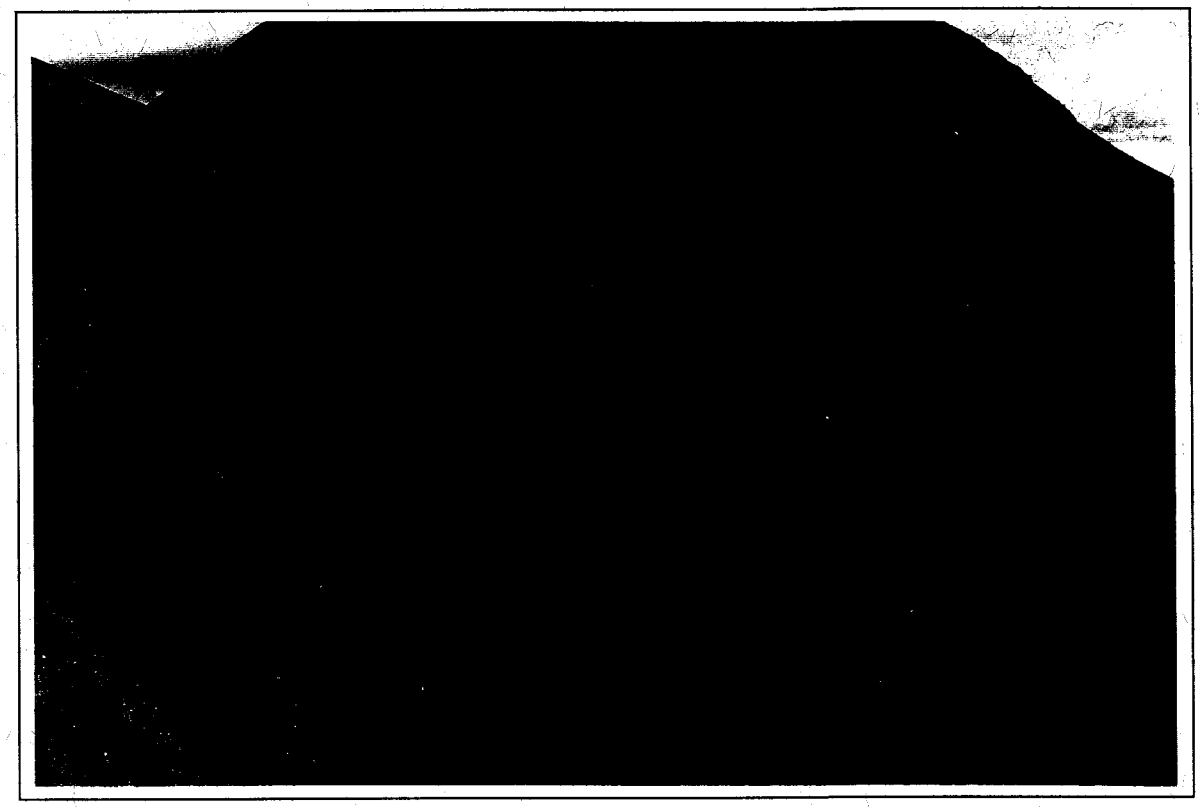
MN -067

PWGSC

Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE SAMOVAR ABANDONED MINE SITE



prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
Public Works and Government Services Canada

March 1997

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada
Canada

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of the

SAMOVAR MINE SITE

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Executive Summary

The Samovar exploration site is located at 63° 01' 12" N, 130° 36' 48" W, approximately 165 km northeast of the village of Ross River. Environmental Services, Public Works and Government Services Canada was retained to conduct an assessment of the Samovar abandoned mine site to a) identify specific environmental and human safety risks and aesthetic concerns; b) provide clean-up recommendations; and c) provide a Class "D" cost estimate for recommended remediation or mitigation measures. The Samovar mine site was inspected by PWGSC on 16 August, 1996.

Assessment components included mine openings and workings, buildings and infrastructure, waste disposal areas, waste rock disposal areas, surface water (including seepage and receiving waters), and hazardous and non-hazardous materials on the site.

The assessment concluded that there are no health and safety concerns, and that remains of a cabin and non-hazardous waste materials are minor aesthetic concerns. Waste rock could become acid-generating, and metals could be mobilized and transported to an unnamed stream southeast of the site.

Recommended actions include:

1. Consolidation and burial of non-hazardous solid waste materials using available waste rock.

2. Implementation of a minimum five-year water quality sampling program to monitor the potential onset and effects of acid generation from waste or underlying host rock on receiving waters. The monitoring program should provide water quality data for spring freshet, middle summer and late fall runoff conditions.

Table of Contents

Appendix A - Site Photographs
Appendix B - Analytical Results

1. INTRODUCTION AND BACKGROUND

In 1993, assessments of 49 abandoned Yukon mine exploration and development sites were completed under the Arctic Environmental Strategy - Action on Waste program by DIAND Technical Services. These assessments were intended to provide a general overview of historical activities, describe site infrastructure, workings and wastes, describe existing environmental or safety concerns on each site, and provide general recommendations for remediation or mitigation work, as appropriate.

At the Samovar site, the overview assessment (INAC, 1994) identified no obvious environmental or safety concerns and low-priority aesthetic concerns with respect to a site building. No rock, soil or water samples were collected for this overview assessment.

Indian and Northern Affairs Canada has determined that further investigation is warranted. Environmental Services, Public Works and Government Services Canada was retained to conduct an environmental assessment of the Samovar abandoned mine site to a) identify specific environmental and human safety risks and aesthetic concerns; b) provide clean-up recommendations; and c) provide a Class "D" cost estimate for recommended remediation or mitigation measures. The Samovar mine site was inspected by PWGSC on 16 August, 1996.

1.1 Location

The Samovar exploration site is located at 63° 01' 12" N, 130° 36' 48" W, approximately 165 km northeast of the village of Ross River (Figures 1 and 2).

1.2 Overview of Site Development

Samovar (also known as the Tea Barite property) was first staked in 1975. Bulk samples have been taken in 1975, 1976, 1980, 1982, and 1995. A 12.5 kilometre road was built to the property in 1976. About 9,000 tonnes of barite have been shipped from the property.

The property was restaked as Tay in 1990 by J. Coyne, and the property is presently held by Coyne and Sons of Whitehorse. The claims are in good standing and development work is ongoing.

Coyne and Sons constructed a 40,000 tonne/year mill to process barite from their Tea Barite property. The company processed a 600 tonne bulk sample from material stockpiled at the mill site and produced 15,000 40-kg bags of high quality barite in 1995. The Tea Barite deposit hosts open-pit mineable reserves of 250,000 tonnes with no stripping requirement. The geological reserve on the property is one million tonnes.

Physical disburbance is limited to access roads constructed to the mine site and small open cuts on the mountainside (Photos 1 - 4). A waste rock pad has been constructed

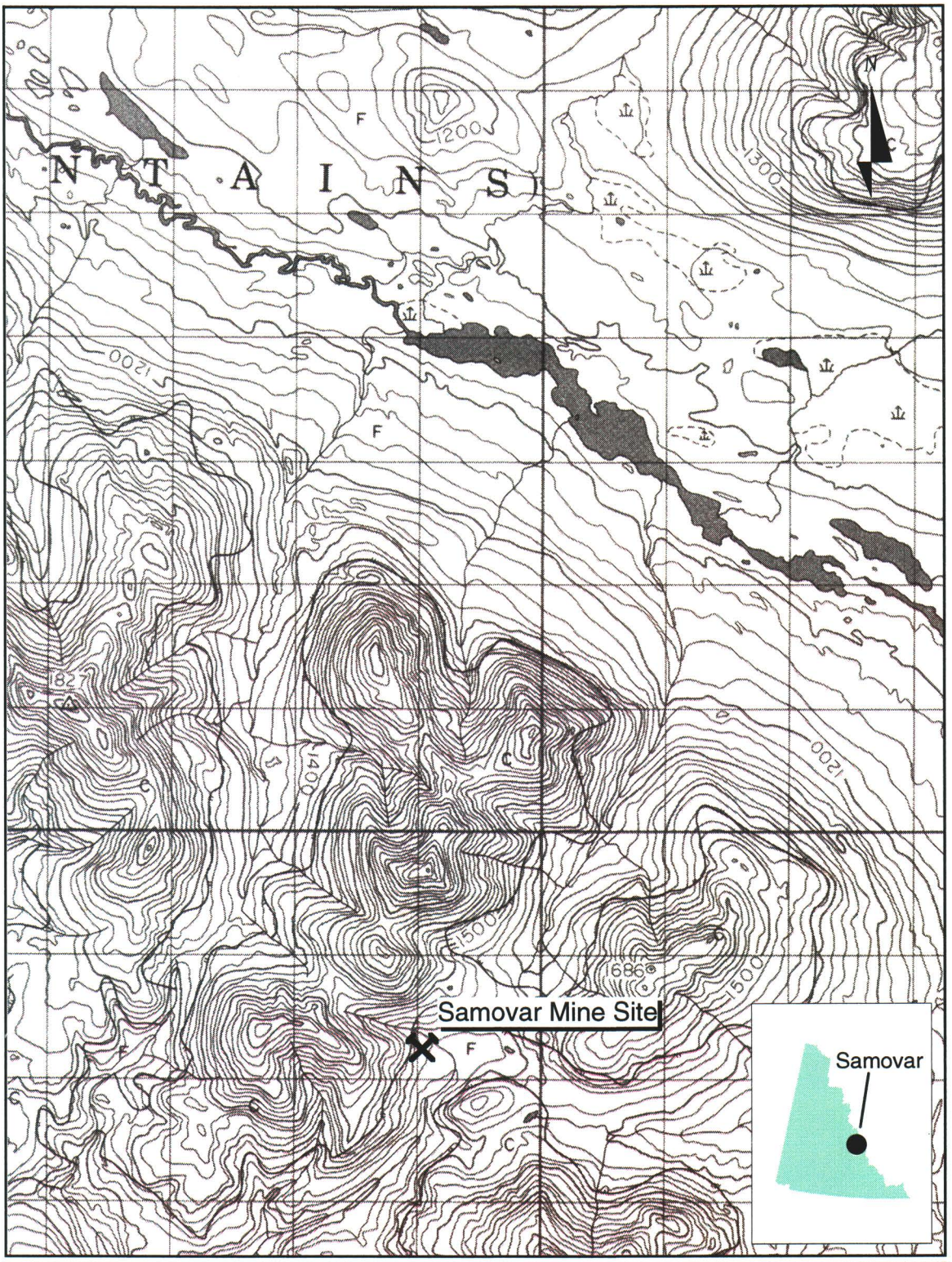


Figure 1: SAMOVAR SITE

N.T.S. 105 O/2 Map Name: Yukon Territory Map Scale: 1:50,000

Latitude: 63° 01' 12" N Longitude: 130° 36' 48" W

Legend

Road

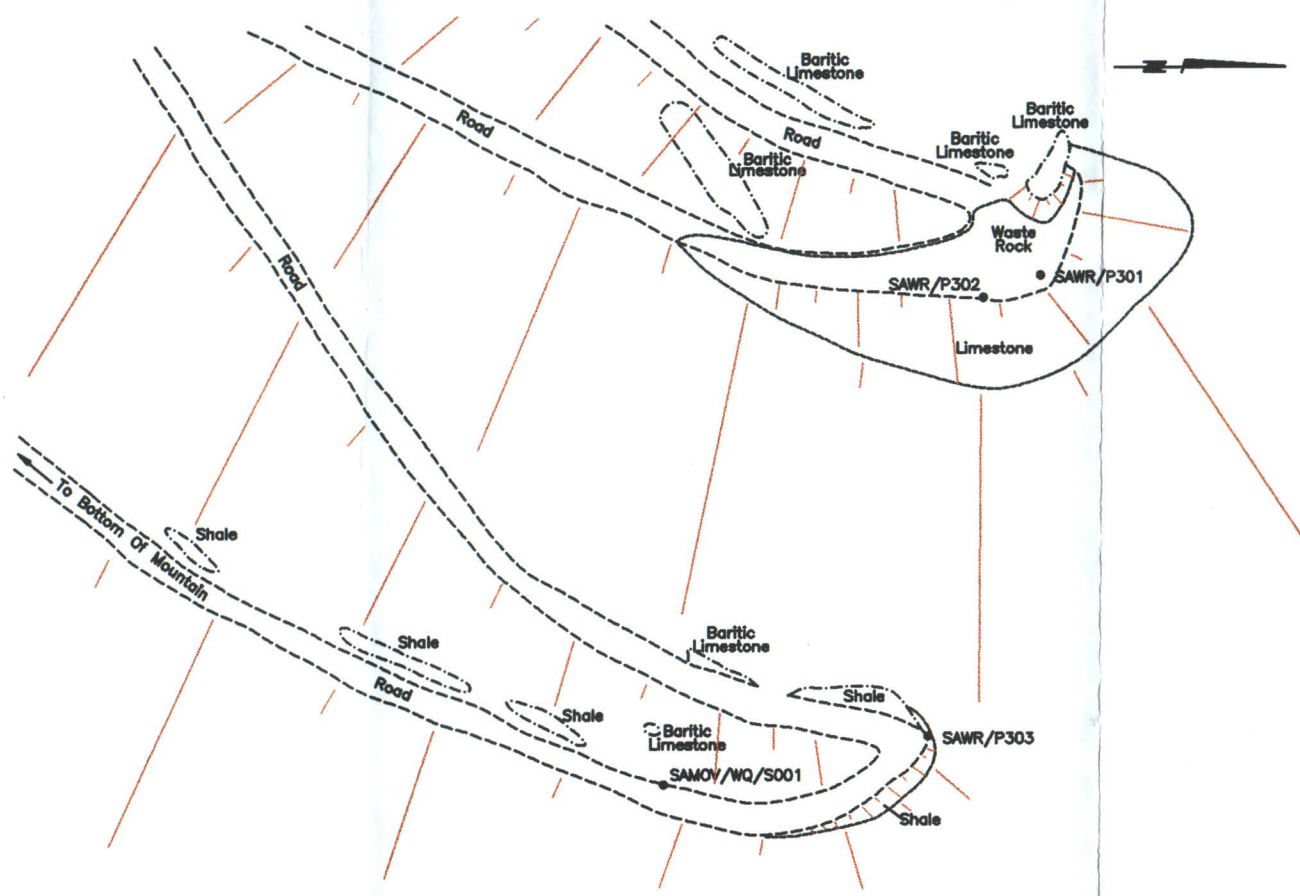
Extent Of Waste Rock

• SAWQ/A3/1 Water Quality Sample (site designation)

• SAWR/P1/1 Waste Rock (site designation

Slope Down

Extent of Debris, Timber, Cable, Pipe, etc.



Waste Rock Sample#	paste pH Sample#	paste cond. µS/cm
SAWR/P301	5.10	40
SAWR/P302/1	4.84	30
SAWR/P302/2	5.04	40
SAWR/P303	–	–
SAWR/P304	–	–

Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\SAMOVAR\SAMOVA-1

Public Works And Government Services Canada
Travaux publics et Services gouvernementaux Canada
Architectural & Engineering Services Western Region

designed by: / dessiné par: / date:
drawn by: / dessiné par: R.N. Nov. /96
approved by: / approuvé par:
revisions:

Drawing title: / Titre du dessin:
Samovar Mine
Site Development & Geological Information
Yukon Territory

project no. / no. du projet: 626967
dwg. no. / dessin no. 1 of 1

adjacent to the mine access road at the base of the slope (Photo 5).

1.3 Site Access

Samovar is accessible by 4-wheel drive vehicles along an 10 km compacted gravel road branching from the North Canol road. At the time of inspection (17 August, 1996), the Samovar mine access road was being used by a horse pack-train enroute to MacMillan Pass from the North Canol roadway. All site areas are easily accessed by foot.

2. PURPOSE AND SCOPE OF WORK

This assessment was carried out by PWGSC for Indian and Northern Affairs Canada to a) identify potential environmental and human safety risks associated with specific abandoned mine sites and b) to provide recommendations and preliminary cost estimates for remediation or mitigation of those risks. Accordingly, the following assessment activities were completed:

- Inspection of mine openings and workings, buildings and infrastructure, and waste disposal areas
- Photo documentation and mapping of relevant site features
- Sampling of waste rock disposal areas, stained soils, surface water (including waste rock seeps and receiving waters) and barrel contents
- Identification and inventory of hazardous and non-hazardous materials on the site
- Identification of potential or actual environmental pathways and receptors for site contaminants
- Assessment of human safety hazards and potential for accidental or deliberate access to hazardous areas
- Assessment of acid rock drainage potential in waste rock and mine development areas

Upon completion of these activities, preliminary cost estimates were generated to meet the following remediation/mitigation requirements:

- Physical stabilization of waste rock disposal areas
- Sealing of all mine openings
- Consolidation and landfill of all non-hazardous, non-combustible solid wastes
- Remediation and/or removal and disposal of contaminated soils as required to meet CCME Commercial/Industrial criteria for soils
- Removal and disposal of hazardous solid wastes
- Draining, cleaning and disposal of drums, ASTs, or other containers containing petroleum products or other liquid hazardous wastes

- Onsite flaring or removal and off-site disposal of petroleum products and other liquid hazardous wastes
- Demolition of buildings and infrastructure to foundation level and burning of combustible non-hazardous materials in approved location

3. SITE ASSESSMENT METHODOLOGY

3.1 Assumptions

At the Samovar mine site, the assessment was limited to the area specifically developed or occupied for mine exploration or mining purposes and off-site environmental resources potentially affected by mine exploration or development activities. The access road to Samovar was not included in this assessment.

3.2 Assessment Criteria

CCME Criteria

The Canadian Council of Ministers of the Environment (CCME) Interim Canadian Environmental Quality Criteria for Contaminated Sites are numerical limits for contaminants in soil and water intended to protect, maintain or improve environmental quality and human health at contaminated sites in general.

CCME criteria include two types of benchmarks for soil and water quality: assessment criteria and remediation criteria. Assessment criteria are approximate background concentrations or approximate analytical detection limits for contaminants in soil and water, and remediation criteria are for specified uses of soil and water. Remediation criteria are for generic use and do not address site-specific conditions.They are considered generally protective of human and environmental health for specified uses of soil and water at contaminated sites. The remediation criteria for soil are classified by three land uses:

1) Agricultural,
2) Residential/Parkland, and
3) Commercial/Industrial.

Remediation criteria for water are classified by four uses of water likely of concern at contaminated sites:

1) Freshwater aquatic life,
2) Irrigation,
3) Livestock watering, and
4) Drinking water.

For the Yukon mine assessments, Commercial/Industrial criteria were used to assess soil contaminants and the Freshwater Aquatic Life criteria were used to assess surface water quality.

Mine Reclamation in Northwest Territories and Yukon (INAC, 1992)

This report defines factors which are to be considered in reclamation of abandoned mine sites operating in northern climates. Factors include:

- open pit and underground mines
- special mines such as uranium, sand and gravel, and coal
- waste rock and tailings disposal
- acid generation and leaching, and
- estimating cleanup costs.

3.3 Methods

3.3.1 Background Information

Available background information was consolidated from the Yukon Chamber of Mines mine records, Whitehorse Public Library, Yukon Archives holdings, and records and reports from the Yukon Renewable Resources Library, Yukon Water Board, DIAND Lands Branch, DIAND Water Resources, and DIAND Library. INAC (1994) provided an overview assessment of the Samovar mine site to that date. Other published information sources were examined for site or regional information as applicable. On the basis of available information, knowledge gaps regarding existing or potential safety and environmental risks at the site were identified and a site assessment plan was developed.

3.3.2 Site Assessment Components

A site assessment was conducted to identify existing or potential safety and environmental risks on the site. The assessment included the following components:

Waste Rock disposal areas were inspected and sampled by a professional geologist to assess acid rock drainage potential by:

- Identifying waste rock mineralization with potential to release acidic and/or metal-contaminated drainage
- Mapping and logging waste rock, pit walls and rock faces as appropriate
- Collecting and field testing representative samples of mine wastes

Mine Openings were inspected and documented to identify closure requirements.

Non-Hazardous Site Debris was inventoried.

Contaminated Soil Areas were measured and sampled to determine the degree of contamination and estimate soil volumes for remediation.

Hazardous Materials were inventoried and sampled for analyses of contaminant constituents, as necessary.

Buildings and other Structures were inspected for hazardous materials and assessed for stability.

Borrow Sources were identified and assessed for accessibility and approximate quantity and type of granular material as applicable.

Scale site plans were prepared to identify the dimensions and locations of site structures, mine workings and adits, waste rock disposal areas, on-site sampling locations (as applicable), and any other pertinent information.

3.3.3 Sampling Methods and Quality Assurance

Test Pit Sampling

Test pits were excavated to depths between 0.3 m and 1.0 m. Horizons in the test pit walls were logged, noting colour/weathering, rock composition, primary and secondary mineralization, particle size distribution, paste pH and paste conductivity, and moisture content. Test pits were photographed and the locations marked on the field map.

Approximately 2 kg of rock was collected at each sample site. For test pits showing a homogeneous wall face, a plastic sheet was placed at the bottom of the test pit and the pit wall was cut vertically down with a cleaned shovel. All rock larger than 75 mm in size was discarded. The sample was coned and quartered, discarding opposite quarters, until a 2 kg sample was obtained.

Where test pit walls showed distinct horizons (distinguishable by the sulphide and carbonate contents), each horizon was sampled.

Water Sampling

Samples were collected from surface streams upstream and downstream of mine-related flows, and from representative seeps emanating from waste rock, pit walls, and/or adits.

250 ml water samples were collected by hand, facing upstream, ensuring that the sample was not contaminated by disturbed sediment, debris and other floating materials. Sample bottles were rinsed three times with water from the sample stream prior to collecting the sample.

2 ml of HNO_3 were immediately added to water samples intended for metals analyses. For analyses of non-metallic parameters, water samples were brim-filled to minimise head space, placed in a cooler, and maintained at 4° C until delivery to the laboratory.

Soil Sampling

Soil lithology was recorded from observations of the side walls of the test pit, and soil samples for both field and laboratory testing were collected. Observations were recorded for each soil sample site, including soil particle size, consistency, colour, moisture, discoloration, stratification, odour, and any other observations of significance.

Samples were collected at depth intervals selected on the basis of stratigraphic observations and anticipated or apparent contamination. The lab samples were collected using disposable latex gloves and decontaminated stainless steel sampling utensils. All samples intended for organic analyses were stored in laboratory-cleaned 250 ml glass jars; samples intended for metals analyses were placed in new "Whirl-Pak" bags. All samples were placed in a cooler for shipment to the laboratory.

Quality Assurance

Quality Assurance (QA) is a set of procedures for ensuring that the results of chemical analyses are (and can be shown to be) accurately representative of field conditions. A complete QA program includes both a field component and a laboratory component.

In addition to the standard sample collection methods outlined above, the field QA measures that were implemented for this assessment study include:

- chain of custody procedures and forms;
- a sample labelling and sample location identification scheme;
- laboratory preparation of all sampling containers;
- laboratory defined sample preservation and shipping procedures; and
- regular maintenance (including re-calibration) and cleaning of field equipment.

Laboratory QA measures included replicate analyses of selected soil and water samples. Replicate analytical results were submitted with each analytical report.

4. ENVIRONMENTAL SETTING

4.1 Mineralization

Regional geology consists primarily of sedimentary rock, with a small component of granitic rock. Principal mineral types include quartzite, conglomerate, slate, phyllite, shale, limestone, dolomite, sandstone, argillite, chert, granodiorite and quartz diorite (Douglas and MacLean 1963).

Locally, a barite-rich zone about 100 metres thick occurs at the base of a shale member. Bulk sampling indicated that the barite is of high quality and requires only screening prior to grinding to yield a product exceeding minimum drilling mud specifications. Minor amounts of variscite occur with the barite. The deposit is easily amenable to open pitting with no stripping ratio.

The main showing grades from a carbonate-rich base (witherite and limestone), with grey baritic shale and black carbonaceous shale, to a sulphate-rich top (bedded barite). Minor interbedded chert occurs throughout the section but tends to be more common towards the base. At least three other small showings occur nearby. The barite ore is cut by a 60-foot shear zone on the south side of the deposit.

4.2 Hydrology

Regional drainage is to the southwest, combining to become the headwaters of the Pelly, Ross, MacMillan, Hess and Rogue rivers.

Local runoff and snowmelt from the north and east slopes of the Samovar property drains southeast toward an unnamed stream at the base of the mountain. The stream is is about 175 metres east of the main workings, and curves southwestward to pass the mine site again at a distance of 500 metres. Hydrological/water quality records are not available for streams in the Samovar area. One waste rock seep was observed about 150 m southeast and downhill of the main workings.

4.3 Climate

Burns (1974) indicates the Samovar area lies within a 760 mm mean annual precipitation isohyet. MacMillan Pass, at 1409 m elevation, receives about 680 mm. Inferences from data at surrounding stations indicates the annual precipitation increases rapidly from west to east, particularly in the north, as elevations increase. Mean annual temperatures, estimated from isotherm lines of Burns (1973), are between -6°C to -9°C.

4.4 Vegetation

Samovar is situated on the treeline at about 1420 m elevation. Open black spruce occurs below the site where drainage is somewhat restricted or the water table is held up by permafrost, with paper birch scattered among the black spruce. Alpine fir occurs in the subalpine. Shrub birch and willow form prevalent communities, occurring from valley bottoms to well above treeline.

Patterned fen and bog communities, mostly dominated by sedge, willow and ericaceous shrubs, are common in the valley below the mine site. Sedge tussocks, usually with willows and ericaceous shrubs, dominate the understory on mid to lower slopes. Lichens cover hummocks, peat plateaus and on well-drained shattered rock. Alpine vegetation, consisting of lichens, moss, sphagnum, willows, ericaceous shrubs and some forbs, occurs along an thin margin above the treeline, above which are essentially unvegetated talus slopes.

4.5 Fish and Wildlife Resources

Fisheries data for the Samovar site was not available.

4.6 Site Topography and Soils

The MacMillan Pass area was glaciated during the most recent ice advance, and probably during earlier glacial periods. Only mountain peaks stood above the ice masses. Ice movement was generally in a westward direction, moving down from the mountains. Scouring was more intense in this area than further south, probably due to greater ice accumulation. Surficial deposits mantle most of the mid and lower slopes. Morainal deposits and glaciofluvial material are generally deep in valley bottoms, while upper slopes consist of talus or scree material and bare rock.

Samovar is situated on a 35° east-facing slope. The mine trenches are located at an approximate elevation of 1400 m above sea level. Samovar's topography below the mine site exhibits typical polygonal surfaced peat plateaus and peat hummocks common to most valley bottoms in the region. Lower slopes also have hummocky surfaces. The upper slope is covered with talus or scree contributed by freeze-thaw fracturing of sedimentary rock.

5. SITE DESCRIPTION AND FINDINGS

5.1 Buildings, Infrastructure, and Equipment

A small cabin is the only significant structure at the Samovar site. Details of construction features and interior contents are summarized in Table 5.1.

Table 5.1 Samovar Building Construction Features and Interior Contents

Structure	Construction Features	Interior Contents	Photo No.
Cabin	-3.6 x 5 m in plan and 2 m in height - "2 x 4" wood frame - plywood exterior cladding and 2 pieces 2 x 3 m galvanized sheathing - no roof	- wooden bench	6

5.2 Non-Hazardous Waste Materials

Two non-hazardous material disposal areas were discovered on the Samovar property. Locations and inventoried materials are summarized in Table 5.2. Compacted volume of non-hazardous waste materials is estimated at 5 m^3.

Table 5.2 Samovar Non-Hazardous Waste Materials

Area	Location	Inventoried Materials	Photo No.
Mine access road	Approx. 300 m east of upper slope workings	- bowser-style truck tank, approx. 22,500 litre volume, empty (bullet holes in tank) - one 4x4-vehicle axle and transmission assembly - one 1 x 1 x 2 m unlocked steel storage container - 2 empty drums within 50 m radius of bowser tank	7
Cabin		- 1 empty drum - one steel tubing radio mast, approx 5 m length	

5.3 Mine Openings

There are no underground mine openings at this site.

5.4 Hazardous Materials

No stained soils or other hazardous materials were discovered at the Samovar site.

5.5 Surface Water Quality

A water sample, SAMOV-WQ-S001, was collected from a seep that originated in a shear zone along the road. Estimated discharge at SAMOV-WQ-S001 was less than 1 L/sec. The

seep water surfaced along the mountain road three times, extending for less than 100 metres each time before disappearing into the overburden. Two surface water samples were obtained from a small unamed stream north of and below the trenched area. SAMOV-WQ-S002 and SAMOV-WQ-S003 were collected approximately 50 m upstream of the open pit and 50 m downstream of the drainage path from the open pit respectively. Complete analytical results are provided in Appendix B; significant results are summarized in Table 5.3.

Table 5.3 Significant Results - Samovar Surface Water Samples

Sample ID	Sample Location	pH	Conductivity (μmhos/cm)	Metallic Parameters	Other Parameters
SAMOV-WQ-001	Seep on slope, approx 150m below trenched area	5.9	466	Al, Se, Ag, Zn > CCME F.A.L. criteria	Sulphate = 221 mg/l
SAMOV-WQ-002	Unamed stream approx. 50 m upstream of waste rock dumps	7.4 [6.5]	137 [60]	-	Sulphate = 47.7 mg/l
SAMOV-WQ-003	Unamed stream approx. 125 m downstream of waste rock dumps	7.5 [6.6]	137 [60]	-	Sulphate = 45.9 mg/l

Note: 1) pH and conductivity readings in square brackets are field measurements; non-bracketed readings are lab measurements
2) CCME F.A.L. refers to CCME Freshwater Aquatic Life

The seep sample (SAMOV-WQ-001) was found to have Al, Se, Ag, and Zn above CCME Freshwater Aquatic Life criteria, as well as elevated sulphate. Fe and Se in the two stream samples (SAMOV-WQ-002and SAMOV-WQ-003) exceeded CCME Freshwater Aquatic Life criteria; however, the stream water is neutral (pH 7.4) with conductivity measurement of 137 μS/cm, and sulphate in both stream samples was markedly lower than in the seep sample.

5.6 Waste Rock Disposal Areas

The stripping ratio of the open pit deposit is near zero. Only minor amounts of waste rock (on the order of a few hundred tonnes) are present at the upper level of the site, generally from road and drilling platform construction. Approximately 4,000 tonnes of stockpiled ore is located in a well drained area on black carbonaceous shale at the base of the mountain.

Samples SAWR/P301, SAWR/P302/1, and SAWR/P302/2 were collected from two test pits in the barite-rich limestone at the drilling platform of the open pit. A sample of the black carbonaceous shale was collected from waste rock at a switchback on the road

(SAWR/P303). Sample SAWR/P304 was collected from the ore stockpile at the base of the mountain. Sample locations and descriptions and a summary of field test results are given in Table 5.4.

Table 5.4. Waste Rock/Ore Stockpile Descriptions and Field Test Results

Sample No.	Sample Location and Description	Summary of Field Tests
SAWR/P301	Sample collected at the edge of the drill platform in the open pit. The sample was collected over a thickness of 20cm. It contained angular fragments of dark grey silified barite ore. <1% of the fragments surfaces were oxidized. The outcrop in the pit is baritic limestone.	Field paste pH was 5.10, paste conductivity was 40 μS/cm.
SAWR/P302/1	Sample collected from an area 1.5m x 1.5m that was anomalous for its red staining at the drill platform. The sulphide rich barite ore was sampled. It was 5cm thick.	Field paste pH was 4.84, paste conductivity was 30 μS/cm.
SAWR/P302/2	Sample collected over a thickness of 15 cm below SAWR/P302/1. The dark grey silified barite ore.	Field paste pH was 5.04, paste conductivity was 40 μS/cm.
SAWR/P303	Sample collected at the edge of a switch back on the mountain access road in the black calcarious shale.	No field paste pH or paste conductivity tests conducted for these samples
SAWR/P304	Sample P304 was collected in a barite ore stockpile at the base of the mountain.	No field paste pH or paste conductivity tests conducted for these samples

The samples were submitted for Acid Base Accounting (ABA) tests and determination of metals by Inductively Coupled Plasma - Atomic Emission Spectrophotometry (ICP-AES). Results of these analyses are presented in Appendix A and summarized in Table 5.5. All samples contained less than 1% total sulphur and therefore, were not tested for sulphate sulphur concentrations. Acid Potential (AP) was calculated on the total sulphur concentration rather than on the sulphide sulphur concentrations. This is a conservative estimate of AP since acid paste pH values indicate that some sulphide oxidation has taken place.

Table 5.5 Acid-Base Accounting Test Results - Samovar Waste Rock Samples

Sample #	Paste pH	Total Sulphur (%)	Sulphur as SO_4 (%)	AP	NP	Net NP	NP/AP
SAWR/P301	7.12	0.27	No assay	8.44	18.94	10.50	2.24
SAWR/P302-1	6.14	0.27	No assay	8.44	-3.06	-11.50	<0.1
SAWR/P302-2	6.55	0.25	No assay	7.81	-0.94	-8.75	<0.1
SAWR/P303	5.41	0.36	No assay	11.25	-2.81	-14.06	<0.1
SAWR/P304	7.98	0.25	No assay	7.81	24.25	16.44	3.10

AP - Acid Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material
NP - Neutralization Potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material
Net NP - Net Neutralization Potential equals tonnes $CaCO_3$ equivalent per 1000 tonnes of material

Samples of baritic limestone waste (P301 and P302/2) had paste pH values of approximately 5.0 and conductivities of 40 μS/cm. Both samples have NP:AP ratios less than 3, although sample P301 had significantly more neutralizing potential (NP) than sample P302/2 (19.0 kg$CaCO_3$ eq./t and -1.00 kgCaCQ eq./t respectively). Resulting NP:AP ratios for the two samples were 2.2 and <0.1, respectively, indicating that both are potentially acid generating. Sample P302/1 is also composed of the sulphide-rich baritic limestone. This sample had a lower paste pH value (4.8) than the other two samples collected at the drill platform. However, the acid generating potential of this sample was similar to that of sample P302/2 and had an NP:AP ratio of <1.0.

Metal levels in these samples are generally low excepting barium, which was higher than 360 ppm for all three samples. The oxidized sample P302/1 also contained high concentrations of copper (167 ppm) and iron (4.0%), and all three samples contained high concentrations of zinc (ranging between 88 ppm and 242 ppm).

Sample P304 was collected in a barite ore stockpile. The acid base accounting chemistry of this sample was similar to that of sample P301 with alkaline laboratory paste pH and a NP:AP ratio indicating low acid generating potential (NP:AP of 3.1). The barium concentration was higher (4019 ppm) but copper, iron and zinc concentrations were lower.

The sample from the black carbonaceous shale (P303) had a laboratory paste pH of 5.4 and a NP:AP ratio <0.1, indicating that the sample is potentially acid generating. Metal levels, including barium, are similar to or lower than those in all other samples.

6. CONCLUSIONS

Existing or potential health and safety hazards or environmental/aesthetic concerns associated with the Samovar mine site are summarized in Table 6.1, and are examined more fully in sections 6.1 - 6.3. It should be noted that development work at the Samovar mine site is ongoing; therefore, Samovar should be classified as an active, not abandoned, site.

Table 6.1 Summary of Hazards or Concerns at Samovar Mine Site

Site Assessment Component	Hazard or Concern
Buildings, Infrastructure, and Equipment	Minor aesthetic concern
Non-Hazardous Waste Materials	Non-hazardous wastes near cabin and mine access road are a minor aesthetic concern
Waste Rock Disposal Areas	Waste rock is potentially acid-generating; seep water contains metals above CCME Freshwater Aquatic Life criteria
Mine Openings	None
Hazardous Materials	None

6.1 Health and Safety

No health or safety concerns were identified at the Samovar site.

6.2 Environmental Risks

The small volume of waste rock and ore stockpiled at the Samovar site poses few environmental risks. The material does not appear to be causing a negative impact on the adjacent stream. However, this conclusion is based on sampling conducted on a single day in the dry season.

6.3 Aesthetic Concerns

The mine access road is used by tourists and outfitters, and therefore the cabin, fuel bowser, and other miscellaneous solid wastes located at or near the mine access road are considered a minor aesthetic concern.

7. RECOMMENDATIONS

Recommended remediation and management actions are compliant with applicable federal or territorial regulations and criteria, rely upon available technology, and intended to be appropriate for local conditions and sensitivities.

Recommendation 1. To address aesthetic concerns, the cabin should be burned and solid waste materials shoud be consolidated, crushed, and buried. The preferred burial location is at the cabin location. Waste rock cover material is available at that site, and the materials will be isolated from the stream running to the east and south of the mine site.

Recommendation 2. Additional water quality sampling is recommended to monitor effects of possible acid generation from waste or underlying host rock. Samples should be collected at SAMOV-WQ-002 and SAMOV-WQ-003 to monitor background water quality and inputs from the mine site respectively. Samples should be analyzed for dissolved metals, pH, conductivity, and sulphate, and the results compared to the CCME criteria for Freshwater Aquatic Life. The monitoring program extend for at least 5 years and provide water quality data for spring freshet, middle summer and late fall runoff conditions.

8. COST ESTIMATES TO IMPLEMENT RECOMMENDATIONS

An estimated breakdown of expected remediation/mitigation costs to an accuracy of 25% is provided under separate cover to this report. The cost estimate includes contractor and project management costs and contingency.

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Appendix A

Site Photographs

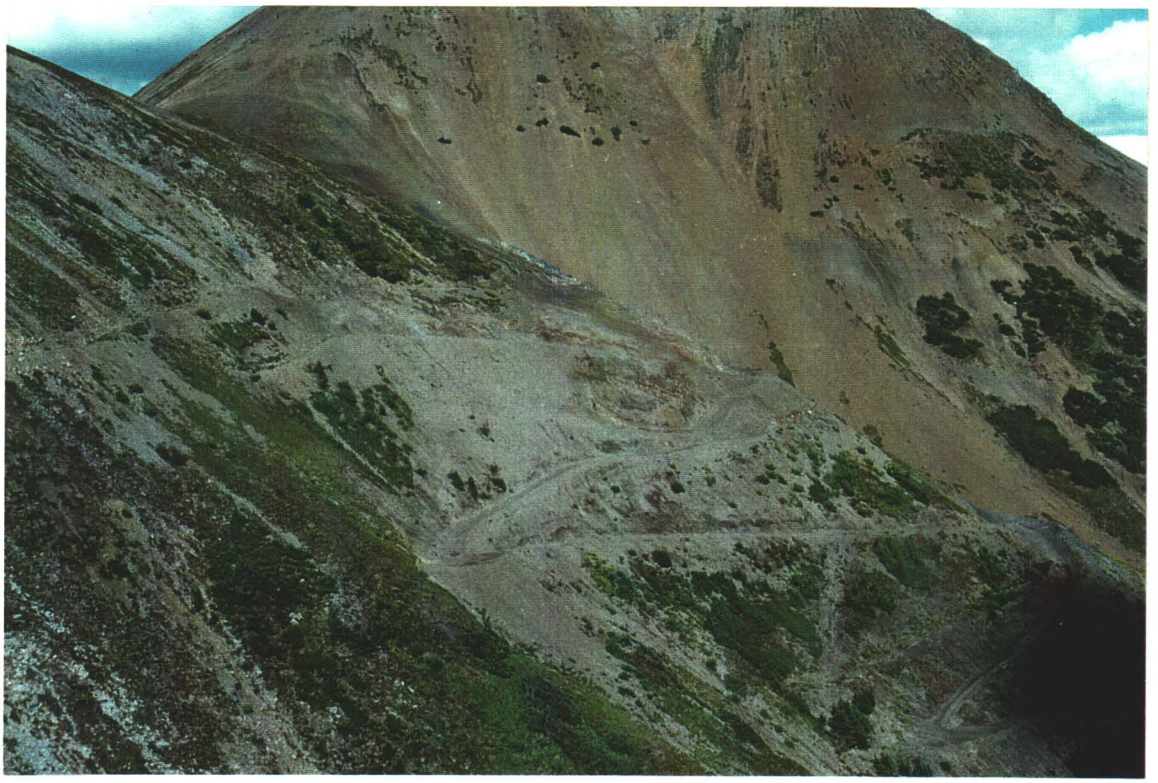

Photo 1. Road cut and trenching, looking north.

Photo 2. Excavation in upper trench area.

Photo 3. Upper level trenching; excavation face visible near centre of photo.

Photo 4. Access road to upper level trenches; seep visible as wet patch on the road near the centre of the photo.

Photo 5. Waste rock pad constructed near mine access road at base of slope.

Photo 6. Cabin on mine access road.

Photo 7. Bowser-style truck tank on mine access road at base of slope.

Appendix B

Analytical Results

1988 Triumph Street, Vancouver, B.C., Canada V5L 1K5 analytical service laboratories ltd. FAX: 604/253-6700 TEL: 604 253-4 88

CHEMICAL ANALYSIS REPORT

Date: September 24, 1996

ASL File No. G4270

Report On: Soil, Water And Product Analysis

Report To: **Public Works & Gov't Services**
Environmental Services
204-1166 Alberni Street
Vancouver, BC
V6E 3W5

Attention: **Mr. Tim Sackmann**, Manager, Contaminated Sites

Received: August 20, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Heather A. Ross, B.Sc.
Project Chemist

Frederick Chen, B.Sc.
Supervisor, Trace Metals Lab

RESULTS OF ANALYSIS - Water[1]

File No. G4270

			SAMOV-WQ -001
			96 08 15 14:00
Physical Tests			
Conductivity (umhos/cm)			466
Hardness		CaCO3	203
pH			5.88
Dissolved Anions			
Acidity		CaCO3	6.9
Alkalinity - Total		CaCO3	4.1
Sulphate	SO4		221
Total Metals			
Aluminum	T-Al		0.125
Arsenic	T-As		0.0001
Barium	T-Ba		0.08
Beryllium	T-Be		<0.005
Boron	T-B		<0.1
Cadmium	T-Cd		0.0017
Calcium	T-Ca		77.9
Chromium	T-Cr		<0.001
Cobalt	T-Co		<0.02
Copper	T-Cu		<0.001
Iron	T-Fe		0.28
Lead	T-Pb		<0.001
Lithium	T-Li		<0.02
Magnesium	T-Mg		2.13
Manganese	T-Mn		0.512
Mercury	T-Hg		<0.00005
Molybdenum	T-Mo		<0.03
Nickel	T-Ni		0.04
Selenium	T-Se		0.0019
Silver	T-Ag		0.0002
Sodium	T-Na		<2
Vanadium	T-V		<0.03
Zinc	T-Zn		0.146

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
Results are expressed as milligrams per litre except where noted.

RESULTS OF ANALYSIS - Water[1]

File No. G4270

			SAMOV-WQ -002	SAMOV-WQ -003
			96 08 15 14:15	96 08 15 14:30
Physical Tests				
Conductivity (umhos/cm)			137	137
Hardness		CaCO3	57.1	56.9
pH			7.38	7.48
Dissolved Anions				
Acidity		CaCO3	1.0	1.7
Alkalinity - Total		CaCO3	10.6	10.7
Sulphate	SO4		47.7	45.9
Total Metals				
Aluminum	T-Al		0.052	0.076
Arsenic	T-As		<0.0001	<0.0001
Barium	T-Ba		0.26	0.33
Beryllium	T-Be		<0.005	<0.005
Boron	T-B		<0.1	<0.1
Cadmium	T-Cd		<0.0002	<0.0002
Calcium	T-Ca		18.9	18.8
Chromium	T-Cr		<0.001	<0.001
Cobalt	T-Co		<0.02	<0.02
Copper	T-Cu		<0.001	0.001
Iron	T-Fe		0.04	0.05
Lead	T-Pb		<0.001	<0.001
Lithium	T-Li		<0.02	<0.02
Magnesium	T-Mg		2.43	2.41
Manganese	T-Mn		<0.005	<0.005
Mercury	T-Hg		<0.00005	<0.00005
Molybdenum	T-Mo		<0.03	<0.03
Nickel	T-Ni		<0.02	<0.02
Selenium	T-Se		0.0013	0.0013
Silver	T-Ag		<0.0001	0.0001
Sodium	T-Na		<2	<2
Vanadium	T-V		<0.03	<0.03
Zinc	T-Zn		<0.005	<0.005

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except where noted.

dichloromethane followed by a clean-up using silica gel column chromatography. This clean-up procedure has been found to effectively remove aliphatic and heterocyclic hydrocarbons which could potentially interfere with the analysis. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection.

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

This analysis is carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion or filtration (EPA Method 3005), followed by instrumental analysis by atomic absorption spectrophotometry (EPA Method 7000), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

Mercury in Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association. A cold-oxidation procedure involving bromine monochloride is used, followed by instrumental analysis by cold-vapour atomic absorption spectrophotometry (CVAAS).

End of Report

APPENDIX

CHAIN OF CUSTODY FORMS

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

analytical service laboratories ltd.
Specialists in Environmental Chemistry
1988 Triumph Street
Vancouver, BC
Canada V5L 1K5
FAX: (604) 253-6700
TEL: (604) 253-4188
TOLL FREE: (800) 665-0243

CLIENT: PWGSC ENVIRONMENTAL SERVICES
204 - 1166 ALBERNI ST.
VANCOUVER B.C.
V6E 3W5
PH/FAX#: (604) 623 6388 / (604) 623-6239
CONTACT: TIM SICKMANN.
SAMPLED BY: T. SICKMANN, A. LAUDRUM, D. CHARBONEAU

PAGE 1 OF 5
YUKON A.M.D., PHASE II ACC./96
ASL CONTACT: HEATHER THOMAS
CLIENT PROJECT #:
PO #:
DATE SUBMITTED:
RESULTS REQUIRED BY:

64270

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	TOTAL METALS	IMMEDIATES	TOTAL VOLATILES	P.A.H.	CHLORINATED PHENOLICS	COMMENTS
1	RU - BL - 1	BARREL	96 14 08 11:00 AM/PM	ø	✓	✓				
2	RU - BL - 2	"	96 14 08 11:00 AM/PM	ø	✓	✓				
3	RU - BL - 5	"	96 14 08 11:00 AM/PM	ø	✓	✓				
4	RU - BL - 6	"	96 14 08 11:00 AM/PM	ø	✓	✓				
5	RU - BL - 7	"	96 14 08 11:00 AM/PM	ø	✓	✓				
6	RU - SL - 201	SOIL	96 15 08 1:00 AM/PM	ø	✓		✓			
7	RU - SL - 202	"	96 15 08 1:00 AM/PM	ø	✓		✓			
8	RU - SL - 203	"	96 15 08 1:00 AM/PM	ø	✓		✓			
9	RU - SL - 204	"	96 15 08 1:00 AM/PM	ø				✓		
10	RU - SL - 205	"	96 15 08 1:00 AM/PM	ø	✓		✓			
11	RU - SL - 206	"	96 15 08 1:00 AM/PM	ø	✓		✓			
12	RU - SL - 207	"	96 15 08 1:00 AM/PM	ø	✓		✓			
13	FO - SL - 201	"	96 20 08 11:00 AM/PM	ø	✓		✓			
14	FO - SL - 301	"	96 13 08 11:00 AM/PM	ø	✓		✓			
15	SG - SL - 203	"	96 17 08 11:30 AM/PM	ø	✓					

NOTES/COMMENTS

· Immediates = SO_4^{2-}, Acidity, Alk, pH, Conductivity

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	DB	96/08/20 (Y/M/D)
AFFILIATION	ASL	: AM/PM

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

analytical service laboratories ltd.
Specialists in Environmental Chemistry
1988 Triumph Street
Vancouver, BC
Canada V5L 1K5
FAX: (604) 253-6700
TEL: (604) 253-4188
TOLL FREE: (800) 665-0243

CLIENT: PUREGL ENVIRONMENTAL SERVICES
204 / 1111 ALBERNI ST
VANCOUVER, B.C.
V6E 3W5
PH/FAX#: 623 6388 / 623 6279
CONTACT: TIM SHACKLEMAN
SAMPLED BY: T. SHACKLEMAN, M. LANDRIAULT, D. CHARBONNEAU

PAGE 2 OF 5
YUKON A.M.D., PHASE II, ALL 4L
ASL CONTACT: HEATHER THOMAS
CLIENT PROJECT #:
PO #:
DATE SUBMITTED:
RESULTS REQUIRED BY:

ANALYSIS REQUESTED

TOTAL METALS, DISSOLVED METALS, GENERAL CHEMISTRY

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION			COMMENTS
16	SH - WQ - A1 - 1	WATER	96 07 24 12:00 AM/PM	NITRIC	✓		
	SH - WQ - A1 - 1	"	96 07 24 : AM/PM	Ø		✓	
17	DU - WQ - STR - 302	"	96 08 17 9:30 AM/PM	NITRIC	✓		
	DU - WQ - STR - 302	"	96 08 17 9:30 AM/PM	Ø		✓	
18	FO - WQ - STR - 001	"	96 08 13 11:00 AM/PM	NITRIC	✓		
	FO - WQ - STR - 001	"	96 08 13 11:00 AM/PM	Ø		✓	
19	FO - WQ - STR - 301	"	96 08 13 11:30 AM/PM	NITRIC	✓		
	FO - WQ - STR - 301	"	96 08 13 11:30 AM/PM	Ø		✓	
20	FO - WQ - STR - 302	"	96 08 13 11:30 AM/PM	NITRIC	✓		
	FO - WQ - STR - 302	"	96 08 13 11:30 AM/PM	Ø		✓	
21	RU - WQ - STR - 001	"	96 08 14 12:30 AM/PM	NITRIC	✓		
	RU - WQ - STR - 001	"	96 08 14 12:30 AM/PM	Ø		✓	
22	RU - WQ - STR - 002	"	96 08 14 12:30 AM/PM	NITRIC	✓		
	RU - WQ - STR - 002	"	96 08 14 12:30 AM/PM	Ø		✓	
			: AM/PM				

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D : AM/PM	Y M D : AM/PM
AFFILIATION		

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

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1988 Triumph Street
Vancouver, BC
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CLIENT: RWGSC ENVIRONMENTAL SCIENCES
104 / 1100 ALBERNI ST
VANCOUVER, B.C
V6E 3W5

PH/FAX#: 623 6388 / 623 6234

CONTACT: TIM SPICKMAN

SAMPLED BY: T. SPICKMAN, A. LAURUM, D. CUNNINGHAM

PAGE 3 OF 5

YUKON A.M.D. PHASE II ALL QL

ASL CONTACT: VERONICA INNIS

CLIENT PROJECT #:

PO #:

DATE SUBMITTED:

RESULTS REQUIRED BY:

ANALYSIS REQUESTED: TOTAL METALS; IMPURITIES; GENERAL CHEMISTRY

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)				FIELD PRESERVATION														COMMENTS
23	RU-WQ - STR - 003.	WATER	96	05	14	12:30 AM/PM	NITRIC	✓													
	RU-WQ - STR - 003	"	96	05	14	12:30 AM/PM	∅		✓												
24	SG - WQ - STR - 202.	"	96	05	17	10:00 AM/PM	NITRIC	✓													
	SG - WQ - STR - 202	"	96	05	17	10:00 AM/PM	∅		✓												
25	MACT - WQ - STR - 001	"	96	05	15	11:00 AM/PM	NITRIC	✓													
	MACT - WQ - STR - 001	"	96	05	15	11:00 AM/PM	∅		✓												
26	MACT - WQ - STR - 002	"	96	05	15	11:15 AM/PM	NITRIC	✓													
	MACT - WQ - STR - 002	"	96	05	15	11:45 AM/PM	∅		✓												
27	MACT - WQ - 003	"	96	05	15	11:30 AM/PM	NITRIC	✓													
	MACT - WQ - 003	"	96	05	15	11:30 AM/PM	∅		✓												
28	MACT - WQ - 004	"	96	05	15	1:00 AM/PM	NITRIC	✓													
	MACT - WQ - 004	"	96	05	15	1:00 AM/PM	∅		✓												
29	MACT - WQ - 005	"	96	05	15	1:16 AM/PM	NITRIC	✓													
30	MACT - WQ - 005	"	96	05	15	1:15 AM/PM	∅		✓												
						: AM/PM															

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y / M / D : AM/PM	Y / M / D : AM/PM
AFFILIATION		

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CLIENT PAGE 4 OF 5

ASL CONTACT

CLIENT PROJECT #

PO #

DATE SUBMITTED

RESULTS REQUIRED BY

PH/FAX# 623-6388 / 623-6234

CONTACT T. SOCKLMANN

SAMPLED BY T. SOCKLMANN, A. LAVALLEY, D. CHARLISON

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	TOTAL METALS	DISSOLVED METALS	GENERAL CHEMISTRY	PAH	COMMENTS
30	SAMW-WQ-001	WATER	96 08 15 2:00 AM/PM	NITRIC	✓				
	SAMW-WQ-001	WATER	96 08 15 2:00 AM/PM	Ø		✓			
	SAMW-WQ-002	"	96 08 15 2:15 AM/PM	NITRIC	✓				
31	SAMW-WQ-002	"	96 08 15 2:15 AM/PM	Ø		✓			
	SAMW-WQ-003	"	96 08 15 2:30 AM/PM	NITRIC	✓				
32	SAMW-WQ-003	"	96 08 15 2:30 AM/PM	Ø		✓			
	~~SAMW-WQ~~		: AM/PM	~~NITRIC~~					
	[redacted]		: AM/PM	Ø					
33	SG-SL-201	SOIL	96 08 17 11:00 AM/PM	Ø	✓		✓		
34	SG-SL-202	SOIL	96 08 17 11:00 AM/PM	Ø	✓		✓		
35	CAMBLER-SL-001	SOIL	96 08 17 10:45 AM/PM	Ø	✓		✓		
	" SL-001		: AM/PM	NITRIC	✓				
			: AM/PM	Ø		✓			
			: AM/PM	NITRIC	✓				
			: AM/PM	Ø		✓			

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D : AM PM	Y M D : AM PM
AFFILIATION		

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

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analytical service laboratories ltd.
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CLIENT _____ PAGE 5 OF 5

ASL CONTACT _____

CLIENT PROJECT # _____

PH/FAX# _____ PO # _____

CONTACT _____ DATE SUBMITTED _____

SAMPLED BY _____ RESULTS REQUIRED BY _____

ANALYSIS REQUESTED

Alk. Chlorides TDN Metals Inorganics

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION																		COMMENTS
	DU WQ STR 301		17	ϕ	✓																	
36	301			NITRIC		✓																
	Sk WQ 201			NITRIC																		
37	201			ϕ																		
	COMB WQ ST -001		17	NITRIC																		
38	-001		17	ϕ																		
	FORT - WQ - STR -002		17	NITRIC																		
39	-002		17	ϕ																		

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN _____
COLD _____
AMBIENT _____
TOTAL PACKAGES _____

RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D	Y M D
AFFILIATION	: AM PM	: AM PM