



## ***Memorandum***

**To:** Emilie Hamm **From:** SLR Consulting (Canada) Ltd.

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**Company:** Government of Yukon  
Assessment and Abandoned Mines

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**cc:** **Date:** November 22, 2016

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**Subject:** ***FINAL - MOUNT NANSEN MINE  
AMP MONTHLY ASSESSMENT – SEPTEMBER 2016***

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### **1.0 INTRODUCTION**

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

The following Events are not included in this monthly assessment:

- AMP Event 7 - Changes in Pit Water Level Elevation outside of Historic Norms
  - Due to on-going pit-wall stability concerns, data required for the AMP assessment will not be collected and AMP Event 7 will not be assessed on a monthly basis until further notice.
- AMP Event 8 - Changes in Groundwater Quality Downgradient of the Brown-McDade Pit
  - Assessment of this AMP event is carried out on a bi-annual basis in the spring and fall and was last reported on in the June 2016 AMP assessment. The spring assessment was not completed for June 2016 due to lack of sufficient sampling data for 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

For assessment of Event 9, water quality sampling of the Brown-McDade Pit is required, monthly, and this monthly data is then evaluated annually under the AMP. Due to on-going pit-wall stability concerns, data required for the AMP assessment has not been collected since July 2015.

Note that as it has not been possible to conduct an assessment of the three AMP events related to the Brown-McDade Pit in over a year, it is recommended that AAM consider alternate means of assessing the effects of the Brown-McDade pit and drainage on the downgradient environment.

## 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	<ul style="list-style-type: none"> <li>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,</li> <li>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.</li> </ul>	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 September 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	<ul style="list-style-type: none"> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Total Arsenic	No	<ul style="list-style-type: none"> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Arsenic	No	<ul style="list-style-type: none"> <li>September dissolved arsenic concentration of 0.01 mg/L was below the Management Threshold of 0.15 mg/L.</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Total Cadmium	No	<ul style="list-style-type: none"> <li>September total cadmium concentration of 0.001 mg/L was below the Management Threshold of 0.02 mg/L.</li> <li>Statistically significant decreasing trend in total cadmium concentrations.</li> </ul>
Total Zinc	No	<ul style="list-style-type: none"> <li>September total zinc concentration of 0.3 mg/L was at the Management Threshold of 0.3 mg/L.</li> <li>Statistically significant decreasing trend in total zinc concentrations.</li> </ul>

### 2.3 Follow-Up Action Required

No AMP triggers were activated at WQ-DC-D1b under AMP Event 1 during the September 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. 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.

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	<ul style="list-style-type: none"> <li>• Monitoring results at WQ-SEEP above the reference EQS for Dissolved Arsenic (0.15 mg/L), Total Iron (1.0 mg/L), 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,</li> <li>• Three consecutive monitoring results at WQ-SEEP greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>• A statistically significant increasing trend (0.05) which, when extrapolated forward one year, would result in values greater than the 95<sup>th</sup> 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.</li> </ul>	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 September 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	<ul style="list-style-type: none"> <li>September sulphate concentration (622 mg/L) was below the 95<sup>th</sup> percentile threshold value of 822.6 mg/L.</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach the threshold value for another 7 years.</li> </ul>
Total Cyanide	No	<ul style="list-style-type: none"> <li>September concentration (0.02 mg/L) was below the EQS threshold value of 0.300 mg/L.</li> <li>Total cyanide concentration in September was below the 95<sup>th</sup> percentile threshold value of 0.076 mg/L.</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
WAD Cyanide	No	<ul style="list-style-type: none"> <li>September concentration (0.009 mg/L) was below the EQS threshold value (0.1 mg/L).</li> <li>WAD Cyanide concentration was below the 95<sup>th</sup> percentile threshold (0.035 mg/L).</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Total Arsenic	Yes	<ul style="list-style-type: none"> <li>The arsenic concentration in September (0.052 mg/L) was below the 95<sup>th</sup> percentile threshold value of 0.057 mg/L.</li> <li>Statistically significant increasing trend estimated to reach the threshold value (0.057 mg/L) in less than 1 year.</li> </ul>
Dissolved Arsenic	Yes	<ul style="list-style-type: none"> <li>September concentration (0.038 mg/L) was below the EQS threshold value of 0.15 mg/L.</li> <li>The dissolved arsenic concentration in September was above the 95<sup>th</sup> percentile threshold value of 0.035 mg/L.</li> <li>Statistically significant increasing trend in dissolved arsenic concentrations, estimated to reach the 95<sup>th</sup> percentile threshold value (0.035 mg/L) in less than 1 year.</li> </ul>
Total Cadmium	No	<ul style="list-style-type: none"> <li>September concentration (0.00037 mg/L) was below EQS threshold of 0.02 mg/L.</li> <li>September concentration was below the 95<sup>th</sup> percentile threshold of 0.00117 mg/L.</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Total Iron	Yes	<ul style="list-style-type: none"> <li>September concentration (6.64 mg/L) is above the EQS threshold of 1.0 mg/L and concentrations have been since at least 2008.</li> <li>September concentration was below the 95<sup>th</sup> percentile threshold of 20.8 mg/L.</li> <li>Non-significant increasing trend in concentrations.</li> </ul>

Indicators	Trigger Activation	Results
Dissolved Iron	Yes	<ul style="list-style-type: none"> <li>September concentration (5.06 mg/L) was below the 95<sup>th</sup> percentile threshold of 9.67 mg/L.</li> <li>Statistically significant increasing trend estimated to reach 95<sup>th</sup> percentile threshold value in less than 1 year.</li> </ul>
Total Manganese	Yes	<ul style="list-style-type: none"> <li>September concentration (5.42 mg/L) was above EQS threshold of 0.5 mg/L and has been since 2008.</li> <li>September concentration was below the 95<sup>th</sup> percentile threshold value of 9.2 mg/L.</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Dissolved Manganese	No	<ul style="list-style-type: none"> <li>September concentration (5.3 mg/L) was below the 95<sup>th</sup> percentile threshold value of 8.8 mg/L.</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Total Zinc	Yes	<ul style="list-style-type: none"> <li>September concentration (0.035 mg/L) was below the EQS threshold of 0.3 mg/L.</li> <li>September concentration was above the 95<sup>th</sup> percentile threshold value of 0.028 mg/L.</li> <li>Statistically significant increasing trend estimated to reach 95<sup>th</sup> percentile threshold value in less than 1 year.</li> </ul>

### 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 trends 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	<ul style="list-style-type: none"> <li>Four consecutive average weekly results greater than the upper 95<sup>th</sup> percentile or lower than the lower 5<sup>th</sup> 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</li> <li>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.</li> </ul>	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 September 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	<ul style="list-style-type: none"> <li>Throughout September, the average weekly Seepage Pond pumping rates (157.14 to 171.79 L/min) did not exceed the upper 95<sup>th</sup> percentile threshold (240.12 L/min).</li> <li>Throughout September, the average weekly Seepage Pond pumping rates (157.14 to 171.79 L/min) were not below the 5<sup>th</sup> percentile threshold (156 L/min).</li> <li>Statistically significant decreasing trend in the Seepage Pond pumping rate.</li> </ul>
Seepage Pond water level	Yes	<ul style="list-style-type: none"> <li>Throughout September, the average weekly Seepage Pond water levels (1077.2 masl) did not exceed the upper 95<sup>th</sup> percentile threshold (1077.5 masl).</li> <li>Throughout September, the average weekly Seepage Pond water levels (1077.2 masl) were not below the 5<sup>th</sup> percentile threshold (1077.1 masl).</li> <li>Statistically significant decreasing trend in the Seepage Pond water levels.</li> </ul>
Seepage Pond water level rate of change	No	<ul style="list-style-type: none"> <li>Throughout September, the average weekly Seepage Pond water level rate of change (-0.01 to 0.01 m/day) did not exceed the upper 95<sup>th</sup> percentile threshold (0.092 masl).</li> <li>Throughout September, the average weekly Seepage Pond water level rate of change (-0.01 to 0.01 m/day) was not below the upper 5<sup>th</sup> percentile threshold (- 0.1 masl).</li> <li>Non-significant decreasing trend in the Seepage Pond water level rate of change.</li> </ul>

#### 4.3 Follow-up Action Required

The Seepage Pond pumping rate trigger was activated in September by a statistically significant decreasing trend in the Seepage Pond pumping rate. Pumping rates did however increase in September and pumping rate averages remained within the range bounded by the lower 5<sup>th</sup> percentile and 95<sup>th</sup> percentile. A similar pattern of increased pumping rates in August and September occurred in 2015 as well. Flow rates were last verified by volumetric measurement in August 2016.

The Seepage Pond water level trigger was also activated in September by a statistically significant decreasing trend in water levels. Consultation with a Geotechnical Engineer in October 2016 concluded however that there are no concerns with respect to dam instability caused by low upstream water levels and low seepage pumping rates, and erosion on the upstream face of the dam is not likely to affect the integrity of the dam. For additional details on this assessment, see the August 2016 AMP assessment memo.



## 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	<ul style="list-style-type: none"> <li>Three consecutive monitoring results at WQ-DC-U or WQ-DC-R greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or,</li> <li>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 95<sup>th</sup> percentile. For the purposes of AMP trend line development, data from 2008 and on is used for the trend analysis.</li> </ul>	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 September 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	<ul style="list-style-type: none"> <li>September concentration (443.0 mg/L) was below the 95<sup>th</sup> percentile threshold (785.1 mg/L).</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 7 years.</li> </ul>
Total Arsenic	No	<ul style="list-style-type: none"> <li>September concentration (0.026 mg/L) was below the 95<sup>th</sup> percentile threshold (0.052 mg/L).</li> <li>Statistically significant increasing trend in total arsenic concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 12 years.</li> </ul>
Dissolved Arsenic	No	<ul style="list-style-type: none"> <li>September concentration (0.010 mg/L) was below the 95<sup>th</sup> percentile threshold (0.031 mg/L).</li> <li>Statistically significant increasing trend in dissolved arsenic concentrations but not estimated to reach threshold value for another 4 years.</li> </ul>
Total Cadmium	No	<ul style="list-style-type: none"> <li>September concentration (0.00024 mg/L) was below 95<sup>th</sup> percentile threshold (0.00066 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Total Iron	No	<ul style="list-style-type: none"> <li>September concentration (5.01 mg/L) was below the 95<sup>th</sup> percentile threshold (10.5 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Iron	No	<ul style="list-style-type: none"> <li>September concentration (0.49 mg/L) was below the 95<sup>th</sup> percentile threshold (5.35 mg/L).</li> <li>Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 12 years.</li> </ul>
Total Manganese	No	<ul style="list-style-type: none"> <li>September concentration (0.88 mg/L) was below the 95<sup>th</sup> percentile threshold value of 5.94 mg/L.</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Manganese	No	<ul style="list-style-type: none"> <li>September concentration (0.89 mg/L) was below the 95<sup>th</sup> percentile threshold value of 5.68 mg/L.</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Total Zinc	No	<ul style="list-style-type: none"> <li>September concentration (0.033 mg/L) was below the 95<sup>th</sup> percentile threshold (0.090 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>

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

Indicators	Trigger Activation	Results
Sulphate	No	<ul style="list-style-type: none"> <li>September concentration (358 mg/L) was below the 95<sup>th</sup> percentile threshold (490.8 mg/L).</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 8 years.</li> </ul>
Total Arsenic	No	<ul style="list-style-type: none"> <li>September concentration (0.014 mg/L) was below the 95<sup>th</sup> percentile threshold (0.055 mg/L).</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Dissolved Arsenic	No	<ul style="list-style-type: none"> <li>September concentration (0.008 mg/L) was below the 95<sup>th</sup> percentile threshold (0.018 mg/L)</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Total Cadmium	No	<ul style="list-style-type: none"> <li>September concentration (0.00004 mg/L) was below 95<sup>th</sup> percentile threshold (0.00044 mg/L).</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>
Total Iron	No	<ul style="list-style-type: none"> <li>September concentration (1.35 mg/L) was below the 95<sup>th</sup> percentile threshold (6.09 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Dissolved Iron	No	<ul style="list-style-type: none"> <li>September concentration (0.42 mg/L) was below the 95<sup>th</sup> percentile threshold (1.58 mg/L).</li> <li>Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 5 years.</li> </ul>
Total Manganese	No	<ul style="list-style-type: none"> <li>September concentration (0.49 mg/L) was below the 95<sup>th</sup> percentile threshold value of 2.96 mg/L.</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Dissolved Manganese	No	<ul style="list-style-type: none"> <li>September concentration (0.52 mg/L) was below the 95<sup>th</sup> percentile threshold value of 2.56 mg/L.</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Total Zinc	No	<ul style="list-style-type: none"> <li>September concentration (0.005 mg/L) was below the 95<sup>th</sup> percentile threshold (0.068 mg/L).</li> <li>Statistically significant decreasing trend in concentrations.</li> </ul>

### 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 September 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 Creeks, 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	<ul style="list-style-type: none"> <li>Three consecutive monitoring results at WQ-VC-R or WQ-VC-R+150 greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>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 95<sup>th</sup> percentile. For the purposes of AMP trend line development, data from 2008 and on will be used for the trend analysis.</li> </ul>	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 September 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	<ul style="list-style-type: none"> <li>September concentration (28.1 mg/L) was below the 95<sup>th</sup> percentile threshold (45.9 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Arsenic	No	<ul style="list-style-type: none"> <li>September concentration (0.0009 mg/L) was below the 95<sup>th</sup> percentile threshold (0.002 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Dissolved Cadmium	No	<ul style="list-style-type: none"> <li>September concentration (0.00002 mg/L) was below the 95<sup>th</sup> percentile threshold (0.00009 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Dissolved Iron	No	<ul style="list-style-type: none"> <li>September concentration (0.11 mg/L) was below the 95<sup>th</sup> percentile threshold (0.270 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Manganese	No	<ul style="list-style-type: none"> <li>September concentration (0.051 mg/L) was below the 95<sup>th</sup> percentile threshold (0.120 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Dissolved Zinc	No	<ul style="list-style-type: none"> <li>September concentration (0.0024 mg/L) was below the 95<sup>th</sup> percentile threshold (0.0082 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>

### 6.3 Follow-up Action Required

No AMP triggers were activated at WQ-VC-R under AMP Event 5 during the September 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	<ul style="list-style-type: none"> <li>Three consecutive monitoring results at WQ-PC-D greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>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 95<sup>th</sup> 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.</li> </ul>	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 September 2016 water quality data.

The results of the assessment are summarized in Table 13.

**Table 13: Summary of AMP Event 6 Assessment**

Indicators	Trigger Activation	Results
Total Cadmium	No	<ul style="list-style-type: none"> <li>September concentration (0.0018 mg/L) was below the 95<sup>th</sup> percentile threshold (0.0044 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>
Total Copper	No	<ul style="list-style-type: none"> <li>September concentration (0.031 mg/L) was below the 95<sup>th</sup> percentile threshold (0.040 mg/L).</li> <li>Non-significant decreasing trend in concentrations.</li> </ul>
Total Zinc	No	<ul style="list-style-type: none"> <li>September concentration (0.17 mg/L) was below the 95<sup>th</sup> percentile threshold (0.42 mg/L).</li> <li>Non-significant increasing trend in concentrations.</li> </ul>

**7.3 Follow-up Action Required**

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