



Coeur Alaska Inc.
Kensington Gold Project
APDES ANNUAL REPORT
Volume 2: Water Quality
2013



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1.0 Introduction

This volume of the Annual Water Quality Monitoring Summary report contains the results of water quality monitoring conducted in 2013 in accordance with the requirements of the Alaska Pollutant Discharge Elimination System (APDES Permit No. AK0050571) for the Kensington Gold Mine, near Juneau, Alaska. A graphical presentation of water quality data collected at both outfalls and receiving water monitoring stations, along with tabular summary statistics is included in this summary report.

Please note that due to agency requests for historical data, graphical representation of data from 2006-2013 are presented for Outfall 001 and all receiving water stations with the exception of stations SMP-5 and SH113. SMP- 5 sampling began in 2009 and SH113 sampling began in 2007. Additionally, sampling at Outfall 002 did not commence until December 2010, in line with the commissioning of the Tailings Treatment Facility (TTF) Water Treatment Plant (WTP).

2.0 Methods

Monitoring of water quality at Outfall 001 (treated mine discharge) and Outfall 002 (treated tailings pond water) occurred during 2013 as required by the APDES permit. In addition to outfall sampling, monitoring was conducted at four receiving water streams (Johnson, Slate, Sherman and Ophir Creeks) for ambient upstream and downstream water quality. The following list describes the sampling activities at these outfalls and receiving water stations:

2.1 Monitoring Currently Active

- Continuous monitoring of flow and pH at Outfall 001 effluent; daily samples from the effluent of Outfall 001 for total suspended solids (TSS) analysis; weekly water sampling of the effluent for analysis of field, general and trace parameters; quarterly sampling of the effluent for TDS anions and cations; monthly sampling of the effluent for whole effluent toxicity testing.
- Continuous monitoring of flow and pH at Outfall 002 effluent along with; daily samples from the effluent of Outfall 002 for total suspended solids (TSS) analysis; weekly water sampling at Outfall 002 effluent for analysis of field, general and trace parameters; monthly

sampling of the effluent for whole effluent toxicity testing. Monthly receiving water field, general and trace parameters from stations MLA, SMP-5 (twice monthly for manganese), SLB and SLC on Slate Creek; stations SH113 (twice monthly for manganese), SH105, SH109 on Sherman Creek; stations JS2, JS4 and JS5 on Johnson Creek. Stations SH111 and SH103 on Ophir Creek were also sampled monthly.

2.2 Monitoring Currently Suspended

- No monitoring is currently suspended.

2.3 Changes during 2013 Monitoring

- Four field-scale test cells were constructed in August of 2013 to assess the environmental stability of the graphitic phyllite material. The testing program is aimed at providing an evaluation of the weathering behavior of the graphitic phyllite present at the TTF west abutment under ambient conditions. On-going water quality monitoring of these field cells will continue throughout 2014.
- The commencement of Pit 3 acid rock drainage inspections

3.0 QC Summary

3.1 Plan QC

Coeur Alaska has complied with the approved Quality Assurance Project Plan (QAPP) for the 2013 water quality data. At least ten percent of all lab reports are reviewed for issues pertinent to the five categories of quality control:

- Precision
- Accuracy
- Comparability
- Representativeness
- Completeness

Based on the results of this review, lab reports, individual samples, or individual parameters within samples may be qualified on a variety of issues as:

- Accepted

-
- Estimated
 - Rejected

No data were rejected from the 2013 dataset. During 2008, Coeur implemented the practice of completing the QA/QC review of all data gathered for the NPDES permit on a monthly basis in conjunction with preparation of the monthly Discharge Monitoring Report. This was continued through 2013 to allow for timely resolution of any issues identified during the QA/QC review with the contract laboratory or field personnel.

3.1.1 Precision- Field Blind Duplicate Comparison

Precision is a qualitative measure of the reproducibility of a measurement under a given set of conditions. Precision in the analytical results of laboratory analysis is determined by laboratory quality control measures such as duplicate matrix spikes and sample duplicates. The plan criterion for laboratory precision is a relative percent difference between duplicate samples of less than or equal to 20%. In addition, field blind duplicate sample pairs, which are collected throughout the year, are also used as a quality control for precision in the laboratory results.

Receiving water sample field duplicates are selected and collected on a random basis. The total number of receiving water field duplicates collected during 2013 was 35. The relative percent difference (RPD) was calculated for each duplicated parameter. 4.0% of all duplicated parameter results were greater than 20% RPD and therefore did not pass the precision criteria. Compared with previous years, 2012 had a 7.5 % failure, 2011 had a 5% failure, 9% in 2010, 6% in 2009, 7% in 2008 and 12% in 2007. No field blind duplicates were collected from either Outfall 001 or Outfall 002. The results of comparisons between duplicate sets are tabulated in **Appendix A**.

3.1.2 Accuracy

Accuracy in the analytical results of laboratory analysis is determined by percent recovery of laboratory quality control measures such as matrix spikes, control samples and method blanks. The criterion for accuracy in most analytical procedures is a percent recovery between 85 and 115 percent. Less than 1 % of all sample results typically fail this criterion and are qualified

appropriately in the database. Accuracy in field measurements is controlled and verified by using calibrated instruments. Field meters were calibrated prior to their use during 2013 monitoring.

3.1.3 Representativeness

Representativeness is controlled by sampling plan design, sampling techniques and sample handling procedures.

3.1.4 Comparability

Comparability is maintained by using consistent sampling and analytical methods as well as consistent units of measurement. ALS Environmental, formerly Columbia Analytical Services located in Kelso, Washington has conducted all NPDES/APDES water quality analyses since March 2008. This has helped maintain comparability within data sets. In addition, the sample and data management process is streamlined.

3.1.5 Completeness

As stated in the QAPP for the Kensington Gold Project, the completeness criterion goal for monitoring data is 90% due to the extreme conditions observed on site. Overall data capture was close to 100% for 2013. Two field parameters were missed at Outfall 001 and one at Outfall 002. All other sites had 100% data collection unless there was no flowing water; such was the case at Ophir Creek site SH111 in January, February, March, April and again in March for site SH103.

3.2 Detection

The laboratory Practical Quantitation Limit (PQL) remained consistent for each analytical method during all 2013 for all water quality monitoring. Arsenic, lead, silver and chromium were not detected in any samples collected from the receiving water stations on Slate, Sherman, Ophir and Johnson Creeks. Nickel was not detected at Johnson, Sherman and Ophir Creeks. Selenium remained undetected throughout the year at Johnson, Slate and Ophir Creeks. Selenium was also not detected in Sherman Creek with the exception of two results at site SH113. Aluminum was present in all receiving water samples. Manganese was present in all Slate Creek samples. Manganese was slightly over the detection level in background Sherman samples, but was present in all downstream samples. On Sherman Creek copper concentrations throughout the year were low with the highest concentration at the background. Zinc was not present in the Sherman

background samples and downstream on four occasions. Aluminum was detected in all samples collected from Sherman Creek and Ophir Creek stations. Upstream Ophir Creek samples with the exception of aluminum only contained one metal result above the detection limit, which was July's zinc result. Johnson Creek contained aluminum and manganese concentrations throughout the year. Copper was detected only in September at all Johnson Creek sites. The number of undetected metals per site among the four receiving water streams was highest in Ophir Creek, followed by Johnson Creek, then Sherman Creek and lastly Slate Creek.

As expected, sulfate, TDS and hardness parameters were detected in all samples collected from all stations on each of the four receiving water creeks. TDS and conductivity were highest in downstream samples from Slate Creek with the exception of a few months at the downstream Ophir Creek site. TDS and conductivity also showed an increase in downstream samples from Sherman Creek during the winter months. Conductivity was low in upstream Johnson samples but showed some increase downstream. Hardness was lowest in Johnson Creek, followed by Sherman Creek, Slate Creek and then Ophir Creek.

Low-level detection limits, provided through the use of method 1631, were used to determine mercury concentrations in the receiving waters. Mercury was detected in 4 samples at Johnson Creek, one at JS-2, and three at JS-4. At Sherman Creek, mercury was not detected at SH109 and was detected in two samples from SH113 and one sample from SH105. Ophir Creek had no detectable levels of mercury throughout the year. In the case of Slate Creek, mercury was detected on most sampling occasions at both upstream and downstream sites. MLA had the fewest detectable results with 9, whereas all remaining downstream stations had 10 detectable mercury results.

4.0 General Major Chemistry

Area waters generally:

-
- Have peak water temperature in August or September
 - Are at or near oxygen saturation
 - Have mildly basic pH
 - Seasonal fluctuation of conductivity with peak values in the winter
 - Contain low levels of sulfate
 - Are generally soft (in most cases <100ppm hardness)
 - Have low concentrations of dissolved metals

5.0 Summary Statistics

Summary statistics were calculated for all parameters at each discharge and receiving water station. The calculations include the minimum, maximum, arithmetic mean and standard deviations for each monitoring station contained in the 2013 data set. The results are presented in Tables 7 through 20. Also included in the summary tables are the total number of samples collected, total number of non-detect results and the percentage of non-detects.

6.0 Watersheds

Upstream/downstream receiving water monitoring stations are present on Johnson, Slate, Ophir and Sherman Creeks. A comparison of the chemistry between these station pairs is discussed below. Tables 1 through 6 contain the monitoring parameters that remained undetected for the entire year at each station.

6.1 Receiving Waters- Johnson Creek

Monitoring Sites

- JS2- Johnson Creek upstream of disturbance
- JS4- Johnson Creek downstream of Bridge 1
- JS5- Johnson Creek downstream of mill process area and Bridge 2

6.1.1 Major Chemistry

Water quality monitoring on Johnson Creek was intended to identify potential impacts from mill facility construction and operation. The water sampling sites are somewhat confusingly labeled since JS-5 lies downstream of Bridge 2, which is between JS-2 (background, upstream site) and JS-4 (downstream of Bridge 1). Water quality at Johnson Creek shows some seasonal trends for temperature, TDS, nitrate, pH, and sulfate. Some elevation of conductivity, turbidity, TDS, sulfate, hardness, and color is also seen from upstream to downstream, particularly in winter months (Figures 6 - 8). Downstream temperature tended to be higher than the background site. The highest temperature was recorded at JS-4 in July (8.6°C) and lowest again at JS-4 in January (0.2°C). Nitrate was present at similar concentrations at all sites, with slightly lower concentrations during summer months. On average pH tended to be slightly higher at the downstream site, JS-4, with the highest value of 7.93 occurring in April. There was little fluctuation between the sites throughout the year with the lowest value of 6.7 reported at the background site JS-2.

Sulfate showed fairly consistent increases downstream through the year with both downstream sites being higher in winter and early spring and lower in summer. The highest sulfate level was 15.7 mg/L at JS-5 in April. Dissolved oxygen was very similar at all sites throughout 2013. Conductivity measurements were consistently higher downstream throughout 2013. Values ranged from 17 umhos/cm to 126.8 umhos/cm. Turbidity was less than 4 NTUs at all sites throughout the year with the exception of JS-4 in May with a value of 6.55 NTU. Total dissolved solids consistently increased from upstream to downstream with the highest result of 85mg/L in April at JS-5. Hardness showed consistent increases downstream during 2013. Hardness varied slightly throughout the year at JS-2, with a low of 10mg/L in September and high of 19.3 mg/L in March. The downstream sites were markedly higher in late winter/early spring, with JS-5 ranging from 18 to 47 mg/L from August to January. JS-4 ranged 54.4 to 23.7 mg/L during that same timeframe. All sites were less than 30 mg/L from May through September. Color was not detected at JS-2 during 2013. Color was detected at JS-5 in January, February, April, August and September and at JS-4 in January, February, March, April, and August. The highest color value recorded was 25 cu in September at JS-4.

Ammonia mostly remained undetected at all Johnson Creek sites throughout 2013. Chloride remained at or near the detection level at all Johnson Creek sites throughout 2013. TSS was detected once at each site throughout 2013 on Johnson Creek, JS-4 had the peak result of 18.0 mg/L.

6.1.2 Trace Chemistry

The majority of dissolved metals (8 of the 13) tested at Johnson Creek were not detected at any sites at any time of the year. These included arsenic, cadmium, chromium, lead, nickel, selenium and silver. Concentrations of aluminum were higher at downstream sites (JS-4 and JS-5) than the upstream site (JS-2) throughout 2013. The highest aluminum levels recorded in Johnson Creek in 2013 were at JS-4, 334 ug/L in May and 99.9 ug/L in September. Manganese was also elevated at JS-4 in May (42.8 ug/L) and slightly in September (14.3ug/L). Manganese never exceeded 7.0 ug/L at JS-2 throughout the year.

Copper was detected once at JS-2 in 2013; it was present once at the two downstream sites (JS-4 & JS-5) with the highest result being 1.6 ug/L at JS-4 in September, which is still below the hardness-based WQS. Dissolved mercury was detected once at JS-2 and JS-5 throughout the year, while JS-4 showed a total of three detectable results – the highest of 0.0021 ug/L in September. Dissolved zinc was detected at all Johnson Creek sites periodically through 2011. Zinc detection decreased in 2012 and was detected only twice. In 2013 the downward trend continued with no detectable zinc at any of the Johnson Creek sites.

Comparison with 2006 to 2012 data shows that Johnson Creek pH was slightly lower than previous years. In 2013 the higher pH values trended towards 7.5 s.u. whereas in previous years the higher values trended towards 8.5 s.u. Turbidity in 2013 was similar to previous years with the all results below 1.5 NTU with the exception of two JS-4 results of 2.02 NTU in April and 6.55 NTU in May. Total suspended solids demonstrated similar levels compared to previous years with the exception of a spike in May seen at all three Johnson Creek sites. The highest TSS result of 18 mg/L occurred in May at JS-4. In 2013 mercury was detected five times, whereas it was detected on eight occasions in 2012, five in 2011, three times in 2010, twice in 2009 and once in 2008. 2006 and 2007 showed much more frequent occurrences of mercury. Manganese levels showed a

slight elevation in 2013 compared to the previous year, but levels did not get as high as they were in 2006 when they exceeded 70 ug/L on three occasions. Copper was not detected from 2006 to 2009, but did appear in November 2010 and again in four instances in 2011. In 2012 copper was detected twice with both results having concentrations lower than the previous year. In 2013 copper was detected once at each Johnson Creek site. Nickel has not been detected in Johnson Creek since September of 2007.

Nitrate levels showed a similar pattern to previous years, with concentrations trending higher in late spring. Sulfate levels also showed a similar pattern to previous years, being lowest in June and July and increasing in August. In 2013 ammonia was not found at JS-2 and JS-4 and was detected once at JS-5 in July. Ammonia was not detected in 2012 or 2011 at all Johnson Creek sites. Ammonia was detected twice at very low levels in 2010 and was previously detected at the end of 2006 and 2007 and in January 2008.

6.2 Receiving Waters - Slate Creek

Monitoring Sites

- MLA- Middle Lake Slate Creek upstream of disturbance
- SMP-5 (Site #5) – Downstream of the tailings impoundment dam
- SLB – East Fork Slate Creek upstream of confluence with West Fork Slate Creek
- SLC- Slate Creek downstream of confluence with West Fork Slate Creek

6.2.1 Major Chemistry

Water quality monitoring on Slate Creek in 2013 was intended to identify potential impacts from the Tailings Treatment Facility (TTF). Figures 9 through 12 are graphical presentations of analytical results gathered throughout the year. Compared to the other streams, Slate Creek was the warmest, most likely due to the presence of lakes in the system that warm up in summer due to their large surface area. Only Upper Slate Lake contributes to this warming affect now as Lower Slate Lake has been converted to a tailings treatment facility. MLA is the sampling site upstream

of the tailings treatment facility, SMP-5 is approximately 200 meters downstream of the tailings impoundment dam. SLB is approximately 1.6 kilometers downstream of the tailings treatment area and SLC is 10 meters further downstream from SLC and receives water from both east and west forks of Slate Creek. Temperatures on Slate Creek appeared similar to 2012 results, the highest 2013 temperature recorded at MLA was 19.5°C.

DO and chloride exhibited similar trends when compared to previous year's results (Figures 9 - 12). pH exhibited a lower trend than last year with the lowest result of 6.89 s.u. at the background site MLA. Dissolved oxygen measured at Slate Creek stations showed a seasonal trend similar to those of the other receiving water streams in being higher in winter months. Dissolved oxygen measurements at all Slater Creek sites were similar throughout 2013. The lowest DO was observed at MLA in July at 7.03 mg/L. Dissolved oxygen increases as temperature decreases and is likely to be lower in the lake (near MLA) than downstream where several cascades help to mix oxygen into the water. Chloride results in Slate Creek samples were higher than results from Johnson Creek throughout the year, but still well within water quality standards. Chloride was highest at SLB (12.1 mg/L) with MLA typically being less than 2 mg/L and SMP-5 between 1.4 and 12.5 mg/L and SLC demonstrating a chloride range of 2.1 to 8.9 mg/L.

Conductivity tended to be higher at all sites in Slate Creek when compared to Johnson Creek and was highest at SMP-5 in January (489 umho/cm). This was lower than last year's peak conductivity result of 732umho/cm at SMP-5. Background conductivity was 33.4 umhos/cm at this time. Site SLC was 116.1 umho/cm at the same time. During the rest of the year, conductivity had a wide range from 33.4 to 489 umho/cm at all sites. Sulfate showed a similar pattern with all sites ranging from 1.68 mg/L to 225 mg/L in 2013 with SMP-5 recording the peak value. Up from 2012 where the highest sulfate value was 187 mg/L at SMP-5. Sulfate at MLA remained less than 2.8 mg/L throughout the year. During 2013 turbidity was low at all sites, MLA being the lowest (usually less than 1 NTU) and the highest result of 1.33 NTU at SLC in October. Ammonia was not detected at MLA in 2013. SMP-5, SLB and SLC typically ranged from non-detect to 1.35 mg/L. Similar to 2012 nitrate was not detected at MLA in 2013, but was detected at low levels in most samples downstream throughout the year.

Hardness demonstrated a similar trend to last year, downstream sites having higher values than the background site. Generally downstream hardness was above 50 mg/L with spikes reaching 274 mg/l at SMP-5 in March. Hardness was the lowest at the background site (MLA) with results ranging from 29 to 64 mg/L. TDS remained low at MLA throughout the year, ranging from 40 – 80 mg/L. However SLB, SLC and SMP-5 showed higher levels of TDS with a peak value of 467 mg/L at SMP-5 in March. TSS was below detection limits at all four stations throughout 2013 as was the case in 2012. Color showed little variation from upstream to downstream, and was lowest at all sites during lower flows in the summer (20 to 35 cu). Some color is attributable to tannins in the water associated with vegetation die-off in the lakes. The West Fork has no lakes so it would be expected to have less color and have a dilution effect on SLC, such was the case in 2013 with the lowest color value of 15 cu reported at SLC.

6.2.2 Trace Chemistry

Trace metals not detected in Slate Creek during 2013 were arsenic, chromium, lead, selenium and silver. Manganese was higher in late winter/early spring with the highest result of 161ug/L at SMP-5 (Figures 9-12), down from the 2012 peak result of 256 ug/L at SMP-5. Aluminum tended to range similarly among the Slate Creek sites with the highest at site SLC reaching 156 ug/L in October. The September, October and November MLA aluminum values resulted in elevated aluminum downstream at stations SLB, SMP-5 and SLC. Effective October 24th, 2013 Upper Tolerance Limits (UTLs) were established for the Slate Creek sites. As a result the elevated aluminum results were within tolerance limits.

Cadmium was not detected at Slate Creek sites MLA, SLB and SLC in 2013 and found once at the detection level at SMP-5.

Copper was not detected at MLA, but occurred three times at SMP-5, twice at SLB and once at SLC. The greatest copper value of 1.6 ug/L occurred at SMP-5 in April. Iron levels trended similarly among all the sites. The lowest iron levels among all sites occurred in midsummer. SMP-5 showed slightly elevated levels of iron in March (0.647 mg/L). All samples throughout 2013 were below the iron WQS of 1 mg/L.

Elevated levels of manganese were observed at SMP-5 and SLB during the first part of the year. The highest value, 161 mg/L occurred at SMP-5 in February.

Nickel was not detected at MLA during any month, nor was it detected at SMP-5, SLB and SLC from October through December. The highest concentration occurred at SMP-5 in March yielding a copper result of 3.2 ug/L. Zinc was present only once at MLA in July. Zinc was detected at low concentrations in all twelve samples throughout the year at SLB. SMP-5 returned the highest zinc result of 8.6 ug/L in April, but below the WQS of 140 ug/L. Zinc levels were detected on five occasions at SLC with a peak value of 3.8 ug/L.

Mercury was detected at very low levels in the majority of samples collected from all Slate Creek monitoring stations. The values among sites trended similarly. The highest mercury result occurred at station SLC (0.0046 ug/L). A comparison of Slate Creek data with the previous year shows that pH was slightly lower at all sites including background in the latter part of 2013, but still within the 6.5 to 8.5 s.u. threshold. Sulfate was relatively low at all Slate Creek sites through 2006 and up to June 2007, remaining below 5 mg/L. Sulfate increased at SLB and SLC from August 2007 to February 2008 and showed a peak of 16 mg/L at SLB in April 2008. Levels dropped again in May 2008, but again increased to around 15mg/L in September 2008 with another peak in September 2009. Sulfate levels approached 17 mg/L in March 2010, but the greatest increase was seen in December 2010 when sulfate reached 85 mg/L. 2011 showed an increase in sulfate levels for all stations except MLA. In 2012 sulfate showed a significant decrease compared to 2011. The highest sulfate levels occurred at stations SMP-5 and SLB with respective values of 166 and 187 mg/L. Compared to previous years, sulfate in 2013 demonstrated an upward trend with the greatest values occurring at sites SMP-5 and SLB. Their respective sulfate peaks were 225 mg/L and 214 mg/L, both below the WQS of 250 mg/L. Nitrate was present at low levels (<0.2 mg/L) during 2006 and occasionally in 2007 and early 2008. It was not detected between April 2008 and February 2009 but appeared again at all sites from March to June 2009 (around 0.35 mg/L). This contrasted with 2010 when no nitrate was detected at MLA and only very low levels were present at SLB in March and May (<0.1 mg/L) followed by an increase at SLB in December (0.36 mg/L). Similar to 2010, in 2011 MLA did not have detectable levels of nitrate with the exception of one result in May of 0.055 mg/L. 2012 demonstrated consistently low levels of nitrate for the majority of the year at all sites, however the last quarter of the year showed

an upward trend at all sites with the exception of MLA. Again in 2013 nitrate was not detected at site MLA. At the downstream sites SMP-5, SLB and SLC nitrate fluctuated with peak values in March and August, the greatest occurring at SMP-5 (3.19 mg/L), but remaining below the WQS of 10 mg/L.

In 2013 conductivity remained below 200 umho/cm at MLA and SLC, however SMP-5 and SLB showed a greater range with fluctuations between 53.8 and 489 umho/cm. Similar to 2013, during most of 2012, conductivity typically ranged from around 100 to 300umho/cm at MLA and SLC. However, at SMP-5 and SLB higher levels occurred January through March ranging from 379umho/cm to 572 umho/cm, then again higher levels of conductivity occurred in October through December. The highest conductivity in Slate Creek in 2012 was 632 uhmos/cm recorded at SMP-5 in December. TDS typically fluctuated from 60 to 80mg/L among all Slate Creek sites in 2006, increasing slightly in August 2007 when MLA reached 100 mg/L, SLB reached 110mg/L and SLC registered 710 mg/L. MLA showed a peak of 180 mg/L in November 2007, while downstream sites remained less than 100 mg/L. TDS levels were mostly 60 to 100 mg/L during 2008 with SLB reaching 129 mg/L in September 2008. TDS remained relatively stable in 2009 fluctuating between 30 and 85 mg/L at all sites. This continued into 2010 until SLB increased to 114 mg/L in July, 146 mg/L in October and 225 mg/L in December. TDS in 2011 showed similar trending with conductivity with the highest level in March at SLB (474 mg/L) and SMP-5 exhibited a similar pattern. In 2012 TDS trended lower than 2011. MLA values stayed below 100 mg/L for the year with the exception of one result in October. SLB and SMP-5 trended similarly through the year with SMP-5 yielding the highest result of 387 mg/L in March. In 2013 TDS at MLA remained below 81 mg/L for the year whereas the downstream sites yielding higher values. SMP-5 recorded the highest TDS result of 467 mg/L followed by SLB (424 mg/L) and SLC (213 mg/L).

In 2006, color was very similar at MLA and SLB remaining around 40cu through the first part of the year then increasing in October to 120cu at MLA and 130cu at SLC. MLA tended to show the highest color in 2007, 2008, and 2009 with color reaching a maximum of 210cu in September 2007. The highest color level for 2009 was 125cu in November at SLB. Color was lower in 2010 decreasing to 15cu in June and only reaching 80cu in November. 2011 demonstrated an increase with summer levels at all sites ranging from 15 -150cu. Similarly in 2012

color ranged 10-120 cu with MLA generally having the highest values throughout the year. In contrast with 2012, SLB and SLC had the greatest color values of 120 cu whereas MLA's peak value was 100 cu.

Cadmium was not consistently detected at SLB until August 2007, reaching a peak in April 2008 (1.9 ug/L). Cadmium was just above the WQS in March 2010 and was not detected June through December during 2010. Cadmium showed a drop in 2011 with no results over the WQS. Cadmium once again decreased in 2012, it remained undetectable at all sites throughout the year. Again in 2013 cadmium remained undetected at Slate Creek sites with the exception of SMP-5 having one result at the detection level of 0.1 ug/L. Copper has never been detected at MLA, and was first detected downstream at SLB in September 2006 (2 ug/L). Low levels (1.0 ug/L) were present on three occasions in 2007, then slightly higher levels (4 ug/L) in October and November 2007 and again in April and September 2008. These levels came close to the hardness-based WQS, but did not exceed it. Copper was detected at low level during the first part of 2010, but has not been detected after May during 2010. Copper in 2011 continued a downward trend with all results below the WQS and the highest result occurring at SMP-5 (3.1 ug/L) in October. Copper in 2012 was non-detectable at all sites throughout the year with the exception of one result at the detection level at SMP-5. Copper in 2013 was periodically detectable at SMP-5, SLB and SLC, the peak value occurred at SMP-5 in April (1.6 ug/L). Iron levels were highest at MLA from January to April 2006 and March/April 2007, but were exceeded by SLB in July-December 2006 (peak of 0.43 mg/L in July 2006), September-October 2007 and September 2008 (0.45 mg/L). Iron levels were lower in 2009 and 2010, peaking at 0.252 mg/L at MLA in November 2009 and 0.247 mg/L at SLB in May 2010. In 2011 iron trended similarly among the sites with all results under 0.2 mg/L, which is under WQS of 1mg/L. Showing a similar pattern in 2012, iron trending similarly among the sites with all results under the WQS. Again, Iron in 2013, trended similarly among the sites, the peak values occurring in early spring. SMP-5 reported the highest iron value of 0.647 ug/L in March.

Aluminum has occasionally been present in background samples at concentrations exceeding the WQS of 87ug/L, but rarely the permit limit of 143ug/L eg. January 2006 (99 ug/L), October 2007 (90 ug/L), April 2008 (106 ug/L), October 2008 (89 ug/L) and December 2008 (90 ug/L), April 2010 (101 ug/L), November 2010 (95ug/L), December 2010 (214 ug/L). Levels

downstream at SLB have also exceeded the WQS as follows: October 2006 (119 ug/L), October 2007 (124 ug/L,) April 2008 (134 ug/L), September 2008 (145 ug/L), December 2008 (90 ug/L), January 2010 (92 ug/L) and April 2010 (101 ug/L). The background level was frequently responsible for the high aluminum recorded downstream. Aluminum at MLA was 82 ug/L in February 2010, but this did not exceed the WQS. Aluminum levels at SLB and SLC were much lower than MLA in December 2010. In 2011, aluminum continued to be present in higher concentrations which is thought to have resulted in increased downstream results during summer and early fall. Aluminum increased in 2012, with several results over the water quality standard in early spring and fall. This can be attributed to increased concentrations at the background site MLA. Continuing that same trend in 2013, aluminum values in September, October and November were elevated at the background site, which resulted in elevated downstream values. SLC had the highest aluminum value in 2013 which occurred in October (156 ug/L), the background result for that same sample event was 88.8 ug/L. All aluminum results during the year remained below the UTLs.

Mercury had a peak of almost 0.01 ug/L at SLB in 2008, but only reached 0.003ug/L at SLB and 0.005 ug/L at SLC in 2009. 2010 levels were similar to 2009, but only reached a maximum of 0.0026 ug/L at MLA and SLB. During 2011 mercury levels were similar to 2010 except for one result at SMP-5 (0.0654 ug/L) in July which is thought to be an anomaly as it was well above all other results for SMP-5 in 2011. Mercury in 2012 was periodically present in low concentrations at all sites; all results were below the WQS. Mercury was detected in the majority of the samples from all sites in 2013. Compared to previous years mercury showed very similar trends with no marked increase. Zinc was not detected during the first part of 2006, appearing at low levels in both background and downstream sites in fall 2006. Zinc levels at SLB increased in May 2007 and exceeded the WQS in March 2008 (81.2ug/L), April 2008 (180 ug/L), October 2008 (72.7 ug/L), January 2009 (58.3 ug/L), but values were much lower throughout the rest of 2009 and 2010, only reaching 13.7 ug/L in April 2010. Zinc continued a downward trend in 2011 with a peak value of 12.0 ug/L in August. Zinc in 2012 continued to trend downward with the highest result of 6.0 ug/L found at SLB in October. In 2013, among the downstream sites zinc trended slightly higher than in 2012, with the highest result detected at SMP-5 (8.6 ug/L).

Nickel was present at SLB and SLC at low levels during 2006, increased in August 2007 and peaked in April 2008, but remained less than 5ug/L in 2009 and less than 2 ug/L in 2010. Nickel marked a slight increase during 2011 with a peak value of 4.4 ug/L in October. During 2012 nickel showed a decrease with the peak value of 1.7 ug/L occurring at SMP-5 in March. Nickel was undetected at MLA in 2013. At sites SMP-5, SLB and SLC nickel was found at low levels with an increase over last year's peak value (1.7 ug/L); the 2013 peak value was 8.6 ug/L at SMP-5. Manganese was not detected at downstream sites during the first part of 2006, but showed elevated levels at SLB in September 2006 (90 ug/L). Background manganese was above the WQS at this time (56 ug/L) and again in December 2006, March, April, August, November and December 2007, November 2008 and October 2009. SLB exceeded the WQS for manganese in October and November 2007, March, April, October, November, December 2008, January and May 2009, and January, March, May and December 2010. The highest level recorded was 228ug/L in March 2010. As with previous years, 2011 demonstrated an increase in manganese concentrations with a peak value of 334 ug/L in March. Manganese in 2012 was similar to 2011 results, with higher trends in winter and early spring. In 2013 manganese showed a marked decrease at all downstream sites starting in March. The greatest manganese value was 161 ug/L at SMP-5 whereas the previous year the manganese value was 256 ug/L at the same site.

6.3 Receiving Waters- Sherman Creek

Monitoring Sites

- SH109- Upper Sherman Creek upstream of disturbance
- SH113- Sherman Creek downstream of Outfall 001
- SH105- Sherman Creek downstream at mouth of creek

6.3.1 Major Chemistry

Water quality monitoring on Sherman Creek was intended to help identify any potential impacts from underground mine activities as all drainage from the mine flows to the Sherman Creek drainage (Figures 13 -15). Temperature is typically highest at SH113 just downstream from

the 001 effluent and coolest at SH109 the background station for Sherman Creek. However this was not the case in 2013 the highest temperature was at SH109 and the lowest at SH105. Overall, there was little difference in temperature between these sites throughout the year. Dissolved oxygen was similar at upstream and downstream sites throughout the year. Measurements of DO tended to be lower in summer as water temperature increased and DO was higher in winter as temperatures decreased. All sites exhibited peak DO values in December. Measurements of pH appeared consistent among the three Sherman Creek sites. The highest pH was 7.81 at SH109 in January, whereas the previous year the highest value was 8.29 at SH109. Monitoring station SH105 had the greatest range in pH values of all the Sherman Creek sites.

Conductivity was highest at site SH113 (middle site) and lowest at SH109 (upper site). All three sites showed highest conductivity during July and August. Turbidity was less than 1.0 NTU throughout the year at all sites. Turbidity was 0.92 NTU at SH105 in May, which accounts for the highest value in 2013. Total dissolved solids tended to increase from upstream to downstream and were higher during late winter months. TDS was highest at SH113 (209 mg/L) in February and lowest at SH109 (<20 mg/L) in June.

During 2013 ammonia was detected in all twelve samples at SH113, ranging from 0.18mg/L to 1.33 mg/L. Ammonia was present five times at SH105 with a peak value of 0.42 mg/L. Ammonia was undetectable throughout the year at SH109 with the exception of one result at the detection limit in August. The nitrate level at the upstream site was below 0.3 mg/L throughout the year. Of the three sites, SH113 showed the highest level in February at 4.1 mg/L while SH105's peak downstream value reached 1.83 mg/L in December. All reported measurements were below the WQS of 10mg/L. Sulfate, chloride and hardness tended to be highest at SH113 and lowest at SH109. Sulfate tended to be higher at SH113 than other sites. The highest sulfate result was found at SH113 in December (52.5 mg/L). The lowest sulfate level recorded at SH109 was 3.32 mg/L in May. Sulfate was less than 36 mg/L at SH105 throughout the year and less than 10 mg/L at SH109. Chloride was detected in all samples for SH105 and SH113. SH109 reported detectable levels of chloride during the first five months of 2013 and was then non-detectable for the remainder of the year. Chloride reached a peak of 11.6 mg/L at SH113 in April. All chloride concentrations were well below the water quality standard of 250 mg/L.

Hardness was relatively high (>70 mg/L) at SH113 throughout the year with the exception of June and July where the hardness was 44.1 and 63.9 mg/L respectively. Throughout the year hardness remained below 51 mg/L at SH109 and below 91 mg/L at SH105. As expected for all sites hardness was lowest during summer months. The highest hardness values were found at SH113 in December and March. Total suspended solids were not detected at SH105 and SH109. Totals suspended solids were detectable only once at SH113 in February (6.0 mg/L).

6.3.2 Trace Chemistry

Trace metals not detected in Sherman Creek during 2013 were arsenic, cadmium, chromium, lead, nickel, and silver. Aluminum tended to be higher at SH105 near the stream mouth than both SH109 and SH113. This suggests there is some source of aluminum downstream that is not associated with the 001 effluent. Aluminum at SH105 reached 70.0 ug/L in May accounting for the highest value in 2013. Peaks were observed at upstream sites during May and June, but were still lower than the downstream SH105 station. Copper was detected once at SH105 and twice at both SH113 and SH109, all copper values remained low in 2013. The highest level for copper was 1.9 ug/L at SH109 in September. Manganese was detected at low levels in ten of the twelve samples from SH109; it was also present in all samples at SH113, with concentrations reaching 99.9 ug/L in February and 101ug/L in March. Mercury was detected at SH113 on two occasions, August and September. SH105 had the greatest level of all sites in September with a mercury result of 0.0014 ug/L. Mercury was not detected at SH109 in 2013. Zinc was not detected at SH109 in 2013. Zinc was found once at both SH105 and SH113 in low concentrations. The highest value for Zinc was 3.9 ug/L in April at SH105. All total iron was found on five occasions on Sherman Creek throughout 2013 two times at SH113 and once at SH109 and two at SH105 all concentrations were below 1.0 mg/L with the highest being 0.232 mg/L at SH113 in May.

A comparison with previous data shows that Sherman Creek appeared to have slightly lower pH in the latter half of 2008 than previous years, but remained at normal levels in 2009 and 2010. The pH at the background site SH109 was lower than usual in August 2010. This changed in 2011 with pH values at SH109 ranging between 7.5 and slightly over 8.0. The same pattern held for SH109 throughout 2012. Sites SH105 and SH113 exhibited steady pH values between 7 and 8 with the exception of one value of 6.76 at SH113 in November 2012. During 2013 pH once again

was steady at all Sherman Creek sites throughout the year. All pH values maintained a range between 7 and 8 pH with the exception of one value at SH113 dipping to 6.77 pH in October.

Turbidity appeared lower in 2011 than 2010, this may be in part due to higher background turbidity in 2010, but 2011 displayed the opposite results with much lower background turbidity. Turbidity in 2012 remained below 3 NTU, with the highest result of 2.8 NTU occurring at the background site in May. Turbidity demonstrated little fluctuation at all sites throughout 2013, all values remained under 1.0 NTU. Ammonia was present at a low level in late 2006 and early 2007, spring of 2007 and December 2007, then it remained undetected until June and August 2009 and July-September and December 2010. In 2011 ammonia was present in the majority of the samples from SH113 whereas it remained undetected at all other sites with the exception of one result in July at SH105. The peak ammonia value in 2011 was 1.12 mg/L at SH113. Ammonia in 2012 was detected once at SH105, once at SH109 and seventeen times at SH113. The peak ammonia result of 0.69 mg/L occurred at SH113 in October. Ammonia concentrations increased at SH113 in 2013, it was detected in all twelve samples; the highest value of 1.33 mg/L occurred in August. Ammonia was detected at low concentrations once at SH109 and five times at SH105 in 2013.

Chloride appeared to have an increasing trend from July 2007 to March 2008, but was present at much lower levels (less than 4 mg/L) from May 2008 and remained below 6mg/L during 2009 and the first half of 2010. Slightly higher chloride levels (8-14 mg/L) were observed in August, September and December 2010, but these levels are well below the 250 mg/L WQS. Again in 2011 a slight upward trend for chloride was noted in the downstream sites with a peak value of 18.7 mg/L at SH113. Chloride in 2012 was present in most samples with the exception of five non-detect results at SH109. Chloride trended similar to 2011 with the peak value of 19.0 mg/L at SH113 in December. Very little change in chloride concentrations were noted at all Sherman Creek sites during 2013. The highest chloride value again occurred at SH113 (11.6 mg/L), which was down from last year's peak chloride value.

Nickel seems to have declined since July 2007. It was not detected between June 2008 and November 2009 and most of 2010 (only detected in February, September, December at low level). Fewer detections of nickel occurred in 2011 when compared to previous years. Only two samples had nickel results both in March at SH113 and both under 2.0 ug/L. Nickel continued to follow a

downward trend with no detectable concentrations at any Sherman Creek sites in 2012. Again in 2013 nickel remained undetected at all Sherman Creek sites. Manganese was low until July 2007, increasing at SH113 at high flow in fall of 2007 and spring and fall of 2008. Manganese levels at SH113 never exceeded 26 ug/L in 2009, but in 2010 three samples exceeded 50ug/L. The upward trend of manganese continued in 2011 with slightly more than half the samples at SH113 over 50 ug/L. Manganese trended upward at SH113 during the first three months of 2012 with five results greater than 80 ug/L. However for the remainder of the year all results were below 42 ug/L with the exception of one result of 60.7 ug/L at SH113. As for the other sites manganese remained below 35 ug/L for 2012. In 2013 manganese demonstrated an upward swing at SH113 during the first part of the year; the highest value of 101 ug/L occurred at this site in March. However after March manganese concentrations dropped below 50 ug/L for the remainder of the year with the exception of one result of 70 ug/L in December. The other two sites yielded lower levels of manganese in 2013, SH105's peak value was 35 ug/L and SH109 levels remained below 4 ug/L.

Iron was detected at SH105 in previous years (twice in 2006 and twice in 2007). Iron was not detected in 2008 and appeared only once at SH113 in 2009 (January) and once in 2010 (November) at low levels. In 2011 Iron was detected three times with all values at or below 0.075 mg/L. During 2012 iron was periodically detected at all sites with the greatest result of 0.177 mg/L occurring at SH113 in April. Similarly in 2013 iron was periodically detected at all sites, again SH113 had the highest value of 0.232 mg/L in May but then remained undetected thereafter during 2013.

Sulfate, TDS and conductivity tend to follow hardness patterns, peaking at SH113 in February 2008, March 2009, and February 2010. The same pattern continued in 2011 with sulfate, TDS and conductivity peaking in March, with the exception of TDS peaking in February at SH113. Conductivity has typically been higher at SH113 than upstream or downstream sites and this held true though 2011, 2012 and 2013. Conductivity during the historical peak months of January through April was higher in 2011 as compared to previous years during the same period. Conductivity in 2012 followed a similar pattern when compared to 2011. During the peak months of January through April 2013 conductivity showed a slight increase over the previous year. TDS followed historical patterns at all sites, peaking in the winter and decreasing during the summer months. Sulfate has demonstrated a downward trend since 2008 with a peak value of 82.9mg/L in

February as compared to February's peak value in 2010 of 40.7 mg/L. Sulfate showed a slight increase during peak months in 2011 but was still lower than historical peaks. Following the 2011 trend sulfate during 2012 peaked in the winter/early spring months with a high result of 58.9 mg/L at SH113 in February. No changes were noted with the sulfate trends in 2013. The highest value was reported at SH113 (52.5 mg/L) in December. Similarly, TDS has exhibited a downward trend since 2008. TDS in February of 2008 was greater than 200 mg/L whereas TDS in February of 2010 was less than 150 mg/L. TDS appeared to take an upward turn from 2010 with increased peak values between 175 and 200 mg/L recorded in 2011. TDS in 2012 appeared the same with peak values between 125 mg/L and 211 mg/L. TDS in 2013 continued with the same trend with peak values reported at SH113 ranging from 176 mg/l to 209 mg/L. Hardness values decreased slightly over last year's values, 2012 had three peak values between 100 mg/L and 118 mg/L. Hardness in 2013 increased slightly with the peak values at SH113 ranging 120 mg/L to 124 mg/L. Hardness at SH105 remained below 91 mg/L throughout 2013 and SH109 as expected returned results below 60 mg/L.

Historically nitrate has been observed at low levels in Sherman Creek. It showed a slight increase in February, May, October and November 2007 and in February 2008 then remained low until April to June of 2009 when levels were similar to November 2007. Nitrate levels in 2010 appeared slightly lower than 2009. Nitrate levels in 2011 were greater than 2010 levels with peak values between 1.3 and 1.9 mg/L whereas the previous year ranged approximately 1 mg/L less. However, 2012 nitrate levels were lower than the previous year and more closely resembling pre-2011 levels with peak values less than 1.4 mg/L. Nitrate in 2013 remained at typical levels at site SH109. SH113 nitrate values showed an upward trend predominantly during the first part of 2013 with a value of 4.10 mg/L. Similar to SH113, SH105 nitrate concentrations increased during the first part of the year then trended downward during the spring and summer months.

6.4 Receiving Waters- Ophir Creek

Monitoring Sites

- SH111- Ophir Creek upstream of Comet Development Rock Stockpile
- SH103- Ophir Creek downstream of Comet Development Rock Stockpile

6.4.1 Major Chemistry

Water quality monitoring on Ophir Creek is intended to help identify any potential impacts from mine construction and development activities associated with the Comet Development Rock Stockpile. Figures 16 and 17 are graphical presentations of analytical results gathered throughout 2013. Monitoring station SH111 is often unavailable for sampling during low flow periods and frozen conditions in winter and at times inaccessible due to avalanche danger. Occasionally monitoring station SH103 is also unavailable for sampling due to frozen conditions. During previous years under the sampling plan monitoring was only required at SH111 and SH103 once every other month between May and November. Effective September 1st 2011 under the new APDES permit monitoring at both sites was increased to monthly, year-round.

As with the other receiving waters, Ophir Creek's monitoring data exhibited many trends in accordance with expected seasonal changes, increasing in summer and decreasing in winter. DO was very similar at both sites each time measurements were made. Measured conductivity at SH103 has often been the highest of all 12 monitoring sites on the project receiving waters, reaching 650 umhos/cm from January to April 2009 and 495 umhos/cm in November 2009. No samples were collected during this period in 2010. The highest recorded conductivity in 2010 was 165umhos/cm in November with 161umhos/cm recorded in October. Consistent with previous years, SH103 had a high conductivity result of 558 umhos/cm in December 2011. Following a similar but in increasing trend the highest conductivity measurement for SH103 was 828 umhos/cm in April 2012. Again in 2013 SH103 reported the highest conductivity among all sites, 773 umhos/cm – down from 2012.

During 2012 total dissolved solids were present at similar concentrations at both sites in May through October (less than 100mg/L) and increased at SH103 in November reaching a peak in April (566 mg/L). Due to no water in the stream no samples were collected at the background site in January, February, March, April and then again December. In 2013 TDS at SH103 showed a slight decline, the majority of results remained below 100 umhos/cm. There were four results above 300 umhos/cm but were lower than last year's peak values. SH111 TDS remained under 50 umhos/cm for all sample events in 2013. Sulfate was found at low concentrations at SH111 for each sample event in 2012. Such was the case again in 2013, all sulfate results remained below 4 mg/L at SH111. In 2013 compared to SH111, SH103 had higher sulfate concentrations with two peak values over the WQS, 279 mg/L in January and 265 mg/L in April. Consistent with sulfate and TDS, hardness showed a similar pattern with the concentrations less than 100mg/L at both SH103 and SH111 – May through October. In the past chloride tended to be higher in winter than summer and was not detected at all in 2010 May-November samples. In 2011 chloride samples were detected in May at both stations and ranging 1.0 and 2.5 mg/L. In 2012 chloride ranged higher with concentrations 1.1 – 5.2 mg/L. Chloride in 2013 was not detected at SH111 and showed a similar trend at SH103 with values ranging from non-detect to 6.6 mg/L. In 2013's trend, nitrate levels were up slightly at SH103, December's value reached 8.73 mg/L all other values were 6.1 mg/l or less. SH111 showed little variation from previous years and remained at or below 0.62 mg/L for 2013.

The pH results were slightly lower than previous years; samples collected at SH103 and SH111 ranged between 6.77 and 7.77. Ammonia was not detected in any Ophir Creek samples in 2011; this was also the case in 2010. The same pattern followed in 2012 with no detectable concentrations of ammonia. Again in 2013 ammonia was not detected at the Ophir Creek sites. Same as the previous year total suspended solids also remained undetected through 2013 at both Ophir Creek sites. Color was found at the detection level twice at the background site and detected six times at SH103, the greatest result was 10 cu.

6.4.2 Trace Chemistry

Non-detected metals for both SH111 and SH103 included arsenic, cadmium, chromium, iron, lead, mercury, nickel, selenium and silver. Copper was not detected for SH111, and was present in low concentrations in five of the twelve samples from SH103. Zinc was present in one sample at SH111 and also present in one sample collected from SH103. The highest zinc value was at SH111, 3.5 ug/L. Similar to previous years, manganese was not detected at the background site, but was present in a third of the samples from SH103 with values ranging from 1.2 to 2.8 ug/L.

Similar to 2012, low levels of aluminum were measured in all samples collected at both Ophir Creek sites during 2013 with little difference between the sites. Of the two sites, SH103 had the higher aluminum results with values ranging 3.3 to 10.6 ug/L. SH111 and SH103 had by far the lowest concentrations of aluminum of all the receiving waters, as was the case in 2008 – 2013.

7.0 Discharges

7.1 Outfall 001

The Comet water treatment plant (WTP) discharge (Outfall 001) was sampled weekly, resulting in at least four times the data compared to most receiving water stations. This larger group of sample results is a greater opportunity to identify trends (Figures 18a – 18c). Discharge Monitoring Reports containing results of required monitoring were submitted each month during 2013.

7.1.1 Major Chemistry

Dissolved oxygen (DO) in the effluent tended to be higher in winter (11-13 mg/L) and lower during the summer season (7-11 mg/L). DO is typically negatively correlated with temperature, which was seen to increase from less than 4°C from January to early March to around 8°C in April, reaching a maximum of 12.3°C in July, before declining to the year's low of 3.8°C in November. Grab samples for turbidity are collected from the effluent and background station SH109 weekly in conjunction with the effluent composite samples. The difference between background turbidity and effluent turbidity remained low for the year (under the limit of 5 NTU).

The peak effluent turbidity reached 2.95 NTU in March. Background turbidity reached 2.4 NTU in early April, but effluent turbidity remained less than 1.0 NTU.

pH fluctuated little throughout 2013 with the exception of one peak value of 10.0 s.u. recorded in November. The period of time the pH was out of the 6.5 to 8.5 s.u. threshold was relatively short; pH readings were in compliance greater than 99% of the time in 2013.

Both TDS and sulfate (associated with calcium and magnesium) were well below permit limits in 2013. Throughout the year, major cations (represented by hardness) and anions (represented by sulfate), plus total dissolved solids showed consistent trends with few spikes. TDS ranged 199-373 mg/L for the year. Effluent sulfate was less than 84 mg/L through the year. Downstream hardness ranged 32.7 to 239 mg/L in 2013, higher than the previous year.

Daily samples were collected for TSS analysis. In 2013 all but three samples were non-detect. Once in May and twice in October the respective detectable results were 12.8, 4.0 and 5.2 mg/L. The same occurred in 2012 with three detectable results all within the WQS; whereas in 2011 there were eighteen detectable results some of which exceeded the WQS. In 2010 there were nineteen TSS samples above the detection limit but all below the WQS.

Ammonia exhibited an upward trend compared to 2012; four samples exceeded the maximum daily limit of 4 mg/L. In general, ammonia ranged between 0.65 and 8.4 mg/l. Nitrate was positively correlated with ammonia. Nitrate ranged 1.44 -12.3 mg/L for the year with three results greater than 10.0 mg/L.

7.1.2 Trace Chemistry

Arsenic, cadmium, chromium, lead and silver were undetected in effluent samples during 2013. This followed the 2012 pattern except cadmium was an additional non-detect parameter in 2013. Arsenic and cadmium were undetected in 2011. Chromium and silver were undetected in 2010. Cadmium, copper and lead were undetected in 2009. Copper was only detected on one occasion in 2013 with a result of 4.0 ug/L. This was down from 2012 where copper was detected on seventeen occasions. Lead was present in four samples in 2011, undetected in 2012 and as mentioned undetected again in 2013. In 2013 aluminum remained at low concentrations (less than 31 ug/L) similar to the previous year. Iron demonstrated little variation from last year; levels remained below 0.4 mg/L throughout the year. Mercury concentrations were similar to 2012

values with the exception of a spike reaching 0.0060 ug/L in February. However, all results remained below the permit limit of 0.0200 ug/L. Zinc concentrations varied little throughout the year with only two detectable results, the greatest being 2.5 ug/L. Nickel concentrations fluctuated little throughout the year from non-detect to 4.2 ug/L. In 2013 nickel's pattern reflected the previous year's trends. Selenium demonstrated more variation than in 2012, throughout 2013 values mostly ranged from 1.0- 4.2 ug/L.

Manganese trended downward considerably in 2013 with values ranging from a high of 307.0 mg/L in January to a low of 8.9 mg/L in June, after which concentrations remained mostly below 50 ug/L for the remainder of the year. The average manganese result was 190 ug/L in 2010, dropped to 157 ug/L for 2011 and dropped slightly again 2012 with an average of 155 ug/L. Continuing the same downward trend in 2013 the average manganese concentration was 71.5 ug/L. Overall, manganese concentrations for the effluent after June 2013 reflected pre-operation concentrations found in 2006.

7.1.3 Whole Effluent Toxicity Testing

Whole Effluent Toxicity (WET) Tests were conducted monthly on the 24-hour composite samples collected from Outfall 001 effluent. The following three tests were rotated throughout the year such that each test was conducted once a quarter:

- *Pimephales promelas* (fathead minnow)- static, renewal, larval survival and growth test.
- *Ceriodaphnia dubia* (water flea)- 7-day static, renewal, survival and reproduction test.
- *Selanastrum capricornutum* (green algae)- 4-day static, growth.

All monthly WET tests conducted on Outfall 001 effluent in 2013 were within permit limits.

7.2 Outfall 002

Outfall 002 discharge is from the tailing treatment facility (TTF), which began in early December 2010 after a new water treatment plant was commissioned. 2013 was the third full year of operation for the TTF water treatment plant. Discharge Monitoring Reports containing results of

required monitoring were submitted each month during 2013. Graphical representations of Outfall 002 data can be found in Figures 19a – 19c.

7.2.1 Major Chemistry

pH fluctuated some throughout 2013 at Outfall 002. Results ranged from 6.5s.u. to 8.5 s.u, which were within the compliance range for the year. Flow rate also fluctuated throughout 2013 ranging from 780 gpm to 1325 gpm while staying under the permit limit of 1500 gpm. Temperature, as expected, trended seasonal through the year. Temperature varied from 1.7°C in April to 15.2 °C in August. Background samples for turbidity were collected weekly at MLA in conjunction with the effluent grab samples. The difference between background turbidity and effluent turbidity remained low through the year, with no noticeable peaks; effluent turbidity remained below 2.0 NTU for 2013.

In 2013 sulfate ranged between 93.3 and 245 mg/L, below the WQS of 250 mg/L. Previously in 2012 sulfate in ranged between 179.0 and 250.0 mg/L. In 2011 sulfate exceeded the permit limit on six occasions. During 2013 TDS exceeded the WQS on two occasions with respective values of 607 and 621 mg/L, the remainder of the TDS results were below 460 mg/L. In 2012 total dissolved solids (TDS) ranged from 279 mg/L to 4 82mg/L, below the permit limit of 500 mg/L, whereas in 2011 one permit exceedence occurred.

2013 hardness demonstrated increased variability when compared to the previous year. Variability occurred mainly during late summer and fall, during which time values ranged from 278 to 129 mg/L. In 2012 hardness ranged from 210 to 278 mg/L, slightly less compared to 2011 when effluent hardness ranged from 181 to 319 mg/L. Downstream hardness fluctuated considerably in 2012 ranging from 39.6 - 236 mg/L, the higher values occurring in winter and early spring. Again in 2013 downstream hardness showed a wide range of values with a low of 32 mg/L in May and high of 272 mg/L in March. The wide range of values may be attributed to varying flow rates at the sample site.

Daily samples were collected for total suspended solids (TSS) through 2012. Thirty seven samples had detectable results all well below the permit limit. This was an increase over 2011 when seven samples had detectable amounts of TSS. Similar to 2011, during 2013 all but six TSS

results were non-detect. All remained below the WQS, the peak 2013 TSS value was 11.2 mg/L in July. Ammonia remained well below daily maximum permit limitations in 2013. Generally in 2013, ammonia stayed above 1.0 mg/L through August after which it trended downward to less than 1.0 mg/L for the remainder of the year. Nitrate tended to fluctuate more than ammonia in 2013 with a range of 3.84 to 1.67 mg/L.

7.2.2 Trace Chemistry

Arsenic, chromium, lead, and silver were undetected at Outfall 002 effluent samples during 2013. Similar to 2012, aluminum was present in all samples during 2013. Results ranged from 6.4 to 375.0 ug/L, this resulted in one spike in January over the permit limit. Aluminum remained generally below 50 ug/L for the rest of the year with no further exceedences. Overall iron trended downward in 2013. During the first four months of 2013 iron remained around 0.65 mg/L before dropping below 0.50 mg/L for the rest of the year, with the exception of one result in December. There were no iron exceedences in 2013. Nickel trended up and down through the year remaining below 6.3 ug/L except for one spike of 11.6 ug/L in December, which remained below the hardness-based limit of 31 ug/L. Zinc was detected in about two-thirds of the effluent samples in 2013 all of which occurred between January and September. The peak 2013 zinc value was 22.7 ug/L in May. Copper was periodically detectable throughout 2012 none of the sample results were greater than 1.9 ug/L, this demonstrated a slight increase over 2011. Copper in 2013 appeared to trend with zinc with higher values January through September; zinc registered a peak value of 3.2 ug/L in July which was below the WQS of 4.5 ug/L. Compared to 2012, there were more non-detect mercury results - 23 of the 55 samples. The greatest mercury result was 0.0032 ug/L, down from last year's peak value. Mercury was detectable for most of 2012 with a peak value of 0.0047 in December. This was an increase over 2011 where in the first third of the year mercury was not detected in effluent samples.

7.2.3 Whole Effluent Toxicity Testing

Whole Effluent Toxicity (WET) tests were conducted monthly on the 24-hour composite samples collected from Outfall 002 effluent. The following three tests were rotated throughout the year such that each test was conducted once a quarter:

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- *Pimephales promelas* (fathead minnow)- static, renewal, larval survival and growth test.
 - *Ceriodaphnia dubia* (water flea)- 7-day static, renewal, survival and reproduction test.
 - *Selanastrum capricornutum* (green algae)- 4-day static, growth.

All monthly WET tests conducted on Outfall 002 effluent in 2013 were within permit limits.