

Yukon Abandoned Mine Assessment
OLIVER (BOULDER CREEK) MINE SITE

Prepared for:

Waste Management Program
Indian and Northern Affairs Canada

Environmental Services
Public Works and Government Services Canada

November 1998

Executive Summary

The Oliver exploration site (previously identified as "Boulder Creek" in DIAND files) is located at 63°45'38"N, 136°30'38"W, approximately 40 km northeast of Stewart Crossing. Environmental Services, Public Works and Government Services Canada was retained to conduct an assessment of the Oliver abandoned mine site to identify specific environmental and human safety risks and aesthetic concerns. Oliver was inspected by PWGSC on July 28, 1998. Assessment components included mine workings and non-hazardous materials on the site.

No mining-related workings were visible other than two former diamond drill pads. Neither of these features poses any safety risk. Overall mining-related disturbance is very limited.

Mineral and waste rock at the Oliver site contain abundant carbonates, and therefore the potential for ARD is negligible. No hazardous materials or stained soil were observed at this site. Aesthetic concerns associated with a wooden tent frame platform and metal wastes are very minor. No further assessment or remedial work is required for this site.

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Yukon Abandoned Mine Assessment

OLIVER (BOULDER CREEK) MINE SITE

1. BACKGROUND

In 1993, assessments of 98 abandoned Yukon mine exploration and development sites were completed under the Arctic Environmental Strategy - Action on Waste program by DIAND Technical Services. These initial assessments provided a general overview of historical activities, described site infrastructure, workings and wastes, summarized existing environmental or safety concerns on each site, and provided general recommendations for remediation or mitigation work. No rock, soil or water samples were collected during the 1993 DIAND assessments.

In 1996, PWGSC Environmental Services completed assessments of 49 abandoned mine sites, with follow-up assessments in 1997 and early 1998 at six of those sites. DIAND Waste Management has determined that the remaining 49 sites should be assessed; candidate sites for this second round of assessments were identified in accordance with a process shown in Figure 1.

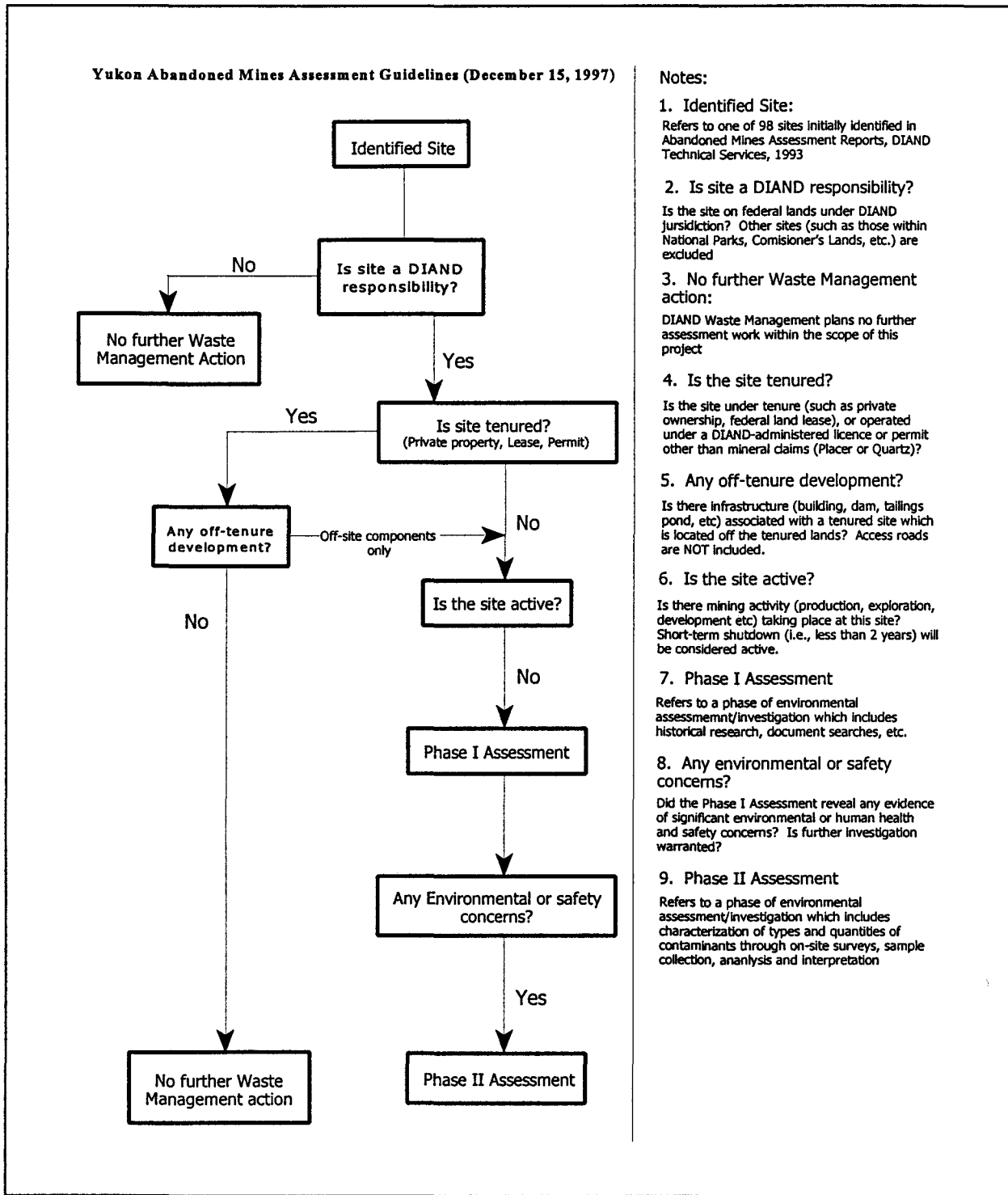
1.1 Location and Site Access

The Oliver exploration site (previously identified as "Boulder Creek" in DIAND files) is located at 63°45'38"N, 136°30'38"W, approximately 40 km northeast of Stewart Crossing. Site access is by helicopter from Carmacks or Mayo.

1.2 Overview of Site Development

Staked as EPD claim (YA30569) in June 1978 by CCH Resources (Campbell Chibougamau Mining Ltd) and Inco, which performed mapping and sampling later in the year. In 1979, Billiton Exploration Canada joined CCH and Inco and formed the Cortin Project, which added Lamb and Flag claims. The joint venture carried out soil sampling and hand trenching in 1979 and 1980, drilled 4 holes (322 m) in 1979 and 8 holes (1524 m) in 1981, and performed geochemical and geophysical surveys in 1981. CCH changed its name to Campbell Resources Inc in 1980.

In April 1992 G.S. Davidson and B. Harris restaked the occurrence with NHL claim 1-56 (YB28373). Davidson registered the NHL claim 21-24 (YB28393) separately in his own name. In the summer of 1994 Davidson carried out a small reconnaissance exploration program on his claims. Davidson restaked the NHL claim 1-12 & 25-28 (YB43907) in February 1995 (Yukon Geology Program Minfile 106C 019).



Notes:

1. **Identified Site:**
Refers to one of 98 sites initially identified in Abandoned Mines Assessment Reports, DIAND Technical Services, 1993
2. **Is site a DIAND responsibility?**
Is the site on federal lands under DIAND jurisdiction? Other sites (such as those within National Parks, Comisioner's Lands, etc.) are excluded
3. **No further Waste Management action:**
DIAND Waste Management plans no further assessment work within the scope of this project
4. **Is the site tenured?**
Is the site under tenure (such as private ownership, federal land lease), or operated under a DIAND-administered licence or permit other than mineral claims (Placer or Quartz)?
5. **Any off-tenure development?**
Is there infrastructure (building, dam, tailings pond, etc) associated with a tenured site which is located off the tenured lands? Access roads are NOT included.
6. **Is the site active?**
Is there mining activity (production, exploration, development etc) taking place at this site? Short-term shutdown (i.e., less than 2 years) will be considered active.
7. **Phase I Assessment**
Refers to a phase of environmental assessmemnt/investigation which includes historical research, document searches, etc.
8. **Any environmental or safety concerns?**
Did the Phase I Assessment reveal any evidence of significant environmental or human health and safety concerns? Is further investigation warranted?
9. **Phase II Assessment**
Refers to a phase of environmental assessment/investigation which includes characterization of types and quantities of contaminants through on-site surveys, sample collection, analysis and interpretation

Figure 1. DIAND Abandoned Mine Assessment Flowchart

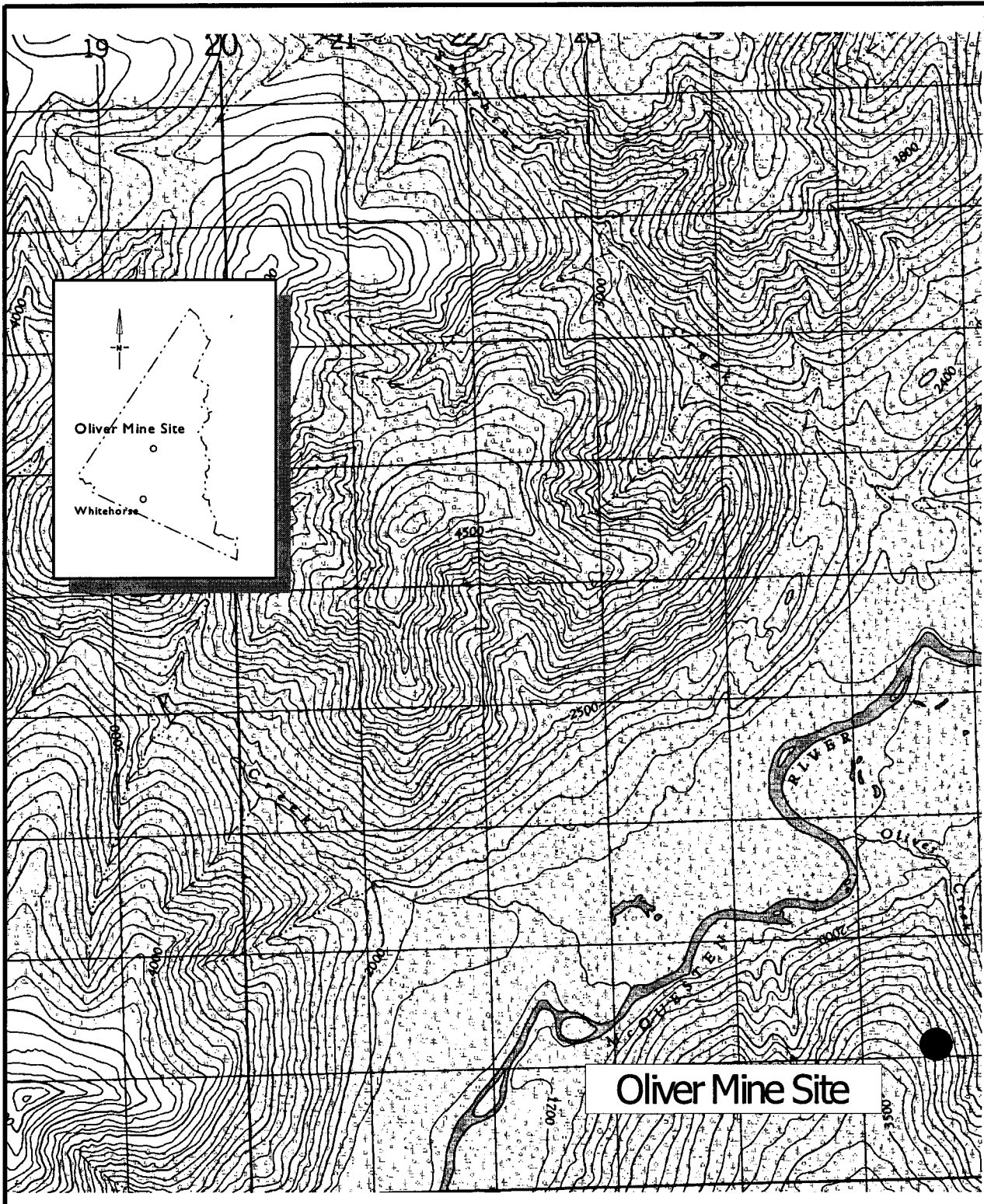


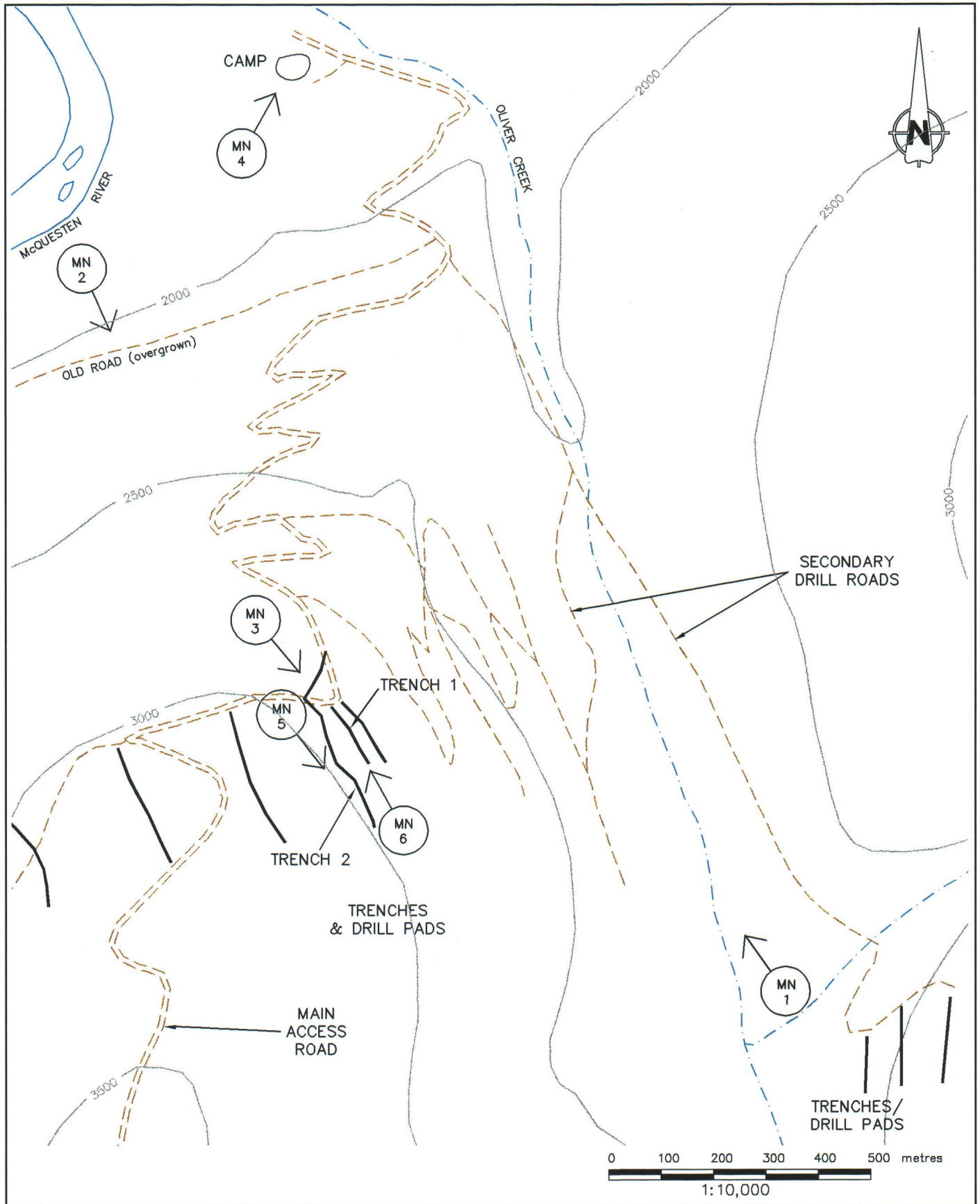
Figure 2. **Oliver Mine Site**

Map Sheet: 115 P15

Map Scale: 1:50,000

DIAND Site No. 115P-15-1

Site Location: 63°45' 38", 136° 30' 38"



FILE REF: OLIVER.DWG



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PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

ARD ASSESSMENT, YUKON

OLIVER
SITE DEVELOPMENT AND PHOTOS

PROJECT NO.
1CP001.04

DATE
NOV. 1998

APPROVED

FIGURE

3

1.3 Previously-Identified Site Issues

DIAND's file for the Oliver (Boulder Creek) site did not contain any information related to existing or potential environmental and human safety risks or aesthetic issues.

2. PURPOSE AND SCOPE OF WORK

Since environmental and human health/safety-related site information was essentially non-existent, PWGSC Environmental Services visited the Oliver site on July 28, 1998 to identify any existing or potential mine-related environmental and health/safety issues. Assessment activities included:

- Visual inspection of mine workings;
- Photo documentation and mapping of relevant site features;
- Identification and inventory of non-hazardous materials on the site;
- Assessment of safety hazards and the probability of human access to hazardous areas ;
and
- Assessment of acid rock drainage potential in waste rock and mine development areas.

3. MINERALIZATION

The Oliver claims consist of several east-trending tin/silver anomalies hosted in breccias and scarns near the contact of Cretaceous granitic intrusives and metasediments of the Hyland Group (Late Proterozoic or Early Cambrian).

The claims are underlain by micaceous quartzite, phyllite and argillaceous quartzite, along the south-dipping southern limb of the McQuesten anticline. A white medium-grained muscovite granite intrudes the metasediments. East dipping shear zones with related breccia and north-south trending faults disrupt the succession.

The mineralization is associated with retrograde chlorite-actinolite-pyrrhotite-pyrite-cassiterite scarn and chlorite-cassiterite breccias. Cassiterite and native silver, along with minor pyrrhotite, pyrite, chalcopyrite and sphalerite occur in the matrix of the breccias and associated veins.

4. SITE DESCRIPTION AND FINDINGS

4.1 Buildings, Infrastructure, and Equipment

No buildings, infrastructure, or equipment were observed at the Oliver site.

4.2 Non-Hazardous Waste Materials

No non-hazardous wastes were found at Oliver.

4.3 Hazardous Materials

No stained soils or other solid hazardous materials were observed during the site visit. No petroleum hydrocarbons or other liquid hazardous wastes were present.

4.4 Surface Water Quality

No ponded water, surface runoff, or seepage were observed; therefore no surface water samples were collected.

4.5 Waste Rock Disposal Areas

No waste rock disposal areas were present at Oliver.

4.6 Mine Excavations

Three bulldozed trenches were the only mining-related excavations at Oliver. The largest trench is approximately 25 m long, 5 m deep and varies between 3 and 5 m in width; the other trenches are about 2.5 to 3 m deep and 20-25 m long. None of the trenches pose any risk to human health and safety.

Two samples were collected from a test pit located in sidecast material from the largest trench. Field paste pH measurements were neutral to slightly acidic, while paste conductivities were low. Acid base Accounting and bulk assay results showed the samples to be relatively non-reactive with low sulphide and neutralization potential, with elevated arsenic, copper, manganese, lead, tin and zinc. A short-term leachate extraction test performed on one sample produced leachate with copper and zinc above CCME criteria for protection of aquatic life.

Sidecast material contains oxidation products, including soluble arsenic, copper, iron, manganese, and zinc. However, given the small volume of material present, the concentrations and total metal load that could be flushed from these materials is very small (see the *Determination of Acid Rock Drainage Potential* report for the Oliver site attached as Appendix A).

5. CONCLUSIONS AND RECOMMENDATIONS

PWGSC's inspection revealed no substantial health and safety hazards. No environmental and only very minor aesthetic concerns exist at Oliver.

No further assessment or cleanup work is required.

REFERENCES

Bow River Resources Ltd. and Highhawk Mines Ltd., February, 1975. Assessment Report No. 061490. prepared by J.W. MacLeod.

Indian and Northern Affairs Canada. "Mine Reclamation in Northwest Territories and Yukon". Prepared by Steffen, Robertson and Kirsten (B.C.) Inc. for DIAND Northern Affairs Program, April 1992.

Indian and Northern Affairs Canada. Exploration and Geological Services Division, 1996. Yukon Minfile No. 115P 030.

Appendix A
Determination Of Acid Rock Drainage Potential

1CP001.04

**OLIVER (BOULDER CREEK)
ACID ROCK DRAINAGE
ASSESSMENT REPORT**

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**OLIVER (BOULDER CREEK)
ACID ROCK DRAINAGE
ASSESSMENT REPORT**

1. INTRODUCTION

This appendix reviews the existing and potential acid rock drainage (ARD) conditions at the Oliver (Boulder Creek) site. The report: "*Yukon Abandoned Mine Site Assessment, Evaluation Of Acid Rock Drainage, 1998 Review Report*", prepared by SRK, includes similar assessments for a number of sites, and details regarding the site assessment methodology, ARD remediation options and option evaluation. The accompanying Public Works and Government Services Canada (PWGSC) report "*Phase I Environmental Assessment of the Oliver (Boulder Creek) Abandoned Mine Site*", presents the complete environmental assessment of the Oliver site.

The Oliver site is located in the McQuesten District, Yukon Territory, approximately 40 kilometres north-northeast from Stewart Crossing (Figures 1 and 2). A rough gravel road provided access to the site in the past, but the condition of the road is poor, and current access to the site is by helicopter.

Mining related disturbances include the access road, drill pads, a small camp and core storage area (DIAND, 1996), and three large trenches (Yukon Exploration and Geology, 1979-1980) (Figure 3).

The group of claims was first staked as the EPD claims in 1978. From 1979 to 1981, mapping, soil sampling, drilling and geophysical surveys were completed. Additional mapping was carried out in 1992 and 1994 (DIAND, 1996).

2. GEOLOGY AND MINERALIZATION

The Oliver claims consist of several east-trending tin/silver anomalies hosted in breccias and scarns near the contact of Cretaceous granitic intrusives and metasediments of the Hyland Group (Late Proterozoic or Early Cambrian).

The claims are underlain by micaceous quartzite, phyllite and argillaceous quartzite, along the south-dipping southern limb of the McQuesten anticline. A white medium-grained muscovite granite intrudes the metasediments. East dipping shear zones with related breccia and north-south trending faults disrupt the succession.

The mineralization is associated with retrograde chlorite-actinolite-pyrrhotite-pyrite-cassiterite scarn and chlorite-cassiterite breccias. Cassiterite and native silver, along with minor pyrrhotite, pyrite, chalcopyrite and sphalerite occur in the matrix of the breccias and associated veins.

3. WASTE DISPOSAL AREAS

3.1 Description

The only significant “mining” waste evident at this site was the side cast material from the surface trenching and road building, as shown in Figure 3, and Photos MN1, MN3, MN5 and MN6. The largest of the three trenches (Trench 1) is five metres deep, three to five metres wide and 20 to 30 metres long, leaving a pile of side cast that contains up to 600 m³ of material (Photo MN6). The other trenches are shallower, and contain up to 300 m³ of side cast. The majority of this material is loose colluvial soils or weathered bedrock.

The road building activities have also disturbed the surface soils.

Some vegetation has been re-established on the roads, however vegetation is sparse on the trenched areas.

3.2 Samples

A single test pit was dug in the side cast of Trench 1, and two samples were collected for analysis (Photo MN6). The sample location is shown on the detailed plan of Trench 1. The test pit log is provided in Table 1. Sample OL/WR/Px1/01 was collected from the iron stained horizon at a depth of 0 to 30 cm. Sample OL/WR/Px1/02 was collected from the moderately stained horizon at depths of 30 to 60 cm. Both samples consisted of dark grey schist with quartz and tourmaline.

No surface water was found at the site.

3.3 Analytical Results

Results of the geochemical analyses are provided in Tables 2 and 3.

3.3.1 Paste Parameters

The field paste pH values were 6.67 for the iron stained horizon, and 5.85 for the underlying materials. Field paste conductivities were both 20 $\mu\text{S}/\text{cm}$. These results indicate that there is little or no carbonate neutralization potential in these rocks. They also indicate there is not a significant amount of stored oxidation products.

3.3.2 Acid Base Accounting and Bulk Chemistry

The acid base accounting results in Table 2 indicate the samples are relatively non-reactive, with a low sulphide and low neutralization potential. Both samples contain a moderate amount of sulphate, indicating sulphides were once present in these materials, but that they have oxidized to form soluble sulphate species.

The samples both contained elevated arsenic, copper, manganese, lead, tin, and zinc concentrations.

3.3.3 Short-term Leach Extraction Results

The results of the short-term leach extraction test on Sample OL/WR/Px1/01 are provided in Table 3. The results indicate that this sample contains a moderate amount of soluble arsenic (0.0046 mg/L), copper (0.02 mg/L), iron (0.05 mg/L), manganese (0.04 mg/L), and zinc (0.498 mg/L). Compared to toxicity based guidelines for freshwater aquatic life, the copper and zinc concentrations are elevated (see Table 3), however the total volume of waste material is so small, that periodic flushing of these

materials is not expected to have a significant impact on the downstream water quality.

4. EXISTING AND POTENTIAL ACID ROCK DRAINAGE CONDITIONS

The side cast material from the trenching operations represents a maximum of 1200 m³ of material, most of which is shallow colluvial soils and weathered bedrock. This material does contain stored oxidation products, including soluble arsenic, copper, iron, manganese, and zinc. However, given the small volume of material present, the concentrations and total metal load that could be flushed from these materials is very small.

It is concluded that the impact on the receiving environment is minimal. Remediation requirements are therefore limited to providing public safety and improving the aesthetic appearance of the site.

5. REMEDIATION OPTIONS

From an aesthetics and public safety perspective, it would be beneficial to fill-in the deeper trenches. This would prevent further slumping and would restore the ground to a more stable and passable configuration. It would also allow natural vegetation to be reestablished, and may prevent some flushing of the side cast materials. Such an effort would require a small bulldozer. Given the current state of the access road, this option does not appear to be feasible. If pursued, the amount of ground disturbance associated with bringing in such equipment would need to be weighed against the benefits of filling in the trenches.

The second option would be to "do nothing". The trenches are sufficiently sloped as to allow wildlife to escape from them. Over time, it is expected that the native vegetation would reestablish in these areas.

Given the cost, the potential difficulties in bringing in the appropriate equipment, and the small amount of risk associated with the mining related disturbances, the do-nothing option is recommended.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The Oliver site should be regarded as a moderately advanced exploration site, with minimal surface disturbances, and a negligible potential for ARD. The above evaluation indicates that “do nothing” is the preferred option for the Oliver site.

6.2 Recommendations

No further laboratory test work or monitoring is recommended for this site.

7. REFERENCES

DIAND, Exploration and Geological Services Division, 1996. Yukon Minfile No. 115P 030.

Edmond, D.S. 1986. Tin and Tungsten Veins and Skarns in the McQuesten River Area, Central Yukon. In Yukon Geology, Vol. 1; Exploration and Geological Services Division, Yukon, DIAND. p. 113-118.

Edmond, D.S., 1990. Geology, mineralogy and Geochemistry of Tin and Tungsten veins, breccias and skarns, McQuesten River region (115 P (north) and 105 M 13), Yukon. In: Yukon Geology, Vol. 3; Exploration and Geological Services Division, Yukon, DIAND. p. 133-159.

Yukon Exploration and Geology, 1979-1980. EPD Claims 1-84. p. 278.

Yukon Exploration and Geology, 1982. EPD claim, p. 217.

TABLE 1
Oliver, Descriptions of Side-Cast Samples

Sample Id	Sample Description
OL/WR/Px1/01	Fine-grained, strongly iron-stained rock from 0 to 30 cm depth. Freshly broken clasts are dark grey siltstone, phyllite and schist. Sulphides not visible, and no reaction is evident in a fizz test.
OL/WR/Px1/02	Sample collected from 30 cm to 60 cm depth, below OL/WR/Px1/01. As above, but less strongly stained and oxidized.

TABLE 2
Oliver, ABA and Bulk Chemistry Results

Parameter	Units	Sample Number OLWR		
		Px1/01	Px1/02	Px1/01 (duplicate)
Paste pH	su	6.67	5.85	na
Paste Conductivity	µS/cm	20	20	na
Paste pH	su	5.7	6.5	6.5
S(T)	%	0.19	0.08	na
S(SO ₄)	%	0.17	0.06	na
AP	kg CaCO ₃ eq/t	0.6	0.6	0.6
NP	kg CaCO ₃ eq/t	-1.1	2.8	3.3
Net NP	kg CaCO ₃ eq/t	-1.8	2.1	2.6
NP/AP	-	<0.1	4.4	5.2
Ag	ppm	9.2	4.8	na
Al	%	3.35	2.64	na
As	ppm	965	355	na
Ba	ppm	160	180	na
Be	ppm	2.5	2	na
Bi	ppm	35	15	na
Ca	%	0.56	0.58	na
Cd	ppm	<1	12	na
Co	ppm	5	10	na
Cr	ppm	57	78	na
Cu	ppm	481	296	na
Fe	%	14.12	9.96	na
K	%	0.22	0.25	na
Mg	%	0.66	1.06	na
Mn	ppm	1590	2240	na
Mo	ppm	<2	<2	na
Na	%	0.05	0.05	na
Ni	ppm	17	28	na
P	ppm	680	590	na
Pb	ppm	430	288	na
Sb	ppm	5	5	na
Sc	ppm	5	4	na
Sn	ppm	270	200	na
Sr	ppm	24	21	na
Ti	%	0.03	0.03	na
V	ppm	50	45	na
W	ppm	10	10	na
Y	ppm	8	9	na
Zn	ppm	3725	3071	na
Zr	ppm	16	11	na

TABLE 3
Oliver, Short Term Leach Extraction Results

Parameter	Units	Sample Number OL/WR Px1/01	CCREM Guidelines Fresh Water Aquatic Life
pH (96 hr)	su	5.5	6.5-9.0
Cond. (96 hr)	uS/cm	28	
Acy (pH 4.5)	(mg/L CaCO ₃)	0.0	
Acy (pH 8.3)	(mg/L CaCO ₃)	2.5	
Alk	(mg/L CaCO ₃)	2.3	
SO ₄	(mg/L)	11	
Al	mg/L	<0.2	0.005-0.1*
Sb	mg/L	<0.2	
As	mg/L	0.0046	0.05
Ba	mg/L	<0.01	
Be	mg/L	<0.005	
Bi	mg/L	<0.1	
B	mg/L	<0.1	
Cd	mg/L	<0.01	0.0002-0.0018*
Ca	mg/L	3.15	
Cr	mg/L	<0.01	0.002
Co	mg/L	<0.01	
Cu	mg/L	0.02	0.002-0.004*
Fe	mg/L	0.05	0.3
Pb	mg/L	<0.05	0.001-0.007*
Li	mg/L	<0.01	
Mg	mg/L	0.6	
Mn	mg/L	0.04	
Mo	mg/L	<0.03	
Ni	mg/L	<0.05	0.025-0.150
P	mg/L	<0.3	
K	mg/L	<2	
Se	mg/L	<0.2	0.0001
Si	mg/L	7.55	
Ag	mg/L	<0.01	0.0001
Na	mg/L	<2	
Sr	mg/L	0.028	
Tl	mg/L	<0.2	
Sn	mg/L	<0.03	
Ti	mg/L	<0.01	
V	mg/L	<0.03	
Zn	mg/L	0.498	0.03

Notes: 1. Values in bold are greater than freshwater aquatic life criteria.
 2. The detection limit of some parameters exceeds the criteria.
 * dependent on hardness and pH of receiving waters (generally more sensitive at lower pH or hardness)

Appendix B
Site Photographs



MN 1. Aerial view of site looking northwest (McQueston River visible at top right of photo).



MN 2. Aerial view of Oliver site from the north.



MN 3. Aerial view of trench area ("Trench 1" is the largest trench at centre of photo).



MN 4. Aerial view of camp area.



MN 5. "Trench 2" (uphill from "Trench 1").



MN 6. "Trench 1" showing stained rock and overburden sidecast, and sample location OL/WR/Px1 .

Appendix C
Assessment Methodology

OLIVER (BOULDER CREEK) MINE SITE ASSESSMENT METHODOLOGY

1. Assessment Area Constraints

The abandoned mine site assessments carried out for DIAND Waste Management have been restricted to a) the area specifically developed or occupied for mine exploration or mining purposes (i.e., excavation areas, waste rock dumps, mine camp) and b) any off-site environmental resources potentially affected by the mine-specific exploration or development activities. The assessments include all infrastructure associated with the specific site exploration or development, regardless of whether the infrastructure is located on or off the mine claim area. However, access roads have not been included in these assessments.

2. Assessment Criteria

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
- waste rock and tailings disposal
- acid generation and leaching, and
- estimating cleanup costs.

3. Methods

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 Oliver (Boulder Creek) 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.

3.2 Site Assessment Components

Waste rock disposal areas were assessed by a professional geologist for Acid Rock Drainage (ARD) and metal leachability potential. The ARD and leachability assessment included:

- review of existing site geological data to identify probable areas and sources of ARD and leachable metals; and
- mapping and logging of waste rock disposal areas and rock faces as appropriate for

the site.

Mine-related disturbances (diamond drill pads) were visually inspected and documented to identify any safety concerns.

Non-hazardous site debris was inventoried. Scale site plans were prepared to identify the dimensions and locations of site features, wastes, and any other pertinent information.