derived from the weathering of rocks and from precipitation. Conductivity concentration ranges extensively in the 1000s and 100s range. Cation concentrations reflect the presence of gypsum (calcium sulphate dihydrate) and dolomite (calcium magnesium carbonate) in the elevated levels of magnesium and calcium. Sampling locations S1, S2 and S3 have the highest calcium concentrations, followed by S4, S5, and S6 which had calcium levels one order of magnitude less, but still elevated above typical Nova Scotia concentrations for watercourses in igneous or metamorphic geology. Sodium and chloride are elevated at S2 and highest at S6 which may indicate effects of road salt, tidal influence and/or sea spray. Magnesium concentrations are relatively consistent, with S3 having the highest levels above the other sampling locations. Sulfate concentrations range in the high 100s to low 1000s at S1 and S2 due to the gypsum.

Despite the watersheds having been logged and farmed, turbidity and total suspended solids are low despite the high silt content in the surficial soils and erosion in the woods and fields. The highest levels were recorded at S1, S2, S3, and S6.

Alkalinity is very high at all stations due to the limestone/dolomite geology which is comprised of carbonate. This significant buffering capacity of the geology is also reflected in the pH levels, which generally range from 6.80 to 8.20 over all sampling locations. A single CCME FWAL exceedance was observed at S5 on March 1, 2005 (pH of 6.43).

The majority of metal levels are below detectable levels. Aluminium and iron exceed the CCME FWAL at all stations, a feature of Nova Scotia surface waters. The presence of heavy metals above detectable limits is not frequent. Copper concentrations exceeding CCME FWAL were observed on three occasions: S2 in May 2005, S4 in April 2008, and S6 in December 2005. Zinc concentrations exceeded the CCME FWAL at stations S1, S2 and S3 on a few occasions. A number of zinc readings denote possible guideline exceedances given raised detection limits above guideline criterion due to matrix interference.

The higher than typical levels of strontium are likely due to the proximity of the water sampling location to seawater and its presence in evaporates (gypsum, dolomite and limestone).

In all sample analyses, with the exception of November 2004, detection limits for cadmium, selenium, and silver were greater than the guideline criteria. As a result, comparisons to CCME FWAL are inconclusive; all the samples represent possible guideline exceedances. In future laboratory analyses, CGC will request that lower detection limits be used to eliminate the ambiguity involved with detection limits that are greater than guideline values.

Several guideline comparisons for aluminium, arsenic, copper, iron, thallium and zinc were inconclusive due to raised detection limits above CCME FWAL, which were caused by matrix interference. Matrix interference occurred on a few occasions for samples collected at S4, S5, and S6 and on several occasions for samples collected at S1, S2, and S3.

4.2.10 FRAMEWORK OF WATER QUALITY AND QUANTITY MONITORING PLANS

If approval for the development of the Miller's Creek Mine Extension is granted, one year prior to commencing the work, the following surface water monitoring program will be implemented:

- o Continue monitoring the 19 streams for flow (with detailed photo logging). All of the streams do not need to be monitored throughout the mine's life. Monitoring could commence one year prior to watershed/catchment disturbance and continue until the affected watershed/catchment rehabilitation is achieved. Details of monitoring frequency and duration will be discussed with NSE and presented in the IA approval application.
- o Maintain the three surface water pressure transducers installed in Stream 1, 17, and 18 which will be set to record data continuously;
- o Collect data for continuous discharge, or stream water level elevations that could be converted to discharge, for the outlets projected to be affected by the proposed development, based on the hydrologic model;
- o Collect data for continuous discharge, or stream water level elevations that could be converted to discharge, for outlets projected to be *not* affected by the proposed development, as a check on the data from the hydrologic model;
- o Install continuously recording rain gauges, as part of the continuous stream data recording. As well, such on-site gauges would allow determining the timing of the rain events and the timing of the catchment response, further improving the calibration and predictive capability of the Site modeling tool that has been assembled; and
- o Continue monitoring surface water quality at the six surface water locations (S1-S6). All of the sampling locations do not need to be monitored throughout the mine's life. Monitoring could commence one year prior watershed/catchment disturbance and continue until the affected watershed/catchment rehabilitation is achieved. QA/QC sampling will be conducted more frequently so that a minimum of 10% of the samples submitted to the lab are duplicated. Field and trip blanks will also be included. A detailed surface water quality monitoring program will be developed in consultation with NSE and presented in IA approval application.

A map showing property boundaries, wetlands, watercourses, water bodies, existing and proposed surface water monitoring stations is included as Figure 4.2-2. The proposed monitoring stations were selected with property access in mind. If CGC Inc.

does not own a property necessary to install/access the proposed monitoring stations, property access will be negotiated with property owners.

4.2.11 ASSESSMENT OF TIME PERIOD REQUIRED FOR LAKES PROPOSED IN RECLAMATION PLAN TO FLOOD AND PROVIDE WATER TO DOWNSTREAM USERS

The proposed rehabilitation condition is shown on Figure B.7.7 of Appendix B.2. Two lakes (*i.e.*, the West Lake and the East Lake) are proposed to be created. Both lake levels were set to the nearest topographical low. The West Lake has a lake level of 45 m AMSL and the East Lake has a lake level of 21 m AMSL shown on Figures B.7.7 and B.7.8. This simulation was used for the assessment of groundwater flow pattern and the potential impact when full rehabilitation occurs.

The filling times for the West Lake and the East Lake were estimated with considerations of available water from both the groundwater inflow at the full extension and the net recharge over lakes. As the lakes are being filled up, the groundwater inflow rates will be reduced, due to reduced hydraulic head. As an estimate, half of the groundwater inflow rate at the full scale mine extension was used as an average available groundwater inflow for lake-filling. Half of this available groundwater inflow was assumed to be flowing towards the West Lake and the other half towards the East Lake. The lake volumes were calculated using Surfer 8.0 (Golden Software, 2007) using the corresponding mine floor elevations and the lake water levels. The available water from precipitation (without lake surface evapotranspiration as a net recharge) was calculated over the areas of the corresponding lakes. Based on Environment Canada data, the net recharge over surface water is 690 mm/year. The details of parameters and the results of the lake-filling times are presented in Table B.7.5 of Appendix B.2. It is estimated that it will take up to 47 years and 24 years to fill the West Lake and the East Lake, respectively; however, this could change depending on the final aerial extent of the lakes and the amount of backfill in each.

Additional details regarding the groundwater model are included in Appendix B.2.

4.2.12 STORMWATER MANAGEMENT PLAN TO ENSURE A CONTINUED WATER SUPPLY TO THE DOWNSTREAM REACHES OF IMPACTED CATCHMENTS

As discussed throughout Section 4.2, and specifically in the hydrologic modeling report (Appendix C.1), the proposed mine footprint and stockpiles will have an impact on surface water drainage patterns and runoff distribution over the life of the project. The majority of impacts to water quantity will be on Catchment 66 (Appendix C, Figure C.4), which contains Shaw Brook, and within which the majority of the pit development will take place.

CGC has significant experience in the control and management of surface water runoff gained through the operation of the existing Miller's Creek site. The area of the current active mine that is dewatered is more than double the size of the entire proposed extraction area of the Mine Extension Project, so knowledge gained through mine dewatering can be easily applied to the proposed site.

As discussed in the EARD, during development and operation, a stormwater management plan will be in place to ensure that runoff from all disturbed areas is properly treated by utilizing both short term (*e.g.* silt fencing, diversion ditching, temporary check dams) and long term (*e.g.* permanent ditching, storm water ponds, buffer zones) stormwater and best management practices. Temporary controls may be required during initial mine development to ensure that discharge quality limits are met before the pit is able to function as a settling pond itself. Comprehensive sediment and erosion control for all project phases and stormwater management plans would be developed during the industrial approvals process, which would conform to all NSE guidelines and requirements, such as the NSE Erosion and Sediment Control Handbook for Construction Sites. Monitoring of off-site discharges will be carried out by CGC Inc. on a regular basis during both development and operation, according to NSE requirements for frequency and parameters.

In order to ensure continued water supply to the downstream reaches of impacted catchments, rainfall and runoff intercepted by the extraction and stockpile areas will be collected in interception ditches, directed towards stormwater management ponds, treated, and released back to the watershed.

In order to maintain pre-development flows in the affected watercourses, controlled volumes of water will be released from the stormwater treatment ponds into the watercourses. Comprehensive baseline data, which will include developing stage-discharge curves, will be collected for all the simulated impacted outlets/streams. The volume of water discharged to the watercourses will be based on continuous flow data. The continuous flow data collected will be compared to comprehensive baseline flow data; the difference between pre- and post-development flows will be release from the stormwater management ponds in a controlled manner. For example, continuous water level data might be collected at outlet O6-2 using a pressure transducer. The water levels measured could be transmitted to CGC Inc. via satellite or a phoneline, then would converted to a flow using the stage discharge curve. The difference between the measured flow and the baseline flow for similar weather conditions (*i.e.* temperature and precipitation) could be released from the stormwater ponds via a weir controlled by raising/lowering a gate. The gate would be raised/lowered to a level that would only allow a flow equal to the baseline - measured discharge difference. Similarly, in order to maintain pre-development flows to the conservation area (discussed in Section 4.3), the dump pond could be used as a stormwater management pond and water released in the same manner via a man-made gate.

Following reclamation, a system of lakes in the headwaters of the peninsula would ensure continued supply of water downstream. As discussed in Section 4.2.11, the water level in both lakes will be set to the topographic low. The flow discharged to the downstream reaches would be controlled using a series of weirs to reduce the need for power generation.

Stormwater management pond design is discussed in Section 4.2.13. Detailed stormwater management plans based on a catchment by catchment basis will be developed at the Industrial Approval stage.

4.2.13 SETTLING POND DESIGN AND OPERATION

The general approach to hydraulic structure design is to design for whatever the design annual event may be (*e.g.* 10-year) and then check for "no damage" under the 100-year event. The risk is "probability over life". The probability of the 100-year event (1% per year) occurring over 20 years totals about 20% over a life, which is why 100-year, or 1% annual risk, is used.

The annual design level (10-year, 25-year, etc.) of stormwater retention structures depends on a number of things, including potential for damage, opportunity for detecting any damage before failure, and opportunity for repair. Stormwater ponds are usually very low risk, easy to inspect and catch incremental damage, and easy to repair. So a low event, like 10-year, is usually acceptable for design but it still must not be damaged to the point of failure under the 1% event (100-year).

The standard approach has always been to the limit the extrapolation of measured data to twice the record length. The basic idea is to "design around" the uncertainty.

In this case, CRA suggests using an "adaptive approach". Design rainfalls are known for present conditions and for the next 10 to 20 years. Uncertainty lies beyond the 20-year mark, which is why the ponds should be built for known conditions. The design can always be adapted if a larger facility is needed later on.

Routine monitoring and damage inspections will be part of the standard operation and maintenance (O&M) practices. O&M practices in accordance with the NSE Erosion and Sedimentation Control Handbook will be followed. Specific O&M details will depend on the final pond design.

CGC understands the need for erosion control measures during land disturbance projects and has a lot of experience in controlling and directing water to allow time for suspended solids to settle out. Typical measures that would be used include the installation of rock-lined ditches with check dams, placement of silt fence, spreading of hay on exposed soil, and construction of settling ponds with overflow controls. Gypsum is a known natural flocculent which can clear muddy water in ponds by aggregating soil particles (Nature's Way Resources), so sediment in runoff from gypsum exposed areas tends to settle out relatively quickly.

At the IA stage, specific details pertaining to pond design and operation will be determined in consultation with NSE. Such details will include effluent monitoring requirements, routine integrity inspections, and determining whether providing safe passage of the 100-year event is sufficient or whether the event must actually be detained.

4.2.14 RELEVANT EXISTING APPROVALS

The following approval is included for reference in Appendix D:

- Non-Mineral Registration 002

No other relevant approvals exist for the proposed Miller's Creek Mine Extension area.

4.2.15 DEPICTION OF FINAL PROPOSED PROJECT

Maps showing the final project development, including watercourses, wetlands, and proposed surface water monitoring stations are shown on Figure 4.2-2. Conceptual settling pond locations are depicted on Figure 4.2-3. Detailed drainage patterns are not depicted on any of the figures. Survey data needs to first be collected. Detailed locations and the drainage design at the Industrial Approval stage of the Project.

4.2.16 CONTINGENCY PLANS FOR ACCIDENTAL SPILLS TO ENSURE PROTECTION OF WATER RESOURCES

As a requirement of the Industrial Approval application/amendment for this mining operation, CGC Inc. will prepare for NSE's approval, a contingency plan for accidental events. The contingency plan will be part of the environmental management plan (EMP), which will be submitted as part of the application for IA. These include: discharges of liquid effluents, protection of groundwater resources, noise and dust control, protection of flora and fauna, solid and hazardous wastes management, and contingency planning. The EMP will include detailed mitigative measures and proposed monitoring plans.

CGC Inc. currently operates with the "Windsor Plant (CGC Inc.), Crisis Response Plan & Emergency Procedures, 2007/2008". CGC Inc. also has a plan on file with Transport Canada, Transport Dangerous Goods Directorate, for the transportation of explosives products: "Emergency Response Assistance Plan 2-0161, For Application during Emergencies in the Transportation of Explosives". Please refer to Appendix I of the EARD for these documents.

4.3 SPECIES AT RISK

All of the species-at-risk known to occur on the Project site are flora species (both vascular plants and lichens). Issues relevant to flora species-at-risk in regards to the Proposed Project are discussed in detail in the Flora Species-At-Risk Report prepared for this Project (Appendix E).

4.3.1 ECOLOGICAL INTEGRITY OF THE CONSERVATION AREA

The proposed CGC Conservation Area is a large, continuous expanse of calcareous habitat, which supports considerable populations of vascular plant and cyanolichen species of concern. None of the environmental conditions discussed in the previous subsections will be negatively affected by the development of a gypsum mine to the north of the proposed Conservation Area:

- Landscape position will not be affected;
- Proximity to forest edges/exposure will not be affected;
- Local climate will not be affected;

- Soil moisture levels will not be affected;
- Humidity regime will not be affected;
- Ground and surface water quality will not be affected;
- Acid rain will not be produced;
- Temperatures will not be affected;
- Soils and substrates physical characteristics will not be affected;
- Soil and substrate pH values will not be affected;
- Natural patterns in forest succession will not be affected;
- Air quality will not be affected; and
- Species interactions will not be affected.

The Conservation Area will be undisturbed by the proposed Project, and will be protected by CGC to ensure it remains undisturbed. It will never be logged, nor will further anthropogenic disturbances be permitted, unless required to protect species at risk in which case this would be completed under the direction of applicable regulatory agencies.

Until recently, *C. parviflorum* var. *pubescens* was considered a subspecies of the European yellow lady's-slipper, *C. calceolus.* Population viability analysis modeling has shown that *C. calceolus* can persist in a protected area where there are only slow changes in habitat through secondary forest succession (Nicolè *et al*. 2005). No changes in habitat are predicted to occur in the Conservation Area, aside from natural succession. As succession tends to occur patchily in forests such as that on the Conservation Area, there should always be suitable habitat available for yellow lady's-slipper within the Conservation Area.

Nicolè *et al.*'s (2005) population viability analysis also indicated the importance of habitat versus individual conservation for the protection of *C. calceolus* populations. Over 40 ha of potentially suitable habitat will be preserved and protected within the Conservation Area, and over 3230 stems, representing several hundred plants ranging from seedlings to large established clumps, will remain undisturbed.

The current abundance of yellow lady's-slipper on the Project site near disturbed areas indicates that the yellow lady's-slipper population in this area is temporarily elevated above 'normal' levels (*ie*., what the level would be if historic mining had not occurred). It is unclear why the yellow lady's-slipper is so abundant in some disturbed areas, though it is likely due to reduced competition on gypsum-rich soils. The heavy reliance of yellow lady's-slipper on mychorrhizal relationships early in the life history may give this species an advantage on these nutrient-poor gypsum-rich soils, on which other species may have trouble becoming established. As these disturbed areas continue to be naturally revegetated, approaching pre-disturbance conditions, the resulting higher soil nutrient levels and vegetation diversity will likely result in the yellow lady's-slipper population decreasing to pre-disturbance levels.

The dominant ecological characteristics currently present within the Conservation Area, such as elements of composition, structure, function, and ecological processes are not predicted to be affected beyond the limits of their expected natural ranges of variation. The ecosystem of the Conservation Area will remain resilient to most perturbations imposed by natural environmental dynamics.

The Conservation Area will support detailed monitoring plans and/or research plans on species-at-risk occurring within its boundaries. Protection plans for species-at-risk known from the Project site are discussed in the following section.

Further in-depth discussion of the ecological integrity of the Conservation Area is provided in Section 3.3 of the Flora Species-At-Risk Report prepared for this Project and provided in Appendix E.

4.3.2 PROTECTION PLAN FOR SPECIES AT RISK

A draft Protection Plan for species-at-risk in the proposed Project extraction area is provided in Section 4.0 of the Flora Species-At-Risk Report prepared for this Project and provided in Appendix E.

Over the life of the Project, some specimens of flora species-at-risk will be removed, due to their location within the planned extraction area of the proposed Project. Species-at-risk present in the planned extraction area are yellow lady's-slipper, black ash, Canada buffaloberry, and the lichens *S. saccata* and *C. cristatum*. To protect species of concern which will lose specimens growing in the extraction area, CGC will develop a Flora Species of Concern Protection Plan to ensure all specimens of species of concern located elsewhere on the site are protected. The Protection Plan will discuss the following actions to protect species-at-risk in the proposed extraction area:

- Exclusion Zones
- Buffer Zones and Minimal Habitat Disturbance
- Motorized vehicle restrictions
- Training of staff to recognize and report species
- Seed Collection/Transplantation
- Reporting of Illegal Collection or Picking

- o Collection of Additional Species Knowledge
- o Maximized Use of Native Species in Reclamation

The Flora Species of Concern Protection Plan will supplement the Environmental Protection Plan (EPP), which will be developed once the Project receives approval. A framework for the Flora Species of Concern Protection Plan is provided in Section 4.0 of the Flora Species–at-Risk Report provided in Appendix E. In addition, a detailed habitat assessment will be conducted for each location of species-at-risk prior to removal.

4.3.3 LOCATION OF SPECIES AT RISK, WETLANDS, WATERCOURSES, AND PROPOSED CONSERVATION AREA RELATIVE TO THE MINE FOOTPRINT

Figure 4.3-1 depicts the locations of all species-at-risk, wetlands, watercourses, and the proposed Conservation Area in relation to the proposed mine footprint.

4.3.4 ECOLOGICAL SIGNIFICANCE OF THE PROPOSED PROJECT SITE

The ecological significance of the proposed Project Area is discussed in detail in Section 2.0 of the Flora Species-At-Risk Report (Appendix E).

Karst topography is found in areas underlain by Windsor and Mabou Group strata. Within Nova Scotia, there is approximately 3,140 km^2 of land that has the potential to exhibit karst topography (Figure 1, Appendix E). Neily *et al*. (2003) identified 11,715 ha of potential karst topography in the lowlands of Hants and Colchester counties alone.

The proposed Project site will encompass a total area of 386 ha over its lifetime; actual gypsum extraction will occur on 155 ha. Thus, the total area to be mined over the lifetime of the proposed Project represents 0.05% of the potential karst topography known from the entire Province.

4.3.5 AREAL EXTENT OF THE CONSERVATION AREA

The proposed Conservation Area will cover a continuous area of 46 ha (Figure 4.3-1) in the centre of the project site. A small portion (1.2 ha) of the northwestern edge of the Poplar Grove Habitat of Concern, which is an area listed on NSDNR's Significant Habitats and Species database due to the presence of yellow lady's-slipper and eastern leatherwood, falls within this proposed area. The proposed Conservation Area contains a cross-section of the habitat types found within the Project footprint, including wetlands, streams, mature forests, karst topography, and gypsum outcrops and cliffs. It is also known to support specimens of all the listed vascular plant species known from the Project site, and to contain additional suitable habitat for these species.

A better appreciation of the varied topography within the conservation area is shown in figure 4.3-2. The diagram shows generalized geology, approximate depth to bedrock and other surface features.

The proposed area was chosen because it represents a cross section of the rare or endangered species found in the Project area. CGC has been very open to discussing changes to the boundaries that are beneficial to rare flora and Project viability. The boundaries have been adjusted several times to minimize impacts to wetlands, streams, and flora species of concern. The proposed Conservation Area is defined on the east by CGC's property boundary with adjacent landowners. Species of concern may cross this boundary, but CGC has no control over their current or future status. The southern boundary is controlled partly by the Shaw Brook watershed boundary and the extent of the stockpile that is being created through mine development. The north and west boundaries of the proposed Conservation Area are controlled by the mine boundaries that were chosen to provide a considerable ecological buffer around the areal extent of the ram's-head lady's-slipper, as well as an old rail bed, which forms a natural man-made border. Since EARD was submitted for review in February 2008, the northwest boundaries of the Conservation Area have been adjusted to avoid all of Wetland 12. The adjusted boundaries are depicted on Figure 2.1.

Figure 4.3-3 depicts a cross-section of the topography of the site, running north to south through the Conservation Area in the vicinity of Wetland 12. This figure depicts both existing topography and predicted changes due to development of the mine and stockpiles. As seen in the figure, the increase in elevation of the southern portion of the site due to the creation of the stockpiles will not cause impacts to Wetland 12 or the CA due to shading.

This figure also depicts the existing interpolated groundwater elevation and the simulated groundwater elevations at full mine life and full reclamation. This clearly shows that in the long term there will be no permanent decrease in depth to the groundwater elevations as a result of the Project. The Conservation Area has groundwater in bedrock between 10 – 25 metres below it. At the present time, the hydrogeological modeling conducted for this project (Appendix B2) predicts that the groundwater elevation will decrease by a maximum of 45 metres by the end of the

Project's life. Once mining ceases and the pit fills with water, the groundwater elevation in this area is predicted to be approximately 15 metres above the existing level, due to the proximity to the water filled mine pit. This reinforces the need to monitor water levels closely during the life of the Project and beyond, and to conduct additional modeling as additional new groundwater data become available.

A discussion of the predicted groundwater levels and possible implications to the Conservations Area's integrity can be found in Section 4.1.

4.3.6 FRAMEWORK OF SPECIES AT RISK AND HABITAT CONSERVATION, RESEARCH, AND MONITORING PLAN

Prior to mine development, a detailed long-term research and monitoring program for the vascular plant and lichen species-at-risk in the Conservation Area will be developed in consultation with NSDNR, academia and the Confederacy of Mainland Mi'kmaq (CMM). A draft monitoring plan for black ash, developed in collaboration with CMM, is provided in Appendix E-1. A draft table of contents for a Research and Monitoring Plan for rare flora species occurring in the Conservation Area is provided at the end of this section. The research and monitoring program will be specifically aimed at benefiting the species-at-risk by providing information on habitat requirements and reproduction to facilitate long-term survival in the Conservation Area. Collaboration with experienced botanists and lichenologists will help to clearly define limitations on current knowledge surrounding the resilience, population ecology, and life history of the vascular plant and lichen species-at-risk occurring within the Conservation Area. As requested in the TOR, the long-term monitoring plan will be defined in ten-year intervals and will include annual counts or surveys of the individual rare plants and lichens. The monitoring program will begin with a preliminary survey, which will provide updated baseline habitat data on the species-at-risk. During the baseline surveys, specimens may be marked to allow tracking throughout the monitoring program. Annual monitoring surveys will follow. Collection of at least two years of baseline data prior to Project activities will provide knowledge of the natural year-to-year variation in population demographics of the species at risk.

The framework of the species-at-risk and habitat conservation, research, and monitoring plan, as well as a suggested tables of contents, is provided in Section 7.0 of the Flora Species-At-Risk Report (Appendix E). These plans are tentative until the Project receives regulatory approval. Requirements for detailed monitoring and research plans are expected to be outlined in the Terms and Conditions of the Project Approval. The final plans will then be developed in collaboration with DNR, species recovery teams, scientists and other experts.

4.3.7 FRAMEWORK OF OPERATIONS MANAGEMENT PLAN

A detailed Mine Development Plan, detailing the phased schedule of extraction for the proposed mine, will be prepared by CGC once the Project receives regulatory approval. This plan will take into account species-at-risk affected by each extension phase and will outline mitigation activities required for Project approval.

Figure 4.3-4 depicts the conceptual planned extent of the proposed Project at 20, 40 and mine life (~70 year) intervals. Table 4.3-1 depicts the current populations of flora species-at-risk within the extraction area and their approximate time frame of removal.

4.3.8 FRAMEWORK OF RECLAMATION PLAN TO PROTECT SIGNIFICANT HABITATS AND SPECIES AT RISK, INCLUDING PROPOSED RECLAMATION MONITORING

Removal of gypsum via mining cannot remove the calcareous nature of an area. Once mining activities have been completed and terrain has been altered, the site will still be fully capable of supporting plant species which prefer soils with high calcium levels (calciphile species). Calciphile vascular plant species, such as yellow lady's-slipper (*Cypripedium parviflorum*) and Canada buffaloberry (*Sheperdia canadensis*), have been observed (B. Cameron, pers. obs.) to have colonized stockpiles and previously disturbed areas, even without the benefit of progressive re-vegetation activities (discussed in Appendix E, Section 6, Reclamation).

An experimental framework to monitor natural revegetation of the disturbed areas (stockpiles) will be established. This plan will involve setting up permanent monitoring stations (quadrats) at several locations on the new stockpiles shortly after they are created. Once the stockpiles reach full capacity, they will be surveyed and baseline data, such as aspect exposure, soil type, slope, etc. will be recorded. The topography of each stockpile will be mapped and the resulting maps used to examine hydrological patterns on each stockpile.

Botanical surveys of vegetated areas near the monitoring stations will be conducted. All plants growing within a specific area will be recorded, and the percent cover of each will be determined. These quadrats will be surveyed on a regular basis (annually or biannually) during the growing season to document changes in plant species composition and percent cover over time. The data will be compared with the list of species growing in the vicinity of the stockpiles

A photo-point station at each monitoring station will also be established. At each station, photographs will be taken to record the general appearance of the monitoring station, in such a way that similar photographs may be taken in following survey years. These photo point stations are a useful tool for documenting changes in vegetation, which may not be detected via statistical methods or quadrat surveys. The quadrats themselves may also be photographed in this manner for comparison between survey years. The framework of the reclamation plan for the Project is provided in Section 6.0 of the Flora Species-At-Risk Report prepared for this Project and provided in Appendix E.

Final reclamation monitoring plans will be developed in consultation with DNR, species recovery teams, scientists and other experts.

4.3.9 POTENTIAL FOR PRIVATE LAND CONSERVATION ON NEIGHBORING PROPERTIES

CGC remains open and willing to engage in discussions with property owners interested in contributing land to increase the size of the proposed Conservation Area, but recognizes the various issues that may arise from these contributions.

4.4 WETLANDS

As originally described in Section 6.4 of the EARD, sixteen wetlands were identified within the footprint of the mine extraction and stockpile area, of which twelve wetlands of various size and function would be removed by Project activities. Two additional wetlands (Wetlands 17 and 18) excluded from the EARD due to their anthropogenic origins and geomorphological characteristics, have been included in the Focus Report. Wetlands 17 and 18 are small historic mine pits that were abandoned and have subsequently filled with water. No attempt to create wetland habitat in these old pits is apparent. Wetland 17 and 18 are deep (>2m) and clear (low primary production), with little apparent soil accumulation and hydrophytic vegetation, and are not consistent with any classification described in the Canadian Wetland Classification System (National Wetlands Working Group, 1997).

Three types of wetland classes are located within the study site including basin marsh, basin swamp, and shallow water wetland. Except for two larger wetlands (Wetlands 1 and 12), the majority of wetlands in the project area are small (< 1 ha) and isolated, and have no hydrological connectivity to watercourses or other wetlands. Generally, the wetlands on site have been historically disturbed by forestry practices and mining activities, as evidenced by old mine pits, tree stumps, tractor ruts and slash of varying ages throughout the ecosystem. The wetland locations are provided in Figure 4.4-1. The wetland sizes, types, descriptions and functions are summarized in Table 4.4-1. Data on wetlands are based upon on-site field measurements and observations, as well as groundwater and surface water modeling. For detailed ecological descriptions and functions of the wetlands in the Project site, refer to Section 6.4 of the EARD.

As a component of EA approval for the Miller's Creek Mine Extension, the TOR identified key areas of concern related to impacts on wetlands within the footprint of the proposed mine. Under provisions of the Nova Scotia *Environment Act* (1994-95) and the *Operational Bulletin Respecting Alteration of Wetlands* (2006), any impacts or alterations to wetlands, and the subsequent mitigation measures, must be addressed prior to EA and wetland alteration approval. The TOR state that the following concerns must be addressed:

- Additional modeling to ensure species-at-risk survival in Wetland 12
- Quantitative assessment of the proposed Project's impacts to surface water and groundwater inputs to streams and wetlands
- Mitigative options to maintain natural annual and interannual hydroperiods for streams and wetlands
- Monitoring protocols to assess adequacy of mitigative options
- Application of the mitigative sequence to wetland conservation to each wetland identified within the Project area
- Analysis of avoidance options and associated impacts to ecosystems and Project viability

CGC recognizes the importance of wetland habitat to the environment, the community and the Province of Nova Scotia. Currently, over 230 acres of wetland and associated upland habitat on CGC owned land is conserved under a Wetland Stewardship Agreement with Ducks Unlimited Canada.

4.4.1 ADDITIONAL MODELING TO ENSURE SPECIES-AT-RISK SURVIVAL IN WETLAND 12

The purpose of this subsection is to address the survival of species-at-risk, in particular the ram’s-head lady’s-slipper population associated with Wetland 12. As previously stated in Section 4.3, the ram’s-head lady’s-slipper population associated with Wetland 12 is located outside the wetland boundary and is situated on the adjacent south-facing slope (~25° slope) immediately north of the wetland. Background information on the habitat requirements and natural history of ram’s-head lady’s-slipper is provided in Section 4.3.

In order to adequately ensure the hydrological function of the wetland and its immediate surroundings, CGC modified the outline of the proposed mine pit to avoid Wetland 12, the ram's-head lady's-slipper population immediately adjacent to Wetland 12, and in part, the surrounding sub-watershed. Avoidance modeling of Wetland 12 was based on results from groundwater modeling (See Appendix B1 and B2), a desktop assessment of topographical features and catchment areas, and field verification. As recommended by NSDNR, the proposed conservation area will encompass Wetland 12 and the area surrounding Wetland 12.

Based on observational assessment of Wetland 12 and the adjacent slope, the ram’s-head lady’s-slipper population receives its water from precipitation run-off, rather than directly from the water in Wetland 12. Although plant communities on sloped sites often obtain primary moisture from soil seepage via gravity-driven groundwater, no evidence of groundwater seepage was observed during any field assessment. In addition, the groundwater modeling determined the water table is 13 m below Wetland 12 (Appendix B1 and B2). Therefore, Wetland is not subject to significant water level fluctuations and potential uphill water flow through capillary action. Figure 4.3-3 depicts a cross-section of the existing topography through Wetland 12 and the predicted changes in groundwater elevation due to mine activities.

Removal of part of the upland drainage basin could potentially remove a portion of the precipitation-based water supply to Wetland 12; however, the Project will not impact the amount of precipitation falling in the Wetland 12 sub-watershed. As described in Section 4.3, soil moisture levels could be compromised as the pit is quarried away due to the increased edge habitat along the northern edge of the Conservation Area. Monitoring protocols and mitigation measures addressing impacts related to water supply and moisture levels for Wetland 12 and the surrounding area are provided in Sections 4.4.4 and 4.4.5.

While portions of the upland drainage area for Wetlands 12 will eventually be removed, it is important to recognize that mining activities in the vicinity of Wetland 12 will not occur until the later stages of the Project (>30 years from present). For that reason, implementing absolute mitigation measures at this stage in the Project is ill-advised as wetlands are dynamic systems that experience spatial and temporal variations. In addition, the uncertainty associated with climatic changes may warrant alternate mitigation measures. For that reason, currently proposed mitigation measures for each wetland are provided in Section 4.4.5. As Wetland 12 will be included in the conservation area, monitoring programs will allow for a defensible implementation of adaptive mitigation measures as mining activities approach Wetland 12. To ensure significant adverse effects of the Project on Wetland 12 are mitigated, any future mitigation measures for Wetland 12 will be developed in consultation with NSDNR and NSE.

4.4.2 QUANTITATIVE ASSESSMENT OF IMPACTS TO HYDROLOGICAL INPUTS TO STREAMS AND WETLANDS

As the majority of wetlands will be removed by the Project (Wetland 1-11, 17 and 18), this subsection will focus on assessing the impacts to the hydrological inputs of wetlands to be avoided (Wetlands 12-16).

Based on groundwater modeling and observational data, Wetlands 15 and 16 are situated at the water table and are, therefore, subject to fluctuations in water levels. Figure 4.4-2 depicts a cross-section of the existing topography through Wetlands 15 and 16 and the predicted changes in groundwater elevation due to mine activities. For Wetland 15, the groundwater modeling predicts an estimated 42 m drawdown in the groundwater level after 20 years, 40 years and at the end of mine life. For Wetland 16, the groundwater modeling predicts a gradient in drawdown from 12 m in the northeast and 21 m in the southwest. The resulting drawdown in groundwater will invariably degrade the hydrological integrity of Wetlands 15 and 16 without mitigative measures. Mitigative options to maintain natural annual and interannual hydroperiods for wetlands is provided in Section 4.4.3.

No permanent surface water courses provide water to Wetlands 12, 13, 14, 15 and 16. These wetlands receive water from direct precipitation, intermittent streams created from precipitation run-off, and in the case of Wetland 15 and 16, from groundwater. The water level in Wetlands 12, 13 and 14 are maintained by their low geomorphic position within the Project site and low permeability of the overburden substrate.

As described in Table 4.4-1, the hydrological input to Wetland 16 includes surface water seepage from Wetland 15 and precipitation run-off. Hydrological seepage from Wetland 15 to Wetland 16 is controlled by the presence of the old-logging/mining road and beaver damming. Based on an observational assessment, substantial seepage occurs during periods of continuous high precipitation when the road and beaver dam are breeched. When water levels are low in Wetland 15, water seeps or percolates slowly through the road as is evident by the saturation of soils in the small poorly-defined channel between Wetlands 15 and 16. Hydrological flow between Wetlands 15 and 16 will be maintained, and loss of hydrological input from direct precipitation and precipitation run-off will be mitigated. Mitigative options are described in Section 4.4.3.

The Project will not impact the amount of precipitation falling in the watershed; however, the catchment area of these wetlands will be reduced to varying extents. As described in Appendix C1 (Section 3.0), stock pile areas are predicted to initially absorb 100% of the precipitation, thus preventing surficial run-off from stockpiles to avoided wetlands. Where run-off does occur, the stockpiles are designed such that the volumes will be similar to that received by the avoided wetlands prior to the mine operation. For more details on surficial run-off from stockpiles and the hydraulic conductivity of stockpiles to existing overburden, refer to Appendix C1. Remaining run-off not received within the watershed stream network or wetlands may be accumulated and perhaps pumped to wetlands if necessary. Further mitigative options to reduce or prevent loss of hydrological input from direct precipitation and precipitation run-off are described in Section 4.4.3.

A discussion on the quantitative impacts of the Project on the hydrological inputs to streams is discussed in Section 4.2.

4.4.3 MITIGATIVE OPTIONS TO MAINTAIN NATURAL ANNUAL AND INTERANNUAL HYDROPERIODS FOR STREAMS AND WETLANDS

A summary of mitigative options for maintaining the annual and interannual hydroperiods for streams and wetlands is provided in Section 4.4.4 (Table 4.4-2). A discussion on mitigative options to maintain annual and interannual hydroperiods for streams is discussed in Section 4.2.

4.4.4 MONITORING PROTOCOLS TO ASSESS ADEQUACY OF MITIGATIVE OPTIONS

Monitoring protocols to assess the adequacy of mitigative options is provided in Appendix G.

4.4.5 APPLICATION OF THE MITIGATIVE SEQUENCE FOR WETLAND CONSERVATION TO EACH WETLAND IDENTIFIED WITHIN THE PROJECT AREA

Wetland avoidance is the first step in the mitigative sequence to preventing project related impacts on wetland functions, either by choosing an alternate design or site for development. CGC, in consultation with NSDNR and NSE, has completed several design modifications to the proposed extraction and stockpile area to avoid impacts on wetlands, where possible, without compromised Project viability. As previously completed and documented in the EARD, CGC has implemented avoidance measures on Wetlands 13-16. Due to location of the mineral reserves and the nature of surface mining, impacts to the majority of wetlands (Wetlands 1-11, 17 and 18) within the core mine extraction and stockpile areas are unavoidable.

Minimizing adverse environmental effects to wetlands is the second step in the mitigative sequence and is applied when wetland avoidance is not possible. The term "minimize" can be interpreted differently depending on the legislated goals of the governing agencies and is often applied when proposed wetland alteration involves the partial filling, draining, flooding or excavating of wetland area. For this Project, all wetlands will be either avoided or removed; therefore, minimization refers to reducing adverse effects related to sediment discharge from areas surrounding each wetland and the maintenance of hydrological, biogeochemical and habitat functions of each wetland. A summary of mitigation measures for minimizing significant adverse effects of the Project on avoided wetlands is provided in Table 4.4-2. Reiteratively, it is important to recognize that mining activities in the vicinity of Wetlands 6-14, 17 and 18 will not occur for more than 30 years from present. Also, it is important to note that determining impacts to wetlands and species-at-risk is near impossible based on the time-line of the Project (~ 70 years) and the complexities of the ecosystem. For that reason, the mitigation measures are intended to be adaptive and account for the dynamic nature of wetlands and ecosystems.

Wetlands compensation is the final step in the mitigative sequence and is applied when all other options for avoidance and minimization have been exhausted. The development of the Project will now require the removal of the 13 wetlands (Wetland 1-11, 17 and 18) resulting in 6.18 ha of wetland loss. In adherence to NSE's Policy of *No Net Loss of Wetland Function*, CGC will compensate for the removal of the 13 wetlands by creating marsh- and swamp-type wetlands. The low permeability of the clay soils, the karst topography, and the presence of hydrological sources throughout the catchment areas provides sufficient areas for wetland creation. The location of the created wetlands will be determined in consultation with NSE and NSDNR.

Given the temporal scale of wetland removal in the mine extraction and stockpile area, CGC is proposing to use "compensation banking", thereby, creating wetlands on the existing mine site in advance of the removal of wetlands. Wetland compensation banking provides a way to mitigate unavoidable wetland impacts before they occur and allows for direct, statistically defendable comparisons between created wetlands and the natural wetlands being replaced. The direct comparisons will allow regulatory agencies to determine the success of the created wetlands and the need for a biased wetland creation to wetland removal ratio (usually 3:1 ratio) established by NSE. Should wetland creation be required at the standard 3:1 ratio, CGC will create a total of 18.54 ha of wetland habitat in the existing mine area or the proposed extension area.

CGC's Wetland Compensation Plan will provide wetland habitat equally (or more) productive than the habitat removed by the Project. As the majority of wetland habitat to be removed is marsh and swamp-type wetlands, creation of these wetland classes will adhere to the NSE Policy of *No Net Loss of Wetland Function.* The monitoring plan for assessing the success of the created wetlands is discussed in Section 4.4.4.

4.4.6 ANALYSIS OF AVOIDANCE OPTIONS AND ASSOCIATED IMPACTS TO ECOSYSTEMS AND PROJECT VIABILITY

As specified in Section 4.4.1 and 4.4.5, CGC, in consultation with NSDNR and NSE, has completed several design modifications to the proposed mine pit and stockpile areas to avoid impacts on wetlands, where possible, without compromised Project viability. The ultimate decision to avoid some wetlands and remove others is a direct function of the location of the mineral reserves and the nature of surface mining. If all wetlands were avoided within the extraction and stockpile areas, the Project would not be viable. In addition, CGC has forgone developing over 40 ha of the estimated 200 ha of potential gypsum extraction (~14.5 million tons) for the purpose of the Conservation Area to facilitate the protection of species-at-risk (*e.g.*, ram's-head lady's slipper) and wetlands on the Avon Peninsula.

Except for Wetlands 1 and 4 (which are hydrologically connected), no wetlands being removed have direct hydrological connectivity to any surface water courses or wetlands outside the Project footprint. From the landscape perspective, impacts to ecosystems from wetland loss are expected to be minimal (1.6% of the Project footprint). From a watershed perspective, wetland loss varies among catchment areas. Percent wetland losses in each impacted catchment area are summarized below.

Catchment ID	Catchment Area (ha)	Wetland Loss (ha)	Percent Wetland Loss
Catchment 66	393.67	5.16	1.31
Catchment 53	165.28	0.74	0.45
Catchment 51	104.58	0.13	0.09
Catchment 31	169.58	0.15	0.09
Catchment 52	72.53	0	0
Catchment 35	342.89	0	0
Catchment 28	67.46	0	0
Catchment 64	355.09	0	0

Provided mitigation measures designed to eliminate, reduce and/or compensate for adverse impacts to wetlands are successfully applied, the removal of approximately six hectares of wetland area will have minimal impacts on the surrounding ecosystem. In addition, the creation of more than 18 ha of similar marsh- and swamp-type wetlands will compensate for the functional loss of existing wetlands.

4.5 FISH AND FISH HABITAT

Section 3.5 of the Terms of Reference for the Focus Report for CGC Fundy Gypsum, Miller's Creek Mine Extension Project stipulated a fish and fish habitat survey of all streams affected by the project by qualified aquatic scientists. Habitat surveys were undertaken by Susan Belford, M.Sc. who is Conestoga-Rovers & Associates (CRA) senior aquatic ecologist with 24 years of experience in fish habitat assessments, which included working at Habitat Management at Fisheries and Oceans Canada. She was assisted by Amanda Facey, a junior aquatic ecologist of CRA with five years of habitat assessment experience.

The catchment area of five watercourses to be altered by the proposed mine extension were surveyed for fish and fish habitat: Shaw Brook, Fish Brook and three unnamed tributaries to the Avon River in the vicinity of the Avon Peninsula area of Hants County. These watercourses are shown on Figure 4.5-1.

The habitat assessments included a description of physical units, in-stream cover, substrate composition, stream depth and width, overhead cover and water colouration. Fish presence/absence were noted in each watercourse. Maps of the surveyed areas are provided in Figure 4.5-2 to 4.5-6

Shaw Brook

Shaw Brook is the largest watercourse on the peninsula. On June 12, 2008, an electrofishing survey was conducted on Shaw Brook, for the second time. The first survey was undertaken in 2007 in the upper reaches.

There are two branches of Shaw Brook, an eastern and western branch, although not named as such. On the western branch, no fish were caught in the reach above the large beaver pond, also referred to locally as Dump Pond, which was a mine working area over 50 years ago. The dumping of waste material below the beaver dam is an ongoing local activity. As described in the Environmental Assessment Registration Document (CRA 2007), the brook habitat in this reach has been completely silted over from forest practices and uncontrolled runoff flowing into the watercourses. Photos 1 to 12 shows this condition. Figure 4.5-2 shows the survey reaches and photo references.

Photo 1: Beaver dam at access road.

Photo 2: Shaw Brook as crossed by access road (note, no culvert).

Photo 3: CRA employee standing in Shaw Brook channel.

(Note the mud blanketing the streambed.)

Photo 4: CRA employee footprints in Shaw Brook channel – note the mud.

Photo 5: Stagnant water of upper reaches of Shaw Brook and mud substrate.

Photo 6: Habitat of upper reaches of Shaw Brook - puddles of shallow stagnant water.

Photo 7: Shaw Brook upstream of Dump Pond.

Photo 8: Shaw Brook confluence with Dump Pond.

Photo 9: Beaver dam at end of Dump Pond.

The beaver dam on Dump Pond is large (about 4 to 5 m high) and an obstruction to fish passage and migration (Photo 9). Electrofishing was undertaken 200 m downstream of Dump Pond in areas where water was present. No fish were caught and no viable fish habitat was present. The channel is silted over with a thick veneer of mud.

Photo 10: Shaw Brook immediately below the beaver dam at DumpPond.

Photo 11: Shaw Brook 100 m downstream of Dump Pond.

Photo 12: same location as Photo 11, note thick mud deposits.

Total rainfall for June in 2008 was 69.1 mm, the Environment Canada Climate Normals from 1971 to 2000 record an average rainfall in June in Windsor of 88.4 mm. Therefore, the water level in Shaw Brook is typical for that time of year.

Photo 13 shows habitat in the channel downstream of the proposed conservation area. The watercourse at this point in the catchment area is still exhibiting intermittent characteristics response to rainfall events and negligible groundwater baseflow.

Photo 13: Shaw Brook below the proposed conservation area.

On the easterly tributary, Shaw Brook is spring fed below the larger wetland and last (2nd) beaver pond (of which there are several); therefore, the groundwater baseflow is sufficient to maintain a constant flow. This reach of Shaw Brook is outside of the extraction area. Photos 14 to 18 show that stream channel is poorly defined to none-existent in the upper reaches. The habitat survey was undertaken three days following a rainfall of 27.5 mm on August 25th, 1.3 mm on August 27th and 3.2 mm on August 28th. Two sticklebacks were observed in a puddle in isolation of any flowing water. Their occurrence is questionable. No channel was evident below this puddle, water appears to flow over ground in a dispersed manner through the vegetation.

Photo 14: Upper reach on the easterly branch of Shaw Brook, below 1st beaver dam.

Photo 15: One of the stagnant puddles in upper reaches of easterly branch of Shaw Brook.

Photo 16: Area where the channel of Shaw Brook should be - below the beaver dam. (Note following 27.5 mm rainfall.)

Photo 17: Area where the channel of Shaw Brook should be - below the beaver dam. (Note following 27.5 mm rainfall.)

Photo 18: Area above 2nd beaver pond, isolated puddles of water.

Photo 19: The 2nd beaver pond. See Figure 4.5-1 for location.

Below the beaver pond, the spring occurs which feeds the remaining reach with groundwater baseflow and provides a sustainable flow. This reach is outside the proposed mine extension footprint. Photos 20 and 21 show that the upper reaches of this tributary are a series of long, slow moving pools and still waters with a mud substrate and a well defined channel.


Photo 20: Step pools and stillwater habitat of the easterly branch of Shaw Brook.


Photo 21: Step pools and stillwater habitat of the easterly branch of Shaw Brook.

Photo 22 shows the lower end of this tributary before its confluence with the west branch of Shaw Brook. This reach is outside of the proposed mine extension area.

Photo 22: Lower reach of easterly branch of Shaw Brook before it confluences with westerly branch. Same slow Stillwater, poll habitat. No habitat exists for salmonids.

The lower half of Shaw Brook flows through agricultural land. Sections of this watercourse appear to be channelised due to uniformity in channel dimensions. Also cattle have been allowed to roam and herded through the brook resulting in tramping down of banks and deposition of manure.

Photo 23: Shaw Brook lower reach habitat. With the amount of active agriculture around this reach, the channel appears to have been straightened (channelised).

Photo 24: Gravel in the watercourse occurs where crossings are established in the cattle field.

Photo 25: Access road across Shaw Brook – farm field.

Photo 26: Shaw Brook upstream of Avondale Road, note improperly sized culvert. Cattle have trampled the watercourse banks through this field.

Photo 27: Shaw Brook downstream of Avondale Road, note instream habitat disturbance from trampling, improperly size culvert and excavation for cattle watering.

Electrofishing was also undertaken in Shaw Brook upstream of the Avondale Road (area in Photo 26). Within a 30 m reach, American eel (*Anguilla rostrata*), brook stickleback (*Culaeta inconstans*) and threespine stickleback (*Gasterosteus aculeatus*) were caught. Eels are widespread throughout the province. The brook stickleback occurs in the shallow weedy and grassy portions of freshwater streams or small bog lakes. The threespine stickleback occurs in freshwater and brackish water habitats through the province.

It is only the most upper reach of the westerly branch of Shaw Brook that will be removed during mine development. That reach is intermittent and only transports surface runoff during rainstorm events and snowmelt. No fish were observed nor caught during several surveys in 2007 and 2008. The fish habitat has been destroyed through forestry practices at the northern end and altered and destroyed by agricultural practices in the southern end of Shaw Brook.

Unnamed Tributary to the Avon River (Watercourse B)

Two first order headwater watercourses will be removed from the mine development. Refer to Figure 4.5-3 for the photographic log references. These upper reaches, as well as much of this watercourse, is ephemeral and only carry stormwater and melt water flows. Photos 28 to 31 show the dry conditions in July.

Photo 28: Headwater of unnamed tributary – grassy, dry, intermittent channel.

Photo 29: Dry, intermittent channel.

Photo 30: Headwater of the east branch of unnamed tributary.

Photo 31: Headwater of east branch unnamed tributary.

Around the middle of the reach, the watercourse is dry (Photo 32). The scouring indicates high inundation during rainfall events. The watercourse provides surface runoff and is a drainage channel only. There is no viable fish habitat in this watercourse above Avondale Road.

Photo 32: Second order stream habitat of unnamed tributary.

Photo 33: Improperly installed culvert at property entrance off Avondale Road in unnamed tributary.

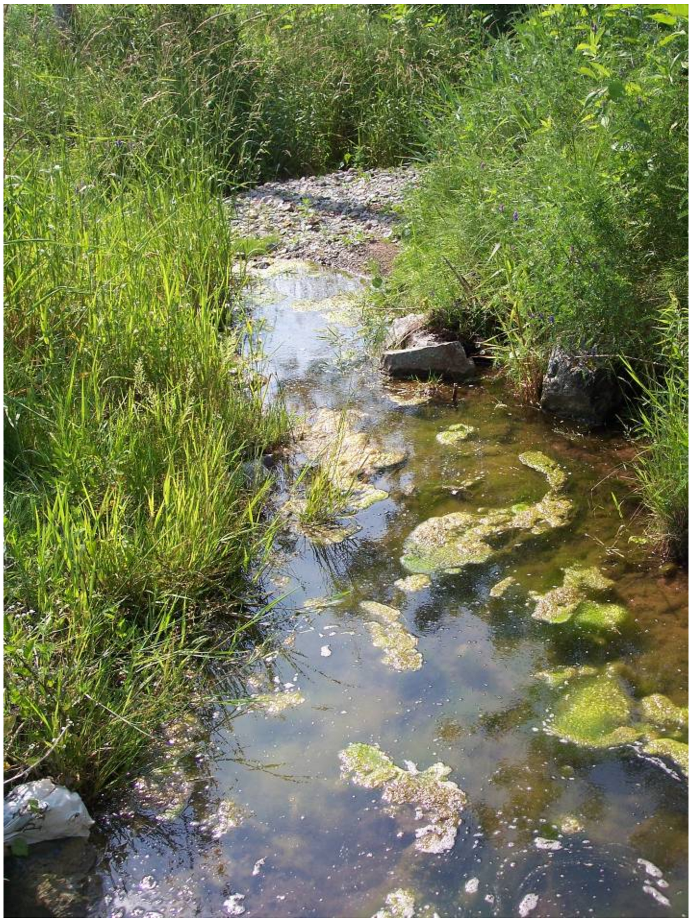

Photo 34: Unnamed tributary along Avondale Road ditch. (Note stagnant and eutrophic condition of water.)

Photo 35: Unnamed tributary on downstream side of Avondale Road as it enters farmers field.

Unnamed Tributary to the St Croix River (Watercourse C)

The uppermost end of a first order tributary will be affected by stockpile placement. This stream is an ephemeral watercourse as seen in Photo 36. Refer to Figure 4.5-4 for the photograph log references.

Photo 36: Unnamed tributary channel – no viable fish habitat.

Unnamed Tributary to the St. Croix River (Watercourse D)

The headwaters of the west and east branches of this unnamed tributary will be covered under stockpiles. Refer to Figure 4.5-5 for the photographic log references. Photo 37 shows the lack of fish habitat on the west branch which is another intermittent (ephemeral) stormwater drainage channel.

Photo 38 shows the headwater of the east branch of this unnamed tributary which is proposed to be covered by stockpiles. As before, this channel is an intermittent stormwater drainage channel which does not support fish nor provide fish habitat.

Photo 37: Upper west branch of unnamed tributary.

Photo 38: Upper east branch of unnamed tributary.

Fish Brook

Two headwater branches of Fish Brook are proposed to be covered by stockpiles. Refer to Figure 4.5-6 for the photographic log references.

Photo 39 was taken on the most western south branch of Fish Brook. This is an intermittent channel that carries surface runoff during precipitation and snowmelt. This reach of watercourse does not support fish nor provide fish habitat.

Photo 39: Southwest branch of Fish Brook.

Photos 40 to 46 show the easterly south branch of Fish Brook. This is an intermittent channel that carries surface water runoff during precipitation and snowmelt. This reach of the watercourse does not support fish nor provide fish habitat.

Photo 40: Headwater marsh on southeast branch of Fish Brook.

Photo 41: Ephemeral drainage channel of southeast branch of Fish Brook.

Although well out of the project area, Photos 42 and 43 shows the lower reach habitat of Fish Brook. The channel has been damaged in the past from agricultural practices. There are no fish in this watercourse nor productive fish habitat above the road.

Photo 42: Lower reach of Fish Brook, west of Belmont Road in farmers field.

Photo 43: **Lower reach of Fish Brook, west of Belmont Road in a farmer's field.**

4.6 RECLAMATION

Reclamation was discussed in Section 5.6.3 of the EARD (Feb 2008). As a review of the CGC approach and understanding of reclamation, the goals and responsibilities of reclaiming a mining site are key elements of the project plan, and have a goal to return the land to an equal or better state than prior to the disturbance. In the case of the lands associated with the Miller's Creek Mine Extension project, there has been extensive mining and forestry, as well as limited agriculture, that have created many of the existing landforms and character of the site. CGC has been turning previously mined or otherwise disturbed land and formerly natural landscapes back to a natural state for decades – land that is now used for wildlife, farming, and recreation and has plant and animal species of equal or greater diversity than "natural" landscapes.

Reclamation of land disturbed by past or ongoing surface mining is an essential component of mitigating impacts to terrestrial flora. Where reclamation is not completed and a landscape remains disturbed, terrestrial habitat may be impacted in the long term but will reestablish itself through recolonization of lands by plant and animal species. Properly planned and executed reclamation can accelerate this natural process. The goal of reclamation is to produce a landscape that is safe, stable and compatible with the surrounding landscape and final land use. This is generally achieved by grading, contouring, capping with soil, revegetating, flooding mined areas, and allowing time for nature to recolonize.

Reclamation of the proposed Miller's Creek Extension site will involve both natural and progressive reclamation. Each of these processes is discussed in the Flora Species-At-Risk Report (Appendix E, Section 6.0).

It should be noted that gypsum is regularly used as a soil amendment product in the agriculture industry to supply calcium (Ca) to the soil. It is a natural substance that is permitted for use in organic crop production in Canada (Agriculture and Agri-Food Canada). There is a variety of crops and vegetation that are known to benefit from gypsum, including corn, grapes, potatoes, blueberries, peanuts, flowers, landscape plants, and marshland vegetation (Nature's Way Resources). As such, once final pit slopes are achieved, vegetation can be established relatively quickly.

CGC will develop a reclamation plan in consultation with NSDNR and NSE, with input from other stakeholders, including the community. The regulatory requirements and process for reclamation plans are well known and understood by CGC and were provided in the EARD. Detailed reclamation plans will be provided in the IA application for the site should the EA be granted. As it will be decades before portions of the proposed site are ready to be rehabilitated, it is difficult to determine at this stage, what the final end use of the site will be; however, it is likely that it will be some form of recreational with water use. A variety of other potential options were provided in the EARD and these should be referred to. It should be noted as well that the timeframe for the project presents a unique opportunity in that local residents with ideas for future land use have a long timeframe for forming these ideas and presenting them through the CLC. Reclamation plans are based on the best information available today. The plan may be changed or refined in the future as the project progresses or based on new information or technologies for reclamation. Graphically, the conceptual reclamation plan is provided as Figure 4.6-1. Other conceptual images of what the reclaimed mine could look like were also provided in the EARD.

Recognizing that the detailed reclamation plan elements are not fully known yet, as consultation with NSE, DNR and the yet unformed CLC will be a necessary component for development, CGC would expect to include the following elements in the detailed reclamation plan.

Introduction

This section will provide a background discussion on the historical and present operations of the Miller's Creek mine site. It will also present the goals of the reclamation plan for the site.

Environmental Setting

This section will present information on:

- Regional and Local Land Use
- Regional Topography
- Climate
- Geology
- Hydrogeology
- Surface Water Hydrology
- Wetlands
- Flora and Fauna
- Conservation Area

Mining Plan

This section will discuss the current and future mining plans for the site; such as progression of extraction areas and stockpiles, road construction, dewatering, hours of operation.

Progressive Reclamation Plan

The reclamation plan for the proposed site will be developed with consideration given to the following:

- long-term land-use options;
- adjacent land owners and residents of the community;
- view planes;
- safety of the public;
- habitat development;
- flora and fauna;
- buffer zones;
- water management;
- slope stabilization;
- wetlands.

It will also present a conceptual figure of the final rehabilitated site, which will include details of vegetative test plots, created wetlands, locations of species at risk, and access to water bodies.

References:

Agriculture and Agri-Food Canada. Gypsum as an Organic Amendment in Lowbush Blueberry Production, May 2004.

Nature's Way Resources. www.naturesswayresources.com

5.0 FOCUS REPORT SUMMARY AND CONCLUSIONS

5.1 GROUNDWATER

The comprehensive groundwater work completed at the site and the modeling report indicate that the mine can operate without significant adverse effects to local domestic wells or to the groundwater regime such that significant impacts to soil moisture, surface water or wetlands will not occur. In many cases the predicted impacts are within the normal annual fluctuations recorded within the bedrock aquifer on the Avon Peninsula. Post-mining, the groundwater regime will return to conditions similar to pre-mining conditions. A comprehensive monitoring program will be in place to determine if predictions found in the groundwater modeling report will occur. Careful consideration has been given to the development of mitigation options should impacts be measured that are beyond what is predicted. The timeframe of the project also needs to be considered in that the extraction area progresses slowly (over 70 years) thereby allowing for new technologies and strategies to augment the already known and proven methods. Specifically, of reducing impacts in the case of groundwater, there are a variety of methods for reducing the impacts should they be determined to be adverse such as:

- altering dewatering schedules, rates, methods and locations
- sealing of significant fractures using bentonite or local clays
- varying the schedules for extraction of materials in different zones of the extraction area based on rainfall and seasonal considerations

5.2 SURFACE WATER

A total of six watersheds, forty-one sub-catchments, and sixteen outlets discharging to St. Croix River, Avon River, and Kennetcook River were defined in the hydrologic model. Results of the modeling effort indicated that seven out of the sixteen outlets will be impacted by the mine development. The proposed mine footprint and stockpiles will have an impact on surface water drainage patterns and runoff distribution over the life of the project. Minor changes to the overall hydrologic budget for the area are also expected. The majority of impacts to water quantity would be for the Shaw Brook outlet and associated catchments, within which the majority of the pit development will take place. In fact, the total volume intercepted at the Shaw Brook outlet was simulated to be 45%, regardless of return period.

Similarly, baseflow changes due to mine development were simulated using the groundwater model developed for this site. Based on this model, baseflow in four streams will decrease over the mine life. The most significant impacts are expected to occur in Shaw Brook , where the 3 L/s baseflow is expected to disappear completely by the 40-year development stage. Although surface water flow will be affected by baseflow reductions, this component of flow only represents a fraction of total flow in Shaw Brook.

In order to ensure continued water supply to the downstream reaches of impacted catchments, rainfall and runoff intercepted by the pit and stockpile areas will be collected and treated in stormwater ponds followed by controlled release back to the watershed.

Following reclamation, a system of lakes in the headwaters of the peninsula would ensure continued supply of water downstream. Proper stormwater management and other mine management best practices will also be employed to protect water quality for all discharges from the site. Monitoring programs will be developed on a watershed by watershed basis as the mine progresses.

5.3 SPECIES AT RISK

As discussed in detail in Section 4.3 of the Flora Species-at-Risk Report (Appendix E), none of the environmental parameters within the CGC Conservation Area are expected to be significantly adversely affected by the proposed Project. To summarize:

- Preferred landscape position of species will not be affected;
- Proximity to forest edges/exposure will not be affected;
- Local climate will not be affected;
- Soil moisture levels will not be affected;
- Humidity regime will not be affected;
- Ground and surface water quality will not be affected;
- Acid rain and air quality will not be affected;
- Temperatures will not be affected;
- Soils and substrates physical characteristics will not be affected;
- Soil and substrate pH values will not be affected;
- Natural patterns in forest succession will not be affected;
- Air quality will not be affected; and
- Species interactions will not be affected.

While some parameters, such as soil moisture, have slight potential to be impacted, monitoring and replacement of the water supply will more than adequately mitigate these impacts.

The Conservation Area will be undisturbed by the proposed Project, and will be protected by CGC to ensure it remains undisturbed. It will never be logged, nor will further anthropogenic disturbances be permitted, unless required to protect species at risk and this would only be completed with NSDNR knowledge and input.

The dominant ecological characteristics currently present within the CGC Conservation Area, such as elements of composition, structure, function, and ecological processes are not predicted to be affected beyond the limits of their expected natural ranges of variation. The ecosystem of the CGC Conservation Area will remain resilient to most perturbations imposed by natural environmental dynamics.

The Conservation Area will support detailed monitoring plans and/or research plans on species-at-risk occurring within its boundaries. Protection plans for species-at-risk known from the Project site are discussed in Section 4.0

The potential benefits to the Nova Scotia ram's head lady's-slipper population due to the proposed Project far outweigh the potential risks. The Project will result in decreased disturbance to the species, both direct and indirect. Direct disturbances are those that directly affect the species such as picking of blooms, herbivory, or removal of plants. Indirect effects are those that affect any aspect of the species' habitat (soil compaction, changes in hydrology, etc.), which may then negatively impact the long-term health or resilience of the population. The Project will result in reduced potential direct impacts to ram's-head lady's-slipper via removal by recreational activities, agriculture, and forestry. It will also decrease risks to this species from invasive species and flooding by beaver activity due to the stringent monitoring the population on the proposed Project site will be subject to if the project proceeds. The potential for indirect impacts such soil compaction and hydrologic changes due to recreational activities, agriculture, and forestry will also be reduced. While a slight increase in potential indirect effects from mining activities, (hydrology impacts) may occur, this risk will be mitigated by monitoring and replacement of the water supply if necessary. A considerable population of this species is known to have existed alongside an active gypsum mine for decades, and a second population exists very close to a historically-mined area. In summary, the potential for harm to this species decreases if the project Proceeds, as the population occurring in the CGC Conservation Area will be protected from activities such as agriculture, forestry, and recreational activities, all of which may pose threats if the population remains unprotected. Monitoring of this population will also provide additional knowledge of this species' life history requirements in Nova Scotia, which will be applicable to populations of this species occurring elsewhere in the province.

5.4 WETLANDS

Eighteen (18) wetlands have been identified in the Project area. CGC, in consultation with NSDNR and NSE, has completed several design modifications to the proposed mine pit and stockpile area to avoid impacts on wetlands, where possible, without compromised Project viability. In summary, 13 wetlands (total area of 6.18 ha) will be unavoidably removed by Project activities and five (5) wetlands (total area of 3.29 ha) will be avoided. The loss of wetlands will be compensated using "wetland banking". Wetland banking involves creating wetlands in advance of the removal of wetlands and allows for determining the success of created wetlands to replace the form and function of removed wetlands.

Mitigative measures to ensure the ram's-head lady's-slipper population associated with Wetland 12 will be implemented, including silt fencing and soil moisture meters. Monitoring of the ram's-head lady's-slipper population will be conducted as part of the wetlands monitoring program and the conservation area monitoring. Mitigation measures to maintain hydrological inputs to wetlands will be implemented. The outline of a monitoring plan has been developed to assess the adequacy of mitigative options. The monitoring plan will be long-term, adaptable and statistically rigorous, and will be based on a measure of ecological integrity and wetland condition.

5.5 FISH AND FISH HABITAT

All of the watercourse reaches on the Avon Peninsula that may be removed by the proposed mine operations or covered by stockpiles are headwaters of streams that only carry surface runoff during rainfall events and snowmelt. These ephemeral reaches are dry in between these events as there is no groundwater baseflow and as a result they do not provide fish habitat and subsequently support fish.

Waterflows were monitored and described in the Environmental Assessment Registration Document (EARD). The fish and fish habitat were also described in the EARD. The conclusions of the repetitive surveys remains that same, that no fish habitat occurs in the proposed footprint of the mine extension project and that any surface runoff or groundwater recharge from the mine site will be collected, treated and directed to watercourses to maintain their water quality and quantity in the lower reaches.

DFO Canada has concluded that the Project is not likely to result in impacts to fish and fish habitat. Formal approval will not need to obtained from DFO in order to proceed with the Project (Appendix F).

5.6 RECLAMATION

Details relative to commitments made on reclamation have been provided in various sections and Appendices. In summary, CGC recognizes the importance of reclamation plans and their role in overall management of lands associated with this project. Reclamation plans by nature are dynamic and involve constant refinement and input from the public via the Community Liaison Committee (CLC), regulators via the annual review of the Mining Report and monitoring data and the proponent/mine operator. CGC has a long corporate and local history in naturalizing mined areas to create wetland and terrestrial habitats that are used by an abundance of species, including many yellow listed species as described in the EARD and Flora Species at Risk Report.