Rockland Ltd
Rock Engineering and Mine Backfill Specialist

Mr. Audie MacDonnell
Yukon Zinc Corporation
Suite 701, 475 Howe Street
Vancouver, BC
V6C 2B3

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Dear Sir,

Re: INSPECTION REPORT FOR QUARTZ MINING LICENSE - UNDERGROUND GEOTECHNICAL INSPECTION

1.0 INTRODUCTION

The Quartz Mining License (QML, 2006) issued for Wolverine Mine (Wolverine) requires an annual inspection of various mine facilities by a professional engineer. The result of each inspection along with recommendations and remedial actions should be submitted in a form of written report to the Yukon Energy, Mines and Resources.

At the request of Yukon Zinc Corporation (YZC), Dr. Khosrow Aref, P. Eng. of Rockland Ltd. has carried out the inspection and provided recommendations for the geotechnical aspects of underground. The underground inspection was divided into a number of investigations and the results were submitted in several reports to YZC. This letter summarizes briefly the results of all investigations and intended to satisfy the "Reporting and Inspection" terms set by the QML (QML, 2006).

2.0 UNITS

The SI unit system was adopted for all data presented in this report. Since some data are commonly expressed in other unit systems, both SI and the equivalent units are included.

3.0 QUARTZ MINING LICENSE REQUIREMENTS

The following requirements have been specified in Section 10 of the QML (2006) for Wolverine:

10.0 Reporting and Inspections

10.1 The licensee must ensure that an annual physical inspection is conducted by an engineer by July 1st of each year of all of the structures, works and installations located at the site including:

a) seepage collection dam, tailings impoundment structures;
b) waste rock damps, including and temporary waste rock dumps;
c) ore stockpiles
d) temporary ore stockpiles
e) diversion structures (channel and dams);
f) mill
g) mine
h) camp infrastructure; and,
i) any other engineered structures, works or installations associated with undertaking

10.2 Within forty-five (45) days of the inspection referred to in paragraph 10.1, the licensee must submit to the Chief a written report by an engineer documenting the results of the inspection, including a summary of the stability and status of all the inspected structures, works and installations and describing any recommendations for remedial actions made as a result of the inspection.

The following sections describe briefly the inspection program carried out and provide pertinent conclusions along with recommendations which have been reached.

4.0 INSPECTION PROGRAM

The inspection program consisted of several site visits to Wolverine. The current underground excavations, as shown in Figure 1, consist of a Ramp, several Stopes Accesses (SAs), Stopes and Fresh Air Raises (FARs).

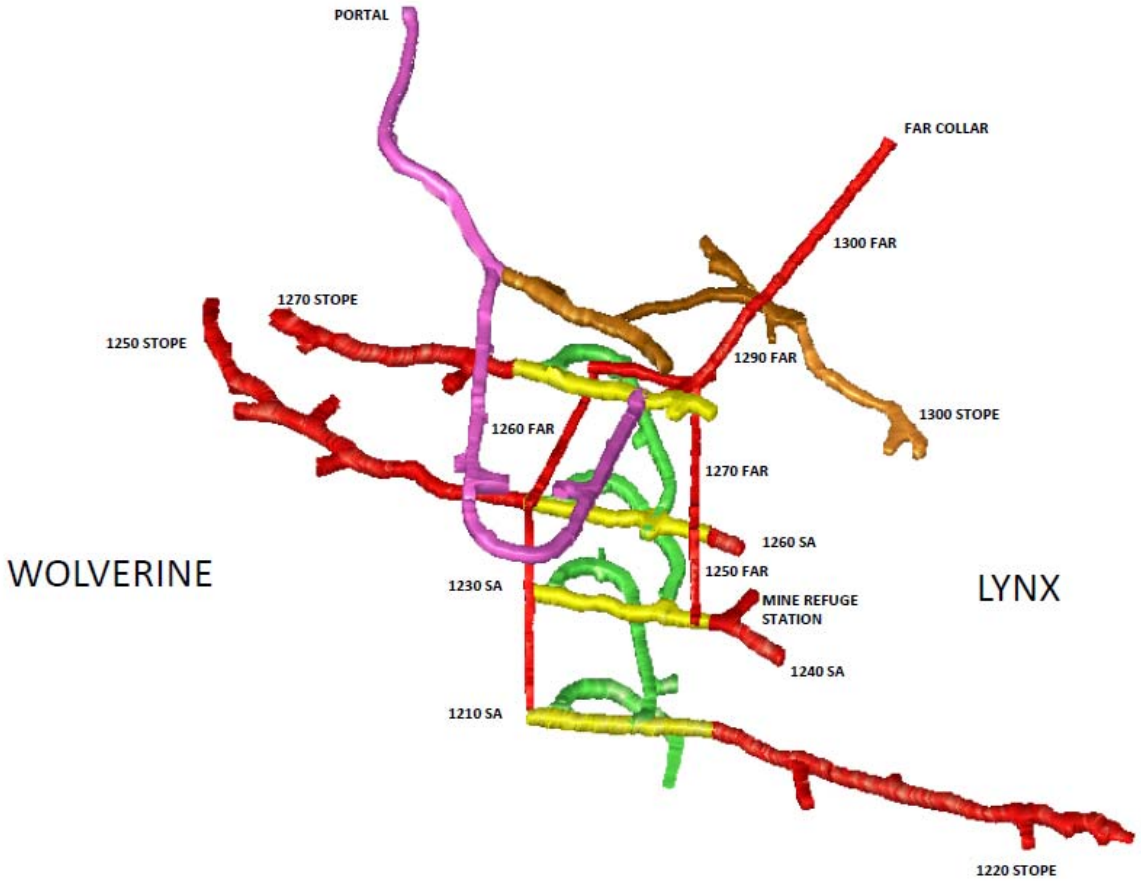

Figure 1: Ramp, SAs, Stopes and FARs at Wolverine mine

The inspections were divided into following areas:

i. Pull test program
ii. Portal to 1280 SA intersection
iii. 1300 SA (From ramp at 1300 level junction to 1300 level FAR overcast)
iv. Ramp from 1280 SA to 1260 SA intersections
v. Ramp from 1260 SA intersection to the end of the ramp
vi. Stope accesses, stopes and fresh air raises

The ground condition and ground support requirements of each area was investigated separately and the results were submitted to YZC.

5.0 SUMMARY OF INSPECTION REPORTS

The inspection report, in general, consisted of visual examination of underground excavations and geotechnical analyses. The analyses, employing both empirical and numerical methods, were carried out to assess stability and ground support requirements for excavated areas. The observations and conclusions drawn from these investigations along with recommendations were discussed in each report. In addition, monitoring and quality control programs were recommended for inspected areas.

5.1 RESULTS OF THE PULL TEST PROGRAM

A pull test program using several types of bolts along the ramp was carried out (Rockland, 2010a). The program has resulted in the following conclusions and recommendations:

- Pull test results provided the range of anchorage capacity for Split Set, resin rebar and Omega bolts;
- Pull test results on FS-33 and FS-39 Split Set bolts show wide ranges of anchorage capacity;
- Limited Pull test results on resin rebar show consistent anchorage capacity. Additional tests require to confirm the results in different rock types;
- Pull tests on Omega bolts, 2.4 m (8') and 3.7 m (12') on walls and back respectively, show consistent anchorage capacity in different rock type; and,
- According to a brief worldwide search, Omega or an equivalent bolts, such as Swellex, are used as one of the main ground support system in mines with weak ground condition similar to Wolverine.

Therefore, Omega / Swellex or equivalent bolts are recommended for application at Wolverine.

5.2 PORTAL TO 1280 SA INTERSECTION

The results of Ramp inspection from the Portal to 1280 SA intersection are included in a report (Rockland, 2010b). The following conclusions and recommendations have been reached:

- The stability based on a visual monitoring classification, in general, appeared to be "good" with no evidence of any structural or stress controlled sloughing. Several maintenance recommendations, as identified in the inspection report, should be implemented;
- The ground support guideline requires placement of additional 3.7 m (12') Super Swellex and 2.4 m (8') Swellex or an equivalent bolts on a 1.2 m x 1.2 m (4' x 4') grid on the back and walls respectively. This design is only applicable for the ramp size up to 5 m high by 5 m wide; and,
- All ramp intersections should be reinforced with 3.7 m (12') Super Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid and 12 cm (5") shotcrete thickness;
- A monitoring and quality control program, as described in the inspection report, should be implemented.

5.3 1300 SA (FROM RAMP AT 1300 LEVEL JUNCTION TO 1300 LEVEL FAR OVERCAST)

The results of Ramp inspection from 1300 level junction to 1300 level FAR overcast are included in a report (Rockland, 2010c) and a follow-up amendment. The following conclusions and recommendations have been reached:

- The inspection of bullhorn area indicated that several have moved and all bullhorns should be replaced with a better alternative. A bracket and bolting combination which minimizes the movements was recommended;

- The minimum ground support guideline outside the bullhorn area was established which requires placement of additional 3.7 m (12') Super Swellex and 2.4 m (8') Swellex or equivalent bolts on a 1.2 m x 1.2 m (4' x 4') grid on the back and walls respectively. Since the ground support was installed in 2005, the shotcrete, Fibre Reinforced Shotcrete (FRS) thicknesses and presence of Galvanized Welded Wire Mesh (GWWM) should be checked;
- All back intersections should be reinforced with 3.7 m (12') Super Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid, GWWM and 12 cm (5") shotcrete thickness; and,
- A monitoring and quality control program, as described in the inspection report, should be implemented;
- Though the suggested brackets are significantly better than the installed bullhorns, it could gradually move and regarded as "temporary" type ground support. The recommendation was subsequently amended with a "permanent" type of ground support for this area;
- For back up to 8 m wide and walls up to 4 m high, the minimum ground support for the bullhorn area should consist of 3.7 m (12') and 2.4 m (8') Super Swellex and Swellex placed on a 1 m x 1 m (3' x 3') grid in the back and walls respectively and 20 cm (8") shotcrete on the back and walls to the sill. However, where the wall height exceeds 4 m, 3 m (10') Swellex should be implemented; and,
- In the "extremely poor / exceptionally poor ground condition" of the cribbed / steel set area, the Connectable Swellex support should also be employed. For drift up to 3.6 m x 3.6 m, 6 m (20') long connectable Swellex should be placed on a 1.8 m x 1.8 m (6' x 6') grid. The pattern should include one in the crown (center back), one on each shoulder wall and one in the mid height of each wall. As the wall height increases, the connectable length on the wall should increase too.

5.4 RAMP FROM 1280 SA TO 1260 SA INTERSECTIONS

The results of Ramp inspection from 1280 SA to 1260 SA are included in a report (Rockland, 2010d). The following conclusions and recommendations have been reached:

- The stability, based on a visual monitoring classification, in general, appeared to be "fair to good" with no evidence of any structural or stress controlled sloughing. Several maintenance recommendations, as identified in this report, should be implemented;
- The results of numerical modelling and empirical assessments indicated that Crossover 2 is "unstable" and Crossovers 1, 3 and 9 are "stable";
- Using the numerical modelling, additional ground support systems were recommended for crossovers;
- In order to monitor Crossovers 2 and 3, an instrumentation program consisting of several extensometers should be implemented;
- The ground support guideline requires placement of additional Super Swellex and Swellex or an equivalent bolts and shotcrete; and,
- The intersection ground support requirements were evaluated and additional ground support, as specified in the inspection report, should be implemented.

5.5 RAMP FROM 1260 SA INTERSECTION TO THE END OF THE RAMP

The results of Ramp inspection from 1260 SA intersection to the end of ramp are included in a report (Rockland, 2010e). The following conclusions and recommendations have been reached:

- Excluding the bottom of the ramp, no fall of ground or instability has been reported and the stability, in general, appeared to be "fair to good". In the bottom of the

ramp, shotcrete cracking and fall out of the back are evident due to bigger ramp dimensions, presence of ramp crossovers and higher depth;

- Up to 160 m below the surface, the minimum ground support, consisting of 3.7 m (12') and 2.4 m (8') Super Swellex and Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid in the back and walls respectively and 10 cm (4") shotcrete to 1.5 m (5') from the sill are required. From 160 m below the surface to the end of the ramp at 200 m below the surface, the walls ground support should increase to 3 m (10') long. This minimum ground support guideline should also include #8 GWWM on the back and walls to 1.5 m (5') from the sill and 50 mm (2") FRS for the remainder of walls;
- The results of numerical modelling and empirical assessments indicated that Crossovers 4, 5 and 7 are "unstable" and Crossovers 6 and 8 are "stable";
- Using the crossover dimensions and numerical modelling, the ground support for each crossover were recommended;
- The ramp intersection ground support requirements were evaluated and additional ground support should be implemented as recommended in the inspection report;
- In order to monitor Crossovers 4, 5 and 7, an instrumentation program consisting of several extensometers should be implemented; and,
- Minimal sill survey shots available at / from crossover 7 to the end of the ramp. The actual ramp dimensions should be compared to ramp dimensions considered in this report and the ground support should be adjusted where significant deviation is observed.

5.6 STOPE ACCESSES, STOPES AND FRESH AIR RAISES

The results of Ramp inspection SA, Stopes and FARs are included in a report (Rockland, 2010f). The following conclusions and recommendations have been reached:

- Excluding the accident location in 1220 SA, the stability appeared to be "fair to good" in SAs and Stopes. No falls of ground or instability has been reported in FARs and, excluding 1290 Draise, the stability appeared to be "fair to good";
- A review of major structures within SAs indicates presence of numerous faults and shear zones some containing significant gouge and graphitic shear zones. The average rock quality of SAs and Stopes is "very poor" based on the Q rock mass classification;
- Representative in-situ stress field are essential to confirm various analyses carried out, for future geomechanical analyses and mine planning purposes. An in-situ stress measurement program should be planned as soon as possible;
- The minimum ground support for 1300 SA, 1250 SA and 1270 SA, should consist of 3.7 m (12') and 2.4 m (8') Super Swellex and Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid in the back and walls respectively and 5 cm (2") shotcrete to 1.5 m (5') from the sill. However, where the wall height exceeds 5 m (16'), 3 m (10') Swellex should be implemented. For 1220 SA, where the typical SA dimension is 5.5 m high x 5.2 m wide, the walls' ground support should be 3 m (10') long at all time and 7.5 cm (3") shotcrete. This guideline should also include #8 GWWM on the back and walls to 1.5 m (5') from the sill and 5 cm (2") and 7.5 cm (3") FRS for the remainder of walls;
- The Stopes' ground support should be 3.7 m (12') and 2.4 m (8') Super Swellex and Swellex placed on a 1 m x 1 m (3' x 3') grid in the back and walls respectively to 1 m from the floor with the mid-height wall support of 12' (3.7 m) long. For 1220 Stope, where the typical SA dimension is 5.5 m high x 5.2 m wide, the walls' ground support should increase to two 3.7 m (12') long Swellex at the mid-height on walls. This guideline should also include #6 GWWM on the back and walls to the sill;
- The actual size, including the cobbling height, and shape of excavations have significant influence on the size of yielded element zone around the SAs / Stopes and required ground support. In order to maintain stability, future dimensions (with cobbling height) of SAs / Stopes and including extension of current Stopes, as stated in the Wolverine feasibility study (Snowden, 2007), should be limited to 4 m (H) x 4

m (W). Where Stope dimensions exceed these dimensions, depending upon the excavation size, longer bolts with shotcrete should be implemented for SAs and Stopes;

- The minimum ground support for intersections within SAs should consist of 3.7 m (12') and 3 m (10') Super Swellex and Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid in the back and walls respectively and 7.5 cm (3") shotcrete to 1.5 m (5') from the sill. This guideline should also include #8 GWWM on the back and walls to 1.5 m (5') from the sill and 7.5 cm (3") FRS for the remainder of walls;
- The minimum ground support for FARs should consist of 2.4 m (8') Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid in the back and walls respectively and 7.5 cm (3") shotcrete to 1 or 1.5 m (3' or 5'), depending upon the FAR size, from the sill. This minimum ground support guideline should also include #8 GWWM on the back and walls to 1 or 1.5 m (3' to 5') from the sill, depending upon the FAR size, and 7.5 cm (3") FRS for the remainder of walls; and,
- The minimum ground support of overcasts' walls or back up to 5 m should consist of 3.7 m (12') Swellex placed on a 1.2 m x 1.2 m (4' x 4') grid with #8 GWWM and 13 cm (5") shotcrete on the back and walls to 1.5 m (5') from the sill and 13 cm (5") FRS for the remainder of walls. For the walls or back greater than 5 m and less than 10 m, the minimum ground support should be replaced with 5.5 m (18') Swellex with the same pattern and GWWM but 15 cm (6") shotcrete and 15 cm (6") FRS.

5.7 General Comments

The following general comments are applicable to all inspection reports:

- Various analyses and ground support guidelines provided in the inspection reports were based on limited geotechnical information available at Wolverine. It is important to confirm and / optimize these results with underground observations, pull test results, instrumentation and back analyses. Further, it was attempted to

use the representative rock quality for all assessments, where extremely poor / very poor ground condition are encountered, additional longer ground supports with shotcrete should be implemented;

- The analyses, conclusions and recommendations provided in each report address the area(s) of interest and do not apply to any other excavations or deeper extension of excavations. Further, the design and recommendations must be implemented in its entirety as some aspects of the design could influence others; and,
- Various analyses carried out in each report were based on available information at the time of preparation of this report. Should this information differ, before, during or after implementation, the recommended design guidelines have to be re-evaluated.

I trust that the information provided in this letter satisfies the Quartz Mining License requirements. If you have any questions or comments, please do not hesitate to contact me.

Yours truly

ROCKLAND LTD.

Khosrow Aref, Ph. D., P. Eng. (British Columbia)

Principal

REFERENCES

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Rockland Ltd. 2010b. Ramp inspection – Portal to 1280 SA intersection. Letter report to Yukon Zinc Corporation. July 22.

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Rockland Ltd. 2010d. Inspection report – Ramp from 1280 SA to 1260 SA. Wolverine Mine, Yukon Zinc Corporation. September 6

Rockland Ltd. 2010e. Inspection report - Ramp from 1260 SA intersection to the end of the ramp. Wolverine Mine, Yukon Zinc Corporation. October 13.

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