PHASE II ENVIRONMENTAL ASSESSMENT OF THE GOLD HILL

ABANDONED MINE SITE

prepared for:

Action on Waste Program
Indian and Northern Affairs Canada

prepared by:

Environmental Services
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EXECUTIVE SUMMARY

A phase II environmental assessment was conducted at the Gold Hill abandoned mine site (60^0 18'09" N, 135^0 08'42" W) in July, 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 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 the only concerns at the site are aesthetic in nature. Two buildings, metal pails and a minor amount of domestic waste were noted near the bottom of the valley. The wood material should be burned and buried on site. The metal waste should be transported off site and disposed of.

No further test work is recommended on the minor amount of waste rock generated during trenching.

Table 1: Summary of Potential Hazards at Gold Hill Mine Site

ASSESSMENT COMPONENT	RISK	RECOMMENDATION
1. Building, Infrastructure, Equipment		
2 Buildings	Aesthetic concern	Burn wood and bury ashes; dispose of metal off site
Trenching	Minor aesthetic concern	None
2. Non-Hazardous Waste Material		
Scattered wood, two drums, one piece of metal	Aesthetic concern	Burn wood; dispose of metal off site
3. Hazardous Materials		
None		
4. Water Quality		
Mine Seepage - None		
Site Drainage - None		
Receiving Waters - Seasonal stream		
5. Waste Rock Disposal Areas		
Waste Rock - small vol. trenched	Low environmental risk	None
6. Mine Openings		
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.

At the Gold Hill abandoned mine site, the 1993 report recommended further investigation into possible environmental impacts resulting from the previous mining activities. According to this report, the potential areas of concern included: environmental concerns with respect to the road construction and trench excavation; and aesthetic concerns with regard to the buildings and other minor wastes noted at the site. No rock, tailings, soil or water samples were collected in this assessment.

In light of these preliminary findings, 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 Gold Hill abandoned mine site to a) identify specific environmental and human safety risks; and b) provide clean-up recommendations.

1.1 LOCATION

The Gold Hill abandoned mine site is located at 60° 18'09"N latitude and 135° 08'42"W longitude. It is located 28 km north west of the village of Carcross and 23 km south west of Robinson on the South Klondike Highway south of Whitehorse. The site is near the top of Pugh Peak in the Boundary Ranges (Coast Mountains) between 1850 and 1900 m above sea level.

1.2 OVERVIEW OF SITE DEVELOPMENT

The property was first staked in 1906. Later that year a staking rush occurred following the discovery of quartz carrying free gold and telluride minerals on Gold Hill. According to D.D. Cairnes of the Geological Survey of Canada (GSC) in his Report on a Portion of the Conrad and Whitehorse Mining Districts, Yukon published in 1908 (Publication No. 982) and H.S. Bostock in GSC Memoir 284 (p. 335) considerable surface development was conducted but no underground

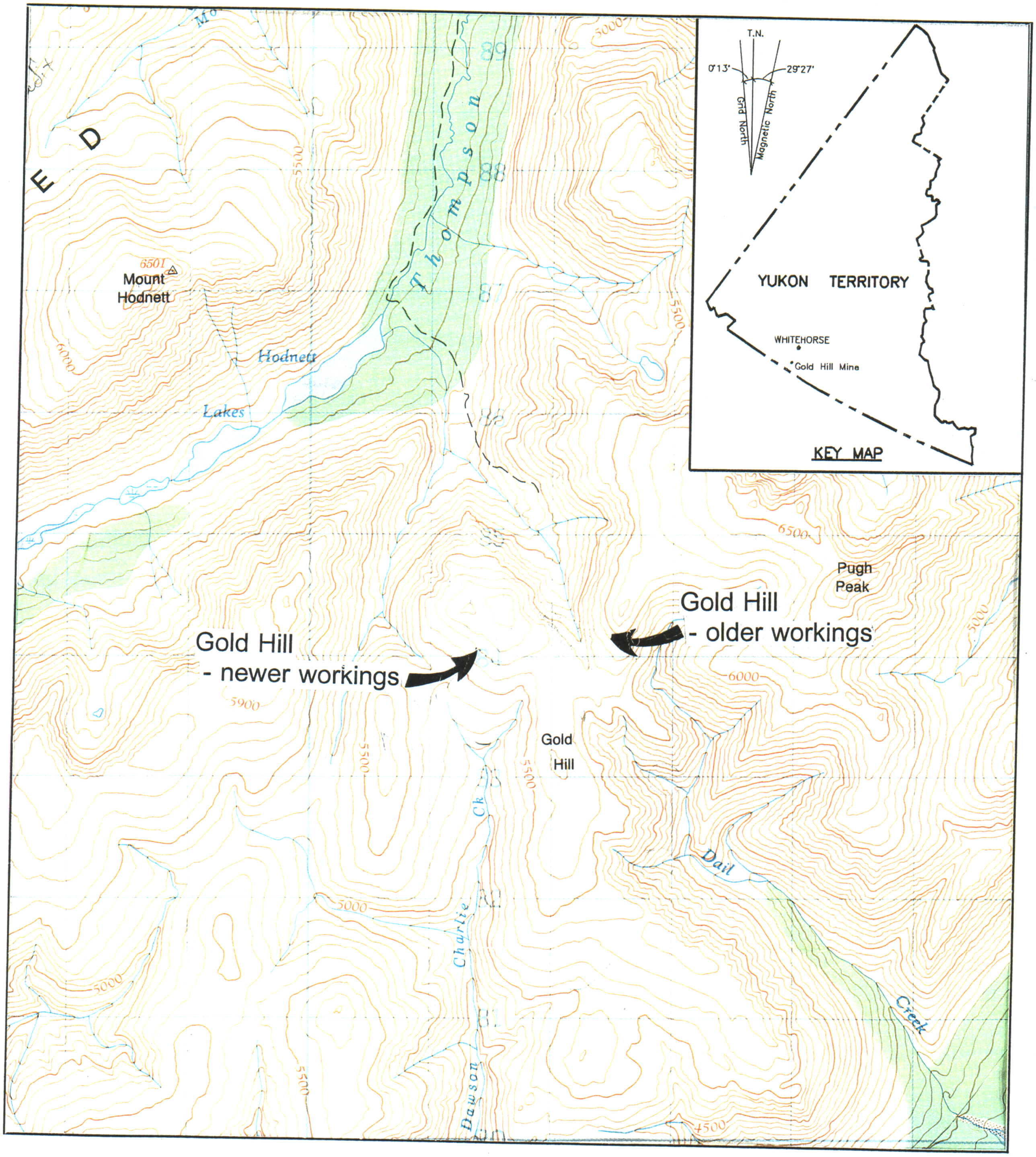

Figure 1. **Location of Gold Hill Mine - 1:50,000, NTS- 105 D/6 [Energy Mines and Resources Canada: 1986]**

development is reported. However, several hundred feet of development, in the form of drifts, cross-cuts, shafts, etc. are reported by D.D. Cairnes of the GSC (Memoir No. 31, p. 112). This development apparently occurred in the overburden and was not hard rock mining.

Between 1984 and 1986 trenching was conducted on the property using explosives and a bulldozer. In 1989 bulk samples were collected. Drilling occurred in 1989 and 1990.

1.3 SITE ACCESS

The site is accessible by all terrain vehicle from the base of the mountain at the first Hodnett Lake. Access to the base of the mountain is possible by four wheel drive vehicle on an un-maintained road along Thompson Creek, a tributary of Watson River.

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 m 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 Gold Hill 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:

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 streams 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 Gold Hill 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, 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 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

Mineralization at the site occurs in quartz veins within a belt of schist adjacent to rhyolite. The quartz veins occasionally contain free gold (Au), sylvanite ($AgAuTe_4$), hessite (Ag_2Te), and telluric ochre (TeO_2), however, the vein is generally barren of ore, containing only occasional disseminated particles of pyrite (FeS_2), and slight amounts of gold (Au) and silver (Ag) (GSC Memoir No. 31, pp. 111, 112).

4.2 SURFACE HYDROLOGY

Both the site and regional drainage are to the north west draining into the easternmost Hodnett Lake along a zero order stream that was dry at the time of the site visit (see Figure 1).

Hydrological and water quality data are not available for the unnamed zero order stream running below the Gold Hill mine site. No surface water was noted at the site at the time of the site visit.

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, Gold Hill experiences colder temperatures.

4.4 VEGETATION

The Gold Hill mine site occurs within the Yukon Stikine Highlands ecoregion. Alpine tundra dominates the site, with vegetation limited to tussock grasses, lichens, moss and willow. At lower elevations, adjacent to Hodnett Lakes and along the access road below the site, subalpine areas are dominated by alpine fir with some white spruce and white birch.

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. Pika and arctic ground squirrel colonies were noted at 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, and waterfowl such as mergansers and harlequin ducks are found in the rivers at lower elevations.

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 trenching has occurred on the flat peak of Gold Hill and the mine camp, represented by the two buildings, located at the bottom of a steep valley on the north west side of the hill. Both sides of the valley are dominated by bare rocky slopes that appeared to be relatively stable. Below the camp the terrain gradually levels into a partially forested valley containing Hodnett Lakes approximately 2 km north west of the site.

4.7 PERMAFROST

Gold Hill 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

The buildings, infrastructure and equipment observed in and around the site are listed in Table 2.

Table 2: Buildings, Infrastructure and Equipment

Inventoried Material	Location	Comments
~10 m x 3 m bldg.	bottom of northwest valley	wood frame with some aluminum siding; poor condition
wood outhouse	bottom of northwest valley	plywood construction; destroyed

5.2 NON-HAZARDOUS WASTE MATERIALS

The non-hazardous waste material observed in and around the site are listed in Table 3.

Table 3: Non-Hazardous Waste Materials

Waste Material	Number/ Volume	Location
2 empty pails	23ℓ each	adjacent to buildings
miscellaneous domestic waste	< 5 m^3	adjacent to buildings

5.3 HAZARDOUS MATERIALS

No hazardous wastes were noted at the site.

5.4 SURFACE WATER QUALITY

No surface water was noted at the site.

5.5 WASTE ROCK DISPOSAL AREAS

The limited waste rock on site is a result of trenching. Three grab samples were collected from the waste rock along the side of the trenches. Sample GH/WR/P301 was collected from the mineralized quartz vein material TR 84-6, created in the 1980's. Sample GH/WR/P302 was collected from rhyolite piled beside trench TR 84-5. Sample GH/WR/P303 was collected from mineralized quartz vein material excavated by trenching over 50 years ago.

The samples were analyzed for Acid Base Accounting (ABA) and metals concentrations. Sample locations are shown on the site map. Sample descriptions and a summary of the analytical results are presented in Table 4.

All samples had neutral paste pH values ranging from 6.55 to 7.55. The total sulphur content of the samples was low, ranging from 0.04% to 0.14%. The NP:AP ratio of the sample of the mineralized material collected from the recent trenching (P301) was 36.06, indicating that the material has a low acid generating potential. The Neutralization Potential to Acid Potential (NP:AP) ratios of the unmineralized waste rock from the recent trenching (P302) and the mineralized material from the older turn of the century trenching (P303) were 2.95 and 1.70, indicating that the material is potentially acid generating.

Metal concentration in the piles beside the trenches were generally low. Sample P301 and P302 contained 251 ppm and 123 ppm arsenic, respectively. The chromium concentrations ranged from 74 ppm to 156 ppm and manganese concentrations were greater than 900 ppm.

Table 4: Summary Acid/Base Accounting Test Results

Sample #	Paste pH	Total S (%)	SO_4 (%)	AP	NP	Net NP	NP/AP
GH/WR/P301	7.55	0.14	no assay	4.38	157.75	153.38	36.06
GH/WR/P302	7.30	0.04	no assay	1.25	3.69	2.44	2.95
GH/WR/P303	6.55	0.04	no assay	1.25	2.13	0.87	1.70

5.6 MINE OPENINGS AND EXCAVATIONS

No indication of underground development work was found during the site assessment. Evidence of extensive surface trenching, circa 1910, was observed on the north side of Gold Hill. These trenches have sloughed in since that time and approximately 50% of the disturbed area is now fully revegetated. The site resembled a reclaimed alluvial mining area more than a hard rock mine site. The more recent trenching is located a short distance to the west of the old workings.

5.7 TAILINGS

No tailings are present because no ore was milled on site.

6.0 CONCLUSIONS

The only concern at the site is the aesthetic appearance of the two abandoned buildings and small amount of waste discarded in the building area.

6.1 HEALTH AND SAFETY

There do not appear to be any safety issues related to the site.

6.2 ENVIRONMENTAL RISKS

The amount of waste rock at the site is small and was generated by surface trenching. Although samples from two of the trenches are potentially acid generating, none of the material is currently generating acid as indicated by the near neutral paste pH values. This includes material excavated by trenching over 50 years ago. Metal concentrations are low and with the lack of water at the site, appear to have no negative impact on the local environment.

6.3 AESTHETIC CONCERNS

Aesthetic concerns arise from the two buildings and scattered debris noted in the valley.

It is apparent from the site observations that the recent disturbances caused by trenching on the site will be non-detectable to the general public within 80 years if no reclamation work is undertaken on the site.

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.

Recommendation 1.

It is recommended that the buildings be demolished and burned and the ashes buried on site for aesthetic reasons.

Recommendation 2.

It is recommended that metal site debris, including portions of the building and domestic waste, be collected and transported off site for aesthetic reasons. The debris can be collected using locally available labour.

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-06-2, Gold Hill Abandoned Mine Assessment. Prepared for Indian and Northern Affairs Canada.

Energy, Mines & Resources. 1974, National Atlas of Canada. 4th Edition.

Environment Canada Atmospheric Environment Service. Canadian Climate Normals. 1961-1990.

Environment Canada Atmospheric Environment Service. Canadian Climate Normals. 1951-1980.

Environmental Protection and Assessment Branch, June 1996. Draft Contaminated Sites Regulations. Yukon Renewable Resources.

APPENDIX A

SITE PHOTOGRAPHS

GOLD HILL
Photographic Record

July 28, 1996

Photos	Description
G.H. # 1	Deteriorating Shack on Site
G.H. # 2	Interior of Shack
G.H. # 3	Miscellaneous Wood Debris
G.H. # 4	Barrels to be Collected
G.H. # 5	Miscellaneous Metal Debris
G.H. # 6	Access Road to Camp in Valley below Mine Works
G.H. # 7	Trenching on top of Mountain
G.H. # 8	Access Road leading to Valley below Site

Photo # 1 - Deteriorating Shack on Site

Photo # 2 - Interior of Shack

Photo # 3 - Miscellaneous Wood Debris

Photo # 4 - Barrels to be Collected

Photo # 5 - Miscellaneous Metal Debris

Photo # 6 - Access Road to Camp in Valley below Mine Works

Photo # 7 - Trenching on top of Mountain

Photo # 8 - Access Road leading to Valley below Site