Appendices

Appendix E
Hydrogeological Reports

SEABRIGHT RESOURCES INC.

HYDROGEOLOGICAL INVESTIGATION
BEAVER DAM MINE

PROJECT NO. M1289

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July 30, 1986
Project No. M1289

Seabright Resources Inc.
Suite 301, 6100 Young Street
Halifax, Nova Scotia

Attention: Mr. P. Keohane, P.Eng.

Dear Sir:

Re: Hydrogeological Study Report - Beaver Dam Mine

Please find enclosed four copies of the above report. This report outlines the results of three separate hydrogeologic studies at the Beaver Dam site:

- Packer Injection Study
- Austin Shaft Dewatering Program
- Groundwater Exploration Program

Please contact either myself or Suther A. Yuill, P.Eng. at this office should you have any questions regarding the enclosed.

Sincerely yours,

JACQUES, WHITFORD & ASSOCIATES LTD.

for / Suther A. Yuill

David S. MacFarlane, M.Sc.

DSM/sd

Consulting Engineers

PROJECT NO. M1289

HYDROGEOLOGICAL INVESTIGATION

PREPARED FOR

SEABRIGHT RESOURCES INC.
BEAVER DAM MINE
HALIFAX COUNTY, N.S.

BY

JACQUES, WHITFORD & ASSOCIATES LTD.

Halifax, Nova Scotia July 22, 1986

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1.0 INTRODUCTION

1.1 Purpose

At the request of Seabright Resource Inc., Jacques, Whitford and Associates Limited has undertaken a series of field studies at the site of the proposed Beaver Dam Gold Mine. The primary purpose of the work was to obtain site-specific hydrogeologic information sufficient to provide a preliminary prediction of groundwater inflows and mine water quality prior to the construction of the new mine portal. Secondary objectives were to evaluate the feasibility of developing groundwater resources for both mine process and potable uses.

1.2 Location

The Beaver Dam gold mine is located approximately 80 km northeast of the City of Halifax, 55 km southeast of Truro, and 70 km from the Gays River milling facility (Figure 1.1). Access to the site is via a 6 km Nova Scotia Department of Transportation haulage road (Beaver Dam Road), off of Route 224 which connects the Villages of Sheet Harbour and Upper Musquodoboit (Figure 1.1). Upgrading of the mine access road is currently underway. The mine site is located adjacent to the Killag River which lies within the watershed of the West Branch Sheet Harbour River which has a total drainage area of about 300 km^2.

1.3 Report Organization

The field investigations were carried out in three phases between May 6, 1986 and July 12, 1986. Section 2.0 outlines the results of a packer injection program conducted on selected exploration boreholes for the Beaver Dam site. The packer testing program was designed to determine the range of hydraulic conductivity values associated with the various rock types and structures comprising the Beaver Dam ore zones. An estimation of mine inflow rates for sizing of pumps is made based on the range of hydraulic conductivity observed.

Section 3.0 outlines the results of a comprehensive pump test and water quality monitoring program conducted on the existing Austin Mine workings. Analysis of time-drawdown data provide an assessment of the bulk hydraulic properties of the shallow (0-22 m) bedrock zones. The continuous, on-site monitoring of water quality provides on assessment of the expected mine effluent quality from the new mine. Monitoring of water level elevations in diamond drill holes distributed across the proposed mine site was carried out during the shaft dewatering to determine the extent of hydraulic response across the Beaver Dam Mine Site.

Section 4.0 outlines a groundwater exploration program conducted on behalf of Seabright Resources Inc. Test pitting was carried out to determine the feasibility of infiltration gallery construction at Crusher Lake, and pipeline construction from Crusher Lake to the mine. One test well was constructed and pump tested to determine the hydraulic properties of the glacial till overburden, and the feasibility of dug well water supplies.

Section 5.0 is a summary of the findings of the various studies, and their implications on the proposed new mine.

Section 6.0 includes recommendations for monitoring of groundwater quantity and quality during mine construction.

1.4 Previous Studies

Very little previous information regarding groundwater flows in the Beaver Dam area is available. A discussion of the regional hydrogeology of the area is presented in Jacques, Whitford and Associates Limited (1986) Environmental Assessment of the Beaver Dam Mine Site, and is included in Appendix 1 for reference purposes.

2.0 PACKER TESTING PROGRAM

2.1 Purpose

Due to the remote location of the Beaver Dam mine site, and the lack of any previous hydrogeological evaluation in the mine area, there were some concerns regarding the volumes of groundwater which may be generated by a mine in the area. Of particular concern was the possibility of groundwater inflows to the mine excavation from the major fault zones in the area such as Mud Lake Fault, from thick deposits of saturated sand and gravel overlying portions of the area, and from existing mine workings such as the Austin Shaft.

The flow of water into the proposed Beaver Dam Mine workings will be dependant on the degree of secondary permeability of the quartzite bedrock. Groundwater transmission in crystalline bedrock in Nova Scotia is governed by the frequency, orientation and aperture of the fracture joints and faults developed in the bedrock. Two methods of evaluating the hydraulic characteristics of fractured rock are commonly used; large scale pumping tests, and packer injection testing. Pumping tests provide the best assessment of the bulk hydraulic characteristics of the overall rock mass surrounding a mine site, however, such investigations are generally extremely expensive and time consuming, requiring several deep vertical drilled wells and observation wells to render reliable results. Packer testing can provide a good statistical determination of the range and variation of hydraulic conductivity provided sufficient measurements are made.

At the Beaver Dam Mine site, the presence of more than 90 exploration diamond drill holes at various attitudes, and the resultant good understanding of the structural geology of the area provided by the geologic logs, allowed the design of a packer injection testing program sufficient in scope to evaluate the hydraulic properties of the various structures and rock types associated with the new mine.

Preliminary discussions with Seabright Resources geologic personnel, and examination of diamond drill geologic logs and vertical cross-sections, led to the selection of 16 diamond drill holes that should yield good, representative packer test results. The criteria used to choose the holes include:

(i) the holes should be as vertical as possible to minimize possible equipment problems, and to allow closer correlation between measured groundwater levels and acting hydraulic head at each packer test location.

(ii) the holes should intersect the primary zones of interest, i.e. the Mud Lake Fault Zone; the ore zone, both deep and shallow; the axis of the Beaverdam anticline; and representative zones of the three main rock types, grey-wacke, argillite and quartzite.

2.2 Method

Field work was carried out during the period of June 5 to June 15, 1986. Of the sixteen holes chosen, packer tests were carried out in nine holes. Five holes were found to be blocked at various depths and no tests were done. In total, 56 packer tests were performed over a period of 8 days.

The packer test equipment consisted of two, one metre-long inflatable packers, connected by a 4.5 m perforated pipe. A small diameter line connected the packers to a source of nitrogen gas at the surface, which was used to inflate the packers and seal the zone between them. The perforated pipe was connected to a high pressure hose line which also ran to the surface. The hose line was connected, through a flow meter and pressure gauge, to a pump. The entire packer apparatus was raised and lowered by a wireline winch system.

The wireline cable was marked in order to determine testing depths. The hose line underwent a certain amount of stretching and thus, would not have been reliable for depth measurements. All hose line connections were pressure tested to ensure that leakage was not taking place. The use of the high pressure hose resulted in superior packer testing results, than would have been the case with the usual E-Rod methods.

The following testing procedure was employed: The packer apparatus was lowered to the required testing depth, and a nitrogen pressure of 300 psi was applied to the packer. After a short wait of approximately 2 minutes, to ensure that the packers had inflated and there were no leaks in the nitrogen line, the pump was started, and water was allowed to flow into the packered zone, at an initial pressure of 25 psi above hydraulic head at that point. This pressure was maintained and the amount of flow recorded every minute until a steady state condition was reached. The water pressure was then sequentially increased to 50 psi and 90 psi, and similar measurements were taken at those pressures. On completion of the testing, the nitrogen pressure was released. When the packers had deflated, the apparatus could be located at the next testing depth. The wireline-winch packer apparatus devised for this study provided an efficient and cost-effective method of testing inclined boreholes.

The tested intervals for each hole are listed on Table 2.1. Hydraulic conductivities (K) were calculated at each pressure level, and the geometric means of the results at each testing interval are given in Table 2.2. Geometric means are considered most appropriate for log-normally distributed hydraulic conductivity data. Figure 2.1 illustrates a typical cross-section through the Beaver Dam Anticline in the vicinity of the portal area and also shows the distribution of packered zones.

2.3 Discussion of Results

Hydraulic conductivities ranged from 1.0×10^{-6} m/sec to 3.7×10^{-10} m/sec, with an overall geometric mean of 2.7×10^{-8} m/sec. The three different rock types had the following geometric mean hydraulic conductivities: argillite, 8.2×10^{-9} m/sec; greywacke, 4.8×10^{-8} m/sec.; quartzite, 2.0×10^{-7} m/sec. Tests conducted in the Mud Lake Fault Zone indicated a mean K of 2.3×10^{-8} m/sec. The mean hydraulic conductivity along the Beaver Dam Anticlinal axis was 9.1×10^{-7} m/sec.

FIGURE 2.1 Typical Geologic Cross - Section (0 + 75 W) Illustrating the Location of Packer Injection Zones. Hydraulic Conductivity Values in m/sec.

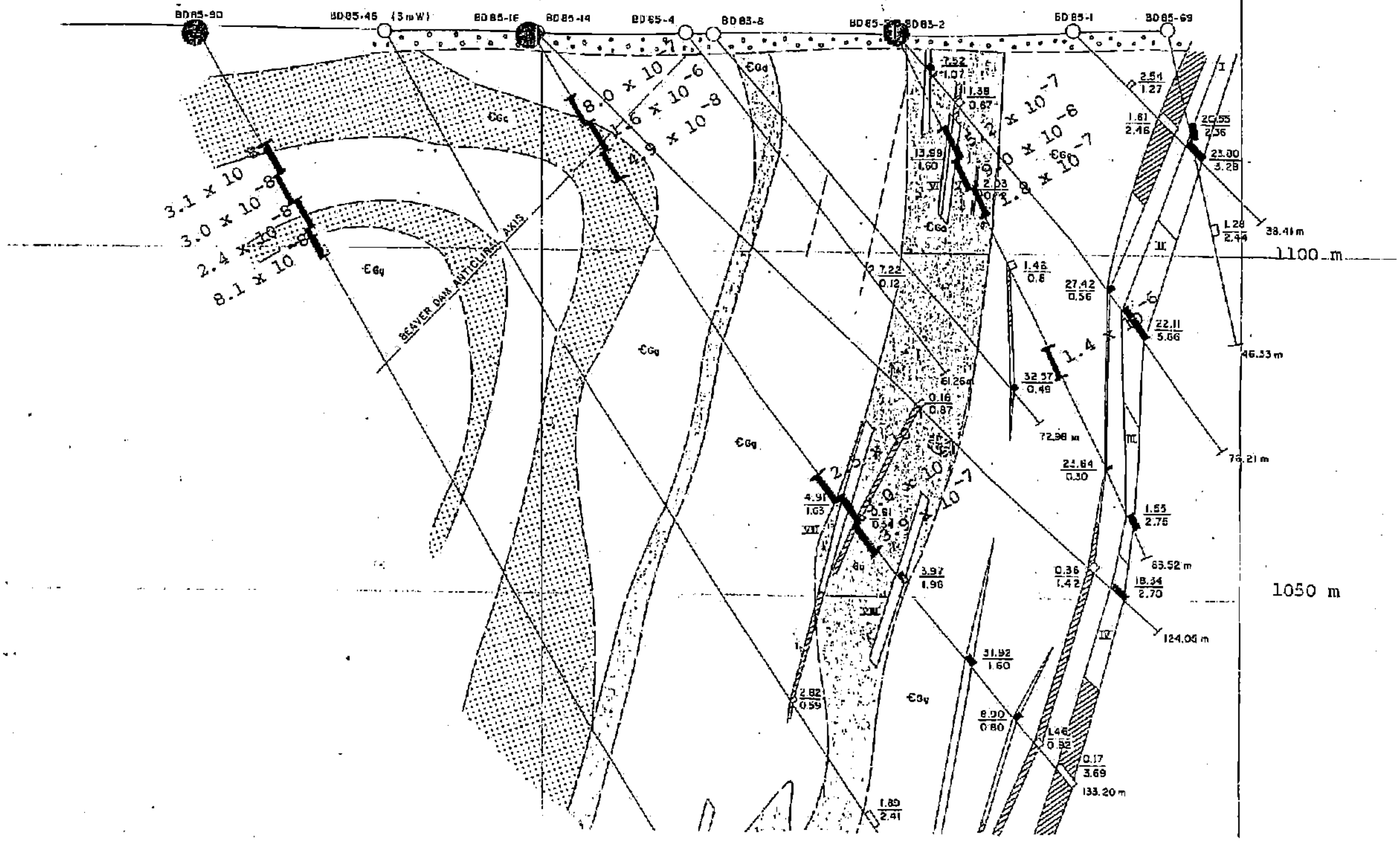


TABLE 2.1: PACKER TESTING INTERVALS

Diamond Drill Hole	Tested Interval (m)	Diamond Drill Hole	Tested Inverval (m)	Diamond Drill Hole	Tested Interval (m)
85-5	15.2 - 19.8	85-29	13.7 - 18.3	85-83	39.6 - 44.2
	19.8 - 24.4		24.1 - 28.7	Fault Zone	48.8 - 53.3
Shallow Ore	24.4 - 29.0	Shallow Anticline	33.5 - 38.1		57.9 - 62.5
	50.3 - 54.9 hole	Deep Ore	39.6 - 44.2		71.6 - 76.2
	blocked below 55m		102.1 -106.7	Mineralized	80.8 - 85.3
			106.7 -111.3		
85-7	15.2 - 19.8			85-90	19.8 - 24.4
	19.8 - 24.4	85 -43	19.8 - 24.4		24.4 - 29.0
	24.4 - 29.0		24.4 - 29.0	Shallow Broken	29.0 - 33.5
Faulted Zone	56.4 - 61.0	Anticline	47.2 - 51.8	Quartzite	33.5 - 38.1
	65.5 - 70.1		51.8 - 56.4		
	88.4 - 93.0		62.5 - 67.1		
			67.1 - 71.6		
85-13	21.6 - 26.2		117.3 -121.9		
	25.9 - 30.5		121.9 -126.5		
	81.7 - 86.3		126.5 -131.1		
Deep Ore Zone	86.0 - 90.6		131.1 -135.6		
	90.2 - 94.8		135.6 -140.2		
	94.5 - 99.1		140.2 -144.8		
	98.8 -103.4				
85-16	10.6 - 15.2	85-82	15.2 - 19.8		
	15.2 - 19.8		19.8 - 24.4		
Portal Area	19.8 - 24.4	Shallow Fault	24.4 - 29.0		
	76.2 - 80.8		30.5 - 35.1		
	80.8 - 85.3		41.1 - 45.7		
	85.3 - 89.9		45.7 - 50.3* hole		
			blocked below 52 m		

TABLE 2.2: HYDRAULIC CONDUCTIVITIES

Diamond Drill Hole	Depth (m)	K (m/sec)	D.D.H	Depth (m)	K (m/sec)	D.D.H.	Depth (mm)	K (m/sec)
85-5	15.2 - 19.8	5.2×10^{-7}	85-29	13.7 - 18.3	4.7×10^{-7}	85-83	39.6 - 44.2	1.5×10^{-8}
	19.8 - 24.4	9.0×10^{-8}		24.1 - 28.7	9.9×10^{-8}		48.3 - 53.3	1.0×10^{-8}
	24.4 - 29.0	1.8×10^{-7}		33.5 - 38.1	9.4×10^{-7}		57.9 - 62.5	1.2×10^{-9}
	50.3 - 54.9	1.4×10^{-6}		39.6 - 44.2	9.0×10^{-8}		71.6 - 76.2	7.1×10^{-9}
				102.1 -106.7	4.9×10^{-8}		80.8 - 85.3	2.7×10^{-8}
85-7	15.2 - 19.8	4.7×10^{-8}		106.7 -111.3	1.6×10^{-8}			
	19.8 - 24.4	1.1×10^{-8}				85-90	19.8 - 24.4	3.1×10^{-8}
	24.4 - 29.0	8.4×10^{-7}	85-43	19.8 - 24.4	8.3×10^{-9}		24.4 - 29.0	3.0×10^{-8}
	56.4 - 61.0	2.0×10^{-9}		24.4 - 29.0	2.6×10^{-8}		29.0 - 33.5	2.4×10^{-8}
	65.5 - 70.1	5.4×10^{-7}		47.2 - 51.8	1.0×10^{-6}		33.5 - 38.1	8.1×10^{-8}
	88.4 - 93.0	3.0×10^{-8}		51.8 - 56.4	2.3×10^{-7}			
				62.5 - 67.1	2.7×10^{-9}			
	21.6 - 26.2	2.0×10^{-8}		67.1 - 71.6	3.4×10^{-9}			
	25.9 - 30.5	2.4×10^{-8}		117.3 -121.9	1.0×10^{-9}			
	81.7 - 86.3	5.8×10^{-8}		121.9 -126.5	7.6×10^{-10}			
	86.0 - 90.6	4.1×10^{-8}		126.5 -131.1	2.6×10^{-9}			
	90.2 - 94.8	2.8×10^{-8}		131.1 -135.6	1.6×10^{-9}			
	94.5 - 99.1	2.5×10^{-8}		135.6 -140.2	5.5×10^{-10}			
	98.8 -103.4	4.3×10^{-8}		140.2 -144.8	3.7×10^{-10}			
85-16	10.6 - 15.2	8.0×10^{-7}	85-82	15.2 - 19.8	3.6×10^{-8}			
	15.2 - 19.8	1.6×10^{-6}		19.8 - 24.4	1.1×10^{-6}			
	19.8 - 24.4	4.9×10^{-8}		24.4 - 29.6	1.9×10^{-6}			
	76.2 - 80.8	2.5×10^{-7}		30.5 - 35.1	8.0×10^{-7}			
	80.8 - 85.3	3.0×10^{-7}		41.1 - 45.7	6.1×10^{-7}			
	85.3 - 89.9	3.9×10^{-7}		45.7 - 50.3	4.6×10^{-7}			

TABLE 2.3: INFLOW RATES

Level	Tunnel Length (m)	Hydraulic Conductivity (m/sec)	Inflow Rate (l/s [igpm])
1125	615	5.0×10^{-7}	4.9 [65.0]
1100	590	1.0×10^{-7}	0.9 [12.5]
1075	595	1.0×10^{-8}	0.1 [1.5]
1050	555	5.0×10^{-8}	0.4 [6.0]
		TOTAL	6.3 [85.0]

The testing program has demonstrated that, with the exception of shallow bedrock zones and the anticline axis, the bedrock at Beaver Dam Mine is considered to be relatively tight. This likely accounts for the poor water well yields reported for the Guysborough county area southeast of the site. Hydraulic conductivity generally decrease with depth, as would be expected, and tends to be lower in the mineralized argillite and quartzite zones then in the quartzite host rock. The higher bedrock permeabilities associated with the anticline axis (range 1.1 x 10^{-6} m/s to 4.7 x 10^{-7} m/s) are associated with the increased fracturing and deformation in the core of the overturned anticline fold. Hydraulic conductivity can be expected to be higher on the southern limb where bedding is more or less vertical.

Testing has shown that the hydraulic conductivity of the Mud Lake Fault zone is relatively low (mean 2 x 10^{-8} m/s) ranging from 1.1 x 10^{-6} m/s near ground surface at borehole 85-82 to 1.2 x 10^{-9} m/s) at 60 m depth at borehole 85-83. This is likely due to the presence of clay-like gouge materials which would tend to fill fractures and block groundwater flow. The Seabright Resources Geologist's log's describe the material as highly brecciated, very broken quartzite containing black graphite gouge material with poor core recoveries. The boreholes, as a result, were often unstable and tended to deform or cave in the fault areas. Several of the holes originally selected for packer testing (62, 5, 82) were found to be blocked at various depths.

It is concluded from the above, that the Mud Lake Fault zone will not likely be a major source of groundwater inflow to the mine. It should be noted, however, that the fault zones are saturated, and could be very unstable and would require special consideration should mining penetrate such rock materials.

The ore zones tend to exhibit the lowest values of hydraulic conductivity (geometric mean 1.5 x 10^{-8} m/s, range 5 x 10^{-7} m/s to 3.7 x 10^{-10} m/s). This is likely due to the presence of abundant quartzite veins and mineralized fill material in the rock fractures. Permeability appears to decrease with depth (K 10^{-10} m/s, borehole 85-43, 85-16). This suggests that the mine zones should be relatively "dry", with the majority of groundwater inflows occurring at shallower levels and via major joints in the bedrock.

Borehole 85-16 is located on the baseline at 0 + 75 m west, and penetrates the shallow bedrock zone where the mine portal will be constructed. Bedrock permeability inferred from the packer testing (Table 2) ranges from 1.6 x 10^{-6} m for a fractured quarzite zone about 13 to 14 meters in depth, to 5.0 x 10^{-10} m/s, averaging 3.5 x 10^{-7} m/s for the upper 78 m of bedrock at the portal location. This suggests that no large groundwater flow would be expected from bedrock in the immediate area of the portal. The most likely source of inflow would be from the overlying glacial tills (estimated K = 2 x 10^{-5} m/s from pump test of test hole # 1) and possibly from an old mine shaft found during portal preparation work approximately 50 meters to the north. The shaft was pumped out by Seabright personnel to a depth of 4.6 m (5.5 m to bottom) and exhibited a very slow recovery, confirming the above predictions. The dewatering of Austin Shaft 100 m to the east, (Section 3.0) with an estimated k of 9 x 10^{-7} m/s exhurted a low flow rate in the order of 3 L/S (40 igpm).

2.4 Calculation of Mine Inflow

In order to calculate the quantity of water inflow that might be expected into the mine workings, several assumptions were made. It was assumed that the hydraulic gradient at every point was equal to one. This is the worst case, and in practice the gradient will likely be somewhat less than one, especially after long time period when dewatering of the overlying rock mass has been achieved.

Actual gradients, however, could not be determined with the existing inclined borehole setups. It was also assumed that seepage would be occurring through all faces of the tunnels, (i.e. roof, floor and walls). Although it is acknowledged that most flow will be via individual fractures, the scale of the mine is large enough that sufficient fracture interconnectivity should occur to result in a hydraulic continuity around the mined area.

Plans of initial workings at four levels, 1125, 1100, 1075 and 1050 were measured to estimate exposed tunnel surface areas, assuming 4 m square tunnels. The average hydraulic conductivities at each level were used. Table 3 gives the measured tunnel lengths, hydraulic conductivities used, and calculated inflow rates.

The total calculated inflow into the tunnels at four levels, 6.3 l/s (85 igpm), may be affected by ore seam workings, fractures not encountered in the packer testing program and fluctuations in groundwater levels, but the calculated value should be representative of average conditions.

A projected mine inflow rate in the order of 100 igpm is considered reasonable for this area. Pump testing of the existing Austin Shaft supports this conclusion with an average inflow of 40 igpm at the 22 m level. Mine discharge rates of 50 igpm and 230 igpm were estimated for the Lake and Holman shafts respectively at nearby Caribou mine (NSDOE Files). During initial portal construction, flow rates may reach or exceed this projection due to inflow from the shallow overburden aquifer or surface water, but rates should decline once the incline portal has been stabilized. During mining, it is possible to encounter sudden groundwater flows from individual fractures, however, such flows should be short term as the fracture is dewatered.

2.5 Summary

A total of 56 determinations of bedrock permeability from 9 inclined exploration boreholes represent the range of hydraulic conductivity variation expected for the various rock types and structures associated with the Beaver Dam Mine. Bedrock hydraulic conductivity averaged 3 x 10^{-8} m/s for the site, ranging from 1 x 10^{-6} m/s to 4 x 10^{-10} m/s. The highest values were found to be associated with the anticline axis and the lowest values were associated with the deep ore zones. The Mud Lake Fault zone was found to have a low K, and the portal area was also found to be relatively tight.

In conclusion, no anomalous water-bearing fracture zones were detected by this packer program. For the exploration portal, an estimated mine inflow rate in the order of 6.3 L/S (85 igpm) is calculated. Full scale mining should be less than 15 L/S (200 ipgm). Dewatering testing conducted on the nearby Austin Shaft suport these predictions.

Pump sizing should therefore be capable of handling both the inflow water and process water used for drilling (est. 3-8 L/S (50 igpm). Some recycling of process water may be feasible within the mine.

3.0 AUSTIN SHAFT PUMP TEST AND GEOCHEMICAL EVALUATION

3.1 Purpose

A comprehensive geochemical monitoring program was conducted concurrent with a dewatering test of the existing Austin Mine workings located approximately 150 meters east of the proposed new mine portal. The primary purpose of the dewatering program was to provide additional site-specific hydrogeologic and groundwater quality information for the prediction and assessment of mine pumping requirements and effluent chemical quality for the new gold mine. The specific objectives of the study were to:

- Assess the bulk hydraulic properties of the shallow bedrock zone (0 - 22 m depth) as an aid in predicting mine inflow for the new mine.
- Evaluate water quality characteristics during pumping of the workings, with particular attention to geochemical variations during drawdown.
- To determine the degree of fracture continuity across the Beaver Dam mine site by monitoring drawdown response in available diamond drill holes during pumping of Austin Shaft.

A secondary purpose, was to allow Seabright geologists an opportunity to examine the old workings.

3.2 Method

A high capacity, 40 hp submersible turbine pump was installed to a depth of 22 m in the Austin Mine shaft by R. Hopper Well Drilling Limited. Discharge was controlled by an orifice plate and discharge water was directed to a waste rock pile adjacent to a large swamp area. Drawdown was monitored with an electric tape in a drop tube strapped to the pump riser pipe. A valve and flow-through cell were connected to the discharge pipe to facilitate water quality monitoring and sample collection.

Pumping began on June 18, 1986 at 1330 hours at a discharge rate of 500 igpm. Drawdown, ph, dissolved oxygen, temperature and electrical conductance were monitored for a total of 16 hours until drawdown reached the top of the pump bowls (20.5 m). Pumping was terminated at 0535 hours June 19, 1986 and recovery was monitored for 7 hours. The pump was again turned on, for approximately 1.5 hours until water level again reached the top of the pump. The mine was then allowed to recover for a period of two weeks.

Because the initial pump could only dewater the mine to within 1.5 meters of the bottom, a second 30 hp centrifugal pump was acquired and installed in the well on July 8, 1986. The larger submersible pump was started on July 8, 1986 at 1350 hours at a pumping rate of 480 ipgm. The pump was shut down for 6 hours to observe recovery trends, and then restarted. Drawdown and water quality were monitored in a similar manner to test #1. When the large pump broke suction on July 9, 1986 at 1440 hours at 20.8 m after a total of 14 hours of pumping, the smaller centrifugal pump was started at a rate of 166 igpm until it broke suction at 1130 hours, July 10, 1986 at about 21.6 m depth. The initial 10 minutes of pumping after start-up of the second pump produced slightly turbid water due to pump turbulance, however, this quickly shifted to a colorless, ordorless discharge throughout the remainder of the test.

Pumping rate dropped to approximately 38 igpm and remained stable for the final 7 hours of the test. A steady-state flow rate of 38 igpm was measured for the Austin shaft at 21.6 m of depth. Time drawdown data and plots are presented in Appendix 2.

During the mine dewatering, continuous monitoring of water quality was maintained, and selected samples were sent to the Environmental chemistry laboratory for analysis of metals and major ions. Field monitoring of ph, temperature, dissolved oxygen and electrical conductance were performed in a flow-through cell specially devised for this project. This device prevented the rapid degassing of the mine water and prevented contact with the atmosphere, resulting in more reliable measurement of these sensitive parameters. Samples subjected to metal analysis were field preserved with nitric acid in test # 1, and unpreserved in test #2.

Appendix 2 contains drawdown and recovery data and time-drawdown plots for the two pump tests. The results of laboratory analysis and field analysis of water quality for the two pumping tests are presented on Tables 3.1 to 3.3. A summary of available groundwater quality data for the Beaver Dam site is presented on Table 3.4. The orientation of Austin Shaft and diamond drill holes monitored during the test are shown on Figure 1.2.

3.3 Discussion of Results

Time drawdown data for the two dewatering tests were very similar (Appendix 1). At a pumping rate of 480 to 500 igpm, an average drawdown of 192 cm/hr (1.5 inches/min) was observed until water level reached the top of the drift where drawdown decreased to approximately 13 cm/hr as the workings were dewatered. In test #2, when the centrigugal pump was in operation at a rate of 167 igpm, drawdown continued from 20.8 m to suction break at approximately 21.8 m at a rate of about 5 cm/hr, accelerating over the last 0.3 m due to depression-dewatering around the pump. In both tests, the Austin shaft exhibited a consistant recovery rate of 2.5 cm/hr (1"/hr) within the workings, accelerating to about 5 cm/hr within the shaft. It took approximately 2 weeks for full recovery to occur after test #1. The faster drawdown rate exhibited during pump test #2 may be due to a combination of distance-dewatering effects (incomplete recovery), low permeability of the bedrock, lack of rainfall, and lower mean static water level (1.2 cm lower than the June 18 test).

When drawdown reached the bottom of the pump at 21.8 m below shaft collar, the discharge decreased to a steady-state pumping rate of 3 L/S (38 igpm) throughout the final 7 hours of testing. The discharge remained clear, and no evidence of excessive turbidity was observed. Minutes prior to the drop in discharge rate, increasing amounts of clean bark chips and wood debris were observed in the flow-through cell, which signalled that drawdown was approaching the intake screen. The water remained clear and odor-free over the last few hours of pumping.

An empirical estimate of mine water volume 2273 m^3 (0.5 MIG) was made based on the assumption of 2300 m^3 (625,000 imp gal) water pumped and 3 L/S (40 igpm) mine inflow rate. Assuming a 40 igpm steady state flow rate, a bulk apparent transmissivity of 18.7 m^3/d/m (1253 igpd/ft) is estimated assuming a tunnel length of 425 m (from mapping supplied by Seabright Inc.) and an average drift size of 2 m square. This suggests a hydraulic conductivity in the order of 9 x 10^{-5} cm/s, for the upper 22 m of bedrock in this area.

The Austin Shaft, containing approximately 2300 m^3 of water, exhibits a steady shaft pumping rate of 3 L/S (38 igpm). This value is lower than estimates of steady state discharge rates reported from the nearby Caribou Gold Mine (NSDOE, 1983). The Holman Shaft containing 45,500 m^3 of water was pumped at a rate of 17.4 LS (230 igpm) and the Lake Shaft containing 25,000 m^3 of water was pumped at 3.8 L/S (50 igpm).

To assess the impact of the Austin Shaft on the proposed portal, and to determine the area affected by the mine dewatering, several of the existing diamond drill holes were monitored periodically during the dewatering operation. (Table 3.5). Drawdown distribution in various boreholes during both tests showed that there is hydraulic continuity over a large area of the mine site. The greatest drawdowns were observed in the area bounded by lines 0 + 25 E and 0 + 75 E, which is underlain by the Austin workings. Drawdowns of greater than 12.2 m (40 ft) were observed at boreholes 52 and 59, which are believed to penetrate the northern extensions of the Austin workings. Running water could be heard at borehole 52. Several of the boreholes immediately adjacent to the Austin workings (83-71, 85-2, 85-3) were dry to depths greater than 7.6 m. Drawdowns of up to 1 m were observed as far west as BD-85-18, and 85-1 in the vicinity of the proposed portal (0 + 75E). It is possible that some of these inclined boreholes may encounter un-mapped workings along the Austin Seam (Figure 1.2). The majority of the boreholes west of line 0 + 50E exhibited minor or no water level response during testing. Because all of the observation holes are inclined at attitudes of 45° to 70°, further assessment of bedrock hydraulic properties is not practical.

It is concluded from the above, that there is a fair to moderate degree of fracture continuity along the Austin Seam, and in shallow bedrock surrounding the Austin Shaft. It is likely that due to the existing natural fracture distribution, and due to blasting of new mine workings, that long term dewatering of mined workings will influence other boreholes at distances exceeding 100 m, and the new mine, in time, would likely dewater the Austin Shaft.

Water Quality

Water quality during the pumping tests remained relatively steady (pH 6.8; D.O. 2.2 ppm; conductance 82 mS; temperature 5.3 °C) until drawdown entered the mine workings. (Tables 3.1 to 3.3). When drawdown reached 1.5 meters from the bottom, the dissolved oxygen content began to rise to about 3.0 ppm (test #1) and 5.0 ppm (test #2) due to uptake of oxygen in the mine shaft. When drawdown broke suction at 21.8 m depth, the dissolved oxygen increased dramatically due to aeration at the pump intake. This was accompanied by a rise in pH as degassing of dissovled CO_2 gas occurred. A laboratory experiment conducted on a preseved water sample exhibited a similar rise in pH from 6.51 to 7.3 after 2 days of exposure to the air. This suggests that mine effluent waters should be of neutral pH and that mine waters are likely saturated with respect to calcite derived from the bedrock.

Throughout the pumping there was continual increase in major ions, TDS (43 to 83 ppm), hardness (28-45 mg/L), pH (6.4-7.4) alkalinity (24-56 mg/L, silica (5.2-9.5 mg/L), suspended solids (0.3 - 7.3 mg/l) and metals such as arsenic (0.04 - 0.17 mg/L); iron (0.32 - 2.6 mg/L), manganese (0.3 - 0.38 mg/L), and a drop in concentration of nitrate (0.13 to (0.05 ppm).

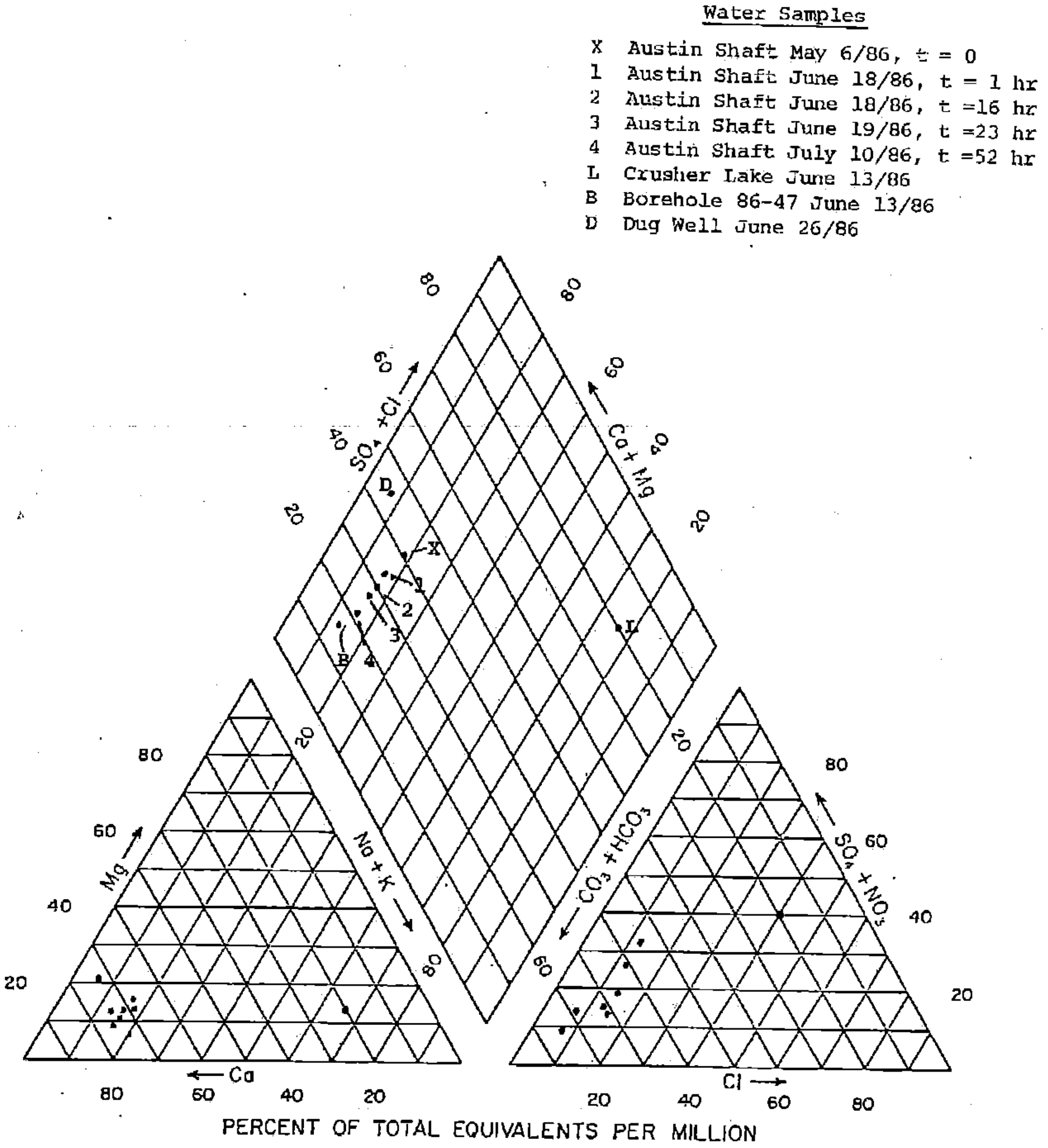


FIGURE 3.1 Distribution of Major Ions, Water Quality Samples Seabright Resources Inc. Beaver Dam Mine, 1986.

It is apparent that, from the unpumped sample bailed from the shaft May 6, 1982, through the two pump tests, the chemistry of the Austin Shaft water is approaching that of natural deep groundwater as exhibited at diamond drill hole 86-47 (Table 3.4). This is illustrated graphically in Figure 3.1 which shows the linear trend in groundwater chemistry towards that of deep groundwater (B). Borehole 86-47 is a flowing artesian well which was pumped several times for drilling water, and is therefore, considered resprentative of the deep bedrock groundwater quality.

Analysis was carried out of heavy metals regulated under the Metal Mining Liquid Effluent Guidelines (EPS, 1978), (Tables 3.1, 3.2). Arsenic concentrations increased steadily with time of pumping, from a background concentration of 0.04 mg/L stabilizing at approximately 0.17 mg/L after 16 hours of continuous pumping. Iron also increased from a background value of 0.32 mg/L (bailed) to 2.6 mg/L near the end of pump Test #2. Concentration of iron and arsenic show a reasonably good degree of correlation in Test #1 (preserved samples), but decrease markedly in Test #2, (unpreserved), likely due to increasing turbidity and aeration during the later stages of the test.

Manganese concentration was observed to increase from a background of 0.03 mg/L (bailed) to 0.13 mg/L at the end of Test #1, and increased throughout Test #2 from 0.23 mg/L to 0.38 mg/L. It is possible that the source of the manganese may be from recharge from the overlying Mud Lake Fault bog or from mineralized zones. Although no obvious leakage was observed within the Austin Shaft, the sound of cascading water could be heard at borehole 85-56, which reportedly penetrates the workings. Other boreholes such as 85-52 and 85-50 may transmit surface water to the mine, which lies just 15 m (50 ft) below the bog. Humic acids concentration remained unchanged at 1.8 ppm. Concentrations of the other major metals, lead (<.002 mg/L); copper (<0.01 mg/L), zinc (0.01 mg/L) and nickel (<.02 mg/L) remained unchanged throughout both tests.

Continuous monitoring of pH was carried out in-situ using a flow-through cell which prevented contact between the sample and the atmosphere. During the May 6, 1986 sampling prior to pumping, pH levels wre measured at 6.8 (Table 3.4). During the first pump tests, ph remained essentially stable at 6.7, but rose to about 7.7 at the beginning of pump Test #2. This increase may be due to oxidation and degassing of groundwater in the mine during the recovery of Test #1. Dissolved oxygen levels increased to 3.0 ppm (Test #1) and 5 ppm (Test #2) after periods of recovery. A similar increase in pH from 6.8 to 7.35 was seen near the end of Test #2 under aeration conditions.

It was noted that after a period of recovery within the workings, there was a large drop in pH from 6.8 to 5.1 (Test #1 after 7 hours of recovery) and from 7.7 to 6.8 after a series of pump stoppages in Test #2. This suggests that there may be some oxidation of sulfide mineralization on the walls and floor of the workings as groundwater recharge occurs. The subsequent rise in pH after 2 1/2 weeks of recovery had occurred and dissolved oxygen had become depleted, suggests buffering of the mine water by such processes as calcite dissolution or sulfate reduction. Acid generation testing conducted on the wasterock from Austin Shaft indicates a mild acid generation capacity (1.2 to 1 ratio). Testing of the non-mineralized quartzite bedrock indicates a significant acid consuming potential (33 to 1 ratio). This could account for the observed variation in pH. It is noted that the drop in pH to 5.1 after 23 hours of pumping in Test #1 resulted in a slight decrease in arsenic concentration to 0.14 mg/L. Arsenic solubility is known to increase with increasing pH.

The chemical analysis and monitoring conducted during the Austin Shaft dewatering indicates that the effluent quality from this mine and the proposed portal should fall within the MMLEG (1978) guidelines. The Beaver Dam metal concentrations are well below those monitored during the Caribou Mine dewatering, carried out in 1983 (Table 3.6). It is interesting to note that the concentrations of arsenic, iron, aluminum and manganese exhibited a significant decrease after passage through a bog area. It is reasonable to conclude that the large bog separating the mine site and Cameron Flowage will afford adequate attenuation of the low levels of metals released from the new mine.

3.4 Summary

A dewatering program conducted on the existing Austin Mine Shaft at Beaver Dam mine has demonstrated that bedrock permeability in the upper 22 m is relatively low in the order of 9.0 x 10^{-7} m/s, resulting in a steady state discharge rate of only 3 litres/sec (40 ipgm) for the Austin workings. An empirically-derived mine volume of 2273 m^3 (0.5 MIGD) is calculated. The shallow bedrock exhibits a fair to moderate fracture interconnectivity, exhibited by measureable borehole hydraulic head response at distances of up to 100 m from the workings. Approximately one meter of drawdown was observed in boreholes adjacent to the proposed new mine portal, which suggests that there will be some minor hydraulic interaction between the two mines at that point. The majority of the new workings would be located further to the west. The majority of the water pumped from Austin Shaft appears to be derived from deep groundwater, rather than surface sources.

Monitoring of discharge water quality suggests that the effluent from the new mine should meet the requirements of the Metal Mining Liquid Effluent Guidelines. The water is described as a soft slightly oxidized (2 ppm D.O.), calcium bicarbonate water, typical of Meguma-Group groundwater in Nova Scotia. Although there is potential for minor acidic drainage in the mine workings, chemical analysis suggests that there is a reasonable degree of buffering capacity in the groundwater (pH 7.3) and the un-mineralized bedrock. Mine effluent pH should be in the range of 6.0 to 7.5, depending on the pumping rate from the mine, and the relative percentage of sulfide mineralized to non-mineralized wall rock.

Suspended solid loads from undisturbed mine sumpage water should also be within the guideline. Should levels exceed the guideline due to drilling and blasting operations, then measures can be implemented to treat the small flow volumes expected at the discharge point.

TABLE 3.1: AUSTIN SHAFT PUMPING TEST # 1 WATER QUALITY DATA, JUNE 18, 1986

	10 min.	1 hr.	4 hr.	6 hr.	9 hr.	16 hr.	23 hr.*	24 hr.
Metals**								
Arsenic	0.10	0.10	0.14	0.16	0.17	0.17	0.14	0.15
Iron	1.1	0.96	1.5	1.8	1.8	1.4	1.4	1.3
Manganese	0.06	0.05	0.07	0.05	0.09	0.11	0.12	0.13
Lead	<0.002	<.002	<.002	<.002	<.002	<0.002	<.002	<.002
Copper	<0.01	<.01	<.01	<.01	<.01	<0.01	<.01	<.01
Zinc	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nickel	<0.02	<0.02	<.02	<.02	<.02	<0.02	<.02	<.02
Sodium		2.8				3.3	2.3	
Potassium		1.1				1.1	1.0	
Calcium		13.0				16.0	10.0	
Magnesium		1.3				1.2	1.2	
Hardness		37.8				45.0	30.0	
Alkalinity		31.7				30.5	25.4	
Sulfate		7.2				7.0	7.2	
Chloride		3.8				4.6	3.8	
Flouride						<0.1		
Silicate						6.1		
Phosphate						0.01		
Nitrate						0.07		
Ammonia						<0.05		
TDS						57.0		
Susp. Solids						6.8		
Colour (TCU)						25.0		
Turbidity (JTU)						8.9		
Conductance (uS)						85.0		
pH						6.6		
Field Parameters								
Dissolved O_2 (ppm)	1.6	1.8	2.15	2.20	2.35	2.50	3.0	3.2
pH	6.73	6.67	6.74	6.72	6.31	6.81	5.46	6.92
Temp (°C)	5.9	5.5	5.5	5.5	5.2	5.5	5.8	5.8
Cond. (uS)	56.0	55.0	55.0	54.0	59.0	60.0	63.0	62.0
Drawdown (m)	.25	3.83	10.41	12.74	15.29	16.74	16.58	16.81

* 7 hours of recovery between t = 16 hr. and t = 23 hr.

** metals were field preserved with nitric acid

All parameters in mg/L unless otherwise noted.

TABLE 3.2: AUSTIN SHAFT PUMPING TEST # 2 WATER QUALITY DATA, JULY 8-12, 1986.

Sample No.	1	2	3*	4	5	6	7
Time	2 hr.	22 hr.	25 hr.	44 hr.	46 hr.	49.5 hr.	52.5 hr.
Metals							
Arsenic	.06	.08	.26	.11	.14	.14	.11
Iron	1.1	1.3	8.9	1.9	2.6	1.3	2.6
Manganese	.23	.27	.40	.32	.35	.33	.38
Lead	<.002	<.002	.009	<.002	<.002	<.002	<.002
Copper	<.01	<.01	.02	<.01	<.01	<.01	<.01
Zinc	.01	.01	.02	<.01	<.01	<.01	<.01
Nickel	<.02	<.02	<.02	<.02	<.02	<.02	<.02
Sodium							4.4
Potassium							1.4
Calcium							21.0
Magnesium							2.0
Hardness							60.5
Alkalinity							56.5
Sulfate							9.4
Chloride							4.4
Flouride							<.1
Silicate							9.5
Phosphate							<.01
Nitrate							<.05
Ammonia							<.05
TDS							83.0
Sup. Solids							7.3
Colour (TCU)							7.5
Turbidity (JTU)							19.0
Conductance (uS)							153.1
pH							7.4
Humic Acid							1.8
Aluminum							0.06
Boron							0.02
Barium							0.007
Beryllium							<0.005
Chromium							<0.01
Cadium							<0.01
Cobalt							0.01
Antimony							<0.02
Selenium							<0.10
Tin							<0.03
Vanadium							<0.01
Field Parameter							
Dissolved O_2	1.59	1.8	-	4.8	15.4**	13.2	13.4
pH	7.78	-	6.98	6.78	7.29	7.29	7.20
Temp (°C)	6.7	-	-	6.3	6.3	6.3	6.3
Cond. (uS)	81.0	-	-	85.0	88.0	89.0	75.0
Drawdown (m)	9.4	16.9	16.9	17.82	17.7	17.7	17.7

* Start-up of centrifugal pump caused a short period of turbidity

** Pump breaking suction, t = 45 hr. All paramotors in mg/L unless otherwise noted.

TABLE 3.3: FIELD CHEMISTRY DATA, AUSTIN SHAFT DEWATERING TEST

TEST NO. 1, JUNE 18 - 19, 1986

Time (min)	Drawdown (m)	Temp.(°C)		pH	Cond.(uS)	D.O.(mg/L)	Sample
June 18/86							
13:30	0			6.73	54	2.3	
13:35							
13:39							
13:45	0.25	5.9	4.6	6.7	56	1.60	#1
13:55	0.80	5.5	4.6	6.71	56	1.65	
14:05	1.52	5.5	4.5	6.72	56	1.75	
14:15	2.69	5.8	4.7	6.72	56	1.65	faint H_2S odor
14:25	3.29	5.5	4.5	6.70	55	1.75	from other shaft
14:35	3.83	5.5	4.5	6.67	55	1.80	#2
15:05	5.64	5.9	4.8	6.61	52	2.05	Turbidity increase
15:35	7.72	5.7	4.7	6.59	50	2.00	
16:35	9.14	5.5	4.7	6.72	52	2.00	
17:35	10.41	5.5	4.6	6.74	55	2.15	#3
18:35	11.43	5.5	4.4	6.65	50	2.20	
19:35	12.74	5.5	4.2	6.72	54	2.20	#4
21:35	14.63	5.50	3.8	6.78	59	2.30	
22:35	15.29	5.2	3.6	6.31	59	2.35	#5
23:35	15.87	5.1	3.5	6.48	60	2.32	
June 19/86							
00:35	15.97	5.3	3.5	6.15	60	1.70	
02:45	16.22	5.5	3.5	6.51	60	7.40	MS
04:35	16.58	5.3	3.5	6.4-6.8*	60	2.40	*Shifting
05:35	16.74	5.5	3.5	6.5-6.86*	60	2.50	MS #6
PUMP OFF (SHORT RECOVERY 7 1/2 HOURS) 12:52							
12:52	16.58	5.8	4.0	5.12	64	3.35	#7
13:01	16.62	5.8	4.2	5.46	63	3.0	
13:11	16.65	5.8	4.4	5.95	63	3.0	
13:21	16.70	5.8	4.4	6.71	63	3.0	
13:31	16.72	5.8	4.6	6.72	62	3.0	
13:41	16.76	5.8	4.6	6.90	62	3.05	
14:01	16.81	5.8	4.6	6.92	62	3.2	#8
14:17	16.86	5.8	4.6	6.92	62	3.0	

TEST NO. 2, JULY 8 - 11, 1986 July 8/86

Time (min)	Drawdown (m)	Temp.(°C)		pH	Cond.(uS)	D.O.(mg/L)	Sample
July 8/86							
14:07		6.9	7.0	7.96	33	1.31	
15:00	7.28	6.9	6.6	7.80	84	1.40	
16:00	9.39	6.9	6.7	7.78	81	1.59	#1
17:00	11.08	6.9	6.5	7.69	78	1.98	
18:00	12.45	6.8	6.6	7.69	76	2.25	
July 9/86	PUMP OFF 00:01 to 06:00 (6 hr. recovery)						
12:00	16.89						#2
14:53	16.88	9.2		6.98			#3
July 10/86							
09:00	17.66	6.8	6.5	6.78	87	5.5	
10:00	17.82	5.3	6.3	6.78	85	4.8	#4
11:00	17.96	5.3	6.3	7.10	88	4.8	
12:00	18.00	5.3	6.3	7.29	88	15.4	#5
13:00	18.00	5.3	6.3	7.33	89	10.6	
13:30	18.00	5.6	6.3	7.35	89	12.4	
15:30	18.00	5.6	6.3	7.29	89	13.2	#6
18:30	18.00	5.3	6.3	7.20	75	13.4	#7

TABLE 3.4: Water Quality Analysis for Groundwater Samples, Beaver Dam Mine (1986)

		AUSTIN MINE SHAFT					
	Depth Below Water	May 6/86 7 metres (Bailed)	May 6/86 17 metres (Bailed)	June 19/86 16 hr. pumping#1	July 10/86 52 hr. pumping#2	June 13/86 Flowing DDH 86-47	June/86 Dug Well pumped
Sodium	mg/L	2.1	2.3	3.3	4.4	4.4	2.0
Potassium	mg/L	0.9	0.8	1.1	1.4	1.3	0.3
Calcium	mg/L	8.3	9.5	16.0	21.0	24.3	21.0
Magnesium	mg/L	1.0	1.1	1.2	2.0	2.0	3.5
Hardness ($CaCO_3$)	mg/L	25.0	28.34	45.0	65.0	69.0	67.0
Alkalinity ($CaCO_3$)	mg/L	20.3	23.5	30.5	56.5	69.0	40.7
Sulfate	mg/L	8.0	8.0	7.0	9.4	7.5	22.0
Chloride	mg/L	3.3	3.1	4.6	4.4	4.6	6.4
Fluoride	mg/L	<0.1	<0.1	<0.1	<.1	0.2	<.1
Silica	mg/L	4.8	5.2	6.1	9.5	12.0	3.9
Orthophosphate	mg/L	0.02	<0.01	.01	<.01	.01	<.01
Nitrate + Nitrite	mg/L	0.18	0.13	.07	<.05	<.05	0.12
Ammonia	mg/L	<0.05	<0.05	<.05	<.05	<.05	<.05
Arsenic	mg/L	0.04	0.04	0.12	0.11	.04	.04
Iron	mg/L	0.3	0.32	1.2	2.6	.50	2.3
Manganese	mg/L	<0.01	0.03	0.15	0.38	.31	.25
Lead (HGA)	mg/L	<0.002	<0.002	.003	<.002	<.002	.009
Copper	mg/L	<0.01	<0.01	.01	<.01	<.01	.01
Zinc	mg/L	<0.01	<0.01	.02	<.01	<.01	.03
Total Dissolved Solids	mg/L	39.0	43.0	57.0	83.0	94.0	84.0
Suspended Solids	mg/L	<0.3	<0.3	6.8	7.3	0.8	382.0
Color	T.C.U.	5.0	5.0	25.0	7.5	20.0	12.5
Turbidity	J.T.U.	1.5	2.3	8.9	19.0	0.4	87.0
Conductivity (umho/cm)	umHo/cm	69.0	76.0	85.0	153.0	161.0	149.0
pH	units	6.30	6.40	6.6	7.3	7.4	6.8
Humic Acid	mg/L	2.0	2.0		1.8		
Aluminum	mg/L	<0.05	<0.05		0.06		
Boron	mg/L	<0.02	<0.02		0.02		
Barium	mg/L	<0.005	<0.005		0.007		
Beryllium	mg/L	<0.005	<0.005		<0.005		
Chromium	mg/L	<0.01	<0.01		<0.01		
Cobalt	mg/L	<0.01	<0.01		0.10		
Nickel	mg/L	<0.02	<0.02	<.02	<.02		
Antimony	mg/L	<0.05	<0.05		<0.02		
Selenium	mg/L	<0.1	<0.1		<0.10		
Tin	mg/L	<0.03	<0.03		<0.03		
Vanadium	mg/L	<0.01	<0.01		<0.01		
Mercury	ug/L	<0.05	<0.05		-		
Cadmium-ICP	mg/L	<0.01	<0.01		<0.01		
Field Measurements							
pH	units	6.77	6.80	6.81	7.20		
			(downward drift)				
Conductivity	umho/cm	47.0	50.0	60.0	75.0		
Temperature	(°C)	5.0	4.2	5.5	6.3		
Dissolved Oxygen	ppm	2.0	2.0	2.5	13.4		
			(June 18, 1986)				
Odor	TCC	NONE	NONE	NONE	NONE		

TABLE 3.5: HYDRAULIC HEAD MONITORED AT SELECTED DIAMOND DRILL HOLES DURING THE AUSTIN SHAFT DEWATERING PROGRAM

Beaver Dam Mine
Depth in Meters Below Ground Surface

Borehole No.	Test #1	Test #2
85-8	0.889	2.20
85-18	0.31	1.10
85-4	0.52	--
85-5	0.749	1.51
85-1	0.711	2.18
85-64	0.673	1.91
85-67	0.616	1.32
85-6	0.502	4.81
85-10	0.0	--
85-13	0.013	--
85-31	1.42	4.25
85-34	2.55	3.61
85-82	2.74	2.79
85-52	7.67	12.38
85-50	0.940	--
85-56	6.22	12.35
85-9	0.254	--

TABLE 3.6: CARIBOU GOLD MINE, AUGUST 26, 1983 WATER QUALITY ANALYSIS

Parameter (mg/L)	Discharge Pipe	Surface @ Culvert	Bog Area
Arsenic	1.3	1.3	.25
Iron	3.4	3.0	.22
Manganese	1.5	1.5	.22
Lead	<.002	.002	<.002
Copper	<.01	<.01	<.01
Zinc	0.02	.01	<.01
TDS	204.0	203.0	179.0
Conductivity(umho/cm)	340.0	340.0	300.0
pH	7.1	7.2	7.5
Aluminum	.17	.17	<.05
Boron	<.02	<.02	<.02
Barium	.04	.04	.02
Beryllium	<.005	<.005	<.005
Cadmium	<.002	<.002	<.002
Chromium	<.01	<.01	<.01
Cobalt	<.01	<.01	<.01
Nickel	<.02	<.02	<.02
Antimony	<.05	<.05	<.05
Selenium	<.10	<.10	<.10
Tin	<.03	<.03	<.03
Vanadium	<.01	<.01	<.01

Source: NSDOE Environmental Assessment Records

4.0 WATER SUPPLY EXPLORATION PROGRAM

4.1 Purpose

A program of groundwater exploration was carried out by Jacques, Whitford & Associates Ltd. on behalf of Seabright Resources Inc. to evaluate the feasibility of developing a groundwater supply for potable and mine uses. A groundwater source was preferred over a surface water source for a number of reasons, including possible closer proximity to the mine site, thus reducing capital expenditures for piped service; better overall water quality, which would reduce or eliminate water quality treatment requirements; and long term security of supply, since little is known about the hydrology of the available surface water sources. Projected water demand for both potable and mine supply uses was in the order of 3 liters/second, which, with the appropriate storage capacity, would require a well or wells capable of at least 3 L/S (40 igpm) sustained yield.

4.2 Method

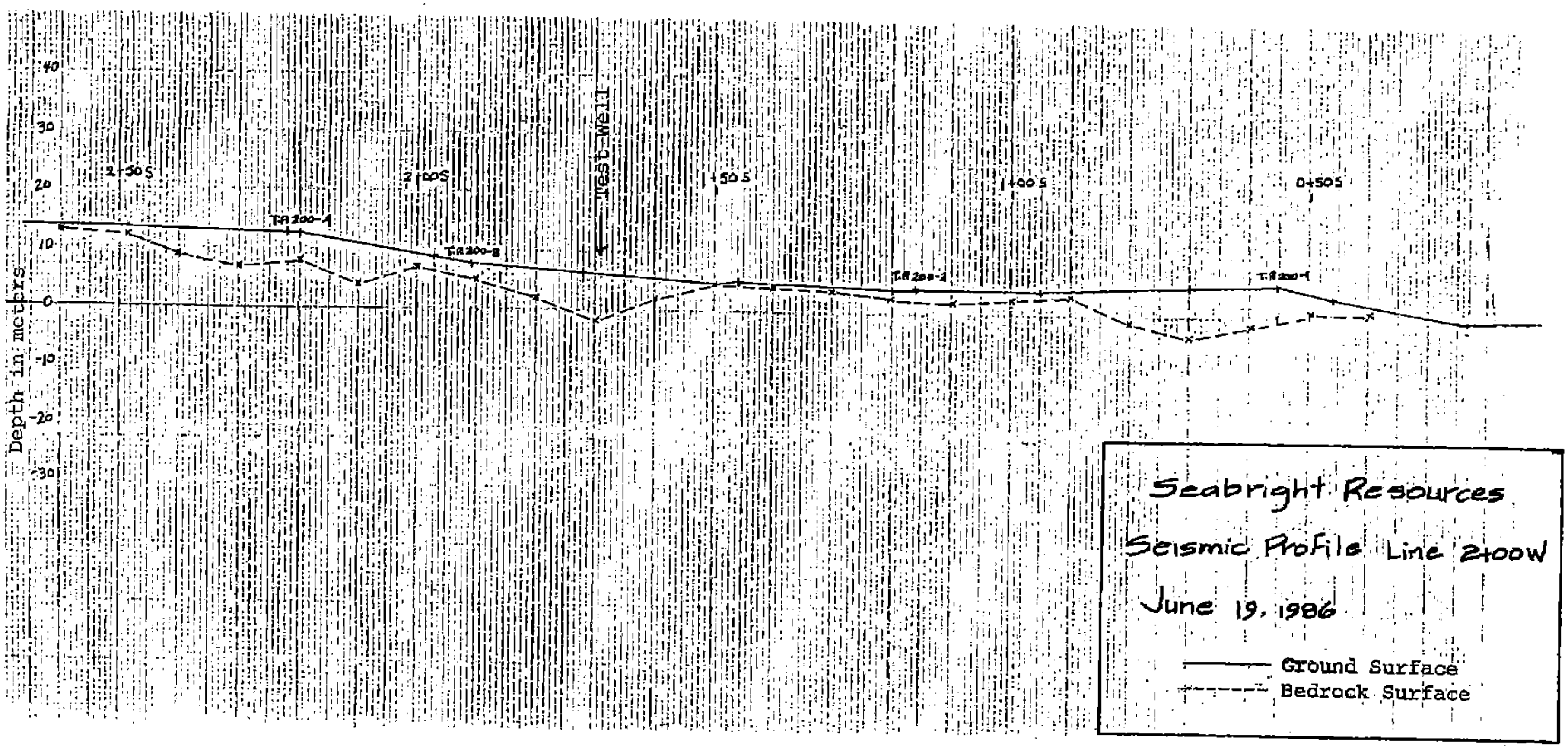
Previous drilling attempts in the area of the temporary construction camp failed to develop a viable bedrock well. A 91 meter test well at the construction camp yielded no water after stimulation by blasting. The low hydraulic conductivity values determined by packer injection testing on selected diamond drill holes (Section 2.0) further suggest a low probability of developing bedrock wells in excess of 0.07 to 0.4 L/S (1 to 5 igpm). An average hydraulic conductivity of 2.7 x 10^{-8} m/s suggests a bulk transmissivity of 0.21 m^2/d (14.3 igpd/ft) for a 91 m (300 ft) drilled well, which would be expected to yield about 0.1 L/S (1.5 igpm). This is within the range and somewhat lower than values determined for pump testing of wells completed in quartzite bedrock in Halifax County (mean yield 0.2 L/S) and Guysborough County (mean yield 0.23 L/S) (Appendix 1). A further indication of low bedrock transmissivity is the very slow recovery of Austin Shaft after dewatering of 0.6 m/day (see Section 3.0).

Because of the low probability of developing the required 3 L/S from bedrock wells, exploration then focused on the silty sand and gravel glacial till overburden which mantles the mine site. Diamond drilling north of the centre line indicates overburden thickness varying between 1.5 metres to over 22 metres in a bedrock depression developed over Mud Lake Fault, and averaging 3.5 to 4.5 metres in the vicinity of the mine site and portal. Significant volumes of groundwater may be associated with the sand and gravel deposits reported in the Mud Lake Fault Trench, however, this area is designated for future exploration. The flat lying area of the mine site may have some potential for dug well development, but potential for contamination or dewatering due to mine activities is present.

With consideration of the topography, drainage, bedrock structure and available information on overburden thickness, it was reasoned that the best location for dug well exploration may be the base of the slope between the mine site and Crusher Lake. A seismic refraction profile (Figure 4.1) was run normal to the slope at 2 + 00 W adjacent to the waste rock storage area. This profile inferred an undulating bedrock topography and an apparent depth of 5 to 8 m (25 ft). A second possible exploration area was identified near Crusher Lake.

A test pit program was conducted on June 26, 1986 to locate sites for dug wells or lateral screen collectors. Based on the seismic data, Test Pit # 1 was excavated across the apparent bedrock depression from Station 1 + 75 S to 1 + 65 S on line 2 + 00 W. Bedrock was encountered at a depth of 4.9 m, and not the 7.0 m inferred from the seismic profile. Four additional test pits constructed within a 50 m radius of Test Pit # 1 varied in depth from 3.3 m to 4.0 m, with similar stratigraphy.

Four soil samples were collected from Test Pit # 1 for grain size analysis at Jacques, Whitford & Associates Ltd. laboratory (Appendix 3). Overburden is described as a 0.6 m layer of orange-brown silty sand and gravel overlying olive brown sandy gravel with some silt containing angular



Seabright Resources

Seismic Profile Line 2+00W

June 19, 1986

FIGURE 4.1 SEISMIC PROFILE LINE 2 + 00 W. SEABRIGHT RESOURCES INC.
BEAVER DAM MINE, HALIFAX COUNTY, N.S.

Scale: 1:1000		Fig. No: 4.1	JACQUES WHITFORD & ASSOC. LTD.
Date: July 25'86	Dwn. By: DDH	Appd.	

quartzite and slate cobbles and boulders up to 1 m in diameter. Boulder content generally increases with proximity to bedrock surface. Soil texture becomes finer with depth in Test Pit # 1 with increasing silt and boulder content. Grain size distribution lies within a fairly uniform range, averaging 61% gravel, 24% sand, 15% silt and less than 1% clay. Test Pit # 1 was subsequently pump tested to evaluate the hydraulic characteristics of the glacial till overburden (Section 4.3).

On July 11, 1986 five additional test pits were constructed in the vicintiy of Crusher Lake to evaluate the feasibility of induced infiltration from the lake. Preliminary field reconnaissance identified a series of east-west striking bedrock ridges with intervening depressions containing glacial till and bog-organic deposits. Test Pit # 6 was constructed near Crusher Lake on the access road approximately 15 m from a bedrock ridge. Bedrock was encountered at 1.83 m depth, and a good flow of water was observed at 0.6 m depth, however, this was likely derived from a bog area adjacent to the well (pH = 4.6). Overburden was a dense yellow brown silty till, with numerous quartzite fragments.

Test Pits #7 and #9 were constructed to assess the feasibility of burying a pipeline from Crusher Lake. The weathered bedrock surface can be excavated to about 1 m depth, therefore blasting should be minimal.

Test Pit # 8 was constructed adjacent to Crusher Lake to assess the feasibility of installing lateral screens for induced infiltration. Bedrock was encountered at 0.75 m beneath black organic peat deposits. Profiling of the bog area around the southern end of Crusher Lake indicated from 4.3 m near the edge of the lake to 0.6 m of peat bog overlying bedrock. Test pit logs for the 9 test holes are presented in Appendix 3.

4.3 Pump Test Evaluation

A 5.77 m corrugated plastic culvert, 46 cm in diameter was perforated over the bottom 1.8 meters and installed in Test Pit # 1. The hole was backfilled with 1.2 m of coarse gravel followed by 2.4 m of waste rock to above the water table. Glacial till was used to cap the test pit to ground surface. A 3-hp electric submersible pump was installed for pump testing the well.

A series of step drawdown test (1.5 igpm, 12 ipgm, 20 igpm) were carried out and recovery measurements were then made. Analysis of the time-drawdown data infer an apparent transmissivity of 4.85 m^2/d (325 igpd/ft) and a long term continuous safe yield of 1.5 igpm. The hydraulic conductivity of the overburden is estimated at 2 x 10^{-5} cm/s from the pump test data. This is typical of sandy silt glacial tills in Nova Scotia.

A water quality sample was collected at the end of the pumping test and submitted to the Environmental Chemistry laboratory at the Victoria General Hospital for analysis (Table 3.4). The water chemistry is typical of shallow glacial till aquifer in Nova Scotia, exhibiting higher pH (6.8), alkalinity (51 ppm) and less corrosiveness than the lake water. Elevated iron, manganese and turbidity are a consequence of the well construction method, and turbulence caused by overpumping. The detectable arsenic may be derived from the mine waste rock used in the construction of this test well. Final groundwater quality from a properly constructed dug well would be expected to be lower in these parameters. Iron and manganese would be the most likely water quality problems, and these aesthetic concerns can be effectively treated.

4.4 Summary

It is apparent from the testing carried out to date that a large yield of groundwater will not be available from a single well in the immediate vicinity of the mine site. The test well, when properly constructed and developed, may be capable of about 0.2 L/S (2 igpm) continuous yield, and up to 5 igpm short term yield. Although this well could be developed to supply the majority of potable needs, it may be more cost effective to derive water from the surface water supply line which will be required to supply the mining needs.

Testing in the vicinity of Crusher Lake indicates a poor chance of locating an infiltration gallery along the lake shores which are bedrock controlled. The end closest to the mine site is overlain by thick peat bog deposits, which could result in very poor water quality to underlying screened collectors.

The most feasible water supply alternative for the Beaver Dam Mine is therefore surface water from either Cameron Flowage, or Crusher Lake. Work is currently underway to develop a water supply from Cameron Flowage upstream of the bog outfall. (Jacques, Whitford and Associates Limited, 1986, Job No. M1292).

5.0 CONCLUSIONS

The results of packer injection testing and mine dewatering operations conducted at the Beaver Dam Mine site indicate that the proposed new gold mine workings should encounter relatively low groundwater inflows. An estimated mine water discharge rate of 6.4 L/S (85 igpm) is predicted for the exploration portal, based on packer testing results and the location of the mine tunnels. All hydrogeologic evidence currently available for the site (test drilling, packer testing, shaft dewatering) suggests a steady-state mine effluent discharge rate in the order of 7.5 to 15 L/S (100 to 200 igpm) for a full scale mine. The majority of the flow will be expected from the shallowest mine horizon. Once this zone has been dewatered and appropriately grouted, long term discharge rates from the remaining deeper horizons should be less than 7 to 10 L/S (90 - 130 igpm).

It is anticipated that there should be no problem in the handling of natural groundwater inflow and process waters used for drilling purposes in this mine. There may be some opportunity to employ recirculation of waters within the mine, thereby reducing the total pumping requirements.

Packer injection testing of existing inclined diamond drill holes penetrating the proposed mine workings indicate an overall geometric mean hydraulic conductivity of 2.7×10^{-8} m/s, ranging from 1×10^{-6} m/s to 3.7×10^{-10} m/s. Bedrock permeability was found to decrease with depth and with bedrock type from quartzite to greywacke to argillite, and was lowest for the deep mineralized ore zones. The Mud Lake Fault zone was found to be of low hydraulic conductivity (2.3×10^{-8} m/s), although somewhat unstable. The highest bedrock K values were associated with the crest and axis of the overturned anticline and shallow bedrock (0-20 m).

The shallow bedrock adjacent to the proposed portal has an apparent hydraulic conductivity of 3.5×10^{-7} m/s, which correlates with the estimated K of 9×10^{-7} m/s for shallow bedrock around Austin Shaft. A pumping test conducted in 4.9 m of silty sand glacial till overburden 150 m from the portal area indicated a K of 2×10^{-7} m/s. This suggests that inflows to the portal area during construction should be controllable. Pumping of an old mine shaft discovered adjacent to the portal should aid in the control of shallow groundwater flows.

A dewatering test performed on the Austin Mine workings indicated a steady-state mine discharge rate of 3 L/S (40 igpm). Analysis of the time drawdown data suggests that the majority of this inflow was derived from the shallow zones, and that the deeper portion of the abandoned mine workings below 22 m depth was contributing only small amounts of water. Increasing manganese concentration and a shift in water chemistry towards deeper groundwater characteristics suggest that flow is derived from both surface bog sources overlying the working, but primarily from deeper groundwater. This dewatering test indicates that flow rates from the new mine which will be situated in simular geology and structures should also be low, and results confirm the predictions generated by the packer test data.

Continuous, in-situ monitoring of effluent water quality during the dewatering test has demonstrated that the quality of effluent from the new mine should meet the Metal Mining Liquid Effluent Guidlines with minimal or no treatment required. With the exception of arsenic (0.4 -0.17 mg/L), iron (0.3 - 2.6 mg/L) and manganese (0.3 - 0.38 mg/L), all parameters fall within the Canadian Drinking Water Guidelines. Monitoring has shown that there is a small tendency for acidic drainage within the mine after periods of non-pumping, due to contact with mineralized wall rock however, the buffering capacity of the natural groundwater and the quartzite bedrock tend to neutralize this tendency. Under continuous pumping, the effluent would be expected to be a neutral pH (7.4), moderately alkaline groundwater with up to 3 ppm iron and minor arsenic concentration (0.10 - 0.20 mg/L).

Although suspended solids loads under undisturbed conditions are expected to be low, drilling and blasting would be expected to contribute to suspended solids loading. Given the volumes of water expected, it should be feasible to treat the effluent (if necessary) both in the mine sump and at the surface, prior to its release to the bog area. Monitoring of mine effluent quality will determine treatment requirements. The large bog area will afford significant natural attenuation of suspended material and dissolved metals.

Monitoring of the existing diamond drill holes during dewatering of Austin shaft indicates that some hydraulic interconnection likely occurs between the existing workings and the proposed mine. A total drawdown of 1 m was observed near the portal area during the testing. This interconnection may be due in some part to past mining activity along the Austin lead. It is likely that the Austin workings would eventually be dewatered by the new mine, although flow rates would be expected to be small.

Exploration for groundwater resources in the Beaverdam Mine area indicates a poor probability of development of groundwater resources for mine use. Bedrock aquifers exhibit low transmissivity in the order of 0.5 to 1.0 m^2/d, and drilled wells would be capable of less than 3 igpm. Overburden within 200 m of the mine building is generally too thin to develop reliable dug or screened wells. One test well located on line 2 + 00 west may be capable of 2 igpm. The most promising groundwater development possibility lies in the deep bedrock trench (22 m) developed over Mud Lake Fault, west of the site, however, the area is designated for future exploration activities.

As a result of the above, it was decided to develop surface water supplies from Crusher Lake or Cameron Flowage. It is concluded, based on work done to date, that the proposed Beaver Dam Mine will be relatively "dry" after the shallow drifts have been stabilized, and steady state drawdown has been achieved. Mine discharge waters are not expected to pose a serious threat to the environment and should remain within the Metal Mining Liquid Effluent Guidlines with minimal or no treatment required. The naturally occurring iron, manganese, arsenic and aluminum discharged with the effluent should be effectively removed through passage through the swamp prior to release to Cameron Flowage.

6.0 RECOMMENDATIONS

1. Mine water discharge rates and water chemistry should be monitored on a regular basis to ensure that parameters remain within the MMLEG requirements.

2. Although low steady state flow rates in the order of 7.6 L/S (100 igpm) are anticipated for this mine, water pressures ahead of the stope workings should be measured to ensure that all instantaneous flows of groundwater from undetected fractures are anticipated. Such flows should rapidly decrease to steady state rates after fracture dewatering has occurred.

3. A long term groundwater monitoring program should be established to monitor groundwater levels in the Austin Shaft, and bedrock zones above and around the mine workings during mine development. Such monitoring would provide an assessment of the source of flow into the mine, and the degree of fracture dewatering. To accomplish this, it would be necessary to construct a series of observation wells around the site, or to develop some of the existing diamond drill holes.

4. The existing overburden test well should be retained to monitor overburden hydraulic head variation over the summer season. If head does not drop significantly, it may be feasible to develop this as a dug well for auxiliary uses.

5. The geologic and hydrogeologic nature of the Mud Lake Fault Zone suggests that caution should be exercised during mine excavation in these areas. Although the highly brecciated material exhibits a low hydraulic conductivity, the material is saturated and could collapse into the workings. Standard procedures for mine wall stabilization should be implemented in this area.

6. Consideration should be given to recycling of water within the mine for drilling activities and dust control. This would reduce the volume of sump water requiring disposal, and reduce make-up water requirements.

7. Although initial work suggests that discharge water would not be hazardous, over the life of a mine the discharge quality could vary depending on mining activity and zones encountered. Contingency plans should be prepared for treatment of acidic waters with lime addition or to reduce suspended sediment loads by floccuation should such be found to be needed.

APPENDIX 1

TAKEN FROM REPORT NO. M1285

Hydrogeology

Because of the remoteness of the Beaver Dam site, very few site-specific data regarding groundwater quality or flow are currently available. The nearest residential areas are located along route 224 from Upper Musquodoboit 19 km to the northeast and the Village of Marinette 10 km to the south. No impacts on existing groundwater supplies are anticipated in relation to the proposed mining operation.

The following discussion of regional hydrogeology is based on general knowledge of the hydrogeology of the Meguma Bedrock in the eastern portions of Nova Scotia, for example, Halifax and Guysborough counties. The Beaver Dam mine site is underlain by highly resistate crystalline bedrock comprised of Goldenville Quartzite intruded by Devonian-aged granites.

In Nova Scotia, the predominance of steeply-dipping subvertical fracturing, and bedrock strike perpendicular to regional topographic gradient favors the development of short groundwater flow regimes and vertical permeability greater than horizontal permeability. This results in relatively short distances of flow from areas of recharge to areas of discharge, in the order of 1 to 5 km (Lin, 1975). This suggests that groundwater recharging in the highland region to the south of the area (elevation 170 m) flows across the mine site to discharge into Cameron Flowage on the Killag River at an average gradient of about 2.5 percent.

Groundwater Flow

Groundwater flow in fractured crystalline rock is controlled by secondary permeability and fracturing. Locally, bedrock groundwater flows can be expected to be predominantly southeastward along the dominant fault trends, with smaller flows in the northeast and east directions (Figure 3.3.) Groundwater flow in the sandy silt glacial till overburden is expected to mirror the topographic surface, with recharge occurring on the basin boundaries and uplands, and discharge to the Killag River watershed.

Drilled wells (45-61 m deep) in quartzite bedrock generally yield from 0.04 to 0.4 L/S (0.5-5 IGPM) (N.S. Strait of Canso Environment Comm. 1975). Yields vary greatly depending on the degree of fracturing of the bedrock. Table 3.5 illustrates the range of transmissivity (T) and safe yield (Q_{20}) for 37 wells drilled in quartzite bedrock in Halifax and Guysborough counties (NSDOE pump test inventory). Geometric mean T is low (0.8 m^2/d) compared to an average of 4.1 m^2/d for Meguma Bedrock in Nova Scotia. Well yields in Guysborough County range from 0.05 to 2.4 L/s (0.7-32 IGPM), averaging 0.22 L/s. Specific capacity averages 0.1 L/s per meter of drawdown, compared to 0.04 L/S/m for Halifax County. Pump test data for Nova Scotia indicate that T generally decreases from Yarmouth to Canso, likely because of decreasing degree of metamophorism and less overall fracturing.

TABLE 3.5: Summary of Pump Test Data for Wells Completed in Goldenville Quartzite, Halifax and Guysborough Counties, Nova Scotia

	Range	Mean X	Mean (G)	SD (X)	N
HALIFAX COUNTY					
Well Depth (m)	15.2 - 137.2	67.1	(68.6)	33.2	31
Transmissivity (m^2/d)	.02 - 14.0	2.1	(0.86)	3.1	31
20-yr-safe yield (L/S)	.015 - 4.2	.53	(0.20)	0.9	31
Specific Capacity (L/S/m)	.001 - .16	.04	(0.035)	0.05	31
GUYSBOROUGH COUNTY					
Well Depth (m)	44.8 - 155.4	99.1	(89.0)	46.6	6
Transmissivity (m^2/d)	0.08 - 11.2	2.5	(0.75)	4.3	6
20 yr-safe yield (L/S)	0.05 - 0.46	0.27	(0.23)	0.89	6
Specific Capacity (L/S/m)	0.001 - 0.06	0.11	(0.01)	0.25	6

x = Arithmetic Mean
G = Geometric Mean

SOURCE: N.S. Department of the Environment, Pump Test Inventory

The presence of a dry (91 meter) well near the mine site, and low well yields for Guysborough County wells tend to support this conclusion.

Preliminary results of a packer testing program conducted on the site also support the low transmissivity of the non-mineralized quartzite bedrock (Jacques, Whitford and Associates Ltd., 1986 in preparation). Packer permeability measurements were carried out in June of 1986 for 56 zones 4.6 m in length, which is representative of the various structural rock features identified in the geologists logs (for example fault zones, fractures, Anticline axis, ore zones, etc.). Hydraulic conductivity averages 2.7×10^{-8} m/s (geometric mean) and ranges from a high of 1×10^{-6} m/s in the shallow zones of Mud Lake Fault and the anticline axis, to less then 4×10^{-11} m/s in the deep ore zone and unfractured rock. Hydraulic conductivity generally decreases with depth, and is low in the ore zone, likely because of fracture filling by quartz veins. Results of bedrock permeability testing will be reported at a later date.

Notwithstanding the above, experience in other mineralized areas of the province has shown that bedrock T and permeability can be greater for Meguma bedrock intruded by Devonian granites and near fault zones. In the Beaver Dam area, the highest bedrock permeabilities would therefore be expected to occur near the granite contact southwest of the site, and adjacent to the major fault zones.

Measurements of hydraulic head in the various mine shafts around the property indicate bedrock water levels varying from 3 to 4 m below ground surface, and dominant groundwater flow direction to the west and northwest, along the strike of bedrock and topographic gradient. Mine shafts, where groundwater levels approach ground surface, appear to be influenced by surface water drainage into the workings. The 3 m depth to water in the Austin and Whip leads may be indicative of actual piezometric surface for shafts penetrating to about 22 m. The majority of the diamond drill holes exhibited static water levels averaging 0.3 meters below ground surface in the vicinity of the cleared area. In the swamp area, most boreholes penetrating Mud Lake Fault were flowing at ground surface, usually at rates of less than 0.1 L/S. Borehole BD-86-47 was measured at a flow rate of 0.1 L/S (1.3 IGPM). The presence of water in most trenches indicates high water table conditions over most of the site which appears to be a net regional groundwater discharge area.

Conversations with the geologists regarding drilling conditions on site indicated that most of the deep boreholes were making enough water to sustain drilling. Some boreholes exhibited loss of drilling fluid to adjacent holes (BD-85-24, 31, 27) which indicates some cross connection, at least in the shallow zones. Boreholes in the Mud Lake Fault Zone were full of gouge material and highly unstable, and generally exhibited low flows due to clogging, and also resulted in low packer permeability values. The degree of bedrock fracturing appears to increase towards the Austin Shaft end of the baseline; likely a result of tectonic movements associated with the fault zones. The drillers stated that negligible movement of water levels was observed in Austin Shaft during pumpage (0.4 - 4.0 L/S) for drilling purposes. A water well 91 m deep constructed for the temporary mining camp on the hill south of the mine was dry, even after stimulation by blasting.

The above discussions suggest that the bulk bedrock hydraulic conductivity in the vicinity of the mine site is relatively low and that the greatest flows will be expected in the southeast end of the site towards Mud Lake Fault. The variability of fracture permeability and hydraulic characteristics of the shallow zone around the Austin Shaft will be assessed in greater detail upon completion of current field work.

In this region of Nova Scotia, most domestic water supplies are obtained from dug or drilled wells. Dug wells developed in the glacial till overburden appear to be the most common domestic supply, yielding large volumes of good quality water from stratified sands and gravels such as are found at the west side of Sheet Harbour, and 0.08 to 0.8 L/S from quartzite tills such as underlie the area. Higher yields may be encountered if sufficient thicknesses of saturated sand and gravel are encountered on the site. A program of overburden exploration is currently being conducted to evaluate the water-bearing characteristics of thick overburden deposits identified by seismic profiling.

Groundwater Quality

Quality of groundwater from Goldenville quartzite aquifers is generally good (NSDOE Well Water Quality Inventory). The most common domestic water quality complaint is that iron and manganese levels are in excess of the respective drinking water limits of 0.30 mg/L and 0.05 mg/L set for aesthetic reasons (Health, and Welfare Canada, 1978). In gold mining districts, arsenic concentrations in excess of the 0.05 mg/L health standard commonly occurs, and is generally believed to be derived from arsenopyrite mineralization associated with vein deposits in the bedrock (Grantham & Jones, 1976; McCurdy 1980, Bottomley 1984). Shallow overburden wells generally exhibit similar trends, without arsenic problems.

To date, groundwater samples from the Beaver Dam area are limited to samples from Austin Shaft collected at depths of 10 m and 21 m below the water surface (Table 3.6). Water is a typical calcium carbonate groundwater of good chemical quality. All parameters are within tolerable limits. Arsenic levels at 0.04 mg/L and iron at 0.3 mg/L are typical of groundwaters in mine areas. The downward drift of pH and upward drift in conductivity suggest a slightly reducing condition, confirmed by later dissolved oxygen measurements of 2.0 ppm. A flowing deep borehole (86-41) and several other deep boreholes also exhibited reducing trends (H_2S odors). Detectable nitrate concentrations are likely to caused by vegetation and timbers in the shaft. Profiles of temperature, electrical conductance and dissolved oxygen were also made for the Austin Shaft (Table 3.7) and shows a slight increase in conductivity (TDS) and decrease in temperature with depth, as would be expected. Groundwater from these mine shafts are remarkably clear and are not expected to be an environmental problem.

TABLE 3.6: Water Quality Analysis for Austin Shaft,
Beaver Dam Mine (May 6,1986)

Depth Below Water Surface		7 metres AU-1	17 metres AU-2
Sodium	mg/L	2.1	2.3
Potassium	mg/L	0.9	0.8
Calcium	mg/L	8.3	9.5
Magnesium	mg/L	1.0	1.1
Hardness ($CaCO_3$)	mg/L	25.0	28.3
Alkalinity ($CaCO_3$)	mg/L	20.3	23.5
Sulfate	mg/L	8.0	8.0
Chloride	mg/L	3.3	3.1
Fluoride	mg/L	<0.1	<0.1
Silica	mg/L	4.8	5.2
Orthophosphate	mg/L	0.02	<0.01
Nitrate + Nitrite	mg/L	0.18	0.13
Ammonia	mg/L	<0.05	<0.05
Arsenic	mg/L	0.04	0.04
Iron	mg/L	0.3	0.32
Manganese	mg/L	<0.01	0.03
Lead (HGA)	mg/L	<0.002	<0.002
Copper	mg/L	<0.01	<0.01
Zinc	mg/L	<0.01	<0.01
Total Dissolved Solids	mg/L	35.0	43.0
Suspended Solids	mg/L	<0.3	<0.3
Color	T.C.U.	5.0	5.0
Turbidity	J.T.U.	1.5	2.3
Conductivity (umho/cm)	umHo/cm	69.0	76.0
pH	units	6.30	6.40
Humic Acid	mg/L	2.0	2.0
Aluminum	mg/L	<0.05	<0.05
Boron	mg/L	<0.02	<0.02
Barium	mg/L	<0.005	<0.005
Beryllium	mg/L	<0.005	<0.005
Chromium	mg/L	<0.01	<0.01
Cobalt	mg/L	<0.01	<0.01
Nickel	mg/L	<0.02	<0.02
Antimony	mg/L	<0.05	<0.05
Selenium	mg/L	<0.1	<0.1
Tin	mg/L	<0.03	<0.03
Vanadium	mg/L	<0.01	<0.01
Mercury	ug/L	<0.05	<0.05
Cadmium-ICP	mg/L	<0.01	<0.01

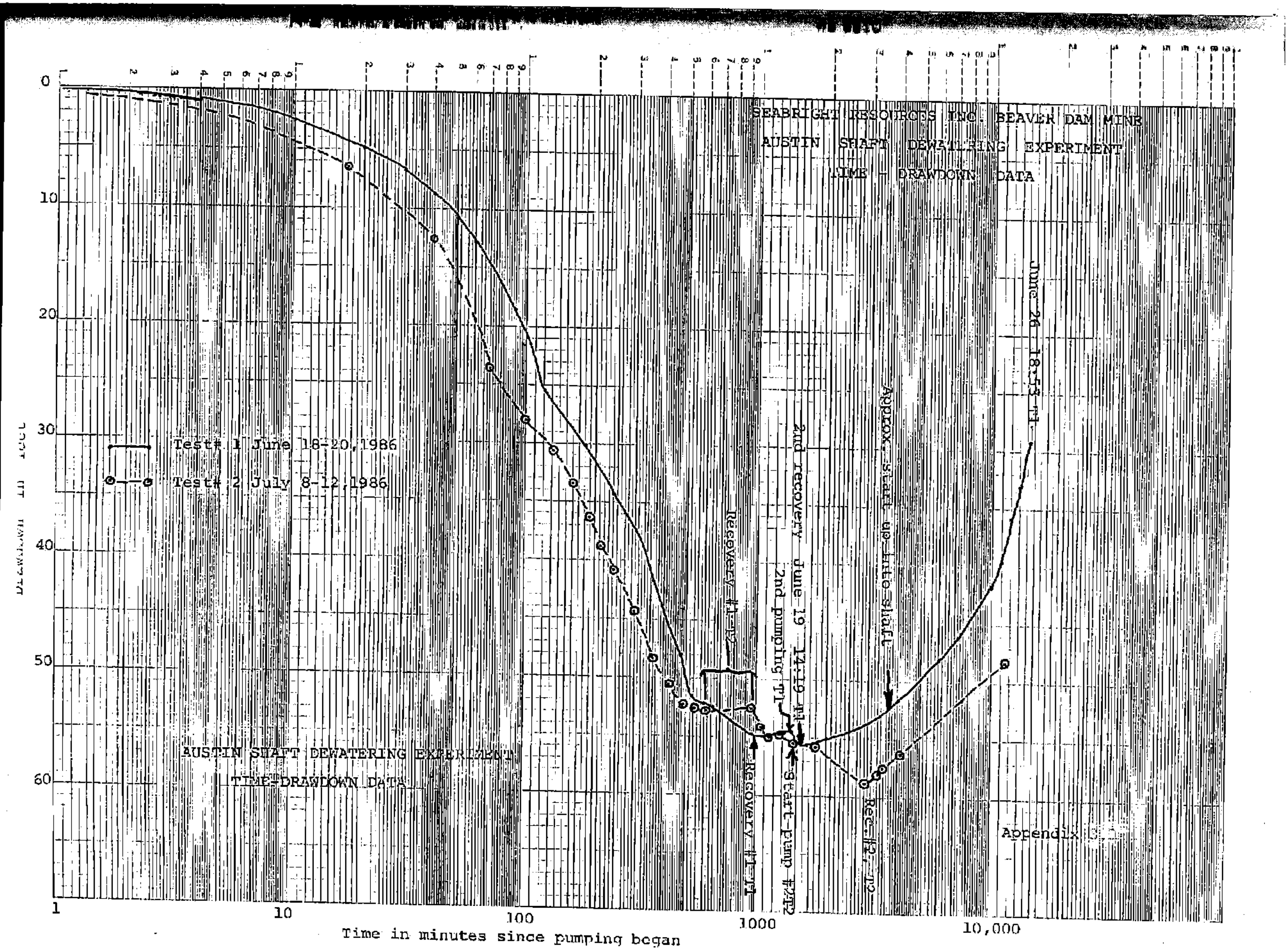
Field Measurements

pH	units	6.77	6.80 (downward drift)
Conductivity	umho/cm	47.0	50.0
Temperature	(°C)	5.0	4.2
Dissolved Oxygen	ppm	2.0	2.0 (June 18, 1986)
Odor	TCC	NONE	NONE

TABLE 3.7: Electrical Conductance and Temperature Profile for Austin Shaft, Beaver Dam (May 6, 1986)

Depth Below Reference(m)	Depth Below Water Level(m)	Temperature (°C)	Conductivity uS/cm	Salinity 0/00
3	0	5.9	45	0.0
5	2	5.5	45	0.0
7	4	5.5	47	0.0
9	6	5.4	47	0.0
11	8	5.4	49	0.0
13	10	5.4	49	0.0
15	12	5.4	50	0.0
22	19	4.7	50	0.0

Measurements by YSI Model 33 STC Meter.


SEABRIGHT RESOURCES INC. BEAVER DAM MINE
AUSTIN SHAFT DEWATERING EXPERIMENT
TIME - DRAWDOWN DATA
Test# 1 June 18-20,1986
Test# 2 July 8-12,1986
June 26 18:53 T1
Approx. start up into shaft
2nd recovery June 19 14:19 T1
2nd pumping T1
Start pump #2T2
Recovery #1 T2
Recovery #1 T1
Rec.#2, T2
AUSTIN SHAFT DEWATERING EXPERIMENT
TIME-DRAWDOWN DATA
Appendix 3
0
10
20
30
40
50
60
DRAWDOWN IN FEET
1
10
100
1000
10,000
Time in minutes since pumping began

Appendix 3

1/3

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

DATE JUNE
LOCATION BEAVERDAM MINE
WELL AUSTIN SHAFT

HYDRO. DDH
WEATHER CLEAR

	DRAWDOWN TEST				RECOVERY TEST		
TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN	YIELD (gpm)	RESIDUAL DRAWDOWN	t/t'	SAMPLE
JUNE 18/86 1335	0	12.67	0	500 igpm			
1339	4	13.50	0.83				
1345	10	15.42	2.75				#1
1355	20	17.67	5.00				
1405	30	19.58	6.91				
1415	40	21.50	8.83				
1425	50	23.42	10.75				#2
1435	60	25.25	12.58				
1505	90	31.17	18.50				
1535	120	38.00	25.33				
1635	180	42.67	30.00				
1735	240	46.83	34.16				#3
1835	300	50.17	37.50				
1935	360	54.42	41.75				#4
2135	480	60.67	48.00				
2235	540	62.83	50.16				#5
2335	600	64.75	52.08				
JUNE 19/86 0035	660	65.08	52.41				
0245	780	65.92	53.25				#6
0435	900	67.08	54.41				
0535	960	67.58	54.91				#7
	TURN OFF pump		7 hour Recovery (#1)				
0540	965	67.61			54.94	193	
0542	967	67.61			"	138	
0545	970	67.61			"	97	
0549	974	67.61			"	69.5	
0554	979	67.60			54.93	51.5	
0600	985	67.59			54.92	39.4	
0610	995	67.58			54.91	28.4	
0620	1005	67.55			54.88	22.3	
0630	1015	67.53			54.86	18.5	

Appendix 3

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

2/3

DATE
LOCATION
WELL

HYDRO.
WEATHER

TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN	YIELD (gpm)	RESIDUAL DRAWDOWN	t/t'	SAMPLE
	DRAWDOWN TEST				RECOVERY TEST		
JUNE 14/86	1025	67.52			54.85	15.8	
0700	1045	67.47			54.80	12.3	
0720	1065	67.45			54.78	10.1	
0740	1085	67.43			54.76	8.7	
0800	1105	67.39			54.72	7.6	
0830	1135	67.34			54.67	6.5	
0900	1165	67.30			54.63	5.7	
0930	1195	67.26			54.59	5.1	
1000	1225	67.22			54.55	4.6	
1030	1255	67.18			54.51	4.3	
1100	1285	67.14			54.47	4.0	
1130	1315	67.11			54.44	3.7	
1200	1345	67.09			54.42	3.5	
1235	1380	67.07			54.40	3.3	
		START PUMPING		500 IGPM			
1247	1392	67.07	54.40				
1249	1394	67.07	54.40				
1252	1397	–	–				
1254	1399	67.13	54.46				
1257	1402	67.15	54.48				
1301	1406	67.19	54.52				#8
1311	1416	67.32	54.65				
1321	1418	67.44	54.77				
1331	1428	67.52	54.85				
1341	1438	67.65	54.98				
1401	1498	67.83	55.16				#9
1417	1513	68.00	55.33				
1417		TURN OFF PUMP		RECOVERY	#2		
1417	0 1513	68.05			55.38	1	
1418	1 1514	68.05			55.38	1485	
1419	2 1515	68.05			11	743	

Appendix 3

3/3

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

DATE

LOCATION

WELL

HYDRO.

WEATHER

	DRAWDOWN TEST				RECOVERY TEST		
TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN	YIELD (gpm)	RESIDUAL DRAWDOWN	t/t'	SAMPLE
	3 1516	68.05			55.38	495	
	4 1517	"			"	372	
	5 1518	"			"	298	
	6 1519	"			"	248	
1433	16 1529	68.02			55.35	94	
1443	26 1539	68.02			55.35	58	
1453	36 1549	67.99			55.32	42	
1503	46 1559	67.99			55.32	33	
1523	66 1579	67.93			55.26	23	
1553	94 1609	67.91			55.24	17	
1615	116 1631	67.85			55.18	14	
1645	146 1661	67.81			55.14	11	
JUNE20/86 1010	1190 2705	66.76			54.09	2.3	
14:23	1443 2958	66.55			53.88	2.0	
JUNE26/86	9543 11,058	52.14			39.47	1.16	
	9843 11,358	51.16			38.49	1.15	
JUNE27/86	10,099 12,314	47.65			34.98	1.14	
JUNE28/86	12,243 13,758	43.09			30.42	1.12	
	12,596 14,111	41.84			29.17	1.11	

Appendix 3

1/3

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

DATE JULY 8 - 10, 1986
LOCATION BEAVER DAM MINE
WELL AUSTIN SHAFT

HYDRO. DSA, DAC
WEATHER CLEAR, WARM
YIELD 200 usgpm

	DRAWDOWN TEST			RECOVERY TEST			
TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN ft (~~m~~)	FEET BTOC	RESIDUAL DRAWDOWN (m)	t/t'	SAMPLE
JULY 8/86 13:50	0	12.91"					
13:07	17	19.46	6.55				
1430	40	25.71	12.8				
1500	70	36.79	23.88				
1530	100	40.96	28.05				
1600	130	43.71	30.8				#1
1630	160	46.50	33.59				
1700	190	49.25	36.34				
1730	210	51.83	38.92				
1800	240	53.75	40.84				
1900	300	57.38	44.47				
2000	360	61.29	48.38				
2100	420	63.58	50.67				
2200	480	65.17	52.26				
2300	540	65.58	52.67				
2400	600	65.79	52.88 PUMP	SHUT OFF	TILL 0600		
JULY 9, 1986 0600	960	65.21	52.30 START	PUMP (Recovery 0.58 ft in 6 hr (1"/hr)			
0700	1020	66.19	53.28				
0800	1080	67.12	54.21				
0830	1110	67.50	54.59				
0900	1140	67.79	54.88	PUMP OFF			
1000	1200	67.69	54.78				
1100	1260	67.56	54.65	START PUMP (Recovery .19 ft/2hr or 1"/hr)			
1200	1320	68.33	55.42	STOP PUMP; change pumps			#2
1443	1440	68.27	55.36	START CENTRIFUGAL PUMP			
1500	1500	68.29	55.38	(INITIAL RISE in h when pump started)			#3
1600	1560	"	"				
1700	1620	"	"				
1800	1680	68.29	"				
1900	1740	68.54	55.63				
2000	1800	68.67	55.76				

DRILLER/YEAR HOPPER
WELL DEPTH 72.'
CASING LENGTH MINE SHAFT

PUMP SETTING 71' 10"
PUMP TYPE Centrifugal
SPECIFIC CAPACITY (Q/S)

Appendix 3

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

DATE ____________________ HYDRO. ____________________
LOCATION ____________________ WEATHER ____________________
WELL ____________________

	DRAWDOWN TEST				RECOVERY TEST		
TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN	YIELD (gpm)	RESIDUAL DRAWDOWN	t/t'	SAMPLE
July 9/86 2100	1860	69.88	55.97				
2200	1920	69.08	56.17				
2300	1980	69.29	56.38				
2400	2040	69.58	56.67				
July 10/86 0100	2100	69.67	56.76				
0200	2160	69.75	56.84				
0300	2220	69.92	57.01				
0400	2280	70.08	57.17				
0500	2340	70.25	57.34				
0600	2400	70.42	57.51				
0700	2460	70.58	57.67				
0800	2520	70.79	57.88				
0900	2580	70.85	57.94	Reached bottom of drop pipe			
1000	2640	"					#4
1100	2700	"		Pump clogging with debris			
1200	2760	"		60 gpm Broke suction @ t = 1130 hrs.			#5
1300	2820	"		38 gpm			
1330	2850	"					
1530	2970	"					#6
1630	3030	"					
1830	3150	"		38 gpm Pump off; Start recovery			#7

JACQUES WHITFORD AND ASSOCIATES LIMITED PUMP TEST REPORT

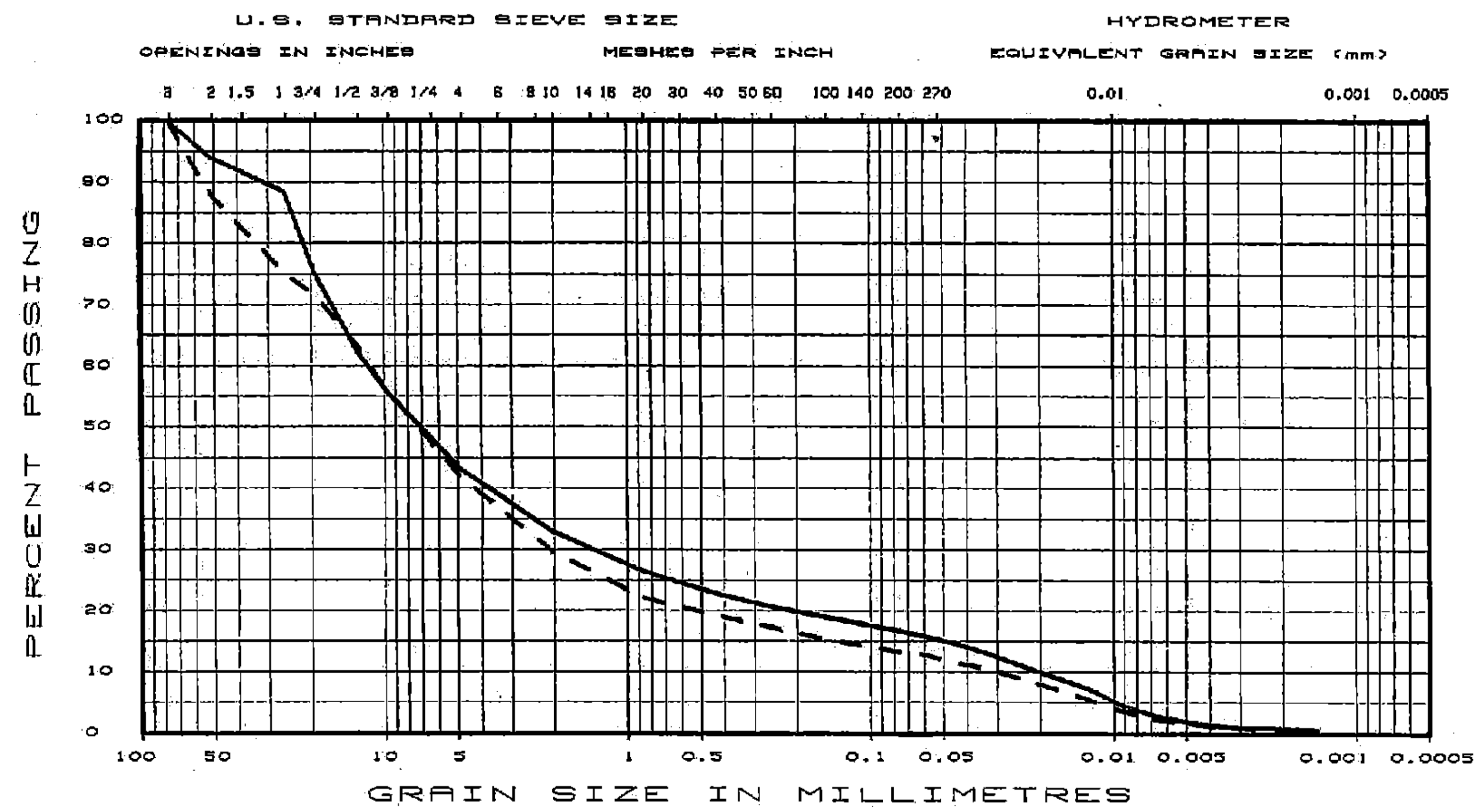
DATE JULY 10, 11, 1996
LOCATION BEAVERDAM MINE
WELL AUSTIN SHAFT
HYDRO.
WEATHER

	DRAWDOWN TEST				RECOVERY TEST		
TIME/DATE	TIME (min.)	FEET BTOC	DRAWDOWN +1½	YIELD (gpm)	RESIDUAL DRAWDOWN	t/t'	SAMPLE
JULY 10, 1996 1930	0	69.83	56.92		58.92		
20:00	30	69.54	56.63		58.63		
21:00	90	69.31	56.40	2½ (.40)	58.40		
22:00	150	69.08	56.17		58.17		
24:00	270	68.88	55.97		57.97		
JULY 11, 1996 0200	390	68.71	55.80		57.80		
0400	510	68.54	55.63		57.63		
0600	630	68.38	55.47		57.47		
0700	690	68.29	55.38		57.38		
0800	750	68.21	55.30		57.30		
0900	910	68.12	55.21		57.21		
1020	890	68.04	55.13		57.13		
1400	1110	67.75	54.84	(1"/hour)	56.84		
1700	1290	67.54	54.63		56.63		
JULY 12/96							
J							
July 16 @ 1350	8360	59.58	46.67				
1510	8440	59.25	46.34			1.4 min	

* WATER LEVEL MEASURED FROM NOTCH IN FLOOR

* MEASURING POINT ~ 2.0 Ft lower than top of drop tube

* NOTE: RECOVERY MEAS. DATUM 1.5 Ft lower than for drawdown.

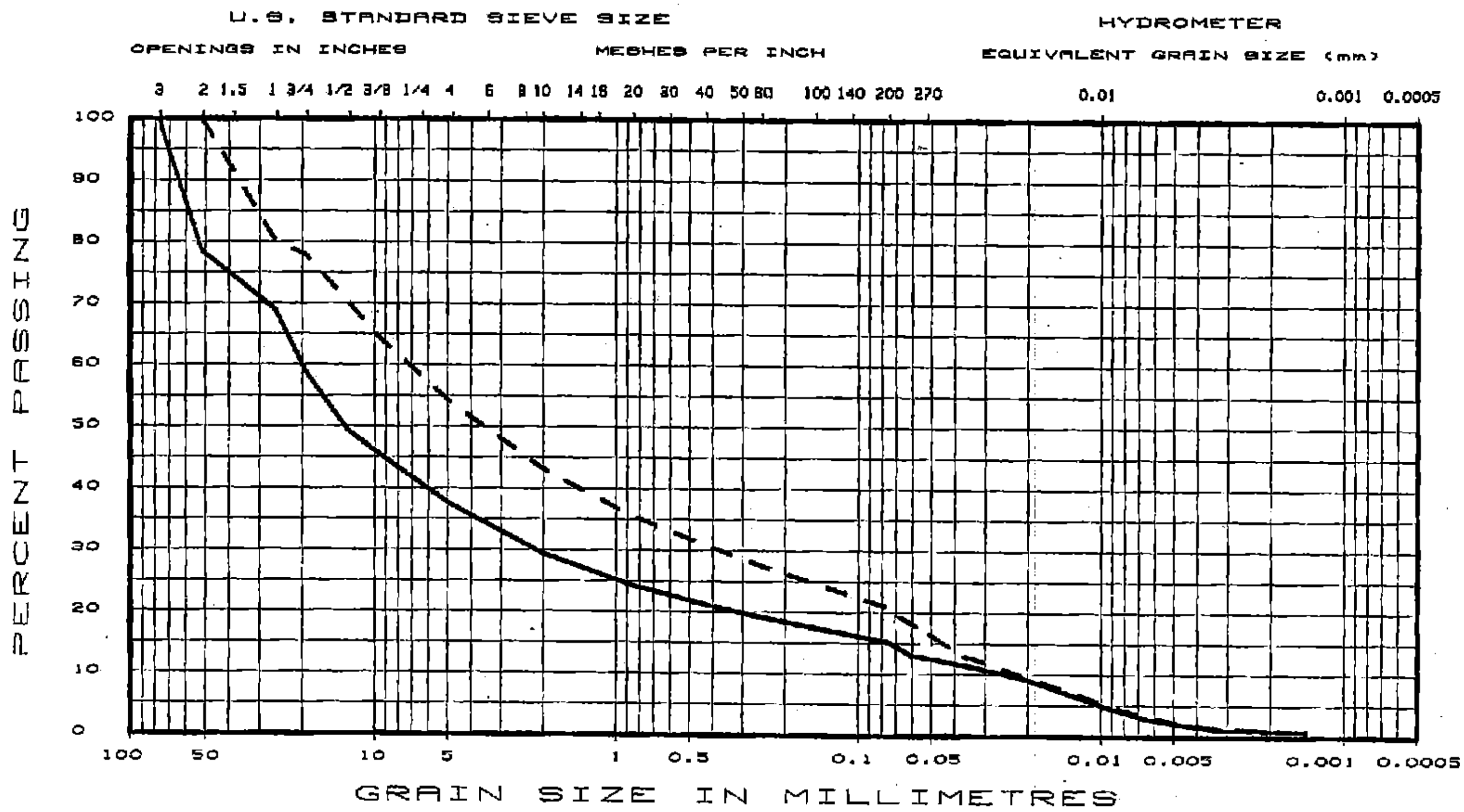


GRAVEL		SAND			SILT & CLAY
Coarse	Fine	Coarse	Medium	Fine	

Unified Soil Classification

	TEST PIT	SAMPLE	DEPTH	DESCRIPTION
———	1	1	0'-5'	Sandy GRAVEL, some silt
— — —	1	2	5'-10'	Sandy GRAVEL, some silt

M1289



GRAVEL		SAND			SILT & CLAY
Coarse	Fine	Coarse	Medium	Fine	

Unified Soil Classification

	TEST PIT	SAMPLE	DEPTH	DESCRIPTION
———	1	3	10'-15'	Sandy GRAVEL, some silt
— — —	1	4	15'-16'	Sandy GRAVEL, some silt

M1289

APPENDIX 3

Test Pit Logs, Beaverdam Mine, June 25, 1986 (TP1-TP5); July 12 (TP6-TP9)

Test Pit # 1 (2 + 00W; 1 + 75S)

0 - 0.61 m	orange brown, silty sand and gravel
0.61 - 3.33 m	olive brown, sandy gravel, with some silt. Numerous boulders of quartz and slate.
3.33 - 4.57 m	olive brown, sandy gravel with some silt. Slatey clasts more numerous than quartzite clasts. Large boulders 0.15 - 0.46 m in diameter.
4.57 - 4.88 m	silty sand and gravel.
4.88 - 5.0 m	quartzite bedrock. Water table 1.8 m. 0.46 m diameter culvert installed in hole for pump testing.

Test Pit # 2 (2 + 00W; 1 + 65S)

0 - 0.61 m	orange brown silty sand and gravel.
0.61 - 3.3 m	olive brown sandy gravel with silt, numerous boulders.
3.3 - 3.5 m	quartzite bedrock.

Test Pit # 3 (2 + 25W; 1 + 75S)

0 - 0.9 m	orange brown, sandy silt and gravel.
0.9 - 3.35 m	olive brown silty sand and gravel, quartzite boulders.
3.35 - 3.4 m	quartzite bedrock.

Test Pit # 4 (2 + 25W; 1 + 65S)

0 - 0.6 m	black and orange brown, sandy silt, gravel and boulders.
0.6 - 2.1 m	yellow-gray sandy silt and gravel.
2.1 - 4.0 m	olive brown, silty sand and gravel, numerous boulders.

Test Pit # 5 (1 + 80W; 1 + 75S)

0 - 0.6 m	rootmat, black and orange sandy silt with gravel.
0.6 - 1.8 m	yellow brown, silty sand and gravel.
1.8 - 3.35 m	olive brown sandy silt and grvel, slatey gravel and boulders. Water table at 1.5 m. Sample collected for sieve analysis.

Note: Test pits 1 to 5 constructed in the vicinity of TP # 1 which was pump tested to evaluate well feasibility.

Test Pit # 6 (5 + 00W; 2 + 50S)

0 - 0.15 m	moss, rootmat
0.15 - 0.61 m	weathered red to black organic soil, water entering @ 0.61 m from bog area.
0.61 - 1.83 m	yellow brown, silty sand till with quartz boulders to 0.3 m diameter, dense.
	broken quartzite bedrock.

APPENDIX 3
(continued)

Test Pit # 7 (5 + 20W; 2 + 50S)

0 - .15 m	moss, rootmat
.15 - .61 m	reddish brown, silty sand loam, minor quartzite clasts.
.61 - 1.0 m	broken quartzite bedrock, no water.

Test Pit # 8 (5 + 00W; 2 + 75S)

0 - 0.76 m	black, organic peat and muck, strong H_2S odor
0.76 - 1.0 m	black organic silt
1.0 - 1.22 m	broken quartzite bedrock, some water.

Test Pit # 9 (5 + 15 W; 2 + 00S)

0 - 0.15 m	moss, rootmat
0.15 - 1.5 m	yellow brown silty sand loam, becoming more gravelly with depth. Numerous large quartzite boulders indicate proximity to bedrock.
1.5 - 2.0 m	hard quartzite bedrock. No water. Test pit indicates that bedrock ridge can be ripped to about 1.2 m depth by excavator.

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ASSESSMENT OF POTENTIAL OPEN PIT GROUNDWATER INFLOWS
BEAVER DAM GOLDPROJECT
NOVA SCOTIA

Report prepared for:

Atlantic Gold Corporation
Suite 506 / 815 Pacific Highway
Chatswood Nest NSW 2067

Report No: 1501_R01

April 2015

In association with: Peter O'Bryan & Associates
George, Orr and Associates (Australia)

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1 INTRODUCTION

Atlantic Gold Corporation is assessing the feasibility of developing an open pit gold mine at their Beaver Dam Project in Nova Scotia, Canada, and are currently preparing documentation for a Bankable Feasibility Study. The proposed open put has dimensions 690 m by 360 m at the crest, and has a maximum depth of 200 m.

This report provides an assessment of potential groundwater inflows to the proposed open pit at the Beaver Dam Project. The assessment is based on previous hydrogeological investigations by Jacques, Whitford and Associates Limited, and the results of recent hydraulic conductivity testing by Stantec Consulting Ltd.

Recommendations for monitoring of groundwater during mining and the periodic assessment of these data are included.

2 PROJECT SETTING

2.1 Location and Topography

The Beaver Dam Project is located in central Nova Scotia about 85 km NE of Halifax and about 25 km from the North Atlantic Ocean. Beaver Dam is about 20 km NE of Atlantic Gold's Touquoy Gold Project (Figure 1)

The project site lies in an area of relatively low local topographic relief at an elevation of around 140 m, with scattered drumlins to 160 m elevation. Regional surface water drainage is predominantly to the south east along several poorly drained stream channels and shallow lakes, and there are several low-lying boggy areas across the site.

Vegetation coverage in and around the project site consists of spruce, fir, and some hardwood. Logging has been conducted in the area, and there has recently been clear felling of timber in the immediate vicinity of the project site.

The proposed open pit adjacent to Cameron Flowage, a stillwater area on the Killag River and a remnant of past logging operations (JWA, 1986a). Cameron Flowage is around 1.2 km long by up to 120 m wide (Figure 2). All surface water generated within the drainage catchment that includes the proposed open pit flows into Cameron Flowage.

There is a shallow sediment settling dam located in the eastern part of the proposed open pit (Figure 2). This dam was used to trap sediment generated by the dewatering of the Seabright underground operations in the mid-1980s before discharging to Cameron Flowage.

2.2 Prior Mining History and Dewatering

The following discussion is mostly adapted from Schofield (2015).

Gold was discovered at Beaver Dam in 1868, with first production recorded in 1871.

Intermittent attempts to develop a mine in the area occurred until 1949, with the property changing ownership several times. Some of these attempts focused on the Austen Shaft which was collared in 1902 and developed initially to a depth of 30 m with crosscuts 19 m north and 12 m south at a depth of 22 m. The southern crosscut was extended to a length of 90 m in 1927, and an incline was sunk to 61 m in 1936 from the southern crosscut.

The Austen Shaft and associated underground workings are within the perimeter of the proposed Beaver Dam open pit.

In 1985 the leases were acquired by Seabright Resources Inc who subsequently conducted a number of exploration programs which delineated an auriferous zone between 20 m and 30 m wide over a strike length of 700 m and depth 600 m. Between 1986 and 1988 Seabright conducted exploration from a new underground development that reached a maximum depth of 105 m and spanned 400 m of strike. All of the Seabright workings are within the perimeter of the proposed open pit, and they are not connected with any of the developments from the Austen Shaft.

No records of rates of long-term mine dewatering during the previous phases of mining and underground exploration have been discovered. There are notations that the Austen Shaft was dewatered on at least six occasions – 1928, 1934, 1954-57, 1965, and twice by Seabright in the late 1980s.

Jacques, Whitford and Associates Limited conducted a hydrogeological investigation at Beaver Dam in 1986 prior to Seabright's underground exploration program (JWA, 1986b). This work included a pumping test to dewater the Austen Shaft and associated workings. The results of this testing program are discussed in Section 3.1.

2.3 Rainfall, Evaporation, and Temperature

Precipitation data are available from the Middle Musquodoboit weather station, 33 km west of the Beaver Dam project site (CRA, 2005).

Precipitation occurs as rain, and during the cooler winter months as snow. Average annual precipitation (including snow as equivalent rainfall) is around 1,400 mm, and this is evenly distributed throughout the year with average monthly precipitation of between 100 mm and 140 mm. Lake evaporation data presented in CRA (2005) indicates evaporation rates are negligible from November to April, and range between

40 mm/month and 110 mm/month from May to October. Annual lake evaporation is around 500 mm, which is about 40% of the annual precipitation.

Average monthly temperatures range between -6°C in January and 18°C in July.

2.4 Geology and Hydrogeology

The Beaver Dam gold deposit is within the Meguma Group, which is a sequence of Cambro-Ordovician sandstones and mudstones that form the southern half of the province of Nova Scotia. The Meguma Group is divided into two stratigraphic units: the basal Goldenville Formation and overlying Halifax Formation. The dominant lithologies are greywacke in the Goldenville Formation and argillite in the Halifax Formation. The Goldenville Formation is at least 5,600 m thick, and the average thickness of the Halifax Formation is 4,400 m.

The Meguma Group sedimentary sequence was uplifted and deformed into a series of tightly folded sub-parallel northeast trending anticlines and synclines during the Arcadian Orogeny. This sequence has been metamorphosed to between greenschist and amphibolite (staurolite) facies, and intruded by granites and minor mafic intrusives.

The Meguma Group sequence, and predominantly the Goldenville Formation, is host to most of the gold mineralisation that has been exploited in Nova Scotia since 1860.

The Beaver Dam Project is within the argillite dominated Moose River Member of the Goldenville Formation (Figure 3). This member also hosts the Touquoy deposit to the SW and Fifteen Mile Stream deposit to the NE (Figure 1).

The Moose River Member is folded into three sub-parallel anticlines at Beaver Dam, and the gold deposit is associated with the southern overturned limb of the central anticline which dips to the north at between 75° and 90°. The sequence at Beaver Dam is sinistrally offset by two northwest trending faults: the Mud Lake Fault and the Cameron Flowage Fault. The Mud Lake Fault is described from drill cores as a 2 m to 3 m zone of gouge within a 10 m to 20 m wide brecciated zone.

The Meguma Group sequence at Beaver Dam is covered by glacial till deposits of varying thickness and occasional shallow peat bogs. The range of grain size of the till materials is large, being from clay to boulder. Regionally the sheet of till deposits has a mean thickness of about 3 m, but locally it can be up to 20 m thick (eg, at drumlin deposits). At Beaver Dam the till sheet is about 5 m thick, and there is evidence of a sediment-filled gully up to 25 m deep which intersects the trace of the Mud Lake Fault.

Groundwater occurs at shallow depths at the Beaver Dam site, and Cameron Flowage is probably an area of groundwater discharge. The bedrock sequence forms a fractured rock aquifer system, and this overlain by a thin aquifer in the till. The degree of hydraulic connection amongst the smaller bedrock fracture systems is probably poor to moderate, and the main zones that are capable of storing and transmitting relatively large amounts of groundwater would be the larger scale faults.

The volume of groundwater stored in the bedrock aquifer is probably small, and this reflects the relatively small primary porosity of these rocks. Some of the larger bedrock structures may be hydraulically connected to surface water bodies which may become sources of aquifer recharge under a mine dewatering scenario.

Descriptions of drilling conditions through the Mud Lake Fault in JWA (1986b) indicate boreholes were quite unstable in this section, and groundwater flows were “low”. The latter comment appears to refer to the groundwater yielding capability of boreholes for the purpose of supplying water for drilling rigs. One borehole, BD-86-47, is noted to be a flowing artesian borehole with measured flow rate of 0.1 L/sec. BD-86-47 is located slightly north of the south east end of Cameron Flowage, and has a total depth of 500 m.

3 PREVIOUS HYDROGEOLOGICAL INVESTIGATIONS

Jacques, Whitford and Associates conducted a hydrogeological investigation at the Beaver Dam site in 1986 prior to the exploration work by Seabright Resources Inc (JWA, 1986b). The objectives of the investigation were to predict the rates of groundwater inflow to the proposed underground exploration development, and the quality of water flowing into the underground. The scope of the investigation included a pumping test to dewater the Austen Shaft, and several single borehole packer tests using some of the diamond core holes. The results of this work are discussed in Sections 3.1 and 3.2.

In 2014, Stantec Consulting Ltd conducted packer testing of one diamond core hole at the Beaver Dam site. The objective of this investigation was to determine the hydraulic conductivity of various parts of the bedrock sequence at Beaver Dam including the Mud Lake Fault. Results of this work are discussed in Section 3.3.

3.1 Austen Shaft Dewatering 1986

This test involved pumping from the Austen Shaft, and monitoring water levels in the shaft during pumping and recovery (JWA, 1986b). The maximum pumping water level that could be achieved during testing was around 22 m. This depth is equivalent to the depths of the crosscuts that were developed off the shaft in 1902.

The first pumping test commenced at 1:35pm on 18 June 1986. The static water level (SWL) in the shaft prior to pumping was noted to be 3.86 m below the datum for the test, which presumably was close to ground level. The pumping rate during the test was

2,275 kL/day (26.3 L/sec), and all of the available drawdown was exhausted after 16 hours of pumping.

A graph of drawdown versus time from this pumping test is presented in Figure 4. There are three linear segments in this drawdown-time graph, with the rate of drawdown tending to decrease at longer times during the test. The linear trends of drawdown versus time indicate that, in this instance. there is a linear relationship between water level and water storage volume in each of the three vertical intervals of the shaft and its associated developments. This also indicates that the rate of pumping during the test was much greater than the rate of groundwater seepage into the shaft and underground developments.

The total volume of water pumped from the Austen Shaft and associated developments in the June 1986 test was 1,520 kL.

A second group of pumping tests was conducted in July 1986. In one of these test pumping occurred until the available drawdown was exhausted, and the pumping rate was then reduced to maintain a steady water level. The final pumping rate of 2.9 L/sec (249 kL/day) was maintained for a period of 5½ hours. Note that this pumping rate can be interpreted as the maximum rate of groundwater seepage into all of the underground voids of the Austen Shaft and associated underground developments which extend to a depth of 61 m.

3.2 Packer Testing 1986

Jacques, Whitford and Associates selected nine existing diamond core holes for conducting single borehole packer injection tests to determine values of formation hydraulic conductivity. Boreholes for testing were selected on the basis of their inclination (near-vertical holes preferred), and the lithology and structure intersected (Mud Lake Fault, ore zones, the anticline axis, greywacke, argillite, and quartzite). Initially sixteen boreholes were selected a possible candidates for testing, however only nine were suitable. Packer test were conducted in 56 intervals within these boreholes. The locations of the boreholes used for packer testing are indicated on Figure 5, and listed in Table 1.

A “straddle” packer consisting of a 4.5 m length of perforated pipe with 1 m long inflatable packers at either end was used in this testing program. The packer assembly was run in and out of the hole on a wireline. Nitrogen gas was used to inflate the packers, and water was injected into the packed-off interval through a high-pressure hose.

Table 1 lists the intervals in each borehole that were tested, the lithology and structure in these intervals, and the values of hydraulic conductivity calculated from the test data by JWA (1986b). All boreholes listed in Table 1 are inclined with dip angles between -60° and -70° at the collars, and the depth intervals are the depths within the borehole, ie these are not vertical depth intervals.

The range of hydraulic conductivity values determined by the 1986 testing program is 3.7×10^{10} m/sec and 1.9×10^{-6} m/sec. The mean of the set of values is 2.5×10^{-7} m/sec, and the geometric mean (approximate median)(1) value is 4.8×10^{-8} m/sec.

Five of the 1986 packer tested intervals intersected to Mud Lake Fault. Hydraulic conductivity determined from this group of tests ranges between 1.2×10^{-9} m/sec and 1.9×10^{-6} m/sec, and the mean and geometric mean values are 3.7×10^{-7} m/sec and 1.5×10^{-8} m/sec, respectively.

All of the values of hydraulic conductivity determined from the 1986 packer testing program are relatively small, and are not unusual given the geological and structural settings.

3.3 Packer Testing 2014

Stantec Consulting Ltd conducted five packer tests in diamond cored borehole BD14-188 in December 2014 (Stantec, 2015). The location of BD14-188 is indicated on Figure 5.

BD14-188 was selected for packer testing so that the tested intervals included the hanging wall sequence, the Mud Lake Fault, and the foot wall sequence. Five intervals were tested, with test interval lengths ranging between 8 m and 64 m. Results are listed in Table 1.

Stantec note that one of the tested intervals in the hanging wall and both tested intervals in the footwall did not accept any of the injected water. The values of hydraulic conductivity inferred from these three tests are indicated by the "<" character in Table 1.

Hydraulic conductivity calculated from the two successful packer tests conducted in December 2014 are within the range of hydraulic conductivities calculated from the 1986 testing program. The value of K determined by the test of the Mud Lake Fault is 1.0×10^{-8} m/sec, which is again within the range of values determined for this structure in the 1986 testing.

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[1] The geometric mean value of several hydraulic conductivity results based on similar tests is generally taken to be the best representative large-scale estimate of this parameter for subsequent use in groundwater flow rate calculations.

Stantec note that the intersection of the Mud Lake Fault in BD14-188 had a significantly higher rock mass quality than was anticipated on the basis of cores from adjacent boreholes. The implication is that parts of the Mud Lake Fault have larger hydraulic conductivities than the value determined from this packer test.

The geometric mean value of all of the hydraulic conductivity results from the 1986 and 2014 testing programs is 4.5 x 10^{-8} m/sec.

4 ESTIMATES OF OPEN PIT GROUNDWATER INFLOW RATES

As groundwater occurs at shallow depths across the Beaver Dam site, groundwater seepage into the proposed open pit will be one issue that will need to be managed basically from the start of mining.

Groundwater can be expected to seep into an open pit developed at the Beaver Dam site through the surficial glacial till deposits, and though fractures and structures in the bedrock. As dewatering progresses and groundwater levels in the vicinity of the open pit are lowered, some surface water bodies which are presently groundwater discharge areas may become areas of groundwater recharge. The main effect of this recharge will be to maintain some of the seepage into the open pit.

4.1 Seepage from Till

Atlantic Gold's Touquoy Project, 20 km SW of Beaver Dam, has similar geological and hydrogeological settings to Beaver Dam, with a thin sheet of surficial glacial till overlying folded and fractured argillite and greywacke. The estimated average groundwater inflow rate into an open pit at Touquoy from the till is 450 kL/day (5.2 L/sec) (Peter Clifton & Associates, 2006). Given the proposed open pits at Touquoy and Beaver Dam have similar crest perimeter lengths, this estimate of groundwater inflow rate from the till can also be applied to the Beaver Dam site.

Some spatial variation in the rates of groundwater inflow from the till must be expected around the crest of the pit. There are likely to be sections of the wall where seepage rates are negligible and other sections where the seepage is noticeable. Some seasonal variation in seepage rates from the till is also expected. The recommended approach for managing groundwater seepage from the till is discussed in Section 5.

4.2 Seepage from Bedrock

The results of extensive packer testing of the bedrock at Beaver Dam did not identified any large-scale permeable units from which large rates of groundwater seepage into an open pit could be expected. The geometric mean (approximate median) value of the entire set of hydraulic conductivity values determined from these tests is 4.5×10^{-8} m/sec. This is a relatively small value of this parameter, however this is consistent with the lithology of the sequence at Beaver Dam apparent from diamond cores.

Some caution is needed when using the results of packer tests conducted in diamond core holes. Packer tests in core holes may underestimate the actual hydraulic conductivity of the tested interval due to blinding, or blocking, of permeable fractures by fine grained drill cuttings or viscous drilling fluid. It is not possible to quantify the magnitude of these effects, and they may not necessarily be a significant factor. The set of hydraulic conductivity results from the tests at Beaver Dam appears reasonable given the lithology and the type of aquifer (fractured bedrock).

One uncertainty is the role of the Mud Lake Fault in groundwater seepage into the proposed Beaver Dam open pit. All of the packer tests which have been conducted in the Mud Lake Fault produced hydraulic conductivity estimates which are not significantly different from the remainder of the tests. However, the Mud Lake Fault is described as a 2 m to 3 m zone of gouge within a 10 m to 20 m wide brecciated zone, and is noted to be associated with borehole instability issues during drilling. The Mud Lake Fault is only known from cores, and it was not intersected by any of the underground developments associated with the Austen Shaft and the Seabright workings.

If the actual hydraulic conductivity of the Mud Lake Fault is larger than indicated by the results of the packer tests, groundwater inflow rates to an open pit at Beaver Dam will be influenced more by the small hydraulic conductivities of the greywacke and argillite sequence. Recommendations for managing groundwater pressures in the Mud Lake Fault are included in Section 5.

Figure 6 is a graph of hydraulic conductivity versus depth based on the results of the packer tests. Only the results of the testing in 1986 have been included in this graph. While there is generally weak correlation between hydraulic conductivity and depth apparent in Figure 6, there is a tendency for the smaller values of K to occur at greater depths. This is an expected trend, and can be explained by slight dilation of fractures at shallower depths.

An estimate of the rate of groundwater inflow through the bedrock to an open pit at Beaver Dam can be made using a model which assumes that all of the flow enters the pit through the north and south walls (ie, the longer walls in the pit – see Figure 2). For a pit wall 800 m long and 100 m deep, and assuming a bulk formation hydraulic conductivity of 4.5×10^{-8} m/sec (the geometric mean of the packer test results) and hydraulic gradient of 1 (a conservative assumption), the estimated rate of groundwater seepage is 311 kL/day. The estimated groundwater seepage rate into the 100 m deep pit from both the north and south walls would thus be 622 kL/day (7.2 L/sec). In deeper sections of the pit, groundwater inflows are expected to be smaller than these values due to the lower formation hydraulic conductivities that tend to occur with increasing depth at Beaver Dam.

It is recommended that a range of groundwater seepage rates from bedrock at Beaver Dam of between 100 kL/day (1.2 L/sec) and 1,000 kL/day (12 L/sec) be used for planning purposes.

5 RECOMMENDATIONS FOR MANAGING GROUNDWATER SEEPAGE

From a mine dewatering perspective there are two groundwater seepage issues at the proposed Beaver Dam open pit that require attention:

- Seepage from the glacial till deposits into the open pit (eg seepage that migrates along the till/bedrock contact)
- Seepage from the bedrock sequence into the open pit and the associated groundwater pressures in the pit walls – this is an important issue that can influence open pit wall stability

The above issues follow from the hydrogeological setting of the site, and different approaches are required to control inflows and seepage from these sources.

5.1 Seepage from Till

The glacial till at Beaver is a sheet of poorly sorted sediment with a fine grained matrix averaging 5 m thick. There is evidence of a sediment-filled gully up to 25 m deep which intersects the trace of the Mud Lake Fault.

Rates of seepage from the till exposed around the perimeter of the open pit will vary, and will primarily be related to the proportion of fine grained matrix material. Larger rates of seepage can be expected where the till is relatively coarse and contains a small proportion of fines.

Seepage rates from the till to the open pit will also vary by small amounts seasonally due to normal seasonal changes in the level of the water table. Seepage rates from the till are expected to be greatest following the spring thaw and during the early summer months.

Where the till consists of relatively coarse grained gravels with a small proportion of fines there is the potential for larger groundwater inflows to occur. Whether these inflow rates are sustained will depend on the lateral extent of the gravel deposits, and the degree of interconnection between the gravels and surface water bodies. This may require further investigation if the risk is considered significant.

The estimated rate of groundwater seepage from the till into an open pit at Beaver Dam 450 kL/day. This is considered to be an average value, with seasonal variations superimposed.

Although the total rate of groundwater seepage from the till into the open pit is not expected to be large, if left unmanaged this could result in erosion, slumping of the till, and possibly water flowing over the crest of the pit. It is recommended that this seepage be intercepted and diverted before it reaches the open pit. This can be achieved with an open drain at the base of the till which is dug a short distance into the top of the bedrock, and one or more sumps at low points in the drain to collect the seepage and pump it from the pit. Because the expect flow rates are relatively small, the cross section area of the drain can safely be of order 1 m^2 and still provide sufficient carrying capacity. The drain may need to be lined where it crosses major structures to prevent recharge occurring to the bedrock groundwater system as this may cause problems for pit wall stability.

Where thicker accumulations of till occur drains and sumps will need to be positioned deeper within the open pit to intercept any seepage.

Figure 7 presents a conceptual design of a drain at the base of the till in an open pit at Beaver Dam. The distance between the edge of the drain and the inner pit crest (ie, bedrock crest) is about 30 m. This is also the recommended length of sub-horizontal drain holes in the pit walls (see Section 5.2).

5.2 Seepage from Bedrock

The ambient water table at Beaver Dam is close to the land surface and the bedrock sequence is saturated. Groundwater will therefore flow into an open pit at Beaver Dam, and dewatering will be required to maintain dry working conditions. Lowering of groundwater pressures in the pit walls will also be required for wall stability purposes, and dewatering of the bedrock sequence exposed in the walls will be important from this perspective. Dewatering facilities will also be needed in the pit to remove surface water that collects after rainfall.

Seepage through the bedrock sequence at Beaver Dam will largely be controlled by geological structures, and will vary around the pit due to variations in the density of joints and fractures, and the occurrence of major faults.

Managing groundwater pressures in the pit walls at Beaver Dam will require groundwater levels to be monitored in piezometers behind the walls, and groundwater pressures in the walls to be dissipated by means of sub-horizontal drain holes. It is recommended that drain holes be located to intersect permeable structures 20 m to 30 m back from the walls. If possible, drain holes should be selectively located in areas where seepage is an obvious issue rather than placing them at regular spacing on every bench of the pit. A greater density of drains may be required to control groundwater pressures within and near the Mud Lake Fault.

Figure 7 presents a conceptual design of pit wall drainage by means of sub-horizontal drain holes. Drains should be about 30 m long, and can be drilled with a blast hole rig. Flows from drains will generally diminish over time, and drains on the higher benches may eventually cease flowing as the mine is developed. Discharge from drains should be directed to a sump either through a series of pipes or channels. Collaring of drain holes may be necessary if large and persistent flow rates are encountered, however in most cases flows are expected to be no greater than a trickle and should diminish over time.

Monitoring of groundwater levels will require piezometers to be constructed at the pit crest, and progressively on some benches as the open pit is developed. Piezometers can be vertical boreholes drilled to a depth of 40 m to 50 m, possibly with a blast hole drilling rig, and cased with 32 mm or 40 mm PVC pipe which has been slotted from 10 m below surface. The annulus outside the slotted casing should be packed with graded sand (~2 mm grain size) to about 3 m above the top of the slots. Slots can be cut with a hacksaw, or machine slotted casing can be used if this is available.

Piezometers located at the pit crest will require the glacial till sequence to be collared to below the till/bedrock contact so that groundwater in the till cannot seep into the borehole. These piezometers should also include annular bentonite clay seals of height about 1 m on top of the sand pack. It may be necessary to modify the design of these piezometers during construction to ensure that the bentonite seal is a few metres below the till/bedrock contact.

All piezometers should be finished with steel surface casing about 0.7 m above ground level, and these casings should be painted bright orange or green so that they are clearly visible. Piezometers should be surveyed to determine locations and reference elevations for measuring water levels against.

For planning purposes, allowance should be made for piezometers at the pit crest to be around 200 m apart, ie there will be nine or ten piezometers around the crest of the proposed Beaver Dam open pit. Transects of piezometers every 50 m vertically down the pit wall should be constructed at every second crest piezometer.

Data from the piezometers will provide profiles of the phreatic surface which will be important for assessing pit wall stability. If access to piezometers over the longer term is uncertain, consideration should be given to equipping these facilities with pressure transducers that connect to logging units at the crest of the pit.

6 REMAINING HYDROGEOLOGICAL ISSUES

Hydrogeological issues at Beaver Dam that may need to be considered are:

- Quality and quantity of any groundwater that may need to be discharged off site, ie in excess of what can be utilised for ore processing
- Groundwater and surface water monitoring programs that may need to be established under statutory requirement for mining operations in Nova Scotia

A possible issue that may need to be considered given the setting is the effect of freezing temperatures on groundwater seepage close to the pit walls. The expansion of water that occurs at temperatures below 4°C and when ice is formed has the potential to cause slight dilation of the rock mass and joints. This process may lead to exfoliation at the pit walls. Whether this will be a significant process in an open pit at Beaver Dam is unclear. Avoiding this condition would require that the wall rocks be completely dewatered, especially close to the face of the pit.

Peter Clifton & Associates

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Table 1: Beaver Dam Project Packer Testing Results

Borehole	From	To	Lithology / Structure	K (m/sec)
BD85-005	15.2	19.8	Argillite	5.2×10^{-7}
	19.8	24.4	Argillite	9.0×10^{-8}
	24.4	29	Argillite	1.8×10^{-7}
	50.3	54.9	Greywacke	1.4×10^{-6}
BD85-007	15.2	19.8	Argillite	4.7×10^{-8}
	19.8	24.4	Argillite, Quartzite	1.1×10^{-8}
	24.4	29	Quartzite	8.4×10^{-7}
	56.4	61	Greywacke / Fault	2.0×10^{-9}
	65.5	70.1	Greywacke	5.4×10^{-7}
	88.4	93	Argillite	3.0×10^{-8}
BD85-013	21.6	26.2	Greywacke	2.0×10^{-8}
	25.9	30.5	Greywacke, Quartzite	2.4×10^{-8}
	81.7	86.3	Greywacke, Argillite	5.8×10^{-8}
	86	90.6	Argillite	4.1×10^{-8}
	90.2	94.8	Argillite	2.8×10^{-8}
	94.5	99.1	Argillite	2.5×10^{-8}
	98.8	103.4	Argillite	4.3×10^{-8}
BD85-016	10.6	15.2	Greywacke, Quartzite	8.0×10^{-7}
	15.2	19.8	Quartzite	1.6×10^{-6}
	19.8	24.4	Quartzite	4.9×10^{-8}
	76.2	80.8	Greywacke, Argillite	2.5×10^{-7}
	80.8	85.3	Greywacke, Argillite	3.0×10^{-7}
	85.3	89.9		3.9×10^{-7}
BD85-029	13.7	18.3	Argillite	4.7×10^{-7}
	24.1	28.7	Greywacke	9.9×10^{-8}
	33.5	38.1	Greywacke	9.4×10^{-7}
	39.6	44.2	Greywacke	9.0×10^{-8}
	102.1	106.7	Greywacke, Argillite	4.9×10^{-8}
	106.7	111.3	Greywacke	1.6×10^{-8}
BD85-043	19.8	24.4	Quartzite	8.3×10^{-9}
	24.4	29	Greywacke, Argillite	2.6×10^{-8}

continued…

Table 1 (cont): Beaver Dam Project Packer Testing Results

Borehole	From	To	Lithology / Structure	K (m/sec)
BD85-043 (cont)	47.2	51.8	Greywacke	1.0×10^{-6}
	51.8	56.4	Greywacke	2.3×10^{-7}
	62.5	67.1	Greywacke	2.7×10^{-9}
	67.1	71.6	Greywacke	3.4×10^{-9}
	117.3	121.9	Greywacke	1.0×10^{-9}
	121.9	126.5	Greywacke	7.6×10^{-10}
	126.5	131.1	Greywacke	2.6×10^{-9}
	131.1	135.6	Greywacke, Argillite	1.6×10^{-9}
	135.6	140.2	Argillite	5.5×10^{-10}
	140.2	144.8	Argillite	3.7×10^{-10}
BD85-082	15.2	19.8	Greywacke	3.6×10^{-8}
	19.8	24.4	Greywacke	1.1×10^{-6}
	24.4	29	Quartzite / Fault	1.9×10^{-6}
	30.5	35.1	Greywacke	8.0×10^{-7}
	41.1	45.7	Quartzite	6.1×10^{-7}
	45.7	50.3	Quartzite	4.6×10^{-7}
BD85-083	39.6	44.2	Greywacke / Fault	1.5×10^{-8}
	48.8	53.3	Greywacke / Fault	1.0×10^{-8}
	57.9	62.5	Greywacke / Fault	1.2×10^{-9}
	71.6	76.2	Argillite	7.1×10^{-9}
	80.8	85.3	Greywacke, Argillite	2.7×10^{-8}
BD85-090	19.8	24.4	Quartzite	3.1×10^{-8}
	24.4	29	Greywacke	3.0×10^{-8}
	29	33.5	Greywacke, Quartzite	2.4×10^{-8}
	33.5	38.1	Greywacke, Quartzite	8.1×10^{-8}
BD14-188	12	23	Hanging wall	$<1.0 \times 10^{-8}$
	33	50	Hanging wall	5.0×10^{-9}
	117	125	Fault	1.0×10^{-8}
	147	160	Foot wall	$<2.0 \times 10^{-9}$
	147	210	Foot wall	$<4.0 \times 10^{-10}$

Notes: "K" is hydraulic conductivity
Boreholes with prefix "BD-85" tested in 1986 (JWA, 1986b)
Borehole BD14-188 tested in 2015 (Stantec, 2015)

Appendix F
Wetland Functional Assessment Summary Table

Wetland Functional Assessment Summary Table. Beaver Dam Mine Project

Significant Function	WL 1	WL 2	WL 3	WL 4	WL 5	WL 6	WL 7	WL 8	WL 9	WL 10	WL 11	WL 12	WL 13	WL 14	WL 15	WL 16	WL 17
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	M-L	M-L	M	M	M	M	M	M	L	M	M	M	M	M	M	M	M
SF3	H	H	H	H	H	M	M	H	M	H	H	H	H	H	M	H	H
SF4	M	H	H	H	H	H	M	H	M	M	M	H	M	H	H	H	M
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	N	SpC, S2S3, S3, S3B, S3S4, S3S4N, S3S4B	N	S2S3	N	N	N	Thr, S3, S3N, S3B, S3S4B	N	S2S3, S3, S3N, S3S4B	N	S3	S3	Thr, SpC	N	S3, S3B, S3S4N, S3S4B	SpC, S3, S3N, S3B, S3S4B
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	NAT	NAT	NAT	NAT	MOD	MOD	NAT	NAT	NAT	MOD	NAT	MOD	NAT	NAT
SF14	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N	N	Y	Y	N
SF15	M	H	H	M	M	H	H	M	H	H	L	H	L	L	M	M	M
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H	H
SF19	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N
SF20	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF21	NA	NA	NA	H	NA	NA	NA	H	NA	H	M	NA	M	H	L	NA	H
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	H	H	L	H	M	M	M	H	L	M	H	H	H	M	L	M	H
SF24	H	H	H	H	H	M	M	H	H	H	H	M	H	M	M	H	H
SF25	N	N	N	Leptogium corticola (S2S3)	N	N	N	N	N	N	N	Carex wiegandii (S3)	N	Degelia plumbea (SARA and COSEWIC SpC, NSESA V)	N	N	Degelia plumbea (SARA and COSEWIC SpC, NSESA V)
SF26	N	Y	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y
SF27	N	Boreal Chickadee (S3), Gray Jay (S3), American Robin (S5B, S3N), Greater Yellowlegs (S3B, S3S4M), Pine Siskin (S2S3), Purple Finch (S4S5B, S3S4N), Red-breasted Nuthatch (S3), Red Crossbill (S3S4), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B), Wilson's Snipe (S3B), Yellow-bellied Flycatcher (S3S4B)	N	N	N	N	N	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B), Gray Jay (S3), American Robin (S5B, S3N), Greater Yellowlegs (S3B, S3S4M), Ruby-crowned Kinglet (S3S4B), Yellow-bellied Flycatcher (S3S4B)	N	Gray Jay (S3), American Robin (S5B, S3N), Pine Siskin (S2S3), Swainson's Thrush (S3S4B), Yellow-bellied Flycatcher (S3S4B)	N	N	N	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B)	N	Gray Jay (S3), Purple Finch (S4S5B, S3S4N), Ruby-crowned Kinglet (S3S4B), Wilson's Snipe (S3B), Yellow-bellied Flycatcher (S3S4B)	Peregrine Falcon (SARA, COSEWIC SC, NSESA V, SIB), American Robin (S5B, S3N), Greater Yellowlegs (S3B, S3S4M), Northern Harrier (S3S4B), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)
SF28	M	M	M	M	M	M	M	H	M	H	M	M	M	M	M	M	H
SF29	L	L	L	L	L	L	L	M	L	M	L	L	L	L	L	L	M

Notes:

* SF7/SF25/SF27 is considered a red rated function if a species present is listed by SARA or NSESA as Endangered/Threatened/Special Concern; or Ranked by ACCDC as S1.

Birds included in these results are indicative of point count location within or adjacent to wetland, and does not confirm use of the wetland as crucial supporting habitat.

Cells highlighted in red indicate this function is considered to be critical to the watershed or represent a highly degraded watershed. These functions are typically unique or rare or associated with a high risk to the watershed if lost (NSE 2014c).

Unless otherwise stated: H=High; M=Moderate/Medium; L=Low; Y=Yes; N=No; NAT=Natural; MOD=Modified; Smod= Significantly Modified; Thr=Threatened; SpC=Special Concern; End=Endangered

**SF14, SF21 where hydrologically connected features extend beyond PA boundaries, source of a stream/headwater was inferred from Wet Areas Mapping.

[1] Predicted NSE WSS Layer indicates WL64 is a WSS as a result of the presence of the OSFL in 2009. However, 2016 breeding bird surveys did not confirm the presence of the OSFL. See the SAR/SOCI section in the report for additional information.

Wetland Functional Assessment Summary Table. Beaver Dam Mine Project

Significant Function	WL 18	WL 19	WL 20	WL 21	WL 22	WL 23	WL 24	WL 25	WL 26	WL 27	WL 28	WL 29	WL 30	WL 31	WL 32	WL 33	WL 34	WL 35	WL 36	WL 37	WL 38	WL 39	WL 40	WL 41	WL 42	WL 43	WL 44	WL 45	WL 46
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	M	M	M	L	L	L	L	L	L	L	L	M-L	L	M-L	L	L	M	M-L	L	L	M-L	M	M	M	M	M	M	M	M
SF3	H	M	M	M	H	H	M	L	H	H	L	H-M	H	H	H	H	M	M	H	M	H	L	H	M	M	H	M	H	H
SF4	H	M	M	M	H	M	M	L	M	M	L	M	H	H	H	H	M	M	M	M	M-L	L	M	M	H	H	H	H	H
SF5	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	N	S3N, S3B, S3S4N	N	N	N	N	N	N	N	N	N	End, SpC, Thr, S2S3, S3	N	N	N	S3	N	N	N	N	N	N	N	N	S3, S3N, S3S4B	N	N	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	MOD	NAT	MOD	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	MOD	NAT	NAT
SF14	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y
SF15	H	H	L	H	H	H	H	H	H	M	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	M	H	L
SF16	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	M
SF19	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF20	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF21	NA	NA	M	NA	NA	NA	NA	NA	NA	NA	NA	H	NA	NA	NA	M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	H	NA	M
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	L	M	H	M	M	L	H	H	L	M	M	H	H	M	L	H	H	H	H	M	M	H	H	L	H	M	H	M	M
SF24	M	M	M	H	H	H	M	L	H	M	L	H	H	H	H	H	M	M	M	H	H	L	M	H	M	H	M	H	H
SF25	N	N	N	N	N	N	N	N	N	N	N	Erioderma pedicellatum (SARA/COSEWIC/NSESA End)	N	N	N	Carex wiegandii (S3)	N	N	N	N	N	N	N	N	N	N	N	N	N
SF26	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y
SF27	N	American Robin (S5B, S3N), Greater Yellowlegs (S3B, S3S4M), Purple Finch (S4S5B, S3S4N)	N	N	N	N	N	N	N	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	N	N	N	N	N	N	N	N	N	N	N	N	Boreal Chickadee (S3), Gray Jay (S3), American Robin (S5B, S3N), Ruby-crowned Kinglet (S3S4B)	N	N	N	N
SF28	M	M	M	M	M	M	M	M	M	M	M	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Significant Function	WL 47	WL 48	WL 49	WL 50	WL 51	WL 52	WL 53	WL 54	WL 55	WL 56	WL 57	WL 58	WL 59	WL 60	WL 61	WL 62	WL 63
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	M	M	M	M	M	M	M	L	M	M	M	M	M	M	M	M	L
SF3	M	L	H	H	H	M	H	M	M	M	H-M	H	M	M	H	H	H
SF4	H	M	H	H	H	H	H	M	H	M	M	M	M	M	M	H	M
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
SF7	N	S3	N	N	Thr, S2S3, S3, S3N	N	Thr, S3, S3S4B	S3, S3N, S3S4B	N	S1, S3, S3B	Thr	N	S2S3, S3, S3N, S3B, S3S4N, S3S4B	N	SpC, S2S3, S3N, S3S4B	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	MOD	NAT	NAT	NAT	NAT	NAT	MOD	MOD	MOD	NAT	NAT	MOD	NAT	NAT	NAT	NAT
SF14	N	N	N	N	N	Y	Y	N	N	Y	N	N	N	N	N	N	N
SF15	H	M	H	H	H	M	M	H	H	M	M	H	H	H	M	M	H
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	M
SF19	N	N	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N
SF20	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y
SF21	NA	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	H	L	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	M	H	M	M	H	M	H	M	H	H	H	M	H	M	H	M	M
SF24	M	M	H	H	H	M	M	M	M	M	H	H	M	M	H	H	H
SF25	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF26	N	Y	N	N	N	Y	Y	N	N	Y	Y	N	Y	N	Y	Y	N
SF27	N	N	N	N	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B), Gray Jay (S3), American Robin (S5B, S3N), Pine Siskin (S2S3)	N	Chimney Swift(SARA/COSEWIC T, NSESA E, S2B S1M), Boreal Chickadee (S3), Yellow-bellied Flycatcher (S3S4B)	Gray Jay (S3), American Robin (S5B, S3N), Swainson's Thrush (S3S4B)	N	Gray Jay (S3), Greater Yellowlegs (S3B, S3S4M), Red-breasted Nuthatch (S3)	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B)	N	Gray Jay (S3), American Robin (S5B, S3N), Greater Yellowlegs (S3B, S3S4M), Pine Siskin (S2S3), Purple Finch (S4S5B, S3S4N), Ruby-crowned Kinglet (S3S4B), Spotted Sandpiper (S3S4B), Swainson's Thrush (S3S4B), Wilson's Snipe (S3B)	N	American Robin (S5B, S3N), Swainson's Thrush (S3S4B)	N	N
SF28	M	M	M	M	M	M	M	M	M	H	M	M	H	M	H	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	M	L	M	L	L

Wetland Functional Assessment Summary Table. Beaver Dam Mine Project

Significant Function	WL 64	WL 65	WL 66	WL 67	WL 68	WL 69	WL 70	WL 71	WL 72	WL 73	WL 74	WL 75	WL 76	WL 77	WL 78	WL 79	WL 80	WL 81	WL 82	WL 83	WL 84
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	M	M	M	M	M	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF3	M	M	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H	H	H	H	L
SF4	M	M	H	H	M	H	M	M	M	H	M	H	M	H	H	M	M	M	H	H	M
SF5	N[1]	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	S3B, S3S4B	N	Thr, S3, S3N, S3S4B	N	N	N	N	Thr, S3, S3B, S3S4B	Thr, S3, S3B, S3S4B	N	N	N	Thr, S3N, S3S4B	N	N	N	S3	N	N	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	MOD	NAT	MOD	NAT	NAT	NAT	NAT	NAT	MOD	MOD	MOD	NAT	MOD	NAT	NAT	MOD	MOD	NAT	NAT	NAT	MOD
SF14	Y	N	Y	N	N	N	N	N	Y	Y	Y	N	N	Y	N	N	N	N	N	Y	N
SF15	H	H	M	M	L	H	H	H	M	H	L	H	L	M	H	L	H	H	H	H	H
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	M	H	M	M	M	M	H	H	L	L	L	H	L	L	H	L	H	H	H	M	H
SF19	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
SF20	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SF21	NA	NA	H	L	M	H	NA	NA	NA	NA	H	NA	H	NA	NA	H	NA	NA	NA	NA	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	H	L	H	H	H	H	M	M	M	H	H	M	H	M	M	M	H	L	M	L	M
SF24	M	M	M	H	H	H	H	H	H	M	M	H	M	M	M	H	M	L	H	H	L
SF25	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	*Listera australis* (S3)	N	N	N	N
SF26	Y	N	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N	N	Y	N	N	N	N	N
SF27	Northern Goshawk (COSEWIC NAR, S3S4B), Blackpoll Warbler(S3S4B), Greater Yellowlegs (S3B, S3S4M), Swainson's Thrush (S3S4B)	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), American Robin (S5B, S3N), Blackpoll Warbler(S3S4B), Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	N	N	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), Gray Jay (S3), Greater Yellowlegs (S3B, S3S4M), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), Gray Jay (S3), Greater Yellowlegs (S3B, S3S4M), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	N	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), American Robin (S5B, S3N), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	N	N	N	N	N	N	N	N
SF28	M	M	H	M	H	H	M	M	M	M	M	M	M	M	M	H	M	M	M	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Wetland Functional Assessment Summary Table. Beaver Dam Mine Project

Significant Function	WL 85	WL 86	WL 87	WL 88	WL 89	WL 90	WL 91	WL 92	WL 93	WL 94	WL 95	WL 96	WL 97	WL 98	WL 99	WL 100	WL 101	WL 102	WL 103	WL 104	WL 105	WL 106	WL 107	WL 108
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF3	L	M	L	H	M	M	H	H	M	M	H	H	H	H	H	H	H	H	M	M	M	M	H	H
SF4	M	M	M	H	M	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	S2S3, S3, S3N, S3S4B	N	N	S2S3, S3, S3N	Thr, S3, S3N, S3S4B	N	N	N	N	N	N	N	N	S3B, S3N, S3S4B	N	N	N	N	N	N	N	N	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	NAT	NAT	NAT	MOD	NAT	MOD	MOD	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT
SF14	N	N	N	N	N	Y	N	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF15	H	H	H	H	H	M	H	M	H	M	H	H	H	L	H	H	H	H	H	H	H	H	H	H
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF19	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF20	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF21	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	L	L	L	M	M	H	M	M	L	H	M	M	L	M	L	M	M	H	L	L	L	M	L	L
SF24	L	M	L	H	M	M	M	M	M	H	H	M	H	H	H	H	M	M	M	M	M	M	H	H
SF25	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF26	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF27	American Robin (S5B, S3N), Evening Grosbeak (S3S4B, S3N), Pine Siskin (S2S3), Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B)	Barn Swallow (COSEWIC T, NSESA E, S3B)	N	Gray Jay (S3), American Robin (S5B, S3N), Pine Siskin (S2S3)	American Robin (S5B, S3N), Red-breasted Nuthatch (S3), Swainson’s Thrush (S3S4B)	N	N	N	N	N	N	N	N	American Robin (S5B, S3N), Gray Catbird (S3B), Ruby-crowned Kinglet (S3S4B)	N	N	N	N	N	N	N	N	N	N
SF28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Wetland Functional Assessment Summary Table. Beaver Dam Mine Project

Significant Function	WL 109	WL 110	WL 111	WL 112	WL 113	WL 114	WL 115	WL 116	WL 117	WL 118	WL 119	WL 120	WL 121	WL 122	WL 123	WL 124	WL 125	WL 126	WL 127	WL 128	WL 129	WL 130	WL 131	WL 132	WL 133
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF3	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF4	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	N	S3, S3S4N, S3S4B	N	SpC	S3, S3S4, S3S4B, S3S4N	N	S3	N	N	N	N	N	N	N	N	N	N	N	S3	N	S3, S3S4B	N	N	Thr, S3, S3N, S3S4B	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT	NAT
SF14	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF15	H	H	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF19	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF20	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF21	NA	M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	M	L	M	M	M	L	M	M	L	M	M	L	L	L	M	M	M	M	M	L	M	L	L	M	L
SF24	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF25	N	N	N	N	N	N	Listera australis (S3)	N	N	N	N	N	N	N	N	N	N	N	Listera australis (S3)	N	Listera australis (S3)	N	N	N	N
SF26	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF27	N	Boreal Chickadee (S3), Purple Finch (S4S5B, S3S4N), Ruby-crowned Kinglet (S3S4B)	N	N	Black-backed Woodpecker (S3S4B), Purple Finch (S4S5B, S3S4N), Red-breasted Nuthatch (S3), Red Crossbill (S3S4), Swainson's Thrush (S3S4B)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Black-backed Woodpecker (S3S4B), Red-breasted Nuthatch (S3)	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), Gray Jay (S3), American Robin (S5B, S3N), Black-backed Woodpecker (S3S4B), Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	N
SF28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Significant Function	WL 134	WL 135	WL 136	WL 137	WL 138	WL 139	WL 140	WL 141	WL 142	WL 143	WL 144	WL 145	WL 146	WL 147	WL 148	WL 149	WL 150	WL 151	WL 152	WL 153	WL 154
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF3	H	H	H	H	M	H	H	H	H	M	M	M	M	M	M	L	M	M	M	H	M
SF4	H	H	H	H	H	H	H	H	H	M	H	M	M	M	M	M	M	M	M	M	M
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF7	N	S3	S3, S3S4B	S3	N	N	N	N	S3S4B	SpC	N	N	N	S3	Thr, S3, S3N, S3S4B	N	N	S3	N	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	NAT	MOD	MOD	NAT	MOD	MOD	MOD	MOD	MOD	MOD	NAT	MOD	MOD	MOD	NAT	NAT	NAT	MOD
SF14	N	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF15	H	M	H	L	H	H	H	H	M	M	M	H	H	H	H	H	H	H	H	H	H
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF19	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF20	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF21	NA	NA	NA	M	NA	NA	NA	NA	M	M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	M	H	M	M	M	L	L	L	M	H	H	M	H	H	H	H	L	L	M	M	L
SF24	H	H	H	H	M	H	H	M	M	M	M	M	M	M	M	M	L	M	M	H	M
SF25	N	Listera australis (S3)	N	*Listera australis (S3)*	N	N	N	N	N	N	N	N	N	Listera australis (S3)	N	N	N	N	N	N	N
SF26	N	Y	N	Y	N	N	N	N	Y	Y	Y	N	Y	N	N	N	N	N	N	N	Y
SF27	N	N	Ruby-crowned Kinglet (S3S4B)	N	N	N	N	N	Ruby-crowned Kinglet (S3S4B)	Eastern Wood-Pewee (COSEWIC SC, NSESA V, S3S4B)	N	N	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), Gray Jay (S3), American Robin (S5B, S3N), Ruby-crowned Kinglet (S3S4B)	N	N	Red-breasted Nuthatch (S3)	N	N	N
SF28	M	M	M	M	M	L	M	L	M	M	M	M	H	M	M	M	L	M	M	M	H
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Significant Function	WL 155	WL 156	WL 157	WL 158	WL 159	WL 160	WL 161	WL 162	WL 163	WL 164	WL 165	WL 166	WL 167	WL 168	WL 169	WL 170	WL 171	WL 172	WL 173	WL 174	WL 175
SF1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF2	H	H-M	H-M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
SF3	H	H-M	H	M	H	M	H	M	M	H	M	M	H	H	H	H	H	M	H	H	M
SF4	H	H	H	M	H	H	H	H	H	H	M	M	M	M	M	H	H	H	M	M	M
SF5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y	Y	N
SF7	N	Thr, S3, S3N, S3S4B, S3S4N	Thr, S3, S3S4, S3S4B	N	N	N	N	N	N	S3S4B	S3, S3S4N	N	N	S3N, S3S4B, S3S4N	N	N	N	N	Thr, S3, S3S4B	N	N
SF8	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF9	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF10	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF11	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF13	NAT	NAT	NAT	MOD	NAT	NAT	NAT	NAT	NAT	NAT	MOD	NAT	NAT	NAT	NAT	NAT	NAT	MOD	NAT	NAT	NAT
SF14	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N
SF15	H	H	H	H	L	L	H	H	H	H	M	H	H	H	H	M	L	H	L	L	M
SF16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SF17	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SF18	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SF19	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	Y
SF20	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N
SF21	NA	NA	H	M	M	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	NA	H	NA	M	NA	NA
SF22	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF23	M	H	H	H	M	L	M	H	L	M	M	M	M	H	M	M	M	M	M	M	M
SF24	M	M	H	L	M	H	M	H	M	H	M	L	M	H	H	M	H	L	H	H	M
SF25	N	N	*Vaccinium corymbosum (S3S4)*	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SF26	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	Y	N	Y	Y	N
SF27	N	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B), Gray Jay (S3), American Robin (S5B, S3N), Black-backed Woodpecker (S3S4B), Purple Finch (S4S5B, S3S4N), Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	Olive-sided Flycatcher (SARA, COSEWIC, NSESA T, S3B), Bay-breasted Warbler (S3S4B), Red-breasted Nuthatch (S3)	N	N	N	N	N	N	Northern Harrier (S3S4B), Ruby-crowned Kinglet (S3S4B)	Boreal Chickadee (S3), Purple Finch (S4S5B, S3S4N)	N	N	American Robin (S5B, S3N), Blackpoll Warbler(S3S4B), Purple Finch (S4S5B, S3S4N), Ruby-crowned Kinglet (S3S4B)	N	N	N	N	Canada Warbler (SARA/COSEWIC T, NSESA E, S3S4B), Gray Jay (S3), Black-backed Woodpecker (S3S4B), Ruby-crowned Kinglet (S3S4B), Swainson's Thrush (S3S4B)	N	N
SF28	M	M	H	L	H	H	M	M	M	M	M	L	M	M	M	M	H	L	M	M	M
SF29	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L	L	L	L

Significant Function	WL 176	WL 177	WL 178	WL 179
SF1	L	L	L	L
SF2	M	M	M	M
SF3	H	M	M	M
SF4	M	M	M	M
SF5	N	N	N	N
SF6	N	N	N	N
SF7	N	S3, S3S4B	N	S3, S3S4B
SF8	N	N	N	N
SF9	N	N	N	N
SF10	N	N	N	N
SF11	N	N	N	N
SF12	N	N	N	N
SF13	NAT	NAT	NAT	NAT
SF14	N	N	N	N
SF15	H	H	H	H
SF16	Y	Y	Y	Y
SF17	L	L	L	L
SF18	H	H	H	H
SF19	Y	N	Y	Y
SF20	N	Y	N	N
SF21	NA	NA	NA	NA
SF22	N	N	N	N
SF23	M	M	M	H
SF24	H	M	M	M
SF25	N	N	N	N
SF26	N	N	N	N
SF27	N	Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), Swainson’s Thrush (S3S4B)	N	Red-breasted Nuthatch (S3), Ruby-crowned Kinglet (S3S4B), Swainson’s Thrush (S3S4B)
SF28	M	M	M	M
SF29	L	L	L	L

Appendix G
Wetland Characterization Table

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
Mine	WL1.1	Surface Water (A1) High Water Table (A2) Hydrogen Sulphide (C1)	*Carex trisperma* *Osmunda cinnamomea*	*Nemopanthus mucronatus* *Picea mariana*	*Picea mariana* *Acer rubrum*	40-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL1.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Maianthemum trifolium*	*Picea mariana* *Nemopanthus mucronatus*	*Larix laricina* *Picea mariana*	100-0cm Organic	Histosol (A1)
Mine	WL1.3	High Water Table (A2) Water-Stained Leaves (B9) Saturation (A3)	*Carex trisperma* *Cornus canadensis*	*Nemopanthus mucronatus*	*Larix laricina* *Picea mariana*	65-0cm Organic	Histosol (A1)
Mine	WL1.4	High Water Table (A2) Saturation (A3)	*None*	*Nemopanthus mucronatus* *Larix laricina* *Viburnum nudum*	*None*	170-0cm Organic	Histosol (A1)
Mine	WL2.1	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*None*	*Picea mariana* *Larix laricina*	*Larix laricina* *Picea mariana*	45-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL2.2	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Carex atlantica*	*Picea mariana*	*None*	60-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL2.3	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*None*	*Picea mariana* *Larix laricina*	*Larix laricinia*	40-0cm	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL2.4	High Water Table (A2) Saturation (A3) Stunted or Stressed Plants (D1)	*None*	*Picea rubens* *Larix laricina* *Pinus strobus*	*None*	80-0cm Organic	Histosol (A1)
Mine	WL2.5	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Kalmia angustifolia* *Gaultheria hispidula*	*Nemopanthus mucronatus* *Viburnum nudum*	*Larix laricina* *Picea rubens*	100-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL2.6	High Water Table (A2) Saturation (A3)	*Carex trisperma* *Osmunda cinnamomea*	*Nemopanthus mucronatus* *Abies balsamea*	*Abies balsamea* *Picea mariana* *Acer rubrum*	40-0cm Organic	Histosol (A1)
Mine	WL2.7	High Water Table (A2) Saturation (A3)	*Eleocharis tenuis*	*Larix laricina* *Picea rubens* *Juniperus communis*	*Larix laricina*	60-0cm Organic	Histosol (A1)
Mine	WL2.8	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) **Secondary Indicators:** Drainage Patterns (B10)	*Dryopteris campyloptera* *Oxalis montana*	*Abies balsamea*	*Picea rubens*	18-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Position (D2)					
Mine	WL3	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Maianthemum trifolium*	*Abies balsamea* *Gaylussacia baccata*	*Larix laricina* *Acer rubrum*	40-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL4.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Aquatic Fauna (B13) Hydrogen Sulphide (C1)	*None*	*Larix laricina* *Picea mariana* *Alnus incana*	*Larix laricina*	100+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL4.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Carex trisperma* *Osmunda cinnamomea*	*Picea mariana* *Acer rubrum* *Alnus incana*	*Picea mariana* *Acer rubrum*	100+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL5	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Picea mariana* *Nemopanthus mucronatus*	*Abies balsamea* *Picea mariana* *Acer rubrum*	50-0cm Organic	Histosol (A1)
Mine	WL6	Saturation (A3) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9)	*Rubus pubescens* *Cornus canadensis*	*Abies balsamea*	*Acer rubrum* *Picea mariana* *Betula papyrifera*	20-0cm Organic	Histosol (A1)
Mine	WL7	Saturation (A3) Algal Mat or Crust (B4) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9)	*Scirpus cyperinus* *Glyceria striata*	*None*	*None*	18-0cm Organic	Histosol (A1)
Mine	WL8.1	High Water Table (A2) Saturation (A3)	*Carex trisperma* *Cornus canadensis*	*Picea mariana* *Abies balsamea*	*Picea mariana*	35-0cm Organic	Histosol (A1)
Mine	WL8.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Aquatic Fauna (B13)	*Carix stricta* *Chamaedaphne calyculata*	*Larix laricina*	*None*	45-0cm Organic	Histosol (A1)
Mine	WL8.3	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex stricta* *Chamaedaphne calyculata* *Myrica gale*	*None*	*Larix laricina* *Acer rubrum* *Picea mariana*	40-0cm Organic	Histosol (A1)
Mine	WL8.4	High Water Table (A2) Saturation (A3)	*Kalmia angustifolia* *Carex trisperma*	*Larix laricina* *Picea mariana*	*Larix laricina* *Picea mariana*	60-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
Mine	WL9	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Sparsely Vegetated Concave Surface (B8) **Secondary Indicators:** Stunted or Stressed Plants (D1)	*Kalmia angustifolia*	*Picea mariana*	*Picea mariana* *Acer rubrum*	10-0cm Organic	Histosol (A1)
Mine	WL10	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex stricta* *Chamaedaphne calyculata*	*Gaylussacia baccata*	*None*	40-0cm Organic	Histosol (A1)
Mine	WL11.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Carex stricta* *Chamaedaphne calyculata*	*Picea mariana* *Viburnum nudum* *Acer rubrum*	*None*	65-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL11.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9)	*Glyceria grandis*	*Alnusincana* *Abies balsamea*	*Acer rubrum* *Picea mariana*	25-0cm Organic	Histosol (A1)
Mine	WL12.1	High Water Table (A2) Saturation (A3)	*Carex trisperma* *Osmunda cinnamomea*	*Abies balsamea* *Acer rubrum* *Picea mariana*	*Acer rubrum*	35-0cm Organic	Histosol (A1)
Mine	WL12.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) **Secondary Indicators:** Drainage Patterns (B10) Stunted or Stressed Plants (D1)	*Carex trisperma* *Osmunda cinnamomea*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Picea mariana*	35-0cm Organic	Histosol (A1)
Mine	WL13.1	High Water Table (A2) Saturation (A3) Water Marks (B1) Algal Mat or Crust (B4) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Thin Muck Surface (C7)	*Glyceria grandis*	*Picea mariana*	*Larix laricina* *Picea mariana*	80-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL13.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Glyceria canadensis* *Carex trisperma*	*Acer rubrum* *Abies balsamea*	*Acer rubrum* *Picea mariana*	40+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Water-Stained Leaves (B9) Aquatic Fauna (B13) Hyrdrogen Sulphide Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Position Stunted or Stressed Plants (D1)					
Mine	WL14.1	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Glyceria canadensis* *Osmunda cinnamomea* *Carex trisperma*	*Abies balsamea*	*Picea mariana* *Betula papyrifera*	60-0cm Organic	Histosol (A1)
Mine	WL14.2	High Water Table (A2) Saturation (A3)	*Carex stricta* *Rosa virginiana*	*Viburnum nudum* *Alnus incana*	*Acer rubrum*	40-0cm Organic	Histosol (A1)
Mine	WL14.3	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulfide	*Eriophorum angustifolium* *Chamaedaphne calyculata*	*Viburnum nudum*	*None*	70-0cm Organic	Histosol (A1)
Mine	WL15	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulfide	*Glyceria grandis*	*Acer rubrum* *Larix laricina*	*None*	50-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL16	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex atlantica* *Vaccinium oxycoccos*	*Larix laricina* *Viburnum nudum* *Acer rubrum* *Picea mariana*	*None*	5-0cm Organic	Histosol (A1)
Mine	WL17.1	High Water Table (A2) Saturation (A3)	*Carex stricta* *Carex trisperma*	*Viburnum nudum*	*Larix laricina* *Picea mariana* *Abies balsamea*	35-0cm Organic	Histosol (A1)
Mine	WL17.2	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Juniperus communi* *Grais spp.*	*Larix laricina* *Picea mariana*	*Larix laricina* *Picea mariana*	100+ Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL18	High Water Table (A2) Saturation (A3)	*Carex trisperma* *Gaultheria hispidula*	*Larix laricina* *Picea mariana*	*Larix laricina* *Picea mariana*	35-0cm Organic	Histosol (A1)
Mine	WL19	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex trisperma* *Scirpus cyperinus*	*Acer rubrum* *Betula populifolia*	*None*	20-0cm Organic 0-12cm Mineral	Histic Epipedon (A2)
Mine	WL20	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda regalis*	*Acer rubrum* *Ilex verticillata* *Alnus incana*	*Acer rubrum* *Larix laricina*	100cm+ Organic	Histosol (A1) Hydrogen Sulphide (A4)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Moss Trim Lines (B16) Drainage Patterns (B10) Dry-Season Water Table (C2) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)					
Mine	WL21	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Cornus canadensis*	*Abies balsamea* *Betula papyrifera cordifolia*	*Abies balsamea* *Betula papyrifera cordifolia*	22-0cm Organic 0-15cm Mineral	Histic Epipedon (A2)
Mine	WL22	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Moss Trim Lines (B16) Geomorphic Positions (D2)	*Ocemena nemoralis* *Cornus canadensis*	*Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea* *Acer rubrum*	27-0cm Organic	Histic Epipedon (A2)
Mine	WL23	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Carex trisperma*	*Abies balsamea* *Picea mariana* *Betula papyrifera cordifolia*	*Picea mariana* *Abies balsamea*	22-0cm Organic	Histosol (A1)
Mine	WL24	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Picea mariana*	25-0cm Organic	Histosol (A1)
Mine	WL25	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Moss Trim Lines (B16)	*Carex trisperma* *Osmunda cinnamomea*	*Abies balsamea* *Acer rubrum*	*Abies balsamea* *Picea mariana*	46-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Dry-Season Water Table (C2) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)					
Mine	WL26	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Water Marks (B1) Algal Mat or Crust (B4) Secondary Indicators: Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Osmunda cinnamomea*	*Dead fall*	*Dead fall*	id Assessm	Histosol (A1)
Mine	WL27	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9)	*Glyceria striata*	*Acer rubrum* *Abies balsamea*	*Acer rubrum* *Abies balsamea* *Picea mariana*	20-0cm Organic 0-10 Mineral	Histic Epipedon (A2)
Mine	WL28	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Stunted or Stressed Plants (D1) Geomorphic Positions (D2)	*Rubus hispidus* *Carex trisperma*	*Picea mariana* *Betula papyrifera cordifolia*	*Pinus strobus*	42-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL29.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Nemopanthus mucronatus*	*Acer rubrum* *Larix laricina* *Picea mariana*	35-0cm Organic	Histosol (A1)
Mine	WL29.2	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda regalis*	*Nemopanthus mucronatus* *Gaylussacia baccata*	*Acer rubrum* *Larix laricina*	45-0cm Organic	Histosol (A1)
Mine	WL29.3	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Rhynchospora alba*	*Nemopanthus mucronatus* *Larix laricina*	*Larix laricina*	45-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL29.4	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea* *Carex trisperma*	*Picea mariana* *Abies balsamea*	*Abies balsamea* *Picea mariana*	60-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL29.5	High Water Table (A2) Saturation (A3)	*Kalmia angustifolium*	*Nemopanthus mucronatus* *Picea mariana*	*Larix laricina* *Picea mariana*	35-0cm Organic	Histosol (A1)
Mine	WL29.6	Surface Water (A1) High Water Table (A2)	*Rhynchospora alba* *Chamaedaphne calyculata*	*None*	*None*	50-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water-Stained Leaves (B9) Aquatic Fauna (B13)					
Mine	WL30	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Cornus canadensis* *Gaultheria hispidula*	*Abies balsamea* *Picea mariana*	*Picea rubens*	25-0cm Organic	Histosol (A1)
Mine	WL31	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1)	*Osmunda cinnamomea* *Maianthemum canadense*	*Nemopanthus mucronatus* *Picea mariana*	*Picea mariana*	65-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL32	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Dry-Season Water Table (C2) Stunted or Stressed Plants (D1) Geomorphic Positions (D2) Shallow Aquitard (D3)	*Maianthemum trifolium*	*Abies balsamea*	*Picea mariana* *Abies balsamea*	22-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL33	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Stunted or Stressed Plants (D1) Geomorphic Positions (D2)	*Osmunda cinnamomea* *Carex trisperma* *Cornus canadensis*	*Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea* *Picea mariana*	40+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL34	High Water Table (A2) Saturation (A3) Iron Deposits (B5) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Stunted or Stressed Plants (D1) Geomorphic Positions (D2) Drainage Patterns (B10) Moss Trim Lines (B16) Dry-Season Water Table (C2)	*Carex trisperma* *Fragaria virginiama*	*Abies balsamea* *Betula alleghaniensis*	*Abies balsamea*	40+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL35	High Water Table (A2)	*Osmunda cinnamomea*	*Abies balsamea*	*Picea mariana*	42-0cm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Dry-Season Water Table (C2) Moss Trim Lines (B16) Geomorphic Position (D2)	*Carex trisperma*		*Abies balsamea*	Organic	
Mine	WL36	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Dry-Season Water Table (C2) Geomorphic Position (D2)	*Osmunda cinnamomea*	*Abies balsamea* *Acer rubrum*	*Abies balsamea* *Picea mariana*	32-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL37	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Geomorphic Position (D2)	*Oclemena accuminata* *Oclemena nemoralis*	*Betula papyrifera cordifolia* *Betula alleghaniensis*	*Betula papyrifera cordifolia*	28-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL38	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Dry-Season Water Table (C2) Geomorphic Positions (D2) Stunted or Stressed Plants (D1)	*Thelypteris simulata*	*Abies balsamea* *Ilex verticillata* *Picea mariana*	*Abies balsamea* *Picea mariana*	58-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL39	High Water Table (A2) Water-Stained Leaves (B9) Saturation (A3)	*Osmunda cinnamomea* *Carex trisperma*	*Abies balsamea*	*Acer rubrum* *Picea mariana* *Abies balsamea*	48-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL40	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Osmunda cinnamomea*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Picea mariana*	100+cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL41	High Water Table (A2) Saturation (A3)	*Carex stricta*	*Alnus incana*	*None*	45-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Water Marks (B1) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10) Stunted or Stressed Plants (D1)					
Mine	WL42	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1)	*Carix canescens* *Carex stricta*	*Abies balsamea* *Larix laricina*	*Betula cordifolia* *Picea rubens* *Picea mariana*	20-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL43	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Geomorphic Positions (D2)	*None*	*Picea rubens* *Nemopanthus mucronatus*	*Betula papyrifera* *Picea rubens*	15-0cm Organic	Histosol (A1)
Mine	WL44	High Water Table (A2) Saturation (A3) Drift Deposits (B3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Thelypteris simulata*	*Abies balsamea* *Nemopanthus mucronatus*	*Acer rubrum* *Picea rubens* *Picea mariana*	20-0cm Organic	Histosol (A1)
Mine	WL45	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Stunted or Stressed Plants (D1)	*Nemopanthus mucronatus*	*Abies balsamea* *Picea mariana*	*Picea mariana*	60-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL46	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Aquatic Fauna (B13) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Rubus canadensis* *Glyceria canadensis*	*Acer rubrum* *Betula papyrifera cordifolia*	*Abies balsamea* *Acer rubrum*	22-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL47	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Calamagrostis canadensis* *Iris versicolor*	*Rapid assessment*	*None*	id Assessm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Water Marks (B1) Sediment Deposits (B2) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Aquatic Fauna (B13) Secondary Indicators: Drainage Patterns (B10) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)					
Mine	WL48.1	Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)	*Rubus hispidus*	*None*	*Acer rubrum*	60-0cm Organic	Histosol (A1)
Mine	WL48.2	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Geomorphic Positions (D2)	*Osmunda cinnamomea* *Carex trisperma* *Rubus hispidus*	*Picea mariana* *Betula cordifolia* *Abies balsamea*	*Picea mariana*	55-0cm Organic	Histosol (A1)
Mine	WL49	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8) Secondary Indicators: Drainage Patterns (B10) Geomorphic Positions (D2)	*Carex trisperma*	*None*	*Abies balsamea*	50-0cm Organic	Histosol (A1)
Mine	WL50	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Geomorphic Positions (D2)	*Osmunda cinnamomea*	*Abies balsamea* *Nemopanthus mucronatus*	*None*	40+cm Organic	Histosol (A1)
Mine	WL51	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators:	*None*	*Pinus strobus* *Abies balsamea*	*Betula cordifolia* *Picea rubens*	55-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Drainage Patterns (B10) Geomorphic Positions (D2)					
Mine	WL52	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Drift Deposits (B3) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Aquatic Fauna (B13) Secondary Indicators: Drainage Patterns (B10) Geomorphic Positions (D2) Stunted or Stressed Plants (D1)	*Viola cucullata* *Glyceria striata*	*Abies balsamea*	*Picea rubens*	22-0cm Organic	Histosol (A1)
Mine	WL53	Surface Water (A1) High Water Table (A2) Saturation (A3) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10) Geomorphic Positions (D2)	*Osmunda cinnamomea* *Glyceria striata*	*Acer rubrum* *Picea mariana*	*None*	40-0cm Organic	Histosol (A1)
Mine	WL54	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9) Hydrogen Sulphide (C1) Secondary Indicators: Geomorphic Positions (D2)	*Carex trisperma* *Osmunda cinnamomea* *Kalmia angustifolia*	*Acer rubrum* *Betula cordifolia* *Abies balsamea*	*Picea mariana* *Picea rubrum*	60-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL55	High Water Table (A2) Saturation (A3) Water Marks (B1) Algal Mat or Crust (B4) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators:	*Scirpus cyperinus*	*Salix pyrifolia* *Acer rubrum* *Spiraea tomentosa*	*Acer rubrum* *Abies balsamea*	30-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Drainage Patterns (B10) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)					
Mine	WL56.1	Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10)	*Dryopteris intermedia* *Rubus hispidus* *Carex trisperma*	*Abies balsamea* *Acer rubrum* *Larix laricina*	*Larix laricina*	80-0cm Organic	Histosol (A1)
Mine	WL56.2	High Water Table (A2) Saturation (A3) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators: Surface Soil Cracks (B6) Geomorphic Position (D2) Drainage Patterns (B10)	*Juncus effusus*	*Larix laricina* *Betula papyrifera* *Alnus incana*	*Betula papyrifera*	5-0cm Organic 0-20cm Mineral	Depleted Matrix (F3)
Mine	WL56.3	High Water Table (A2) Saturation (A3) Hydrogen Sulphide (C1) Water-Stained Leaves (B9)	*Kalmia angustifolium*	*Picea mariana*	*Picea mariana*	100cm+ Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL57.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Aquatic Fauna (B13) Hydrogen Sulphide (C1) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Stunted or Stressed Plants (D1) Geomorphic Positions (D2)	*Osmunda cinnamanea* *Carex trisperma*	*Nemopanthus mucronatus*	*Acer rubum* *Picea mariana* *Abies balsamea*	50+ Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL57.2	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Microtopographical Relief (D4)	*Osmunda cinnamanea* *Cornus canadensis*	*Abies balsamea*	*Abies balsamea*	18-0cm Organic	Histosol (A1)
Mine	WL57.3	Surface Water (A1) High Water Table (A2)	*Carex leptalia* *Osmunda cinnamanea*	*Betula alleghaniensis*	*None*	10-0cm Organic	Hydrogen Sulphide (A4) Depleted Matrix (F3)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	**Shrubs**	**Trees**	**Depth**	**Hydric Soil Indicators**
		Saturation (A3) Iron Deposits (B5) Thin Muck Surface (C7) Water-Stained Leaves (B9) Aquatic Fauna (B13) Hydrogen Sulphide (C1) Presence of Reduced Iron (C4) Secondary Indicators: Drainage Patterns (B10) Moss Trim Lines (B16) Dry-Season Water Table (C2) Microtopographical Relief (D4)	*Glyceria striata*			0-12cm Mineral	Histic Epipedon (A2)
Mine	WL58	High Water Table (A2) Saturation (A3) Water Marks (B1) Thin Muck Surface (C7) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10) Geomorphic Positions (D2) Microtopographical Relief (D4)	*Thelypteris simulata*	*Abies balsamea*	*Acer rubrum*	3-0cm Organic 0-18cm Mineral	Depleted Matrix (F3) Histic Epipedon (A2)
Mine	WL59	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Aquatic Fauna (B13) Iron Deposits (B5) Hydrogen Sulphide (C1) Secondary Indicators: Drainage Patterns (B10) Stunted or Stressed Plants (D1)	*None*	*Picea mariana* *Viburnum nudum* *Acer rubrum*	*Picea mariana* *Larix laricina*	30-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL60	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Moss Trim Lines (B16) Dry-Season Water Table (C2) Geomorphic Positions (D2)	*Scirpus cyperinus*	*Picea rubens*	*Picea rubens* *Picea mariana*	24-0cm Organic 0-12cm Mineral	Histic Epipedon (A2)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
Mine	WL61.1	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9) Secondary Indicators: Drainage Patterns (B10)	*Osmunda regalis*	*Acer rubrum*	*Acer rubrum*	20-0cm Organic	Histosol (A1)
Mine	WL61.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex stricta*	*Alnus incana*	*Acer rubrum*	40-0cm Organic	Histosol (A1) Hydrogen Sulphide (A4)
Mine	WL61.3	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda regalis* *Oclemena nemoralis*	*Acer rubrum* *Alnus incana*	*Acer rubrum* *Larix laricina*	5-0cm Organic 0-15cm Mineral	Depleted Matrix (F3)
Mine	WL62	High Water Table (A2) Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9)	*Osmunda regalis*	*Abies balsamea*	*Larix laricina*	16-0cm Organic	Histosol (A1)
Mine	WL63	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Theypteris noveboracensis* *Carex trisperma*	*Abies balsamea* *Nemopanthus mucronatus* *Viburnum nudum*	*Picea mariana* *Acer rubrum* *Abies balsamea*	23-0cm Organic	Histosol (A1)
Haul Road	WL64.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9)	*Carex trisperma* *Thelypteris noveboracensis*	*Betula alleghaniensis*	*Abies balsamea*	20-0cm Organic	Histosol (A1)
Haul Road	WL64.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex trisperma* *Glyceria grandis*	*Abies balsamea*	*Abies balsamea* *Larix laricina*	15-0cm Organic 0-5cm Silt Clay	Histic Epipedon (A2)
Haul Road	WL65	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex echinata*	*Abies balsamea*	*None*	5-0cm Organic 0-15cm Mineral	Histic Epipedon (A2)
Haul Road	WL66.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Mark Marks (B1)	*Carex echinata* *Carex magellanica* *Dulichium arundinaceum*	*None*	*None*	120-0cm Organic	Histosol (A1)
Haul Road	WL66.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Thelypteris noveboracensis*	*Abies balsamea* *Alnus viridis* *Betula alleghaniensis*	*Abies balsamea*	25-0cm Organic	Histosol (A1)
Haul Road	WL66.3	High Water Table (A2)	*Glyceria grandis*	*Larix laricina*	*None*	65-0cm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3)		*Alnus incana*		Organic	
Haul Road	WL67.1	High Water Table (A2) Saturation (A3)	*Chamaedaphne calyculata*	*Picea mariana* *Larix laricina*	*None*	73-0cm Organic	Histosol (A1)
Haul Road	WL67.2	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Viburnum nudum* *Nemopanthus mucronatus*	*Acer rubrum* *Larix laricina* *Abies balsamea*	32-0cm Organic	Histosol (A1)
Haul Road	WL68	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex stricta*	*Spiraea alba* *Rhododendron canadense* *Myrica gale*	*Acer rubrum* *Larix laricina*	72-0cm Organic	Histosol (A1)
Haul Road	WL69	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex stricta*	*Myrica gale*	*None*	100-0cm Organic	Histosol (A1)
Haul Road	WL70	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Scirpus cyperinus*	*Acer rubrum* *Alnus incana*	*Acer rubrum*	28-0cm Organic	Histosol (A1)
Haul Road	WL71	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Glyceria grandis* *Trientalis borealis*	*Abies balsamea* *Betula alleghaniensis* *Picea rubens*	*Betula alleghaniensis*	16-0cm Organic 0-11cm Mineral	Histic Epipedon (A2)
Haul Road	WL72	High Water Table (A2) Saturation (A3)	*Glyceria grandis* *Carex crinita*	*Acer rubrum*	*Acer rubrum*	40-0cm Organic 0-7cm Sandy Loam	Histic Epipedon (A2)
Haul Road	WL73.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma* *Glyceria grandis*	*Alnus incana* *Nemopanthus mucronatus*	*Abies balsamea* *Acer rubrum*	58-0cm Organic	Histosol (A1)
Haul Road	WL73.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Maianthemum trifolium*	*Kalmia angustifolia* *Alnus incana*	*Larix laricina*	36-0cm Organic	Histosol (A1)
Haul Road	WL74.1	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Rubus hispidus* *Carex folliculata*	*Abies balsamea*	*Acer rubrum* *Abies balsamea*	35-0cm Organic	Histosol (A1)
Haul Road	WL74.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Glyceria grandis*	*None*	*Acer rubrum*	10-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Water Marks (B1) Water-Stained Leaves (B9)					
Haul Road	WL75	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Phegopteris connectilis*	*Abies balsamea* *Nemopanthus mucronatus*	*Picea rubens* *Acer rubrum* *Abies balsamea*	60-0cm Organic	Histosol (A1) Hydrogen Sulfide (A4)
Haul Road	WL76.1	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8)	*Lycopus uniflorus*	*Abies balsamea* *Alnus incana*	*Acer rubrum* *Picea mariana*	70-0cm Organic	Histosol (A1) Hydrogen Sulfide (A4)
Haul Road	WL76.2	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex canescens* *Calamagrostis canadensis*	*Alnus incana* *Acer rubrum*	*Picea rubens*	50-0cm Organic	Histosol (A1)
Haul Road	WL77	High Water Table (A2) Saturation (A3) Hydrogen Sulfide Odor (C1)	*Carex stricta* *Rubus pubsescens*	*Betula papyrifera* *Alnus incana*	*Picea mariana* *Acer rubrum*	28-0cm Organic	Histosol (A1)
Haul Road	WL78	High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9)	*Glyceria melicaria* *Carex echinata*	*Picea rubens*	*Picea rubens* *Acer rubrum*	25-0cm Organic	Histosol (A1)
Haul Road	WL79	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex gynandra* *Coptis trifolia*	*Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea* *Picea mariana*	20-0cm Organic	Histosol (A1)
Haul Road	WL80	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Maianthemum trifolium*	*Viburnum nudum* *Picea mariana*	*Picea mariana* *Larix laricina*	36-0cm Organic	Histosol (A1)
Haul Road	WL81	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Glyceria grandis*	*Alnus incana*	*None*	17-0cm Organic	Histosol (A1)
Haul Road	WL82	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Glyceria grandis* *Lycopus uniflorus*	*Abies balsamea* *Acer rubrum*	*Abies balsamea*	20-0 Organic 0-5cm Clay	Histosol (A1) Histic Epipedon (A2)
Haul Road	WL83	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Acer rubrum* *Lycopus uniflorus*	*Betula alleghaniensis*	*Betula alleghaniensis* *Abies balsamea*	23-0cm Organic	Histosol (A1)
Haul Road	WL84	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Rubus hispidus* *Scirpus cyperinus*	*Acer rubrum* *Betula alleghiensis*	*None*	35-0cm Organic	Histosol (A1)
Haul Road	WL85	High Water Table (A2)	*Carex crinita*	*Abies balsamea*	*None*	15-0cm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3)	*Scirpus cyperinus*	*Alnus incana*		Organic	
Haul Road	WL86	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Maianthemum trifolium*	*Betula alleghaniensis*	*Abies balsamea*	40-0cm Organic	Histosol (A1)
Haul Road	WL87	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex trisperma* *Scirpus cyperinus*	*Abies balsamea*	*None*	22-0cm Organic	Histosol (A1)
Haul Road	WL88	High Water Table (A2) Saturation (A3)	*Rubus hispidus* *Carex trisperma*	*Betula papyrifera* *Picea rubens*	*None*	25-0cm Organic	Histosol (A1)
Haul Road	WL89	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Acer rubrum* *Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea* *Picea rubens*	25-0cm Organic	Histosol (A1)
Haul Road	WL90	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Calamagrostis canadensis* *Carex trisperma*	*Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea* *Acer rubrum*	60-0cm Organic	Histosol (A1)
Haul Road	WL91	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Kalmia angustifolia* *Cornus canadensis* *Osmunda cinnamomea* *Vaccinium myrtilloides*	*Alnus incana*	*Acer rubrum* *Larix laricina*	20-0cm Organic	Histosol (A1)
Haul Road	WL92	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Cornus canadensis*	*Picea mariana* *Abies balsamea*	*Acer rubrum* *Picea mariana*	30-0cm Organic	Histosol (A1)
Haul Road	WL93	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Scirpus cyperinus*	*Alnus incana*	*None*	10-0cm Organic 0-22cm Mineral	Histosol (A1)
Haul Road	WL94	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex trisperma* *Cornus canadensis*	*Abies balsamea* *Picea mariana*	*Picea mariana* *Acer rubrum*	20-0cm Organic	Histosol (A1)
Haul Road	WL95	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Dryopteris cristata*	*Virburnum nudum* *Abies balsamea*	*Acer rubrum* *Abies balsamea*	25-0cm Organic	Histosol (A1)
Haul Road	WL96	High Water Table (A2) Saturation (A3)	*Carex trisperma* *Rubus hispidus*	*Betulaa populifolia*	*Acer rubrum* *Abies balsamea* *Picea mariana*	24-0cm Organic	Histosol (A1)
Haul Road	WL97	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Lycopus uniflorus*	*Abies balsamea* *Acer rubrum*	*Abies balsamea*	42-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	**Shrubs**	**Trees**	**Depth**	**Hydric Soil Indicators**
Haul Road	WL98	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Oxalis montana* *Phegopteris connectilis*	*Alnus incana*	*Abies balsamea* *Acer rubrum*	25-0cm Organic	Histosol (A1)
Haul Road	WL99	Surface Water (A1) Water Marks (B1) Water-Stained Leaves (B9)	*Kalmia angustifolia* *Dennstaedtia punctilobula*	*Abies balsamea*	*Abies balsamea* *Picea rubens*	23-0cm Organic 0-3cm Sandy Loam	Histosol (A1)
Haul Road	WL100	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Nemopanthus mucrantus* *Kalmia angustifolia* *Betula papyrifera*	*None*	68-0cm Organic	Histosol (A1)
Haul Road	WL101	Saturation (A3)	*Carex trisperma* *Osmunda cinnamomea*	*Betula populifolia* *Acer rubrum* *Abies balsamea*	*Abies balsamea* *Acer rubrum*	20-0cm Organic	Histosol (A1)
Haul Road	WL102.1	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Cornus canadensis* *Osmunda cinnamomea*	*Ledum groenlandicum*	*Acer rubens* *Picea mariana*	75-0cm Organic	Histosol (A1)
Haul Road	WL102.2	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Thelypteris noveboracensis*	*Picea rubens* *Abies balsamea*	*Abies balsamea* *Picea rubens*	82-0cm Organic	Histosol (A1)
Haul Road	WL103	High Water Table (A2)	*Cornus canadensis* *Kalmia angustifolia*	*Picea mariana* *Betula papyrifera*	*None*	45-0cm Organic	Histosol (A1)
Haul Road	WL104	Saturation (A3) Stunted or Stressed Plants (D1)	*Rubus hispidus* *Cornus canadensis* *Gaultheria hispidula*	*Abies balsamea* *Acer rubrum*	*None*	35-0cm Organic	Histosol (A1)
Haul Road	WL105	High Water Table (A2)	*Osmunda cinnamomea* *Carex trisperma*	*Populus tremuloides* *Betula papyrifera*	*None*	46-0cm Organic	Histosol (A1)
Haul Road	WL106	Water-Stained Leaves (B9)	*Kalmia angustifolia*	*Viburdnum nudum* *Betula papyrifera*	*None*	25-0cm Organic	Histosol (A1)
Haul Road	WL107	Saturation (A3) Drainage Patterns (B10) Stunted or Stressed Plants (D1)	*Coptis trifolia* *Oxalis montana*	*Picea rubens*	*Abies balsamea*	26-0cm Organic	Histosol (A1)
Haul Road	WL108	Saturation (A3) Drainage Patterns (B10) Stunted or Stressed Plants (D1)	*Rubus hispidus* *Osmunda cinnamomea*	*Betula papyrifera* *Abies balsamea*	*None*	26-0cm Organic	Histosol (A1)
Haul Road	WL109	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Nemopanthus mucronatus*	*Picea rubens* *Abies balsamea* *Acer rubrum*	15-0cm Organic	Histosol (A1)
Haul Road	WL110	Surface Water (A1) High Water Table (A2)	*Carex trisperma* *Kalmia angustifolia*	*Abies balsamea* *Picea mariana*	*None*	100-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water Marks (B1) Water-Stained Leaves (B9)					
Haul Road	WL111	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Acer rubrum* *Oxalis montana*	*Picea rubrum* *Abies balsamea*	*Abies balsamea* *Picea mariana* *Acer rubrum*	130-0cm Organic	Histosol (A1)
Haul Road	WL112	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma* *Coptis trifolia*	*Abies balsamea*	*Abies balsamea* *Picea mariana* *Acer rubrum*	68-0cm Organic	Histosol (A1)
Haul Road	WL113	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Carex trisperma*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Acer rubrum*	32-0cm Organic	Histosol (A1)
Haul Road	WL114	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Carex trisperma*	*Abies balsamea*	*Abies balsamea* *Picea rubens*	68-0cm Organic	Histosol (A1)
Haul Road	WL115	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Gaylussacia baccata* *Osmunda cinnamomea*	*Picea rubens* *Picea mariana*	*Acer rubrum* *Picea mariana*	67-0cm Organic	Histosol (A1)
Haul Road	WL116	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Cornus canadensis* *Kalmia augustifolia*	*Picea mariana*	*Picea mariana* *Abies balsamea*	38-0cm Organic	Histosol (A1)
Haul Road	WL117	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Ledum groenlandicum* *Nemopanthus mucronatus* *Coptis trifolia* *Kalmia angustifolia*	*Nemopanthus mucronatus* *Picea mariana*	*Abies balsamea* *Larix laricina*	40-0cm Organic	Histosol (A1)
Haul Road	WL118	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Abies balsamea* *Nemopanthus mucronatus*	*Picea mariana*	87-0cm Organic	Histosol (A1)
Haul Road	WL119	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Kalmia angustifolia* *Vaccinium angustifolium* *Gaylussacia baccata*	*Abies balsamea* *Gaylussacia baccata*	*Abies balsamea*	66-0cm Organic	Histosol (A1)
Haul Road	WL120	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Kalmia angustifolia* *Cornus canadensis* *Carex trisperma*	*Picea rubens* *Picea mariana*	*None*	55-0cm Organic	Histosol (A1)
Haul Road	WL121	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Cornus canadensis* *Vaccinium angustifolium*	*Abies balsamea* *Nemopanthus mucronatus*	*Abies balsamea*	45-0cm Organic	Histosol (A1)
Haul Road	WL122	High Water Table (A2)	*Osmunda cinnamomea*	*Abies balsamea*	*Picea mariana*	63-0cm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3)			*Abies balsamea*	Organic	
Haul Road	WL123	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Nemopanthus mucronatus* *Abies balsamea*	*Picea mariana* *Acer rubrum*	125-0cm Organic	Histosol (A1)
Haul Road	WL124	High Water Table (A2) Saturation (A3)	*Dennstaedtia punctilobula*	*Abies balsamea*	*Picea mariana* *Acer rubrum*	90-0cm Organic	Histosol (A1)
Haul Road	WL125	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea* *Picea mariana*	*Abies balsamea*	*Abies balsamea* *Acer rubrum*	60-0cm Organic	Histosol (A1)
Haul Road	WL126	Saturation (A3)	*Kalmia angustifolia*	*Nemopanthus mucronatus* *Abies balsamea*	*Abies balsamea*	45-0cm Organic	Histosol (A1)
Haul Road	WL127	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Picea mariana* *Nemopanthus mucronatus*	*Picea mariana*	80-0cm Organic	Histosol (A1)
Haul Road	WL128	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Carex trisperma* *Gaylussacia baccata*	*Picea mariana* *Acer rubrum*	*None*	100-0cm Organic	Histosol (A1)
Haul Road	WL129	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Ledum groenlandicum*	*Picea mariana*	*Acer rubrum*	100-0cm Organic	Histosol (A1)
Haul Road	WL130	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Maianthemum trifolium* *Osmunda cinnamomea*	*Picea mariana* *Abies balsamea*	*Picea mariana*	120-0cm Organic	Histosol (A1)
Haul Road	WL131	Surface Water (A1) High Water Table (A2) Saturation (A3) Hydrogen Sulfide Odor (C1)	*Phegopteris connectilis*	*Picea mariana* *Nemopanthus mucronatus*	*Picea mariana* *Acer rubrum*	75-0cm Organic	Histosol (A1)
Haul Road	WL132	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Cornus canadensis*	*Nemopanthus mucronatus* *Picea mariana*	*Picea mariana* *Acer rubrum*	95-0cm Organic	Histosol (A1)
Haul Road	WL133	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma* *Osmunda cinnamomea*	*Kalmia angustifolia* *Ledum groenlandicum* *Nemopanthus mucronata*	*None*	22-0cm Organic	Histosol (A1)
Haul Road	WL134	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Osmunda cinnamomea* *Carex trisperma*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Acer rubrum*	125-0cm Organic	Histosol (A1)
Haul Road	WL135	High Water Table (A2)	*Osmunda cinnamomea*	*Acer rubrum*	*None*	68-0cm	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water-Stained Leaves (B9)		*Pinus strobus* *Picea mariana*		Organic	
Haul Road	WL136	High Water Table (A2) Saturation (A3)	*Thelypteris noveboracensis*	*Acer balsamea* *Acer rubrum*	*Abies balsamea* *Picea rubens*	23-0cm Organic	Histosol (A1)
Haul Road	WL137	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea* *Thelypteris noveboracensis*	*Picea rubens* *Ilex verticillata*	*Acer rubrum* *Picea rubens*	62-0cm Organic	Histosol (A1)
Haul Road	WL138	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Vaccinium oxycoccos*	*Acer rubrum*	*None*	10-0cm Organic	Histosol (A1)
Haul Road	WL139	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Abies balsamea* *Picea mariana*	*None*	65-0cm Organic	Histosol (A1)
Haul Road	WL140	High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Ledum groenlandicum* *Coptis trifolium* *Kalmia angustifolia*	*Nemopanthus mucronatus* *Acer rubrum*	*Abies balsamea* *Larix laricina*	20-0cm Organic	Histosol (A1)
Haul Road	WL141	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Ledum groenlandicum* *Rhododendron canadense*	*Abies balsamea* *Picea mariana*	*None*	18-0cm Organic	Histosol (A1)
Haul Road	WL142	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Ledum groenlandicum* *Carex projecta*	*Acer rubrum* *Ledum groenlandicum*	*None*	26-0cm Organic	Histosol (A1)
Haul Road	WL143.1	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Ledum groenlandicum* *Carex projecta*	*Acer rubrum*	*Picea mariana*	65-0cm Organic	Histosol (A1)
Haul Road	WL143.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Sparsely Vegetated Concave Surface (B8) Water-Stained Leaves (B9) Thick Muck Surface (C7)	*Oxalis montana* *Thelypteris noveboracensis*	*Betula alleghaniensis* *Abies balsamea* *Picea rubrum*	*Acer rubrum* *Abies balsamea*	18-0cm Organic	Histosol (A1)
Haul Road	WL144	Surface Water (A1) High Water Table (A2) Saturation (A3) Stunted or Stressed Plants (D1)	*Carex projecta*	*Picea mariana* *Larix laricina*	*None*	55-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
Haul Road	WL145	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Vaccinium oxycoccos* *Maianthemum trifolium*	*Picea mariana*	*None*	45-0cm Organic	Histosol (A1)
Haul Road	WL146.1	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Drosera rotundifolia* *Carex canescens* *Dulichium arundinaceum*	*None*	*None*	120-0cm Organic	Histosol (A1)
Haul Road	WL146.2	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Lycopus uniflorus* *Triadenum virginicum*	*Abies balsamea*	*Abies balsamea* *Acer rubrum*	45-0cm Organic	Histosol (A1)
Haul Road	WL147.1	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Vaccinium macrocarpon* *Vaccinium oxycoccos* *Carex magellanica*	*None*	*None*	50-0cm Organic	Histosol (A1)
Haul Road	WL147.2	High Water Table (A2) Saturation (A3)	*Carex trisperma*	*Acer rubrum*	*Larix laricina* *Abies balsamea*	50-0cm Organic	Histosol (A1)
Haul Road	WL148	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Chamaedaphne calyculata* *Vaccinium oxycoccos*	*Picea mariana*	*None*	45-0cm Organic	Histosol (A1)
Haul Road	WL149	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Scirpus cyperinus* *Carex trisperma* *Carex magellanica*	*Larix laricina* *Picea mariana*	*None*	65-0cm Organic	Histosol (A1)
Haul Road	WL150	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Rhododendron canadense* *Scirpuus cyperinus*	*None*	*None*	5-0cm Organic 0-20cm Sandy Clay	Histic Epipedon (A2)
Haul Road	WL151	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1)	*Kalmia angustifolia* *Carex trisperma*	*Picea mariana*	*None*	120-0cm Organic	Histosol (A1)
Haul Road	WL152	High Water Table (A2) Saturation (A3)	*Scirpus cyperinus* *Juncus canadensis* *Carex trisperma*	*Acer rubrum* *Picea mariana*	*Picea mariana* *Larix laricina*	40-0cm Organic	Histosol (A1)
Haul Road	WL153	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Maianthemum trifolium*	*Acer rubrum* *Larix laricina*	*None*	65-0cm Organic	Histosol (A1)
Haul Road	WL154	Surface Water (A1) High Water Table (A2)	*Chamaedaphne calyculata* *Dulichium arundinaceum*	*None*	*None*	65-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3)					
Haul Road	WL155	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Abies balsamea* *Picea mariana*	*Abies balsamea* *Acer rubrum* *Picea mariana*	20-0cm Organic	Histosol (A1)
Haul Road	WL156	High Water Table (A2) Saturation (A3)	*Ledum groenlandicum*	*Nemopanthus mucronatus* *Viburnum nudum*	*None*	65-0cm Organic	Histosol (A1)
Haul Road	WL157.1	High Water Table (A2) Saturation (A3)	*Carex stricta*	*Alnus incana* *Acer rubrum*	*Acer rubrum*	50-0cm Organic	Histosol (A1)
Haul Road	WL157.2	High Water Table (A2) Saturation (A3)	*Rubus pubescens* *Carex folliculata*	*Alnus incana*	*Acer rubrum* *Abies balsamea*	20-0cm Organic 0-5cm Mineral	Histic Epipedon (A2)
Haul Road	WL158	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Juncus effuses* *Carex echinata*	*Larix laricina*	*None*	20-0cm Organic 0-10cm Mineral	Histic Epipedon (A2)
Haul Road	WL159	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma*	*Abies balsamea* *Viburnum nudum*	*Betula populifolia* *Acer rubrum* *Picea mariana*	20-0cm Organic 0-5cm Mineral	Histic Epipedon (A2) Depleted Matrix (F3)
Haul Road	WL160	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Chamaedaphne calyculata* *Glyceria canadensis* *Vaccinium macrocarpon*	*Picea rubens* *Acer rubrum*	*None*	20-0cm Organic	Histosol (A1)
Haul Road	WL161	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea* *Ledum groenlandicum* *Carex trisperma*	*Nemopanthus mucronatus* *Picea mariana*	*Picea mariana* *Betula papyrifera*	30-0cm Organic	Histosol (A1)
Haul Road	WL162	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Eleocharis ovata*	*Alnus incana* *Picea mariana*	*Picea mariana* *Acer rubrum*	25-0cm Organic	Histosol (A1)
Haul Road	WL163	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma*	*Picea mariana* *Acer rubrum*	*None (Clear cut)*	5-0cm Organic 0-20cm Mineral	Histic Epipedon (A2)
Haul Road	WL164	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Nemopanthus mucronatus* *Ledum groenlandicum*	*Abies balsamea* *Nemopanthus mucronatus*	*Acer rubrum* *Larix laricina* *Picea mariana*	45-0cm Organic	Histosol (A1)
Haul Road	WL165	Surface Water (A1) High Water Table (A2)	*Cornus canadensis* *Trientalis borealis*	*Alnus incana* *Abies balsamea*	*Acer rubrum* *Abies balsamea*	3-0cm Organic	Histic Epipedon (A2)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water-Stained Leaves (B9)	*Carex trisperma*			0-50cm Mineral	
Haul Road	WL166	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Carex projecta* *Vaccinium macrocarpon*	*Alnus incana* *Acer rubrum*	*None*	40-0cm Organic	Histosol (A1)
Haul Road	WL167	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Osmunda cinnamomea*	*Picea mariana* *Abies balsamea*	*Picea mariana* *Abies balsamea*	50-0cm Organic	Histosol (A1)
Haul Road	WL168	Surface Water (A1) High Water Table (A2) Saturation (A3) Water Marks (B1) Drift Deposits (B3) Sparsely Vegetated Concave Surface (B8) Aquatic Fauna (B13)	*Myrica gale*	*Acer rubrum*	*None*	100-0cm Organic	Histosol (A1)
Haul Road	WL169	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea*	*Nemopanthus mucronatus* *Picea mariana*	*Abies balsamea* *Acer rubrum*	10-0cm Organic 0-5cm Mineral	Histic Epipedon (A2)
Haul Road	WL170	High Water Table (A2) Saturation (A3)	*Osmunda cinnamomea* *Thelypteris noveboracensis*	*Abies balsamea* *Alnus incana* *Picea mariana*	*Acer rubrum* *Picea mariana*	30-0cm Organic	Histosol (A1)
Haul Road	WL171	Surface Water (A1) High Water Table (A2) Saturation (A3) Sediment Deposits (B2) Thin Muck Surface (C7) Stunted or Stressed Plants (D1)	*Coptis trifolia*	*Alnus incana*	*Acer rubrum* *Betula alleghaniensis* *Picea rubens*	17-0cm Organic	Histosol (A1)
Haul Road	WL172	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Solidago canadensis*	*Alnus incana* *Betula populifolia* *Picea mariana*	*Abies balsamea* *Betula populifolia* *Picea mariana*	5-0cm Organic 0-40cm Mineral	Histic Epipedon (A2) Depleted Matrix (F3)
Haul Road	WL173	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Galium pallustre* *Calamagrotis canadensis* *Juncus effusus* *Onoclea sensibilis*	*Alnus incana* *Abies balsamea*	*Picea mariana* *Betula populifolia* *Picea mariana*	40-0cm Organic	Histosol (A1)
Haul Road	WL174	Surface Water (A1) High Water Table (A2)	*Cornus canadensis* *Osmunda cinamomea*	*Pices mariana* *Abies balsamea*	*Acer rubrum* *Abies balsamea*	17-0cm Organic	Histosol (A1)

FOOTPRINT	WETLAND ID*	SURFACE HYDROLOGY	DOMINANT VEGETATION			HYDRIC SOILS	
			Herbs	Shrubs	Trees	Depth	Hydric Soil Indicators
		Saturation (A3) Water-Stained Leaves (B9)			*Picea mariana*		
Haul Road	WL175	Surface Water (A1) High Water Table (A2) Saturation (A3)	*Osmunda claytoniana* *Osmunda cinamomea* *Thelypteris noveboracensis*	*Abies balsamea* *Alnus incana*	*None*	40-0cm Organic	Histosol (A1)
Haul Road	WL176	High Water Table (A2) Water-Stained Leaves (B9) Sparsely Vegetated Concave Surface (B8)	*Carex trisperma* *Carex stricta*	*Betula populifolia* *Abies balsamea*	*Acer rubrum* *Abies balsamea*	4-0cm Organic 0-5cm Mineral	Histic Epipedon (A2) Depleted Matrix (F3)
Haul Road	WL177	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Glyceria canadensis*	*Alnus incana*	*None*	7-0cm Organic	Histosol (A1)
Haul Road	WL178	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Linnea borealis* *Rubus hispidus*	*Alnus incana* *Picea rubens*	*Larix larcina* *Picea rubens* *Betula papyrifera*	80+ cm Organic	Histosol (A1)
Haul Road	WL179	Surface Water (A1) High Water Table (A2) Saturation (A3) Water-Stained Leaves (B9)	*Maianthemum canadensis*	*Alnus incana* *Acer rubrum*	*Picea mariana* *Acer rubrum*	50-0cm Organic	Histosol (A1)

Notes

* Wetland complex: data has been divided into separate vegetated communities which represents the variation in wetland characteristics.

Appendix H
Photographic Log of Watercourses and Fish Habitat

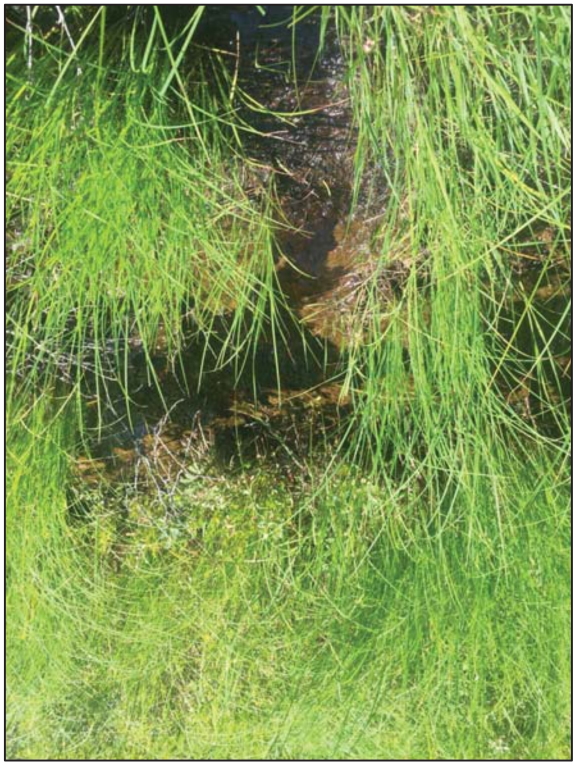

PHOTO 1 - WATERCOURSE 4

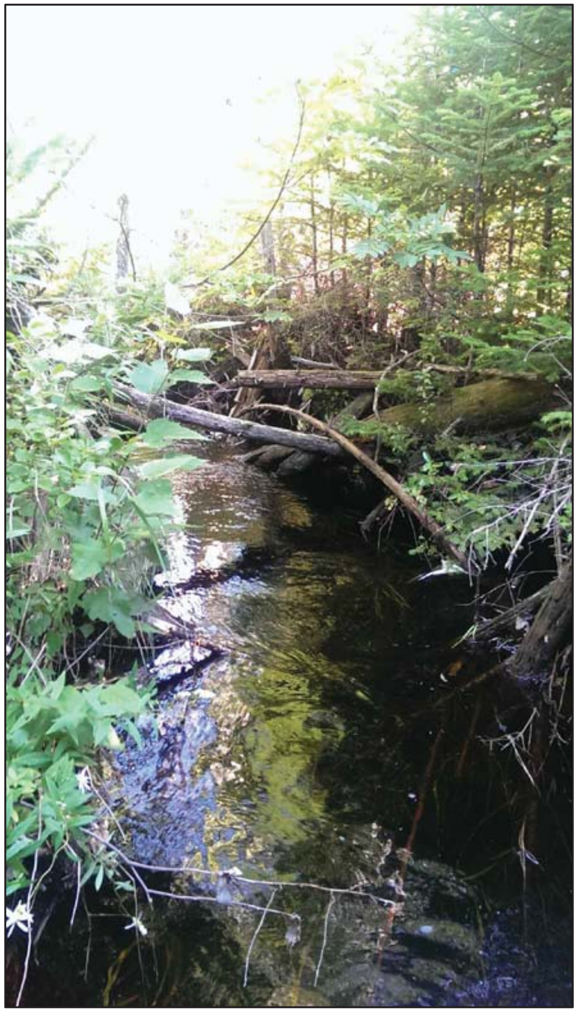

PHOTO 2 - WATERCOURSE 5 NEAR WETLAND 2

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MARINETTE, HALIFAX COUNTY, NOVA SCOTIA
BEAVER DAM MINE PROJECT

088664-20

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H1

CAD File: I:\Drafting\6-chars\08----\0886--\088664\088664-REPORTS\088664-Rpt-4\088664-20(004)GN-DA001.dwg

PHOTO 3 - WATERCOURSE 5 NEAR WETLAND 14

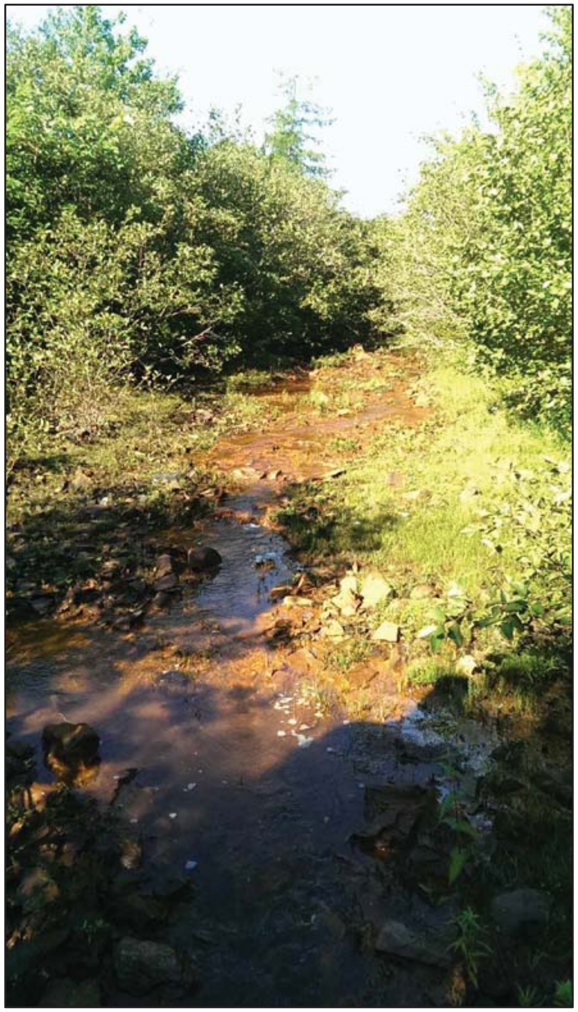

PHOTO 4 - WATERCOURSE 12

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H2

PHOTO 5 - WATERCOURSE 13

PHOTO 6 - WATERCOURSE 14

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H3

PHOTO 7 - CAMERON FLOWAGE

PHOTO 8 - MUD LAKE

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H4

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PHOTO 9 - CRUSHER LAKE

PHOTO 10 - WATERCOURSE A

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H5

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PHOTO 11 - WATERCOURSE B

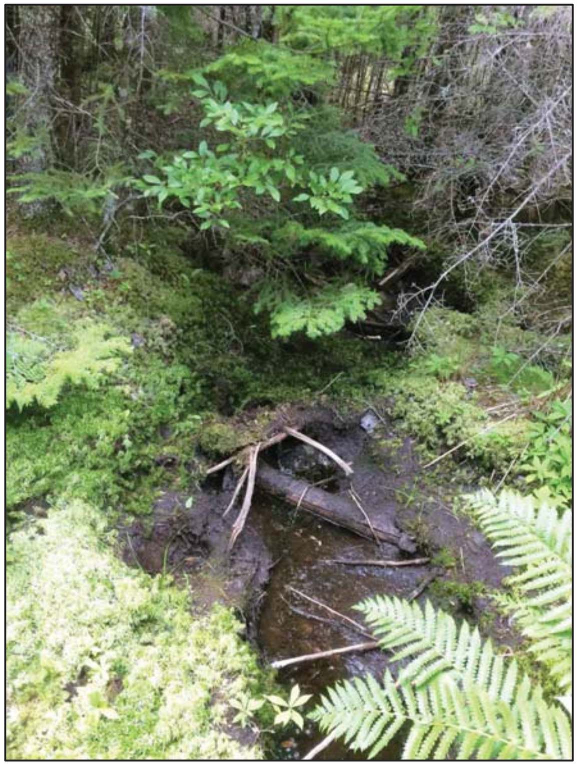

PHOTO 12 - WATERCOURSE D

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FIGURE H6

PHOTO 13 - WATERCOURSE E

PHOTO 14 - WATERCOURSE L

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H7

PHOTO 15 - WATERCOURSE J

PHOTO 16 - WATERCOURSE H

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H8

PHOTO 17 - WATERCOURSE N - WEST RIVER SHEET HARBOUR

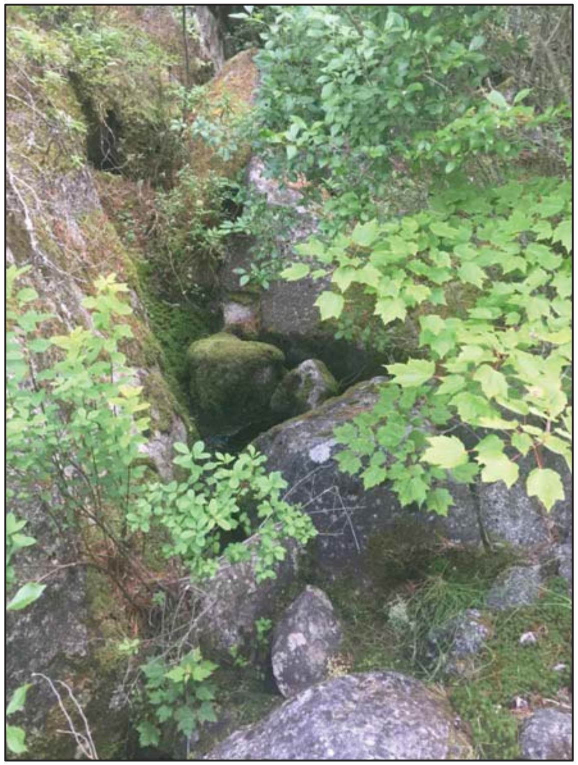

PHOTO 18 - WATERCOURSE Q

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FIGURE H9

PHOTO 19 - WATERCOURSE T

PHOTO 20 - WATERCOURSE V

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H10

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PHOTO 21 - WATERCOURSE O

PHOTO 22 - WATERCOURSE AD - MORGAN RIVER

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H11

PHOTO 23 - WATERCOURSE AA

PHOTO 24 - WATERCOURSE W

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H12

PHOTO 25 - WATERCOURSE AH

PHOTO 26 - WATERCOURSE AE

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H13

PHOTO 27 - WATERCOURSE AG

PHOTO 28 - WATERCOURSE 4 INLET TO WETLAND 13

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H14

PHOTO 29 - WATERCOURSE 4 OUTLET FROM WETLAND 13

PHOTO 30 - WATERCOURSE 5 INSIDE WETLAND 17

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H15

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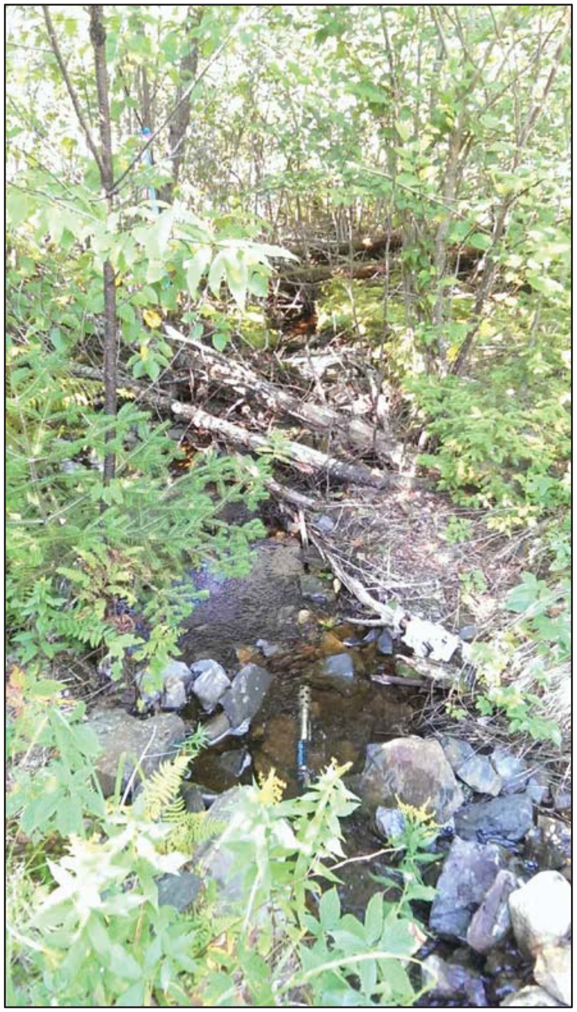

PHOTO 31 - WATERCOURSE 3 IN WETLAND 20

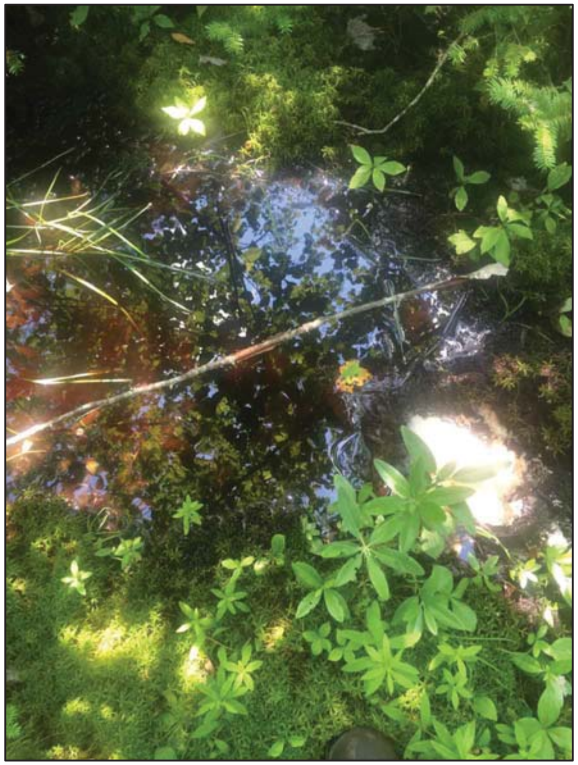

PHOTO 32 - WATERCOURSE 10 IN WETLAND 29

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H16

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PHOTO 33 - WATERCOURSE 11 IN WETLAND 29

PHOTO 34 - WATERCOURSE 11 IN WETLAND 33

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H17

PHOTO 35 - WATERCOURSE 5 IN WETLAND 44
(IMPOUNDED BY BEAVER ACTIVITY)

PHOTO 36 - WATERCOURSE 12 INLET INTO
WETLAND 56

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H18

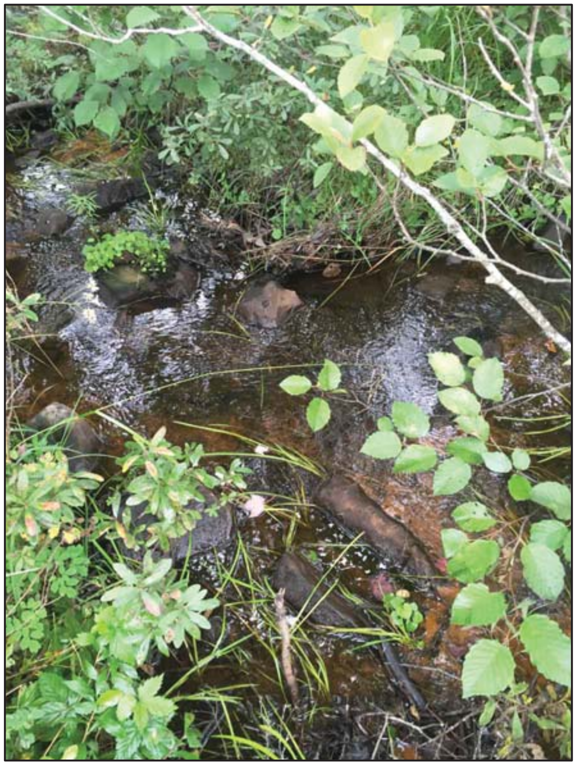

PHOTO 37 - WATERCOURSE 13 IN WETLAND 61

PHOTO 38 - WATERCOURSE A IN WETLAND 64

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H19

PHOTO 39 - WATERCOURSE B IN WETLAND 66

PHOTO 40 - WATERCOURSE E IN WETLAND 73

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H20

PHOTO 41 - WATERCOURSE F IN WETLAND 74

PHOTO 42 - WATERCOURSE G IN WETLAND 76

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H21

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PHOTO 43 - WATERCOURSE Z IN WETLAND 146

PHOTO 44 - WATERCOURSE 154

ATLANTIC GOLD CORPORATION
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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H22

PHOTO 45 - WATERCOURSE AA IN WETLAND 159

PHOTO 46 - WATERCOURSE AA IN WETLAND 160

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PHOTOGRAPHIC LOG OF WATERCOURSES AND FISH HABITAT

FIGURE H23

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Appendix I
Priority Species List

Priority Species List. Beaver Dam Mine Project

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Birds						
Botaurus lentiginosus	American Bittern				S3S4B	Preferred habitats of the American Bittern include freshwater wetlands with tall emergent vegetation. In Nova Scotia, it occurs widely in most regions, but is scarce on the Atlantic slope and Cape Breton Island, where marshes are few and relatively infertile.
Turdus migratorius	American Robin				S5B, S3N	American Robins are common across the continent in gardens, parks, yards, golf courses, fields, pastures, tundra, as well as deciduous woodlands, pine forests, shrublands, and forests regenerating after fires or logging.
Icterus galbula	Baltimore Oriole				S2S3B	The Baltimore Oriole is an adaptable species (found breeding in diverse habitats), but typically favors woodland edge (especially riparian) and open areas with scattered trees; strong preference for deciduous over coniferous trees. During spring and fall migration, it is found in variety of habitats, but generally favors open woodlands, woodland margins, hedgerows, and urban parks.
Dendroica castanea	Bay-breasted Warbler				S3S4B	The Bay-breasted is one of the less widespread warblers, breeding in a narrow band across the closed boreal forests from northeast British Columbia to western Newfoundland, and south just into the U.S.A. Although during migrations and while foraging it is often seen in mixed stands, this bird nests only in conifers. Reaching highest densities in Balsam Fir forest infested with spruce budworm.

Priority Species List. Beaver Dam Mine Project

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Picoides arcticus	Black-backed Woodpecker				S3S4	In the Maritimes, the Black-backed Woodpecker is widely but thinly distributed in conifer forests throughout, becoming more common farther north. The Black-backed Woodpecker is very local in southwest Nova Scotia. These birds forage on trees damaged by forest insects, especially bark beetles, and their characteristic flaking-off bark fragments in search of food can be an aid in detecting them. Nests here are often in quite open situations, such as cut-over areas, open Jack Pine stands, and the edges of woodland gardens.
Poecile hudsonica	Boreal Chickadee				S3	The Boreal Chickadee prefers conifer, and especially spruce, forests across the northern regions of Canada. Boreal Chickadees are found in all parts of the Maritimes. Most are residents, but some wander after breeding season.
Dendroica tigrina	Cape May Warbler				S2B	In summer, the Cape May Warbler is found in northern conifer forests. One of several warbler species that attain high densities during spruce budworm outbreaks, but is more usual in mature spruces than in Balsam Fir stands. Activity is mostly at the tops of tall spruces. Rarely observed in the southwest of Nova Scotia due to unsuitable habitat.
Wilsonia canadensis	Canada Warbler	T	T	Endangered	S3S4B	In Nova Scotia, the Canada Warbler has only been found sparsely on Cape Breton Island and in the extreme southwest of the province. They are less predictable from habitat than most warblers, they are usually found in dense understory vegetation of mature to mid-aged mixed forest, most closely associated with broad-leafed trees and shrubs, but with conifers usually present too.
Chordeiles minor	Common Nighthawk	T	T	Threatened	S2S3B	Common Nighthawks nest on sparsely vegetated or bare ground in open "wastelands" such as pine barrens, forest cut-overs, or burns, and secondarily on flat roofs of buildings.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Sialia sialis	Eastern Bluebird		NAR		S3B	The Eastern Bluebird nests in woodpecker holes, as well as nest-boxes. They forage in open areas of low vegetation with scattered trees for nesting.
Tyrannus tyrannus	Eastern Kingbird				S3B	In its breeding range, the Eastern Kingbird uses open environments; usually breeds in fields with scattered shrubs and trees, orchards, along shelterbelts, and especially along woodland edges in forested regions. A "savannah species", but given suitable nest sites and perches, will nest in many other habitats—e.g., desert riparian, quaking aspen (Populus tremuloides) parkland, recently burned forest, beaver ponds, golf courses and forested river valleys, and urban environments with tall trees and scattered open spaces. Also, appears drawn to water; often nests densely in trees that overhang water or in dead, standing snags surrounded by water.
Coccothraustes vespertinus	Evening Grosbeak				S3S4B, S3N	Evening Grosbeaks breed in mature and second-growth coniferous forests of northern North America and the Rocky Mountains, including spruce-fir, pine-oak, pinyon-juniper, and aspen forests. Less commonly, they nest in deciduous woodlands, parks, and orchards. They breed as far south as Mexico at 5,000–10,000 feet of elevation in pine and pine-oak woodlands. In winter Evening Grosbeaks live in coniferous forest and deciduous forest as well as in urban and suburban areas. When wintering in urban environments they are most abundant in small woodlots near bird feeders.
Dumetella carolinensis	Gray Catbird				S3	The gray catbird inhabits shrubbery in both upland and river-edge situations, mostly in areas where tree cover is of broad-leafed species. The Maritimes are at the northeast edge of its range, and catbirds are nearly absent in upland areas of Cape Breton Island, as well as in regions with extensive conifer forest cover.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Perisoreus canadensis	Gray Jay				S3	The Gray Jay breeds in boreal regions and occurs year-round in the conifer forests. These birds are found all over the Maritimes except where extensive conifer forests are lacking. They seldom leave the spruce and fir forests where they nest.
Tringa melanoleuca	Greater Yellowlegs				S3B, S3S4M	During migration, the Greater Yellowlegs is a familiar sight in salt marshes and around ponds and rivers, but their breeding habitat is very different. Yellowlegs breed in wooded bogs and muskegs access the boreal forest from northern British Columbia and Mackenzie to Labrador, Newfoundland and eastern Nova Scotia.
Charadrius vociferus	Killdeer				S3B	Killdeer are found throughout Nova Scotia, but scarce on the Atlantic slope and on Cape Breton Island. Breed in farmlands, gravel pits, forest clear-cut areas, and open lands along the coast.
Accipiter gentilis	Northern Goshawk		NAR		S3S4	Though it is more generally found in the boreal forest region, likely because less often disturbed there, the Northern Goshawk is also widespread in more temperate habitats. It nests in most forest types found throughout its geographic range. In eastern deciduous forests, Goshawks prefer nesting in mature, mixed hardwood–hemlock stands of birch (Betula sp.), beech (Fagus sp.), maple (Acer sp.), and Eastern Hemlock. Found scattered throughout the forests of the Maritimes. Hunts in diverse habitats ranging from open-sage steppes to dense forests, including riparian areas.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Mimus polyglottos	Northern Mockingbird				S1B	The Northern Mockingbird uses open habitats with scattered shrubs and small trees. In the East, typical habitats are parkland, cultivated lands, and early successional habitat at low elevations. Throughout its range found in suburban and urban habitats such as gardens and cemeteries, especially favoring mowed lawns adjacent to bare areas (e.g. concrete, asphalt, and sidewalks) with access to shrubs or hedges for cover and nesting. Absent from the interior of all forested habitat but frequents forest edge. Found in the same habitat year-round.
Contopus cooperi	Olive-sided Flycatcher	T	T	Threatened	S3B	The Olive-sided Flycatcher is found in open woodlands and other places where scattered trees remain after cutting or fire in forested regions. Found throughout the Maritimes, but not abundantly.
Vireo philadelphicus	Philadelphia Vireo				S2?B	This Philadelphia Vireo is found mainly in broad-leafed trees, in pure or mixed woods, but it sings and forages more often in young stands and in the sub-canopy. Breeding has never been proven in Nova Scotia.
Pinicola enucleator	Pine Grosbeak				S2S3B, SN5	In the Maritimes, the Pine Grosbeak approaches the southern limit of its range, they are found generally in Nova Scotia. In general, they avoid warmer, hardwood-dominated regions.
Carduelis pinus	Pine Siskin				S2S3	The Pine Siskin is primarily found in open coniferous forests. Also breeds in ornamental conifers in parks, cemeteries, and the like, and in mixed coniferous-deciduous and even deciduous tree associations. May forage in trees, shrubs, and grassy areas.
Haemorhous purpureus	Purple Finch				S4S5B, S3S4N	Purple Finches are mostly found in moist, cool conifer forests. They are also found in mixed forests along streams and in tree-lined suburbs.
Sitta canadensis	Red-breasted Nuthatch				S3	Red-breasted Nuthatches live mainly in deciduous woods and in coniferous forests.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Loxia curvirostra	Red Crossbill				S3S4	Red Crossbills are found in mature coniferous forests.
Pheucticus ludovicianus	Rose-breasted Grosbeak				S2S3B	Rose-breasted Grosbeaks use a wide variety of habitats, including deciduous and mixed wooded uplands and lowlands; often at shrubby ecotones at the edge of woods at streams, ponds, marshes, roads, or pastures. Commonly uses second-growth woodlands and well-vegetated suburban areas, parks, gardens, and orchards. Exhibits a preference for mesic woodlands, swamp forests, riparian corridors; avoids dry oak (Quercus spp.) woodlands. Uses a wide variety of habitats during spring and fall migration.
Regulus calendula	Ruby-crowned Kinglet				S3S4B	Ruby-crowned Kinglets prefer spruce-fir forests, however they also live in mixed wood forests, isolated trees in meadows, coniferous and deciduous forests, mountain-shrub habitat, and floodplain forests of oak, pine, spruce or aspen.
Euphagus carolinus	Rusty Blackbird	SC	SC	Endangered	S2B	Rusty Blackbirds use wet coniferous and mixed forests from northern edge of tundra southward to beginning of deciduous forests and grasslands. Frequents fens, alder (Alnus)–willow (Salix) bogs, muskegs, beaver ponds, and other openings in the forest such as swampy shores along lakes and streams. Exceptionally, on Cape Breton Island, Nova Scotia, drier sites such as pasture edges are used. During spring and fall migration, it forages in stubble, pasture, plowed fields, and edges of swamps. Fall migrants also frequent wooded areas, particularly for roosting. Occasionally roosts on the ground in open fields.
Catharus ustulatus	Swainson's Thrush				S3S4B	Swainson's Thrush are predominantly found in closed-canopy forests. Breeding habitat includes deciduous and coniferous forests.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Vermivora peregrina	Tennessee Warbler				S3S4B	In its breeding range, the Tennessee Warbler is associated with Boreal zone in deciduous, mixed, and coniferous forests from near sea level to 450 m. Associated with open areas that contain grasses, dense shrubs, and scattered clumps of young deciduous trees.
Empidonax traillii	Willow Flycatcher				S2B	In general, the Willow Flycatcher prefers moist, shrubby areas, often with standing or running water. During spring and fall migration, it uses areas similar to its breeding habitat.
Gallinago delicata	Wilson's Snipe				S3B	The Wilson's Snipe breeds in sedge bogs, fens, willow (Salix spp.) and alder (Alnus spp.) swamps, and marshy edges of ponds, rivers, and brooks. Requires soft organic soil rich in food organisms just below surface, with clumps of vegetation offering both cover and good view of approaching predators. Avoids marshes with tall, dense vegetation (cattails [Typha], reeds [Phragmites], etc.). In Canada, they use four primary types of breeding habitat: sedge bogs, fens, swamps, and pond and river edges. During spring and fall migration, they use marshes (including cattails), swamps, wet meadows, wet pastures, wet fallow fields, and marshy edges of streams and ditches. As during the breeding season, they require wet organic soils rich in food with clumps of cover.
Wilsonia pusilla	Wilson's Warbler				S3B	Western montane, northern, and northeastern populations of Wilson's Warbler are restricted to mesic shrub thickets of riparian habitats, edges of beaver ponds, lakes, bogs, and overgrown clear-cuts of montane and boreal zone; may reach into alpine zone. During spring and fall migration, occurs in most deciduous shrub habitats, but primarily riparian shrub understory. Also, found in most other woodlands, suburban habitats, agricultural areas, desert scrub, and montane forests.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Empidonax flaviventris	Yellow-bellied Flycatcher				S3S4B	The Yellow-bellied Flycatcher is a characteristic breeding bird of Canadian boreal conifer forests and peatlands. It nests in typically cool, moist conifer or mixed forests, bogs, swamps, and muskegs; landscapes often flat or poorly drained. Breeding habitat is usually well stratified, with open canopy, saplings and seedlings, shrubs, and abundant, thick moss cover. Shade is provided by conifer trees and saplings, as well as layers of shrubs, ferns, and herbs; undergrowth is usually dense.
Other Vertebrates						
Perimyotis subflavus	Eastern Pipistrelle	E	E	Endangered	S1	Prefers partly open country with large trees and woodland edges. Avoids deep woods and open fields. Probably roosts in the summer in tree foliage and occasionally in buildings; may use cave as night roost between foraging forays. Usually hibernates in caves and mines with high humidity. Generally, maternity colonies utilize manmade structures or tree cavities; often in open sites that would not be tolerated by most other bats.
Lasiurus borealis	Eastern Red Bat				S1	The Eastern Red Bat lives in forests, forest edges and hedgerows. It roosts among foliage, usually in deciduous trees, but it will sometimes roost in coniferous trees.
Lasiurus cinereus	Hoary Bat				S1	Hoary Bats are thought to be rare in Nova Scotia. Insectivorous, migratory. Poorly understood. Authorities disagree as to the bat's preference for coniferous versus broadleaf trees. Hoary Bats are thought to prefer trees at the edge of clearings, but have been found in trees in heavy forests, open wooded glades, and shade trees along urban streets and in city parks.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Myotis lucifugus	Little Brown Myotis	E	E	Endangered	S1	For Little Brown Myotis, the maternity colonies often exist in warm sites that facilitate pup growth rates, such as attics of buildings and under bridges, in rock crevices, or in cavities of canopy trees in forests. Males roost during daytime in a wide variety of structures, including buildings and bridges (mainly M. lucifugus), rock crevices, behind flaking bark, and within tree cavities, often at many different sites during the summer. Myotis species generally roost in tall, large-diameter snags that are in the early to middle stages of decay and located in open areas within mature-over mature forest. Myotis lucifugus congregates in caves and abandoned mines used for hibernation through the winter. About 16 hibernation sites are known in Nova Scotia.
Sorex maritimensis	Maritime Shrew				S3	The Maritime Shrew is most often found in marshes and wet meadows. It is only found in two provinces in Canada: New Brunswick and Nova Scotia.
Alces americanus	Mainland Moose			Endangered	S1	Mainland Moose are herbivores who live in boreal and mixed-wood forests. They are often found where there is an abundance of food (twigs, stems, and foliage of young deciduous trees and shrubs). In spring, islands and peninsulas are often used by cows when giving birth. In summer, access to wetlands (and aquatic vegetation) is important.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Myotis septentrionalis	Northern Long-eared Myotis	E	E	Endangered	S1	The Northern Long-eared Bat is found in many regions of Canada. Although there are numerous records of its presence in eastern Canada and the United States, it has only been recorded sporadically in the west. This bat has two habitats: a winter hibernation habitat as well as a summer roosting and foraging habitat. The Northern Long-eared Bat hibernates in caves or abandoned mines during the cold winter months. During the summer months, the bats commonly use crevices behind peeling bark or cavities in partially-decayed trees as summer day roosts. Within thick forests, summer activity may be focused along watercourses and small ponds.
Microtus chrotorrhinus	Rock Vole				S2	Optimal habitat for the Rock Vole is ferns/mossy debris near flowing water in coniferous forests. It also occupies deciduous forest/spruce clear cuts (mainly recent cuts), forest ecotones, grassy balds near forest, and sterile-looking rocky road fills. Occupies shallow burrows and runways. Nests probably are placed under logs or in similar protected sites. They are made of moss with a lining of grass and have multiple entrance tunnels. Breeding season is from March to mid-October.
Lasionycteris noctivagans	Silver-haired Bat				S1	Scarce in eastern Canada. During the summer months, Silver-haired Bats are found in forested habitats, particularly coniferous woodlands, adjacent to aquatic habitats like ponds, lakes and streams. Both sexes fly south between the middle of August and early October.
Chelydra serpentina	Snapping Turtle	SC	SC	Vulnerable	S3	southern New Brunswick and parts of mainland Nova Scotia in ponds, lakes, slow-moving streams and sometimes in brackish water if these water bodies have soft mud bottoms and abundant aquatic vegetation.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Glyptemys insculpta	Wood Turtle	T	T	Threatened	S2	Habitat destruction and fragmentation due to intense development and accompanying stream alterations are serious problems in the southeastern portion of the Wood Turtle's range. Protection of wooded stream corridors, nesting, feeding, basking, and overwintering sites, and an upland buffer would be necessary to include in preserve design
						Lives along permanent streams during much of each year, but in summer may roam widely overland and can be found in a variety of terrestrial habitats adjacent to streams, from deciduous woods, cultivated fields, and woodland bogs, to marshy pastures. Use of woodland bogs and marshy fields is most common in the northern part of the range.
Fish						
Anguilla rostrata	American Eel		T		S5	The American Eel moves from salt water into fresh water when quite young and spend their adult life in fresh water returning to spawn in tropical oceans up to several decades later. Widely distributed in freshwaters, estuaries and coastal marine waters connected to the Atlantic Ocean. Although small streams may be critical to the persistence of eels in a watershed, they may use these streams only once or twice a year, while moving to and from more preferred habitats.
Salmo salar	Atlantic Salmon – Southern Uplands Population		E		S2	Found in freshwater rivers and streams that are clear, cool, and well oxygenated, with gravel, cobble, or boulder bottoms.
Rhinichthys atratulus	Blacknose Dace				S3	The Blacknose Dace is common in cool, clear, gravel bottom rivers and streams, however it can survive in slow moving or stagnant waters.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Culaea inconstans	Brook Stickleback				S3	This species generally occupies cool, clear, heavily weeded, spring-fed creeks, small rivers, lakes, and ponds, usually in shallow, quiet to flowing pools and backwaters over sand or mud. Sometimes it burrows into soft bottoms. Occasionally this fish can be found in brackish water. In a lake in Manitoba, adults were most abundant at the outer margin of emergent vegetation (Moodie 1986). Eggs are deposited in a nest made of plant material by the male just above the bottom in shallow water.
Invertebrates						
Euphydryas phaeton	Baltimore Checkerspot				S3	Found in fresh-water marshes, wet roadsides and meadows. Larvae found feeding on Turtlehead (Chelone glabra) and has been reported to feed on Beardtongue (Penstemon digitalis).
Amblyscirtes vialis	Common Roadside-Skipper				S2	Found in trails, roads in wooded areas and often near streams. Larvae are found feeding off of a variety of grass species.
Polygonia progne	Grey Comma				S3S4	Found in woods and aspen parklands. Larvae found feeding on currants and gooseberries (Ribes sp.) and sometimes Elm (Ulmus sp.).
Danaus plexippus	Monarch	SC	SC		S2B	Almost anywhere during the spring (northward) migration; near the larval foodplains during the breeding season; in the fall commonly near the coast, often in large numbers, all heading south. Larvae are found feeding on the following Milkweed species: Common Milkweed (Ascelpias syriaca) and Swamp Milkweed (A. incarnata), neither of which are abundant plants in Nova Scotia. Common Milkweed is very common in lower Saint John river valley (NB) and possibly north central Nova Scotia.
Pieris oleracea	Mustard White				S2	Found in deciduous woods and bogs. Larvae feed off of various plants belonging to the Brassicaceae (mustard) family.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Lethe anthedon	Northern Pearly-Eye				S3	Found in moist woods and dominated by graminoids in the herbaceous layer of forests. Larvae feed off of woodland grasses such as Bearded Shortgrass (Brachyelytrum erectum) and False Melic Grass (Schizachne purpurascens).
Amblyscirtes hegon	Pepper and Salt Skipper				S2	Found on the edges of forests and streams. Larvae found feeding on a variety of grass species.
Gomphus ventricosus	Skillet Clubtail	E	E		S1	In the Northeast, the larvae inhabit large rivers where they burrow in the soft mud of deep pools.
Satyrium liparops	Striped Hairstreak				S3	Found in deciduous forest edges, gardens and roadsides. Larvae found feeding off of members of the Rosaceae family such as plum and cherries (Prunus spp.). Occurrences with Oak (Quercus spp.), Willow (Salix spp.) and Blueberry (Vaccinium spp.).
Alasmidonta undulata	Triangle Floater				S2S3	Frequently found in stream and rivers in sand and gravel substrates.
Vascular Plants						
Isoetes acadiensis	Acadian Quillwort				S3	In water up to depth of 1m, bordering lakes, ponds or along rivers, infrequent but scattered through province.
Rhamnus alnifolia	Alder-leaved Buckthorn				S3	Grows in wooded swamps or bogs, meadows or alluvial soils in the alkaline regions, in Hants, Cumberland and Inverness Counties.
Vaccinium uliginosum	Alpine Bilberry				S3	Wide tolerance of moisture and fertility, but generally acidic soils in Halifax, Digby & Cape Breton.
Barbarea orthoceras	American Yellow Rocket				S1	Alpine or subalpine zones, shores of rivers or lakes, talus and rocky slopes.
Polypodium appalachianum	Appalachian Polypody				S3?	Cliffs and rocky slopes, distribution unclear.
Viola sagittata	Arrow-Leaved Violet				S3S4	Sterile woods, clearing and fields, common from Yarmouth to Halifax and Hants Counties.
Viola sagittata var. ovata	Arrow-Leaved Violet				S3S4	Sterile woods, clearing and fields, common from Yarmouth to Halifax and Hants Counties.
Salix serissima	Autumn Willow				S1	Fens (calcium-rich wetlands), meadows and fields, swamps.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Geranium bicknellii	Bicknell's Crane's-bill				S3	Colonizes recently burned or cleared land; recently exposed lakeshores, Sporadic from southern counties to central Nova Scotia.
Fraxinus nigra	Black Ash			Threatened	S1S2	Typical habitat includes poorly drained soils and swampy woods.
Polygala sanguinea	Blood Milkwort				S2S3	Prefers acidic or run-out soil as found in fallow fields or brushlands, scattered through central portion of province.
Caulophyllum thalictroides	Blue Cohosh				S2	Shade-tolerant, restricted to river floodplain deciduous forests. A wide and patchy distribution over northern portion of the province from Annapolis River to River Denys in Cape Breton.
Carex tribuloides	Blunt Broom Sedge				S3?	Found in wet forest soils and swales. Collected from Kings and Queens counties to Cape Breton.
Carex tribuloides var. tribuloides	Blunt Broom Sedge				S3?	Found in wet forest soils and swales.
Galium obtusum ssp. obtusum	Blunt-leaved Bedstraw				S2S3	Swamps, swampy grounds, wet areas of prairies, wet woods and thickets, roadside ditches.
Potamogeton obtusifolius	Blunt-leaved Pondweed				S3	Ponds, pools, lakes and sluggish streams often over deep mucky substrate. Northern from Cumberland Co., to northern Cape Breton.
Betula pumila var. renifolia	Bog Birch				S1?	Bogs and meadows amongst alders.
Betula pumila var. pumila	Bog Birch				S2S3	Bogs and meadows amongst alders.
Salix pedicellaris	Bog Willow				S2	Grows in acidic substrate as in bogs; nutrient-rich marshes and in sphagnous lacustrine habitats.
Symphyotrichum boreale	Boreal Aster				S2?	Lacustrine gravels, streamsides and edges of peatlands. Scattered from Yarmouth to Cape Breton and uncommon.
Bromus latiglumis	Broad-Glumed Brome				S1	Floodplain (river or stream floodplains), forests, shores of rivers or lakes.
Anemone canadensis	Canada Anemone				S2	In thickets, meadows and stony shores. Grows in alluvial soils in calcareous regions.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Potentilla canadensis	Canada Cinquefoil				S2S3	Found on dry rock barrens and other open areas in Yarmouth, Halifax, Kings, Shelburne and Hants Co.
Potentilla canadensis var. canadensis	Canada Cinquefoil				S2S3	Found on dry rock barrens and other open areas in Yarmouth, Halifax, Kings, Shelburne and Hants Co.
Piptatherum canadense	Canada Rice Grass				S2	Grows in dry sandy soils. Local and scattered from Shelburne to Halifax and Colchester counties.
Polygonum careyi	Carey's Smartweed				S1	Anthropogenic (man-made or disturbed habitats), meadows and fields, shores of rivers or lakes.
Sisyrinchium fuscatum	Coastal Plain Blue-eyed-grass				S1	Grows on sandy soils. Collected only from western counties.
Eupatorium dubium	Coastal Plain Joe-pye-weed				S2	Found in wet meadows, damp thickets, shores, and along the roadside. It grows best in full sun but can also grow in semi-shade and enjoys grows well-drained soil that is moisture retentive.
Galium aparine	Common Bedstraw				S2S3	Pastures, fields, ditches and streamsides. Very common throughout.
Humulus lupulus var. lupuloides	Common Hop				S1?	Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), forests, shrublands or thickets.
Botrychium lunaria	Common Moonwort				S1	Open slopes. Sand or gravel; shores and meadows. Basic soils. Known from Conrad's Beach, Halifax County and from New Campbellton and Indian Brook in northern Cape Breton.
Equisetum hyemale	Common Scouring-rush				S3S4	Grows in sandy, gravelly soil, on banks or in low areas; often in calcareous regions. Scattered, mostly from Digby County, through the Annapolis Valley, northward to Cape Breton.
Equisetum hyemale var. affine	Common Scouring-rush				S3S4	Grows in sandy, gravelly soil, on banks or in low areas; often in calcareous regions. Scattered, mostly from Digby County, through the Annapolis Valley, northward to Cape Breton.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Cardamine pratensis var. angustifolia	Cuckoo Flower				S1	Moist soil as in meadows, damp fields and other low ground. Scattered in the province, frequent along the Annapolis River and even spreading into roadsides ditches, north to Cape Breton.
Ranunculus sceleratus	Cursed Buttercup				S1S2	Anthropogenic (man-made or disturbed habitats), fresh tidal marshes or flats, marshes, swamps.
Ranunculus sceleratus var. sceleratus	Cursed Buttercup				S1S2	Anthropogenic (man-made or disturbed habitats), fresh tidal marshes or flats, marshes, swamps.
Rudbeckia laciniata	Cut-Leaved Coneflower				S1S2	Floodplain (river or stream floodplains), forests, shores of rivers or lakes, swamps, wetland margins (edges of wetlands).
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower				S1S2	Floodplain (river or stream floodplains), forests, shores of rivers or lakes, swamps, wetland margins (edges of wetlands).
Hypericum dissimulatum	Disguised St John's-wort				S2S3	Wet mucky soils in lacustrine habitats; historically collected from Digby to Halifax Co. with a single specimen from each of Pictou and Guysborough counties.
Goodyera pubescens	Downy Rattlesnake-Plantain				S2	Forms large colonies in woodlands and thickets; Only recently discovered in Nova Scotia (1963) and so far known from Queens, Kings, Annapolis, Hants and Halifax counties.
Epilobium strictum	Downy Willowherb				S3	Bogs and other peatlands; Scattered throughout Cape Breton, infrequent elsewhere.
Arabis drummondii	Drummond's Rockcress				S2	Cliff or talus slope.
Juncus dudleyi	Dudley's Rush				S3	A habitat generalist; known from Annapolis, Hants and Lunenburg counties.
Vaccinium caespitosum	Dwarf Bilberry				S3	Cliff or talus slope, disturbed sites, field meadow.
Vaccinium caespitosum var. caespitosum	Dwarf Bilberry				S3	Cliff or talus slope, disturbed sites, field meadow.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Pilea pumila	Dwarf Clearweed				S1	Usually grows in cool shady habitats as found on forested slopes of maple-beech, in the centre of the province. So far, only known from West Branch, Pictou Co.; Little River, near Brookfield, Halifax Co.; and along the Herbert River, Hants Co. at Woodville.
Pilea pumila var. pumila	Dwarf Clearweed				S1	Usually grows in cool shady habitats as found on forested slopes of maple-beech, in the centre of the province. So far, only known from West Branch, Pictou Co.; Little River, near Brookfield, Halifax Co.; and along the Herbert River, Hants Co. at Woodville.
Baccharis halimifolia	Eastern Baccharis		T	Threatened	S1	Anthropogenic (man-made or disturbed habitats), brackish or salt marshes and flats, coastal beaches (sea beaches), marshes.
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass				S3S4	Found in damp peat, sandy soils that are poorly drained. Common from Yarmouth and Shelburne counties east to Lunenberg Co. Scattered elsewhere.
Solidago latissimifolia	Elliott's Goldenrod				S3S4	Clearings, thickets and bogs, swales and lakeshores. Common in Yarmouth Co., east to Halifax Co.
Carex vacillans	Estuarine Sedge				S1S3	Brackish or salt marshes and flats, intertidal, subtidal or open ocean, shores of rivers or lakes.
Panicum dichotomiflorum var. puritanorum	Fall Panic Grass				S1?	Anthropogenic (man-made or disturbed habitats), shores of rivers or lakes.
Myriophyllum farwellii	Farwell's Water Milfoil				S2	Ponds and slow-flowing fresh water. Scattered across the mainland.
Carex foenea	Fernald's Hay Sedge				S3?	Preferred habitat is dry and sandy soils as on barrens. Scattered from Yarmouth to northern Cape Breton.
Potamogeton zosteriformis	Flat-stemmed Pondweed				S2S3	Lacustrine (in lakes or ponds), riverine (in rivers or streams).
Stellaria crassifolia and var. crassifolia	Fleshy Stitchwort				S1	Frequents pond edges and wet seepy slopes.
Trichostema dichotomum	Forked Bluecurls				S1	Anthropogenic (man-made or disturbed habitats), grassland, meadows and fields, sandplains and barrens.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Carex alopecoidea	Foxtail Sedge				S1	Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), forests, marshes.
Ranunculus gmelinii+	Gmelin's Water Buttercup				S3	Riverine (in rivers or streams), swamps.
Zizia aurea	Golden Alexanders				S1	Meadows, shores, thickets and even wooded swamps. Occasionally reported: Pomquet and South River, Antigonish Co., Upper Musquodoboit, Halifax Co.
Veratrum viride	Green False Hellebore				S1	Open moist meadows. Found once in the meadow along the stream at the Kentville Research Station and to be expected elsewhere. This is possibly native.
Carex viridula var. elatior	Greenish Sedge				S1	Crins of alkaline, lime-rich soils.
Minuartia groenlandica	Greenland Stitchwort				S3	Granite ledges, crevices and gravels, coastal headlands. Halifax and Lunenburg counties; French Mountain, Inverness County. Recently collected from White's Cove, Digby Co.
Lycopodium sabinifolium	Ground-Fir				S3?	Alpine or subalpine zones, anthropogenic (man-made or disturbed habitats), meadows and fields.
Carex haydenii	Hayden's Sedge				S1	Marshes, meadows and fields, shores of rivers or lakes.
Cyperus lupulinus and ssp. macilentus	Hop Flatsedge				S1	Anthropogenic (man-made or disturbed habitats), grassland, meadows and fields.
Carex grisea	Inflated Narrow-leaved Sedge				S1	Floodplain (river or stream floodplains), forests.
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern				S2S3	Fertile soils on woodland hillsides.
Carex lapponica	Lapland Sedge				S1?	Sphagnum bogs, wet, nutrient-poor areas, mostly lowlands
Platanthera grandiflora	Large Purple Fringed Orchid				S3	Favours wet meadows and riparian habitats - More often found in north-central Nova Scotia. Infrequent in southwestern NS.
Hypericum majus	Large St John's-wort				S2	Wet or dry open soil. Widely scattered locations. Until recently, only known from Halifax area and Big Baddeck, Victoria County, and thought to be historic.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Carex adusta	Lesser Brown Sedge				S2S3	Found in dry, open forest or recent clearings on acidic, gravelly soils. Most frequent after fire - Scattered and not common, from Kejimkujik National Park to Cumberland Co.; northern Cape Breton. Recently collected from Williams Lake area of Halifax Co.
Carex granularis	Limestone Meadow Sedge				S1	Anthropogenic (man-made or disturbed habitats), meadows and fields, shores of rivers or lakes, wetland margins (edges of wetlands).
Schizaea pusilla	Little Curlygrass Fern				S3	Sphagnous wet areas, upper peaty lakeshores and undrained depressions. Scattered throughout the Atlantic counties and frequent in the northern plateau of Cape Breton.
Rhinanthus minor ssp. groenlandicus	Little Yellow Rattle				S1	Alpine or subalpine zones, anthropogenic (man-made or disturbed habitats), meadows and fields, mountain summits and plateaus, talus and rocky slopes
Liparis loeselii	Loesel's Twayblade				S3S4	Anthropogenic (man-made or disturbed habitats), fens (calcium-rich wetlands), lacustrine (in lakes or ponds), meadows and fields, shores of rivers or lakes.
Stellaria longifolia and var. longifolia	Long-leaved Starwort				S2	Damp grassy habitats, in sandy or mucky soils. Locally abundant along the Salmon River at Truro and Kemptown, Colchester Co.; along the Musquodoboit and Stewiacke rivers; Isle Haute.
Equisetum palustre	Marsh Horsetail				S1	Of wetlands, marshes and swamps. A single collection each from Kings County and Halifax Co.
Proserpinaca palustris	Marsh Mermaidweed				S3	Lakeshore fens and streamsides.
Hordeum brachyantherum and ssp. brachyantherum	Meadow Barley				S1	Anthropogenic (man-made or disturbed habitats).
Betula michauxii	Michaux's Dwarf Birch				S2	Limited to peat bogs. Scattered localities from Brier Island, Digby Co., east to Guysborough, Cape Breton and Inverness counties.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Amelanchier nantucketensis	Nantucket Serviceberry				S1	Found in disturbed habitats such as roadsides, fields, sandplains, riparian meadows and barrens. Its NS distribution is limited to Cumberland, Shelburne and Halifax counties. No collection for the Halifax Co. locality.
Trisetum spicatum	Narrow False Oats				S3S4	Grows in rocky soils on outcrops, cliffs, streamsides. Found on Cape Blomidon, Cape d'Or and scattered from Halifax and Hants counties to northern Cape Breton.
Allium burdickii	Narrow-Leaved Wild Leek				S1?	Rich deciduous woodlands, wooded bluffs, wooded areas along rivers and streams, and cemetery prairies
Saxifraga cernua	Nodding Saxifrage				S1	Alpine or subalpine zones, cliffs, balds, or ledges.
Ophioglossum pusillum	Northern Adder's-tongue				S2S3	Sterile soils, swamps and sandy or cobbly lakeshores. Known from Yarmouth and Digby Counties; scattered east to Halifax and Amherst; a single Cape Breton record from George River.
Betula borealis	Northern Birch				S2	Bogs and wooded swamps.
Viola nephrophylla	Northern Bog Violet				S2	Cool, mossy sites: bogs, streamsides and wet woods. Rare in Shelburne Co., Colchester and Cumberland counties northward. Generally, a northern ranging species within NS.
Lycopodium complanatum	Northern Clubmoss				S3S4	Open woodlands, thickets, heathland and rocky slopes;
Geocaulon lividum	Northern Comandra				S3	Damp sands and other sterile soils, especially in acid or peaty sites. Disjunct sites in Halifax, Kings and Cumberland counties; widespread but local in Cape Breton.
Thalictrum venulosum	Northern Meadow-rue				S1	Shores of rivers or lakes.
Spiraea septentrionalis	Northern Meadowsweet				S1?	Open, moist areas
Vaccinium ovalifolium	Oval-leaved Bilberry				S1	Sterile and dry soils in barrens, thickets and coniferous woods
Eleocharis ovata	Ovate Spikerush				S2?	Grows on muddy streamsides, streambeds and lakeshores, often in subsiding water.

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Torreyochloa pallida var. pallida	Pale False Manna Grass				S1	Lacustrine (in lakes or ponds), riverine (in rivers or streams), swamps.
Platanthera flava var. herbiola	Pale Green Orchid				S2	Anthropogenic (man-made or disturbed habitats), floodplain (river or stream floodplains), forest edges, forests, fresh tidal marshes or flats, grassland, meadows and fields, riverine (in rivers or streams), shrublands or thickets, swamps, wetland margins (edges of wetlands), woodlands.
Impatiens pallida	Pale Jewelweed				S2	Alluvial soils as along intervales and in thickets. Uncommon from Kings Co,.Isle Haute, to northern Cape Breton and more frequent eastward.
Hieracium paniculatum	Panicled Hawkweed				S3	Mixed forest on dryish soils, especially oak. Occasional from Yarmouth east to Kings and Halifax counties. Common about Kentville and at Kejimkujik.
Rumex persicarioides	Peach-leaved Dock				S2?	Anthropogenic (man-made or disturbed habitats), brackish or salt marshes and flats, coastal beaches (sea beaches), meadows and fields.
Ranunculus pensylvanicus	Pennsylvania Buttercup				S1	Anthropogenic (man-made or disturbed habitats), marshes, shores of rivers or lakes, swamps.
Erigeron philadelphicus	Philadelphia Fleabane				S2	Habitats include fields, meadows and springy slopes. Not common, scattered stations from Digby and Cumberland counties to central Cape Breton.
Erigeron philadelphicus var. philadelphicus	Philadelphia Fleabane				S2	Habitats include fields, meadows and springy slopes. Not common, scattered stations from Digby and Cumberland counties to central Cape Breton.
Empetrum eamesii ssp. atropurpureum	Pink Crowberry				S2S3	Barrens, beach or coastal shore, bog, exposed rock or sand, headland
Empetrum eamesii ssp. eamesii	Pink Crowberry				S2S3	Barrens, beach or coastal shore, bog, exposed rock or sand, headland
Empetrum eamesii	Pink Crowberry				S3	Barrens, beach or coastal shore, bog, exposed rock or sand, headland
Pyrola asarifolia and ssp. asarifolia	Pink Pyrola				S3	Found in moist and riparian forests and in swamps dominated by northern white-cedar (Thuja occidentalis).

Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Carex plantaginea	Plantain-Leaved Sedge				S1	Forests.
Rosa acicularis and ssp. sayi	Prickly Rose				S1	Cliffs, balds, or ledges, ridges or ledges. Inhabits areas of calcareous rock or rich sediments.
Festuca prolifera	Proliferous Fescue				S1S2	Alpine or subalpine zones, cliffs, balds, or ledges, talus and rocky slopes.
Crataegus submollis	Quebec Hawthorn				S1?	edges of fields and thickets, Antigonish and Lunenburg Co. to Cape Breton.
Fraxinus pennsylvanica	Red Ash				S1	Floodplain (river or stream floodplains), forests, shores of rivers or lakes, swamps.
Lachnanthes caroliniana	Redroot	SC	SC	Vulnerable	S2	Shores of rivers or lakes.
Eleocharis erythropoda	Red-stemmed Spikerush				S1	Fens (calcium-rich wetlands), marshes, shores of rivers or lakes, wetland margins (edges of wetlands).
Crataegus robinsonii	Robinson's Hawthorn				S1?	Prairie, meadows, fields.
Carex rosea	Rosy Sedge				S3	Grows in dry soils beneath deciduous forests and thickets. Common from Annapolis Co. to northern Cape Breton.
Hieracium scabrum var. leucocaule	Rough Hawkweed				S1	Usually in poor soils in pastures, fields and fallow sites. Common throughout.
Plantago rugelii	Rugel's Plantain				S2S3	Anthropogenic (man-made or disturbed habitats), grassland, meadows and fields.
Plantago rugelii var. rugelii	Rugel's Plantain				S2S3	Anthropogenic (man-made or disturbed habitats), grassland, meadows and fields.
Cypripedium reginae	Showy Lady's-Slipper				S2	Bog, swamp. Widely scattered localities in province
Salix sericea	Silky Willow				S2	LOake or pond shore, riparian zones. Rare only reported from western NS. Parr Lake and Lake Fanning, Yarmouth Co.; Queens and Lunenburg counties to Halifax County
Eriophorum gracile and var. gracile	Slender Cottongrass				S2	Wet peat and inundated shores. Scattered eastward from Annapolis and Halifax counties.
Agalinis paupercula	Small-flowered Agalinis				S1	Meadows and fields, shores of rivers or lakes, wetland margins.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Limosella australis	Southern Mudwort				S3	Beach or coastal shore, coastal island, lake or pond shore, river or stream. Yarmouth, Shelburne, Queens and Cumberland counties; Sable Island; Cape Breton and likely elsewhere.
Listera australis	Southern Twayblade				S3	Bog, mixed wood forest, swamps. Scattered from Shelburne, to Halifax, to Kings to Cape Breton counties.
Potamogeton pulcher	Spotted Pondweed			Vulnerable	S2S3	Aquatic perennial herb that grows in standing water. Yarmouth, Queens and Halifax Counties, reported in Digby Co.
Halenia deflexa ssp. brentoniana	Spurred Gentian				S1?	Forest edge, forests, meadows and fields
Asclepias incarnata ssp. pulchra	Swamp Milkweed				S3?	Rocky soils along lakeshores, marshes, streamsides or peatland edges. Infrequently found from Yarmouth to Cape Breton.
Veronica serpyllifolia ssp. humifusa	Thyme-Leaved Speedwell				S2S3	Moist soils, fields and roadsides. Common throughout.
Panicum tuckermanii	Tuckerman's Panic Grass				S3S4	Meadows and fields, shores of rivers and lakes.
Equisetum variegatum and var. variegatum	Variegated Horsetail				S3	Wetlands or wet seeps. Wide ranging in NS, with disjunct localities: Halifax County, Cumberland Co., Victoria Co.
Symphyotrichum undulatum	Wavy-leaved Aster				S2	Edges of fields and forests. Lunenburg Co. Queens, Hants, Kings and Halifax counties
Carex peckii	White-Tinged Sedge				S2?	Fry or mesic slopes, mixed deciduous forests, rocky outcrops, old quarries. King's Co., Rhodes Co., Lunenburg Co. Halifax and the Pennants area.
Lysimachia quadrifolia	Whorled Yellow Loosestrife				S1	Disturbed habitat, grassland, woodlands
Vallisneria americana	Wild Celery				S2	Ponds, lakes, and quiet streams at depths of 1 to 4 m. Colchester Co., Halifax Co., Cumberland Co. Reported from Northern Cape Breton.
Allium schoenoprasum and var. sibiricum	Wild Chives				S2	Disturbed habitats, floodplain, meadows and fields, ridges or ledges, shores of rivers and lakes.

Scientific Name	Common Name	SARA[i]	COSEWIC[ii]	NSESA[iii]	SRank[iv]	Habitat Requirements
Allium tricoccum	Wild Leek				S1	Hardwood forest, intervale
Juncus subcaudatus	Woods-Rush				S3	Conifer woods and spruce swamps, where substrate is soggy. Yarmouth to Kings and Halifax Counties. Richmond County
Juncus subcaudatus var. planisepalus	Woods-Rush				S3	Conifer woods and spruce swamps, where substrate is soggy. Yarmouth to Kings, Halifax Counties and Richmond County.
Dichanthelium acuminatum var. lindheimeri	Woolly Panic Grass				S1?	Open sites and sandy soils. Widespread and common.
Bartonia virginica	Yellow Bartonia				S3	Dry barrens, sandy or peaty soils, bogs, lakeshores. Common in southwestern counties becoming scarcer eat to Annapolis and Halifax; St. Peter's area of Cape Breton
Cypripedium parviflorum	Yellow Lady's-slipper				S2S3	Occasionally under mixed deciduous trees
Utricularia ochroleuca	Yellowish-white Bladderwort				S1	Rooted free floating plant
Lichens						
Cladina stygia	Black-footed Reindeer Lichen				S2S3	Most frequent in peatlands, particularly treeless bogs
Anzia colpodes	Black-foam Lichen				S3	This species occurs on the bark of hardwoods, and more rarely conifers, in humid forested habitats throughout temperate eastern North America.
Leptogium corticola	Blistered Jellyskin Lichen				S2S3	This lichen species is widespread and grows on the bases of hardwoods and occasionally on rocks in moist woods.
Collema furfuraceum	Blistered Tarpaper Lichen				S3	On bark of hardwood and sometimes coniferous trees, especially in old forests
Degelia plumbea	Blue Felt Lichen		SC	Vulnerable	S2	Mature forests within varying moisture regimes. Typically located in hardwood stands, with Red maple, Sugar maple, or Yellow Birch.

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Scientific Name	**Common Name**	**SARA**[i]	**COSEWIC**[ii]	**NSESA**[iii]	**SRank**[iv]	**Habitat Requirements**
Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen - Atlantic pop.	E	E	Endangered	S1S2	Mature to over mature Balsam Fir trees in open softwood forests with little to no regenerating understory. Typically, though not necessarily found in or near wetlands or wetland margins.
Physconia detersa	Bottlebrush Frost Lichen				S2S3	On bark and wood; occasionally on rock
Erioderma mollissimum	Graceful Felt Lichen	E	E	Endangered	S1S2	Mature to over mature Balsam Fir trees in open softwood forests with little to no regenerating understory. Typically, though not necessarily found in or near wetlands or wetland margins.
Sticta fuliginosa	Peppered Moon Lichen				S3	Grows on mossy bark
Fuscopannaria leucosticte	Rimmed Shingles Lichen				S1S2	On bark or occasionally rocks often among mosses.

[i] Government of Canada. 2015. Species at Risk Public Registry. Accessed online, 11 December 2015. https://www.registrelep-sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

[ii] Government of Canada. 2015. Committee on the Status of Endangered Wildlife in Canada. Accessed online, 11 December 2015. http://www.cosewic.gc.ca/eng/sct5/index_e.cfm

[iii] Province of Nova Scotia. 2015. Categorized List of Species at Risk made under Section 12 of the Endangered Species Act S.N.S. 1998, c. 11, N.S. Reg. 21/2015 (March 26, 2013). Accessed online, 11 December 2015. https://www.novascotia.ca/just/regulations/regs/eslist.htm

[iv] Atlantic Canada Conservation Data Centre. 2015. Status Ranks. Accessed online, 11 December 2015. http://accdc.com/en/ranks.html