ENVIRONMENTAL PREVIEW REPORT PURSUANT TO THE NEWFOUNDLAND AND LABRADOR *ENVIRONMENTAL PROTECTION ACT*

AGS Fluorspar Project St. Lawrence, NL
Volume 2, Appendix F-I

Submitted to:

Newfoundland and Labrador Department of Environment and Conservation, Environmental Assessment Division

Submitted by:
Canada Fluorspar (NL) Inc.

September 2015

APPENDIX F

Surface Water and Groundwater Quality Monitoring Program

SURFACE AND GROUNDWATER QUALITY MONITORING PROGRAM

The collection of local baseline water quality data is necessary to understand conditions in those areas that could potentially be affected by development of the Project. The Project area includes water bodies and watercourses upstream and downstream of the Project that could potentially receive mine-related discharge and/or could be adversely affected by regional mine-related development. Water quality information is also important to the interpretation of data to be collected as part of the baseline aquatic ecology program.

A preliminary surface water monitoring program was initiated in 2014 to establish background levels of various parameters in surface water around the Project site and support the permitting for the Project. Water quality results obtained during the program were compiled and presented in a baseline report (Golder 2015) along with a compilation of historical water quality data collected in the vicinity between 1984 and 2009.

1.0 CURRENT MONITORING PROGRAM

The basic approach to the water quality monitoring program will be to continue monitoring at the previously documented surface water quality locations, and initiate sampling at monitoring wells installed in 2014 and select historical monitoring wells.

The water quality baseline program will focus on the collection of surface and groundwater samples and in situ measurements of temperature, pH, dissolved oxygen, and conductivity (measured using a multi-parameter meter). Monitoring locations have been selected to characterize spatial and temporal variability in surface and groundwater based on the best understanding of site conditions in relation to the Project’s footprint.

1.1 Monitoring Locations

Monitoring locations were selected to reflect the site development plan. The Project area includes water bodies and watercourses upstream and downstream of the Project that could potentially receive mine-related discharge and/or could be adversely affected by regional mine-related development. Surface and groundwater quality sampling locations are identified in Table 1 and shown on Figure 1 and Figure 2, respectively.

Table 1: Proposed Surface and Groundwater Quality Sampling Locations

Station ID	Location	Northing	Easting
Surface water			
WQ STA 1	Upper Island Pond	5,195,500	617,488
WQ STA 2	Grebes Nest Pond outlet	5,196,191	616,862
WQ STA 3	John Fitzpatrick Pond outlet	5,196,679	617,043
WQ STA 4	Downstream from John Fitzpatrick Pond	5,197,032	616,903
WQ STA 5	Reference area	5,199,379	616,772
WQ STA 6	Downstream of John Fitzpatrick Pond	5,198,773	616,342
WQ STA 7	Downstream of Upper Island Pond	5,195,035	617,429
WQ STA 10	Downstream of Proposed Overburden Stockpile	5,197,158	616,067
WQ STA 11	Downstream of Proposed South Waste Rock Pile	5,196,374	615,776
WS – 10	Salt Cove Brook	5,193,512	620,347
WS – 2	Clarkes Pond outlet	5,195,673	621,983

Station ID	Location	Northing	Easting
WS – 5	Shoal Cove Pond outlet	5,194,407	622,011
Groundwater			
MW14-01A	John Fitzpatrick Pond	5,195,561	617,458
MW14-01B	John Fitzpatrick Pond	5,195,550	617,465
MW14-02A	Upper Island Pond	5,196,293	617,096
MW14-02B	Upper Island Pond	5,196,293	617,101
MW14-04A	Perimeter of mine footprint	5,196,695	615,673
MW14-04B	Perimeter of mine footprint	5,196,693	615,671
BH1	North of Shoal Cove Pond	5,195,125	622,036
BH1B	North of Shoal Cove Pond	5,195,125	622,034
BH8	Outlet of Shoal Cove Pond	5,194,227	622,112
BH8B	Outlet of Shoal Cove Pond	5,194,225	622,115

1.2 Monitoring Frequency

Water quality samples will be collected in the dry, transitional and wet seasons (i.e., August 2015, October 2015 and May 2016). Surface water quality samples will also be collected in February 2016. It is assumed groundwater within the monitoring wells will be frozen during the winter. The proposed sampling frequency was selected to capture seasonal and annual water quality variability.

1.3 Analytical Suite

The suite of parameters for analysis was chosen to be consistent with the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2007) and the Newfoundland and Labrador Environmental Control Water and Sewage Regulations (NL Reg. 65/03). The list of water quality parameters to be analyzed is provided in Table 2.

Table 2: Water Quality Parameter List

Parameter	Units	Detection Limits Recommended to Meet Guidelines [(a),(b)]	Holding Times (days)
Field Parameters			
Conductivity	µS/cm	0.1	-
Temperature	°C	-	-
pH	Units pH	-	-
Dissolved Oxygen	mg/L	0.5	-
Physicochemical 1 (FQ1)			
Conductivity	µS/cm	0.1	7 days
Total Dissolved Solids (TDS)	mg/L	1	7 days
Fluorides	mg/L	0.02	28 days
Total alkalinity	mg/L	5	7 days
hardness	mg/L	-	7 days
pH	units		7 days
N-Nitrite	mg/L	0.01	7 days

Parameter	Units	Detection Limits Recommended to Meet Guidelines [(a),(b)]	Holding Times (days)
N-Nitrate	mg/L	0.05	7 days
Chlorides	mg/L	1.0	7 days
Sulfates	mg/L	2	7 days
Turbidity	NTU	0.1	7 days
Total Suspended Solids (TSS)	mg/L	3	7 days
Total dissolved phosphorus	mg/L	0.002	6 months
Total phosphorus	mg/L	0.002	28 days
Physicochemical 2 (FQ2):			
Ammonia nitrogen		0.05	7 days
Total Nitrogen (TN)	mg/L	0.05	28 days
Bicarbonate	mg/L	-	7 days
Calcium	mg/L	0.1	7 days
Carbonate	mg/L	-	7 days
Magnesium	mg/L	0.1	7 days
Potassium	mg/L	0.1	7 days
Sodium	mg/L	0.1	7 days
Total and Dissolved Metals			
Aluminum (Al)	mg/L	0.01	7 days
Antimony (Sb)	mg/L	0.002	7 days
Arsenic (As)	mg/L	0.002	7 days
Barium (Ba)	mg/L	0.005	7 days
Beryllium (Be)	mg/L	0.002	7 days
Bismuth (Bi)	mg/L	0.002	7 days
Boron (B)	mg/L	0.005	7 days
Cadmium (Cd)	mg/L	0.0003	7 days
Chromium (Cr)	mg/L	0.002	7 days
Cobalt (Co)	mg/L	0.001	7 days
Copper (Cu)	mg/L	0.002	7 days
Iron (Fe)	mg/L	0.05	7 days
Lead (Pb)	mg/L	0.0005	7 days
Manganese (Mn)	mg/L	0.002	7 days
Mercury (Hg)	mg/L	0.000008	28 days
Molybdenum (Mo)	mg/L	0.002	7 days
Nickel (Ni)	mg/L	0.002	7 days
Selenium (Se)	mg/L	0.002	7 days
Silver (Ag)	mg/L	0.0005	7 days
Strontium (Sr)	mg/L	0.005	7 days
Thallium (Tl)	mg/L	0.0001	7 days
Tin (Sn)	mg/L	0.002	7 days
Uranium (U)	mg/L	0.0001	7 days
Vanadium (V)	mg/L	0.002	7 days
Zinc (Zn)	mg/L	0.005	7 days
Radionuclides			
Ra-226	Bq/L	0.05	3 days

(a) CCME (Canadian Council of Ministers of the Environment), 2007. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Winnipeg.

(b) Newfoundland and Labrador Water Resource Act, 2003. Environmental Control Water and Sewage Regulations. Newfoundland and Labrador Regulation 65/03.

Note that not all parameters may necessarily be analysed for at each location or during each sampling program. In particular, radium 226 will be analyzed only during the first round of sampling to confirm concentrations are below the applicable criteria. The parameter list will be reviewed prior to each sampling program.

1.4 Field Quality Control Procedures

The water quality field quality control (QC) program will consist of the collection and analysis of field equipment blanks, and duplicate samples. Each QC sample type is described below:

- Field equipment blanks consist of de-ionized water provided by the analytical laboratory, which is exposed to the sampling environment at the sample site and handled in the same manner as the surface water samples collected during the field program (e.g., preserved, filtered). Field equipment blanks are used to detect potential sample contamination during sample collection, handling, shipping and analysis.
- Duplicate samples (or replicate samples, depending on the number collected) are additional samples collected at the same time and location as surface water samples collected during a field program, using the same sampling methods. They are used to check within-site variation, and the precision of field sampling methods and laboratory analysis.

Quality control samples collected during a field program will account for approximately 10% of the total number of samples submitted for analysis. These samples will be handled, stored and shipped along with field-collected surface water samples, and will be submitted “blind” to the analytical laboratories. Quality control samples will be analyzed for the same set of parameters as the samples collected from surface waters. Field equipment that is used to measure (i.e. weight, water quality parameters, etc.) will be calibrated prior to use in the field.

REFERENCES

CCME (Canadian Council of Ministers of the Environment), 2007. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Winnipeg.

Golder Associates Ltd., 2015. 1407707_DOC0013_Rev 1_Water Quality Baseline Report_20May2015

Newfoundland and Labrador Water Resource Act, 2003. Environmental Control Water and Sewage Regulations. Newfoundland and Labrador Regulation 65/03.

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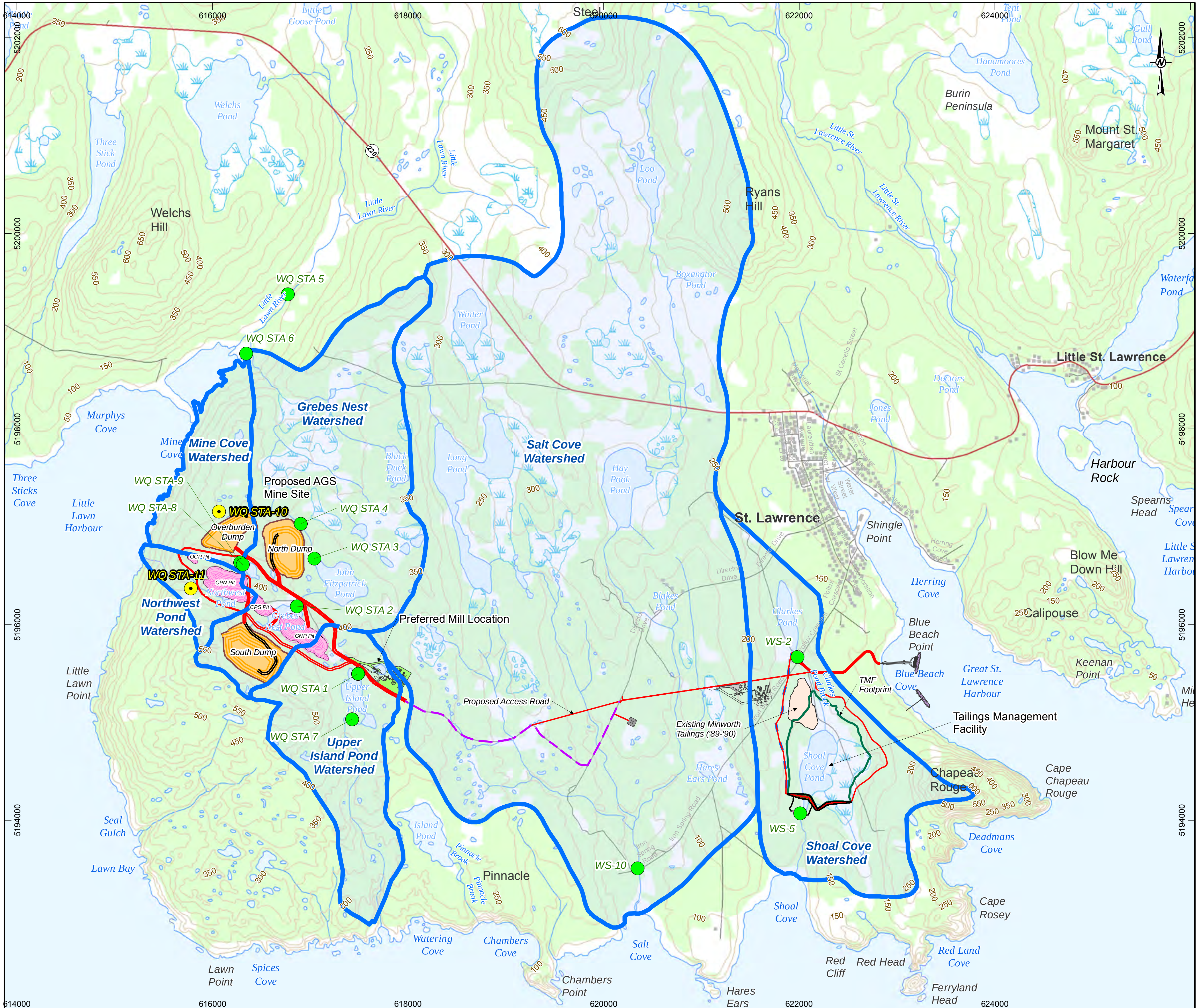

LEGEND

PROJECT COMPONENTS

- Clarkes Pond Diversion Channel
- Proposed Road
- Proposed Upgraded Road
- TMF Footprint
- Final Tailings Dam
- Settling Pond Dam
- Saddle Dike
- Existing Minworth Tailings
- Mine Dump Option
- Pit

WATER QUALITY COMPONENTS

- Proposed Sampling Site
- Surface Water Sampling Site
- Watershed Area

TOPOGRAPHY

- Building
- Highway
- Existing Road
- Contour Line (interval: 50 ft)
- Watercourse
- Waterbody
- Wetland

0 1 2

Kilometres

1:40,000

REFERENCE

SOURCE(S): CANVEC & CANVEC+, 1: 50 000 SCALE, NRCAN.

DATUM: NAD 83. PROJECTION: UTM ZONE 21.

CLIENT

CANADA FLUORSPAR INC.

PROJECT

BASELINE WATER QUALITY PROGRAM

TITLE

PROJECT WATERSHEDS AND WATER QUALITY SAMPLING

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-05-22
DESIGN	DL
GIS	RS
REVIEW	DFL
APPROVED	

PROJECT No.	Rev.	FIGURE
14-07707	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

LEGEND

- Groundwater Monitoring Well

PROJECT COMPONENTS

- Clarkes Pond Diversion Channel
- Proposed Road
- Proposed Upgraded Road
- TMF Footprint
- Final Tailings Dam
- Settling Pond Dam
- Saddle Dike
- Existing Minworth Tailings
- Mine Dump Option
- Pit

TOPOGRAPHY

- Building
- Highway
- Existing Road
- Contour Line (interval: 50 ft)
- Watercourse
- Waterbody
- Wetland

0 1 2
Kilometres
1:35,000

REFERENCE

SOURCE(S): CANVEC & CANVEC+, 1: 50 000 SCALE, NRCAN.

DATUM: NAD 83. PROJECTION: UTM ZONE 21.

CLIENT

CANADA FLUORSPAR INC.

PROJECT

BASELINE WATER QUALITY PROGRAM

TITLE

GROUNDWATER QUALITY SAMPLING LOCATIONS

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-07-22
DESIGN	DL
GIS	RS
REVIEW	DFL
APPROVED	

PROJECT No. 14-07707 | Rev. 0 | FIGURE 2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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APPENDIX G

Stage 1 Screening Level Geochemistry Assessment, Stage 2 and 3 Geochemistry Characterization Program

TECHNICAL MEMORANDUM

DATE August 27, 2015 **PROJECT No.** 0015_1407707 Rev 0

TO Frank Pitman
Canada Fluorspar Inc.

CC Michel Wawrzkow, Norman Wilson, Phonce Cooper, Daryl Johannesen

FROM Dan LaPorte and David Brown **EMAIL** dlaporte@golder.com

CANADA FLUORSPAR INC.
STAGE 1 SCREENING LEVEL GEOCHEMISTRY ASSESSMENT

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Canada Fluorspar Inc. (CFI) to conduct a geochemistry characterization program in support of the proposed AGS Project (the Project). The Project is located in St. Lawrence, in the province of Newfoundland and Labrador (NL). The Project will include construction, operation, rehabilitation and closure of a surface and underground Mine, a Mill, a Tailings Management Facility (TMF), ancillary infrastructure, and a Marine Terminal (Project). The proposed Project will be located partly on a brownfield site used historically for mining. The site is located entirely within the municipal boundaries of the Town of St. Lawrence, on the southern tip of the Burin Peninsula in Newfoundland.

The overall objective of the geochemistry characterization program is to determine the acid generating and metal leaching potential of the waste materials (i.e., ore, waste rock, tailings and dense medium separation (DMS) floats) that will be produced as part of the Project. The geochemistry characterization program is being conducted in phases. Stage 1 is a screening level assessment and includes static testing of a select number of samples to gain an initial understanding of the acid generating and metal leaching potential of the mine wastes and ore. Stage 2 is proposed to be conducted once the mine plan has been finalized and will include additional static testing of the mine waste to ensure appropriate spatial and compositional assessment of acid generation and metal leaching. Stage 3 would be conducted after Stage 1 and Stage 2 are complete and consists of long-term geochemical leach testing (Kinetic Tests) conducted on a limited number of samples.

This technical memorandum presents the results for the Stage 1 geochemistry program and includes analysis of ore, waste rock, tailings, and dense media separation (DMS) float samples.

2.0 PROJECT DESCRIPTION

The proposed AGS mine will consist of four open pits; future underground mine workings; waste rock, overburden, and topsoil dumps/stockpiles; and haul/access roads (Figure 1). The four open pits include: Open Cut Pit (OCP), Central Pit North (CPN), Central Pit South (CPS) and Grebes Nest Pit (GNP). Depth of the open pits will range between 35 m and 145 m. A total of about 27 Million tonnes of waste rock will be generated during the life of the Project. This material will be stored in the two waste rock dumps shown on Figure 1 and some of it will also be used for construction of infrastructure. In addition, overburden and topsoil stockpiles will be established and used throughout the various Project phases for progressive rehabilitation and final site closure.

The TMF is being designed to accommodate 2.8 Million tonnes (or about 2 Million m^3) of flotation tailings generated at the Mill. The TMF will be located at Shoal Cove Pond, where tailings were disposed of from the early 1930s to the late 1950s. This area was selected as a preferred site for tailings disposition, partly because of its historical use during previous mining activities. The TMF at Shoal Cove Pond also can be expanded to accommodate more tailings in the future by increasing the height of the tailings dam should expansion to the Project be considered in the future.

DMS floats will be produced as a by-product of the milling process. The current mine plan at the time of sampling proposed using this material as construction material for the Project or potentially selling as a construction aggregate.

3.0 SITE GEOLOGY

The St. Lawrence area is part of the Avalon Zone of the Appalachian mountain chain in eastern NL. This Zone is characterized by thick dominantly subaerial, volcanic rocks and marine to terrestrial clastic sedimentary rocks of the Late Precambrian Age. These rocks are locally overlain by shallow marine sedimentary and minor volcanic rocks of Cambrian age. Both sequences are locally overlain with angular unconformity by Devonian and Carboniferous age sedimentary and volcanic rocks. The Avalon Zone is intruded by several Late Precambrian and Late Devonian to Carboniferous granites (Roscos Postle Associates (RPA) 2013; Agnerian 2015).

The Project area is primarily underlain by the Late Devonian St. Lawrence Granite and associated porphyritic rocks of similar composition. The porphyritic rocks are locally referred to as rhyolites, and these form sills and dykes within the host metasedimentary rocks at the Mine Site. These igneous rocks intrude older Late Precambrian to Ordovician metasedimentary (argillite) and minor metavolcanic rocks of the Inlet Group. The metavolcanic rocks include porphyritic andesite, lithic and crystal tuff, and brecciated tuff (RPA 2013; Agnerian 2015).

The St Lawrence area hosts at least 40 fluorite veins that range up to 3 km in length and, in some places, exceed 30 m in thickness. These veins are genetically and spatially associated with the St Lawrence Granite and its associated porphyritic rocks. These veins typically follow major faults that cut through the granitic/rhyolitic and metasedimentary rocks of the Project Area. Mineralization at the Project differs from other fluorite veins in the St. Lawrence area as it is predominantly hosted by metasedimentary rocks.

Detailed mineralogy was completed on the ore zone (high and low carbonate ore) using Quantitative Evaluation of Materials by Scanning Electron Microscopy (QEMSCAN). Calcite concentrations were 3.96% and 10.8% in the low and high carbonate ore, respectively. Sulphide concentrations ranged from 1.20 to 1.28% with the main sulphide mineral being sphalerite with trace amounts of galena, pyrite and chalcopyrite.

4.0 SAMPLING PROGRAM

The preliminary data collection of the geochemical characterization program consisted of three components: sample selection, sample collection, and sample analysis (geochemical testing program); the methodology of these components is described in the following sections.

4.1 Sample Selection

The objective of the sample selection process was to collect rock core samples of the main rock units associated with the Project deposit; metasediment and rhyolite. Samples were selected from the 2014 boreholes based on the drilling program provided by CFI. Boreholes were selected across the potential ore zone to ensure the proposed samples were spatially representative of the Project (Figure 1). Depths of the samples were selected for vertical distribution of the metasediments and rhyolite where possible. Although the current mine plan is shown on Figure 1, the mine plan was not available at the time of the borehole and sample selection process. Based on preliminary information, it was estimated that the waste rock would consist of approximately 70% metasediments and 30% rhyolite. Actual expected tonnages of waste rock were not known at the time. The rock core samples submitted for geochemical analysis are summarized in Table 1.

A metallurgical program is currently ongoing at SGS Canada Inc. Lakefield (SGS Lakefield). As part of the program, a high carbonate and low carbonate ore are being processed with DMS floats and tailings being produced as by-product and mill waste, respectively. Samples of both the low and high carbonate ore, DMS floats (one from each ore sample) and tailings (low carbonate ore only) have been collected and submitted for geochemical analysis. At the time of reporting, processing tests of the high carbonate ore had commenced however, no tailings had been generated.

4.2 Sample Collection

Rock core samples were collected by CFI site geologists consistent with the following procedures:

- Rock core observed in the field had the following information from the drill hole logs and core recorded:
  - a description, including a unique sample number, drill hole, and sample depth/interval; and
  - rock type.
- Approximately 5 kilograms (kg) of core for each sample was collected to conduct laboratory tests. The samples were collected as follows:
  - The sample was collected over a 10 metre (m) interval depending on lithology. Smaller intervals were sampled where 10 m intervals of lithology do not exist. To collect a sample from discrete rock types, in some instances, shorter intervals were sampled where the continuity of the rock type along the core depth was less than 10 m.
  - Sub-samples of rock core were taken from 1 m intervals (for example a 10 m sample interval requires 10 sub-samples of about 0.5 kg each).
  - Each sub-sample was approximately equal in weight and visually representative of the interval of the core.
  - The sub-samples were combined into a single sample bag to comprise the sample for the interval.
  - The sample bag was labelled with a unique sample identification number.

Metallurgical testing is currently being conducted on low and high carbonate ore. SGS Lakefield collected samples of ore, DMS floats and tailings during this testing. Tailings samples were collected only from the low carbonate ore processing. There are currently two potential options for the tailings stream that includes the possibility of sulphide removal (e.g., tailings deposited with or without sulphides). Therefore, two samples of tailings, one with and one without sulphide concentrate were submitted for analysis. Since the samples were collected from the low carbonate ore, the tailings with sulphide concentrate can be considered the worst-case end member in terms of potential acid generation.

4.3 Sample Analysis

SGS Lakefield completed the following geochemical analyses on rock core, ore, DMS float and tailing samples:

- Elemental analysis – used to estimate the total amount of metals in the solid phase of the samples.
- Acid-Base Accounting (ABA) − the modified Sobek method (Sobek et al. 1978) was used to develop estimates of the potential for acid generation based on the balance between acid producing and acid neutralizing minerals.
- Net Acid Generation (NAG) test – performed according to the method recommended by AMIRA (2002) to determine the acid generation potential under highly oxidizing conditions.
- Short-term leach testing – Shake flask extraction (SFE) used to develop initial estimates of metal leaching potential of the material in de-ionized (DI) water. The method is described in MEND (2009), using DI water at a 3:1 liquid to solid ratio and shaken for 24 hours.

The following sub-section outlines the details of the testing methods.

4.3.1 Elemental Analysis

Whole rock and bulk metals analyses were conducted to quantify the elemental composition of the materials. Whole rock analysis determines the concentrations of major oxide species by borate fusion / X-ray fluorescence (XRF) to determine the percentage of the following major elements, reported as oxides: Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, TiO_2, and V_2O_5. Bulk metal analysis determines the concentrations of major and trace elements by a multi-acid leach followed by Inductively-Coupled Plasma (ICP) analysis to determine the concentrations of the following elements: Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, F, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V, Y and Zn.

4.3.2 Acid-Base Accounting

ABA measures the bulk quantities of acid generating minerals (e.g., sulphide minerals) and acid neutralizing minerals (e.g., carbonate minerals) to assess whether the materials tested will have sufficient capacity to neutralize the acid potential or if the materials have the potential to generate acidic effluents. The methodology performed on the samples is a modified Sobek method (Sobek et al. 1978) that includes analysis for paste pH, sulphur species (total sulphur, sulphate content and sulphide content), acid potential (AP) and neutralization potential (NP), and carbon species (total carbon and carbonate content). Detailed descriptions of the ABA methods are found in MEND (2009).

4.3.3 Net Acid Generating Tests

Along with ABA, NAG is used as a tool to classify acid generating or non-acid generating materials. The method consists of adding hydrogen peroxide to the sample to induce complete oxidation of the sulphide minerals (and other minerals readily susceptible to oxidation) in the sample. The acid produced as a result of sulphide oxidation reacts with neutralizing minerals. Once the oxidation reaction is complete, the final pH is measured.

4.3.4 Short-term Leach Tests

Short-term leach testing was conducted on all samples to evaluate the metal leaching potential under laboratory conditions. The results of short-term leach tests are commonly used to estimate the potential composition of water that comes into contact with test materials. It is important to note, however, that the results of short-term leach tests do not directly measure the expected effluent chemistry of the test material under ambient conditions.

SFE leach testing was completed to measure the concentrations of constituents in the sample leachate that are readily soluble in water. The SFE leach method is described in Price (1997) and MEND (2009). Samples are mixed with DI water at a 3:1 liquid to solid ratio in an extraction vessel. The vessel is shaken immediately and an initial pH is recorded. The slurry is then shaken for twenty-four hours, after which a final pH is measured and the supernatant is extracted for metal analysis including the following elements: Ag, Al, As, Ba, B, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V, W, Y, and Zn.

4.3.5 Tailings Water

Decant water tests on the water that was associated with the tailings was performed. The sample was tested for the following:

- pH, alkalinity, conductivity, acidity, sulphate, chloride, fluoride; and
- dissolved metals including; Ag, Al, As, Ba, B, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, and Zn.

5.0 RESULTS

5.1 Elemental Analysis

The results of the whole rock and bulk metal analyses are presented in Table 2 and Table 3, respectively. The bulk metal compositions are compared to the typical crustal abundance of elements presented in Price (1997) for the purpose of identifying metals which could be susceptible to metal leaching (Table 3). The results of parameters that exceed typical crustal abundance by at least five times in the majority of samples are summarized as follows:

- The metasediments consisted predominantly of SiO_2, Al_2O_3 and Fe_2O_3 with trace amounts of MgO, Na_2O, K_2O, TiO_2 and Loss on Ignition (LOI). Rhyolite consists predominantly of SiO_2 and Al_2O_3 with trace amounts of Fe_2O_3, Na_2O and K_2O. Ore samples consisted of SiO_2 and CaO with trace amounts of Al_2O_3, Fe_2O_3, K_2O and LOI. DMS floats and tailings consisted of SiO_2, Al_2O_3, CaO and LOI with trace amounts of Fe_2O_3, Na_2O and K_2O.
- Silver concentrations ranged from 0.26 – 0.41 parts per million (ppm) in metasediment, 0.37 – 0.46 ppm in the rhyolite, 1.0 – 1.8 ppm in the ore, 0.52 – 0.55 ppm in the DMS float and 3.0 – 7.0 ppm in the tailings. Nine samples including one metasediment, two rhyolite, and both ore, DMS floats and tailings had concentrations that were at least 5 times the crustal abundance.
- Arsenic concentrations ranged from 1.6 – 37 ppm in metasediment, 2.4 – 5.8 ppm in the rhyolite, 25 – 63 ppm in the ore, 18 ppm in the DMS float and 31 – 86 ppm in the tailings. Six samples of metasediment and both samples of ore, DMS float and tailings had concentrations that were at least 5 times the crustal abundance.

- Bismuth concentrations ranged from 0.16 – 0.61 ppm in the metasediment, 0.23 – 0.60 ppm in the rhyolite, 0.43 – 0.88 ppm in the ore, 0.51 – 0.82 ppm in the DMS floats and 0.56 – 2.3 ppm in the tailings. All samples were more than 10 times the crustal abundance.
- Fluoride concentrations ranged from 850 – 1,800 ppm in the metasediment, 970 – 8,000 ppm in the rhyolite, 261,600 – 432,500 ppm in ore, 58,100 – 74,200 ppm in DMS float, and 50,800 – 57,800 ppm in the tailings. All samples had concentrations that were at least 10 times the crustal abundance.
- Lead concentrations ranged from 23 – 95 ppm in the metasediment, 46 – 59 ppm in the rhyolite, 900 – 1,300 ppm in the ore, 48 – 190 ppm in the DMS float and 360 – 3,700 ppm in the tailings. Seven samples including two metasediment, two ore, one DMS float and two tailings had concentrations of at least 5 times the crustal abundance.
- Lithium concentrations ranged from 130 – 210 ppm in the metasediment, 7 – 26 ppm in the rhyolite, 62 – 74 ppm in the ore, 72 – 87 ppm in the DMS float, and 140 – 150 ppm in the tailings. All seven metasediment and both tailings samples had concentrations of at least 5 times the crustal abundance.
- Antimony concentrations ranged from 0.9 – 2.8 ppm in the metasediment, <0.8 – 0.9 ppm in the rhyolite, 4.2 – 7 ppm in the ore, 1.7 – 2 ppm in the DMS float and 18 – 34 ppm in the tailings. Twelve samples including six samples of metasediment and both samples of ore, DMS float and tailings had concentrations at least 5 times the crustal abundance.

Other parameters that exceeded crustal abundances in at least one sample included calcium, molybdenum, selenium, yttrium and zinc.

5.2 Acid Base Accounting and Net Acid Generation Testing

The ABA results are presented in Table 4 and Figures 2 to 5. The ABA results were interpreted using the guidelines and criteria outlined in MEND (2009). Acid potential (AP), is calculated using the sulphide-sulphur concentration measured in a sample. NP is measured by titration, and indicates the bulk capacity of a sample to neutralize acidity by the dissolution of readily-available carbonate minerals as well as less soluble minerals (e.g., aluminosilicates, silicates, etc.). The carbonate neutralization potential (CO_3-NP) is a calculated value that represents the acidity that the sample can potentially consume through the dissolution of carbonate minerals. The CO_3-NP is calculated from the carbonate content (wt% as CO_3). The results for AP, NP and CO_3-NP are all reported in tonnes $CaCO_3$/1000 tonnes ($tCaCO_3$/1000t).

The NP and CO_3-NP are typically compared for the purpose of evaluating the mineralogical source of NP in a sample. The difference between the NP and CO_3-NP is that the NP represents the ‘bulk’ neutralization potential, whereas CO_3-NP is solely based on the carbonate content of a sample. Thus, in addition to the consumption of acid by readily soluble carbonate minerals, the ‘bulk’ NP incorporates the consumption of acid by less soluble aluminosilicate, silicate and/or other minerals. If the NP is approximately equal to the CO_3-NP, the NP is likely attributable to the dissolution of carbonate minerals. In cases where the NP is significantly greater than CO_3-NP, the NP could be overestimated due to the partial dissolution of the less soluble, non-carbonate minerals. The rate of aluminosilicate or silicate mineral dissolution is generally too slow to provide effective neutralizing capacity under ambient field conditions. However, aluminosilicate and silicates can be the predominant neutralizing mineral phases under low-pH conditions or where water-rock interaction times are long.

An evaluation of the acid generation potential was conducted using the ABA results. Acid generation potential is commonly interpreted according to the ratio of NP to AP, referred to as the neutralization potential ratio (NPR), according to the guidelines recommended by MEND (2009) and described in Table 5.

Table 5: Acid Generation Potential Criteria

Acid Generation Potential	Criteria	Comments
Potentially Acid Generating (PAG)	NPR or CO_3-NPR < 1	Potentially acid generating
Uncertain	1 ≤ NPR or CO_3-NPR ≤ 2	Possibly acid generating if NP is insufficiently reactive or is depleted at a rate faster than sulphides.
Non-potentially Acid Generating (Non-PAG)	NPR or CO_3-NPR > 2	Not expected to generate acidity.

Note: Taken from MEND (2009).

Using bulk NP in the NPR calculation accounts for less reactive silicate minerals as well as the more reactive carbonate minerals. CO_3-NP can be used in the NPR calculations (CO_3-NPR = CO_3-NP / AP) to account for buffering capacity from carbonate minerals only and ignores the neutralizing capacity of the more slowly reacting minerals. Therefore, CO_3-NPR is also presented and used in assessing the ARD potential.

For several reasons, no single NPR is universally applicable with respect to acid generation prediction. Because no single criterion is universally applicable with respect to acid generation prediction, determining the potential for acid generation is not solely based on the NPR criteria, but also on the results of other geochemical analyses (NAG and kinetic test work), up-to-date technical guidance, and professional interpretation. The actual threshold values for a particular test sample are material specific, and could depend on several factors, including chemical and mineralogical composition (i.e., presence and amounts of acid generation and neutralization minerals), morphology (i.e., grain size, texture and crystallinity), long-term weathering and site-specific exposure conditions.

Sulphur Species

The concentrations of total sulphur, sulphide and sulphate contents (all wt% as S) were measured as part of the ABA analyses. The sulphide content is plotted as a function of total sulphur in Figure 2. Sulphide contents range from 0.01 – 0.10 wt% as S in the metasediment, <0.01 wt% as S in the rhyolite, 0.09 – 0.26 wt% as S in the ore, 0.02 – 0.04 wt% as S in the DMS floats and 0.4 – 0.9 wt% as S in the tailings.

Added to Figure 2 is a 1:1 reference line to assess the speciation of the sulphur minerals in the samples. Data points that lie along this line indicate that the sulphur present is in the form of sulphide, presumably as sulphide minerals. As the sample moves below the reference line, the sulphate-sulphur form is increasingly present. All the samples plot below the 1:1 reference line, but closer to the 1:1 reference line than the x-axis; this indicates that sulphide is the dominant sulphur species with some minor sulphate presence. Sulphide and sulphate mineralogy could have ramifications with respect to acid generation potential and leachability of the materials.

QEMSCAN results for the ore show that the dominant sulphide species at the Project is sphalerite with trace amounts of galena, pyrite and chalcopyrite.

Neutralization and Carbonate Neutralization Potentials

Neutralization Potential values ranged from 9 – 12 $tCaCO_3$/1000t in the metasediment, 6.4 – 8.7 $tCaCO_3$/1000t in the rhyolite, 70 – 129 $tCaCO_3$/1000t in the ore, 91 – 177 $tCaCO_3$/1000t in the DMS floats and 94 – 97

$tCaCO_3$/1000t in the tailings. Carbonate neutralization potential (CO_3-NP) ranged from 0.083 – 1.2 $tCaCO_3$/1000t in the metasediment, 0.083 $tCaCO_3$/1000t in the rhyolite, 45 – 106 $tCaCO_3$/1000t in the ore, 73 – 159 $tCaCO_3$/1000t in the DMS floats and 50.7 – 69.4 $tCaCO_3$/1000t in the tailings.

CO_3-NP is presented as a function of bulk NP in Figure 3A (waste rock) and Figure 3B (ore, DMS floats and tailings). To assess the proportion of NP that consists of CO_3-NP, a 1:1 reference line was added to the graph. Where NP is equal to the CO_3-NP, the NP is derived solely from carbonate minerals. Sample points that are located below the 1:1 reference line have some proportion of bulk NP from non-carbonate minerals, such as aluminosilicate and silicate minerals. The metasediment and rhyolite samples (Figure 3A) plot predominantly along the x-axis, well below and to the right of the 1:1 reference line in this case. The higher NP values compared to CO_3-NP indicates that the majority (i.e., >90%) of the acid neutralization potential in the waste rock is from non-carbonate minerals, such as aluminosilicate and silicate minerals. As previously discussed, the rate of aluminosilicate and silicate mineral dissolution is generally too slow to provide effective neutralizing capacity under ambient field conditions. The ore, DMS float and tailings samples (Figure 3B) plot along and slightly below the 1:1 reference line indicating that the majority of neutralization potential is from carbonate minerals.

Acid Generation Potential

The NPR values, calculated as NP / AP, are presented in Table 4; these are compared to the MEND (2009) Acid Generation Potential Criteria that are presented in Table 5. The neutralization potential of the samples are also plotted against the acid potential in Figure 4A (waste rock) and Figure 4B (ore, DMS floats and tailings) along with reference lines representing the MEND (2009) criteria. All samples of waste rock (Figure 4A), ore, DMS floats and tailings (Figure 4B) have NPR values greater than 2 and are classified as non-acid generating.

The CO_3-NPR value was also calculated, which in most cases, is a more conservative estimate of the acid generation potential of a material, as it only accounts for the NP from the relatively more reactive carbonate minerals. The CO_3-NP versus AP values were plotted in Figure 5A (waste rock) and Figure 5B (ore, DMS floats and tailings), along with the MEND (2009) criteria. The metasediment and rhyolite (Figure 5A) have values between 0.13 – 1.6 and are classified as potentially acid generating. Testing will be completed on additional waste rock samples during Stage 2 to confirm the acid generating characteristics of the waste rock. The ore, DMS float and tailings sample without sulphide concentrate (Figure 5B) have CO_3-NPR values between 5.6 – 254 and are considered non-acid generating. The tailings sample with sulphide concentrate has a CO_3-NPR value of 1.9 and is classified as having an uncertain potential to generate acidic conditions. Depending on mineral reactions, it is possible that the tailings sample with sulphide concentrate could be acid generating. However, the tailings were collected from the processing of the low carbonate ore which represents only approximately 30% of the ore. Therefore, the tailings with sulphide concentrate is considered a “worst-case” scenario and not representative of the expected geochemical composition during mining. Once static test results on the tailings are available from the high carbonate ore, a more detailed assessment regarding the acid generation potential of the tailings can be conducted.

Net Acid Generation Testing

NAG testing was completed on all 16 samples. During the NAG test, hydrogen peroxide is added to a sample in quantities sufficient to completely oxidize the sulphide minerals. The pH of the oxidized solution was measured after the completion of the reaction to determine the NAG pH. The NAG pH is a useful indicator of whether a sample contains sufficient internal buffering capacity to neutralize the acidity produced through sulphide oxidation and can be used to verify the results of the ABA testing to determine which samples are potentially acid generating. According to the recommendations in AMIRA (2002) and MEND (2009), samples reporting a

NAG pH value greater than 4.5 are classified as non-acid generating and samples reporting a pH value below 4.5 are classified as potential acid generating.

NAG pH values range from 6.3 – 7.7 in the metasediment, 7.3 – 7.4 in the rhyolite, 9.1 – 9.3 in the ore, 9.9 – 10 in the DMS float and 9.0 – 9.3 in the tailings, indicating that all the samples are classified as non-acid generating based on the NAG testing.

5.3 Short-Term Leach Testing

The results of short-term leach testing are presented in Table 6 (SFE Leach testing). Metal concentrations and pH values in the leachate were compared to the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 2007) and the Newfoundland and Labrador Environmental Control Water and Sewage Regulations (EWSR) (2003) for purposes of determining parameters that may need to be further evaluated as part of an overall site water quality prediction. The average baseline surface water concentrations from Golder (2015) are also presented for comparison. Although the leach test results are compared to surface water quality guidelines, it is important to note that these guidelines do not apply to leach test results and therefore should not be interpreted within a regulatory context. Where guidelines are calculated, the guideline was selected based on the pH and hardness values.

The results of the SFE leach tests (Table 6) are summarized as follows:

- The pH values ranged from 7.9 – 9.0 in the leachate from the waste rock, ore and DMS floats.
- Fluoride concentrations ranged from 0.45 – 9.9 mg/L and were greater than CCME (0.12 mg/L) in all samples.
- Arsenic concentrations ranged from 0.001 – 0.098 mg/L and were greater than CCME (0.005 mg/L) in ten samples including; six metasediment samples, one rhyolite, one DMS float sample and both tailings samples.
- Copper concentrations ranged from 0.00027 – 0.015 mg/L and were greater than CCME (0.002 – 0.004 mg/L) in both tailings samples.
- Iron concentrations ranged from <0.002 – 0.40 mg/L and were greater than CCME (0.3 mg/L) in one metasediment sample (14-CF-010).
- Lead concentrations ranged from 0.00007 – 0.011 mg/L and were greater than CCME (0.001 – 0.007 mg/L) in one metasediment (14-CF-010), the low carbonate ore, both DMS float samples and both tailings samples.

All other parameters were below CCME and ECWSR in the SFE leachate. With the exception of arsenic concentrations (all samples), copper concentrations (ore and tailings) and lead concentrations (ore and tailings), parameter concentrations in the SFE leachate are consistent with the baseline water quality from select streams and ponds within the vicinity of the Project (Golder, 2015).

5.4 Tailings Water

Decant water analysis results for the tailings water are reported in Table 7. The combined tailings samples reported a pH of 8.2 in the supernatant water. The sample reported the following concentrations exceeding the environmental criteria:

- Fluoride concentrations (5.6 mg/L) exceeded CCME (0.12 mg/L);
- Arsenic concentrations (0.019 mg/L) were greater than CCME (0.005 mg/L) but less than ECWSR (0.5 mg/L);
- Copper concentrations (0.0041 mg/L) were greater than CCME (0.004 mg/L) but less than ECWSR (0.3 mg/L);
- Iron concentrations (0.36 mg/L) were greater than CCME (0.3 mg/L) but less than ECWSR (10 mg/L); and
- Lead concentrations (0.015 mg/L) were greater than CCME (0.007 mg/L) but less than ECWSR (0.2 mg/L).

All other parameters were within the CCME and ECWSR criteria. The results of the tailings water analysis are consistent with the results from the tailings short-term leach test and the baseline water quality results (Golder, 2015).

6.0 SUMMARY AND CONCLUSIONS

A total of sixteen samples, including; 10 waste rock, 2 ore 2 DMS float and 2 tailings samples were collected from the Project to conduct a preliminary geochemical characterization. Geochemical static test work was completed on all sixteen samples to evaluate the potential for acid generation and metal leaching.

Acid Generation Potential

ABA testing was completed on all sixteen samples to determine the acid generating potential of the waste rock, ore, DMS floats and tailings. All samples of waste rock, ore, and DMS float had neutral to slightly alkaline paste pH values and low sulphide contents (<0.9 wt% as S). Based on the MEND (2009) NPR / CO_3-NPR criteria, all waste rock samples have NPR values greater than 2 and are classified as non-acid generating. The metasediments and rhyolite waste rock samples have low carbonate contents but also have low sulphide contents. These waste rock samples have CO_3-NPR values less than 1 and testing on additional samples will be completed to confirm acid generating characteristics. Ore and DMS float samples have NPR and CO_3-NPR values greater than 2 and are classified as non-acid generating. NAG pH values for all samples were greater than 4.5, which classifies all the samples as being non-acid generating. Based on the ABA and NAG test results of the waste rock, ore, DMS float and combined tailings samples collected from the AGS project, are considered to be non-acid generating.

The tailings sample with sulphide concentrate has a CO_3-NPR value between 1 and 2 and has an uncertain potential to generate acidic conditions. However, this sample is considered non-acid generating based on the NAG tests. The tailings samples were collected from processing of low carbonate ore which only represents approximately 30% of ore. The combined tailings with sulphide concentrate is considered the worst case in terms of geochemical properties of the expected tailings. Since the majority of tailings will come from the high carbonate ore (approximately 70%) which has approximately 2 times the amount of carbonate based on the ABA results (Table 4), the tailings potential to generate acidic conditions will be assessed further once the test data on the high carbonate ore tailings becomes available.

Metal Leaching Potential

The results of short-term leach test indicate that metal leaching from the waste rock, ore and DMS float does not appear to be an issue under neutral pH conditions. In the SFE results, fluoride concentrations were above CCME guidelines in all samples while select metals (e.g., arsenic, chromium, copper, and lead) were above either CCME or ECWSR guidelines in at least one sample. Parameter concentrations in the leach test results were consistent with the results of the baseline water quality program, with the exception of arsenic in the waste rock and copper and lead in the ore and tailings (Golder, 2015).

The tailings decant water reported elevated concentrations of fluoride, arsenic, copper, iron and lead compared to CCME guidelines consistent with the short-term leach test results of the tailings and the baseline water quality (Golder, 2015). Therefore, SFE results are a good indicator of expected tailings porewater concentrations.

7.0 RECOMMENDATIONS

The overall objective of the geochemistry characterization program is to determine the acid generating and metal leaching potential of the waste materials (i.e., waste rock and tailings) and ore that will be produced as part of the Project. Based on the results of the Stage 1 screening level assessment, the following recommendations are proposed for additional characterization (Stage 2 and 3). Additional geochemical testing of waste rock and tailings is proposed once the mine plan has been determined and should include additional static testing (Stage 2). Samples of waste rock should be selected to ensure appropriate spatial and compositional assessment. The need for long-term geochemical leach testing (Stage 3) should be assessed once static testing is completed. Additional testing on the ore and DMS floats is not recommended as the existing data does not indicate that these materials are potentially acid generating or metal leaching.

The geochemical work program should be consistent with the recommendations of the following recognized documents:

- MEND (Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials 2009);
- Guidelines for Acid Rock Drainage (GARD) Guide (INAP 2013); and
- Price (DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia 1997).

Sampling and testing according to the guidelines is considered a minimum requirement for the evaluation of acid generation and metal leaching. Although the level of effort recommended by these guidelines is generally accepted, each Project should be evaluated independently.

7.1 Waste Rock

As part of the Stage 2 geochemistry assessment, it is proposed that the following be undertaken:

- review of mine plan;
- collect additional samples of the meta sediments and rhyolite; and
- complete laboratory testing.

7.1.1 Mine Plan Review and Sample Selection

Before samples can be selected and collected, the existing mine plan should be reviewed. The mine plan will include currently proposed open pit shells, ore deposit information (block model cross-sections and plan views of the ore deposit area including open pit shells), exploration diamond drillhole locations and associated logs. The goal of the mine plan review is to develop an understanding of the main rock units intersected by the open pits and develop a sample list that is spatially representative of the expected waste materials. The expected tonnage of waste rock and overburden will also be used to select a proportional number of samples of the main rock units. Based on the review, a preliminary sample list will be developed for the purpose of collecting waste rock samples. Samples will be selected from the currently planned 2015 boreholes and collected as drilling progresses.

7.1.2 Laboratory Test Work

Laboratory testing will be completed on the samples collected for the Stage 2 geochemistry program, which consists of static testing and kinetic testing. Details on the laboratory test work are provided below.

Static Testing

Static tests are "one-time" analyses to determine the general geochemical characteristics of a sample, which is the first step in the analysis of the acid rock drainage and metal leaching properties of the rock. The static testing program is proposed to include:

- ABA by the modified Sobek method – used to develop estimates of the potential for acid generation based on the balance between acid producing and acid neutralizing minerals.
- Elemental Analysis of Solids – used to determine the total amount of oxides and metals in the solid phase of the rock samples.
- Short-term Leach Test – De-ionized (DI) water leach test performed according to the method described in Price (1997) and MEND (2009) and is used to develop initial estimates of metal leaching potential.
- Net Acid Generation (NAG) test – performed according to the method recommended by AMIRA (2002) to determine the acid generation potential of the waste rock under highly oxidizing conditions.

Based on geochemistry guidelines listed above, the limited lithological units (2 main waste rock units) and the relative geochemical homogeneity within samples analysed during Stage 1, it is proposed that static testing be completed on an additional 50 samples. The select static testing is proposed as follows:

- ABA, elemental analysis and NAG – 50 samples; and
- Short-term leach test analysis – 25 samples.

Once the static test results have been analysed, the potential for kinetic testing and mineralogy can be assessed.

7.2 Tailings

Once metallurgical test work has been completed on the high carbonate ore, two tailings samples with and without sulphide concentrate will be submitted for geochemical testing. Samples will be submitted for ABA, elemental, NAG and SFE analysis.

The results will be used along with the low carbonate tailings results to mathematically blend the tailings at the expected ratio (70/30) to determine the acid generation potential.

8.0 CLOSURE

We trust that this technical memorandum meets your needs at this time. If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

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Attachments:

Tables:

Figures:

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TABLES

Sample ID	Borehole ID	CFI ID	Sample Interval (m)		Lithology
			From	To	
Waste Rock					
14-CF-001	GS-14-117	GS-14-117 MS 184-194m	184	194	Metasediment
14-CF-002	GS-14-119	GS-14-119 MS 15-25m	15	25	Metasediment
14-CF-003	GS-14-125	GS-14-125 RHY 6.88-15.08m	6.88	15.08	Rhyolite
14-CF-004	GS-14-125	GS-14-125 MS 50-60m	50	60	Metasediment
14-CF-005	GS-14-126	GS-14-126 MS 124-134m	124	134	Metasediment
14-CF-006	GS-14-126	GS-14-126 RHY 160-169m	160	169	Rhyolite
14-CF-007	GS-14-130	GS-14-130 MS 50-60	50	60	Metasediment
14-CF-008	GS-14-132	GS-14-132 RHY 37-47m	37	47	Rhyolite
14-CF-009	GS-14-132	GS-14-132 MS 103-113m	103	113	Metasediment
14-CF-010	GS-14-152B	GS-14-152B MS 170-180m	170	180	Metasediment
15-CF-001	GS-15-180	GS-15-180 MS (5.50-95.00m)	35	45	Metasediment
15-CF-002	GS-15-180	GS-15-180 RHY (95.00-129.07m)	114	124	Rhyolite
15-CF-003	GS15-181	GS-15-181 MS (116.13-154.00m)	16	26	Metasediment
15-CF-004	GS15-181	GS-15-181 MS (88.00-103.68)	91	101	Metasediment
15-CF-005	GS15-181	GS-15-181 RHY (103.68-116.13m)	106	116	Rhyolite
15-CF-006	GS15-181	GS-15-181 RHY (11.40-28.63m)	136	146	Rhyolite
15-CF-007	GS-15-182	GS-15-182 MS (57.11-296.62m)	27	37	Metasediment
15-CF-008	GS-15-182	GS-15-182 RHY (21.25-37.14m)	74	84	Rhyolite
15-CF-009	GS-15-183	GS-15-183 MS (3.55-250.02m)	141	151	Metasediment
15-CF-010	GS-15-184	GS-15-184 MS (5.40-303.63m)	215	225	Metasediment
15-CF-011	GS-15-185	GS-15-185 MS (4.85-343.12m)	300	310	Metasediment
15-CF-012	GS-15-186	GS-15-186 MS (378.78-458.29m)	402	412	Metasediment
15-CF-013	GS-15-187	GS-15-187 MS (107.35-141.27m)	9	19	Metasediment
15-CF-014	GS-15-187	GS-15-187 RHY (4.15-24.06m)	117	127	Rhyolite
15-CF-015	GS-15-188	GS-15-188 MS (5.40-280.98m)	81	91	Metasediment
15-CF-016	GS-15-189	GS-15-189 MS (50.86-302.61m)	156	166	Metasediment
15-CF-017	GS-15-190	GS-15-190 MS (4.65-92.30m)	40	50	Metasediment
15-CF-018	GS-15-191C	GS-15-191C MS (4.00-237.31m)	60	70	Metasediment
15-CF-019	GS-15-192	GS-15-192 MS (390.85-421.00m)	13	23	Metasediment
15-CF-020	GS-15-192	GS-15-192 RHY (3.12-23.70m)	405	415	Rhyolite
15-CF-021	GS-15-193	GS-15-193 MS (6.10-261.80m)	60	70	Metasediment
15-CF-022	GS-15-194	GS-15-194 MS (122.61-152.84m)	136	146	Metasediment
15-CF-023	GS-15-196B	GS-15-196B MS (5.35-331.30m)	130	140	Metasediment
15-CF-024	GS-15-197	GS-15-197 MS (81.76-335.12m)	49	59	Metasediment
15-CF-025	GS-15-197	GS-15-197 RHY (43.78-81.76m)	301	311	Rhyolite
15-CF-026	GS-15-198	GS-15-198 MS (191.93-248.62	0	0	Metasediment
15-CF-027	GS-15-198	GS-15-198 MS (2.67-188.72m)	0	0	Metasediment
Ore					
Low Carb Ore	-	Head-3/4" (Low Carbonate Ore Head Sample)	-	-	Ore
High Carb Ore	-	High Carb-1/2" (High Carbonate Ore Head Sample)	-	-	Ore
Processed Materials					
Low Carb DMS	-	DMS Float (DMS Float For The Low Carbonate Ore)	-	-	DMS Float
High Carb DMS	-	DMS Float (DMS Float For The High Carbonate Ore)	-	-	DMS Float
Combined Tailings	-	-	-	-	Low Carbonate Tailings
Combined Tailings+Sulphide	-	-	-	-	Low Carbonate Tailings

Table 2
Whole Rock Analysis
AGS Project

Parameters	Units	Metasediment							Rhyolite			Ore		DMS Floats		Tailings	
		14-CF-001	14-CF-002	14-CF-004	14-CF-005	14-CF-007	14-CF-009	14-CF-010	14-CF-003	14-CF-006	14-CF-008	Low Carb Ore	High Carb Ore	Low Carb DMS	High Carb DMS	Combined Tailings	Combined Tailings+Sulphide
Borehole		GS-14-117	GS-14-119	GS-14-125	GS-14-126	GS-14-130	GS-14-132	GS-14-152B	GS-14-125	GS-14-126	GS-14-132						
SiO_2	µg/g	60	58	61	63	59	59	59	79	78	79	33	41	59	52	53	50
Al_2O_3	µg/g	20	21	20	19	21	20	20	12	12	11	7.4	9.4	12	12	13	13
Fe_2O_3	µg/g	7.3	9.0	6.9	7.7	6.9	7.2	8.0	1.4	2.7	1.2	2.8	3.4	3.7	4.0	5.4	5.3
MgO	µg/g	2.0	2.2	2.2	2.0	2.0	2.2	2.0	0.040	0.020	0.030	0.66	0.89	0.89	1.1	1.4	1.3
CaO	µg/g	0.84	1.0	0.64	1.1	0.78	0.66	1.6	0.50	0.34	1.5	36	26	11	15	13	14
Na_2O	µg/g	2.1	2.0	2.2	1.9	1.8	2.4	2.0	3.7	4.4	3.8	0.85	0.90	1.6	1.2	1.2	1.5
K_2O	µg/g	4.0	3.5	3.8	3.5	4.6	3.8	3.0	4.5	3.8	3.7	2.0	2.7	3.8	3.4	3.3	3.1
TiO_2	µg/g	1.0	0.96	0.97	0.97	0.99	1.0	0.96	0.060	0.060	0.050	0.33	0.43	0.45	0.52	0.59	0.56
P_2O_5	µg/g	0.17	0.13	0.14	0.17	0.15	0.18	0.16	< 0.01	< 0.01	< 0.01	0.050	0.070	0.060	0.070	0.080	0.070
MnO	µg/g	0.14	0.14	0.070	0.070	0.090	0.13	0.060	< 0.01	< 0.01	< 0.01	0.16	0.23	0.20	0.35	0.25	0.24
Cr_2O_3	µg/g	0.020	0.020	0.020	0.040	0.030	0.030	0.020	0.050	0.040	0.050	< 0.01	< 0.01	< 0.01	0.010	0.030	0.040
V_2O_5	µg/g	0.020	0.010	0.020	0.010	0.020	0.020	0.020	< 0.01	< 0.01	< 0.01	< 0.01	0.010	< 0.01	< 0.01	< 0.01	0.010
LOI	µg/g	3.0	2.5	3.0	2.0	3.7	3.5	3.5	0.62	0.29	0.86	5.3	8.1	6.6	11	7.6	5.9
Sum	µg/g	100	100	100	101	101	100	100	101	101	101	89	94	99	100	99	94

Table 3
Bulk Metals Analysis
AGS Project

Parameters	Units	Price Crustal Abundance	Metasediment							Rhyolite			Ore		DMS Floats		Tailings	
			14-CF-001	14-CF-002	14-CF-004	14-CF-005	14-CF-007	14-CF-009	14-CF-010	14-CF-003	14-CF-006	14-CF-008	Low Carb Ore	High Carb Ore	Low Carb DMS	High Carb DMS	Combined Tailings	Combined Tailings+Sulphide
Borehole			GS-14-117	GS-14-119	GS-14-125	GS-14-126	GS-14-130	GS-14-132	GS-14-152B	GS-14-125	GS-14-126	GS-14-132						
Ag	ppm	*0.075*	**0.41**	0.26	0.30	0.28	0.37	0.30	0.29	**0.46**	**0.42**	0.37	**1.8**	**1.0**	**0.55**	**0.52**	**3.0**	**7.0**
Al	ppm	*82300*	95000	100000	97000	88000	100000	99000	97000	55000	58000	54000	36000	46000	56000	59000	69000	65000
As	ppm	*1.8*	**37**	**11**	**10**	1.6	**36**	**31**	**14**	2.4	2.8	5.8	**63**	**25**	**18**	**18**	**31**	**86**
Ba	ppm	*425*	920	740	720	840	900	670	610	120	120	110	370	370	410	440	560	540
Be	ppm	*3*	4.2	12	4.5	2.1	3.2	2.6	2.7	6.2	13	5.4	2.0	2.2	3.9	3.5	3.4	3.4
Bi	ppm	*0.0085*	**0.25**	**0.40**	**0.19**	**0.16**	**0.30**	**0.23**	**0.61**	**0.60**	**0.23**	**0.24**	**0.43**	**0.88**	**0.51**	**0.82**	**0.56**	**2.3**
Ca	ppm	*41500*	5900	7200	4600	7400	5500	4700	11000	3300	2400	9700	**220000**	170000	66000	95000	91000	93000
Cd	ppm	*3*	0.39	0.28	0.98	0.34	0.97	0.23	0.39	0.74	0.97	0.68	15	4.9	3.3	1.0	**33**	**57**
Co	ppm	*25*	14	20	21	15	15	14	16	0.82	2.3	0.81	7.9	7.6	8.3	8.7	11	14
Cr	ppm	*102*	100	170	150	230	140	140	140	280	280	310	35	42	55	50	230	220
Cu	ppm	*60*	18	29	41	16	22	29	35	6.4	21	14	66	120	41	54	67	230
F	%	*0.0585*	**1200**	**1800**	**1400**	**1000**	**1900**	**990**	**850**	**2100**	**970**	**8000**	**432500**	**261600**	**74200**	**58100**	**50800**	**57800**
Fe	ppm	*56300*	47000	57000	44000	48000	44000	46000	51000	8700	17000	7500	17000	21000	23000	26000	38000	37000
Hg	ppm	*0.09*	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.21	0.090	< 0.05	< 0.05	0.34	**0.64**
K	ppm	*20850*	33000	29000	31000	27000	37000	31000	24000	36000	31000	30000	16000	21000	29000	28000	28000	26000
Li	ppm	*20*	**210**	**150**	**200**	**160**	**200**	**160**	**130**	7.0	7.0	26	62	74	72	87	**150**	**140**
Mg	ppm	*23300*	11000	12000	12000	11000	11000	12000	11000	200	170	150	3600	4700	4500	5800	7700	7200
Mn	ppm	*950*	970	1000	590	640	730	940	490	140	150	100	1100	1600	1300	2500	1900	1800
Mo	ppm	*1.2*	1.0	2.1	**9.4**	1.1	1.1	1.9	0.40	**12**	2.5	4.0	2.0	1.5	3.2	0.90	**8.9**	**11**
Na	ppm	*23550*	14000	14000	15000	13000	13000	16000	13000	25000	31000	27000	4900	5600	11000	8100	7000	6500
Ni	ppm	*84*	36	44	38	37	35	36	35	6.3	5.6	5.7	17	17	18	21	290	120
P	ppm	*1050*	640	450	500	620	580	550	570	8.0	11	10	170	230	210	260	310	290
Pb	ppm	*14*	67	30	**78**	41	**95**	23	44	51	46	59	**1300**	**900**	**190**	48	**360**	**3700**
Sb	ppm	*0.2*	**2.0**	**1.7**	**1.8**	**1.1**	**2.4**	**2.8**	0.90	0.90	< 0.8	0.80	**7.0**	**4.2**	**2.0**	**1.7**	**18**	**34**
Se	ppm	*0.05*	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	**1.2**	**1.2**	< 0.7	< 0.7	< 0.7	< 0.7
Sn	ppm	*2.3*	6.2	3.7	3.4	4.1	7.1	11	2.6	6.9	5.6	4.6	4.0	7.9	4.9	9.6	6.0	6.8
Sr	ppm	*370*	140	170	91	140	110	110	140	25	30	29	76	65	57	59	80	75
Ti	ppm	*5650*	4600	4900	4400	4800	4700	5000	4200	330	370	300	1700	2200	2300	2700	3300	3200
Tl	ppm	*0.85*	2.8	1.6	1.4	1.8	3.2	2.0	1.3	1.2	0.98	1.4	1.4	1.7	1.5	1.8	2.8	3.9
U	ppm	*2.7*	2.4	2.6	2.6	2.3	2.9	2.6	2.4	8.4	11	9.4	1.9	2.2	3.8	2.9	2.7	2.8
V	ppm	*120*	98	110	99	91	100	110	100	3.0	3.0	4.0	37	44	44	53	70	67
Y	ppm	*33*	21	14	15	12	23	18	16	63	78	68	**410**	**340**	140	**220**	**200**	**210**
Zn	ppm	*70*	120	62	180	150	150	67	80	91	110	110	**2400**	**1200**	**690**	250	**10000**	**16000**

Notes:

- Price Crustal Abundance taken from: Price, W.A., 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, Ministry of Energy and Mines. p. 159.

-	- Analysis not completed.
0.7	- Denotes values greater than five times the Price Crustal Abundance.
0.7	- Denotes values greater than ten times the Price Crustal Abundance.

Table 4
Acid Base Accounting
AGS Project

Sample ID	Paste pH	Total Sulphur	Sulphide Sulphur	Sulphate Sulphur	Total Carbon	Carbonate	CO_3-NP[2]	NP[3]	AP[4]	NPR[5]	CO_3-NPR[6]	NAG[1] pH
	s.u.	%	%	%	%	%	t $CaCO_3$ /1000 t			ratio	ratio	s.u.
Metasediment												
14-CF-001	11	0.055	0.03	0.02	0.032	0.03	0.5	12	0.94	13	0.53	7.5
14-CF-002	9.1	0.09	0.08	0.01	0.043	0.045	0.75	10	2.5	4.0	0.3	7.2
14-CF-004	8.9	0.12	0.1	0.02	0.039	0.05	0.83	10	3.1	3.2	0.27	6.3
14-CF-005	9.0	< 0.005	< 0.01	< 0.01	0.024	< 0.025	0.083	9.3	0.31	30	0.27	7.6
14-CF-007	8.7	0.027	0.02	< 0.01	0.035	< 0.025	0.083	11	0.63	18	0.13	7.5
14-CF-009	8.9	0.022	0.01	0.01	0.044	0.03	0.5	10	0.31	32	1.6	7.7
14-CF-010	9.3	0.06	0.04	0.02	0.04	0.07	1.2	11	1.3	8.8	0.93	7.4
15-CF-001	8.7	0.06	0.02	0.04	0.006	< 0.025	0.1	9	0.6	13.8	0.13	7.1
15-CF-002	9.5	0.009	< 0.01	< 0.01	0.037	< 0.025	0.1	7	0.3	22.4	0.27	7.6
15-CF-003	8.9	0.018	< 0.01	0.02	0.039	< 0.025	0.1	12	0.3	38.4	0.27	7.9
15-CF-004	9.0	< 0.005	< 0.01	< 0.01	0.103	0.28	4.7	17	0.3	54.4	15	8.7
15-CF-005	9.6	0.005	< 0.01	< 0.01	0.034	< 0.025	0.1	7	0.3	23.7	0.27	7.4
15-CF-006	9.4	0.015	< 0.01	0.02	0.02	< 0.025	0.1	8	0.3	25.0	0.27	7.1
15-CF-007	8.9	0.009	< 0.01	< 0.01	0.044	0.03	0.5	11	0.3	35.2	1.6	8.0
15-CF-008	8.7	0.006	< 0.01	< 0.01	0.023	< 0.025	0.1	6	0.3	19.8	0.27	7.3
15-CF-009	9.1	0.016	< 0.01	0.02	0.027	< 0.025	0.1	10	0.3	32.0	0.27	7.8
15-CF-010	9.1	0.031	0.01	0.02	0.051	< 0.025	0.1	13	0.3	41.6	0.27	8.0
15-CF-011	8.8	0.041	0.01	0.03	0.02	< 0.025	0.1	31	0.3	99.2	0.27	7.7
15-CF-012	8.8	0.046	0.01	0.04	0.045	0.07	1.2	10	0.3	30.7	3.7	7.6
15-CF-013	9.0	0.021	< 0.01	0.02	0.05	0.095	1.6	12	0.3	38.4	5.1	8.1
15-CF-014	9.2	0.011	< 0.01	0.01	0.058	0.06	1.0	9	0.3	27.8	3.2	7.5
15-CF-015	8.8	0.019	< 0.01	0.02	0.01	< 0.025	0.1	10	0.3	32.0	0.27	7.6
15-CF-016	8.7	0.024	< 0.01	0.02	0.027	< 0.025	0.1	18	0.3	57.6	0.27	7.7
15-CF-017	9.1	0.037	0.01	0.03	0.019	< 0.025	0.1	10	0.3	32.0	0.27	7.6
15-CF-018	8.9	0.063	0.03	0.03	0.011	< 0.025	0.1	9	0.9	9.6	0.09	7.2
15-CF-019	9.1	0.068	0.02	0.05	0.022	0.035	0.6	8	0.6	13.4	0.93	7.4
15-CF-020	8.6	0.014	< 0.01	0.01	0.009	< 0.025	0.1	4	0.3	12.5	0.27	6.9
15-CF-021	9.1	0.012	< 0.01	0.01	0.018	< 0.025	0.1	10	0.3	31.7	0.27	7.5
15-CF-022	9.1	0.121	0.06	0.06	0.191	0.46	7.7	25	1.9	13.3	4.1	10
15-CF-023	9.1	0.025	< 0.01	0.02	0.038	< 0.025	0.1	14	0.3	44.8	0.27	7.8
15-CF-024	9.0	0.039	0.01	0.03	0.042	0.06	1.0	11	0.3	35.2	3.2	7.8
15-CF-025	8.6	< 0.005	< 0.01	< 0.01	0.121	0.355	5.9	13	0.3	41.6	19	8.1
15-CF-026	9.2	0.018	< 0.01	0.02	0.024	< 0.025	0.1	13	0.3	41.6	0.27	7.8
15-CF-027	9.1	0.028	< 0.01	0.03	0.052	0.045	0.8	12	0.3	38.4	2.4	8.0
Count	*7*	*6*	*6*	*5*	*7*	*5*	*7*	*7*	*7*	*7*	*7*	*7.0*
Mean	*9.2*	*0.1*	*0.0*	*0.02*	*0.04*	*0.05*	*1*	*10*	*1*	*15.5*	*0.6*	*7.3*
Min	*8.7*	*0.0*	*0.01*	*0.01*	*0.02*	*0.03*	*0.1*	*9*	*0*	*3.2*	*0.1*	*6.3*
Max	*10.7*	*0.1*	*0.1*	*0.0*	*0.0*	*0.1*	*1*	*12*	*3*	*32.0*	*1.6*	*7.7*

Rhyolite												
14-CF-003	9.3	< 0.005	< 0.01	< 0.01	0.036	< 0.025	0.083	8.7	0.31	28	0.27	7.3
14-CF-006	9.5	< 0.005	< 0.01	< 0.01	0.03	< 0.025	0.083	6.4	0.31	20	0.27	7.4
14-CF-008	9.3	0.006	< 0.01	< 0.01	0.045	< 0.025	0.083	8.5	0.31	27	0.27	7.3
Ore												
Low Carb Ore	8.4	0.32	0.26	0.06	0.83	2.7	45	70	8.1	8.6	5.6	9.1
High Carb Ore	8.6	0.14	0.09	0.05	1.5	6.4	106	129	2.8	46	38	9.3
DMS Floats												
Low Carb DMS	8.6	0.064	0.04	0.02	1.1	4.4	73	91	1.3	73	59	9.9
High Carb DMS	8.7	0.039	0.02	0.02	2.1	9.5	159	177	0.63	283	254	10
Tailings												
Combined Tailings	8.5	0.5	0.4	0.0	1.1	4.2	69.4	94.0	13.4	7.0	5.2	9.0
Combined Tailings+Sulphide	8.5	1.0	0.9	0.1	1.1	3.0	50.7	97.0	27.2	3.6	1.9	9.3

Notes:

- - Analysis not completed.

(1) Net Acid Generation (NAG)

(2) Carbonate neutralization potential (CO_3-NP) = (Carbonate (CO_3) /60.01) * 100.09 * 10

(3) Neutralization potential (NP) is determined directly from Sobek method (Sobek, 1978).

(4) Acid potential (AP) = Sulphide Sulphur (%) x 31.25

(5) Net Potential Ratio (NPR) = NP / AP

(6) Carbonate NPR (CO_3-NPR) = CO_3-NP / AP

Notes for Tables 6 and 7:

0.1	– Denotes a value that is greater than the CCME Guideline for the Protection of Freshwater Aquatic Life
0.1	– Denotes a value that is greater than the Environmental Control Water and Sewage Regulations (ECWSR)

a) CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 with updates to 2011. Winnipeg, MB.

b) Environmental Control Water and Sewage Regulations (ECWSR). 2003. Newfoundland and Labrador Regualtion 65/03. Water Resources Act (O.C. 2003-231). Filed May 23, 2003.

*Chromium guideline for Cr (VI)

A dash "-" indicates that results were not reported for this parameter.

Table 6
Shake Flask Extraction Leachate Analysis
AGS Project

Parameters	Units	CCME Guidelines [(a)]	ECWSR [(b)]	Baseline Water Quality			Metasediment							Rhyolite			Ore		DMS Floats		Tailings	
		Long Term					14-CF-001	14-CF-002	14-CF-004	14-CF-005	14-CF-007	14-CF-009	14-CF-010	14-CF-003	14-CF-006	14-CF-008	Low Carb Ore	High Carb Ore	Low Carb DMS	High Carb DMS	Combined Tailings	Combined Tailings + Sulphide
Borehole				Min	Max	Average	GS-14-117	GS-14-119	GS-14-125	GS-14-126	GS-14-130	GS-14-132	GS-14-152B	GS-14-125	GS-14-126	GS-14-132						
pH	units	6.5-9.0	5.5-9.0	4.98	6.15	5.5	8.0	7.9	8.1	7.9	7.9	8.2	9.0	8.2	8.7	8.7	8.0	7.9	8.0	8.1	8.0	7.9
Conductivity	µS/cm			39	56	50	78	35	80	37	91	72	154	75	59	83	155	150	158	136	168	191
Acidity	mg/L as $CaCO_3$					-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Alkalinity	mg/L as $CaCO_3$			2.5	2.5	2.5	39	13	35	17	32	35	80	23	26	22	27	31	34	33	55	55
Hardness	mg/L			4.5	7.8	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SO_4	mg/L			1	1	1.0	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	8.9	6.0	8.1	2.2	6.2	13
F	mg/L	0.12		0.05	**0.24**	**0.13**	**1.4**	**0.65**	**0.60**	**0.83**	**4.7**	**0.45**	**0.48**	**5.8**	**1.7**	**7.9**	**9.3**	**9.9**	**8.6**	**5.3**	**6.6**	**6.5**
Cl	mg/L	120		9.7	14	13	< 2	< 2	< 2	< 2	< 2	< 2	< 2	2.0	< 2	< 2	8.9	9.0	8.9	5.9	3.1	2.8
Ag	mg/L	0.0001	0.05	0.000050	0.000050	0.000050	0.0000090	0.0000020	< 0.000002	< 0.000002	0.0000050	< 0.000002	0.0000040	0.000018	0.0000090	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	0.000052	0.000017
Al	mg/L			0.13	0.61	0.29	1.4	2.0	1.7	1.7	1.0	1.6	4.7	0.34	0.59	0.23	0.33	0.37	0.66	0.65	0.30	0.22
As	mg/L	0.005	0.5	0.00050	0.0012	0.00064	**0.064**	**0.018**	**0.0098**	0.0026	**0.068**	**0.089**	**0.061**	0.0028	**0.0053**	0.0027	0.0010	0.0022	**0.0098**	0.0036	**0.0095**	**0.0080**
Ba	mg/L		5	0.0026	0.014	0.0066	0.0075	0.0067	0.0043	0.0045	0.017	0.0037	0.014	0.0079	0.0049	0.0063	0.23	0.078	0.062	0.016	0.089	0.091
B	mg/L	1.5	5	0.025	0.025	0.025	0.020	0.016	0.020	0.014	0.040	0.030	0.027	0.0037	0.0038	0.0038	0.0087	0.012	0.015	0.014	0.015	0.011
Be	mg/L			0.00050	0.00050	0.00050	0.000025	0.000061	0.000027	0.000010	0.000020	0.000016	0.00014	0.000094	0.000068	0.000017	0.000022	0.000014	0.000043	0.0000080	0.000041	0.000031
Bi	mg/L			0.0010	0.0010	0.0010	0.0000080	0.0000070	< 0.000007	< 0.000007	< 0.000007	< 0.000007	0.000029	< 0.000007	< 0.000007	< 0.000007	0.0000070	< 0.000007	0.0000090	< 0.000007	0.000027	0.000021
Ca	mg/L			0.38	1.5	1.1	4.9	0.060	3.8	0.30	5.9	3.4	0.58	7.2	4.3	9.1	17	16	14	12	22	24
Cd	mg/L	0.09	0.05	0.000017	0.000044	0.000029	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	0.0000040	0.000037	0.0000060	0.000013	0.000029	0.000010	0.000073	0.000010	0.000058	0.000072
Co	mg/L			0.00050	0.00050	0.00050	0.000093	0.000097	0.000070	0.000046	0.000040	0.000034	0.00020	0.000014	0.000025	0.0000040	0.0000070	0.000010	0.000080	0.000021	0.00016	0.00018
Cr	mg/L	0.001*	0.05*	0.00020	0.00054	0.00024	0.00016	0.00030	0.000090	< 0.00003	0.000040	0.000090	**0.0012**	< 0.00003	< 0.00003	< 0.00003	0.000040	< 0.00003	0.00032	0.000050	0.00065	0.00033
Cu	mg/L	0.002-0.004 [c]	0.3	0.0010	0.0010	0.0010	0.00082	0.00054	0.00054	0.00045	0.00062	0.00027	0.00090	0.00090	0.0012	0.00030	0.00046	0.00028	0.0011	0.00054	**0.015**	**0.015**
Fe	mg/L	0.3	10	0.14	**0.66**	**0.37**	0.055	0.18	0.055	0.069	0.041	0.068	**0.40**	0.013	0.022	< 0.002	< 0.002	< 0.002	0.14	< 0.002	0.18	0.11
Hg	mg/L	0.000026	0.005	0.0000065	0.0000065	0.0000065	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
K	mg/L			0.25	0.49	0.34	7.7	3.2	9.6	3.2	11	8.7	5.3	5.3	4.1	3.6	10	12	13	9.9	7.2	8.0
Li	mg/L			0.0010	0.0027	0.0014	0.062	0.026	0.041	0.052	0.050	0.020	0.015	0.0032	0.0024	0.0041	0.032	0.031	0.034	0.030	0.014	0.020
Mg	mg/L			0.64	1	0.89	0.34	0.056	0.29	0.077	0.40	0.25	0.11	0.13	0.038	0.10	0.61	0.70	0.67	0.61	2.4	2.8
Mn	mg/L			0.0061	0.035	0.020	0.0022	0.0035	0.0015	0.0013	0.0015	0.00097	0.0056	0.0026	0.0035	0.0015	0.017	0.020	0.016	0.016	0.060	0.078
Mo	mg/L			0.0010	0.0010	0.0010	0.0018	0.00036	0.0025	0.00071	0.0037	0.0014	0.00060	0.015	0.0034	0.011	0.051	0.027	0.024	0.0075	0.017	0.059
Na	mg/L			5.9	8.3	7.7	6.5	4.9	5.9	6.0	5.1	6.8	35	4.9	6.2	5.0	4.8	5.3	8.2	8.0	8.3	8.9
Ni	mg/L	0.025-0.15 [c]	0.5	0.0010	0.0010	0.0010	0.00060	0.00040	0.00020	0.00010	0.00020	0.00020	0.00060	0.00010	< 0.0001	< 0.0001	0.00020	0.00020	0.00050	0.00020	0.0013	0.0012
Pb	mg/L	0.001-0.007 [c]	0.2	0.00025	0.0014	0.00065	0.00053	0.00026	0.00016	0.00011	0.00023	0.00011	0.0027	0.00032	0.00068	0.000070	**0.011**	0.00088	0.0021	0.000060	**0.0078**	**0.0083**
Sb	mg/L			0.00050	0.0005	0.00050	0.0041	0.0028	0.0021	0.0011	0.0054	0.0046	0.0028	0.00040	0.00030	0.00060	0.021	0.018	0.0046	0.0024	0.011	0.024
Se	mg/L	0.001	0.01	0.00050	0.0005	0.00050	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sn	mg/L			0.0010	0.0010	0.0010	0.000060	0.000050	0.000040	0.000090	0.000040	0.000040	0.00023	0.000070	0.000070	0.000020	0.000070	0.000070	0.00017	0.00018	0.00018	0.00020
Sr	mg/L			0.0053	0.012	0.0089	0.031	0.00090	0.0076	0.0023	0.031	0.015	0.0029	0.0095	0.011	0.0092	0.11	0.086	0.088	0.052	0.12	0.14
Ti	mg/L			0.0010	0.0072	0.0027	0.0020	0.010	0.0029	0.0047	0.0019	0.0039	0.020	0.00043	0.00099	0.000060	0.00012	0.000080	0.0036	0.000070	0.0043	0.0031
Tl	mg/L	0.0008		0.000050	0.000050	0.000050	0.000018	0.000010	0.000015	0.0000080	0.000036	0.000017	0.000027	0.000047	0.000019	0.000027	0.000087	0.000085	0.000094	0.000041	0.000048	0.000089
U	mg/L	0.015		0.000050	0.00021	0.000083	0.00011	0.000037	0.00029	0.000035	0.00014	0.00026	0.00036	0.00094	0.00090	0.0012	0.00041	0.00035	0.0019	0.00034	0.0032	0.0033
V	mg/L			0.0010	0.0010	0.0010	0.0048	0.0085	0.0076	0.0044	0.0051	0.0090	0.019	0.00017	0.000090	0.00012	0.00021	0.00075	0.0035	0.0033	0.00053	0.00034
W	mg/L					-	0.00050	0.00068	0.00051	0.0011	0.00068	0.00064	0.00053	0.0015	0.0017	0.0049	0.0016	0.0018	0.0012	0.00083	0.00080	0.00098
Y	mg/L					-	0.000023	0.000034	0.000040	0.000019	0.000030	0.000020	0.00020	0.00076	0.00046	0.000034	0.000014	0.000037	0.00049	0.000026	0.00029	0.00018
Zn	mg/L	0.03	0.5	0.0025	0.0089	0.0052	< 0.001	< 0.001	0.0010	< 0.001	< 0.001	< 0.001	0.0040	0.0030	0.0030	< 0.001	0.0010	< 0.001	0.010	< 0.001	0.0090	0.0090

Table 7
Tailings Water Analysis
AGS Project

Parameters	Units	CCME Guidelines [(a)] Long Term	ECWSR [(b)]	Tailings Supernatant
pH	units	*6.5-9.0*	*5.5-9.0*	8.2
Conductivity	µS/cm			409
Acidity	mg/L as $CaCO_3$			133
Alkalinity	mg/L as $CaCO_3$			< 2
F	mg/L	*0.12*		**5.6**
SO4	mg/L			13
Cl	mg/L	*120*		34
Ag	mg/L	*0.0001*	*0.05*	0.000014
Al	mg/L			0.51
As	mg/L	*0.005*	*0.5*	**0.019**
Ba	mg/L		*5*	0.065
B	mg/L	*1.5*	*5*	0.023
Be	mg/L			0.000066
Bi	mg/L			0.000021
Ca	mg/L			29
Cd	mg/L	*0.0009*	*0.05*	0.00013
Co	mg/L			0.00022
Cr	mg/L	*0.001**	*0.05**	0.00087
Cu	mg/L	*0.002-0.004* [c]	*0.3*	**0.0041**
Fe	mg/L	*0.3*	*10*	**0.36**
Hg	mg/L	*0.000026*	*0.005*	< 0.00001
K	mg/L			9.3
Mg	mg/L			4.2
Mn	mg/L			0.13
Mo	mg/L			54
Na	mg/L			0.0013
Ni	mg/L	*0.025-0.15* [c]	*0.5*	0.016
Pb	mg/L	*0.001-0.007* [c]	*0.2*	**0.015**
Sb	mg/L			0.0064
Se	mg/L	*0.001*	*0.01*	< 0.001
Sn	mg/L			0.00015
Sr	mg/L			0.17
Ti	mg/L			0.0046
Tl	mg/L	*0.0008*		0.000087
U	mg/L	*0.015*		0.0049
Zn	mg/L	*0.03*	*0.5*	0.020

FIGURES

0 100 200 300

Metres

1:15 000

LEGEND

- Borehole
- Existing Road
- Proposed Road
- Water Management Diversion Ditch
- Contour Line (interval: 50 ft/15.2m)
- Watercourse
- Waterbody
- Wetland
- Potential Settling Pond
- Topsoil Storage
- Mill (Preferred Location)
- Mine Dump Option
- Pit

REFERENCE

SOURCE(S): VARIOUS DRG, WORLEYPARSONS; CANVEC & CANVEC+, 1: 50 000 SCALE, NRCAN
PROJECTION: NAD 1983 UTM ZONE 21N

CLIENT
CANADA FLUORSPAR INC.

PROJECT
AGS MINE PROJECT, ST. LAWRENCE NL
STAGE 1 SCREENING LEVEL GEOCHEMISTRY ASSESSMENT

TITLE
BOREHOLE LOCATIONS
AGS MINE SITE

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-05-29
DESIGN	DL
GIS	ED
REVIEW	DL
APPROVED	DJ

PROJECT	REV	FIGURE
14-07707	0	1

Figure 2
Sulphide-Sulphur vs Total Sulphur
AGS Project

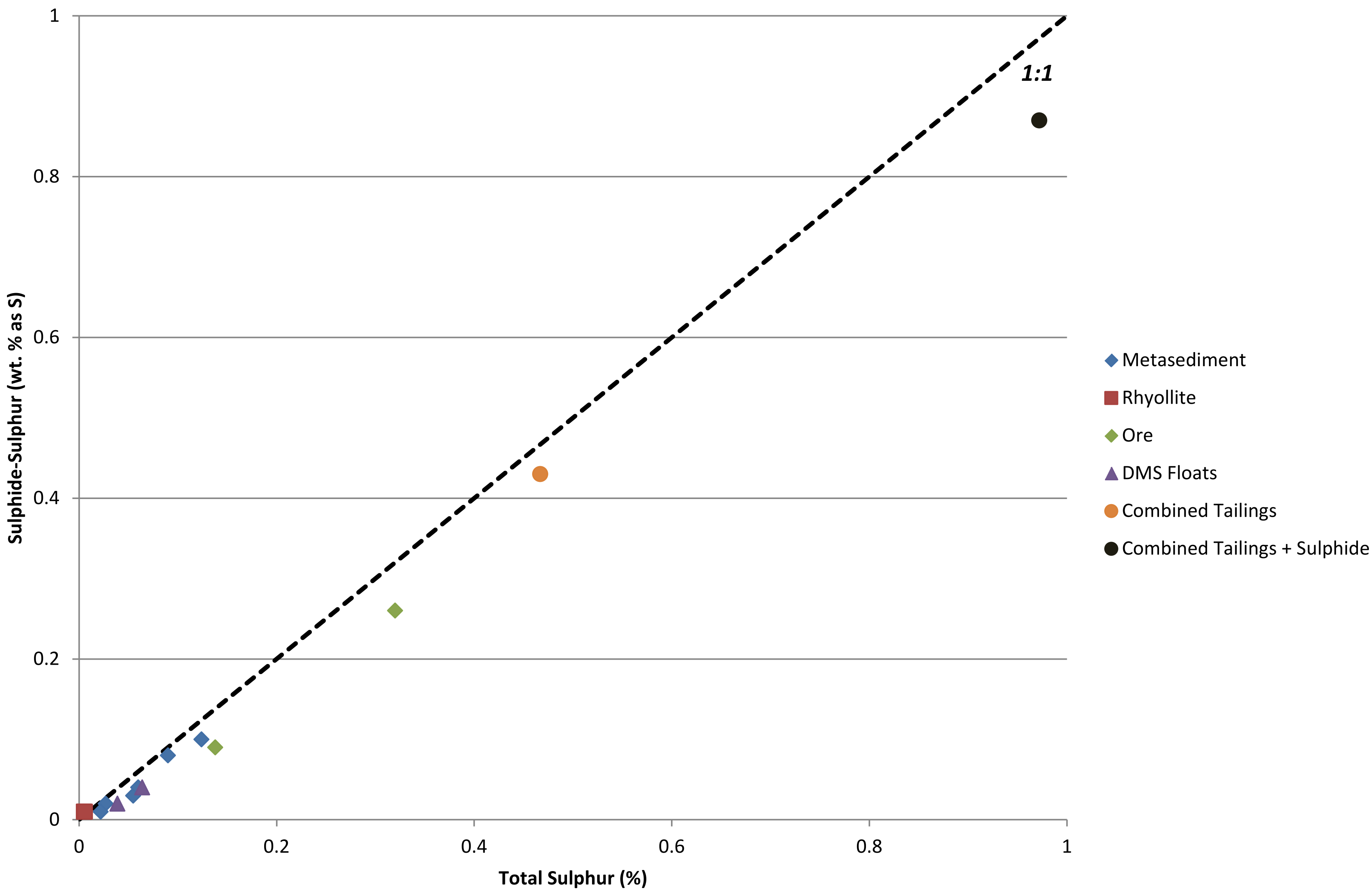


Figure 3A
Carbonate Neutralization Potential vs Neutralization Potential - Waste Rock
AGS Project

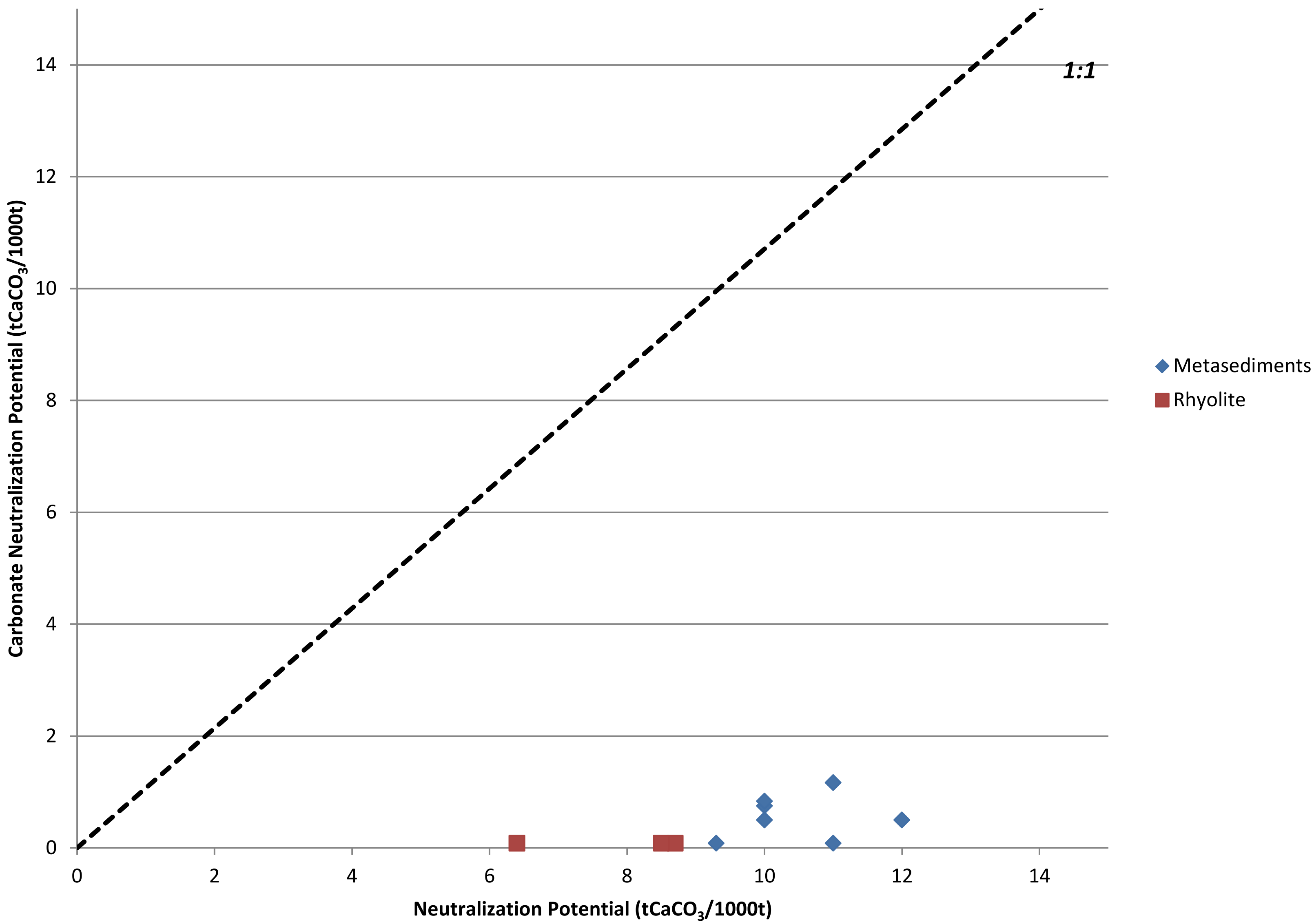


Figure 3B
Carbonate Neutralization Potential vs Neutralization Potential - Ore and Tailings
AGS Project

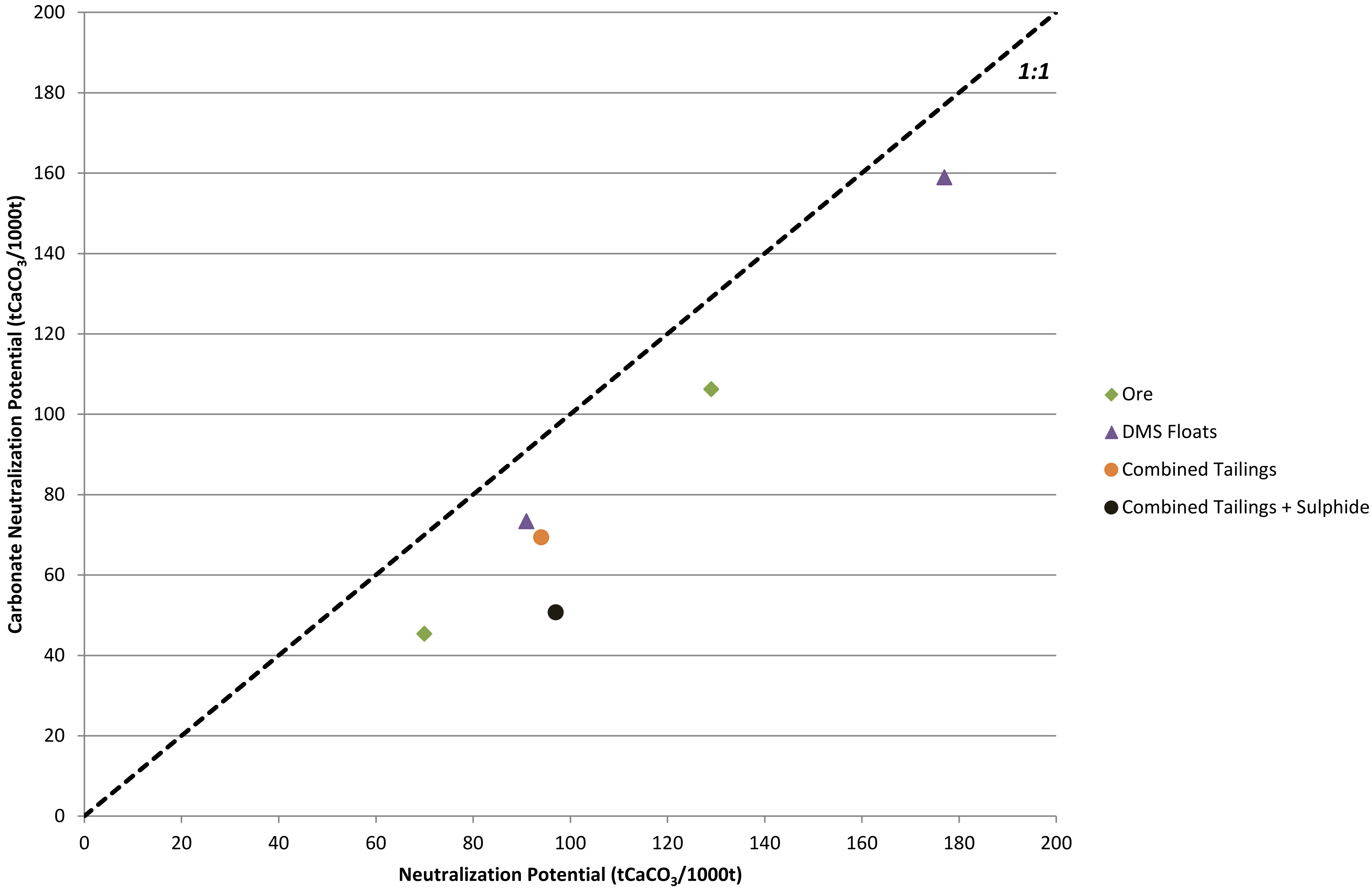


Figure 4A
Acid Potential vs Neutralization Potential - Waste Rock
AGS Project

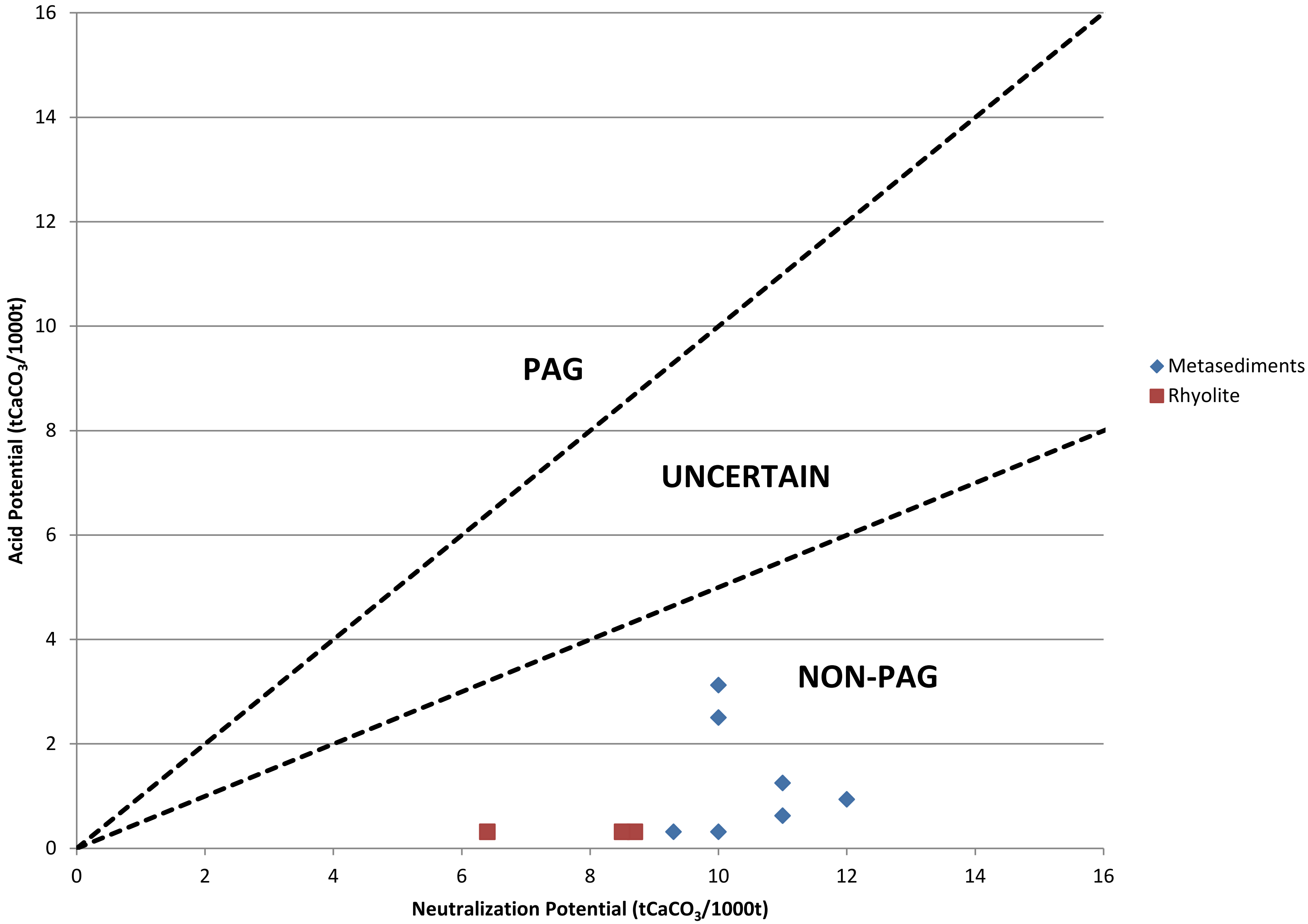


Figure 4B
Acid Potential vs Neutralization Potential - Ore and Tailings
AGS Project

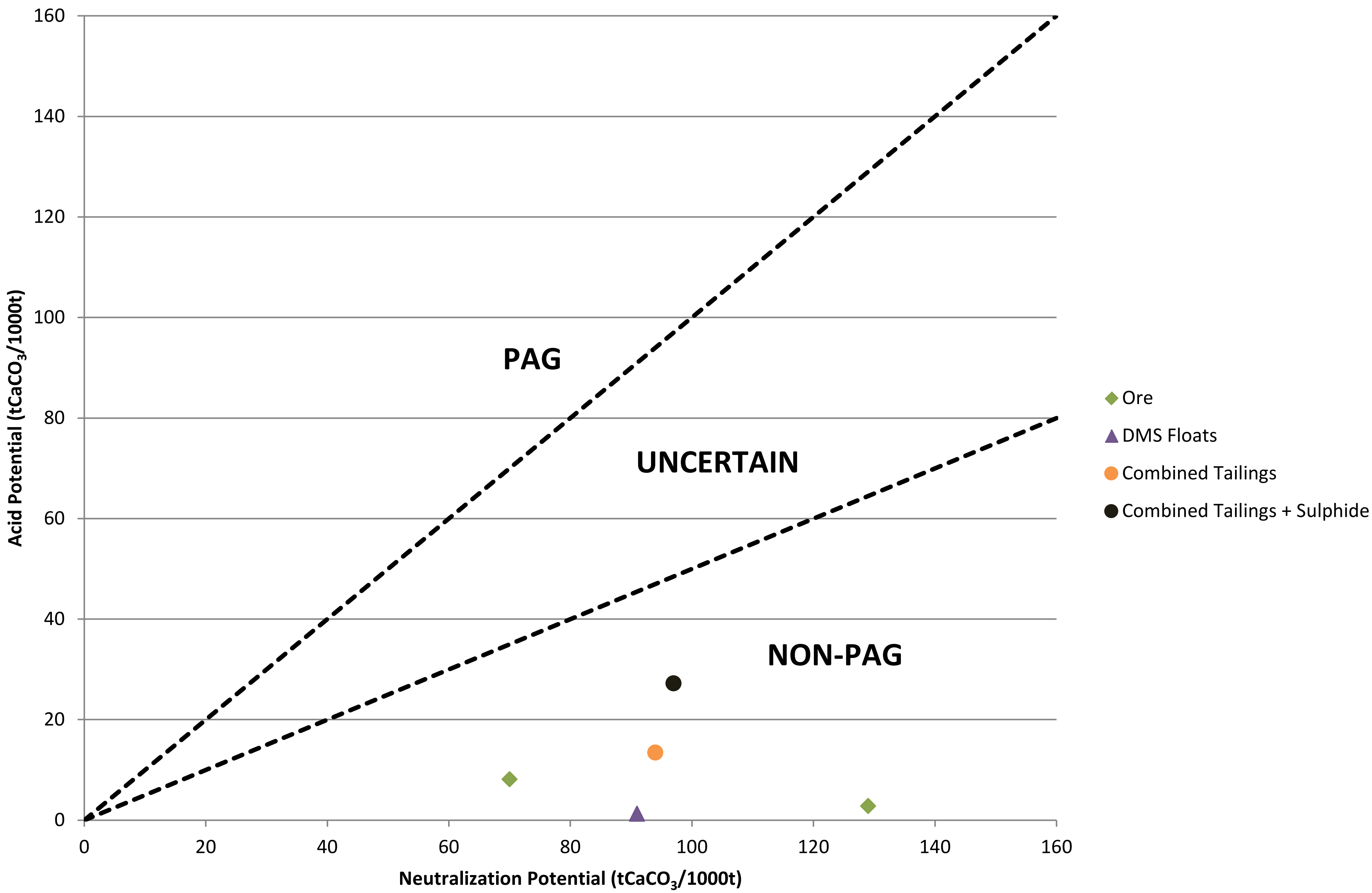


Figure 5A
Acid Potential vs Carbonate Neutralization Potential - Waste Rock
AGS Project

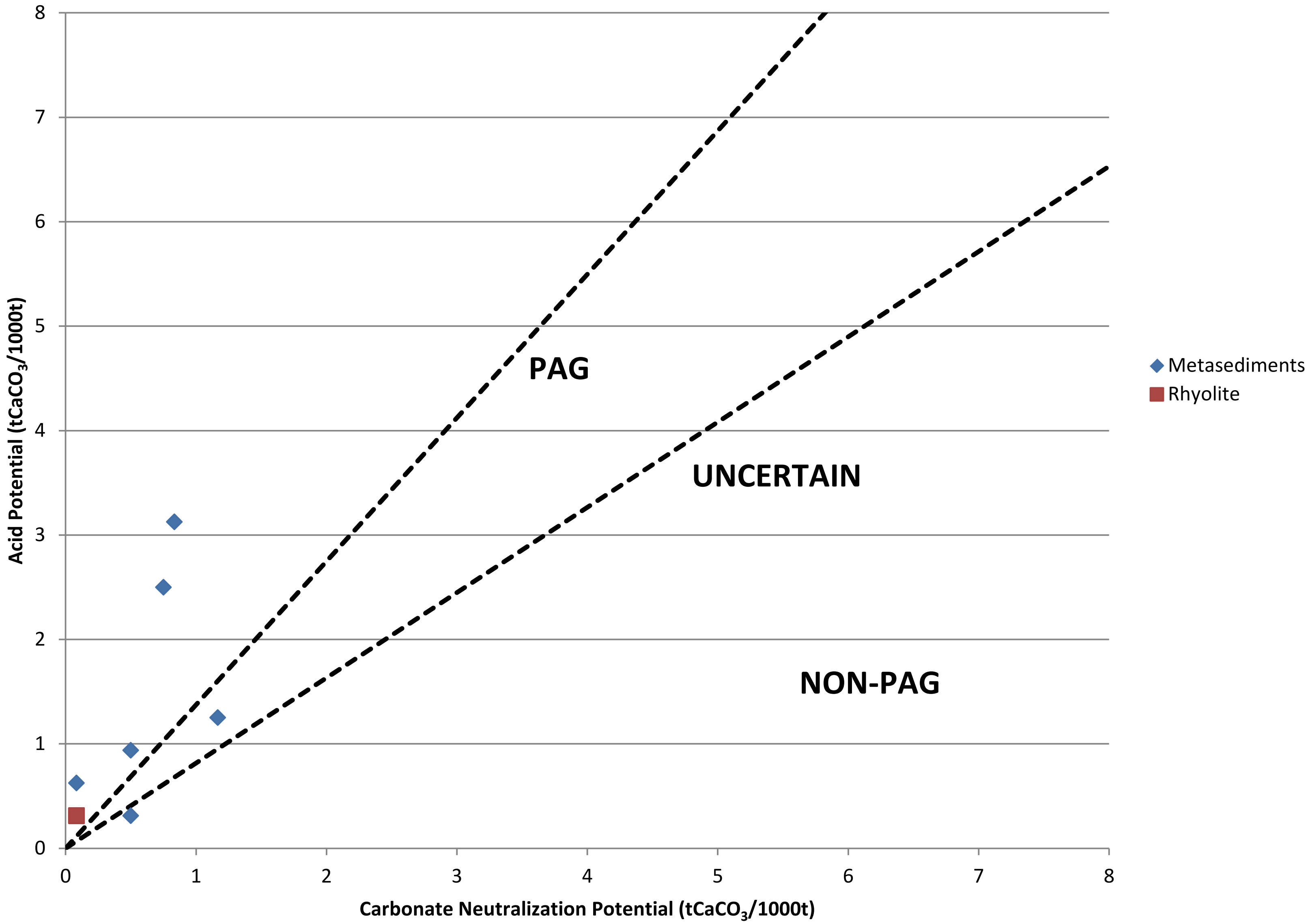
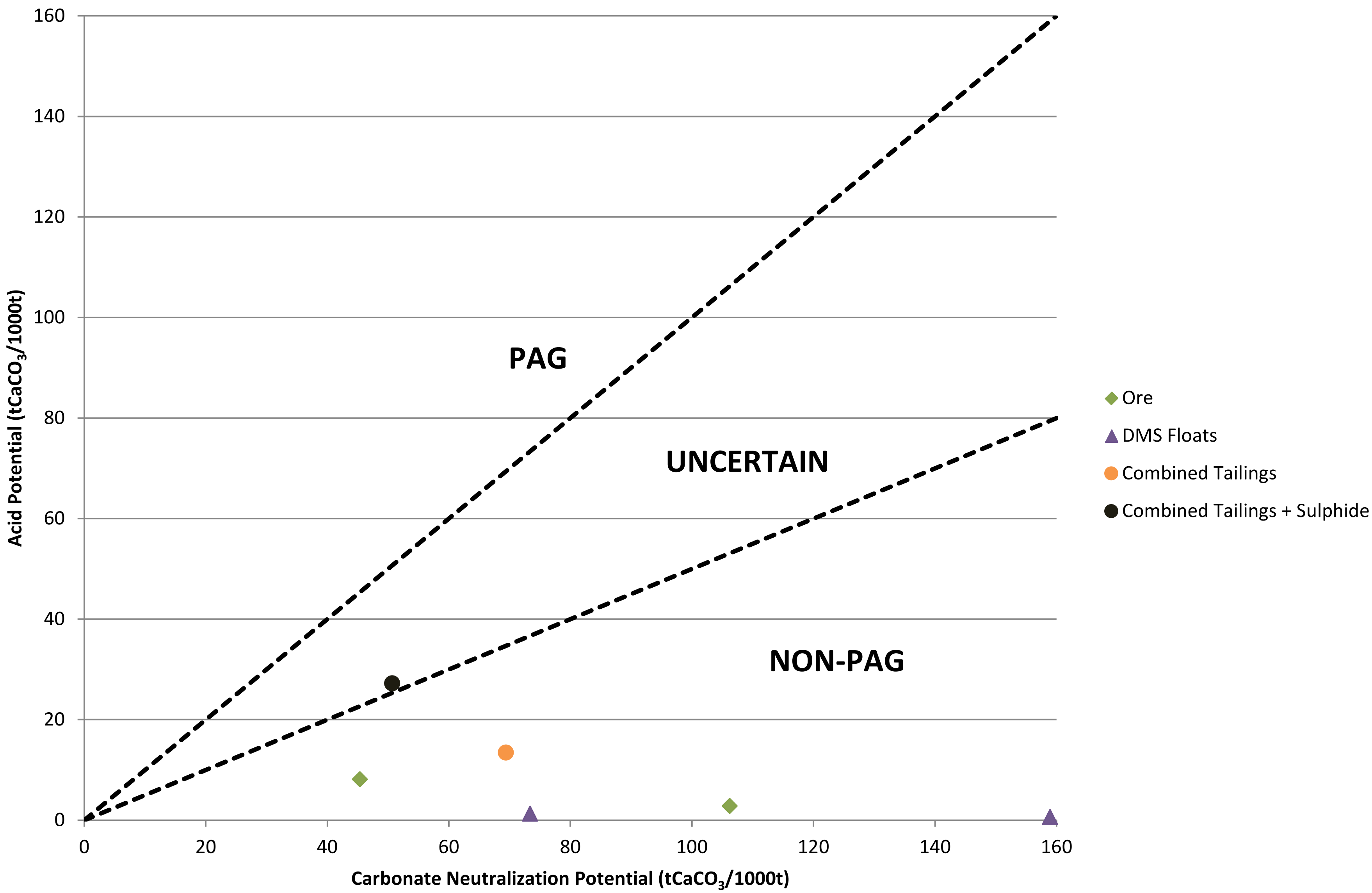


Figure 5B
Acid Potential vs Carbonate Neutralization Potential - Ore and Tailings
AGS Project



TECHNICAL MEMORANDUM

DATE	June 4, 2015	**PROJECT No.**	1407707 (0037_Rev 0)
TO	Phonce Cooper Canada Fluorspar Inc.		
CC	Daryl Johannesen		
FROM	Dan LaPorte and David Brown	**EMAIL**	dan_laporte@golder.com david_brown@golder.com

PROPOSED AGS MINE PROJECT – GEOCHEMISTRY CHARACTERIZATION PROGRAM, STAGE 2

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) is pleased to present our proposed scope of work to Canada Fluorspar Inc. (CFI) for a geochemistry characterization program in support of the Environmental Assessment (EA) for the proposed AGS Mining Project (the Project).

The overall objective of the geochemistry characterization program is to determine the acid generating and metal leaching potential of the waste materials (i.e., waste rock and tailings) and ore that will be produced as part of the Project. Golder proposes a staged approach to the geochemical characterization that allows for the program to develop at a level and pace that complements the development of the Project. The initial stage, Stage 1, includes a screening level assessment with static testing of a select number of samples to gain an initial understanding of the acid generating and metal leaching potential of the waste rock and ore. Stage 2 will be conducted once the mine plan has been determined and will include additional static testing of waste material (e.g., waste rock and overburden) to ensure appropriate spatial and compositional assessment. Stage 3 would be conducted after Stages 1 and 2 are complete and it will consist of long-term geochemical leach testing (Kinetic Tests) conducted on a limited number of waste rock samples collected during Stage 1 and Stage 2 as well as tailings samples collected during Stage 1. Stage 1 of the program will be completed after tailings samples have been tested, results analyzed, and a final report submitted to CFI. The work plan presented below addresses Stage 2 of the geochemistry characterization.

Details on the scope of work and schedule for this work program are provided in the following sections. The geochemical work program that is proposed is consistent with the recommendations of the following recognized documents:

- MEND (Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials 2009);
- Guidelines for Acid Rock Drainage (GARD) Guide (INAP 2012); and
- Price (DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia 1997).

Sampling and testing according to the guidelines is considered a minimum requirement for the evaluation of acid generation and metal leaching. Although the level of effort recommended by these guidelines is generally accepted, each project is evaluated independently and Golder may recommend additional geochemistry test work as more information becomes available during the Project development.

2.0 STAGE 2 - SCOPE OF WORK

As part of the Stage 2 geochemistry assessment, Golder proposes to undertake the following:

- review of mine plan and sample selection;
- sample collection for geochemical analysis;
- coordination of laboratory testing;
- data analysis, compilation and interpretation; and
- reporting.

The scope of work is described in greater detail in the following subsections.

2.1 Mine Plan Review and Sample Selection

Before samples can be selected and collected for Stage 2 of the geochemistry test work, Golder proposes to review the existing mine plan. The mine plan will be provided by CFI to Golder and should include currently proposed open pit shells, ore deposit information (block model cross-sections and plan views of the ore deposit area including open pit shells), exploration diamond drill hole locations and associated logs. The goal of the mine plan review is to develop an understanding of the main rock units intersected by the open pits and develop a sample list that is spatially representative of the expected waste materials. The expected tonnage of waste rock will also be used to select a proportional number of samples of the main rock units

Based on previous discussions with CFI, the sample selection will be from the 2015 infill drilling boreholes that are currently being drilled and sampled at the site. CFI will provide Golder with a list of samples collected to date including borehole and depth intervals. Samples will be selected to provide spatial representativeness. Golder can provide specific sample intervals for boreholes remaining to be drilled to limit the sampling effort.

2.2 Sample Collection

For the Stage 2 program, waste rock sample collection is currently being conducted by CFI geologists as boreholes are being progressed.

CFI will collect, prepare, package and ship the selected rock core samples from the Project site to SGS Lakefield, an accredited laboratory. CFI will be responsible for the costs of shipping the rock core samples. Once the samples arrive at the laboratory, Golder will travel to the laboratory to observe the mineralogy and condition of the core (e.g., extent of weathering, if any) to collect information that may assist in interpretation of the results. Golder will also confirm that all samples were received and coordinate with the laboratory to request the analysis and discuss details of the test work methodology.

2.3 Laboratory Test Work

Laboratory testing is proposed to be completed on the samples collected for the Stage 2 geochemistry program, which consists of waste rock samples from the 2015 infill drilling program and tailings samples from the high carbonate ore processing. The laboratory testing will consist of static testing. Details on the laboratory test work are provided below.

2.3.1 Stage 2 Test Work

Static Testing

Static tests are “one-time” analyses to determine the general geochemical characteristics of a sample, which is the first step in the analysis of the acid rock drainage and metal leaching properties of the rock. The static testing program is proposed to include:

- Acid-Base Accounting (ABA) by the modified Sobek method – used to develop estimates of the potential for acid generation based on the balance between acid producing and acid neutralizing minerals.
- Elemental Analysis of Solids – used to determine the total amount of oxides and metals in the solid phase of the rock samples.
- Short-term Leach Test – De-ionized (DI) water leach test performed according to the method described in Price (1997) and MEND (2009) and is used to develop initial estimates of metal leaching potential.
- Net Acid Generation (NAG) test – performed according to the method recommended by AMIRA (2002) to determine the acid generation of the waste rock under highly oxidizing conditions.

Waste Rock

Based on geochemistry guidelines listed in above and the limited lithological units, Golder has estimated that Stage 2 static testing will be completed on 50 samples. The static testing is proposed as follows:

- ABA, elemental analysis and NAG – 50 samples, and;
- Short-term leach test analysis – 25 samples.

Note, the number of samples is in addition to the samples previously collected and analysed as part of Stage 1. Furthermore, based on the current mine plan which projects approximately 31.3 million tonnes (Mt), there is the potential that further testing may be required.

Tailings

High carbonate ore is currently being processed at SGS Lakefield. It is understood that two tailings samples will be generated; one with and one without sulphide concentrate. It is proposed that static testing be conducted on both samples including; ABA, elemental analysis, NAG and short-term leach test.

3.0 STAGE 2 DATA ANALYSIS

The data analysis scope is for compiling and organizing the data into tables and figures, and for data interpretation according to methods prescribed in MEND (2009), Price (1997) and INAP (2013). The data analysis scope is limited to the data that will be generated as part of the proposed waste rock and tailings testing. A mathematical mixing of the high and low carbonate tailings samples will be conducted at the currently planned ratio (70/30) to better determine the acid generation potential.

4.0 REPORTING

Reporting deliverables that will be provided to CFI under this scope of work as follows:

- Draft report detailing the results of the Stage 2 static testing program; and;
- Final report detailing results of the full static testing program to date and recommendations (if any).

5.0 SCHEDULE

Golder can begin Stage 2 of the project immediately upon receiving written authorization to proceed. The scope of work will be initiated with the review of the available mine plan information, which is expected to be completed early June. The sample selection and collection will be ongoing throughout the summer as the infill drilling program progresses. Laboratory static testing typically takes three to four weeks from the time of arrival of the samples. Once Stage 2 testing is completed, data analysis and reporting will take approximately four weeks to complete.

6.0 CLOSURE

We look forward to continuing to providing assistance at the AGS Mining Project. If you have any questions or comments concerning the contents of this change order, please do not hesitate to contact the undersigned.

Dan LaPorte (M.Sc., P.Geo.)
Hydrogeochemist

Daryl Johannesen (M.Sc., P.Biol.)
Principal

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7.0 REFERENCES

INAP (International Network for Acid Prevention). 2012. Global Acid Rock Drainage (GARD) Guide. www.gardguide.com

MEND, 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Mining Environment Neutral Drainage Program, Natural Resources Canada. December 2009.

Price, W.A., 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, Ministry of Energy and Mines. p.159.

TECHNICAL MEMORANDUM

DATE July 17, 2015 **PROJECT No.** 1407707

TO Frank Pitman
Canada Fluorspar Inc.

CC Michel Wawrzkow; David Brown

FROM Dan LaPorte and Daryl Johannesen **EMAIL** dan_laporte@golder.com

PROPOSED AGS MINE PROJECT – GEOCHEMISTRY CHARACTERIZATION PROGRAM, STAGE 3

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) is pleased to present our proposed scope of work to Canada Fluorspar Inc. (CFI) for a geochemistry characterization program in support of the Environmental Assessment (EA) for the proposed AGS Mining Project (the Project).

The overall objective of the geochemistry characterization program is to determine the acid generating and metal leaching potential of the waste materials (i.e., waste rock and tailings) that will be produced as part of the Project. Golder is completing a staged approach to the geochemical characterization that allows the program to develop at a level and pace that complements the development of the Project.

The initial stage, Stage 1, included a screening level assessment with static testing of a select number of samples to gain an initial understanding of the acid generating and metal leaching potential of the waste rock and ore.

Stage 2, which is currently underway, includes additional static testing of waste rock samples to ensure appropriate spatial and compositional assessment. Characterization of an additional tailings sample is also being completed as part of Stage 2. Stage 3 will consist of long-term geochemical leach testing (Kinetic Tests) conducted on a limited number of waste rock samples collected during Stage 1 and Stage 2 as well as tailings samples.

The Stage 3 geochemical characterization work plan is also in response to regulator comments on the Stage 1 report that recommend long-term testing be conducted on the waste rock and tailings.

Details on the scope of work, schedule and estimated costs for this work program are provided in the following sections. The geochemical work program that is proposed is consistent with the recommendations of the following recognized documents:

- MEND (Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials 2009);
- Guidelines for Acid Rock Drainage (GARD) Guide (INAP 2013); and

- Price (DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia 1997).

2.0 STAGE 3 - SCOPE OF WORK

As part of the Stage 3 geochemistry assessment, Golder proposes to undertake the following:

- coordination of laboratory testing;
- data analysis, compilation and interpretation; and
- reporting.

The scope of work is described in greater detail in the following subsections.

2.1 Laboratory Test Work

Laboratory testing is proposed to be completed on the samples collected for the Stage 1 and Stage 2 geochemistry programs, which consists of waste rock samples from the 2014 and 2015 infill drilling program, and tailings samples from the high and low carbonate ore processing. The laboratory testing will consist of kinetic testing and mineralogy. Details on the laboratory test work are provided below.

Kinetic Testing

Kinetic tests are repetitive leach tests designed to evaluate mineral reactivity over an extended period of time. The test methodology is designed to enhance sulphide oxidation and/or weathering reactions relative to field conditions. Kinetic tests can be used to develop meaningful information with respect to leachate water quality in a relatively short period of time, as compared to actual field conditions, where it may take years for long-term weathering rates to develop. The following testing is proposed:

- Kinetic Testing – used to determine mineral reaction rates - will be conducted according to the method outlined in ASTM D5744-99 (standard test method for accelerated weathering of solid materials using a modified humidity cell).

For the purposes of developing a cost estimate, Golder has assumed that kinetic testing will be completed on five samples including both, waste rock and tailings. Samples will be selected from the static testing dataset, based on the results of the Stage 1 and Stage 2 analyses. This allows the kinetic testing program to focus on key samples that have acid generation and/or metal leaching characteristics of interest. Kinetic testing will be conducted for a minimum of twenty weeks, which is generally considered to be a standard minimum length for kinetic testing to provide meaningful information on weathering rates. However, depending on the trends over the first twenty weeks, the duration of kinetic testing may need to be extended to evaluate longer-term mineral reaction rates. Recommendations to continue or terminate the kinetic testing will be provided to CFI once the data for the first twenty weeks are available.

Mineralogy

Mineralogical analysis is proposed to be completed on five samples (kinetic testing samples) to identify the major, minor and trace mineralogical assemblages. The proposed methodology to determine the mineralogical composition of the samples includes qualitative X-ray diffraction (XRD) with Rietveld refinement. The mineralogical information will assist in determining potential assemblages that could contribute to acid generation and metal leaching.

3.0 STAGE 3 DATA ANALYSIS

The data analysis scope is for compiling and organizing the data into tables and figures, and for data interpretation according to methods prescribed in MEND (2009), Price (1997) and INAP (2013). The data analysis scope is limited to the data that will be generated as part of the proposed Stage 3 testing.

4.0 REPORTING

Reporting deliverables that will be provided to CFI under this scope of work are:

- Interim technical memorandum summarizing the first 10 weeks of kinetic testing;
- Draft report detailing the combined results of Stages 1 to 3 of the geochemistry baseline program; and,
- Final report detailing results of the full geochemistry baseline program to date and recommendations (if any).

5.0 SCHEDULE

Golder can begin Stage 3 of the project once static testing results are received for the Stage 2 program. Laboratory kinetic testing takes at least 20 weeks. Once Stage 3 testing is completed, data analysis and reporting will take approximately four weeks to complete.

6.0 CLOSURE

We look forward to continuing to provide assistance to CFI for the AGS Mining Project. If you have any questions or comments concerning the contents of this change order, please do not hesitate to contact the undersigned.

Dan LaPorte (M.Sc., P.Geo.)
Hydrogeochemist

Daryl Johannesen
Principal

m:\actif\2014\1250\1407707 canada fluorspar-ea-ags mine st-lawrence\3 phase 6-preparation of epr\appendices\canada fluorspar - stage 3 geochemistry workplan (16jul15)db dj.docx

APPENDIX H

Wetland, Avifauna and Species at Risk Assessment Report

Assessment of the Wetlands, Avifauna and Wildlife at Risk in the Proposed Fluorspar Mine Project Footprint Area: Baseline Report

Prepared by

LGL LIMITED
environmental research associates

Submitted to

Canada Fluorspar (NL) Inc.

LGL Report FA0066
22 September 2015

Assessment of the Wetlands, Avifauna and Wildlife at Risk in the Proposed Fluorspar Mine Project Footprint Area: Baseline Report

by

LGL Limited
environmental research associates
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for

Canada Fluorspar (NL) Inc.
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LGL Report FA0066
22 September 2015

Suggested format for citation:

LGL Limited. 2015. Assessment of the Wetlands, Avifauna and Wildlife at Risk in the Proposed Fluorspar Milne Project Footprint Area: Baseline Report. LGL Rep. FA0066. Rep. by LGL Limited, St. John's, NL for Canada Fluorspar (NL) Inc., St. Lawrence, NL. 12 p. + appendices.

Table of Contents

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List of Figures

List of Tables

Executive Summary

This report documents the methods and results of an assessment of wetlands, avifauna, and wildlife at risk that occur in the AGS Fluorspar Project Footprint Area. The desktop wetlands assessment and the avifauna/wildlife at risk on-site survey were conducted in September 2015. Some of the observations made during the avifauna/wildlife at risk survey were used to supplement wetlands information collected from the analysis of aerial photos.

A number of wetlands exist in the Project Footprint Area. They include the following:

- Northwest Pond;
- Grebes Nest Pond;
- Small ponds associated with the open pits, dumps and associated access roads;
- Upper Island Pond;
- Fluvial fen streams and brooks emptying into Salt Cove (five tributaries); and
- A relatively large fen and peatland area associated with Shoal Cove Pond.

Most of the lakes and ponds are oligotrophic in nature and, therefore, are relatively unproductive for wildlife. Some of the Project Footprint Area does support relatively productive fluvial fens that will likely be lost and/or contaminated. The wetlands with the most potential to be affected by the Project is the fluvial fen and peatland complex that occurs immediately east of Shoal Cove Pond. The areas of this wetland is approximately 100 ha.

The PFA falls within the Eastern Hyper-Oceanic Barrens Ecoregion which is characterized by stunted balsam fir, blanket bogs and coastal barrens. Breeding birds characteristic of this habitat type are Swamp Sparrow, Blackpoll Warbler, American Robin and Savannah Sparrow. The species diversity is relatively sparse compared to the more forested ecoregions of Newfoundland and Labrador. Most species of bird listed under the Newfoundland and Labrador *Species at Risk Act* are either unlikely to occur or would be rare in the PFA. The exception is Rusty Blackbird which is known to regularly occur near the PFA at Clarkes Pond and may forage or nest in other ponds or brooks in or near the PFA. A survey for this species after they arrive in the province and are nesting (late May to mid-June) would help determine if Rusty Blackbirds do use the PFA. A more complete survey of nesting birds could be conducted after all migrant bird species are back on the breeding territories during the second week of June.

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1.0 Introduction

In September 2015, LGL Limited (LGL) was engaged by CFI to conduct an assessment of the wetlands, avifauna and wildlife at risk in the AGS Fluorspar Project Footprint Area (PFA) (Figure 1.1). This document serves as a baseline report for this assessment.

The wetlands assessment was conducted by analysis of aerial photos, supplemented by data collected on-site by the LGL team that conducted the two day avifauna/wildlife at risk survey. This report presents the results of this work.

The Government of Canada promotes the conservation of wetlands in order to conserve their ecological and socio-ecological functions now and in the future. Environment Canada has encouraged Canada Fluorspar (NL) Inc. (CFI) to align with the “Federal Policy on Wetland Conservation” (see Appendix 1) that provides for a 'No Net Loss' of wetlands by applying an hierarchical approach, namely, avoidance, minimization of effects, and, as a last resort, compensation. The Newfoundland and Labrador Department of Environment and Conservation (DEC) has also developed a “Policy for Development in Wetlands”. The objective of the provincial policy is to manage developments in wetlands such that water quantity, water quality, hydrologic characteristics or functions, and terrestrial and aquatic habitats of the wetlands are not adversely affected. The policy allows and establishes the criteria for issuing a permit under Section 48 of the *Water Resources Act*.

An ecological land classification (ELC) confirmed at least ten percent of the ELC Study Area is composed wetland habitats, including blanket bogs and marshes, concentrated in the northern portion of the ELC Study Area (see Section 6.2.2 and Figure 6-5 of CFI 2015).

Five species of birds listed under the *Newfoundland and Labrador Endangered Species at Risk Act* have a realistic possibility of nesting in the Project Footprint Area (PFA). These are (1) Rusty Blackbird (*Euphagus carolinus*), Vulnerable; (2) Red Crossbill (*Loxia curvirostra percna*), Endangered; (3) Gray-cheeked Thrush (*Catharus minimus*), Vulnerable; (4) Olive-sided Flycatcher (*Contopus cooperi*), Threatened; and (5) Short-eared Owl (*Asio flammeus*), Vulnerable. The location of the proposed fluorspar mine development is within the general breeding range of each of these species.

Ideally, a survey to determine the presence and abundance of a breeding species of land bird should take place during the breeding season (i.e., late May to early July). However, during the non-breeding season, the likelihood of these species nesting in the PFA can be predicted by assessing the habitat. The habitat, based on aerial photography (Google Earth) and the ELC (see Section 6.2.2 and Figure 6-5 of CFI 2015), shows some potential for these five species to use the PFA as a breeding site.

Source: Golder Associates Ltd.

Figure 1.1 Location of Project Footprint Area (PFA).

The Red Knot (*Calidris canatus rufa*), listed as Endangered under the Newfoundland and Labrador *Endangered Species Act*, migrates through insular Newfoundland from Arctic breeding grounds to wintering areas in South America. The migration period through eastern Newfoundland is typically early August to October. They often stop on beaches and tidal flats in Newfoundland to feed. See Table A2-1 in Appendix 2 for a list of bird species currently listed under the Newfoundland and Labrador *Endangered Species Act*.

The objective of the wetlands/avifauna/wildlife assessment is to inform CFI of existing conditions in the PFA so that it can develop appropriate mitigation measures and monitoring programs to be included in CFI's Environmental Protection Plan and Environmental Effects Monitoring Program.

2.0 Methods

The methods used for the wetlands assessment and the avifauna/wildlife at risk survey are described in the following sections.

2.1 Wetlands Assessment

For the purposes of this work, LGL assessed wetlands that occur either in or very proximate to the PFA. The LGL approach for the wetland assessment includes the following four (4) steps:

1. Review a copy of the St. Lawrence Habitat Stewardship Plan (SLHSP) under the Eastern Habitat Joint Venture of the North American Waterfowl Management Plan;
2. Identify linkages between the SLHSP and the regulatory requirements provided to CFI by the Department of Environment and Conservation (DEC) in the comments on its Registration Document;
3. Assess air photo imagery of wetlands occurring in the PFA and provide a preliminary wetland classification; and
4. Prioritize wetlands based on productivity and potential for supporting wildlife identified as VECs.

Although the wetlands assessment was done primarily through a desktop exercise, the avifauna/wildlife at risk survey team made observations and collected data in the field to supplement the results of the desktop exercise.

2.2 Avifauna/Wildlife at Risk Survey

A two person LGL team conducted the avifauna/wildlife at risk survey in and proximate to the PFA during 15-16 September, 2015. Most of the PFA was investigated from the existing road network. The area where the construction of a new section of road is proposed was observed from where it will meet the existing road as well as from other perspectives. The beaches at

Shoal Cove and Blue Beach Cove were surveyed by walking. Photographs of habitat were taken at key points of interest, including the site of the proposed excavation, preferred mill location and proposed tailings site. The photographs were numbered and catalogued for current and future reference. All birds observed were recorded by species, number and location of observation.

3.0 Results

3.1 Wetlands Assessment

3.1.1 Wetland Habitat Stewardship Plan

In October 2013, the Town of St. Lawrence and the Government of Newfoundland and Labrador signed a Municipal Habitat Stewardship Agreement intended to provide protection and enhancement within designated conservation areas, thereby positively affecting wetland and upland habitats that are fundamental in maintaining and enhancing wildlife populations in the province. In accordance with the Agreement, the Town of St. Lawrence manages wetland habitat within the Management Units and Stewardship Zones in conjunction with technical advice provided by the DEC, Wildlife Division. The Town of St. Lawrence has not yet fully developed a Wetland Stewardship Plan. Presently there has been some municipal zoning of the coastal areas in the municipal boundaries of the Town of St. Lawrence for conservation purposes. Wetlands have not been integrated into the municipal zoning although some have been identified in the ecological land classification registered by CFI (CFI 2015). The DEC is interested in the results of this wetland assessment for CFI and how they may contribute to future decisions and approaches to wetlands for an overall Wetland Stewardship Plan for the town.

3.1.2 Wetland Types

The St. Lawrence area occurs in the Maritime Barrens ecoregion of the Island of Newfoundland. The predominant wetlands in Newfoundland, other than lakes and ponds, are peatlands, particularly oligotrophic (i.e., nutrient poor) bogs. In the vicinity of St. Lawrence, large blanket bogs and basin bogs are common. In areas associated with small rivers, brooks and creeks, peatlands are often enriched with minerotrophic water (i.e., water that has flowed over or through rocks or other minerals, often acquiring dissolved chemicals which raise the nutrient levels and reduce acidity) and support a rich biological diversity. These types of peatlands are typically fens. Smaller areas of marshes are often associated with such sites, particularly in delta areas where the brooks and streams enter ponds or lakes. Fens and marshes generally provide a richer green signature than bogs on air photo and/or satellite imagery, and are expected to provide better wetland habitat (cover and food) for wildlife (Goudie et al. 1988). The small lakes and ponds are oligotrophic and, therefore, are very low in productivity and of limited habitat value for wildlife.

3.1.3 Wetlands in the Project Footprint Area

A number of wetlands either occur in or are proximate to the PFA (Figure 3.1). They include the following:

- Northwest Pond;
- Grebes Nest Pond;
- Small ponds associated with the open pits, dumps and associated access roads;
- Upper Island Pond;
- Fluvial fen streams and brooks emptying into Salt Cove (five tributaries); and
- A relatively large fen and peatland area associated with Shoal Cove Pond.

Source: Golder Associates Ltd.

Figure 3.1 Wetlands in or proximate to the Project Footprint Area, St. Lawrence, Newfoundland and Labrador (non-pond/stream wetlands are coloured dark blue).

The most substantial potential of Project effects relates to the fluvial fen and peatland complex that occurs immediately east of Shoal Cove Pond (Figure 3.2; Figure 10 in Appendix 3). This is an approximate 100 ha wetland area that has a road passing through it. The portion of the wetland west of the road and adjacent to Shoal Cove Pond supports productive fluvial fen habitats. The TMF proposes a saddle dyke that ultimately will inundate and contaminate much of this wetland. The Shoal Cove Pond area is related to the brown field site (Minworth Tailings) immediately upstream of the pond. The current project configuration includes a tailings dam and the inundation of the wetland-peatland area. Because of its proximity to the brownfield area, this site represents the best option for the Tailings Management Facility.

Figure 3.2 Wetlands on east side of Shoal Cove Pond (stream fen and peatland areas are interconnected by small streams; brownfield site immediately above Shoal Cove Pond is also evident.

3.2 Avifauna/Wildlife at Risk Survey

Results of the avifauna/wildlife at risk survey are presented in this section. The habitat at various locations in the PFA are described, followed by the listing of all avifauna observed during the two day survey.

3.2.1 Mine Site Habitat

This area includes various sites associated with the mining activity including CPN Pit, CPS Pit, GNP Pit, Overburden Dump, North Dump and South Dump (see Figure 1.1). Several small unnamed ponds as well as Grebes Nest Pond located in this area will be severely affected by the mining activity. The area at the proposed mine site is characterized by open peat land, with areas of drier barrens, exposed rocky ridges and patches of dense short balsam fir trees (see Figures 1 to 5 of Appendix 3).

The number of species expected to be nesting in this type of habitat is low but includes American Robin (*Turdus migratorius*), Blackpoll Warbler (*Setophaga striata*), Fox Sparrow (*Passerella iliaca*), Swamp Sparrow (*Melospiza georgiana*) and Wilson's Snipe (*Gallinago delicata*). The only birds observed in this area during the survey were several Fox and Swamp Sparrows and one Golden-crowned Kinglet (*Regulus satrapa*).

3.2.2 Preferred Mill Location Habitat

The habitat at the site of the preferred mill location (see Figure 1.1; Figure 6 of Appendix 3) is primarily open peat land with black crowberry (*Empetrum nigrum*), blueberry (*Vaccinium sp*) and sphagnum (*Sphagnum sp*).

3.2.3 Access Road Habitat

The construction of a new access road is proposed across a wide open expanse of peat land (see Figure 1.1). A view of this area from the perspective of where the new access road would join the existing road is provided in Figure 7 of Appendix 3. At the east end of this new road where it connects to the existing road is thickly forested in short balsam fir up to 5 metre in height (see Figure 8 of Appendix 3). Yellow-rumped Warbler (*Setophaga coronata*), Common Yellowthroat (*Geothlypis trichas*), White-throated Sparrow (*Zonotrichia albicollis*), Fox Sparrow and Savannah Sparrow (*Passerculus sandwichensis*) were observed here on 15 September 2015.

3.2.4 Shoal Cove Pond TMF Habitat

The richest looking pond observed in the PFA was Shoal Cove Pond (see Figure 1.1; Figures 9 and 10 of Appendix 3). It is characterized by some shallow waters with a wet sedge border that would potentially be attractive to nesting or feeding waterfowl such a Green-winged

Teal (*Anas crecca*) and American Black Duck (*Anas rubripes*). The only waterfowl present on the pond during the survey visit was a free ranging Mute Swan that had escaped captivity in St. Lawrence. A dozen Herring Gulls (*Larus argentatus*) were bathing in the middle of the pond. Savannah and Swamp Sparrows were observed around the edges.

3.2.5 Beach Habitat at Blue Beach Cove and Shoal Cove

Shoal Cove Pond Brook drains Shoal Cove Pond and enters the ocean at Shoal Cove where there is a sandy beach (see Figure 1.1; Figure 11 of Appendix 3). At the time of the survey, the beach was wide and sandy with little seaweed or other debris on it. Shorebirds observed on Shoal Cove Beach included five Semipalmated Plovers (*Charadrius semipalmatus*) and two Sanderlings (*Calidris alba*). The beach may not be very productive in terms of marine invertebrates, common food types for shorebirds. Norman Wilson conducts fall shorebird surveys at Shoal Cove Beach as part of the Atlantic Canada Shorebird Survey run by the Canadian Wildlife Service. Since 2010, regular fall surveys typically total fewer than 15 individual shorebirds. This is a low number for a beach of this size.

The beach at Blue Beach Cove (see Figure 1.1; Figure 12 of Appendix 3) was characterized by large rounded cobble and was completely devoid any seaweed or sand deposits where shorebirds typically hunt for food. No shorebirds were observed on Blue Beach Cove beach.

3.2.6 Observed Avifauna

All birds observed during the avifauna/wildlife at risk survey in the PFA were recorded. September is fall migration period for most passerines, therefore, the birds encountered at this time of year are not representative of those that may nest in the PFA. Some local breeding species would have already departed the area while other species migrating from other parts of Newfoundland may stop here during migration. A Baltimore Oriole (*Icterus galbula*) observed during the survey is indicative of a species that does not nest in the province but had migrated slightly off course during migration from mainland breeding sites. The 22 species observed are indicated in Table 3.1.

3.2.7 Bird Species at Risk

As previously mentioned, there are five species of birds listed under the Newfoundland and Labrador *Endangered Species Act* that have the potential to nest in the PFA. These include Rusty Blackbird, Red Crossbill, Gray-cheeked Thrush, Olive-sided Flycatcher and Short-eared Owl. In addition, Red Knot has the potential to use the Shoal Cove Beach as a migration stopover point.

Table 3.1 Birds Observed during the PFA Avifauna/Wildlife at Risk Survey, 15-16 September 2015.

Species	Scientific Names	Number	Comments
Green-winged Teal	*Anas crecca*	12	Groups of 3 in Hares Ears Pd, 9 in Blakes Pd in Footprint Area
Common Loon	*Gavia immer*	1	One flying high over Footprint
Semipalmated Plover	*Charadrius semipalmatus*	5	5 at Shoal Cove Beach
Sanderling	*Calidris alba*	1	2 at Shoal Cove Beach
Herring Gull	*Larus argentatus*	20	12 in Shoal Cove Pd, others flying high over Footprint Area
Great Black-backed Gull	*Larus marinus*	5	Flying high over Footprint Area
Red-eyed Vireo	*Vireo olivaceus*	1	In alders on roadside
American Crow	*Corvus brachyrhynchos*	2	Flying high over Alternative Mine Site
Common Raven	*Corvus corax*	2	Flying near Blue Beach Cove
Horned Lark	*Eremophila alpestris*	1	One juvenile in good breeding habitat on Hare Ears Pt, well outside Footprint Area
Boreal Chickadee	*Poecile hudsonicus*	2	In roadside balsam fir
Golden-crowned Kinglet	*Regulus satrapa*	1	In balsam fir scrub at Proposed Mine AGS Mine Site
Hermit Thrush	*Catharus guttatus*	1	In roadside balsam fir
American Robin	*Turdus migratorius*	2	In roadside balsam fir
Black-and-white Warbler	*Mniotilta varia*	1	In roadside alders
Common Yellowthroat	*Geothlypis trichas*	1	In roadside alders
Yellow Warbler	*Setophaga petechia*	1	In roadside alders
Blackpoll Warbler	*Setophaga striata*	10	In roadside alders and balsam fir
Palm Warbler	*Setophaga palmarum*	2	In roadside alders
Yellow-rumped Warbler	*Setophaga coronata*	15	In roadside alders and balsam fir
Black-throated Green Warbler	*Setophaga virens*	1	In roadside alders
Savannah Sparrow	*Passerculus sandwichensis*	12	Various locations along roadside
Fox Sparrow	*Passerella iliaca*	10	Various locations in balsam fir and alders
Swamp Sparrow	*Melospiza georgiana*	15	Various locations in balsam fir and alders
White-throated Sparrow	*Zonotrichia albicollis*	6	Various locations in balsam fir and alders
Baltimore Oriole	*Icterus galbula*	1	In roadside alders
American Goldfinch	*Spinus tristis*	4	In roadside alders

3.2.7.1 Rusty Blackbird

Rusty Blackbird is a widespread but uncommon bird in Newfoundland and Labrador. It nests in wet woods along the edges of ponds and bogs. This habitat is widespread in the province but Rusty Blackbirds are particular with respect to their needs. There is potential habitat in the PFA where Rusty Blackbirds could stop during migration and, potentially, nest. Norman Wilson, who has been birdwatching in the St. Lawrence area since 1998, has observed Rusty Blackbird during 11 of 16 years. Locations of the sightings was split (exact numbers not known) between Clarkes

Pond. and the St. Lawrence community graveyard. Sightings occurred during all seasons including June and July when Rusty Blackbirds should be nesting. Clarkes Pond, a large pond with a forested edge, appears appropriate for nesting Rusty Blackbirds.

Clarkes Pond is not in the PFA but is in the general vicinity. It is not expected to be altered by the mining activity. It is possible Rusty Blackbirds using Clarkes Pond could move to ponds in the PFA. Migrant Rusty Blackbirds could also occasionally use ponds in the PFA.

Generally, based on available habitat, the PFA is likely free of Rusty Blackbirds during the breeding season but it would take a survey during the breeding season (i.e., June) to confirm this.

3.2.7.2 Red Crossbill

Red Crossbill is widespread, albeit in low numbers, throughout Newfoundland. They prefer areas of healthy cone producing coniferous trees. The tree cover is relatively sparse in most of the PFA making it poor habitat for Red Crossbill. Norman Wilson has observed Red Crossbill in this area just once since 1998. He observed this Red Crossbill on an ornamental pine tree in a garden in St. Lawrence. Red Crossbill is very unlikely to nest in the PFA. It could occasionally occur during movements from one area to another.

3.2.7.3 Gray-cheeked Thrush

Gray-cheeked Thrush has a local occurrence throughout Newfoundland and Labrador. The patches of stunted balsam fir in the PFA appear to be suitable habitat for nesting Gray-cheeked Thrush. However, there are many areas of similar habitat in coastal Newfoundland that do not support nesting Gray-cheeked Thrush. A survey focused on listening for singing Gray-cheeked Thrush during June would be required to confirm that Gray-cheeked Thrush does not breed in the area. Norman Wilson has not recorded Gray-cheeked Thrush in the area at any time since 1998, indicating its rarity in the area.

3.2.7.4 Olive-sided Flycatcher

Olive-sided Flycatcher is widespread at low densities during the nesting season in central and western Newfoundland. It is rare on the Avalon Peninsula and may also be rare on the Burin Peninsula. Norman Wilson has not recorded the species in the area since he started birdwatching in the St. Lawrence area in 1998. The species prefers tall trees on the edges of water bodies. The habitat of the PFA is marginal for Olive-sided Flycatcher. This species is considered rare in the St. Lawrence area.

3.2.7.5 Short-eared Owl

The Short-eared Owl is widespread at very low densities in Newfoundland and Labrador. It can be absent for years in certain areas depending on the population cycle of meadow vole

(*Microtus pennsylvanicus*). Populations of meadow vole peak every 2-5 years. The peat land and sparse balsam fir of the PFA is probably not prime habitat for the meadow vole. Norman Wilson has seen only one Short-eared Owl during 16 years of casual birdwatching in the St. Lawrence area. It was observed in the summer of 2015 on the road out to Middle Head Lighthouse on the east side to the entrance to St. Lawrence harbour. Short-eared Owl may occasionally fly through the PFA but is not expected to either regularly occur or nest in the area.

3.2.7.6 Red Knot

Red Knot does move through the island of Newfoundland during fall migration between Arctic breeding areas and wintering grounds in South America. It is a relatively uncommon shorebird with local concentrations sometimes exceeding 20 individuals. The habitat for migrating shorebirds in the PFA is very poor. Although the sandy beach at Sandy Cove looks promising for migrating shorebirds, Norman Wilson has never recorded a sighting of Red Knot. A count greater than 15 shorebirds on this beach is unusual, indicating the poor quality of the beach for feeding shorebirds.

3.2.7.7 Other NL *ESA* Bird Species

Other species listed in the NL *ESA* are too rare on the Burin Peninsula to be considered with a reasonable chance of occurrence in the PFA (see Table A2-1 in Appendix 2). Chimney Swift (*Chaetyra* pelagica) and Common Nighthawk (*Chordeiles minor*) are rare at any time on insular Newfoundland. Peregrine Falcon (*Falco peregrinus*) does not nest on the island of Newfoundland but could potentially pass through the PFA during migration. Piping Plover (*Charadrius melodus melodus*) has been recorded once in the St. Lawrence area but well outside the PFA. This observation occurred after the breeding season and well east of the closest known breeding site in Newfoundland near Burgeo. It is a very rare bird on the Burin Peninsula and adjacent Avalon Peninsula. Harlequin Duck is a locally common wintering bird in Placentia Bay. It could potentially occur during the winter on rocky headlands in the St. Lawrence area but is not likely in the coastal areas of the PFA at Blue Beach Cove or Shoal Cove.

4.0 Conclusion

A number of wetlands either occur in or are proximate to the PFA. They include the following:

- Northwest Pond;
- Grebes Nest Pond;
- Small ponds associated with the open pits, dumps and associated access roads;
- Upper Island Pond;
- Fluvial fen streams and brooks emptying into Salt Cove (five tributaries); and
- A relatively large fen and peatland area associated with Shoal Cove Pond.

The wetlands with the most potential to be affected by the Project are the fluvial fen and peatland complex that occurs immediately east of Shoal Cove Pond. The areas of this wetland is approximately 100 ha.

The PFA falls within the Eastern Hyper-Oceanic Barrens Ecoregion which is characterized by stunted balsam fir, blanket bogs and coastal barrens. Breeding birds characteristic of this habitat type are Swamp Sparrow, Blackpoll Warbler, American Robin and Savannah Sparrow. The species diversity is relatively sparse compared to the more forested ecoregions of Newfoundland and Labrador. Most species of bird listed under the Newfoundland and Labrador *Species at Risk Act* are either unlikely to occur or would be rare in the PFA. The exception is Rusty Blackbird which is known to regularly occur near the PFA at Clarkes Pond and may forage or nest in other ponds or brooks in or near the PFA. A survey for this species after they arrive in the province and are nesting (late May to mid-June) would help determine if Rusty Blackbirds do use the PFA. A more complete survey of nesting birds could be conducted after all migrant bird species are back on the breeding territories during the second week of June.

5.0 Literature Cited

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Appendix 1

The Federal Policy on Wetland Conservation

The objective of the Federal Government with respect to wetland conservation is to ***promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future.***

Goals

In support of the above objective, the Federal Government, in cooperation with the provinces and territories and the Canadian public, will strive to achieve the following goals:

- **maintenance** of the functions and values derived from wetlands throughout Canada;
- **no net loss of wetland functions** on all federal lands and waters;
- **enhancement and rehabilitation** of wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels;
- **recognition** of wetland functions in resource planning, management and economic decision-making with regard to all federal programs, policies and activities;
- **securement** of wetlands of significance to Canadians;
- **recognition of sound, sustainable management practices** in sectors such as forestry and agriculture that make a positive contribution to wetland conservation while also achieving wise use of wetland resources; and
- **utilization** of wetlands in a manner that enhances prospects for their sustained productive use by future generations.

Guiding Principles

In pursuing the above objectives, the Federal Government will respect the following principles. All are critical to this Policy and are not presented in any particular order of importance:

- Wetlands and their functions contribute significantly to the health and well-being of Canadians and are a desirable element of Canada's natural diversity; as such, they are a priority requirement of environmental conservation and sustainable development efforts.
- Wetland conservation is dependent on the incorporation of environmental objectives into the economic decision-making process, as recommended by the (Brundtland) World Commission on Environment and Development, the CCREM National Task Force on Environment and Economy, the Federal-Provincial Agriculture Committee on Environmental Sustainability, and the Sustaining Wetlands Forum.
- Wetlands and wetland functions are inextricably linked to their surroundings, particularly aquatic ecosystems, and therefore wetland conservation must be pursued in the context of an integrated systems approach to environmental conservation and sustainable development.
- On-going development and refinement of scientific knowledge and expertise in Canada is fundamental to the achievement of wetland conservation.

- Wetland conservation can only be achieved through a coordinated, cooperative approach involving all levels of government and the public, including landowners, non-government organizations, and the private sector.
- The Federal Government will play a major role in advocating and achieving wetland conservation, while respecting the jurisdiction of the provinces and territories and the rights of individual landowners.
- In consultation and cooperation with native institutions and representatives in Canada, the Federal Government will promote a cooperative approach to wetland conservation for lands and waters held by the Federal Government for native peoples.
- A basic change in the attitude and perceptions of Canadians regarding wetlands, through communication and education programs, is a vital prerequisite of wetland conservation.
- Canada has a special responsibility to provide leadership in international wetland conservation efforts, through the management of transboundary resources such as water and wildlife in North America, encouragement of global wetland conservation, and active participation in international treaties, conventions and forums.

Appendix 2

Bird Species at Risk

Table A2-1 Birds Listed Under the Newfoundland and Labrador *Endangered Species Act*, including their Status under the *SARA* and COSEWIC.

Common Name	Scientific Name	Status Under Newfoundland and Labrador *Endangered Species Act* (*ESA*)	Status Under *Species at Risk Act* (*SARA*)	Status Under COSEWIC[1]
Red Crossbill *percna subspecies*	*Loxia curvirostra percna*	Endangered	Endangered (Schedule 1)	Endangered
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened (Schedule 1)	Threatened
Peregrine Falcon	*Falco peregrinus anatum*	Vulnerable	No Status (No Schedule)	n/a
Peregrine Falcon	*Falco peregrinus tundrius*	Vulnerable	Special Concern (Schedule 3)	n/a
Rusty Blackbird	*Euphagus carolinus*	Vulnerable	Special Concern (Schedule 1)	Special Concern
Short-eared Owl	Asio flammeus	Vulnerable	Special Concern (Schedule 1)	Special Concern
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened (Schedule 1)	Threatened
Grey-cheeked Thrush	*Catharus minimus*	Vulnerable	n/a	n/a
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened (Schedule 1)	Threatened
Bank Swallow	*Riparia riparia*	n/a	No Status (No Schedule)	Threatened
Barn Swallow	*Hirundo rustica*	n/a	No Status (No Schedule)	Threatened
Bobolink	*Dolichonyx oryzivorus*	n/a	No Status (No Schedule)	Threatened
Red-necked Phalarope	*Phalaropus lobatus*	n/a	n/a	Special Concern
Piping Plover *melodus* subspecies	*Charadrius melodus melodus*	Endangered	Endangered (Schedule 1)	Endangered
Eskimo Curlew	*Charadrius melodus melodus*	Endangered	Endangered (Schedule 1)	Endangered
Red Knot *rufa* subspecies	*Calidris canutus rufa*	Endangered	Endangered (Schedule 1)	Endangered
Harlequin Duck	*Histrionicus histrionicus*	Vulnerable	Special Concern (Schedule 1)	Special Concern
Barrow's Goldeneye	*Bucephala islandica*	Vulnerable	Special Concern (Schedule 1)	Special Concern
Ivory Gull	*Pagophila eburnea*	n/a	Endangered (Schedule1)	Endangered

[1] Committee on the Status of Endangered Wildlife in Canada.

Appendix 3

Photographs of Habitat in the Project Footprint Area

Figure 1. View of proposed site of Overburden Dump showing stunted balsam fir (*Abies balsamea*) and, in the distance, Little Lawn Harbour.

Figure 2. An unnamed pond that will be destroyed by the CPN Pit.

Figure 3. **West end of Grebes Nest Pond showing the rocky shoreline and sparse woodland.**

Figure 4. **Site of North Dump characterized by peat land and scrub balsam fir.**

Figure 5. **Site of GNP Pit characterized by peat land and stunted balsam fir trees.**

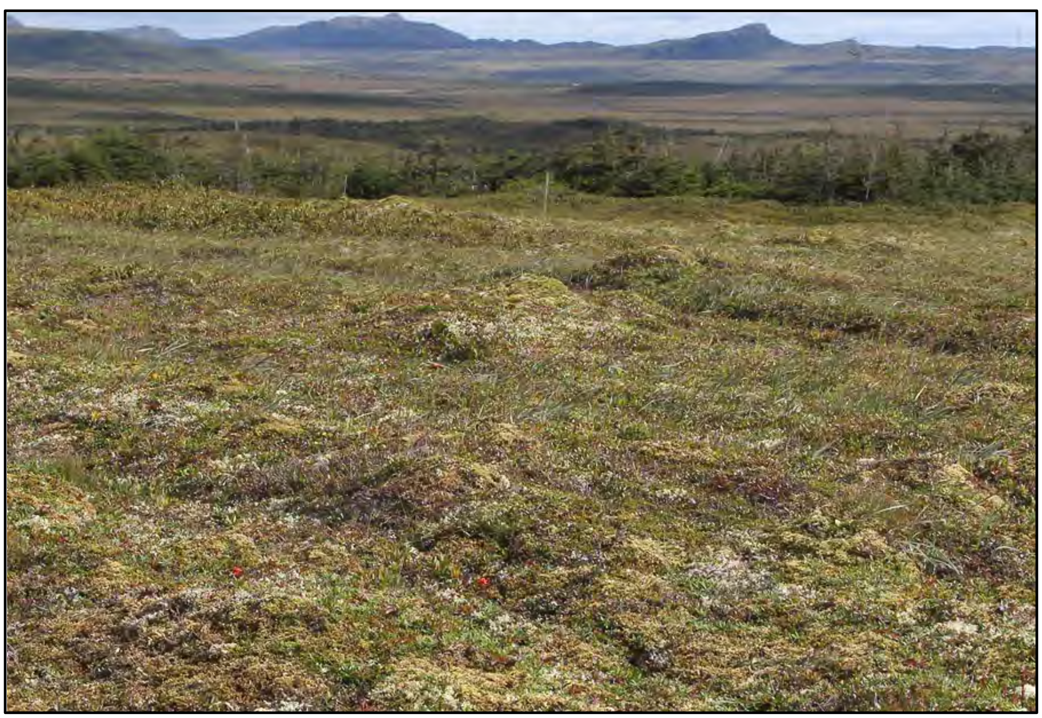

Figure 6. **Site of preferred mill site characterized by open peat land and small areas of stunted balsam fir.**

Figure 7. **View of the route of new proposed road looking east over open bog and peat land.**

Figure 8. **View of the area where east end of a new section of road is proposed. Some of the most luxuriant vegetation of the PFA occurs here.**

Figure 9. **Small wetland at north end of Shoal Cove Pond.**

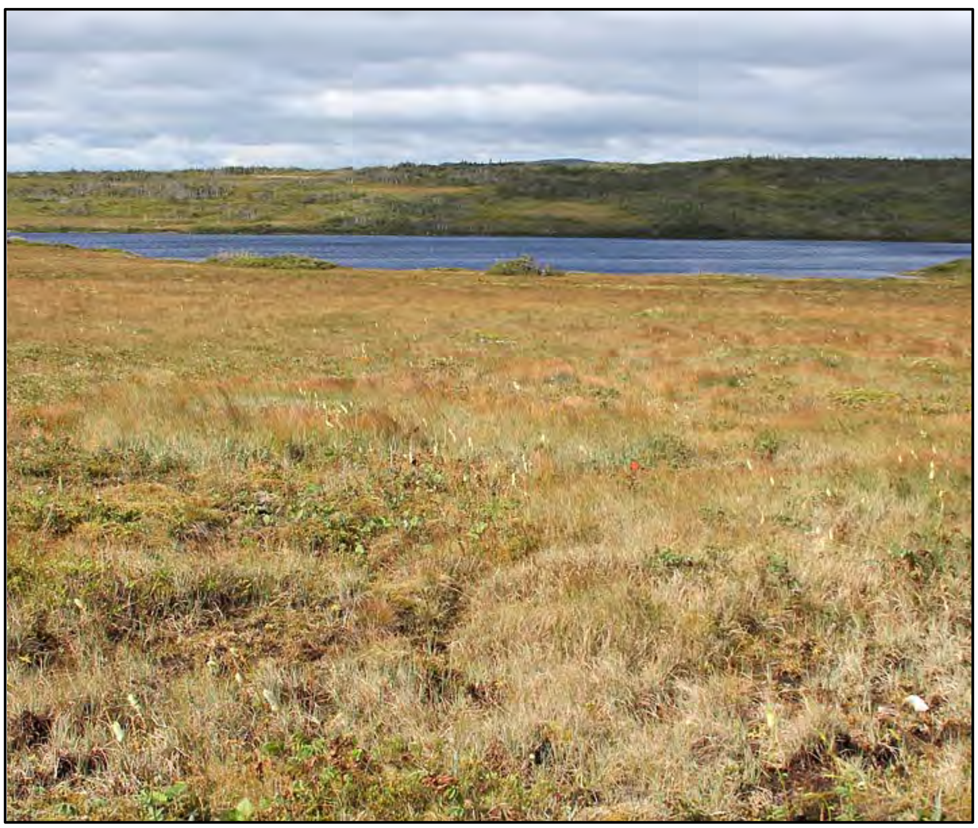

Figure 10. **Peat bog at south east corner of Shoal Cove Pond.**

Figure 11. Beach at Shoal Cove; sandy with small deposits of seaweed.

Figure 12. Beach at Blue Beach Cove; sterile beach of gray and pink cobble stone.

APPENDIX I

Fish Habitat Study

Proposed AGS Fluorspar Mine, St. Lawrence, NL
Aquatic Studies
Field Report

Golder Document Number: 0009-1407707 (rev 0)

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January 15, 2015

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1.0 INTRODUCTION

Canada Fluorspar Inc. (CFI) is intending to mine the AGS vein at St. Lawrence, upgrade an existing mill, construct a new tailings management facility, and build a new deep-water marine terminal in the outer St. Lawrence Harbour for the export of fluorspar concentrate product (the Project). The Project is anticipated to produce 200,000 tonnes of acid grade fluorspar concentrate per year.

The AGS vein has been the focus of CFI's exploration effort in recent months. At this time, it is uncertain if this ore will be extracted using surface or underground mining techniques. The AGS vein underlies Grebe's Nest Pond. Consequently, a survey of fish and fish habitat in the Grebe's Nest Pond and nearby watersheds was required to support the environmental assessment (EA) of the Project.

CFI retained Golder Associates Ltd. (Golder) to complete the EA to support applications for the Project. Golder subsequently retained Sikumiut Environmental Management Ltd. (SEM) to complete freshwater aquatic studies to support the development of the EA. SEM's scope of work was focused on the Grebe's Nest Pond watershed and was limited to the completion of field studies, completion of a field report, and provision of all raw data collected during the studies.

2.0 MATERIALS AND METHODS

2.1 Study Team

The members of the Study Team are identified in Table 2.1, below.

Table 2.1 Team Members

Team Member	Roles and Responsibility
SEM	
Dave Scruton, MES, Senior Scientist	Project manager, coordination, client liaison, field report
Leroy Metcalfe, B. Sc, President & Chief Financial Officer	Financial control, project report QA/QC
Tim Anderson, B.Sc., Senior Scientist	Field team lead, Phase 1 studies (stream surveys and electrofishing)
Jason Lewis, GIS Appl. Spec. Dipl., Env. Tech Dipl., B.A., Geomatics Specialist	Field team lead, Phase 2 studies (lake surveys)
Brad Vaters, Fish and Wildlife Technical Diploma, Biological Technician	Field assistance, Phase 1 and 2 studies
Canadian Fluorspar Inc.	
Milton Noel	Field assistance, Phase 1 and 2 studies

2.2 Work Scope

Through discussions with Golder, the scope of work for the aquatic studies in relation to the Project was divided into 2 phases. Phase 1 focussed on surveys and biological assessment of stream habitats; and Phase 2 focussed on surveys and biological assessment of lake habitats. The work completed during the Phase 1 and 2 studies are detailed below.

2.2.1 Phase 1 – Stream Habitats

Stream Surveys:

- Completion of surveys of the main outflow from Grebe's Nest Pond and any inlet streams to the pond consistent with Fisheries and Oceans Canada's (DFO 2012 Draft) freshwater habitat quantification guidelines.
- Collection of depth/velocity/substrate measurements at previously established discharge stations (n=7) as identified by Golder.

Stream Fish Populations:

- Determination of fish population estimates by quantitative electrofishing (3 pass removal method) at representative habitat types (n=6). Populations were estimated using MicroFish 3.0.

2.2.2 Phase 2 – Lake Habitats

Lake Surveys:

Surveys were completed to collect data for habitat quantification after Bradbury et al. (2001) for Grebe's Nest Pond and John Fitzgerald Pond as follows:

- Bathymetry;
- Substrate and/or vegetation mapping;
- Secchi disc depth;
- Depth/temperature profile; and
- Field water quality.

Lake Fish Community:

- Completion of fish sampling on Grebe's Nest Pond and John Fitzgerald Pond using fyke nets (n=4 per pond, over three net nights) to determine fish species presence/absence, relative abundance, and size distribution. Fish were marked and released to obtain a relative measure of re-capture rate.

Reporting:

- Preparation of a field data report to document: all field methods; all raw survey, chemical, and biological data; fish population estimates (streams); lake bathymetry and habitat mapping; and discharge estimates.

2.3 Stream Habitat Assessment

Stream surveys were completed of the main outflow from Grebe's Nest Pond to the confluence with the ocean. Surveys were completed consistent with the secondary level of habitat assessment as described in DFO's freshwater habitat quantification guidelines (DFO 2012 Draft). In DFO's classification scheme, the key factors used to determine habitat suitability are water velocity, water depth and substrate and the survey collected data for these parameters to assist in determination of habitat suitability for each habitat reach.

The survey techniques are specific for small to mid-sized streams that can be walked or waded and were ideally suited to the watershed evaluated. Stream segments on the outlet of Grebe's Nest Pond were surveyed in an upstream direction from the confluence with the ocean. Stream segments were divided into a number of consecutive sections with sections delineated by an obvious change in habitat type, or alternatively by a fixed length (50 or 100 metres).

For each stream segment, the following general information was documented:

- stream name/identifier;
- date, time of day at start and end;
- GPS coordinates at start and end;
- weather conditions;
- field crew members; and
- and general comments or observations.

Detailed stream survey information was collected using standard field survey methods (e.g., tape, metre stick, velocity meter, wading rod) and included the following:

- section characteristics including section number, GPS location, and length surveyed;
- measurement of cross sections of depth, wetted width and channel width (minimum of three locations; top, middle, bottom);
- classification of meso-habitat types (as %, see Table 1), the total number of pools, pool/riffle ratio;
- classification of substrate types (as %, after Wentworth 1922) and degree of siltation;
- classification of cover types (as %, after Gibson et al.1987);
- qualitative description of bank erosion and stability; and
- identification of potential obstructions to migration and description of each.

All data recorded on field data sheets were verified and photographs taken were catalogued each evening. A digital camera (Nikon Coolpix Model AW110, 16 megapixels, 5X optical zoom, 5-25 mm lens) with built-in GPS capability was used to collect still photography images.

2.3.1 Meso-Habitat Classification

The approach taken for the stream surveys followed the methodology originally described in Scruton et al. (1992) and recently updated in DFO (2012 Draft). This approach mapped all stream habitats at the meso-habitat scale, for subsequent quantification, as described in Table 2.2. The meso-habitat were classified (as proportion [%] of each surveyed reach) as: (i) riffle; (ii) run; (iii) pool; (iv) steady; and (v) rapids/cascades/chutes/falls. Cascades, rapids, chutes, and falls are habitats considered less productive and are used primarily for migratory purposes, and as such, these habitat types were aggregated. In Newfoundland, the terms 'steady' or 'flat' are used interchangeably and for this survey the meso-habitat type steady was adopted. The classification guide (DFO 2012 draft) identified a number of types of pools (e.g., plunge, trench, debris, eddy) but in this survey the single meso-habitat type 'pool' was used which did not distinguish between the type of pool.

Table 2.2. Riverine Habitat Classification Applied to the Project

Habitat Type	Habitat Parameter	Description
Fast Water	**Mean Water Velocity** **Stream Gradient**	**> 0.5 m/s** **Generally > 4%.**
Rapid	General Description	Considerable white water1 present.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	< 0.6 m
	Substrate	Usually dominated by boulder (Coarse) and rubble (Medium) with finer substrates (Medium and Fine) possibly present in smaller amounts. Larger boulders typically break the surface.
	Stream Gradient	Generally 4 to 7%
Falls Chute Cascade	General Description	Mainly white water present. The dominating feature is a rapid change in stream gradient with most water free-falling over a vertical drop or series of drops.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	Variable and will depend on degree of constriction of stream banks.
	Substrate	Dominated by bedrock and/or large boulders (Coarse).
	Stream Gradient	> 7% and can be as high as 100%.
Run	General Description	Relatively swift flowing, laminar, and non-turbulent.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	> 0.3 m
	Substrate	Predominantly gravel, cobble and rubble (Medium) with some boulder (Coarse) and sand (Fine) in smaller amounts.
	Stream Gradient	Typically < 4% (exception to gradient rule of thumb).

Table 2.2. Riverine Habitat Classification Applied to the Project, cont'd.

Habitat Type	Habitat Parameter	Description
Moderate Water	**Mean Water Velocity** **Stream Gradient**	**0.2 to 0.5 m/s** **> 1 and < 4%**
Riffle	General Description	Relatively shallow and characterized by a turbulent surface with little or no white water.
	Mean Water Velocity	0.2 to 0.5 m/s
	Mean Water Depth	< 0.3 m
	Substrate	Typically dominated by gravel and cobble (Medium) with some finer substrates present, such as sand (Fine). A small amount of larger substrates (Coarse) may be present, which may break the surface.
	Stream Gradient	Generally > 1 and < 4%
Steady/ Flat	General Description	Relatively slow-flowing, width is usually wider than stream average and generally has a flat bottom.
	Mean Water Velocity	0.2 to 0.5 m/s
	Mean Water Depth	> 0.2 m
	Substrate	Predominantly sand and finer substrates (Fine) with some gravel and cobble (Medium).
	Stream Gradient	> 1 and < 4 %
Slow Water	**Mean Water Velocity** **Stream Gradient**	**Generally< 0.2m/s (some eddies can be up to 0.4 m/s).** **<1%.**
Plunge Trench Debris Pools	General Description	Generally caused by increased erosion near or around a larger, embedded object in the stream such as a rock or log or created by upstream water impoundment resulting from a complete, or near complete, channel blockage. These pool types may be classified as an entire reach (e.g., pools greater than 60% of the stream width) or as sub-divisions of a fast water habitat.
	Mean Water Velocity	< 0.2 m/s
	Mean Water Depth	> 0.5 m depending on stream size (e.g., may be shallower in smaller systems).
	Substrate	Highly variable (i.e., coarse. medium or fine substrates).
	Stream Gradient	Generally< I %
	Mean Water Velocity	Typically < 0.4 m/s, but can be variable.
Eddy	General Description	Relatively small pools caused by a combination of damming and scour: however, scour is the dominant forming action. Formation is due to a partial obstruction to stream flow from boulders, roots and/or logs. Partial blockage of flow creates erosion near the obstruction. It is typically < 60% of the stream width and hence will be a sub-division of a faster-water habitat type (e.g., Run with 20% eddies).
	Mean Water Depth	> 0.3 m. May vary depending on obstruction type, orientation, streambed and bank material and flows experienced.
	Substrate	Predominantly sand, silt and organics (Fine) with some gravels (Medium) in smaller amounts.
	Stream Gradient	Generally < 1 %
	Stream Gradient	Variable.

Source: DFO 2012 Draft
m = metre
m/s – metre per second

2.3.2 Depth, Velocity, and Discharge

As a general rule of thumb, water velocity and depth measurements were collected on three transects per section at three equidistant (¼, ½, ¾ of width) points along each transect. Mean water column velocity was measured using a Hatch FH950 acoustic Doppler velocity meter, with wading rod. Stream discharge was estimated from the depth/velocity/substrate measurements collected (every 0.5 m across the stream) at previously established discharge stations (n=7).

2.3.3 Substrate

The proportional distribution of substrate (%) was based on a classification of substrate types based on particle size (after Wentworth 1922) as: (i) bedrock; (ii) boulder; (iii) rubble; (iv) cobble; (v) gravel; (vi) sand; (vii) silt; (viii) muck; and (ix) clay. All substrate types are delineated on the basis of size (diameter) and size ranges are indicated in Table 2.3. The degree of siltation was also described qualitatively as the amount of fine particles between and on top of larger substrate types.

Table 2.3 Substrate Types and Particle Size Diameter Used in Surveys for the Project

Substrate Type	Particle Size Diameter
Bedrock	N/A
Boulder	>25 cm
Rubble	14 - 25 cm
Cobble	3 - 13 cm
Gravel	2 mm – 3 cm
Sand	0.06 - 2.0 mm
Silt	<0.06 mm
Muck	>85% organic
Clay	inorganic
Source: Adapted after Wentworth (1922)	

2.3.4 Cover Types, Stream Bank Conditions and Obstructions

The proportion of different cover types was based on a classification developed by Gibson et al. (1987) and described in Scruton et al. (1992). Each cover type is independent of the others and could total over 100%. The cover types were defined as follows:

- Overhanging - Cover provided by grasses and shrubs along the sides of a stream. This vegetation is along the stream edge or hangs out over the stream and includes all grasses and shrubs up to approximately one metre in height. Alders are a common type of overhanging cover on small Newfoundland streams.

- Instream (substrate, logs, debris, etc.) - Cover actually in the stream bed as provided by fallen trees and logs, larger rocks and boulders, accumulated debris, etc. This can also include undercut banks.
- Instream (vegetation) - Cover in the stream bed as provided by live aquatic vegetation including grasses (often flooded), macrophytes, water weeds, mosses, algae, and other plants that can grow in streams. Slow water areas (steadies and flats) may contain water lilies, etc.
- Canopy - Cover provided by mature hardwood and softwood trees along the sides of a stream. Only the tree and foliage that is actually hanging over the stream are included in cover estimates.

The condition of the stream banks was assessed through a qualitative description of whether banks were being eroded as a percentage (%) for each bank and a general overall description of bank stability (good, fair, poor). Bank erosion was assessed through an indication of absence of vegetation along the bank and evidence of soils, debris, etc. slumping into the river. Bank scour from ice and high water was also evidence of erosion.

The presence of undercut banks, as an indication of where the stream has actually cut into the stream edge and formed a wetted area under the stream bank, was assessed. These areas were noted as they are excellent habitat for salmon and trout.

Any potential obstructions to fish movement and migration were also identified and described. For falls and dams, measurements were collected on vertical height (0.1 m), slope (%), width (0.1 m) and length (0.1 m). Photographs and coordinates of the obstruction were also collected.

2.4 Stream Fish Populations

Quantitative electro-fishing surveys (three pass removal method, four passes on EF-3) were conducted at six sites representative of the habitat distribution determined from the stream surveys. All electrofishing was carried out prior to September 15 and under low flow conditions. Electrofishing methods were in accordance with SEM Standard Operating Procedures (SOPs) and in adherence with conditions of the experimental license issued by DFO to Golder (Experimental License # NL-2669-14).

Electrofishing was conducted using a battery operated Smith Root Model 24 backpack electrofisher following protocols and recommendations in Scruton and Gibson (1995) and Sooley et al. (1997). Prior to sampling, fine meshed (0.48 centimetre) barrier nets were placed along the upstream and downstream boundaries of the sites to isolate fish during sampling to prevent immigration/emigration of fish to/from the site during sampling. The sampling team consisted of three individuals: one operating the electrofisher and the other two using dip nets to capture the stunned fish and place them in a 20 litre (L) bucket to await sampling. The hoop of the anode pole of the electrofisher was fitted with 0.48 cm mesh to permit the electrofisher operator to assist in the capture of fish. Sweeps were conducted in a downstream to upstream direction. Three removals were conducted unless the catch pattern dictated additional removals were necessary. Fish were retained in an enclosure until completion of the each electrofishing sweep at which time they were processed.

After the sampling was complete, fish were identified to species and measured for fork length (in millimetres) and weight (in grams). Fish were then placed in a bucket of clean water to recover and returned downstream of the stream section from which they were captured. All data were recorded on field data sheets designed for the study, verified on the same day of sampling, and the data were subsequently entered into Excel spreadsheets for analyses. Photographs of each site were collected and catalogued.

The MicroFish 3.0 for Windows software program was used to analyze the quantitative electrofishing results (Van Deventer and Platts 1985; Van Deventer 1989). The most recent version of this software was accessed and downloaded from http://www.microfish.org. This program calculated maximum-likelihood population estimates (number and biomass), 95% confidence intervals around the estimate, capture probability and length and weight statistics from the removal-depletion sampling data. Estimates were stratified by species.

2.5 Lake Habitat Assessment

The lake fish habitat was assessed as per DFO requirements for habitat quantification as outlined in Bradbury et al. (2001). All work was focused on the two largest ponds in the watershed; Grebe's Nest Pond and John Fitzgerald's Pond.

A full bathymetric survey was completed for both Grebe's Nest Pond and John Fitzgerald's Pond. The surveys were conducted using a Sonarmite DFX dual frequency ecosounder combining both low-frequency (33 kHz) and high frequency (200 kHz) transducers in one unit.

Bathymetry data (x, y, z; longitude, latitude, and depth) were collected along pre-determined transects and data were sent via bluetooth technology from the Sonarmite DFX to a Panasonic Toughbook laptop computer (Model CF-31). After the field program was complete, the bathymetry data were processed using Sonarvista software to remove any anomalies within the data set. Data for the Grebes Nest Pond shoreline UTM coordinates and water level elevations, referenced to mean sea level, were provided by CFI. Data processing involved application of a general process model which included smoothing, transient filtering, and bottom delineation of the raw data. Once all initial processing was complete, the x, y, z data were exported to a .csv file for additional analysis and modelling in ArcGIS. Final maps were created in ArcGIS Version 10.0 and projected to the NAD 83 Zone 21 Coordinate System.

A visual assessment of substrate and/or vegetation distribution throughout the ponds was completed concurrent with the bathymetric survey and the boundaries of the distributions of these habitat attributes were noted on field maps prepared for the survey. This information was determined through visual assessment and use of a hand held GPS to determine the location of specific substrate type combinations and to delineate habitat boundaries. Data processing and mapping involved digitizing shape files that illustrated the location and characteristics of substrate types. The field team also collected photographs of representative habitat types, shoreline types, and other features of interest.

Secchi depth readings (n=4 per pond) were collected using a standard secchi disc. Measurements were collected during both the descent of the disc in the water column and the ascent of the disk, and averaged for each location. These data were used to define the littoral zone and profundal zone in each lake.

Field measurements of water quality variables were collected using a calibrated YSI Series-6 water quality meter, model 650MDS (Multiparameter Display System). The meter was calibrated prior to going into the field. Measurements taken included: temperature (0.01°C), dissolved oxygen (0.01 $mg \cdot L^{-1}$, % saturation [0.1%]), pH (0.01 pH units) and conductivity (1 $\mu S \cdot cm^{-1}$). A profile of these water quality variables, by depth, was collected for each of the ponds.

2.6 Lake Fish Community

Each pond was fished for a total of three 3 nights, using 4 fyke nets per pond. Fyke nets, a non-lethal sampling technique, were deployed and fished in accordance with SEM Standard Operating Procedures (SOPs) and respecting conditions contained in the experimental license issued by DFO. Fyke nets were set at various locations in each lake (e.g., off points of land, close to inlet streams) to target fish moving along the shorelines. Fyke nets consisted of a 'leader', set perpendicular to shore, leading to the entrance of the trap then leading to a series of hoops allowing fish to pass in one direction to the 'bag end' where fish were retained until release. Nets also consisted of two wings which will also lead to the trap opening and were set roughly parallel to shore at 30^0 to the trap. Each net was allowed to fish throughout each day and was checked once per day. Total fishing time (0.1 hours) for each neat and each set was recorded.

After capture, fish were placed in a holding tank, anaesthetized, identified to species, and measured (fork length [mm], weight [g]). A representative sub-sample of fish had scale samples collected for subsequent aging although no analysis/interpretation has been completed. Fish were marked (fin clip or caudal punch) and released to obtain data on the relative rate of re-capture and not to determine a population estimate. After data were collected on captured fish they were released at a distance away from the location of capture.

2.7 Reporting

At the completion of the field program, SEM completed a field data report (this document) to describe all field methods and provide an overview of the field program. All survey, chemical, and biological data collected during the field program were saved in Excel files. All GIS products were produced as maps and the associated *.mxd files constituted the deliverable from the program. Data analyses was restricted to producing fish population estimates and discharge estimates for streams, and production of bathymetry and habitat maps for lakes. No presentation and/or discussion of results were required.

3.0 RESULTS

3.1 Phase 1 – Stream Habitats and Fish Populations

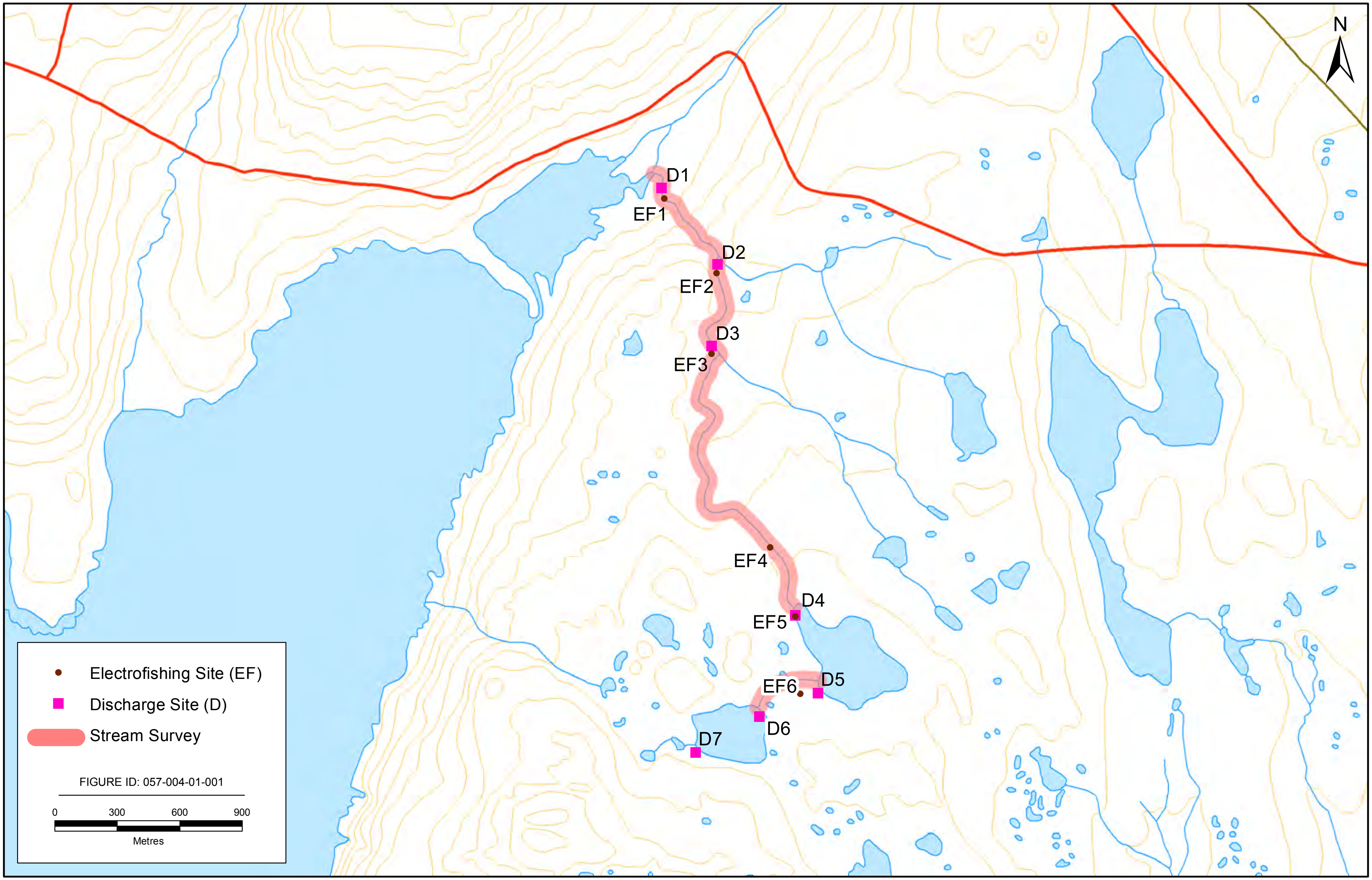
3.1.1 Stream Surveys

Stream surveys were completed between September 11 and 15, 2014 and encompassed the main channel of the Grebe's Nest Pond outlet downstream to the confluence with the ocean (Figure 3.1). A total of 2.53 km linear length of stream was surveyed and a total of 32 sections were included along this length. A total of 32 depth/velocity/substrate transects were also completed along this length. The stream survey data are contained in the attached Excel file (St Lawrence Fluorspar Stream Survey Data.xlsx). Figure 3.1 shows the extent of fluvial habitat surveyed and the location of discharge transects.

Discharge estimates were obtained at seven previously established transects, and locations and discharges are contained in Table 3.1. The width, depth, and velocity data used to calculate discharge are contained in the attached Excel file. Discharge increased from the inflow to Grebe's Nest Pond to the confluence with the ocean due to contributing flow from tributaries. Discharge at Transect 1 was affected by the incoming tide. Flows and water depths were extremely low during estimation of discharge and this has contributed to the wide variability between estimates between locations.

Table 3.1 Location and Discharge Estimates Collected During Stream Surveys

Transect #	Northing	Easting	Stream Width (m)	Discharge ($m^3 \cdot s^{-1}$)
D1 (S1)	5198751	616350	12.6	*0.0278
D2 (S7)	5198398	616656	6.3	0.0790
D3 (S11)	5197975	616638	5.8	0.0450
D4 (S27)	5196680	617042	3.8	0.0042
D5 (S28)	5196308	617150	2.4	0.0035
D6 (S31)	5196193	616867	2.6	0.0196
D7 (S32)	5196021	616563	3.2	0.0080
* Influenced by incoming tide				



Golder Associates

Proposed AGS Flourspar Mine

Stream Survey, Electrofishing Locations and Discharge Measurement Locations, Grebe's Nest Pond Watershed

FIGURE NO:	3.1
PREPARED BY:	SEM
COORDINATE SYSTEM:	UTM NAD 83 Zone 21
DATE:	11/11/2014

3.1.2 Stream Fish Population Estimates

Fish population estimate surveys were conducted between September 13 and 15 at six locations along the main channel of the Grebe's Nest Pond outlet downstream to the confluence with the ocean (Figure 3.1). Site locations and dimensions are provided in Table 3.2. A summary of fishing effort and catch results are contained in Table 3.3. Detailed descriptions of the electrofishing sites, fishing effort, fish catches and meristics are contained in the attached Excel file (St Lawrence Fluorspar Electrofishing Data.xlsx).

Table 3.2 Site Locations and Dimensions for Electrofishing Sites

Site ID	Length (m)	Width (m)	Area (m^2)	Bottom Barrier Net		Upper Barrier Net	
				Northing	Easting	Northing	Easting
EF1	36.8	4.5	165.6	5198723	616416	5198685	616411
EF2	30.0	5.5	165	5198354	616666	5198326	616664
EF3	39.2	2.6	101.9	5197966	616630	5197940	616640
EF4	100	2.1	210	5197082	616866	5197008	616920
EF5	80	3.4	272	5196741	617008	5196677	617040
EF6	100	1.8	180	5196305	617155	5196305	617066

Table 3.3 Summary of Fishing Effort and Catch Results from Electrofishing

Site ID	Effort (s)				Fish Catch (n)				
	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4	Total
EF1	336	244	183	-	26	11	4	-	41
EF2	220	179	190	-	11	4	1	-	16
EF3	190	176	147	162	5	1	3	0	9
EF4	659	518	416	-	62	24	0	-	86
EF5	649	427	277	-	53	16	3	-	72
EF6	648	524	406	-	92	43	29	-	164
Note: s=seconds, n=number of fish captured									

Fish population estimates were determined using MicroFish 3.0 for Windows software program. The program calculated maximum-likelihood population estimates (number and biomass), 95% confidence intervals around the estimate, capture probability and length and weight statistics from the removal-depletion sampling data. Estimates were stratified by species. Results are summarized in Table 3.4 while all data generated by MicroFish are contained in the attached Excel file (St Lawrence Fluorspar Electrofishing Data.xlsx).

Table 3.4 Population Estimates From Electrofishing Results

Site	Total Area (m^2)	Species	Catch (n)	Pop. Est./unit	95% confidence Interval	
					Lower	Upper
1	165.6	Atlantic Salmon	32	20.5	19.3	23.6
		Brook trout	4	2.4	2.4	3.0
		American eel	5	3.0	3.0	3.0
2	165	Brook trout	16	9.7	9.7	10.9
3	101.9	Brook trout	8	7.9	7.9	9.8
		American eel	1	1.0	1.0	1.0
4	210	Brook trout	86	47.1	41.0	55.2
5	272	Brook trout	69	25.7	25.4	26.8
		American eel	3	1.1	1.1	1.1
6	180	Brook trout	163	106.7	92.8	120.6
		American eel	1	0.6	0.6	0.6

3.2 Phase 2 - Lake Habitats and Fish Community

Lake surveys were completed between November 2 and 7, 2014. The bathymetry and habitat survey of Grebe's Nest Pond was completed on November 4 and 5 while water quality and secchi depth measurements were collected on November 5. The bathymetry and habitat survey of John Fitzgerald's Pond was completed on November 6 and 7, 2014 while water quality and secchi depth measurements were collected on November 5.

Bathymetric surveys were completed during high wind conditions and this affected the resolution of the data due to wave conditions. Similarly, two secchi depths collected on John Fitzgerald's Pond indicated the disc was on the lake bottom and SEM had planned to collect additional data but the wave conditions additional sampling from being completed.

Fyke nets were set in Grebe's Nest Pond on November 3 and removed on November 6. Fyke nets were set in John Fitzgerald's Pond on November 4 and removed on November 7.

3.2.1 Lake Habitats

The bathymetric, subsurface substrate, and shoreline substrate and vegetation maps for Grebe's Nest Pond are provided in Figure 3.2, Figure 3.3, and Figure 3.4, respectively, while the locations of secchi depth measurements and the water quality profile are provided in Figure 3.5. Similarly, the bathymetric, subsurface substrate, and shoreline substrate and vegetation maps for John Fitzgerald's Pond are provided in Figure 3.6, Figure 3.7, and Figure 3.8, respectively, while the locations of secchi depth measurements and the water quality profile are provided in Figure 3.9.

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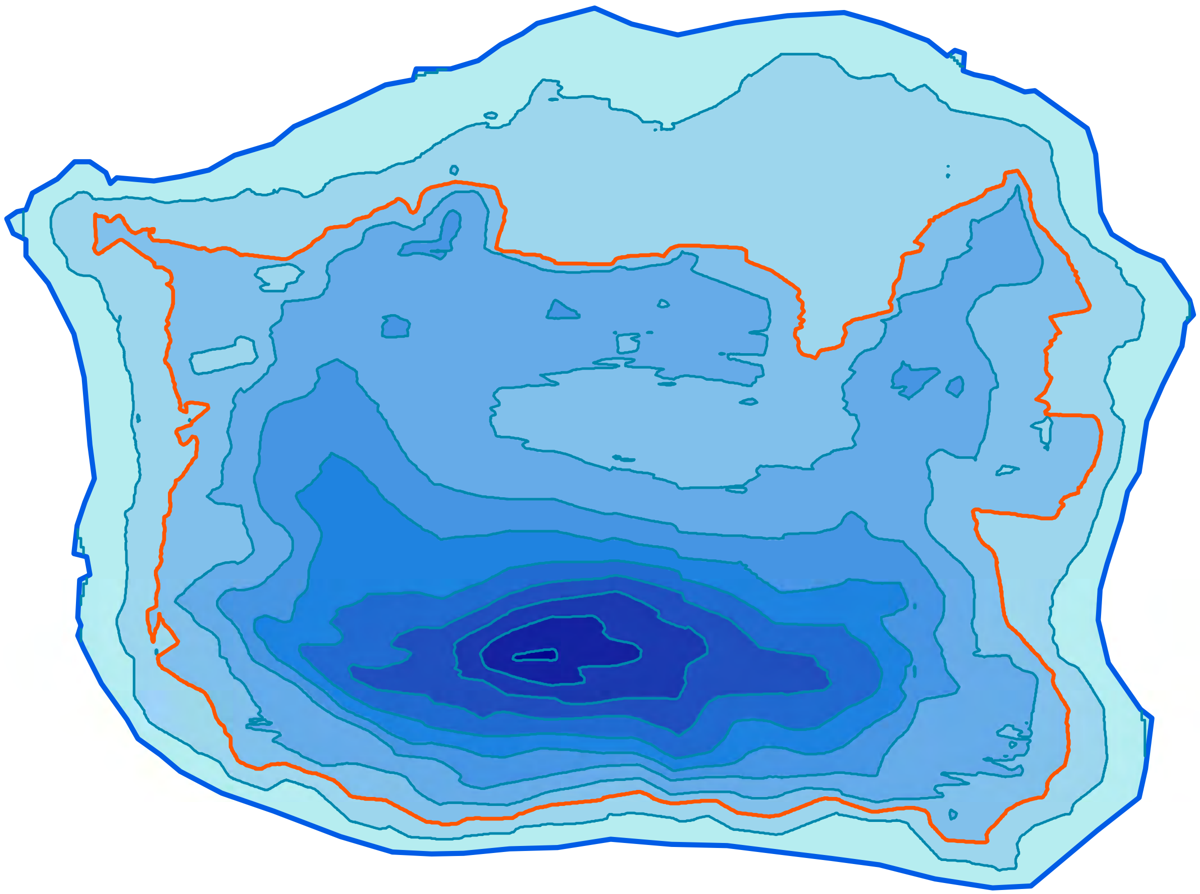


Secchi Depth = 2.0 m
Total Lake Area = 87,712 sq. m
Littoral Zone = 34,475 sq. m
Profundal Zone = 53,237 sq. m

- Bathymetric Contours
- Grebes Nest Pond Secchi Depth
- Shoreline

Depth

(metres)

- 0
- -1
- -2
- -3
- -4
- -5
- -6
- -7
- -8
- -9
- -10

FIGURE ID: 057-004-01-010

0 25 50 75
Metres

NOTES:
1. Bathymetric survey performed by SEM.
2. Shoreline survey performed by Edwards & Associates Ltd.
3. Contour interval = 1m

Golder Associates

Proposed AGS Flourspar Mine

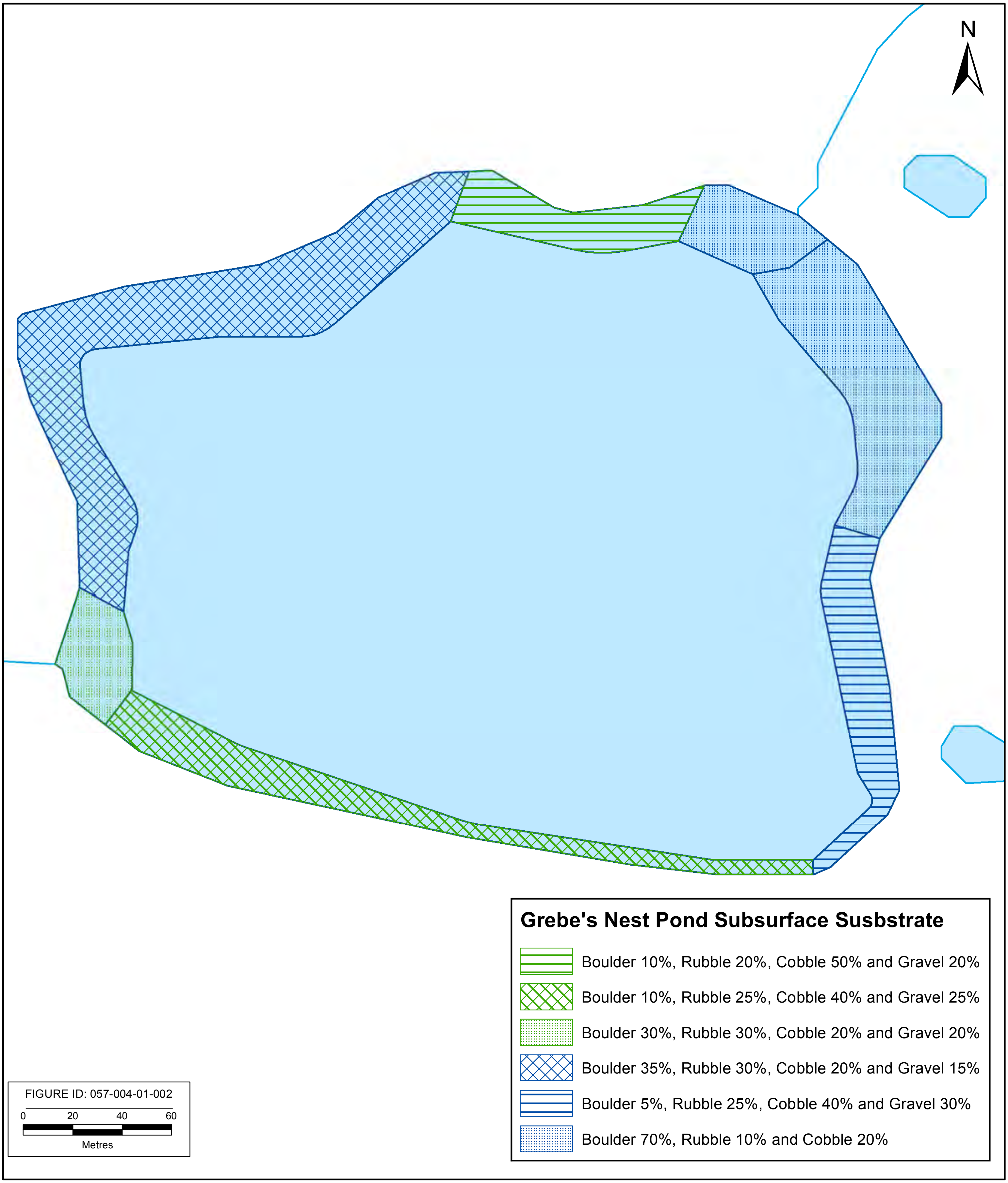
Bathymetry of Grebe's Nest Pond

FIGURE NO: 3.2

PREPARED BY: SEM

COORDINATE SYSTEM: UTM NAD 83 Zone 21

DATE: 26/11/2014



Golder Associates

Proposed AGS Flourspar Mine

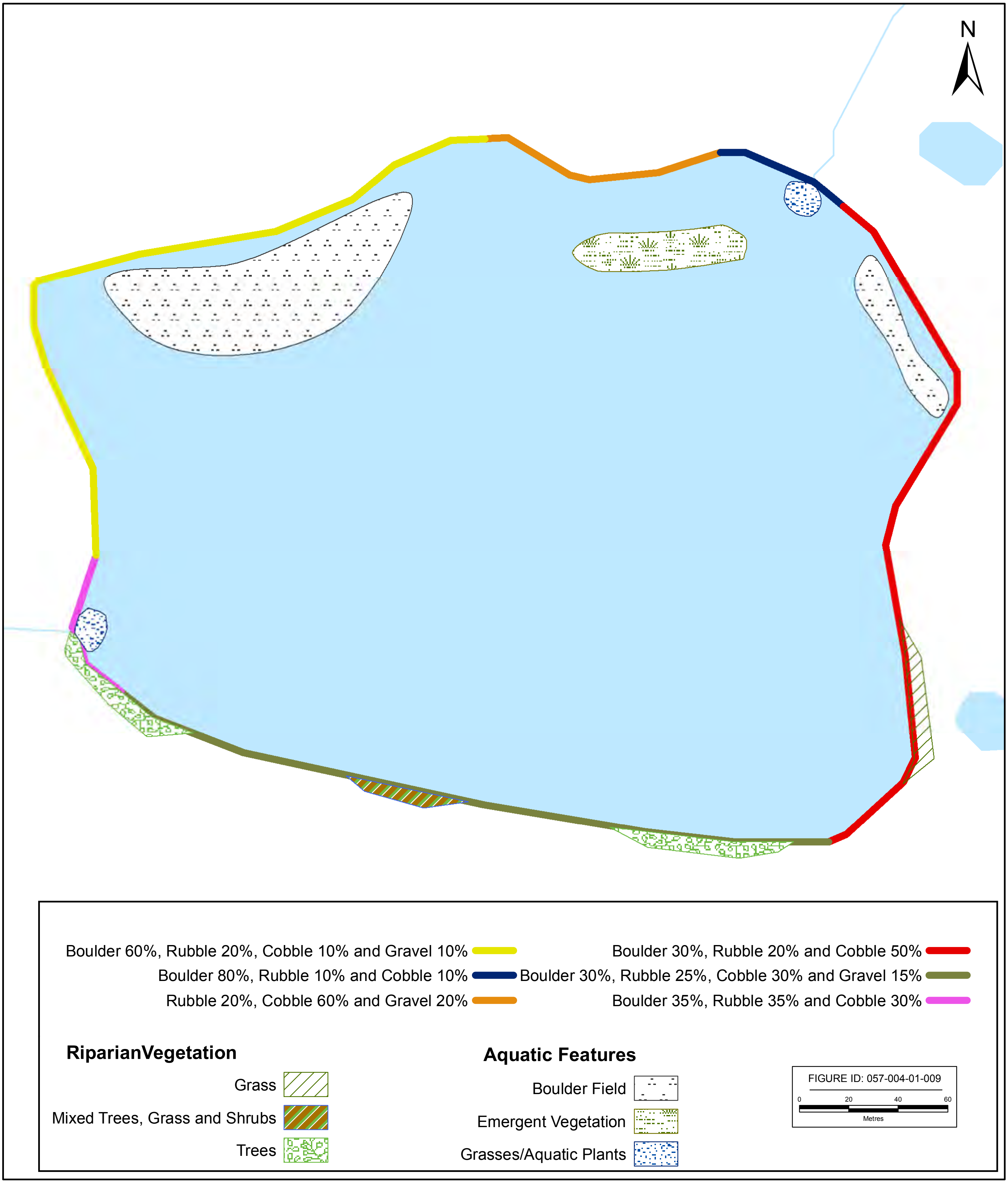
Subsurface Substrate in Grebe's Nest Pond

FIGURE NO: 3.3

PREPARED BY: SEM

COORDINATE SYSTEM: UTM NAD 83 Zone 21

DATE: 11\11\2014



Golder Associates

Proposed AGS Flourspar Mine

Shoreline Substrate and Vegetation in Grebe's Nest Pond

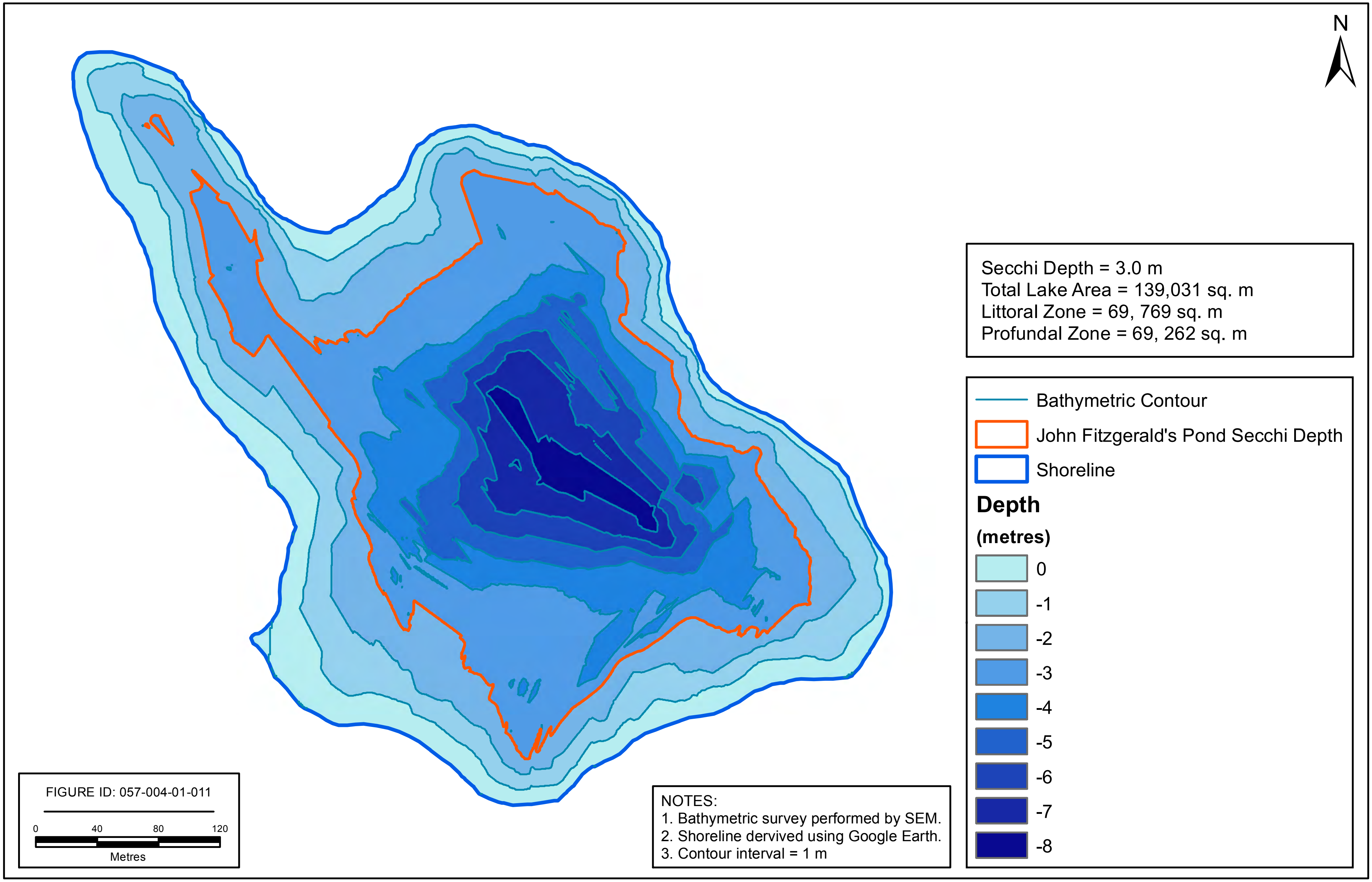
FIGURE NO: 3.4

PREPARED BY: SEM

COORDINATE SYSTEM: UTM NAD 83 Zone 21

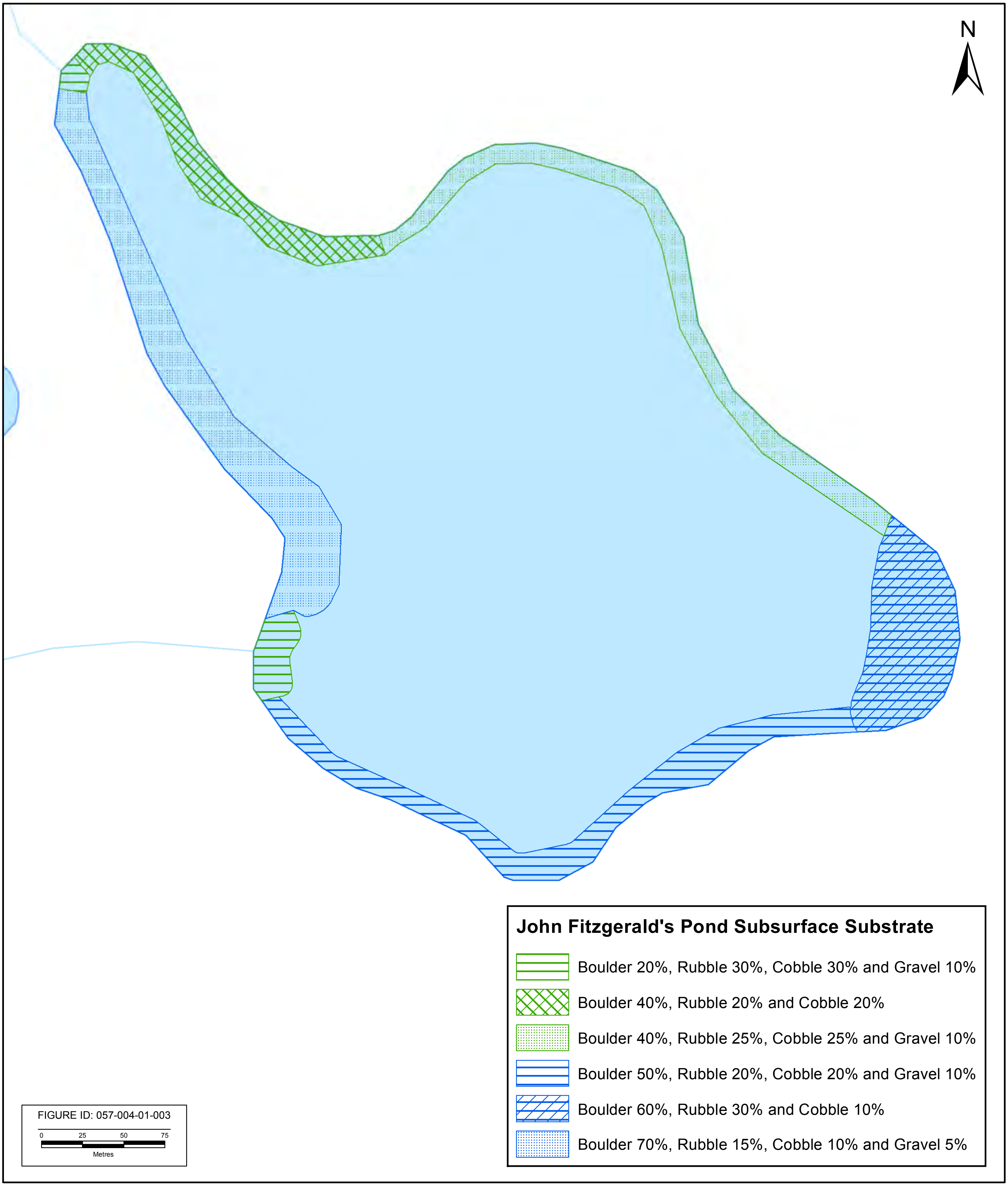
DATE: 11\11\2014

Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.5	PREPARED BY: SEM
	Location of Secchi Depth Measurements and Water Quality Profile in Grebe's Nest Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 11\11\2014

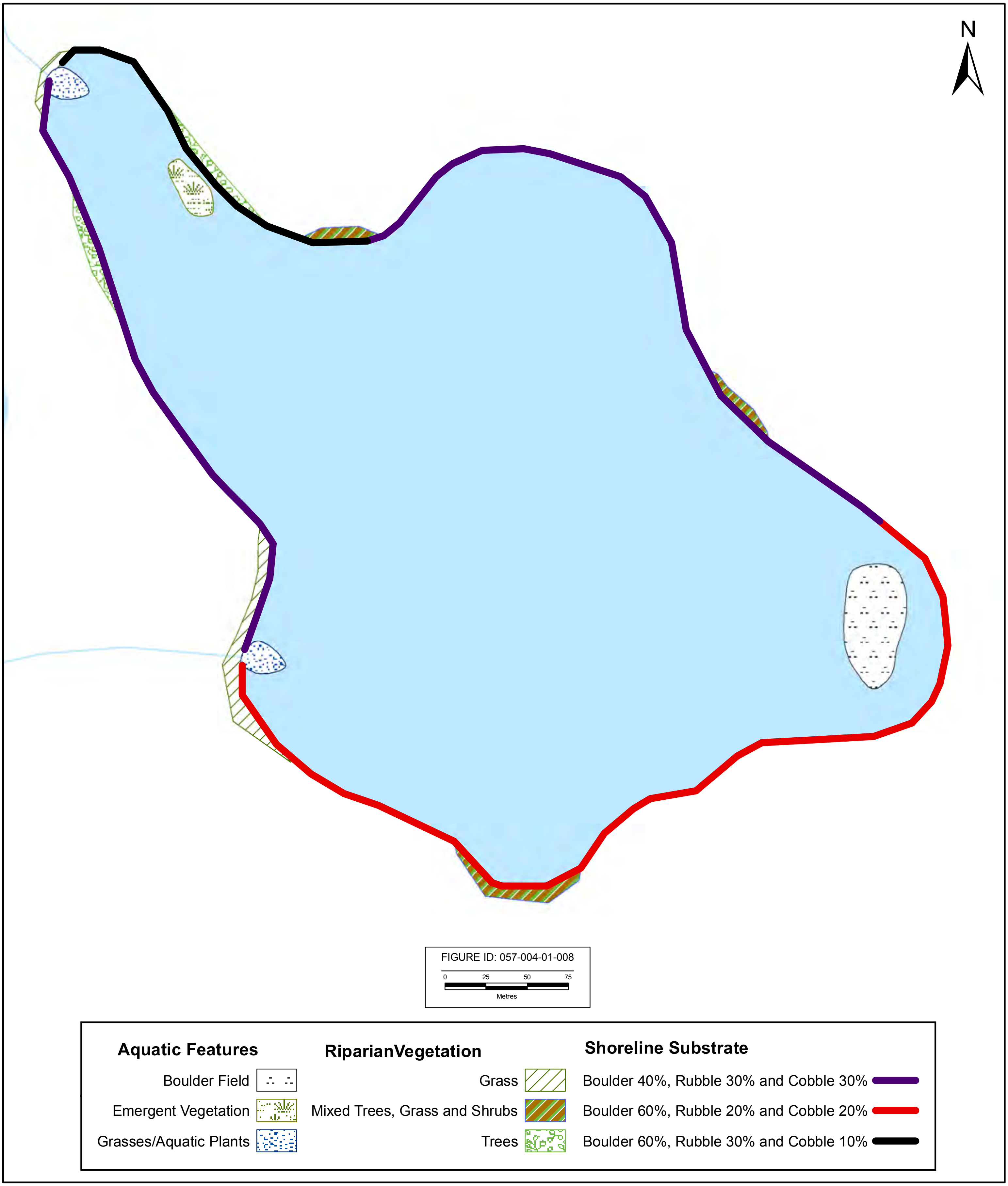


NOTES:
1. Bathymetric survey performed by SEM.
2. Shoreline dervived using Google Earth.
3. Contour interval = 1 m

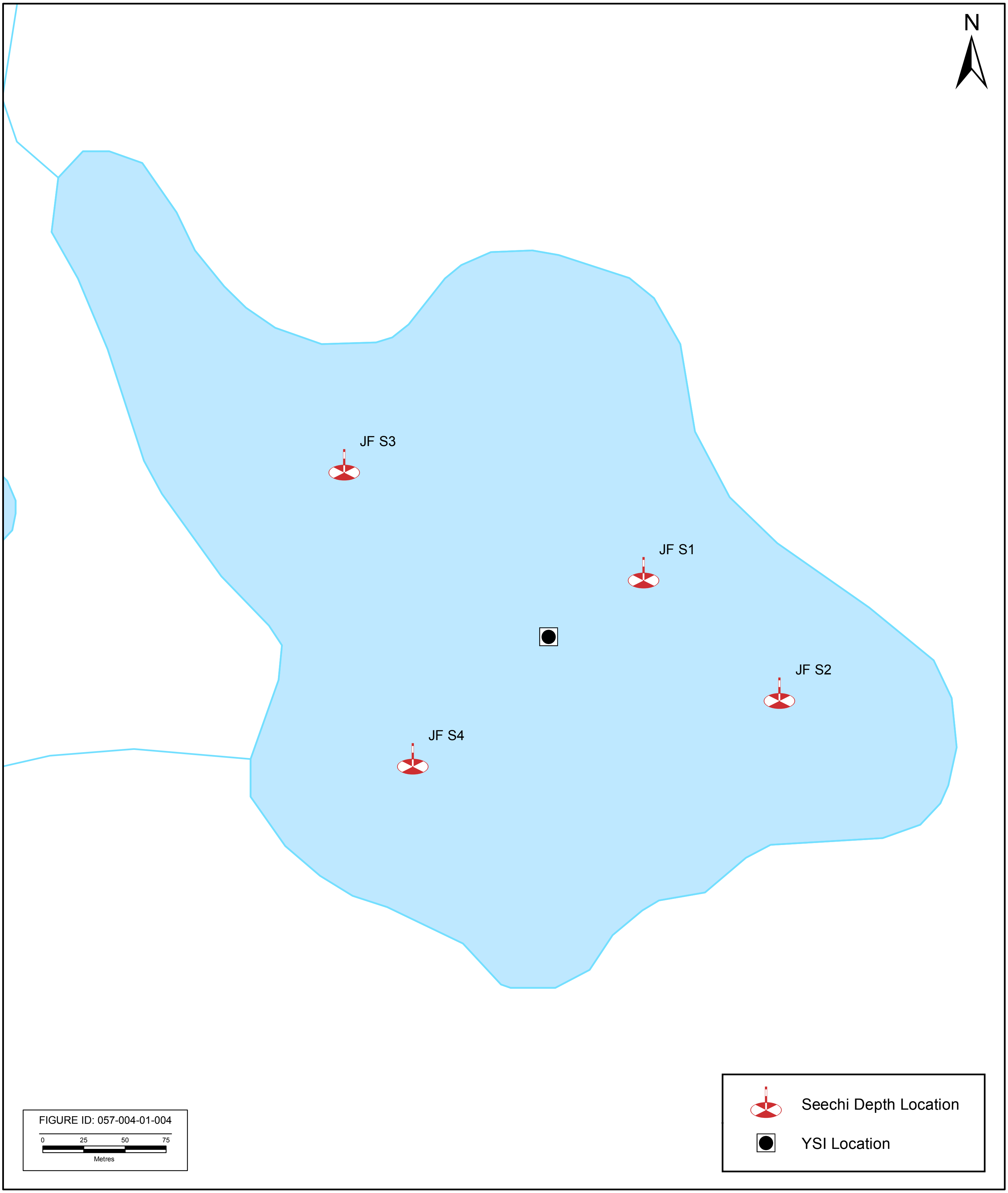
Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.6	PREPARED BY: SEM
	Bathymetry of John Fitzgerald's Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 26/11/2014



Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.7	PREPARED BY: SEM
	Subsurface Substrate in John Fitzgerald's Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 11\11\2014



Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.8	PREPARED BY: SEM
	Shoreline Substrate and Vegetation in John Fitzgerald's Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 11\11\2014



Golder Associates

Proposed AGS Flourspar Mine

Location of Secchi Depth Measurements and Water Quality Profile in John Fitzgerald's Pond

FIGURE NO:	3.9
PREPARED BY:	SEM
COORDINATE SYSTEM:	UTM NAD 83 Zone 21
DATE:	11\11\2014

Secchi depths as determined from surveys are summarized in Table 3.5. Mean secchi depth for Grebe's Nest Pond was 177.4 cm and for the purpose of delineating the littoral and profundal zones in the lake a depth of 2.0 m was used. Similarly, mean secchi depth for John Fitzgerald's Pond was 283 cm and for the purpose of delineating the littoral and profundal zones in the lake a depth of 3.0 m was used.

Table 3.5. Secchi Depth in Grebe's Nest and John Fitzgerald's Ponds

Site ID	Water Depth (m)	Secchi Depth Descending (m)	Secchi Depth Ascending (m)	Average (m)
Grebe's Nest Pond				
GP1	2.2	165	170	167.5
GP2	4.6	167	170	168.5
GP3	5.8	200	215	207.5
GP4	2.5	162	170	166.0
Average				177.4
John Fitzgerald's Pond				
JF1	7.0	3.0	2.9	2.95
JF2	4.0	2.8	2.6	2.70
JF3	2.0	bottom	bottom	
JF4	2.2	bottom	bottom	
Average				2.83

Water quality profiles for Grebe's Nest Pond and John Fitzgerald's Ponds are provided in Tables 3.6 and 3.7, respectively.

Table 3.6. Water Quality Profiles in Grebe's Nest Pond

Depth (m)	Temp. (^{0}C)	DO (mg·L^{-1})	DO (% sat.)	Cond. (µS·cm^{-1})	pH
surface	8.80	12.01	102	57	8.26
1.0	8.71	11.27	96.8	57	7.37
2.0	8.65	11.17	95.8	57	6.99
3.0	8.68	11.14	95.6	57	6.83
4.0	8.56	11.13	95.4	57	6.55
5.0	8.49	11.03	94.4	57	6.18
6.0	8.45	11.09	94.7	57	6.12
7.0	8.37	11.09	94.5	57	6.08
8.0	8.38	11.04	94.1	57	6.03
Note: DO=dissolved oxygen, Cond.=conductivity					

Table 3.7. Water Quality Profiles in John Fitzgerald's Pond

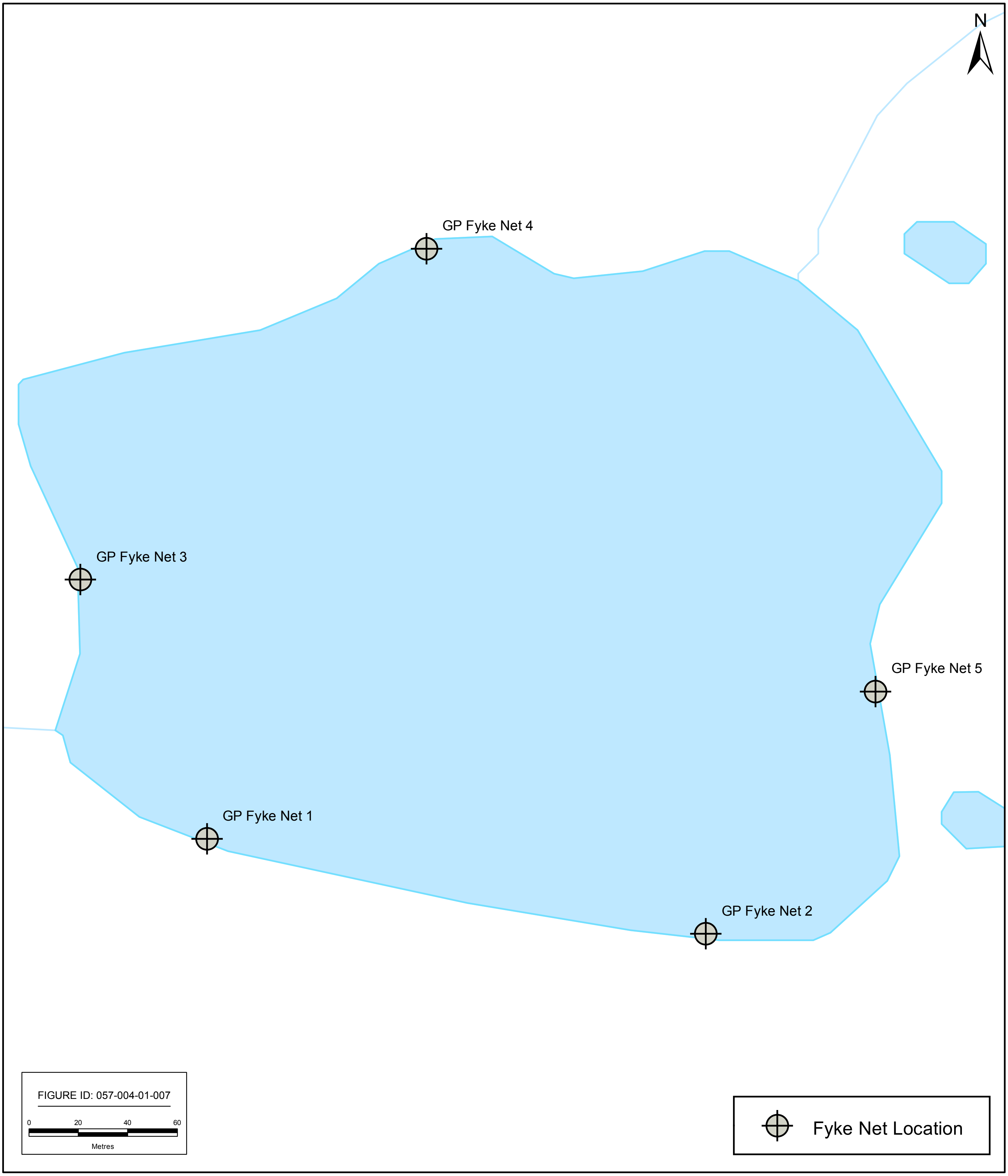
Depth (m)	Temp. (^{0}C)	DO (mg·L^{-1})	DO (% sat.)	Cond. (µS·cm^{-1})	pH
surface	8.87	11.66	100.8	55	6.93
1.0	8.88	11.56	99.7	55	6.40
2.0	8.89	11.52	99.5	55	6.37
3.0	8.89	11.54	99.6	55	6.28
4.0	8.88	11.51	99.2	55	6.20
5.0	8.88	11.40	98.6	55	6.13
6.0	8.89	11.38	98.2	55	6.10
Note: DO=dissolved oxygen, Cond.=conductivity					

3.2.2 Lake Fish Community

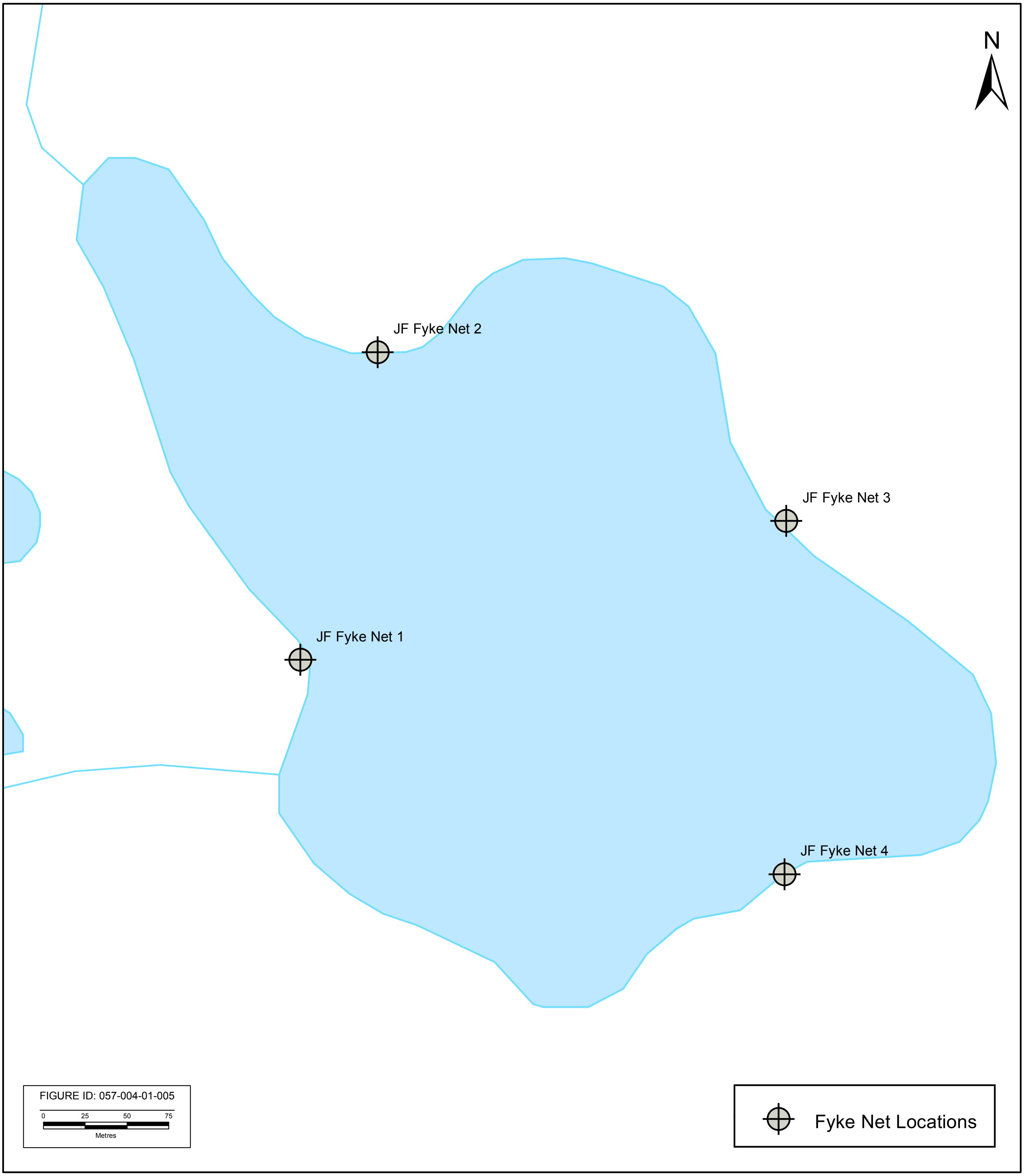
Grebe's Nest and John Fitzgerald's Ponds were fished for a total of three net nights each using 4 fyke nets per pond. Fyke nets were set and maintained at the same location with the exception of one net in Grebe's Nest Pond which was moved after the first net night as no fish were captured. The location of fyke nets sets for Grebe's Nest Pond and John Fitzgerald's Pond are provided in Figures 3.10 and 3.11, respectively. A summary of fishing effort in Grebe's Nest Pond and John Fitzgerald's Pond is provided in Tables 3.8 and 3.9, respectively.

Table 3.8 Details of Fyke Net Fishing Effort in Grebe's Nest Pond

Set ID	Location		Set		Haul		
	Northing	Easting	Date	Time	Number	Date	Time
GP1	616625	5195956	03/11/2014	15:30	Haul 1	04/11/2014	8:26
					Haul 2	05/11/2014	8:45
					Haul 3	06/11/2014	8:00
GP2	no data	no data	03/11/2014	15:30	Haul 1	04/11/2014	8:38
GP3	616585	5196072	03/11/2014	16:00	Haul 1	04/11/2014	8:00
					Haul 2	05/11/2014	9:15
					Haul 3	06/11/2014	8:20
GP4	616738	5196196	03/11/2014	16:45	Haul 1	04/11/2014	7:30
					Haul 2	05/11/2014	8:50
					Haul 3	06/11/2014	8:40
GP5	616893	5196008	04/11/2014	8:30	Haul 1	05/11/2014	8:30
					Haul 2	06/11/2014	9:00



Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.10	PREPARED BY: SEM
	Location of Fyke Nets in Greb's Nest Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 11\11\2014



Golder Associates	Proposed AGS Flourspar Mine	FIGURE NO: 3.11	PREPARED BY: SEM
	Location of Fyke Nets in John Fitzgerald's Pond	COORDINATE SYSTEM: UTM NAD 83 Zone 21	DATE: 11\11\2014

Table 3.9 Details of Fyke Net Fishing Effort in John Fitzgerald's Pond.

Set ID	Location		Set		Haul		
	Northing	Easting	Date	Time	Number	Date	Time
JF1	617142	5196370	04/11/2014	11:30	Haul 1	05/11/2014	14:45
					Haul 2	06/11/2014	12:00
					Haul 3	07/11/2014	7.45
JF2	617186	5196570	04/11/2014	12:15	Haul 1	05/11/2014	14:45
					Haul 2	06/11/2014	13:10
					Haul 3	07/11/2014	8:05
JF3	617454	5196469	04/11/2014	12:35	Haul 1	05/11/2014	15:30
					Haul 2	06/11/2014	13:20
					Haul 3	07/11/2014	8:20
JF5	617431	5196255	04/11/2014	13:05	Haul 1	05/11/2014	15:55
					Haul 2	06/11/2014	13:40
					Haul 3	07/11/2014	8:35

A total of 53 brook trout, including seven recaptures, and one American eel were caught in Grebe's Nest Pond. A total of 84 brook trout, including two recaptures, and one American eel were caught in John Fitzgerald's Pond. A summary of catch data for Grebe's Nest Pond and John Fitzgerald's Pond is provided in Tables 3.10 and 3.11, respectively.

Table 3.10 Summary of Fish Catch from Fyke Netting of Grebe's Nest Pond

Set ID	Haul ID	Species	Catch (n)	Length (mm)			Recaptures (n)
				Min.	Max.	Mean	
GP1	Haul 1	BT	3	151	180	169.0	0
	Haul 1	AE	1	460	-	-	0
	Haul 2	BT	1	184	-	-	1
	Haul 3	BT	5	135	189	166.2	1
GP2	Haul 1	BT	-	-	-	-	-
GP3	Haul 1	BT	3	154	176	164.7	-
	Haul 2	BT	9	125	186	164.4	1
	Haul 3	BT	7	148	174	161.7	2
GP4	Haul 1	BT	4	151	183	163.0	-
	Haul 2	BT	10	114	215	153.5	-
	Haul 3	BT	1	114	-	-	1
GP5	Haul 1	BT	4	136	182	166.3	-
	Haul 2	BT	7	113	198	165.3	1
Total		BT	53				7
		AE	1	460	-	-	0
Note: BT=Brook trout, AE=American eel							

Table 3.11 Summary of Fish Catch from Fyke Netting of John Fitzgerald's Pond

Set ID	Haul ID	Species	Catch (n)	Length (mm)			Recaptures (n)
				Min.	Max.	Mean	
JF1	Haul 1	BT	7	81	190	119.9	-
	Haul 2	BT	1	172	-	172.0	0
	Haul 3	BT	4	176	198	190.3	0
JF2	Haul 1	BT	11	84	193	143.9	-
	Haul 2	BT	8	107	185	156.3	2
	Haul 3	BT	2	111	141	126.0	0
	Haul 3	AE	1	450	-	450.0	-
JF3	Haul 1	BT	16	81	179	118.7	-
	Haul 2	BT	4	87	147	104.5	0
	Haul 3	BT	7	92	212	123.4	0
JF5	Haul 1	BT	13	80	199	98.5	-
	Haul 2	BT	5	95	157	117.0	0
	Haul 3	BT	5	72	124	101.6	0
Total		BT	84	72	212	127.0	2
		AE	1	450.0	-	450.0	0
Note: BT=Brook trout, AE=American eel							

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