MN-070

PWGSC

Quality in Environmental Services

PHASE II ENVIRONMENTAL ASSESSMENT OF THE SILVER CITY 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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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Silver City abandoned mine site (64° 18'37" N, 139° 52'28" W) in August, 1996 by Environmental Services, Public Works and Government Services Canada for the Action on Waste Program, Indian and Northern Affairs Canada. Based on the findings of the Phase I investigation performed in 1993 by DIAND Technical Services, a phase II assessment was conducted to a) identify potential environmental and human health risks associated with the present condition of the mine site, and b) provide recommendations and preliminary cost estimates for remediation of those risks.

A field investigation of the abandoned mine site was conducted to evaluate environmental and human safety concerns with respect to: mine openings and workings; buildings and infrastructure; waste disposal areas; waste rock disposal areas; surface water (including adit and waste rock seepage, and receiving waters); and hazardous and non-hazardous materials on the site.

The results of the investigation concluded that environmental risks from the Silver City mine site are low. An assessment of the acid rock drainage potential shows that the risk to the environment due to the presence of waste rock is currently insignificant. Minor aesthetic concerns arise from a steel water supply pipe running down most of the mountainside towards the river, assorted metal debris nearby and a small metal dumpsite at the base of the hillside where a collapsed and burnt trailer has been left.

Using applicable federal and territorial criteria as well as northern mine reclamation guidelines, the recommendation is that no additional work be conducted on this site. Due to the small volume of debris remaining on site and encroaching vegetative cover, mobilizing equipment to remove or dispose of the debris is not economically feasible. No further test work is recommended on the waste rock.

Table 1: Summary of Potential Hazards at the Silver City Mine Site

Assessment Component	Risk	Recommendation
1. Building, Infrastructure, Equipment		
None		
2. Non-Hazardous Waste Material		
1 - water supply pipe, misc. metal debris	Aesthetic Concern	None
Collapsed trailer (burned)	Aesthetic Concern	None
3. Hazardous Materials		
None		
4. Water Quality		
Mine Seepage	None	
Site Drainage	None	
Receiving Waters	Low environmental impact	No action
5. Waste Rock Disposal Areas		
Large waste pile	Minor environmental risk	No action
6. Mine Openings		
None	None	
7. Tailings		
None	None	

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

1.0 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.

The 1993 report for the Silver City abandoned mine site identified minor surface disturbance and site debris in the form of a water supply pipe as the only issues requiring further investigation. No rock, soil or water samples were collected in this assessment.

In light of these preliminary findings, Indian and Northern Affairs Canada determined that further investigation was warranted. Environmental Services, Public Works and Government Services Canada was retained to conduct an environmental assessment of the Silver City abandoned mine site to a) identify specific environmental and human safety risks; b) provide clean-up recommendations; and c) provide a Class "D" cost estimate for remediation or mitigation of those risks.

1.1 LOCATION

Silver City mine site is located at 64° 18'37"N latitude and 139° 52'28"W longitude. The site is located approximately 35km northwest of the community of Dawson, on the north bank of the Yukon River. The site is between 450-500m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

The work history of the site has been compiled by the Department of Indian Affairs and Northern Development in Yukon Minfile record 116B 037. The history of the site as it pertains to its physical development is summarized here.

Claims at Silver City were first staked in September, 1899. In 1906, a 198m adit and a 15m raise was constructed near the riverbank. Subsequently, the property remained idle until 1926 when 4.5 tonnes of hand picked rock float was shipped to a smelter in Tacoma. In 1929, a second adit located 130m above the river was driven 39.6m.

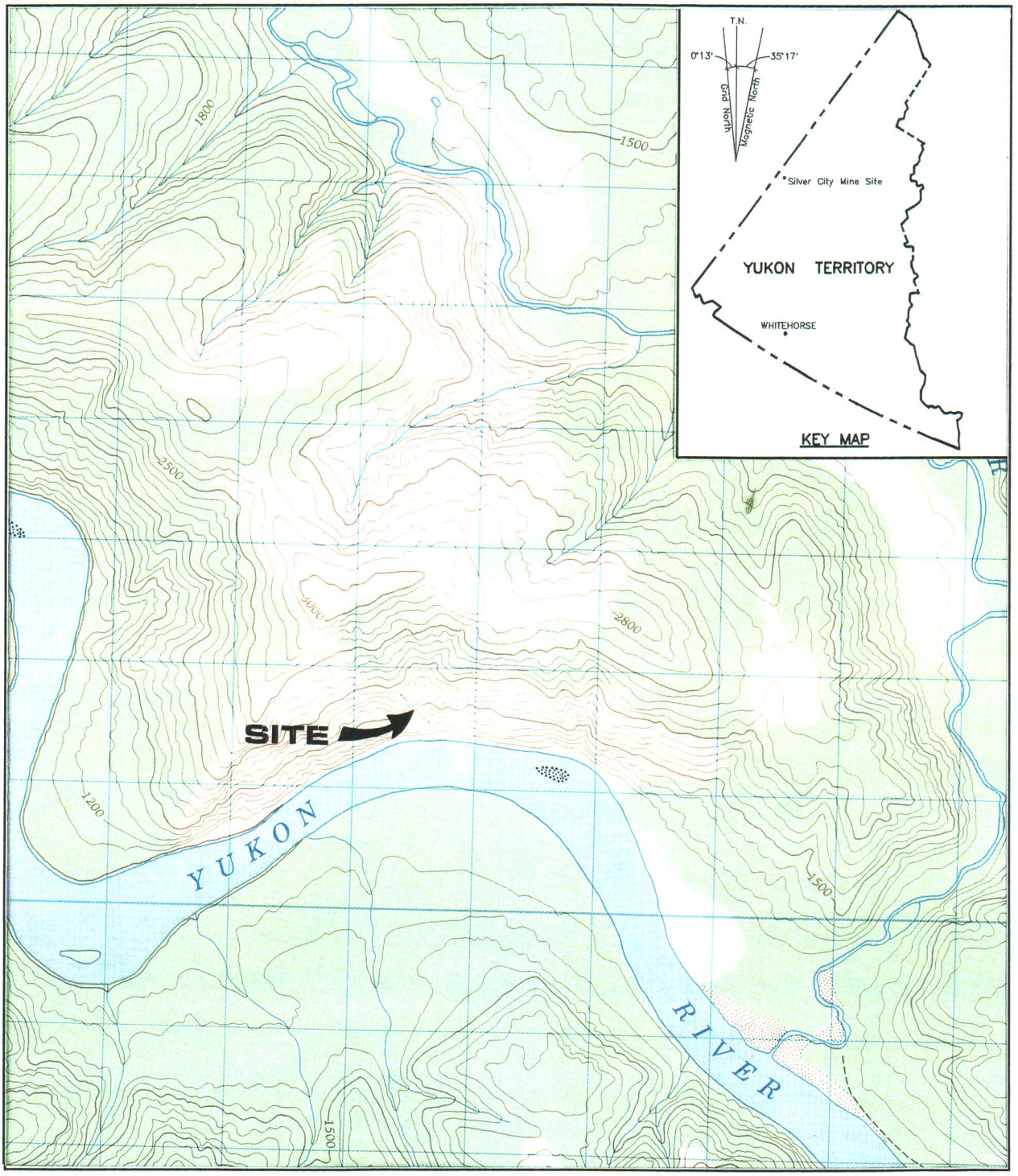

Figure 1. Location of Silver City Mine - 1:50,000, NTS-116 B/5 [Energy Mines and Resources Canada: 1984]

A third adit located 91m above the river was driven 84m in 1962, and hydraulic trenching was conducted. In 1964-65, a 56m adit was completed, as well as 61m of drilling from two holes.

In 1973, a 62.8km winter road was constructed and the site was trenched. The next year 164.6m was drilled from five holes, and additional trenching took place in 1979. Little work has been conducted at the site since then.

1.3 SITE ACCESS

The site is accessible by boat or float planes. Helicopters cannot land at the site.

2.0 PURPOSE AND SCOPE OF WORK

The following assessment activities were completed, where appropriate, during site investigations:

- 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 adit and waste rock seepage, 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; and
- Assessment of human safety hazards and potential for accidental or deliberate access to hazardous 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;
- Chemical stabilization of the waste rock disposal areas as appropriate to local and background conditions, taking into account impact, on-site resources, and accessibility;
- Sealing of all mine openings;
- Consolidation and landfill of all non-hazardous, non-combustible solid

wastes;

- Remediation or removal and disposal of contaminated soils as required to meet the more stringent of: Yukon Government's Contaminated Sites Regulations (1996) Schedule 1; and Canadian Council of Ministers of the Environment's Interim Canadian Environmental Quality Criteria for Contaminated Sites (1991) Commercial/Industrial criteria for soils;
- Removal and disposal of hazardous solid wastes;
- Draining, cleaning and disposal of drums 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; and
- Demolition of buildings and infrastructure to foundation level and burning of combustible non-hazardous materials in approved location

3.0 SITE ASSESSMENT METHODOLOGY

3.1 ASSUMPTIONS

The assessment was limited to the area specifically developed or occupied for exploration or mining purposes, and adjacent areas and resources believed to be affected by these activities. Water samples were taken off-site to determine potential impact to surface water bodies due to mining activities. Access roadways to mine sites were not included in the assessments.

3.2 ASSESSMENT CRITERIA

3.2.1 Criteria and Guidelines

Metal Mining Liquid Effluent Regulations and Guidelines (Environmental Protection Service, Environment Canada, 1977)

The intent of the requirements defined in this document is to limit the discharge of deleterious substances from base-metal, uranium and iron ore mines. These requirements are uniformly applied national standards and intended to provide protection for fish and other aquatic life.

Interim Canadian Environmental Quality Criteria for Contaminated Sites (Canadian Council of Ministers of the Environment, 1992)

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 used as clean-up benchmarks based upon intended land use. Remediation criteria 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.

Contaminated Sites Regulations (draft) (Yukon Government, 1996)

According to these draft regulations a site is contaminated if it used for agricultural, commercial, industrial, parkland, or residential land use and contains a substance in concentration greater than or equal to:

(I) the generic numerical soil standard of Schedule 1, or
(ii) the matrix (pathway specific) numerical soil standards of Schedule 2

and, surface or groundwater used for aquatic life, irrigation, livestock, or drinking water which exceeds a concentration greater than or equal to:

(I) the generic numerical water standard of Schedule 3, or
(ii) the local background concentration of that substance in the soil, surface water, or groundwater.

Below 3 metres of the surface, commercial land use criteria is applicable.

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.

3.2.2 Application of Criteria and Guidelines

For the Silver City abandoned mine site assessment the following criteria were used:

A. Soils:

CCME:	Remediation Criteria for Soil - Commercial/Industrial standard
YUKON RENEWABLE RESOURCES:	Draft Contaminated Sites Regulations - used for hydrocarbon screening parameters

B. Water:

ENVIR. CANADA:	Metal Mining Liquid Effluent Regulations and Guidelines - are compared to seepage from mine openings, and river/stream water quality
BACKGROUND:	Downstream water quality results of rivers and streams are compared to results of upstream (background) water quality
CCME:	Remediation Criteria for Water - Freshwater Aquatic Life guideline for river and stream water quality

[Note: In this screening assessment of water quality, analytical results are primarily compared to background values which may more accurately characterize the local environment.]

C. Mine Clean-Up and Reclamation:

INAC: Mine Reclamation in Northwest Territories and Yukon

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 Silver City abandoned 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, as applicable:

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, tailings, pit walls and rock faces
- 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.

250 ml water samples were collected by hand, facing upstream, ensuring that the sample is 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 destined for metals analyses. For analyses of non-metallic parameters, water samples were brim-filled to minimize 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.

Barrel, Pail, and Above-Ground Storage Tank Sampling

Barrels and pails containing hydrocarbons were sampled with 1.2 m clean hollow glass rods ("drum thieves"), capable of extracting up to 25 ml of product. The rods were inserted into the drum or pail, and the uppermost open tip was sealed to maintain the sample within the rod as it was extracted from the drum or pail. The sampled hydrocarbon was then drained into a 40-ml laboratory-cleaned vial. The extractions were repeated until at least 20-30 ml of product was obtained. The vial was then sealed and placed in a container for shipment to the laboratory. Each used drum thief rod was subsequently destroyed to prevent accidental re-use.

One Above-Ground Storage Tank (AST) was sampled with a stainless steel Bacon bomb sampler. A plunger at the tip of the sampler depressed when contact with the tank bottom was made, allowing petroleum product to enter the body of the sampler. When the sampler was raised, the plunger closed to seal the sampler and allow

removal of the sample from the AST. The sampled hydrocarbon was then drained into a 40-ml laboratory-cleaned vial which was then sealed and placed in a container for shipment to the laboratory. The bomb sampler was cleaned with laboratory-grade detergent between sampling events.

Since hydrocarbon samples were collected only for analyses of Total Halides and metals, no cooling or other preservative was required.

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 labeling 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.

4.0 ENVIRONMENTAL SETTING

4.1 MINERALIZATION

The property is situated on a slope characterized by multiple landslides along steep faults which strike east-west, parallel with the river. Mapping of float on the slide surface indicates that the lower slope is composed of quartz-carbonate rock interbedded with sericite-schist (Yukon Minfile No. 116B 037). This unit is overlain by dioritic rocks which in turn are overlain by quartzite and argillite of probable Paleozoic age. Rhyolite dykes are also present.

The commodities of interest at the site are silver and lead, with zinc, copper and

antimony considered less important. However, the only evidence of mineralization observed at the site was a few pieces of float containing copper oxides found on the waste rock piles.

4.2 SURFACE HYDROLOGY

Both site and regional drainage are to the south, directly into the Yukon River (see Figure 1). The mine itself sits on a steep slope and no stream drainages cut through the site.

No seepage from the waste rock pile was detected however site topography lends itself to seepage through the pile as a result of site drainage and surface infiltration due to precipitation.

4.3 CLIMATE

The closest climatological information is from the town of Clinton Creek (64° 28'N, 140° 44'W at 576 m in 1990: Environment, Canada 1990). Total annual precipitation is approximately 370 mm. This consists of 225 mm of rainfall and 145 mm of snowfall, with the highest snowfall in December and the highest rainfall in August. Temperatures typically range from -27.1 ^{0} C in January to 14.9 ^{0} C in July. Data on the mean annual temperature is unavailable.

4.4 VEGETATION

Silver City mine site occurs within the Klondike Plateau ecoregion. Warmer boreal areas within the Klondike Plateau are characterized by open stands of black and white spruce with some aspen and, occasionally, lodgepole pine. Vegetation on slopes underlain by permafrost include black spruce and paper birch. In valley areas, scrub birch and willow form large stands, while balsam poplar is found along floodplains.

4.5 FISH AND WILDLIFE RESOURCES

Typical mammals in the area include grizzly and black bear, Dall's sheep, caribou, moose, wolf, beaver, fox and hare. Typical bird species include raven, rock and willow ptarmigan, and golden eagle.

4.6 SITE TOPOGRAPHY AND SOILS

The soil development in the Klondike Plateau ecoregion is dominated by turbic

cryosols and eutric brunisols with eutric regosols occurring on floodplains.

The site is located approximately two-thirds up a steep south facing slope and is heavily vegetated throughout.

4.7 PERMAFROST

Silver City is in an area of discontinuous permafrost. No evidence of permafrost was discovered during the site visit.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

No buildings, infrastructure or equipment were left on site.

5.2 NON-HAZARDOUS WASTE MATERIALS

The non-hazardous waste material observed in and around the site is listed in Table 2.

Table 2 Non-Hazardous Waste Materials

Waste Material	Number/ Volume	Location	Comments
Water supply pipe and associated metal debris	1	Extending from base of east scree slope approximately 500m down slope.	Pipe diameter= 75mm, Scraps of corrugated steel nearby
Collapsed trailer unit (burned) and metal debris	< 100m^3	At base of slope near river, among heavy vegetative growth	Location of minor dumpsite from operation

5.3 HAZARDOUS MATERIALS

No hazardous materials were observed at the site.

5.4 SURFACE WATER QUALITY

No stream drainages cut through the site and there are no seeps from waste rock piles. Furthermore, runoff from the site drains directly into the Yukon River which would dilute any constituents washing from the site. Therefore, no water samples were collected.

5.5 WASTE ROCK DISPOSAL AREAS

Several waste rock piles of similar composition were deposited at the base of the slope containing the landslide. The piles are composed primarily of limestone and shale, with minor barren quartz and calcite clasts. The shale often had surficial iron oxide staining. No evidence of sulfide oxidation was seen on the pile surface and no sulphides were identified in the waste.

One sample pit was dug in the largest waste pile at the foot of the slide area, and one rock sample was collected for analysis by Acid Base Accounting (ABA) and determination of metals by Inductively Coupled Plasma - Atomic Emission Spectrophotometry (ICP-AES).

Results of solids analysis are listed in Appendix B and summarized in Table 3. The material in the piles was alkaline and had moderate conductivity (690 µS/cm). The total sulphur concentration was low (0.17%) and the material contains abundant neutralizing potential. The NP/AP value for the sample was 14, indicating that the material has a low potential for generating acid.

TABLE 3 Summary of Waste Rock Test Results

Sample ID	Sample Location and Description	Discussion of Results
SCWR/P1/1	Pit was dug at the top of main waste rock pile. Material is dark grey and contains abundant clasts of shale.	Material has pH=8.1 and is not potentially acid generating (NP/AP=14); high Zn, moderate As, Cu.

Metal concentrations were low in the waste, which contained 222 mg/L zinc, 64 mg/L arsenic, and 94 mg/L of copper. Other metals were present in lower concentrations.

5.6 MINE OPENINGS AND EXCAVATIONS

Although three adits were reported to have been completed on site, none were found during the site investigation. It was surmised that the adits have been covered

over or engulfed by the landslide.

5.7 TAILINGS

No processing of ore was done on site. Therefore, no tailings are present.

6.0 CONCLUSIONS

In general, there were not any health and safety concerns at Silver City Mine and any environmental or aesthetic concerns can be considered minor.

6.1 HEALTH AND SAFETY

There does not appear to be any health and safety issues at the site since there are no mine openings or buildings remaining at the mine.

6.2 ENVIRONMENTAL RISKS

The waste rock at Silver City is not potentially acidic and contains low metal concentrations. The environmental risks associated with this material are, therefore, low.

6.3 AESTHETIC CONCERNS

The waste piles on site are a concern aesthetically. However they can not be seen from the river because of the trees and, from the air, they tend to blend in with the natural landslide above them on the hillside. Vegetation has begun to cover much of the disturbed area and may eventually encroach on the waste piles.

Metal debris remaining on site is limited to two locations, either near the water supply pipe or near the burned trailer unit. The overall volume of debris is low and is well covered by vegetative growth.

7.0 RECOMMENDATIONS

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

Due to the small volume of debris remaining on site and encroaching vegetative cover, mobilizing equipment to remove or dispose of the debris is not economically feasible. Metal debris scattered around the site and waste rock piles pose only minor aesthetic concerns that do not require any action.

8.0 COST ESTIMATES TO IMPLEMENT RECOMMENDATIONS

There are no costs associated with the recommendation provided herein.

REFERENCES

Canadian Council of Ministers of the Environment, 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites. The National Contaminated Sites and Remediation Program.

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Yukon Minfile Report, No. 116B 037.

APPENDIX A

Site Photographs

SILVER CITY

Photographic Record

August 14, 1996

Photos	Description
S.C. # 1	Overview of Silver City Mine from Air
S.C. # 2	Main Excavation Location with probable Rock Chute
S.C. # 3	North End of Waste Rock Ridge
S.C. # 4	Waste Rock Ridge (SCWR/P1/1)
S.C. # 5	Top End of Steel Pipe Leading down Mountainside
S.C. # 6	Assorted Metal Debris near Scree Slope
S.C. # 7	Metal Debris Dump near River
S.C. # 8	Remains of Collapsed Office Trailer near Metal Dumpsite

Photo # 1 - Overview of Silver City Mine from Air

Photo # 2 - Main Excavation Location with probable Rock Chute

Photo # 3 - North End of Waste Rock Ridge

Photo # 4 - Waste Rock Ridge (SCWR/P1/1)

Photo # 5 - Top End of Steel Pipe Leading down Mountainside

Photo # 6 - Assorted Metal Debris near Scree Slope

Photo # 7 - Metal Debris Dump near River

Photo # 8 - Remains of Collapsed Office Trailer near Metal Dumpsite

APPENDIX B

Analytical Results

1988 Triumph Street, Vancouver, B.C., Canada V5L 1K5

analytical
service
laboratories
ltd.

FAX: (604) 253-6700 TEL: (604) 253-4188

CHEMICAL ANALYSIS REPORT

Date: September 13, 1996

ASL File No. G4225

Report On: Soil And Water 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 19, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Heather A. Ross, B.Sc.
Project Chemist

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

REMARKS

File No. G4225

The Acid Base Accounting of the rock samples were subcontracted to BC Research Inc. Please refer to the attached subconsultants report for details.

RESULTS OF ANALYSIS - Sediment/Soil[1] File No. G4225

		CN-WR-P1-1	CN-WR-P2-1	CL-WR-P1-1	SC-WR-P1-1	CA-WR-P1-1
		96 08 13	96 08 13	96 08 13	96 08 14	96 08 11
Physical Tests						
Moisture	%	9.5	8.7	7.6	7.4	4.1
Total Metals						
Antimony	T-Sb	48	61	<20	<20	<20
Arsenic	T-As	871	2050	52.1	63.9	44.5
Barium	T-Ba	50	161	22	127	14
Beryllium	T-Be	0.6	0.8	<0.5	<0.5	<0.5
Cadmium	T-Cd	4	2	<2	<2	<2
Chromium	T-Cr	3	6	229	22	20
Cobalt	T-Co	5	7	89	12	110
Copper	T-Cu	588	407	3	94	737
Lead	T-Pb	5270	3870	<50	<50	<50
Mercury	T-Hg	0.099	0.054	0.640	0.225	0.025
Molybdenum	T-Mo	127	101	<4	14	<4
Nickel	T-Ni	<2	3	1930	56	2140
Selenium	T-Se	<20	<20	<20	<20	<20
Silver	T-Ag	5	21	<2	2	<2
Tin	T-Sn	<30	<30	<30	<30	<30
Vanadium	T-V	18	32	<2	34	34
Zinc	T-Zn	491	254	5	222	90

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

RESULTS OF ANALYSIS - Sediment/Soil[1]

File No. G4225

		SD-WR-P4-1	SD-WR-P3-1	SD-WR-P2-1	SD-WR-P1-1	CA-WR-P2-1
		96 08 15	96 08 15	96 08 15	96 08 15	96 08 11
Physical Tests						
Moisture	%	17.7	21.4	22.6	13.7	7.4
Total Metals						
Antimony	T-Sb	<20	<20	<20	<20	<40
Arsenic	T-As	7.14	8.28	6.95	21.9	17.7
Barium	T-Ba	27	25	38	111	17
Beryllium	T-Be	1.5	4.2	1.5	1.0	<1
Cadmium	T-Cd	<2	<2	<2	<2	<4
Chromium	T-Cr	2	6	3	52	19
Cobalt	T-Co	<2	3	3	21	158
Copper	T-Cu	9	14	11	43	2590
Lead	T-Pb	<50	<50	<50	<50	<100
Mercury	T-Hg	0.150	0.077	0.234	1.26	0.052
Molybdenum	T-Mo	<4	<4	<4	<4	<8
Nickel	T-Ni	13	19	16	90	6510
Selenium	T-Se	<20	<20	<20	<20	<20
Silver	T-Ag	<2	<2	<2	<2	<4
Tin	T-Sn	<30	<30	<30	<30	<60
Vanadium	T-V	15	17	14	52	32
Zinc	T-Zn	15	22	40	135	342

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

Appendix 1 - QUALITY CONTROL - Replicates

File No. G4225

Sediment/Soil[1]		SD-WR-P2-1 96 08 15	SD-WR-P2-1 QC # 70641
Physical Tests			
Moisture	%	22.6	24.1
Total Metals			
Antimony	T-Sb	<20	<20
Arsenic	T-As	6.95	5.14
Barium	T-Ba	38	50
Beryllium	T-Be	1.5	1.9
Cadmium	T-Cd	<2	<2
Chromium	T-Cr	3	4
Cobalt	T-Co	3	3
Copper	T-Cu	11	15
Lead	T-Pb	<50	<50
Mercury	T-Hg	0.234	0.296
Molybdenum	T-Mo	<4	<4
Nickel	T-Ni	16	20
Selenium	T-Se	1.2	1.1
Silver	T-Ag	<2	<2
Tin	T-Sn	<30	<30
Vanadium	T-V	14	17
Zinc	T-Zn	40	54

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

RESULTS OF ANALYSIS - Water[1]

File No. G4225

			CL-WQ-STR-1	SD-WQ-STR1-1	CL-WQ-STR-2	SD-WQ-STR1-2
			96 08 13	96 08 15	96 08 13	96 08 15
Physical Tests						
Conductivity (umhos/cm)			535	281	548	270
pH			8.04	8.02	8.17	8.33
Dissolved Anions						
Acidity		CaCO3	4.4	4.4	<1.0	<1.0
Alkalinity - Total		CaCO3	143	134	148	132
Sulphate	SO4		135	18.9	138	18.2
Total Metals						
Aluminum	T-Al		<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb		<0.2	<0.2	<0.2	<0.2
Arsenic	T-As		<0.2	<0.2	<0.2	<0.2
Barium	T-Ba		0.06	0.06	0.06	0.06
Beryllium	T-Be		<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi		<0.1	<0.1	<0.1	<0.1
Boron	T-B		<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd		<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca		69.5	34.1	66.1	33.6
Chromium	T-Cr		<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co		<0.01	<0.01	<0.01	<0.01
Copper	T-Cu		<0.01	<0.01	<0.01	<0.01
Iron	T-Fe		<0.03	0.16	0.09	0.17
Lead	T-Pb		<0.05	<0.05	<0.05	<0.05
Lithium	T-Li		<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg		26.0	12.4	27.5	11.9
Manganese	T-Mn		0.005	0.036	0.008	0.025
Molybdenum	T-Mo		<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni		<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P		<0.3	<0.3	<0.3	<0.3
Potassium	T-K		<2	<2	2	<2
Selenium	T-Se		<0.2	<0.2	<0.2	<0.2
Silicon	T-Si		3.02	2.80	2.93	2.77
Silver	T-Ag		<0.01	<0.01	<0.01	<0.01
Sodium	T-Na		3	6	4	5
Strontium	T-Sr		0.402	0.305	0.379	0.303
Thallium	T-Tl		<0.1	<0.1	<0.1	<0.1
Tin	T-Sn		<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti		<0.01	<0.01	<0.01	<0.01
Vanadium	T-V		<0.03	<0.03	<0.03	<0.03

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 for pH and Conductivity (umhos/cm).

RESULTS OF ANALYSIS - Water[1]

File No. G4225

		CL-WQ-STR-1	SD-WQ-STR1-1	CL-WQ-STR-2	SD-WQ-STR1-2
		96 08 13	96 08 15	96 08 13	96 08 15
Total Metals					
Zinc	T-Zn	<0.005	<0.005	<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 for pH and Conductivity (umhos/cm).

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Metals in Sediment/Soil

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 Method 3050 or Method 3051, published by the United States Environmental Protection Agency (EPA). The procedures involve a digestion using a 1:1 ratio of nitric acid and hydrochloric acid, along with hotplate or microwave heating. Instrumental analysis is by atomic absorption spectrophotometry (EPA Method 7000) and/or inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010).

Method Limitation: The stated acid digestion will provide excellent results for total recoverable metals; however, it is only partially effective on mineralized or non-environmentally available metals.

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).

End of Report

APPENDIX

RESULTS OF SUBCONTRACTED ANALYSES

September 9, 1996
File: 2-21-900

Mr. Fred Chen
ASL Ltd.
1988 Triumph St.
Vancouver, B.C.
V6C 2V6

Dear Fred:

Subject: ***Results of Acid Base Accounting of Soil Samples.***

Below are the results of acid base accounting of 10 soil samples received August 21, 1996. Samples G4225-1, G4225-5, G4225-6, G4225-7, G4225-8 and G4225-10 are potential net acid producers. All remaining samples are net acid consumers.

Results of Acid Base Accounting:

Sample ID	Paste pH	Total Sulphur (Wt. %)	Maximum Potential Acidity (kg $CaCO_3$/tonne)	Neutralization Potential (kg $CaCO_3$/tonne)	Net Neutralization Potential (kg $CaCO_3$/tonne)
G4225-1	5.7	0.52	16.3	2.0	-14.3
G4225-2	5.4	0.14	4.4	5.0	0.6
G4225-3	9.0	0.02	0.6	422.8	422.2
G4225-4	8.1	0.17	5.3	71.4	66.1
G4225-5	5.4	1.17	36.6	3.7 / 3.2*	-32.9
G4225-6	3.2	0.74	23.1	-20.8	-43.9
G4225-7	4.8	0.30/0.30*	9.4	-3.4	-12.8
G4225-8	4.1	0.62	19.4	-16.9	-36.3
G4225-9	7.7	0.11	3.4	37.2	33.8
G4225-10	5.6	2.22	69.4	19.5	-49.9

*Duplicate analysis.

The analysis were carried out according to Sobek A. et al., EPA-600/2-78-054, March, 1978. Total cost for this work is $700.00, based on our price of $70 per sample. Please find enclosed our invoice for $700.00 plus GST. Thank you for using BCRI.

Sincerely,
BCRI

Tim O'Hearn, P.Eng.
Mine Waste & Drainage
Environmental Services and Technology

BC Research Inc.
3650 Wesbrook Mall
Vancouver. BC
Canada V6S 2L2

Canada
Tel: (604) 224-4331
Fax: (604) 224-0540

USA
Tel: (360) 738-0958
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CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Specialists in Environmental Chemistry
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CLIENT Public Works Canada

PAGE 1 OF 2

ASL CONTACT

CLIENT PROJECT #

PO #

PH/FAX# 403-497-3846/497-3996

CONTACT Ed Dominjan

DATE SUBMITTED Aug 16/96

SAMPLED BY " "

RESULTS REQUIRED BY

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	Metals by ICP	ABA acid-base acct	TM	1MM	COMMENTS
	CN-WR-P1-1	Rock	96 08 13	NO	✓	✓			
	CN-WR-P2-1	"	96 08 13	NO	✓	✓			
	CL-WR-P1-1	"	96 08 13	"	✓	✓			
	SC-WR-P1-1	"	96 08 14	"	✓	✓			
	CA-WR-P1-1	"	96 08 11	"	✓	✓			
	SD-WR-P4-1	"	96 08 15	"	✓	✓			
	SD-WR-P3-1	"	96 08 15	"	✓	✓			
	SD-WR-P2-1	"	96 08 15	"	✓	✓			
	SD-WR-P1-1	"	96 08 15	"	✓	✓			
	CA-WR-P2-1	"	96 08 11	"	✓	✓			
	CL-WQ-STR-1 (1MM)	Water	96 08 13				✓		
	CL-WQ-STR-1 (TM)	"	96 08 13	Nitric Acid		✓			
	SD-WQ-STR1-1 (1MM)	"	96 08 15	None			✓		
	SD-WQ-STR1-1 (TM)	"	96 08 15	Nitric Acid		✓			

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

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

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CLIENT Public Works Canada

ASL CONTACT

CLIENT PROJECT #

PO #

PH/FAX# (403) 497-3846 / 497-3796

CONTACT Ed Domjan

DATE SUBMITTED Aug 16/96

SAMPLED BY Ed Domjan

RESULTS REQUIRED BY

ANALYSIS REQUESTED

LAB USE	SAMPLE IDENTIFICATION	SAMPLE TYPE	DATE/TIME SAMPLED (Y M D)	FIELD PRESERVATION	TM	IMM	COMMENTS
	CL-WQ-STR-2 (IMM)	Water	96 08 13	None		✓	
	CL-WQ-STR-2 (TM)	"	96 08 13	Nitric Acid	✓		
	SD-WQ-STR1-2 (IMM)	"	96 08 15	None		✓	
	SD-WQ-STR1-2 (TM)	"	96 08 15	Nitric Acid	✓		

NOTES/COMMENTS

CONDITION RECEIVED
FROZEN
COLD
AMBIENT
TOTAL PACKAGES

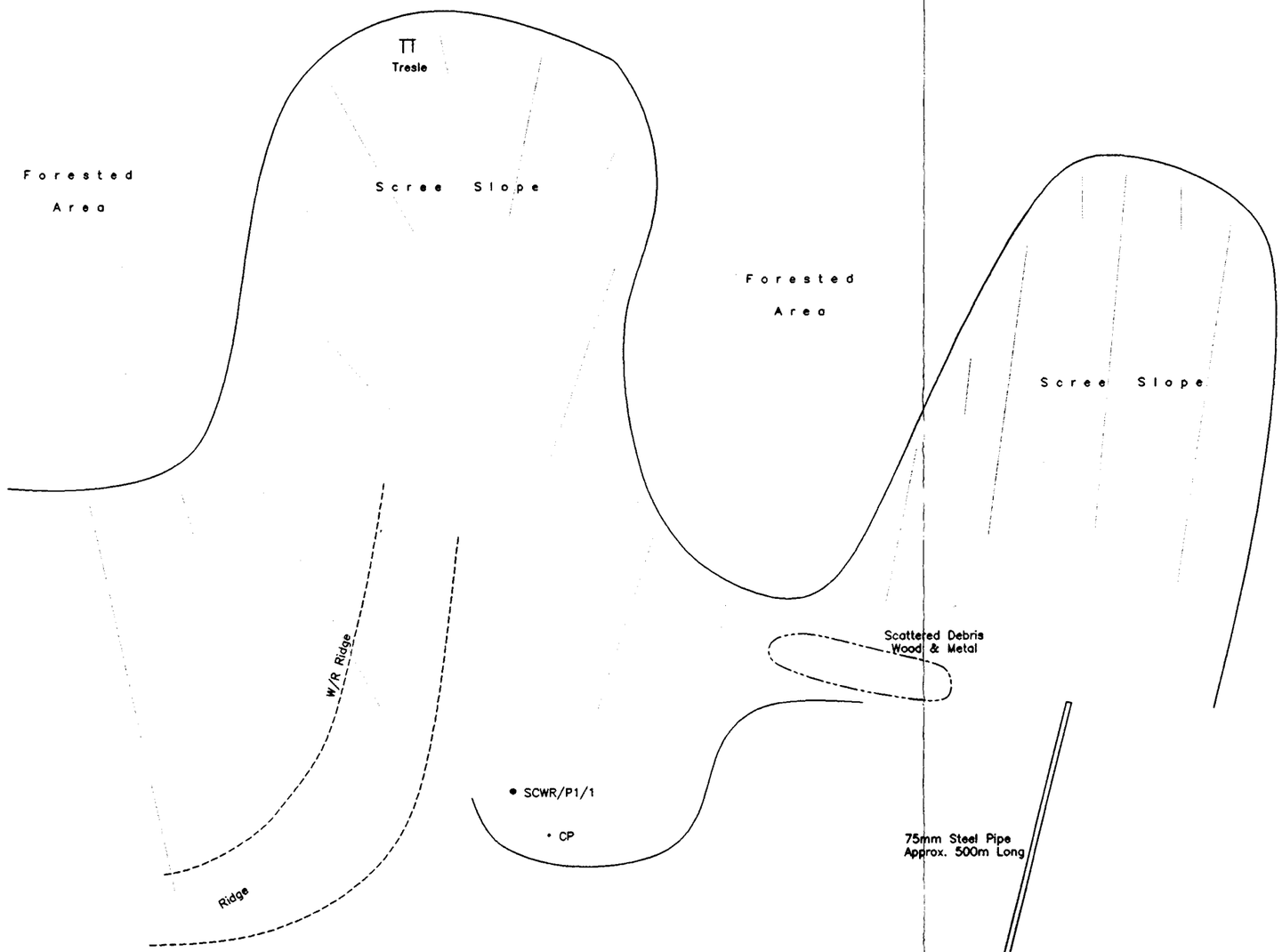
RELINQUISHED BY		
AFFILIATION		
RECEIVED BY	Y M D	Y M D
AFFILIATION	: AM PM	: AM PM

APPENDIX C

Drawings

Legend

- Outcrop Boundry
- W/R — Waste Rock
- Road
- Extent Of Waste Rock
- Trestle, with Track
- • SCWR/P1/1 — Waste Rock (site designat on)
- Slope Down
- Extent of Debris, Timber, Cable, Pipe, etc.



Approx. Scale: 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\SILVCITY\SILCIT-1

Public Works And Government Services Canada / Travaux publics et Services gouvernementaux Canada

Architectural & Engineering Services
Western Region

Silver City Mine
Site Development & Geological Information
Yukon Territory

Project No. / No. du projet: 626967

Sheet No. / No. de la feuille: 1 of 1