KRYOTEK

# Yukon Mining Incentives Program

# Whitehorse Copper Tailings Gold Report

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Target Evaluation

For
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January 31, 2014

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## Table of Contents

# Introduction

## Overview

Kryotek Arctic Innovation Inc. (Kryotek) conducted a drilling and geophysics program at the Whitehorse Copper Tailings for the purposes of defining the presence and quantity of gold in the tailings. Kryotek utilized a SDC-150 Sonic Drill, a Lippmann 4-point Resistivity System and conducted hand sampling, sluicing and panning of samples to obtain gold values.

A large program of sonic drilling and geophysics was proposed for 2013 covering most of the accessible tailings pond area. A late spring delayed access to the site in May when most work was planned. The drill and geophysics equipment was only available on site during late July. Eleven boreholes, ten surface bulk samples and three lines of DC resistivity were conducted. Due to contact resistance problems, only one of the resistivity lines produced viable results.

Tailings thicknesses ranged from 4.5-8.0 m. Visible gold was found in the majority of surface and borehole samples, ranging from microscopic dust to nuggets weighing several milligrams. An average grade of 0.12 g/t was assessed for the 300,000 cubic meter area sampled. This is economic for mining when conducted in conjunction with magnetite extraction.

Resistivity geophysics were effectively used to determine the depth of tailings and location of underlying barren glacial till.

## Rationale

Copper was the primary commodity extracted from the Whitehorse Copper Mine. However, after 1969 it was realized that a significant amount of gold was also present in the ore. In 1970 a gold recovery circuit was installed and almost seven tones of gold was extracted before the mine was closed in 1983. A small amount of the gold mined during 1967-1970 was recovered from the pumps and machinery in the mine. The remainder was flushed out into the tailings ponds. This gold was crushed in the processing plant to a uniform grain size.

Several studies have attempted to locate this gold. Brian Scott drilled a number of small-diameter boreholes in the tailings ponds and had the samples fire-assayed. An average grade of 0.12 g/t gold was recovered (Scott, 2007).

The proponent (Jim Coates), worked on the tailings ponds while employed by the Yukon Geological Survey as a summer student in 2004. Using a gold wheel, he recovered a small amount of gold from surface samples near the old mill site. Access Consulting has

been working with Chuck Eaton of Eagle Industrial Minerals to define the magnetite resource present in the tailings.

Approximately 17,000 oz of gold was recovered per year by the mine. In the two to three years before the gold recovery circuit was installed, a potential 34,000 oz of gold may have been flushed into the tailings ponds. This gold is likely near the bottom of the tailings near the location of the discharge spout at the time. This is similar to a placer deposit, except that the high concentration of magnetite will affect the specific gravity of the tailings slurry, transporting the gold further than would be expected in an alluvial environment. Nonetheless, the majority of the gold should be concentrated close to the slurry discharge pipe.

Due to the low concentration of gold, mining this resource would not be feasible on its own. However, the opportunity to couple a gold recovery circuit onto the Eagle Industrial Minerals existing magnetite recovery system may allow for efficient gold recovery.

**History**

The Whitehorse Copper Mine was owned and operated by Hudson Bay Mining and Smelting from 1967 to 1982. Production numbers state that 267,490,930 pounds of copper, 224,565 ounces of gold, and 2,837,631 ounces of silver were recovered from 11,017,738 tonnes of ore milled (Scott 2007). The tailings ponds have been dormant during the intervening time.

**Location and Access**

The Whitehorse Copper Mine mill site and tailings impoundment are located within the municipal boundaries of the City of Whitehorse, approximately 8 km from the downtown core. It is readily accessible by a 2 km paved road from the Alaska Highway. A power-line runs through the southern end of the FYDB claim block and water is available from the now flooded Little Chief Open Pit (Scott 2007).

## 2013 Investigation Methodology

### Sonic Drilling

A Sonic Drill Corporation SDC150 track-mounted sonic drill was used to collect subsurface samples. This drill uses high-frequency vibrations to advance a 100 mm core tube into the soil. This tube was then withdrawn and the core extracted on the surface. 1.5 m core runs were taken and samples extracted into cloth sample bags, which were labeled with location and depth. Drilling was stopped once glacial till was reached beneath tailings.

### Geophysics

Resistivity was selected for this area as the electrical properties of tailings and cobbly-till are distinct and easily definable. A Lippmann 4-point Resistivity System was used. This system allows up to 40 m of depth penetration. Data was collected and inverted using AGI Earth Imager 2D software. Noisy data points and electrodes with poor contact resistance were removed and data was filtered for spikes or depressions in resistivity. The software produced two-dimensional tomograms using a smoothed, least squares damped and robust inversion parameters. Preliminary interpretations were conducted on the processed data.

*DC Electrical Resistivity Tomography*

This technique injects a direct electrical current into the ground surface, and then measures the voltage that remains at a number of distances from the injection point. As different soils have different resistances to electrical current, a tomogram (subsurface diagram) of resistivity can be produced.

*Induced Polarization Tomography*

This technique is conducted simultaneously with the DC electrical resistivity. As the electrical current is injected into the ground, a charge is retained in soil and rock materials and then decays as a function of time. This differs according to the electrical properties of the ground materials and can be useful in differentiating subsurface material types and boundaries.

*Earth Imager 2D Software*

Earth Imager 2D software (Advanced Geosciences Inc.) was used to invert and process the geophyscics data. This software produced two-dimensional tomograms of resistivity data. The images were processed using both smoothed and robust inversion parameters in order to clarify transitions between material types as well as resistivity properties of those materials.

**Gold Recovery and Analysis**

Samples were processed with a Keene Engineering testing sluice in the Kryotek lab. All material 25 mm and larger was screened, then the fines were run through the sluice, which was fed with a 20 L/m recalculating water supply. Time required was approximately 30 minutes per sample. 10 L samples were concentrated down to 250 mL. Magnetite was removed from the concentrate using a magnetic separator.

The remaining heavy minerals were further concentrated using an Estwing gold pan. Visible gold particles were classified as >2 mg, 1-2 mg, <1 mg and microscopic. Gold grades were then calculated based on visible gold recovered per cubic meter of material. Placer Geologist Bill LeBarge examined the gold grains recovered from surface samples to determine individual nugget weights and grades.

Initially a Falcon Concentrators iCon enhanced gravity recovery system was proposed as a testing system. However, the Keen Engineering system was selected to ensure that grades recovered were within the capability of a standard gravity separation system and did not over-represent recoverable gold. As grades are so low (0.1 g/t) with a high proposed volume of processed material (over 300 t/hour), we wanted to ensure that we did not over-estimate gold values by including microscopic gold which may not be recoverable in production mining.

**Interviews with Former Mill Operators**

Interviews with three operators of the Whitehorse Copper Mill from 1968 to 1982 revealed the following anecdotal, unverified information regarding mill operation:

1. Copper was the primary commodity. Gold recovered was treated as a by-product and little effort was put into gold recovery until the mid 1970s.

2. Gold was discovered in plumbing traps in the pipes used to transport the crushed rock slurry.

3. When gold was discovered to be self-concentrating in the plumbing, a “long-tom” sluice was installed in the mill building. This was 30 cm wide and 3.0 m long with expanded metal and angle-iron riffles. Clean-ups of gold were conducted every several weeks to several months.

4. A significant amount of gold was recovered from the sluice at each clean-up (up to several hundred ounces). More gold likely was flushed out of the system as the riffles became packed and inefficient.

5. The discharge pipe from the mill was allowed to flow into the tailings ponds. When tailings began to build up around the pipe it was moved approximately 10 m. The process was repeated until the ponds were filled.

6. Tailings pond depths varied from 5 to 30 m.

7. Pieces of flattened gold up to 1.0 cm in diameter were recovered from the sluice.

## Maps

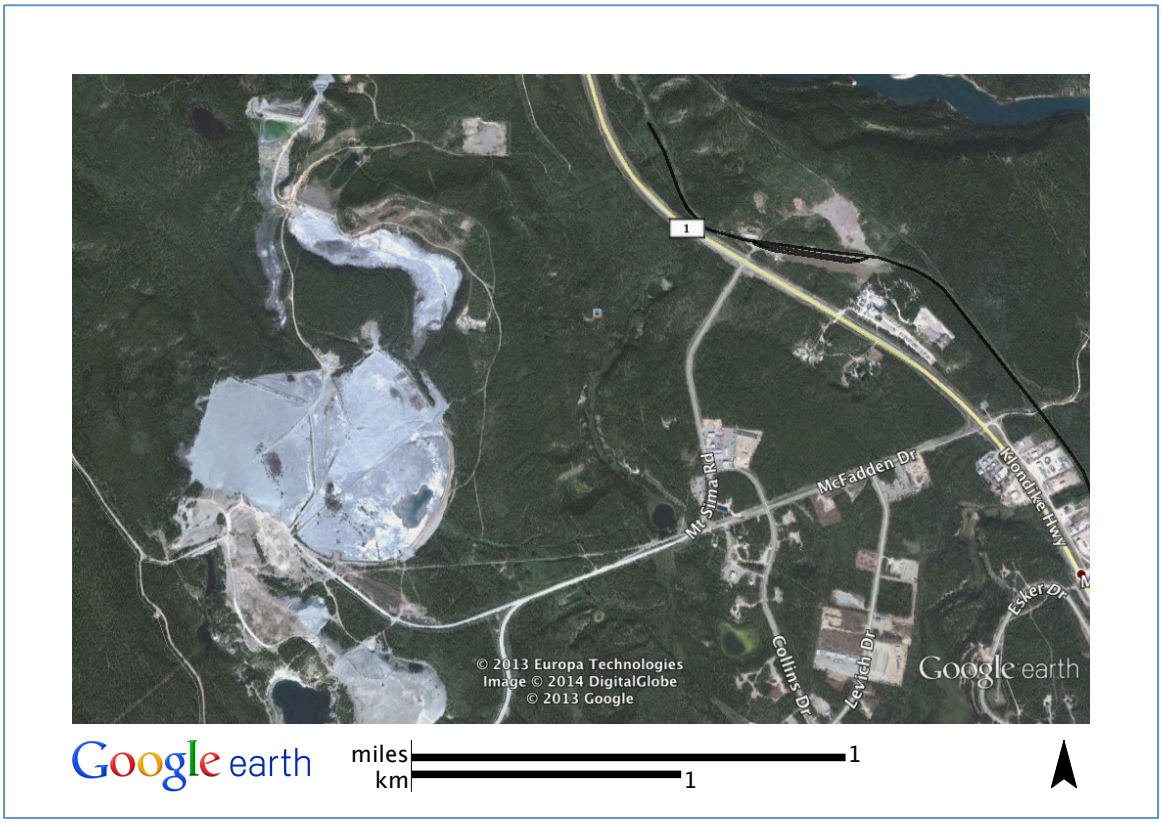


Figure 1. Whitehorse Copper Tailings Ponds, Aerial View

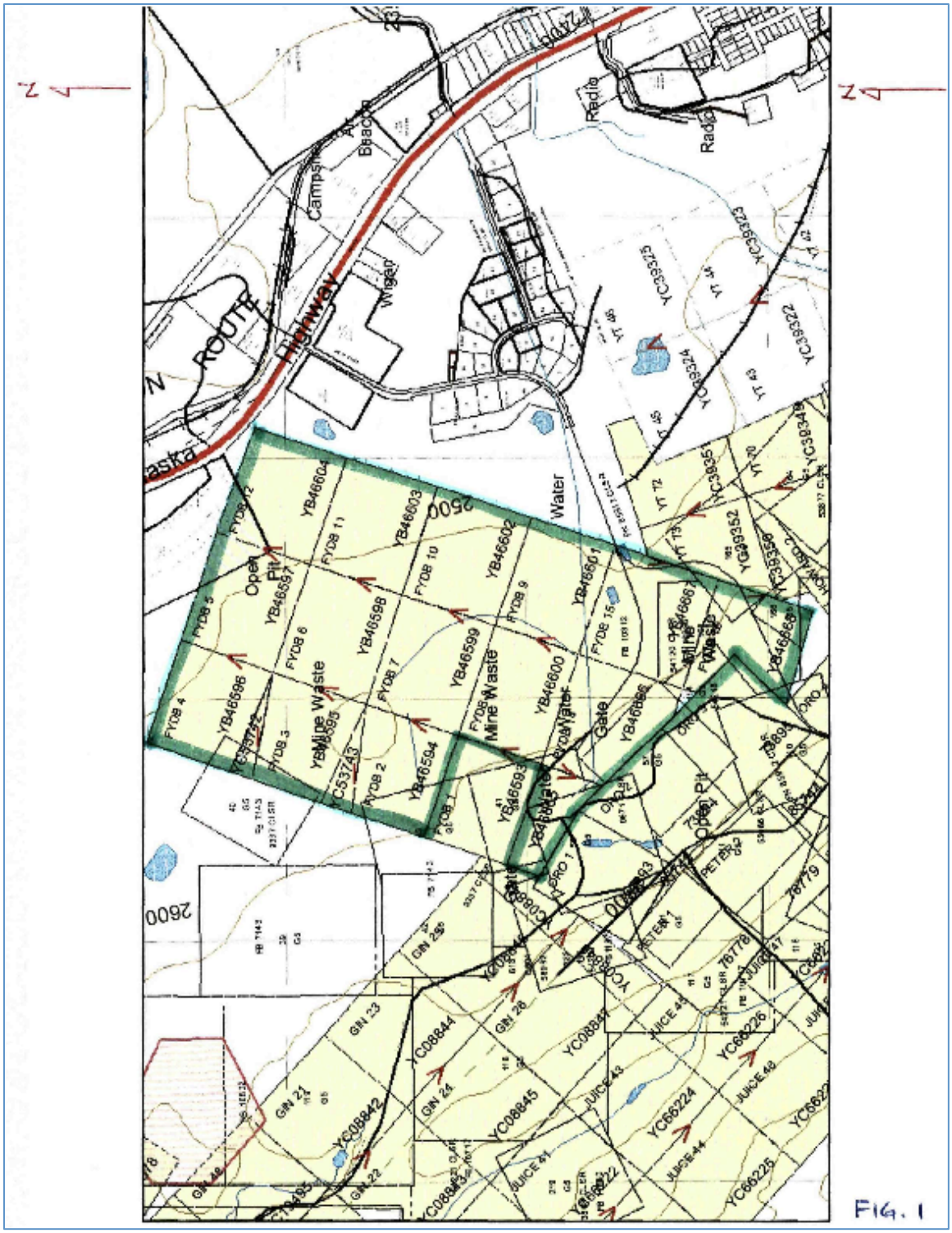

Figure 2. Whitehorse Copper Tailings Ponds Claim Map (From Scott, 2007)

## Surface Sample Results

An initial program of ten 20 L samples taken at the surface, sluiced and panned revealed gold values of 0.1 to 0.5 g/t of visible gold in every sample. These samples were dug with a shovel to a maximum depth of 30 cm and placed in 20 L plastic buckets.

| Sample # | Northing | Easting | Sample Size (L) | Gold (g/t) |
|---|---|---|---|---|
| SS1 | 6722965 | 496632 | 20 | 0.4 |
| SS2 | 6723005 | 496606 | 20 | 0.05 |
| SS3 | 6723045 | 496583 | 20 | 0.1 |
| SS4 | 6723088 | 496559 | 20 | 0.25 |
| SS5 | 6723152 | 496529 | 20 | 0.5 |
| SS6 | 6722982 | 496665 | 20 | 0.05 |
| SS7 | 6722997 | 496697 | 20 | 0.4 |
| SS8 | 6723011 | 496729 | 20 | 0.05 |
| SS9 | 6723025 | 496760 | 20 | 0.1 |
| SS10 | 6723035 | 496784 | 20 | 0.05 |

Table 1. Surface sample results and gold grades

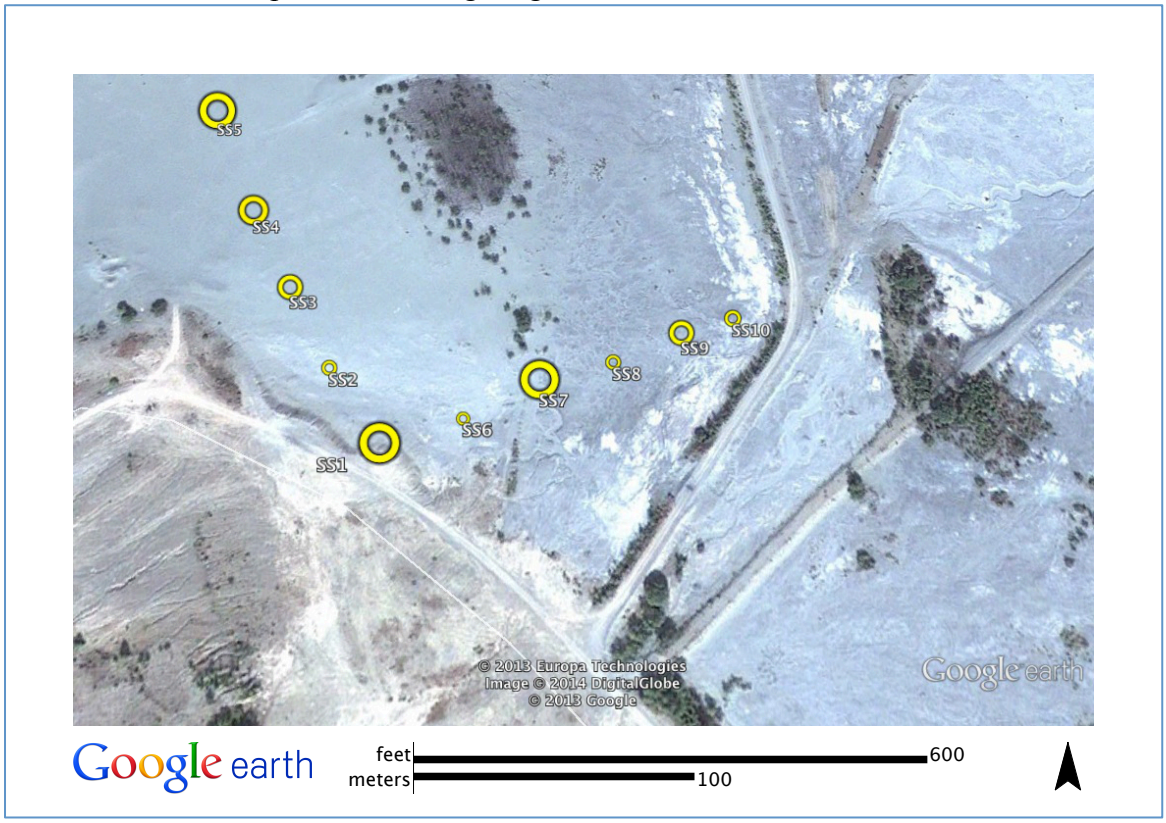


Figure 3. Surface Sample Locations. Size of icons corresponds to relative values of gold recovered.

## Borehole GPS Coordinates

| Borehole # | Easting | Northing | BH Depth |
|---|---|---|---|
| BH1 | 0496629 | 6723011 | 5.0 m |
| BH2 | 0496651 | 6723025 | 6.0 m |
| BH3 | 0496674 | 6723042 | 4.5 m |
| BH4 | 0496699 | 6723055 | 4.5 m |
| BH5 | 0496759 | 6723059 | 4.5 m |
| BH6 | 0496746 | 6723017 | 4.5 m |
| BH7 | 0496736 | 6722984 | 6.0 m |
| BH8 | 0496708 | 6722992 | 6.0 m |
| BH9 | 0496670 | 6723005 | 8.5 m |
| BH10 | 0496655 | 6723083 | 4.5 m |
| BH11 | 0496642 | 6723201 | 4.5 m |

Table 4. Sonic borehole locations depths

## Borehole Results

| Borehole # | 0.0-1.5 m | 1.5-3.0 m | 3.0-4.5 m | 4.5- 6.0 m |
|---|---|---|---|---|
| BH1 | (0.2 g/t)<br>2 small nuggets dust | (0.2 g/t)<br>2 small nuggets | 0 | Till |
| BH2 | 0 | 0 | 0 | Till |
| BH3 | (<0.05 g/t)<br>Fine dust | (0.5 g/t)<br>2 large nuggets, dust | 0 | Till |
| BH4 | 0 | 0 | 0 | Till |
| BH5 | (0.3 g/t)<br>3 small nuggets, dust | (0.1 g/t)<br>1 small nugget | (0.1 g/t)<br>1 small nugget | Till |
| BH6 | (0.6 g/t)<br>2 very large nuggets, dust | (0.1 g/t)<br>1 small nugget, dust | (0.6 g/t)<br>4 large nuggets | Till |
| BH7 | 0 | (0.1 g/t)<br>1 small and dust | dust | dust |
| BH8 | 0 | 0 | 0 | 0 |
| BH9 | Fine dust | 0 | Till | Till (to 8.5 m) |
| BH10 | (0.1 g/t)<br>1 small nugget | 0 | (0.4 g/t)<br>2 medium nuggets | Till |
| BH11 | 0.1 g/t<br>1 small nugget and dust | (0.4 g/t)<br>1 large nugget, 1 medium | Till | Till |

Table 5. Sonic Borehole Results

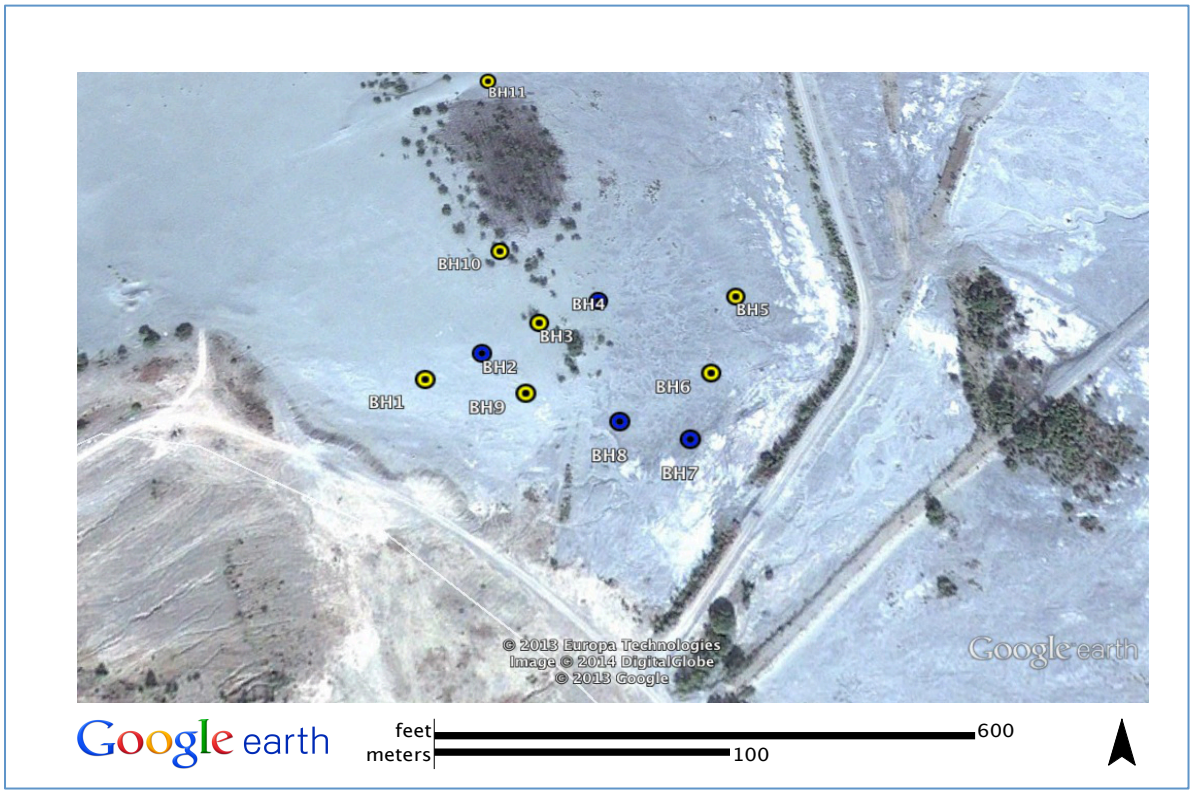


Figure 5. Sonic borehole locations. Yellow icons indicate gold incidence. Blue icons indicate gold absence.

## Geophysics Interpretations

**Whitehorse Copper Tailings Pond Site**

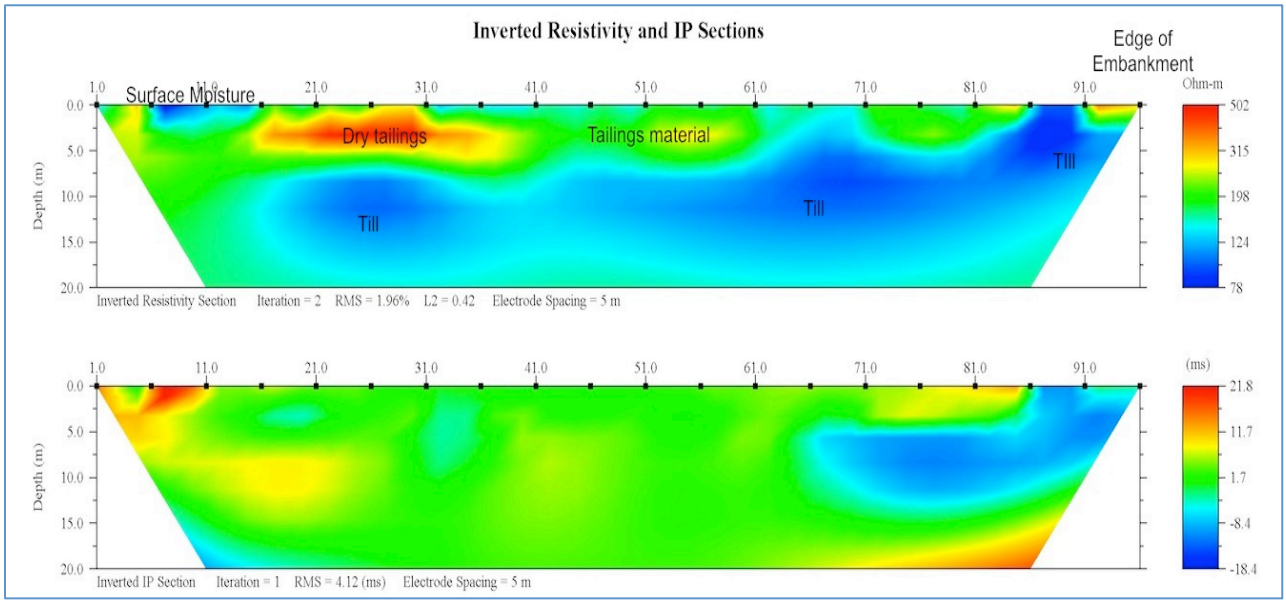


Figure 6. DC Resistivity and IP images

In Figure 6 the tailings can be seen as a higher resistivity unit (green in upper image) above the local glacial till lower resistivity unit (blue in upper image). The depth of tailings ranges from 2-10 m, averaging 5.0 m. This agrees with nearby boreholes, most of which encountered till at 4.5 m. No boreholes were located directly along the geophysics survey line.

The lower induced polarization image shows little distinction between till and tailings or different regions of tailings.

Based on these results, resistivity surveys of the tailings will be an effective technique for determining depth and extent of tailings materials.

## Geophysics GPS Coordinates

| Geophysics Line | Start Easting | Start Northing | End Easting | End Northing |
|---|---|---|---|---|
| 1 | 0496625 | 6722971 | 0496808 | 6723051 |

Table 6. GPS Coordinates for geophysics survey

## Discussion

Geophysics had good agreement with drill results. A strong electrical resistivity contrast between tailings materials and the cobbly-silt till accurately delineates the depth of tailings. Variations in resistivity within the tailings are likely the result of moisture content and not concentrations of magnetite or other conductive minerals. Induced polarization imaging also did not reveal any concentrations of chargeable materials. A much larger program of geophysics can be used to accurately map the depth of tailings and total volume of material, but is unlikely to reveal grade information.

Gold in tailings material may not behave the same as gold in an alluvial placer setting, in which it rapidly moves to the base of saturated sediments. In this case it was suspended in a dense media with high magnetite content. Water content was kept high enough for the material to flow as a fluid, but once free of the discharge pipe it rapidly formed a depositional fan. Large gold particles would have quickly dropped out of suspension, with fine particles being carried a very short distance before coming to rest. As the location and height of the discharge pipe varied considerably and continuously, local concentrations and distribution of gold are more likely the result of ore grades and mill efficiency rather than fluvial processes.

Boreholes did not indicate any increasing concentration of gold or magnetite towards the bottom of the tailings or the contact with till substrate. An even distribution appears to be found vertically throughout the material. However, certain boreholes had gold present at most or all depths, while others were completely absent of gold. This suggests that the variability in gold distribution is due to variations in feed ore grade and efficiency of the gold recovery equipment at the mill.

More drilling is required to collect a larger dataset across the tailings pond area. In these drill holes, one large sample will be collected and processed per hole to determine the areal distribution of gold. More importantly, it will identify areas of little or no gold content so that these can be removed from the resource estimates.

## Viability of Mining

Planned mining of tailings for magnetite by Eagle Industrial Minerals will consist of an excavator feeding tailings into a slurry pipeline at a rate of 300 tons per hour. A magnetic roller will then be used to remove magnetite. The barren tailings will then be processed for gold. At an average grade of 0.1 g/t, 22.5 ounces of gold per day will be recovered. At $1200/oz this grade is sufficient to justify gold extraction.

| **Grams/ton of Feed** | **0.05** | **0.1** | **0.2** | **0.3** | **0.4** | **0.5** |
|---|---|---|---|---|---|---|
| **Grams/day Recovered** | 360 | 720 | 1440 | 2160 | 2880 | 3600 |
| **Ounces/day Recovered** | 11.25 | 22.5 | 45 | 67.5 | 90 | 112.5 |

Table 7. Projected daily gold recovery based on 300 t/hour feed.

## Conclusions and Recommendations

- Average gold content of the tailings material tested is 0.12 g/t. Local concentrations of up to 0.6 g/t were encountered.
- The results agree precisely with Scott (2007) who found average fire-assay grades of 1.2 g/t in tailings within the same area.
- Some boreholes encountered no gold.
- Tailings were found to be 4.5-8 m in depth, dry and overlying silty/cobbly till. All tailings sampled had a significant magnetite content.
- Geophysics was effective in delineating depth and extent of tailings, but not in identifying areas of mineral concentration.
- Mining of gold with average grades of 0.1 g/t at a rate of 300 t/hour would produce up to 22 oz/day of gold. This is makes mining of the deposits viable when coupled with magnetite extraction.
- Based on these results, a 300 m drill program and 20 survey geophysics program extending across the entire tailings area is planned for 2014.

## Photographs


Figure 7. Sonic Drilling, view west over Grey Mountain from Tailings Ponds, July 2013

Figure 8. Fine gold particles recovered from 2013 samples.


Figure 9. Sonic Drilling, view west/southwest to Mt. Lorne from Tailings Ponds, July 2013

## References


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Gold in Skarns Of The Whitehorse Copper Belt L. Meinert - Washington State University – 1985

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Industrial Minerals, Gems And Minor Metals In The Yukon- G. V. White-2003

Application of Biohydrometallurgical Methods for Reprocessing of Whitehorse Copper Tailings - Dr. M. Sagdieva - Institute of Microbiology - Academy of Sciences of Uzbekistan - 2006

YMEP Cost Report and Expense Claim
Kryotek Arctic Innovation Inc.
Whitehorse Copper Tailings Gold Project
13-004

| | Cost | Unit | Total |
|---|---|---|---|
| Ford F-550 Service Truck ($50/day) | $50.00 | 4 | $200.00 |
| Mileage ($0.60/km) | $0.60 | 100 | $60.00 |
| SDC 150 Sonic Drill meterage (77m @ $325/m) | $77.00 | 325 | $25,025.00 |
| ATV ($40/day) | $40.00 | 4 | $160.00 |
| SuperSting Resistivity System ($1500/day) | $1,500.00 | 1 | $1,500.00 |
| Lippmann Resistivity System ($1500/day) | $1,500.00 | 1 | $1,500.00 |
| Sample Processing (54 samples @ $30/sample) | $54.00 | 30 | $1,620.00 |
| Report Writing | $1,250.00 | 1 | $1,250.00 |

| | | | | |
|---|---|---|---|---|
| | | | **Total Costs** | $31,315.00 |
| | Eligible Costs | 50% of total | Eligible Cost | $15,657.50 |
| | | | **Cost Claimed** | **$15,657.50** |

31-Jan-14