PHASE II ENVIRONMENTAL ASSESSMENT OF THE LEGAL TENDER

ABANDONED MINE SITE

prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
Public Works and Government Services Canada

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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Legal Tender abandoned mine site (60^0 05'19" N, 134^0 41'53" W) in July, 1996 by Environmental Services, Public Works and Government Services Canada for the Action on Waste Program, Indian and Northern Affairs Canada. The Phase I investigation performed in 1993 by DIAND Technical Services identified the wrong site. On this basis 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 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 while the adit remains open, there is an even greater risk to human safety in accessing the site. Only a small amount of non-hazardous materials were noted near the adit. As such, no further work is required at the site. An assessment of the acid rock drainage potential for the waste rock shows that only a small portion of the rock is acid generating and no surface water was noted in the area. Due to the small volume of waste rock left at the site, there is little aesthetic concern arising from the small volume of waste remaining at the site.

Table 1: Summary of Potential Hazards at Legal Tender Mine Site

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
None		
2. Non-Hazardous Waste Material		
4 m metal pipe and 1 wood box	None	
3. Hazardous Materials		
None		
4. Water Quality		
Mine Seepage - None		
Site Drainage - None		
Receiving Waters - None		
5. Waste Rock Disposal Areas		
Waste Rock - ~175 tonnes (small vol.)	Minor environmental risk	None
6. Mine Openings		
1 Adit - open; inaccessible	Minor health and safety risk; inaccessible	None
7. Tailings		
None		

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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 and/or mitigation work, as appropriate.

In its 1993 assessment, DIAND Technical Services incorrectly identified another site as the Legal Tender abandoned mine. In actual fact, the Legal Tender site was not assessed during that study.

In light of the lack of information required for an assessment of this mine, 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 Legal Tender abandoned mine site to a) identify specific environmental and human safety risks; and b) provide clean-up recommendations.

1.1 LOCATION

The Legal Tender abandoned mine site is located at 60° 20'10"N latitude and 135° 14'01"W longitude. It is approximately 35 km north west of the Village of Carcross and 25 km south west of Robinson on the South Klondike Highway south of Whitehorse. The site is on the west side of Mineral Hill in the Boundary Ranges (Coast Mountains) between 1450 and 1525 m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

In 1907, a 30 m (100 ft) adit was excavated into the southern face of Mineral Hill, about 305 m (1000 ft) above Watson River (GSC Memoir No. 31, p. 112).

1.3 SITE ACCESS

The adit is only accessible by helicopter to the top of Mineral Hill followed by foot down the steep mountain side between two unstable avalanche trails.

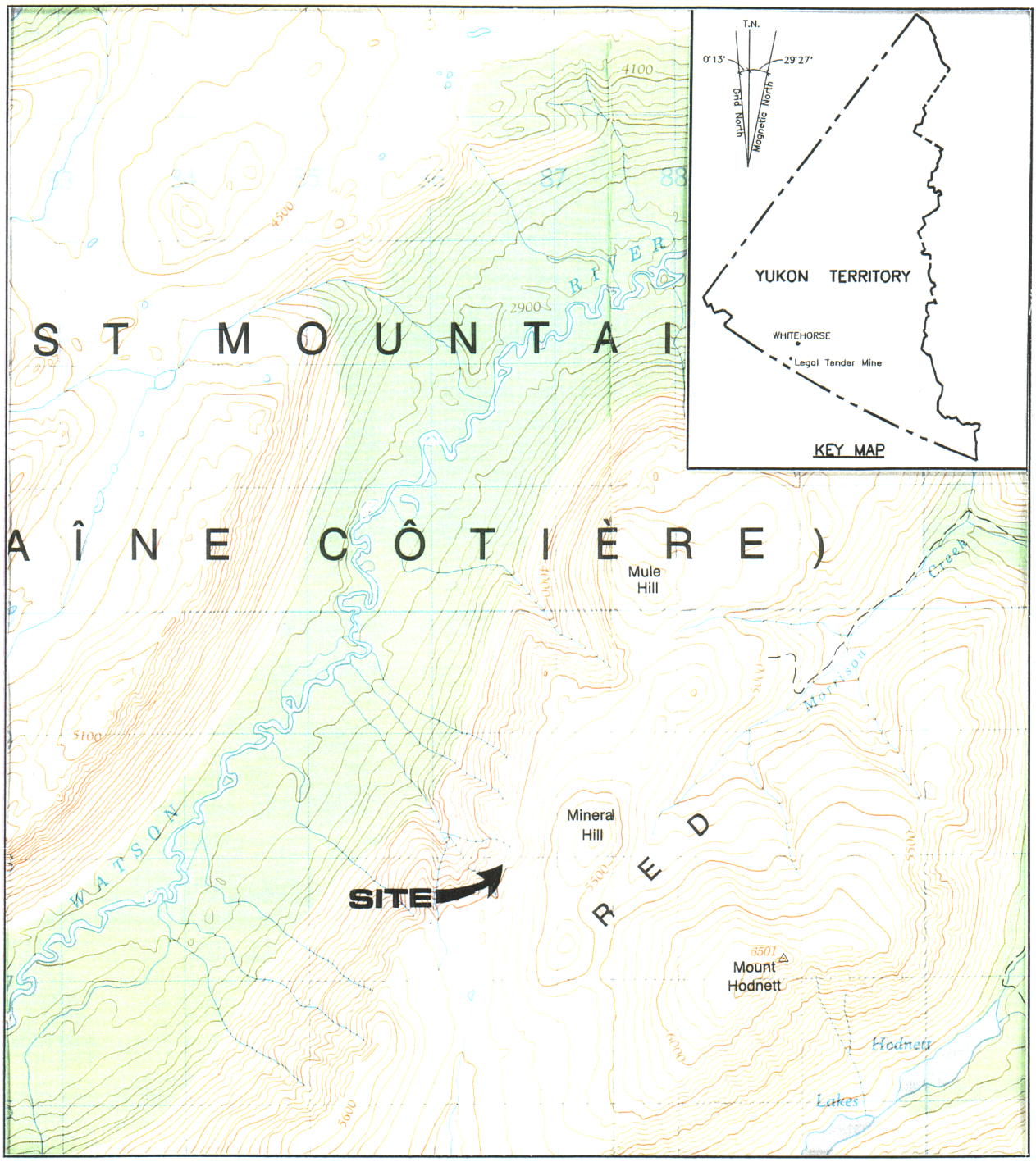

Figure 1. **Location of Legal Tender Mine - 1:50,000, NTS- 105 D/6 [Energy Mines and Resources Canada: 1986]**

2.0 PURPOSE AND SCOPE OF WORK

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 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, recommendations 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

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

According to these draft regulations a site is contaminated if it is 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.

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.

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 Legal Tender abandoned mine site assessment the following criteria were used:

A. Soils:

CCME:	Remediation Criteria for Soil - Commercial/Industrial standard

B. Water:

ENVIRONMENT 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 stream are compared to the results of upstream (background) water quality (if available)
CCME:	Remediation Criteria for Water - Freshwater Aquatic Life standard

[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 Territory

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 Legal Tender 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:

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.

Contaminated Soil Areas were measured and sampled to determine the degree and type 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, and any other pertinent information.

3.3.3 Sampling Methods and Quality Assurance

Test Pit Sampling

Test pits were excavated to a depth of about 0.3 to 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. The test pit was photographed and its location was 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.

For test pit walls showing clearly-distinguishable horizons (distinguishable by the sulphide and carbonate contents), the horizons were sampled individually.

Water Sampling

Samples were collected from surface streams upstream and downstream of mine related flows, and from representative seeps emanating from waste rock, tailings, 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 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, discolouration, 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 Sampling

Barrels 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.

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

Exploration on the site focussed on a mineralized quarts vein hosted in quarts diorite and granodiorite. The vein is composed of finely crystalline quartz, which

contains bands and disseminations of galena (PbS), pyrite (FeS_2) and some chalcopyrite ($CuFeS_2$). Dykes of rhyolitic and andesitic composition cross cut the granodiorite (Aurum Geological Consultants Inc., 1987).

The major commodities identified at this site are silver and gold.

4.2 SURFACE HYDROLOGY

Both the site and regional drainage are to the north west draining into Watson River (see Figure 1).

There was no surface water draining from the site at the time of the site visit, however, it appeared that seasonal drainage paths were located below the site.

No seepage was evident from the adit.

4.3 CLIMATE

The closest climatological information is from the town of Carcross, 60° 11' N, 134° 41' W; 663 m above sea level (Environment Canada, 1980). Total annual precipitation is 211.4 mm. This consists of 118.7 mm of rainfall and 101.3 mm of snowfall. Highest levels of rainfall occur in August and highest levels of snowfall occur in January. Temperatures range from -19.4° C in January to 12.7° C in July. The mean annual temperature is -1.4° C. Due to its higher elevation, Legal Tender experiences colder temperatures.

4.4 VEGETATION

The Legal Tender mine site occurs within the Yukon Stikine Highlands ecoregion. The site is within an alpine ecosystem, with vegetation including scrub heather, dwarf birch, willow, grass and lichen dominating the area. At lower elevations, north west of the site in the Watson River valley, subalpine areas are dominated by white spruce and alpine fir.

4.5 FISH AND WILDLIFE RESOURCES

Typical carnivores in the area include grizzly and black bear and wolf. Arctic ground squirrel, pika and hoary marmot are common rodents noted in the area. A large pika colony, typical of steep rocky areas, was noted above the site. Bird species representative of this alpine habitat include several ptarmigan species and rosy

finch. A number of raptors hunt and nest in the area, including gyrfalcon and golden eagle.

4.6 SITE TOPOGRAPHY AND SOILS

The soils within the Yukon Stikine Highlands ecoregion are predominantly brunisolic and regosolic. Occasionally, cryosolic soils, dystric brunisols and eutric brunisols are also found.

The site is located on the northwest side of Mineral Hill. The valley northwest of the site drops steeply towards the forested area surrounding the broad valley floor surrounding Watson River. The slope on either side above the mine site is a steep rocky slope with two avalanche pathways converging below the site. Directly above the adit is a large outcrop of overhanging rock.

4.7 PERMAFROST

Legal Tender is in an area of discontinuous permafrost. No evidence of permafrost was discovered during the site visit and is not likely to affect project components.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 BUILDING, INFRASTRUCTURE, EQUIPMENT

No buildings, infrastructure or equipment was noted at the site.

5.2 NON-HAZARDOUS WASTE MATERIALS

The only materials noted at the site included a 4 m length of metal pipe and a small wooden box.

5.3 HAZARDOUS MATERIALS

No hazardous materials were noted at the mine site.

5.4 SURFACE WATER QUALITY

No surface water was noted at the site.

5.5 WASTE ROCK DISPOSAL AREAS

Approximately 175 tonnes (190 tons) of waste rock would have been produced from the underground workings, based on the dimensions observed and a specific gravity of 2.65. A thin layer of waste rock is located below the portal along the slope. Quartz rich waste rock has been piled in a small pile to the west of the adit and represents approximately 25% of the waste observed.

Two samples were collected from the waste rock deposited outside of the adit. One from mineralized quartz rich rock (LT/WR/P301) and one from the waste rock (LT/WR/P302). These samples were submitted for Acid Base Accounting (ABA) tests and determination of metals. Sample descriptions and a summary of the analytical results are presented in Table 2.

Samples P301 and P302 had paste pH values of 7.8 and 7.9, respectively. Total sulphur contents were low (0.03% and 0.10 %). The Neutralization Potential to Acid Potential (NP:AP) ratio of the mineralized sample (P301) was 0.76, indicating that the material is potentially acid generating. The NP:AP ratio of the unmineralized sample was 9.67, indicating that it is net acid consuming.

The mineralized sample (301) contained over 3400 ppm lead, 195 ppm chromium, 107 ppm copper, 18 ppm silver and 203 ppm zinc. The metal concentrations in sample P302 were lower. This sample contained 116 ppm lead, 190 ppm zinc and concentrations of chromium and copper below 80 ppm.

Table 2: Summary Acid/Base Accounting Test Results

Sample #	Paste pH	Total S (%)	SO_4 (%)	AP	NP	Net NP	NP/AP
LT/WR/P301	7.79	0.10	no assay	3.13	2.38	-0.75	0.76
LT/WR/P302	7.86	0.03	no assay	0.94	9.06	8.13	9.67

5.6 MINE OPENINGS AND EXCAVATIONS

The portal is 2 m (6.5 ft) high by 1 m (3.5 ft) wide and access to the workings are not restricted, other than by its precarious location between avalanche shoots on the side of a mountain. The underground workings themselves appear to be relatively stable compared to the surrounding terrain. A description of the mine opening is presented in Table 3.

Table 3: Mine Opening

Adit	Location	Drift Length	Condition
1 adit	1525 m; ~150 m from peak of Mineral Hill	30 m	open; relatively stable

5.7 TAILINGS

Ore was not processed at the site and, therefore, no tailings are present at the Legal Tender site.

6.0 CONCLUSIONS

There are no aesthetic or environmental concerns associated with this site. The only health and safety issue is associated with the open adit.

6.1 HEALTH AND SAFETY

The mine adit remains open, however, the health and safety risk associated with the open adit is out-weighed by the risk associated with accessing the site. The site is not readily detectible from Watson River and is not expected to attract the attention of tourists.

6.2 ENVIRONMENTAL RISKS

The waste rock at the site poses few environmental risks. None of the material is currently generating acid, as is evidenced by the alkaline paste pH measurements. The mineralized quartz material is potentially acid generating and contains elevated concentrations of lead and other metals. However, this material has been exposed since 1907 without generating acid and there is no evidence of negative environmental impacts at the site. In addition, the mineralized material composes only one quarter, or approximately 44 tonnes (48 tons) of the total waste rock at the site. The rest of the waste rock is not potentially acid generating and has lower metal concentrations.

6.3 AESTHETIC CONCERNS

The small volume of waste rock at the site is surrounded by avalanche debris and is therefore not considered a concern from an aesthetic point of view. Minor debris remaining at the site is noticeable only at very short distances.

7.0 RECOMMENDATIONS

There are no recommendations required for this site.

REFERENCES

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

DIAND Technical Services, 1993. Assessment Report, 105 D-06-4, Legal Tender Abandoned Mine Assessment. Prepared for Indian and Northern Affairs Canada.

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APPENDIX A

SITE PHOTOGRAPHS

LEGAL TENDER

Photographic Record

July 28, 1996

Photos	Description
L.T. # 1	Open Adit in Side of Mountain
L.T. # 2	Scree Slope below Adit
L.T. # 3	Wood and Metal Debris at Adit
L.T. # 4	Steep Slope below Adit
L.T. # 5	Unstable Rocky Slope above Adit

Photo # 1 - Open Adit in Side of Mountain

Photo # 2 - Scree Slope below Adit

Photo # 3 - Wood and Metal Debris at Adit

Photo # 4 - Steep Slope below Adit

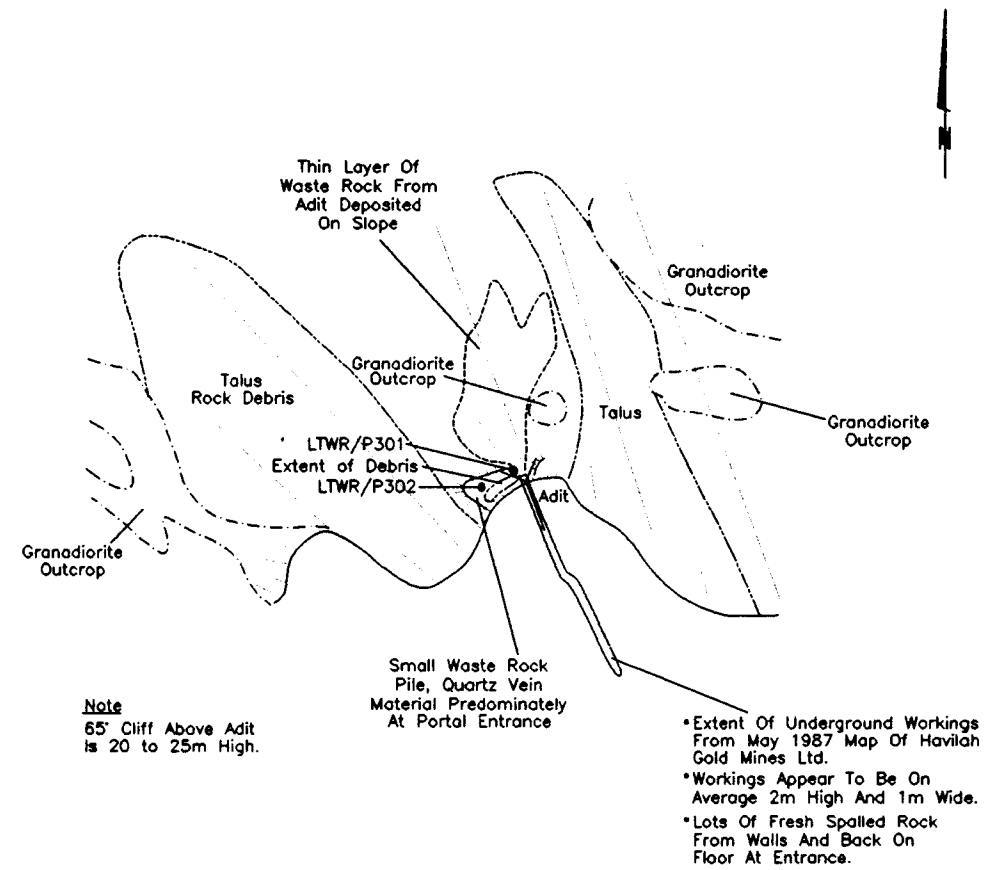
Photo # 5 - Unstable Rocky Slope above Adit

APPENDIX B

DRAWINGS

Legend

- Outcrop Boundry
- W/R — Waste Rock
- O/C — Outcrop
- Adit
- Extent Of Waste Rock
- • LTWR/P1/1 — Waste Rock (site designation)
- Slope Down
- Extent of Debris, Timber, Cable, Pipe, etc.



Note
65' Cliff Above Adit is 20 to 25m High.

0 10 20 30 40

Scale 1:1000

PLOT: 1=1
CAD FILE: INVEN-96\LEGAL\LEGAL-1

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

Architectural & Engineering Services
Western Region

Drawing title: Titre du dessin:

Legal Tender Mine Site Development

Yukon Territory

Designed by: conçu par:
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