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PHASE II ENVIRONMENTAL ASSESSMENT OF THE COBALT ABANDONED MINE SITE

Prepared for:

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EXECUTIVE SUMMARY

The Cobalt abandoned mine site is located at the crest of Cobalt Hill, approximately 19 kilometres northeast of Keno City (63°59'30"N, 134°57'00"W). The extent of underground development consists of a 12.2 metre adit, driven between 1947 and 1948. Trenching, by hand, occurred between 1964 and 1967. A helicopter is required to access the site, since there are no roads within 10 kilometres.

DIAND Technical Services completed a Phase I environmental assessment on the property in 1993. The initial assessment (DIAND, 1994) identified safety concerns associated with an open adit and a low-level environmental risk from a 50 metre by 50 metre area of trenching. No rock, soil, water, or product samples were collected in the initial assessment.

Steffen, Robertson and Kirsten (SRK) were retained to conduct a Phase II environmental assessment of the Cobalt abandoned mine site. An extended period of poor weather prohibited helicopter access, while the SRK field crew was mobilized in the area, and a site visit could not be completed. The following assessment is based solely on a literature review.

The following are the key conclusions and recommendations of the review:

- The underground workings at this remote site do not present a significant health and safety risk because of the remoteness of the site and the small size of the workings.

- A potential for acid generation and metal leaching exists; however, the volume of waste rock and total surface area of exposed bedrock is small, and therefore not likely to contribute significant metal loads to the receiving environment.

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1.0 INTRODUCTION

1.1 Background

As part of the 1993 Arctic Environmental Strategy Action on Waste program, DIAND Technical Services completed Phase I environmental assessments of abandoned exploration and mine sites. The initial assessments provided a general overview of historical activities, described site infrastructure, mine workings and wastes, summarized environmental and/or safety concerns on each site, and provided general recommendations for remediation work. On the basis of the initial assessments, selected sites were chosen for further investigation.

The abandoned Cobalt mine was one of the sites chosen for further investigation. The initial assessment (DIAND, 1994) identified safety concerns associated with an open adit and a low-level environmental risk from a 50 metre by 50 metre area of trenching. No rock, soil, water, or product samples were collected in the initial assessment.

Environmental Services, Public Works and Government Services Canada, retained Steffen Robertson and Kirsten (SRK) to do further investigation. SRK staff were unable to visit the site during repeated attempts between September 19 and 22, 1996. Therefore, the following assessment is based on review of available documents and records.

1.2 Location and Access

The Cobalt mine site is located 19 kilometres northeast of the community of Keno City and 1.5 kilometres south of Keno Ladue River at an elevation of 1065 metres above sea level (see Figures 1 and 2). It is on the north side of Cobalt Hill.

Access to the Cobalt site is difficult. During the summer months the site is only accessible by helicopter (a one hour flight from the Mayo airport). A 30 km long winter tractor trail to the property, which follows the Keno Ladue valley from Elsa, has been used in the past to access the property. This trail is not maintained and considerable work would be required to re-establish the route.

1.3 Overview of Site Development

The site was first staked in 1922. The initial claims had been allowed to lapse and the site restaked several times since then. In September 1996 the mineral rights to the site had again reverted to the crown.

The property was actively explored in the late 1940's when trenches and test pits exposed the mineral occurrence over a 125 metre strike length and a 12.2 metre adit was driven at the south end of the of the zone. 4.5 tonnes of hand-cobbed ore was moved by cat train to the mill at Elsa in 1949 (Yukon Minfile # 105M 034, GSC Memoir 357, p. 61.). Between 1964 and 1967 the property was explored by hand trenching. No record of work on the site since 1967 was found.

2.0 OBJECTIVES AND SCOPE

2.1 Objectives

The objectives of the investigation were to:

- Identify potential environmental and human safety risks and/or aesthetic concerns; and,
- Provide recommendations and preliminary cost estimates for mitigation of those risks and/or concerns.

2.2 Review of Available Information

The investigation was initiated with a review of available background information. Public information was consolidated from the Geological Survey of Canada, Yukon Assessment files, DIAND Exploration and Geological Services, and DIAND Mineral Resource Directorate. Indian and Northern Affairs Canada provided an overview of the Cobalt mine site titled Yukon Assessment Report 105M-15-1 Cobalt Abandoned Mines Assessment, (DIAND, 1994). Other published information sources were examined for site or regional information as applicable. A list of references examined is included in Section 8.0 of this report. J.B. O'Neill, a retired miner with personal experience in the area, was contacted to confirm the site history.

The Yukon Mining Recorder in Mayo was contacted to determine the status of the mining claims at the site to be visited.

2.3 Site Investigation

SRK field personnel made several attempts to visit the site between September 19 and 22, 1996, but bad weather and poor flying conditions prevented them from doing so. Therefore, a site investigation could not be completed, and the assessment had to be completed based on the review of available information.

2.4 Review and Cost Estimates

Preliminary cost estimates were prepared for the following mitigation measures, as appropriate, based solely on the review of background information:

- Sealing of mine openings;
- Physical stabilization of waste rock disposal areas;
- Chemical stabilization of the waste rock disposal areas, taking into account impact, on-site resources, and accessibility;
- Consolidation and landfill of all non-hazardous, non-combustible solid wastes;
- Remediation and/or removal and disposal of contaminated soils;
- Removal and disposal of hazardous solid wastes;
- Draining, cleaning and disposal of drums, storage tanks, or other containers containing petroleum products or other liquid hazardous wastes;
- On-site 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 an approved location.

3.0 ASSESSMENT METHODOLOGY

3.1 Area Assessed

The assessment was limited to the area specifically developed, or occupied during, exploration and mining purposes, immediately-adjacent areas, and the resources believed to be affected by these activities. The winter access road was not included.

3.2 Assessment Criteria

The *Mine Reclamation in Northwest Territories and Yukon* (INAC, 1992) provides guidelines for the clean up and reclamation of mine sites operating in northern climates. These guidelines were applied in the assessment of the following mine features:

- open pit and underground workings;
- waste rock and tailings disposal areas; and,
- acid generation and metal leaching.

The *Interim Canadian Environmental Quality Criteria for Contaminated Sites* (CCME criteria, 1992) 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. Since no samples of soil or water could be collected the CCME criteria were not applied to this site.

3.3 Components Investigated

The following components were assessed during the review to identify existing or potential safety and environmental risks on the mine site:

- *Waste Rock* and site geology information was compiled by a professional geologist to assess acid rock drainage and metal leachate potential by identifying variations in rock type, mineralization and alteration.
- *Mine Openings and Excavation* information was compiled to identify safety concerns and closure requirements.

4.0 ENVIRONMENTAL SETTING

4.1 Mineralization

The commodities of interest at the Cobalt site are silver, lead. A fracture zone cuts phyllitic quartzites and phyllite. The fractures are filled with a gouge of crumpled phyllite and massive galena (PbS) (up to 8 cm thick), with lesser amounts of siderite ($FeCO_3$). The vein material has been heavily oxidized, the galena being partly altered to anglesite and the siderite to limonite and hydrous manganese oxides (GSC Memoir 357, p. 61.). A sample composed mainly of galena was collected and analysed by the GSC from "the upper dump". It assayed 140 g/tonne, silver, 71.8% lead, 0.10% zinc, 0.05% copper, 0.39% antimony and 0.02% cadmium (cadmium was assayed using spectographic determinations). Average metal contents for the whole mineralized zone and the surrounding host rocks were not available.

4.2 Surface Hydrology

Regional drainage flows eastward along Keno Ladue River (Figure 2), which joins up with Beaver River, which is a tributary of the Stewart River. Hydrological data is not available for Keno Ladue River.

The mine workings are located on a ridge above Keno Ladue River. The surface runoff from the mine site flows northward to Keno Ladue River (1.5 kilometres to the north). No flowing streams or creeks are reported in the vicinity of the workings (DIAND, 1994).

4.3 Climate

The area has a continental climate characterized by low precipitation and a wide temperature range. Winters are cold and long, but the short summer has almost continuous daylight during June and July (GSC Memoir 364, pp.3-4). The nearest climatological information, compiled in Environment Canada's Canadian Climate Normals, 1951 to 1980, is from the town of Elsa (Latitude 63°55', longitude 135°29', elevation 814 metres above mean sea level). Total annual precipitation is approximately 410 mm, with the highest snowfall period being October to December and the highest rainfall period in July and August. Elsa has on average 122 days with precipitation per year. Temperatures typically range from - 28°C in January and 20°C in July. The mean

annual temperature is -4°C. Both Elsa and the Cobalt mine site are on the northern side of mountain ranges and at similar elevations.

4.4 Vegetation

The Cobalt mine site occurs within the Yukon Plateau North ecoregion. Vegetation at 1000 metres above sea level on the terraced slopes in the Gustavus Range is typical of warmer Western Boreal areas. Black spruce white spruce, alpine fir, and willows are abundant; aspen poplar, balsam poplar, white birch, and alder are less common (GSC Memoir 364, p.4). The Cobalt site appears to have typical vegetation for the area, based on photographs provided by DIAND (1994). The area has been burnt, probably sometime in the last 20 years given the height of the new growth (DIAND, 1994, Photos 1 and 2).

4.5 Fish and Wildlife Resources

The Cobalt site is expected to be a prime wintering site for moose, similar to the nearby Keno Hill and the Davidson Range. The willow thickets in the clearings could provide habitat for black bear, fox, wolf/coyote, ptarmigan, gopher/marmots, eagles and hawks.

The nearest potential fisheries resource is located between 1 km and 1.5 km to the north in the lowlands surrounding the Keno Ladue River. The Keno Ladue River is unclassified according to the Yukon Placer Authorization. The drainage of Allan Creek, which enters the Keno Ladue River 4 km upstream of the Cobalt site, is classified as Type IV. Type IV streams are streams with no fish or streams with fish having no significant use by First Nations, commercial, sport or domestic fisheries or not contributing to biological diversity.

4.6 Site Topography and Soils

The site is found on the north side Cobalt Hill at the northeast corner of the Gustavus Range of the Yukon Plateau. The Gustavus Range is 37 km long and 15 km wide, having a northeast-southeast trend. Ground surface elevations range from 670 metres above sea level in the broad valley hosting Keno Ladue River to over 2000 metres above sea level at the apex of the Gustavus Range (Mt. Hinton). Cobalt Hill and the Cobalt mine workings are located at an elevation of 1150 metres above sea level.

Surficial soils at the site consist of a thin veneer of glacial till made up of silt with some gravel overlying the bedrock (DIAND, 1994).

4.7 Permafrost

The Cobalt site is in an area of discontinuous permafrost on a north facing slope.

5.0 SITE DESCRIPTION AND FINDINGS

5.1 Buildings, Infrastructure, and Equipment

No buildings, infrastructure or equipment were observed by DIAND Technical Services during their site visit in 1993. The forest fire that past through the area has apparently eliminated any evidence that a trail once existed to the site.

5.2 Non-Hazardous Waste Material

No debris, such as barrels, buildings or other garbage was observed during the 1993 site visit (DIAND, 1994).

5.3 Hazardous Materials

No hazardous materials are reported.

5.4 Water Quality

No water samples have been collected in the vicinity of the Cobalt adit. The site was dry in 1993.

5.5 Waste Rock Disposal Areas

A small pile of waste rock is located above the trenching and on the west side of the adit (Photos 3 and 4). The volume of waste rock produced from the underground exploration program is in the order of 300 tonnes. The assumptions made to derive this estimate are:

- a specific gravity of 2.65;
- a total of 12.2 metres of lateral development; and,
- mine openings 2.5 metres by 3.7 metres.

The trenching and the adit have exposed iron stained rocks (GSC Memoir 357, p. 61). The mineral occurrence contains the occasional erratic 5 to 8 cm wide veinlets of galena,

which is a potential source of metal leachate, and the waste rock on site contains pieces with massive galena (GSC Memoir 357, p.61). The volume of waste present at the site is very small, as is the overall extent of disturbance by trenching.

5.6 Mine Openings and Excavations

An adit, 12.2 metres long, is located at the southeast end of the trenching (Photos 3 and 4). It is open and the ground conditions around the entrance appear stable. The total area disturbed by trenching is probably 125 metres by 50 metres (DIAND, 1994, GSC Memoir 357, p.61).

5.7 Tailings

No milling of ore was done on the site; therefore, no tailings are present.

6.0 RISKS AND CONCERNS

6.1 Health and Safety Risks

The adit on the site has not been sealed to prevent entry and, as such, poses a health and safety hazard. Access to this remote site is difficult and no work is ongoing in the area; however, so the potential for exposure to the hazard, and therefore the safety risk, is low. The area has not seen any exploration activity for several years and the adjacent mineral claims have been allowed to lapse (as of April 9, 1994); therefore, it is unlikely that access to the site will soon be improved.

6.2 Environmental Risks

No physical stability concerns were identified in this assessment.

Chemical stability issues were identified, since it is possible that the underground workings, waste rock and the trenches are sources of acid generation and metal leaching. The mineral occurrence at the Cobalt site is reported to contain the occasional veinlet of massive galena, a lead sulphide which, when allowed to oxidize, can generate acidity and metal leachate. The host rock is phyllite and phyllitic quartzite which typically have a low capacity to neutralize acidity generated by oxidation of sulfides. It is reported that much of the vein material has been heavily oxidized and that the surface of the exposed rock is iron stained, therefore acid generation and metal leaching have probably occurred.

Nonetheless, the risk to the receiving environment due to acid generation and metal leaching is considered low for the following reasons:

- The amount of waste rock is very small (approximately 300 tonnes), and therefore is unlikely to contribute significant metal load;

- The amount of underground development (12 metres lateral development) and the areal extent of the exposed bedrock from trenching (6250 m^2) is small, so the amount of fresh rock exposed to oxygen is also small and unlikely to be a significant source of metal loads; and,

- The site is located near the crest of a hill, which limits the catchment area available for surface runoff. There do not appear to be any streams in the immediate area to receive drainage directly from the mine workings.

6.3 Aesthetic Concerns

Since the areal extent of the disturbance is small and the site is not a tourist attraction no aesthetic concerns are apparent.

7.0 RECOMMENDATIONS

No reclamation activities are recommended for the Cobalt mine site at this time.

The open adit, as it was photographed in 1993, appears to be narrow and in solid rock. Due to the short length of the underground workings and the remote location of the site no mitigation measures are recommended at this time. However, if access to the area is improved in the future consideration should be given to sealing the adit to prevent entry.

Based on the information available, the chemical stability risk associated with the site is considered low and further investigations are not considered necessary.

8.0 REFERENCES

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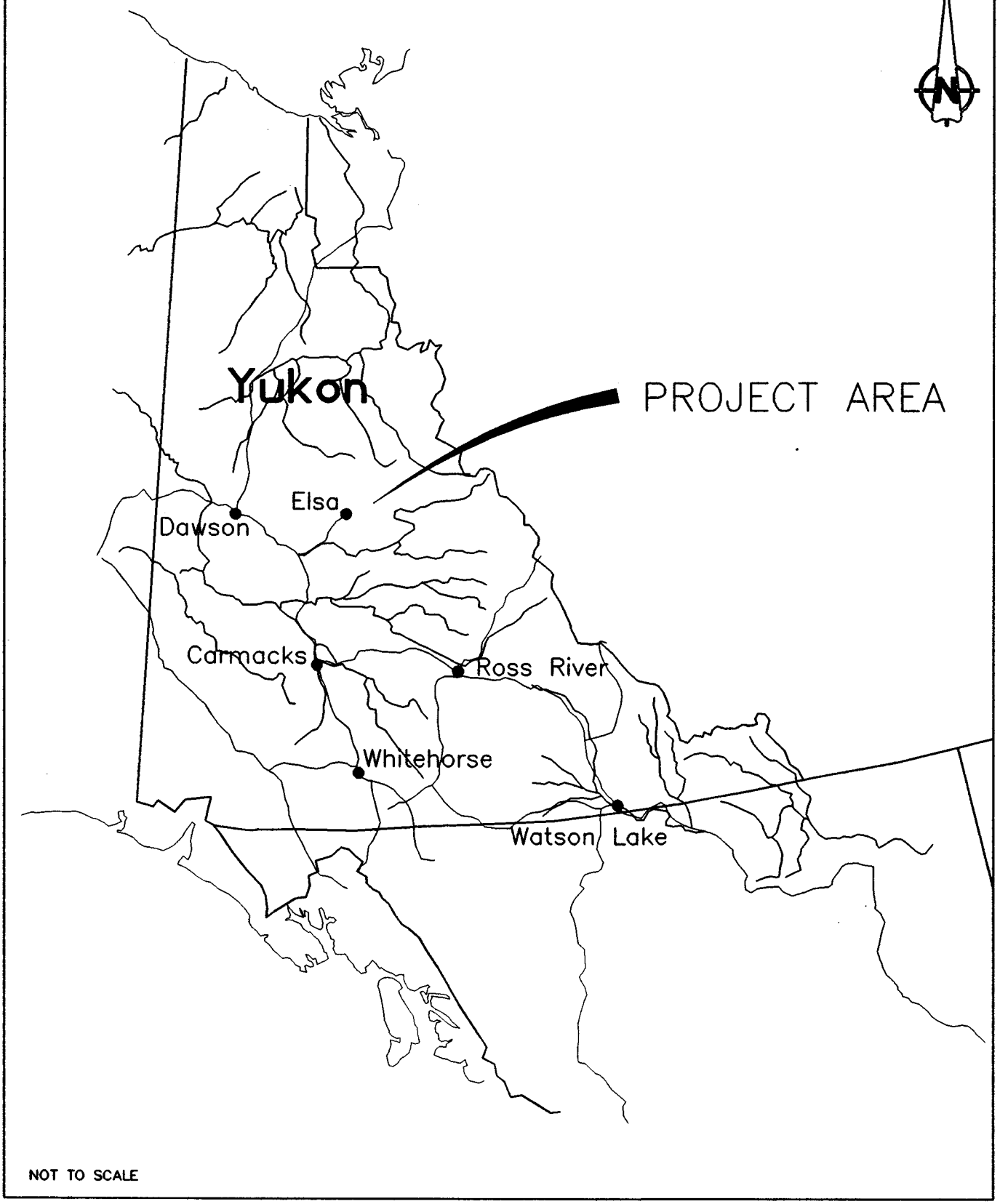
FIGURES



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Phase II Environmental Assessment

Vicinity Map

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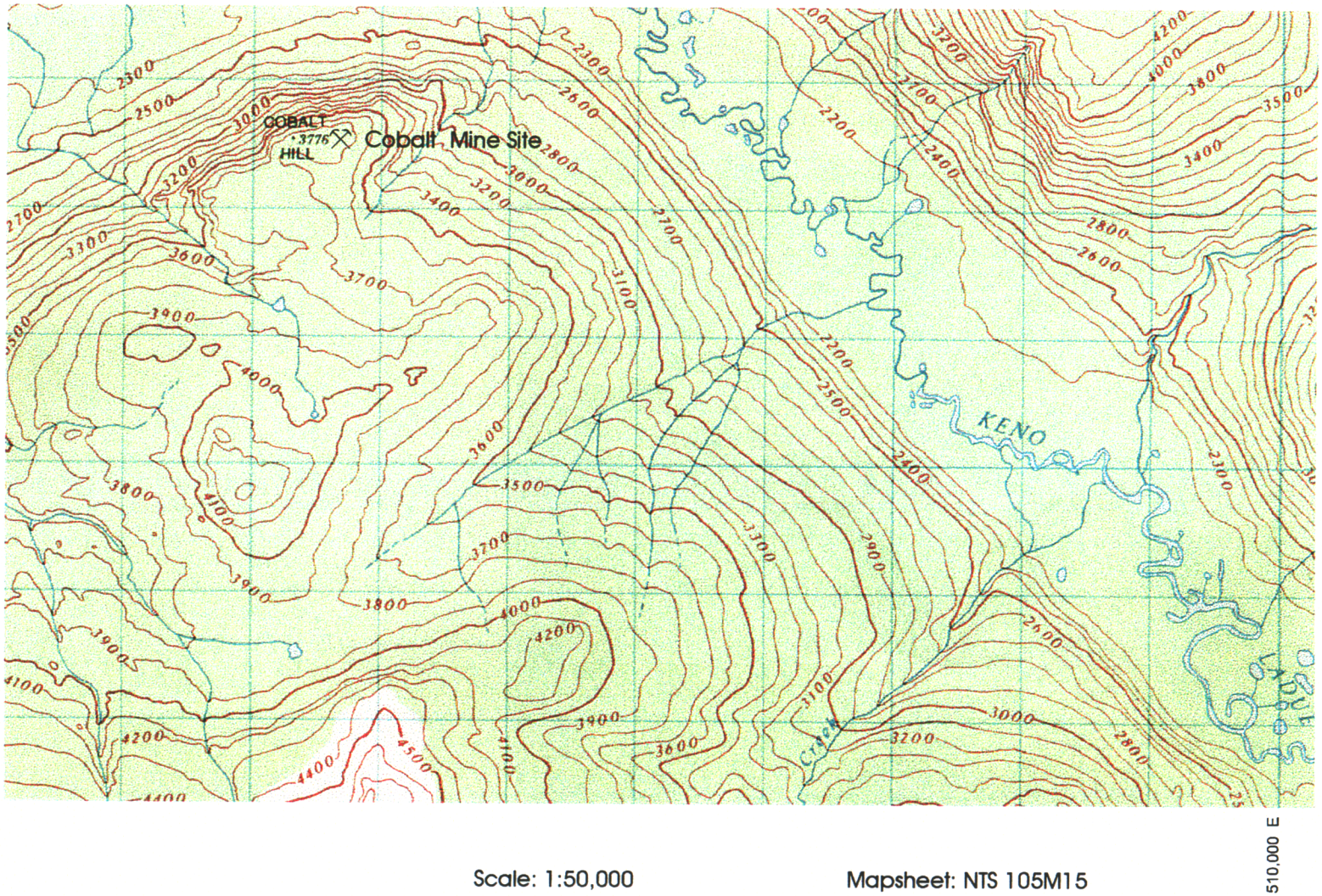

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Mapsheet: NTS 105M15

STEFFEN ROBERTSON AND KIRSTEN Consulting Engineers	Phase II Environmental Assessment
Public Works and Government Services Canada	Cobalt Mine Site Location Map

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APPENDIX A

Photos

Photo 1: Cobalt abandoned exploration site, in an old burn area. Looking south. (Photo reproduced, with permission, from DIAND, 1994)

Photo 2: Trench at Cobalt. Adit is in the centre of the photo, at the upper left side of the trench. Looking west. (Photo reproduced, with permission, from DIAND, 1994).

Photo 3: Adit and waste rock or 'upper dump', above trenching that shows iron staining. Looking southwest. (Photo reproduced, with permission, from DIAND, 1994)

Photo 4: Adit and oxidized waste rock pile. Looking south. (Photo reproduced, with permission, from DIAND, 1994)