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Memorandum

To:	Emilie Hamm	**From:**	SLR Consulting (Canada) Ltd.
Company:	Government of Yukon Assessment and Abandoned Mines		
cc:		**Date:**	August 22, 2016
Subject:	***FINAL - MOUNT NANSEN MINE*** ***AMP MONTHLY ASSESSMENT – JUNE 2016***		

1.0 INTRODUCTION

The following summarizes the June 2016 assessment of the Adaptive Management Plan (AMP) Events, as outlined in the *Mount Nansen Water Quality and Quantity Adaptive Management Plan* (SLR, June 2015):

- AMP Event 1 - Degraded Water Quality in Dome Creek Downstream of Mill Area
- AMP Event 2 - Changes in Water Quality in the Seepage Pond
- AMP Event 3 - Changes in Seepage Pond Inflows/Volume Outside of Historic Norms
- AMP Event 4 - Degraded Water Quality in Dome Creek Downstream of Mine Facilities
- AMP Event 5 - Degraded Water Quality in Victoria Creek at Mine Access Road
- AMP Event 6 - Degraded Water Quality in Pony Creek Downstream of Mine Area
- AMP Event 7 - Changes in Pit Water Level Elevation outside of Historic Norms

The following Events are not included in this monthly assessment:

- AMP Event 8 - Changes in Groundwater Quality Downgradient of the Brown-McDade Pit
  - Well CH-P-13-03/50 was sampled on May 26th. A direct sampling method was used due to low water volume. Currently CH-P-13-03/10 is damaged and requires redevelopment. Well redevelopment plans are in progress. Wells CH-P-13-04/10 and 50 were not sampled during this event because they were frozen. The next sampling event will take place in the late fall of 2016.

    As per the Mt. Nansen AMP, a minimum of four data points are required to complete a trend line development. This assessment will be carried out when sufficient sampling data are available.
- AMP Event 9 - Degraded Water Quality in Brown-McDade Pit

- Assessment of this AMP is carried out on an annual basis and was last reported on in the August 2015 AMP assessment.

2.0 AMP EVENT 1 – DEGRADED WATER QUALITY IN DOME CREEK DOWNSTREAM OF MILL AREA

2.1 Description

The water quality in Dome Creek downstream of the Mill Area is currently affected by surface water runoff and seepage inflows from the Mill Area. The water quality in Dome Creek in this area is measured monthly, when flowing, at WQ-DC-D1b with the exception of spring. At this time, an additional sample is collected during freshet. Water quality data in Dome Creek at WQ-DC-D1b has been collected since 2012.

A summary of the AMP thresholds for Event 1 is provided in Table 1.

Table 1: Summary of AMP Event 1 Thresholds

Indicators	Location	Thresholds	Frequency
Sulphate Total and Dissolved Arsenic Total Cadmium Total Zinc	WQ-DC-D1b	• Monitoring results above the Management Threshold for Dissolved Arsenic (0.15 mg/L), for Total Cadmium (0.02 mg/L) or for Total Zinc (0.3 mg/L); or, • A statistically significant (0.05) increasing trend in the monitoring results from WQ-DC-D1b. For the purposes of AMP trend line development, data for station D1b from 2012 on will be used for the trend analysis.	Monthly

2.2 AMP Event 1 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-DC-D1b was carried out using the June 2016 water quality data.

A summary of the AMP thresholds for Event 1 is provided in Table 2.

Table 2: Summary of AMP Event 1 Assessment

Indicators	Trigger Activation	Results
Sulphate	No	• Decreasing non-significant trend in concentrations.
Total Arsenic	No	• Increasing non-significant trend in concentrations.
Dissolved Arsenic	No	• June dissolved arsenic concentration of 0.02 mg/L was below the Management Threshold of 0.15 mg/L • Increasing trend in dissolved arsenic concentrations but not statistically significant.
Total	No	• June total cadmium concentration of 0.0004 mg/L was

Indicators	Trigger Activation	Results
Cadmium		below the Management Threshold of 0.02 mg/L. • Statistically significant decreasing trend in total cadmium concentrations.
Total Zinc	No	• June total zinc concentration of 0.1 mg/L was below the Management Threshold of 0.3 mg/L. • Statistically significant decreasing trend in total zinc concentrations.

2.3 Follow-Up Action Required

No AMP triggers were activated at WQ-D1-b under AMP Event 1 during the June 2016 assessment. Therefore no follow up is required at this time.

3.0 AMP EVENT 2 – CHANGES IN WATER QUALITY IN THE SEEPAGE POND

3.1 Description

The Seepage Pond at the toe of the tailings impoundment collects shallow groundwater seepage from the tailings area. The seepage collected in the pond is continuously pumped to Dome Creek. The discharge from the Seepage Pond is a primary source of contaminants to Dome Creek including sulphate, arsenic, iron, manganese and cadmium.

The water quality in the Seepage Pond is measured monthly, at the Seepage Pond outlet pipe, WQ-SEEP, with the exception of spring. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

A summary of the AMP thresholds for Event 2 is provided in Table 3.

Table 3: Summary of AMP Event 2 Thresholds

Indicators	Location	Thresholds	Frequency
Sulphate Total and Dissolved Arsenic Total Cadmium Total and Dissolved Iron Total and Dissolved Manganese Total Zinc Total and WAD Cyanide	WQ-SEEP	• Monitoring results at WQ-SEEP above the reference EQS for Dissolved Arsenic (0.15 mg/L), Total Iron (1.0 mg/L) or Total Cadmium (0.02 mg/L), Total Manganese (0.5 mg/L), Total Zinc (0.3 mg/L), Total Cyanide (0.3 mg/L), WAD Cyanide (0.1 mg/L); or, • Three consecutive monitoring results at WQ-SEEP greater than the upper 95th percentile of the reference period (2008 to 2013); or • A statistically significant increasing trend (0.05) which, when extrapolated forward one year, would result in values greater than the 95th percentile. For the purposes of AMP trend line development, data for station WQ-SEEP from 2008 and on will be used for the trend analysis.	Monthly

3.2 AMP Event 2 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-SEEP was carried out using the June 2016 water quality data. The results of the assessment are summarized in Table 4.

Table 4: Summary of AMP Event 2 Assessment

Indicators	Trigger Activation	Results
Sulphate	No	• June sulphate concentration (686 mg/L) was below the 95th percentile threshold value of 822.6 mg/L. • Statistically significant increasing trend in sulphate concentrations but not estimated to reach the threshold value for another 6 years.
Total Cyanide	No	• June concentration (0.02 mg/L) was below the EQS threshold value of 0.300 mg/L. • Total cyanide concentration in June was below the 95th percentile threshold value of 0.076 mg/L. • Non-significant increasing trend.
WAD Cyanide	No	• June concentration (0.008 mg/L) was below the EQS threshold value (0.1 mg/L). • WAD Cyanide concentration was below the 95th percentile threshold (0.035 mg/L). • Statistically significant decreasing trend.

Indicators	Trigger Activation	Results
Total Arsenic	Yes	• The arsenic concentration in June (0.075 mg/L) was above the 95th percentile threshold value of 0.057 mg/L, and was part of 7 consecutive exceedances (December 2015, January, February, March, April, May and June 2016). • Statistically significant increasing trend but not estimated to reach the threshold value for another 2 years.
Dissolved Arsenic	Yes	• June concentration (0.039 mg/L) was below the EQS threshold value of 0.15 mg/L. • Dissolved arsenic concentrations have been above the 95th percentile threshold value of 0.035 mg/L for 14 months in a row (June, June, July, August, September, October, November, December 2015 and January, February, March, April, May and June 2016). • Statistically significant increasing trend in dissolved arsenic concentrations, estimated to reach the 95th percentile threshold value (0.035 mg/L) in less than 1 year.
Total Cadmium	No	• June concentration (0.00027 mg/L) was below EQS threshold of 0.02 mg/L. • June concentration was below the 95th percentile threshold of 0.00117 mg/L. • Statistically significant decreasing trend.
Total Iron	Yes	• June concentration (12.0 mg/L) is above the EQS threshold of 1.0 mg/L and concentrations have been since at least 2008. • June concentration is below the 95th percentile threshold of 20.8 mg/L. • Increasing trend, although not statistically significant.
Dissolved Iron	Yes	• June concentration (5.84 mg/L) was below the 95th percentile threshold of 9.67 mg/L. • Statistically significant increasing trend estimated to reach 95th percentile threshold value in less than 1 year.
Total Manganese	Yes	• June concentration (5.86 mg/L) was above EQS threshold of 0.5 mg/L and has been since 2008. • June concentration was below the 95th percentile threshold value of 9.2 mg/L. • Statistically significant decreasing trend.
Dissolved Manganese	No	• June concentration (5.6 mg/L) was below the 95th percentile threshold value of 8.8 mg/L. • Statistically significant decreasing trend.
Total Zinc	Yes	• June concentration (0.021 mg/L) was below the EQS threshold of 0.3 mg/L. • June concentration was below the 95th percentile threshold

Indicators	Trigger Activation	Results
		value of 0.028 mg/L. • Statistically significant increasing trend estimated to reach 95th percentile threshold value in less than 1 year.

3.3 Follow-up Action Required

The above noted changes in water quality in the Seepage Pond, as measured at WQ-SEEP, have been previously documented in various reports including *Mount Nansen – Assessment of Zinc Concentrations in the Seepage Pond* (SLR 2015) and *Mount Nansen 2013 Annual Surface Water Quality Review* (SLR 2015). As a result of those reports, additional work is being carried out to investigate the sources of the changing water quality in the Seepage Pond, including sulphate, total zinc, total and dissolved arsenic, and total and dissolved iron. Some of the recommendations for proposed study/investigations included:

- A detailed hydrogeological and geochemical assessment of the water quality trend in seepage water and groundwater to fully assess the changing conditions in the Seepage Pond and upgradient in the tailings area, and evaluate potential impacts to ongoing attenuation processes.
- The development of a contingency plan for the potential treatment of Seepage Pond water should the concentrations reach a point where treatment is required.

4.0 AMP EVENT 3 - CHANGES IN SEEPAGE POND INFLOWS/VOLUME OUTSIDE OF HISTORIC NORMS

4.1 Description

The Seepage Pond at the toe of the tailings impoundment collects shallow groundwater seepage from the tailings area. The seepage collected in the pond is continuously pumped to Dome Creek. The maximum design operating level of the Seepage Pond is 1078.1 masl. The pond water levels are measured daily, during open water, via a staff gauge. The discharge pumping rate is measured daily via an inline flowmeter (H-SEEP) installed in 2012 and routinely checked using timed volumetric measurements. Assessment of the water level and water level rate of change triggers occur during the open water season only, while assessment of the pumping rate occurs year round.

The environmental consequence of changes in the Seepage Pond inflows/volumes above historic norms is the potential exposure of aquatic and terrestrial resources, and human users to increased levels of contaminants in the downstream receiving environment in Victoria Creek due to increased seepage from the tailings impoundment area. In addition, as a result of seepage inflows above or below historic norms, there are concerns related to the stability of the dam structure including, dam failure or reduction in hydro-static pressure.

A summary of the current AMP information for Event 3 is provided in Table 5.

Table 5: Summary of AMP Event 3 Thresholds

Indicators	Locations	Thresholds	Frequency
Seepage Pond pumping rate Seepage Pond water level Seepage Pond water level rate of change	H-SEEP	• Four consecutive average weekly results greater than the upper 95th percentile or lower than the lower 5th percentile of the 2012 to 2013 data record on a year round basis for the pumping rate and during open water for the water level and water level rate of change; or • A statistically significant (0.05) increasing or decreasing trend in the monitoring results on a year round basis for the pumping rate and during open water for the water level and water level rate of change. For the purposes of AMP trend line development, data from 2012 on will be used for the trend analysis.	Daily

4.2 AMP Event 3 – Data Review

Assessment under the AMP of the relevant water level and discharge data from H-SEEP was carried out using the June 2016 data.

The results of the assessment are summarized in Table 6.

Table 6: Summary of AMP Event 3 Assessment – H-SEEP

Indicators	Trigger Activation	Results
Seepage Pond pumping rate	Yes	• Throughout June, the average weekly Seepage Pond pumping rates (125.43 to 139.57 L/min) did not exceed the upper 95th percentile threshold (240.12 L/min). • Throughout June, the average weekly Seepage Pond pumping rates (125.43 to 139.57 L/min) were below the 5th percentile threshold (156 L/min) three out of four weeks. • Statistically significant decreasing trend in the Seepage Pond pumping rate.
Seepage Pond water level	Yes	• Throughout June, the average weekly Seepage Pond water levels (1077.1 masl) did not exceed the upper 95th percentile threshold (1077.5 masl). • Throughout June, the average weekly Seepage Pond water levels (1077.1 masl) were not below the 5th percentile threshold (1077.1 masl). • Statistically significant decreasing trend in the Seepage Pond water levels.
Seepage Pond water level rate of change	No	• Throughout June, the average weekly Seepage Pond water level rate of change (0.00 m/day) did not exceed the upper 95th percentile threshold (0.092 masl). • Throughout June, the average weekly Seepage Pond

		water level rate of change (0.00 m/day) was not below the upper 5th percentile threshold (- 0.1 masl). • Decreasing trend in the Seepage Pond water level rate of change, but not statistically significant.

4.3 Follow-up Action Required

The Seepage Pond pumping rate trigger was activated in June by a statistically significantly decreasing trend in the Seepage Pond pumping rate.

5.0 AMP EVENT 4 – DEGRADED WATER QUALITY IN DOME CREEK DOWNSTREAM OF MINE FACILITIES

5.1 Description

Dome Creek, downstream of the tailing impoundment area, receives inputs from the mine site via direct discharge from the Seepage Pond, inflows from the mill area, and seepage and groundwater inflows from mine site facilities. The water quality in Dome Creek below the mine site facilities is measured at stations WQ-DC-U and WQ-DC-R. Station WQ-DC-U is located downstream of the confluence of Dome Creek and the Seepage Pond discharge and station WQ-DC-R is located in Dome Creek at the mine access road crossing. Water quality samples are collected monthly, with the exception of spring. At this time, an additional sample is collected during freshet. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

The water quality in Dome Creek, below the mine site facilities, shows a clear mine-related influence with elevated concentrations of key contaminants of concern including sulphate, arsenic, iron, manganese, cadmium, and zinc. Total and WAD cyanide is also present in Dome Creek below the mine facilities, although at concentrations typically well below the CCME guidelines.

A summary of the AMP thresholds for Event 4 is provided in Table 7.

Table 7: Summary of AMP Event 4 Thresholds

Indicators	Locations	Thresholds	Frequency
Sulphate Total and Dissolved Arsenic Total Cadmium Total Zinc Total and Dissolved Iron Total and Dissolved Manganese	WQ-DC-U and WQ-DC-R	• Three consecutive monitoring results at WQ-DC-U or WQ-DC-R greater than the upper 95th percentile of the reference period (2008 to 2013); or, • A statistically significant (0.05) increasing trend in the monitoring results from WQ-DC-U or WQ-DC-R which, when extrapolated forward one year, would result in values greater than the 95th percentile. For the purposes of AMP trend line development, data from 2008 and on is used for the trend analysis.	Monthly

5.2 AMP Event 4 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-DC-U and WQ-DC-R was carried out using the June 2016 water quality data. The results of the assessment are summarized in Tables 8 and 9.

Table 8: Summary of AMP Event 4 Assessment – WQ-DC-U

Indicators	Trigger Activation	Results
Sulphate	No	• June concentration (510.0 mg/L) was below the 95th percentile threshold (785.1 mg/L). • Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95th percentile threshold value for another 5 years.
Total Arsenic	No	• June concentration (0.049 mg/L) was below the 95th percentile threshold (0.052 mg/L). • Statistically significant increasing trend in total arsenic concentrations but not estimated to reach 95th percentile threshold value for another 5 years.
Dissolved Arsenic	No	• June concentration (0.010 mg/L) was below the 95th percentile threshold (0.031 mg/L). • Statistically significant increasing trend in dissolved arsenic concentrations but not estimated to reach threshold value for another 3 years.
Total Cadmium	No	• June concentration (0.00030 mg/L) was below 95th percentile threshold (0.00066 mg/L). • Decreasing trend, but not statistically significant.
Total Iron	No	• June concentration (5.71 mg/L) was below the 95th percentile threshold (10.5 mg/L). • Increasing trend, but not statistically significant.
Dissolved Iron	No	• June concentration (0.22 mg/L) was below the 95th percentile threshold (5.35 mg/L). • Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 6 years.
Total Manganese	No	• June concentration (1.19 mg/L) was below the 95th percentile threshold value of 5.94 mg/L. • Increasing trend, but not statistically significant.
Dissolved Manganese	No	• June concentration (1.05 mg/L) was below the 95th percentile threshold value of 5.68 mg/L. • Increasing trend, but not statistically significant.
Total Zinc	No	• June concentration (0.032 mg/L) was below the 95th percentile threshold (0.090 mg/L).

Indicators	Trigger Activation	Results
		• Decreasing trend, though not statistically significant.

Table 9: Summary of AMP Event 4 Assessment – WQ-DC-R

Indicators	Trigger Activation	Results
Sulphate	No	• June concentration (445.0 mg/L) was below the 95th percentile threshold (490.8 mg/L). • Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95th percentile threshold value for another 4 years.
Total Arsenic	No	• June concentration (0.024 mg/L) was below the 95th percentile threshold (0.055 mg/L). • Statistically significant decreasing trend.
Dissolved Arsenic	No	• June (average) concentration (0.006 mg/L) was below the 95th percentile threshold (0.018 mg/L) • Increasing trend, but not statistically significant.
Total Cadmium	No	• June concentration (0.00009 mg/L) was below 95th percentile threshold (0.00044 mg/L). • Decreasing trend, but not statistically significant.
Total Iron	No	• June concentration (1.85 mg/L) was below the 95th percentile threshold (6.09 mg/L). • Decreasing trend, but not statistically significant.
Dissolved Iron	No	• June concentration (0.49 mg/L) was below the 95th percentile threshold (1.58 mg/L). • Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 3 years.
Total Manganese	No	• June concentration (0.69 mg/L) was below the 95th percentile threshold value of 2.96 mg/L. • Increasing trend, but not statistically significant.
Dissolved Manganese	No	• June concentration (0.66 mg/L) was below the 95th percentile threshold value of 2.56 mg/L. • Increasing trend, but not statistically significant.
Total Zinc	No	• June concentration (0.009 mg/L) was below the 95th percentile threshold (0.068 mg/L). • Statistically significant decreasing trend.

5.3 Follow-up Action Required

No AMP triggers were activated at WQ-DC-U or WQ-DC-R under AMP Event 4 during the June 2016 assessment. Therefore no follow up is required at this time.

6.0 AMP EVENT 5 – DEGRADED WATER QUALITY IN VICTORIA CREEK AT MINE ACCESS ROAD

6.1 Description

Victoria Creek, downstream of the mine site area, receives inputs from the mine site from surface water inflows and from groundwater inflows from mine site facilities. The receiving environment for the site is represented by sampling location WQ-VC-R. This location is downstream of inputs from both Dome and Back Creek, and includes all potential mine related inputs to the receiving environment. In contrast to Dome Creek, Victoria Creek is known to support fish and fish habitat. The water quality in Victoria Creek at WQ-VC-R is collected monthly, with the exception of spring. At this time, an additional sample is collected during freshet. During winter, water quality in this area is sampled 150 m downstream at WQ-VC-R+150. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

The water quality in Victoria Creek, below the mine site facilities, shows a clear mine-related influence with elevated concentrations of key contaminants of concern, compared to background, including sulphate, dissolved arsenic, dissolved iron, dissolved manganese, dissolved cadmium, and dissolved zinc. The water quality at WQ-VC-R is also significantly influenced by elevated levels of suspended solids from both natural and anthropogenic sources (including placer mining in the Back Creek and Pony Creek watersheds). Due to this influence of upstream sediment inputs, the development of the AMP Event for Victoria Creek is based on dissolved metals. Taking this approach enables the isolation of site-related influences and eliminates the interfering effects of elevated suspended solids contributed from upstream, in the Victoria Creek catchment.

A summary of the AMP thresholds for Event 5 is provided in Table 10.

Table 10: Summary of AMP Event 5 Thresholds

Indicators	Locations	Thresholds	Frequency
Sulphate Dissolved Arsenic Dissolved Cadmium Dissolved Zinc Dissolved Iron Dissolved Manganese	WQ-VC-R or WQ-VC-R+150	• Three consecutive monitoring results at WQ-VC-R or WQ-VC-R+150 greater than the upper 95th percentile of the reference period (2008 to 2013); or • A statistically significant (0.05) increasing trend in the monitoring results from WQ-VC-R or WQ-VC-R+150 which, when extrapolated forward one year, would result in values greater than the 95th percentile. For the purposes of AMP trend line development, data from 2008 and on will be used for the trend analysis.	Monthly

6.2 AMP Event 5 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-VC-R was carried out using the June 2016 water quality data. The results of the assessment are summarized in Table 11.

Table 11: Summary of AMP Event 5 Assessment

Indicators	Trigger Activation	Results
Sulphate	No	• June concentration (36.9 mg/L) was below the 95th percentile threshold (45.9 mg/L). • Increasing trend, but not statistically significant.
Dissolved Arsenic	No	• June concentration (0.0009 mg/L) was below the 95th percentile threshold (0.002 mg/L). • Decreasing trend, but not statistically significant.
Dissolved Cadmium	No	• June (average) concentration (0.00002 mg/L) was below the 95th percentile threshold (0.00009 mg/L). • Decreasing trend, but not statistically significant.
Dissolved Iron	No	• June concentration (0.088 mg/L) was below the 95th percentile threshold (0.270 mg/L). • Increasing trend, but not statistically significant.
Dissolved Manganese	No	• June concentration (0.049 mg/L) was below the 95th percentile threshold (0.120 mg/L). • Increasing trend, but not statistically significant.
Dissolved Zinc	No	• June concentration (0.0053 mg/L) was below the 95th percentile threshold (0.0082 mg/L). • Decreasing trend, but not statistically significant.

6.3 Follow-up Action Required

No AMP triggers were activated at WQ-VC-R under AMP Event 5 during the June 2016 assessment. Therefore no follow up is required at this time.

7.0 AMP EVENT 6 – DEGRADED WATER QUALITY IN PONY CREEK DOWNSTREAM OF MINE AREA

7.1 Description

The water quality in Pony Creek downgradient of the mine area (below the Brown-McDade Pit) is currently affected by the historic practice of depositing waste rock within the stream channel. The water quality in Pony Creek in this area is measured monthly, when flowing, at WQ-PC-D with the exception of spring. At this time, an additional sample is collected during freshet. The collected water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, total and dissolved metals.

The environmental consequence of degraded water quality in Pony Creek is the potential exposure of aquatic and terrestrial resources, and human users to increased levels of contaminants. Water quality in Pony Creek in this area shows a clear site-related influence with elevated levels of total cadmium, copper and zinc in comparison to background water quality.

A summary of the AMP thresholds for Event 6 is provided in Table 12.

Table 12: Summary of AMP Event 6 Thresholds

Indicators	Locations	Thresholds	Frequency
Total Cadmium Total Copper Total Zinc	WQ-PC-D	• Three consecutive monitoring results at WQ-PC-D greater than the upper 95th percentile of the reference period (2008 to 2013); or • A statistically significant increasing trend in the monitoring results from WQ-PC-D when extrapolated forward one year, would result in values greater than the 95th percentile. This trend assessment will be carried out using the trend analysis technique outlined in Section 2.4 of the AMP Protocol. For the purposes of AMP trend line development, data for WQ-PC-D from 2008 and on will be used for the trend analysis.	Monthly

7.2 AMP Event 6 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-PC-D was carried out using the June 2016 water quality data.

Table 13: Summary of AMP Event 6 Assessment

Indicators	Trigger Activation	Results
Total Cadmium	No	• June concentration (0.0042 mg/L) was below the 95th percentile threshold (0.0044 mg/L). • Increasing trend, but not statistically significant.
Total Copper	No	• June concentration (0.093 mg/L) was above the 95th percentile threshold (0.040 mg/L) but was not part of 3 consecutive exceedances. • Increasing trend, but not statistically significant.
Total Zinc	No	• June concentration (0.63 mg/L) was above the 95th percentile threshold (0.42 mg/L) but was not part of 3 consecutive exceedances. • Increasing trend, but not statistically significant.

7.3 Follow-up Action Required

No AMP triggers were activated at WQ-PC-D under AMP Event 6 during the June 2016 assessment. Therefore no follow up is required at this time.

8.0 AMP EVENT 7 - CHANGES IN PIT WATER LEVEL ELEVATION OUTSIDE OF HISTORIC NORMS

8.1 Description

The water quality in the Brown-McDade Pit between 2008 and 2013 was above the reference Environmental Quality Standards (EQS) for several parameters including iron, manganese and zinc. The water level in the Pit fluctuated between approximately 1181 masl and 1184 masl during this period. Water is not actively discharged from the pit. The water balance of the pit is dominated by precipitation and runoff from its immediate catchment, although there is a continual discharge from the Pit via groundwater, estimated at approximately 0.5 L/s (AMEC 2014a, referenced in SLR Consulting 2015). Annually the water level in the pit starts to rise in spring with the onset of freshet and steadily increases until the end of the open water season. During winter, the water level then drops in response to the continuous discharge via groundwater. Although there is no operational target for the Pit, the elevation of the Pony Creek Adit (1185 masl) provides a maximum water elevation limit. The pit water elevation level was measured continuously via a level logger which was downloaded routinely as part of the site routine monitoring program.

The environmental consequence of changes in the Pit water level outside of historic norms is the potential exposure of aquatic and terrestrial resources and human users to increased contaminant loading to the downstream receiving environment of Pony, Dome and Victoria Creeks.

The specific thresholds or triggers that will initiate an action plan are:

- Four consecutive average weekly Pit water level results greater than the upper 95th percentile (1184.09 masl) or lower than the lower 5th percentile (1181.79 masl) of the 2010 to 2013 data record; or
- A deviation from the typical Pit annual water level pattern: increasing during open water and decreasing during winter.

Since at least July 2015, safety issues regarding access to the pit due to potential pit wall instabilities were identified, limiting access to the Brown McDade Pit.

8.2 AMP Event 7 – Data Review

While data from leveloggers has been downloaded and reported, on at least two occasions since July 2015 (including in June 2016), associated information required to interpret the data, such as barologger readings (to permit adjustment of data based on atmospheric pressure changes) and the elevation at which the levelogger was installed (to convert water levels to elevations), remain unavailable. Further, based on June comments from the field, it remains unclear that the levelogger has remained in a location appropriate for measurement of the pit water levels. The installation of a venting levelogger that can be remotely downloaded may provide an alternate method for measuring the water levels, though a safe window for access to the pit would have to be identified to permit the installation. Radio tower line of site to the logger would also have to be confirmed.

The water level in the Brown-McDade Pit has been manually measured on three occasions using a surveying level and rod and reported:

- Jul. 6, 2015: 1180.691 masl;
- Nov. 3, 2015: 1181.071 masl;
- June 24, 2016: 1179.671 masl.

These elevations are all below lower 5th percentile elevations of the AMP reference period of 1181.79 masl. The visual observation notation that the water level in the pit was low complimented the June 2016 water level measurement.

The above data is reported with the following caveat: A new benchmark was installed in 2014 that has been used for a reference elevation for these surveys, presumably since its installation (i.e.was used for all of the above reported surveyed measurements). There is the potential that the current site datum and/or control elevation was shifted in comparison with the AMP reference period, and this has yet to be confirmed. Until this is confirmed, it remains unclear whether or not the manual measurements can be directly compared with the AMP reference period elevations.

8.3 Follow-up Action Required

As evaluation of the three AMP events related to the Brown-McDade Pit have not been able to be assessed due to the various limitations noted in the Introduction of this monthly assessment, and these limitations have existed for over a year, it is recommended that the inability to evaluate events under the AMP for an extended period be a potential trigger for response be considered.

As water levels in the pit are controlled by precipitation and run-off, lower water levels in the pit could result in decreased pit water quality as dilution of groundwater baseflows may be decreased. Current water quality in the pit is unknown, as the pit wall instabilities have made the pit unsafe to access for sampling.

It is recommended that some thought be given towards whether or not alternate methods to evaluate the AMP events can be developed. For example, it may be possible to develop a water balance using site meteorological station precipitation data to verify precipitation levels, calibrated against precipitation data during the reference period and measured pit elevations. Monthly water balance evaluation could provide an estimation of pit water levels.