

REPORT ON 2014 DAM SAFETY INSPECTION

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EXECUTIVE SUMMARY

The New Carolin Mine is located in southwestern British Columbia, approximately 18 km northwest of Hope. The mine operated briefly in the early 1980s and closed in 1984 mainly due to falling gold prices. Mine tailings were stored in a Tailings Storage Facility (TSF). The TSF embankment is approximately 43 m high with a crest length of approximately 300 m.

The TSF was constructed using the downstream construction method and predominantly consists of compacted glacial till fill materials with a compacted rockfill zone on the downstream slope. The glacial till and rockfill materials are separated by filter fabric. A glacial till berm was also constructed on the downstream slope.

New Carolin Gold Corp., who took ownership of the property in 2007, requested Knight Piésold complete the Dam Safety Inspection (DSI) of the TSF and prepare an inspection report that meets the guidelines outlined by the Ministry of Energy and Mines (MEM). The site visit was completed by Les Galbraith, P.Eng., of Knight Piésold Ltd., who visited the site on August 28, 2014 in the company of Ed Beswick, P.Eng., of New Carolin Gold Corp.

A summary of the 2014 DSI is as follows:

- The TSF has a "Significant" dam classification according to the 2014 Canadian Dam Association (CDA) Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams.
- There have been no changes to the TSF or surrounding conditions since the previous inspection in 2012.
- There are currently no working piezometers in the dam.
- There have been no significant visual changes to the dam since the previous inspection in 2012. No signs of deformation were identified on the tailings embankment. The embankment slopes were approximately planar and there was no evidence of cracking, bulging, or slumping in the embankment fill. The embankment crest also appeared to be relatively level with no signs of differential settlement.

Deficiencies and recommendations from the 2014 inspection are consistent with previous inspections, including:

- Lowering the TSF pond elevation. The tailings pond is up against the entire length of the dam. This is a common theme from the previous TSF inspections. The fundamental water management objectives for the TSF are to keep the tailings pond as low as possible and to divert clean surface water away from the facility to the maximum practicable extent. High pond levels generally increase the phreatic surface in dams which can result in increased seepage rates and reduced embankment stability if not properly designed for this condition.
- Completing a flood routing analyses and evaluating the TSF freeboard requirements and spillway routing capacity. The spillway may be undersized for the design flood event. Flood routing analyses should also incorporate potential variations relating to changing climatic conditions.
- Developing a plan to install multiple vibrating piezometers in the dam and foundation materials to provide critical information on the phreatic surface and embankment pore water pressures. This likely includes a drilling program from which geotechnical information can also be collected to support stability assessment.



- Developing an Operations, Maintenance and Surveillance (OMS) Manual, and
- Completing a dam stability evaluation.

There is very little information available on the design and construction of the TSF. It is recommended New Carolin Gold Corp. collect all construction and site investigation information to support the necessary seepage and stability analyses. Additional geotechnical information may need to be collected to support the seepage and stability assessments if insufficient information is available from the initial investigation and construction programs.

The TSF has not been operated since 1984 but it has not officially been closed nor been operated under Care and Maintenance conditions. It is recommended the TSF be operated under Care and Maintenance conditions at the very least, which includes annual safety inspections and regular monitoring of the instrumentation (once installed), until the future of the New Carolin Mine has been decided.

The previous Dam Safety Review (DSR) was completed in 2009. There was very limited information available for the DSR and it was recommended New Carolin Gold Corp. obtain all information relating to the investigations, construction and operation of the TSF for future analyses and reference. Although the next DSR is scheduled for 2019, it would be prudent to complete the next DSR once this information is available and the deficiencies and recommendations mentioned above have been addressed.



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1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The New Carolin Mine is located in south-western British Columbia, approximately 18 km northeast of Hope. The New Carolin gold property currently includes 168 mineral claims over an area of approximately 7,424 hectares. The southeastern border of the property is near Exit 192 on the Coquihalla Highway; approximately 150 km east of Vancouver, BC. The project location is shown in Figure 1.1.



NOTES:

1. This site location plan was obtained from Google Earth Satellite Imagery.

Figure 1.1 Site Location Plan

Gold was discovered in this area in the 1850s, in the form of placer deposits along the Fraser River. The Ward Mine, the first hard rock mine that exploited a deposit of gold hosted in rock adjacent to the faulted eastern margin of the Coquihalla serpentine belt, was operated in 1905 and produced about 135 ounces of gold. Larger-scale operations were developed prior to World War II on the current property, including the Pipestem, Aurum and Emancipation Mines, which collectively produced another 3,700 ounces of gold.

The deposit known as the Idaho Zone, adjacent to the Aurum Mine, was developed in the 1970s by Aquarius Resources, followed by Carolin Mines Ltd. The Carolin Mine was opened in 1982 and



produced over 43,500 ounces of gold during 27 months of operation under the management of Carolin Mines. The mine was closed in 1984, primarily as a result of falling gold prices.

Carolin Mines (later known as Anglo-Swiss Industries) went bankrupt after the Carolin Mine closed. The mine was acquired in the 1990's by Athabaska Resources, which was unable to re-open the mine before gold prices started to fall again. Athabaska declared bankruptcy and the mine was acquired by Tamerlane Ventures, who optioned the property to Century Mining. Century started work at the site again, including the most recent tailings dam and water quality inspections, in 2005. However, Century's strategic focus changed to mines in Quebec and Peru, and, in 2007, Century optioned the property to Module Resources. Module Resources changed its name to New Carolin Gold Corp.in October 2011.

1.2 PREVIOUS DAM SAFETY INSPECTIONS

Previous Dam Safety Inspections were completed in 1995 and 2005 by Golder Associates Ltd. and Knight Piésold (KP) in 2007, 2008, and 2012. A Dam Safety Review (DSR) was completed by KP in 2009. KP was not involved with the project prior to 2007.

A common theme from previous inspections and reviews was that there is very limited information available on the design and construction of the TSF. It is recommended New Carolin Gold Corp. obtain all information relating to the construction and operation of the TSF for future reference.

1.3 SCOPE OF REPORT

New Carolin Gold Corp. requested Knight Piésold Ltd. complete an inspection of the Tailings Storage Facility (TSF) and prepare an Annual Inspection Report that meets the guidelines outlined by the Ministry of Energy and Mines (MEM).

Les Galbraith, P.Eng. of Knight Piésold Ltd. visited the site on August 18, 2014 in the company of Ed Beswick, P.Eng., of New Carolin Gold Corp. to conduct the inspection of the TSF. This report presents the findings of the 2014 TSF inspection. The report also includes a review of deficiencies and recommendations provided in previous inspection reports, including:

- Lowering the TSF pond elevation
- Completing a flood routing analyses and evaluating the spillway routing capacity
- Developing a plan to install multiple vibrating piezometers in the dam and foundation materials to replace the pneumatic piezometers which are no longer functioning, and
- Developing an Operations, Maintenance and Surveillance (OMS) Manual.

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2 – TAILINGS STORAGE FACILITY

2.1 TAILINGS STORAGE FACILITY

Milled tailings were stored on surface in a TSF located approximately 1 km south of the deposit area. The TSF is located in the upper reaches of its catchment area. A brief history and description of the New Carolin Mine TSF is presented below for background information. The historical information was obtained from the 2004 Inspection Report (Golder 2005).

- Design of the TSF was completed by Golder Associates in 1979.
- The TSF was constructed in stages from 1980 to 1984. Construction of the TSF was completed by Emil Anderson Co. Ltd. The TSF was constructed as a compacted glacial till embankment and has a crest elevation of 978.5 m. The embankment is approximately 43 m high as measured from the downstream toe, and has a crest length of approximately 300 m.
- The embankment includes a rockfill drain constructed on the downstream slope of the embankment. Filter cloth separates the rockfill drain from the compacted glacial till embankment.
- The TSF embankment has four finger/rockfill drains extending downstream of the embankment. The finger/rockfill drains appear to be extensions of the rockfill drain.
- The TSF embankment includes a compacted glacial till berm constructed on top of the rockfill drain. The berm was constructed to an elevation of 957 m.
- Instrumentation included the installation of 18 pneumatic piezometers (none are currently functioning).
- An emergency spillway was constructed on the west abutment. The spillway invert elevation is at 977.2 m.
- The pond elevation has typically remained at 977.2 m, which corresponds to the invert elevation of the spillway. The freeboard for the TSF embankment is 1.3 m.

A plan view and typical section through the TSF are included in Appendix A. The plan and section of the TSF were obtained from the Golder 2004 TSF inspection report. A photo of the TSF is shown on Figure 2.1.

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Figure 2.1 Photo of TSF from above Left Abutment

The TSF has not been operated since 1984 but it has not officially been closed nor been operated under Care and Maintenance conditions. It is recommended the TSF be operated under Care and Maintenance conditions, including regular inspections and monitoring of the instrumentation (once installed), until the future of the New Carolin Mine has been decided.

2.2 DAM CLASSIFICATION

The TSF classification has been evaluated according to the 2013 CDA Dam Safety Guidelines and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams. The CDA classification guidelines are summarized in Table 2.1.

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NEW CAROLIN MINE		
TAILINGS STORAGE FACILITY		

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	Population at risk ²	Incremental losses			
Dam Class		Loss of life ³	Environmental and cultural values	Infrastructure and economics	
		Minimal short-term loss.	Low economic losses; area		
Low	None	0	No long-term loss.	contains limited infrastructure or services.	
			No significant loss or deterioration of fish or wildlife habitat.	Losses to recreational facilities,	
Significant	Temporary only	Unspecified	Loss of marginal habitat only.	seasonal workplaces, and infrequently used transportation	
			Restoration or compensation in kind highly possible.	routes.	
High	Permanent	10 or fewer	Significant loss or deterioration of <i>important</i> fish or wildlife habitat.	High economic losses affecting infrastructure, public	
riigii	remanent	10 OF IEWEI	Restoration or compensation in kind highly possible.	transportation, and commercial facilities.	
			Significant loss or deterioration of <i>critical</i> fish or wildlife habitat.	Very high economic losses affecting important infrastructure	
Very high	Permanent	100 or fewer	Restoration or compensation in kind possible but impractical.	or services (e.g., highway, industrial facility, storage facilities for dangerous substances)	
			Major loss of <i>critical</i> fish or wildlife habitat.	Extreme losses affecting critical	
Extreme	Permanent	More than 100	Restoration or compensation in kind impossible	hospital, major industrial complex, major storage facilities for dangerous substances)	

Table 2.1

Dam Classification

The dam classification was reviewed as part of the 2009 DSR and currently has a "Significant" dam classification. There have not been any changes to the TSF or the downstream conditions since 2009, therefore the "Significant" classification for the dam is still relevant. It is important to note that a dam breach inundation study has not been completed for the New Carolin Mine TSF to fully assess potential downstream impacts in the event of a hypothetical dam failure.

The suggested design flood and earthquake design Annual Exceedance Probabilities (AEPs) for the CDA dam classifications during operations, as per the 2013 CDA Dam Safety Guidelines and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams, are shown on Table 2.2.



Dom Class	Annual Exceedance Probability		
	Floods	Earthquakes	
Low	1/100	1/100	
Significant	Between 1/100 and 1/1000	Between 1/100 and 1/1,000	
High	1/3 between 1/1000 and PMF	1/2,475	
Very high	2/3 between 1/1000 and PMF	1/2 between 1/2,475 and 1/10,000 or MCE	
Extreme	PMF	1/10,000 or MCE	

Table 2.2 Suggested Design Flood and Earthquake Levels

Acronyms: PMF, probable maximum flood; AEP, annual exceedance probability; MCE, maximum credible earthquake.

The suggested AEP's for a dam with a "Significant" classification are between 1/100 and 1/1000 for both the flood and earthquake events.

The 2013 CDA Dam Safety Guidelines and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams states that for classifications that provide a range for the AEP, the design "criteria should be commensurate with the range of potential consequences for the particular dam. A risk assessment may be necessary to justify the selection of criteria". The selection of the appropriate AEP when a range is provided by the CDA guidelines should also be commensurate on the ability to quickly respond to potentially adverse conditions. There are no on-site personnel at New Carolin Mine and there is no construction equipment on site; all construction activities are completed by a local contractor from Hope, as required. It is recommended the AEP for the flood (and earthquake design criteria) correspond to the 1/1000 year return event for both the flood and earthquake hazards conditions.

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3 – SITE INSPECTION

3.1 GENERAL

The 2014 site inspection of the TSF was completed on September 18, 2014, by Les Galbraith, P.Eng. of Knight Piésold Ltd. in the presence of Ed Beswick, P.Eng., of New Carolin Gold Corp.

The 2014 site inspection of the TSF included the following activities:

- Visually inspecting the TSF, including the downstream slope and finger/rockfill drains
- Inspection of the spillway and spillway channel, and
- Inspection of the surface runoff diversion works.

Weather conditions at the time of the inspection consisted of overcast skies.

Photographs from the site inspection are provided in Appendix B.

3.2 TAILINGS STORAGE FACILITY

3.2.1 Tailings Embankment

No signs of deformation were identified on the tailings embankment. The embankment slopes were approximately planar and there was no evidence of cracking, bulging, or slumping in the embankment fill. The embankment crest also appeared to be relatively level with no signs of differential settlement. There was no evidence of animal burrowing. There were no signs of wave erosion on the upstream face.

Thick vegetation is well established on the lower section of the dam. Larger trees (approximate diameter of 0.15 m) on the upper section of the dam had recently been cut down due to concerns over the dam/core zone being potentially damaged by the root system penetrating the dam, or by fallen trees uprooting large root balls. It is recommended this practice be continued with trees larger than 0.15 m in diameter being removed from the dam (above the berm).

Seepage was observed along the downstream west and east abutments. This seepage has been observed in previous inspections, including during the August 12, 2014 inspection by Gerry Barcelonia of the Ministry of Energy and Mines. The seepage was clear.

Seepage was also observed from the downstream rockfill finger drains. The seepage rates were very low, and were similar to previous inspections. The seepage was clear.

3.2.2 Embankment Stability Assessment

Completing an updated stability assessment of the TSF embankment is an outstanding recommendation from the 2009 DSR. The stability assessment needs to consider static stability and seismic stability for the Earthquake Design Ground Motion, defined as the 1/1000 year event. The stability assessment will also need to evaluate the liquefaction potential of the tailings and foundation materials.



3.2.3 Water Management

The annual inspection evaluated the physical aspects of the water management program at the TSF. This report focuses on those aspects of the water management plan that are significant from a dam safety perspective.

The main consideration for environmental protection at the site is water management. The fundamental water management objectives for the TSF are to keep the tailings pond as low as possible and to divert clean surface water away from the facility to the maximum practicable extent. Surplus water in the TSF is routed through a spillway located at the left abutment. The water level in the TSF is managed by the spillway invert elevation.

The elevation of the tailings pond at the time of the inspection was approximately 977.2 m, which is slightly below the invert elevation of the TSF. The tailings pond covers the entire facility and is up against the embankment along its entire length (similar to previous inspections). It is recommended the pond water level be lowered as recommended in previous inspection reports to reduce the phreatic surface within the dam.

Surface runoff from outside the facility is currently being diverted around the facility by diversion ditches. These appear to be effective in diverting runoff around the facility. It is recommended the diversion ditches be inspected during each site visit and debris and vegetation in the ditches removed.

3.2.4 Tailings Embankment Spillway

The TSF includes a spillway on the embankment west abutment. There was no flow discharging through the spillway at the time of the inspection. The spillway appeared to be in good condition, showed no signs of erosion, and appears to be effectively managing the maximum water level in the TSF. It is recommended the TSF spillway be inspected during each site visit, and any debris collected in the spillway channel removed.

The spillway was reported to have been designed to pass the 200 year, 24-hour storm event based on hydrologic data collected at the Hope Airport, which is located approximately 20 km SW and 915 m below the mine site. It is possible the precipitation values have been underestimated for the mine site as no accounts of orographic influences on meteorological conditions appear to have been factored into the site precipitation assumptions.

The objective of embankment spillways is to successfully pass the Inflow Design Flood (IDF) defined by the CDA guidelines. The recommended IDF is the 1/1000 year storm event as discussed in Section 2.2.

The New Carolin Mine TSF spillway may be undersized to successfully pass the flood from the IDF. It is recommended a flood routing analysis be conducted to determine the discharge capacity of the spillway and to confirm, or otherwise, whether it is capable of passing storm flows from the IDF. Additionally, it is recommended a debris catch system be installed upstream of the spillway to prevent debris from entering and blocking the spillway channel.



3.2.5 Instrumentation

A total of eighteen pneumatic piezometers were installed during the construction of the TSF embankment. None of the piezometers are currently functioning. It is recommended New Carolin Gold Corp. develop a plan to install new vibrating wire piezometers in key areas of the dam.

3.3 OPERATIONS MAINTENANCE AND SURVEILLANCE MANUAL

An Operations Maintenance and Surveillance (OMS) Manual does not exist for the New Carolin Mine TSF. It is recommended an OMS be developed as per the CDA guidelines.

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4 – SUMMARY AND RECOMMENDATIONS

The New Carolin Mine is located in southwestern British Columbia, approximately 18 km northwest of Hope. Mine tailings were stored in a TSF prior to suspension of operations in 1984. Les Galbraith, P.Eng. of Knight Piésold Ltd. visited the site on August 28, 2014 in the company of Ed Beswick, P.Eng., of New Carolin Gold Corp. to conduct the 2014 inspection of the TSF.

The TSF embankment appeared to be in good condition and no signs of embankment deformation were observed during the site inspection. Seepage from the TSF, identified at the abutments and downstream rockfill finger drains, was consistent with that observed during previous inspections. Seepage from both locations was clear. There appeared to be not noticeable changes from previous inspections, which is not unexpected since the facility has not been operated since 1984. Recommendations include:

- Keeping the tailings pond as low as possible and diverting clean surface water away from the facility to the maximum practicable extent.
- Developing an Operations, Maintenance and Surveillance (OMS) Manual.
- Installing piezometers to replace the pneumatic piezometers which are no longer functioning.
- Completing a dam stability evaluation.
- Evaluating the routing capacity of the spillway. The TSF spillway appears to be effectively managing the pond elevation but may be undersized to safely pass the IDF.

The previous DSR was completed in 2009. There was very limited information available for DSR and it was recommended New Carolin Gold Corp. obtain all information relating to the investigations, construction and operation of the TSF for future analyses and reference. Although the next DSR is scheduled for 2019, it is recommended a DSR be completed once this information is available and the deficiencies and recommendations mentioned above have been addressed.

The TSF design and site conditions must be re-evaluated prior to either resuming operations at the mine or officially shutting the facility for final closure.



5 – REFERENCES

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6 – CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.



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APPENDIX A

TAILINGS STORAGE FACILITY PLAN AND SECTION

(Pages A-1 to A-2)



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APPENDIX B

SITE PHOTOGRAPHS

(Pages B-1 to B-5)





PHOTO 1 – Embankment crest looking west.



PHOTO 2 – TSF spillway.





PHOTO 3 – TSF spillway channel looking upstream.



PHOTO 4 – TSF downstream slope looking west.





PHOTO 5 – Seepage area at right abutment.



PHOTO 6 – Access road on east side of TSF. Diversion ditch on left side of access road.





PHOTO 7 – TSF pond up against embankment. Looking East.



PHOTO 8 - recently cut tree near embankment crest.





PHOTO 9 – Downstream rockfill finger drain.



PHOTO 10 – Top of TSF downstream berm looking west.