CONUMA COAL RESOURCES LIMITED

2017 ANNUAL WATER QUALITY REPORT

WOLVERINE MINE

Prepared for
British Columbia
Ministry of Environment

***Environmental Management Act* – Permit Number: PE-17756**

March 31, 2018

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Executive Summary

In September 2016, Conuma Coal Resources Limited (Conuma) purchased three metallurgical coalmines from Walter Energy Incorporated (Walter). The mines are located in northeastern British Columbia (B.C.). The 2017 Annual Water Quality Report – Wolverine Mine summarizes the Water Quality Monitoring Program results during 2017.

Following a period of care and maintenance from 2014 to 2016, the Wolverine Mine reopened in late 2016, reverting the Water Quality Monitoring Program from a care and maintenance sampling program to an operational sampling program. The Water Quality Monitoring Program continued until the end of 2017 under the direction of Mines Act Permit C-223, Environmental Assessment Commitments M04-01, and PE-17756. Administrative amendments to C-223, M04-01, and PE-17756 placed the Permit in the name of Conuma.

The Wolverine Processing Plant resumed to normal operating conditions in December 2016, whilst pit production resumed in January 2017. Activity increased at the Wolverine Mine throughout the year as mine production expanded.

Surface water sampling included mine-related discharges, Perry Creek, and the Wolverine River as dictated by PE-17756. Cumulative effects sampling as per M04-01 was re-established in Q3 of 2017 after care and maintenance. In March 2017, one non-compliance is noted where SP12-2 exceeded the PE-17756 Total Suspended Solid permit limit of 50 mg/L. Further details regarding this non-compliance, including variances from the sampling program, are discussed within the body of this document.

The collection of groundwater samples from the monitoring water wells was performed per the Terms and Conditions of PE-17756, with the exception of MW-6 in Quarter 1 and MW-1 in Quarters 1 and 2. MW-1 and MW-6 were re-established in August, 2017 as per PE-17756 Appendix A. Details are included regarding variances from permit requirements.

Seeps and sump monitoring resulted in five new sites (Seep 22, Seep 23, Seep 24, Seep 25, and Seep 26) in 2017. The seep and sump monitoring was completed at a frequency dictated by C-223 per the Terms and Conditions of PE-17756.

Sediment monitoring was completed per the Terms and Conditions of PE-17756 in 2017.

The Water Quality Monitoring Program will be continued in 2018 per C-223, M04-01, and PE-17756.

1.0 Introduction

1.1 *Overview*

The purpose of the 2017 Annual Water Quality Report – Wolverine Mine, is to meet the Terms and Conditions under Section 5.2 of the Effluent Permit PE-17756 and fulfill the requirements outlined in C-223 and M04-01. This report has been prepared and submitted by Conuma Coal Resources Limited (Conuma). Included in this report are the results and interpretations of data collected from surface water, groundwater, flow monitoring, seeps and sumps, and sediment monitoring conducted at the Mine during 2017.

In 2017, the Wolverine Mine was responsible for the following:

- Surface and groundwater sampling and reporting
- Air quality monitoring and reporting
- Metal leaching (ML)/acid rock drainage (ARD) monitoring and reporting
- Seep and sump monitoring and reporting
- Cumulative effects monitoring and reporting
- Sediment monitoring and reporting
- Overseeing spill response
- Wildlife management

Environmental staff also supervised the general mine operational implementation of Best Management Practices.

1.2 *Ownership*

Conuma is a privately owned company that was incorporated in British Columbia (B.C.) in 2016. In September 2016, Conuma purchased the Brule, Willow Creek and Wolverine Mines from Walter Energy, Canada. Conuma's head office is located in Tumbler Ridge, B.C. under the management of Mark Bartkowski, President. Conuma's principal business is the acquisition and development of coal properties.

The Wolverine Mine is operated from Tumbler Ridge, B.C.:

Mailing Address ....PO Box 2140, Tumbler Ridge, BC V0C 2W0

Telephone 250.242.3764

The Wolverine Mine is under the management of Byron Eagles, Mine Manager. Executive direction related to the Wolverine Mine is provided by Mark Bartkoski, President. Overseeing of regional environmental activities is Andre Laforest, Senior Environmental Manager.

Implementation and day-to-day direction of the on-site environmental programs are the responsibility of Amanda Wamsteeker, Environmental Manager.

1.3 *Land Tenure*

Conuma's Perry Creek Pit occupies Coal Lease 414696, with an area of 3128 hectares, and is adjoined to the northwest by Coal Licence 391198, with an area of 296 hectares. The Lease and the Licence are part of Conuma's Wolverine coal property, which also encompasses the adjacent East Bullmoose [EB] coal project area. Provincial map-areas 093P.004, 093P.005, and 093P.014 cover the Lease and Licence. All of these Crown coal lands lie within the Liard Mining Division of British Columbia.

Lease 414696 has a term of validity extending until November 2, 2034, provided that annual lease rental is paid, and that annual documentation requirements continue to be met. The Lease is currently paid-up ('in good standing') until November 2, 2018. Licence 391198 has similar rental and documentation requirements, and is subject to annual renewal, with current 'good standing' until December 11, 2018.

1.4 *Location*

The Wolverine open-pit coal mine is located in the Peace River Regional District, approximately 27 kilometers (km) by road southwest of Tumbler Ridge, B.C. Access to the Mine is via Highway 29, approximately 10 km, west of Tumbler Ridge, then southwest along the Wolverine Forest Service Road (FSR) for 17 km.

1.5 *Access/Egress*

There are four road access/egress options at the Wolverine Mine. Main access/egress is located through a security gatehouse at 17.3 km on the Wolverine FSR. Orica, the Mine's contracted explosive company, gains access via a locked gate on the eastern portion of the lease off the Perry Creek Road at 0.25 km. A second locked gate permits occasional access for warehouse personnel to the 'Back 40' storage area on the southwest edge of the lease at 18 km on the Wolverine FSR. A road on the northern edge of the property is available for emergency egress to 4.5 km on the Perry Creek Road; a berm prevents public access but is easily removed for emergency egress. Impassable berms and other measures, such as signs indicating active mining activities, along the mine perimeter deter public access.

2.0 Water Quality Monitoring Program

The 2017 Water Quality Monitoring Program is based on the required surface water, groundwater, seeps and sumps, and sediment sampling program presented in the monitoring and reporting requirements of Permits PE-17756, C-223, and Environmental Assessment Certificate M04-01. This section outlines sampling locations, frequencies and parameter requirements for the Mine.

The following report sections comment on achieved compliance concerning Permit Limits, followed by a detailed discussion of parameters, the British Columbia Water Quality Guidelines (BCWQG), and temporal trends. Full results and graphs are provided in the following Appendices:

- Appendix A : Quality Assurance and Control results
- Appendix B : Surface Water Flow and Discharge Measurements results and graphs
- Appendix C: Groundwater Monitoring results and graphs
- Appendix D: Seep and Sump Monitoring results and graphs
- Appendix E: Surface Water Monitoring results and graphs
- Appendix E: Field Turbidity vs Laboratory TSS results and graphs
- Appendix F: Sediment Monitoring
- Appendix G: Calibration and Calculations
- Appendix H: Management Plans
- Appendix I: Spill Reports
- Appendix J: 2017 Environmental Effects Monitoring Report (Golder)
- Appendix K: Wolverine Mine – 2017 Water Quality Update (Lorax)
- Appendix L: Effluent Permit PE-17756

2.1 *Surface Water Quality Monitoring Program*

Surface water quality sampling is conducted in accordance with the procedures described in the latest version of the British Columbia Field Sampling Manual (Province of British Columbia, 2013). A summary of surface water chemical analyses results for 2017 are provided in Appendix E, with stations described in Table 1. Sampling frequencies are specified in Appendix A of PE-17756 (attached as Appendix L.

Surface water samples are grab samples collected from each monitoring site at the frequencies mandated in permits PE-17756, M04-01 and C-223 and in accordance with the British Columbia Field Sampling Manual (Province of British Columbia, 2013). Samples are collected in laboratory-provided bottles by gloved hand or an extendable sampling pole to ensure that the potential for field contamination is minimized. Sample bottles are labelled with the site name and date of collection. Where access is unsafe due to weather or environmental conditions, samples are collected as close as possible to the original location where the most representative sample can be taken. During winter conditions, holes in the ice are augured or opened using an axe. Each bottle is filled upstream of the sampler to ensure the water quality is stable and unaffected by stirred up sediment and debris. Field measurements of temperature, pH, conductivity and turbidity are also taken upstream of the sampler to ensure stirred sediment does not cause inaccurate readings. In above freezing temperatures, field measurements are taken using a YSI 556. Where temperatures are below freezing, an Oaklan PCTestr35 Multi-parameter unit is used, but is limited to conductivity, temperature and pH. A Hach 2100p turbidity meter is used to measure in field turbidity readings in nephelometric turbidity units (NTU).

Upon completion of sampling, the bottles are packed with ice and a Chain of Custody and sent to the commercial laboratory for analysis within 24 hours of sample collection to ensure hold times are not exceeded.

Flow is measured at the required sample locations by; staff gauge reading; portable flow meter, portable velocity meter or bucket flow methods. Staff gauge readings are taken by averaging the height of flow against the staff gauge to three decimal places. The portable flow meter used is a Sontek Flowtracker where sonar is used to measure the velocity of water flowing past the sensor and converts that into a flow measurement. Calibration and troubleshooting are performed using “Beamcheck” software, included with the instrument. The portable velocity meter used is a Hach FH950 Handheld Flow Meter. This meter utilizes an electromagnetic sensor to measure the velocity of water flowing past the sensor. By recording the depth and width along with the velocity, flows can be calculated. Calibration is performed by inputting zero velocity in the meter while allowing the sensor to stabilize in static water.

A bucket flow is used when the flow or discharge is concentrated in a small area from a culvert or weir. A stopwatch is used to calculate how long bucket with a known volume takes to fill. This is done in triplicate and the time averaged, resulting in a flow measurement.

2.1.1 Surface Water Sampling Sites

Site locations and descriptions are provided in Tables 1 through 3, on the following pages. A map of the monitoring locations is provided in Figure 1 **Error! Reference source not found.**.

Monitoring locations along the Wolverine River that assist in delineating Mine-related influences are:

- WR-2 Downstream of Course Coal Rejects Diversion and some Quintette inflows
- WR-7 Downstream of WR-2, SP18, W14-2, SP14, TS-1, SP12 and SP12-3
- WR-4 Downstream WR-7, SP4b, and SP6
- WR-3 Downstream of WR-4, and Perry Creek

With regards to the influence of Quintette Mine (Teck Resources Limited), Conuma monitors the Wolverine River at WR-2 (Figure 1) to help characterize the influence of loading emanating from the Mesa Dump area. WR-2 is located upstream of all Wolverine related surface water flows with the exception of the Course Coal Rejects Diversion Ditch. Given that WR-2 is located downstream of a decommissioned sediment pond collecting water from Quintette's historic Mesa Dump, this monitoring site is used to isolate potential impacts from the Wolverine Mine site from those associated with impacts from Quintette. The commissioning of the Course Coal Rejects Dump in 2012 could potentially influence the groundwater chemistry upstream of WR-2.

There are six sediment ponds, three exfiltration basins and one tailings pond at the Mine. SP4a was replaced by SP4b in December 2008. SP4b, SP6 and SP12 collect runoff water from the active pit and rock waste dumps. SP14 and SP18 collect runoff water from the plant site area. SP-EXP collects runoff water from the Orica Explosives Site. SP4b, SP14-1, SP18-1, and SP-EXP did not discharge to the receiving environment in 2017. SP12 and SP6 polishing ponds passively discharged throughout the year.

SPC1, SPC2 and SPC3 exfiltration basins collect surface water drainage from the eastern portion of the East Dump. SPC1 and SPC3 decanted throughout the fall with flows never exceeding 1 L/minute. SPC2 decanted for a short period in early April.

PE-17756 requires monthly supernatant sampling if the ponds are not discharging, and monthly discharge sampling if there is flow.

Table 1: Location Description of Surface Water Sample Sites

Site ID	Location Description	UTM Coordinates
WR-1	Wolverine River upstream of all present and proposed mining operations. Provides control baseline upstream of both the Wolverine and Quintette properties. Sampling location: 21.3 km up the Wolverine FSR, located on the east side of the road.	E 0608686 N 6100741
WR-U/S Mine Site	Replaced WR-1 in 2016 PE-17756 amendment. Wolverine River upstream of all present and proposed mining operations. Provides control baseline upstream of both the Wolverine property with influence from one Quintette sediment pond. Sampling location: 18.8 km up the Wolverine FSR. Cross the FSR and CN tracks. Sample upstream of river meander scar that CCR-2 discharges into.	E 0610860 N 6101869
CCR-1	Diversion ditch extending around north and west side of the plant site area. Dry under most conditions. Sampling location: 18.6 km up the Wolverine FSR, follow the ditch up and around the bend to the sign.	E 0610782 N 6102377
CCR-2	Downstream extent of CCR Diversion Ditch. Dry under most flow conditions. Sampling location: 18.6 km up the Wolverine FSR. Cross the FSR and CN tracks. Sample from downstream side of the culvert.	E 0610852 N 6102152
WR-2	Wolverine River downstream of potential inputs from the Quintette property and Wolverine CCR. Sampling location: 17.3 km up the Wolverine FSR, turn east and across CN tracks opposite to the security shack. At the end of road at river, is a path towards the northeast. The sampling location is past dustfall A3, off the beach.	E 0612114 N 6102411
W14-1	W14 Creek upstream of mine site area which drains southern slopes of Fortress Mountain. Sampling location: 17.3 km up the Wolverine FSR, on the west side, past the security gate, following the road up to the Run-of-Mine (ROM) road, and west up the Breaker road, the sample is collected prior to the culvert.	E 0611762 N 6102882
SP18-1	Outflow of Sediment Pond SP18. Sampling location: 17.5 km up the Wolverine FSR. There is a series of 3 culverts on the east side of the CN tracks. Sample is collected here.	E 0611636 N 6102788
W14-2	Clean water diversion ditch downstream of the Wolverine FSR which drains from Fortress Mountain. Sampling location: 17.3 km up the Wolverine FSR, turn east opposite the security shack, downstream of the culvert in the ditch alongside the Wolverine FSR.	E 0611762 N 6102882
SP14-1	Outflow of Sediment Pond SP14. Sampling Location: 17.1 km on Wolverine FSR – SP14 decant.	E 0611951 N 6103080
TS-1	Tailings Seepage Interception Ditch Sampling Location: Just south of SP12 pond edge, culvert that flows under Wolverine FSR, sample on upstream side of culvert at base of Tailings Dam.	E 0612190 N 6103923
SP12-2	Outflow of Sediment Pond SP12. Sampling location: Polishing pond decant.	E 0612303 N 6104041

Table 1 continued: Location Description of Surface Water Sample Sites

Site ID	Location Description	UTM Coordinates
SP12-3	Combined flow of Sediment Pond SP12, TS-1 and area water in ditch 100 metres downstream of CN Railway Line. 16.5 km up the Wolverine FSR on the left side (east). Walk across railroad tracks next to SP12-2 discharge, then south on path to junction with TS-1 and other water flow.	E 0612333 N 6103889
WR-7	Wolverine River downstream of SP12 and potential Quintette inputs, upstream of SP6 inputs. Sampling Location: 14.3 km on Wolverine FSR, south down the road to the Terry Ranch, through gate, follow road, qpproximately 500 meters past the bridge. The sample location is approximately 20 meters south of the road next to the conifer trees. The sample is taken from the bank of the Wolverine River.	E 0612766 N 6104496
SP6-1	Inflow to Sediment Pond SP6. Sampling Location: 14.7 km up the Wolverine FSR, just south of STARS helicopter landing. The staff gauge is located approximately 20 meters downstream of the culvert.	E 0612803 N 6105449
SP4b-1	Outflow of Sediment Pond SP4b. Sampling Location: 13.5 km on Wolverine FSR, outflow culvert on north side of the road.	
SP6-2	Outflow from Sediment Pond SP6 flow via underground pipe to first Oxbow-5 pond, through culvert under railway tracks to second Oxbow-5. Spillway at northeast end of Oxbow-5. Sampling Location: 13.5 km up the Wolverine FSR, east on road across CN tracks, the sample location is at the spillway on the northeast end of Oxbow-5.	E 0613807 N 6105598
SPEXP-1	Outflow of Sediment Pond SPEXP. Sampling Location: Outflow culvert, of SPEXP, take path from Orica Blasting Laydown.	E 0613789 N 6106187
W2-1	W2 drainage collects ditch runoff from Wolverine FSR, drains through culvert under railway tracks to pine flat area. Dry under most flow conditions. Sampling Location: 12.5 km up the Wolverine FSR, on the east side of the road there is a ditch with a culvert going under the train tracks. The sample is taken on the downstream side of the culvert.	E 0614251 N 6105973
WR-4	Wolverine River downstream of all sediment pond inputs from Wolverine mine site area. Sampling Location: 13.5 km up the Wolverine FSR, on the east side there is a road that crosses the train tracks. Keep left. Drive to end of main road (approximately 500 meters), the sample location is on the river bank, marked by a sign.	E 0614248 N6105737
PC-1 (PC-10)	Perry Creek upstream of proposed East Bullmoose Pit area. Provides baseline information. Sampling Location: 12.1 km up the Wolverine FSR, then take Perry Creek Road, at 10 km take West Perry Creek Road, at approximately 1.7 km there is a bridge. The sample site is on the upstream side of the bridge.	E 0604725 N 6106938
PC-2	Perry Creek upstream of all Wolverine operations and upstream of Perry Creek falls which limits upstream extent of fish habitat. Sampling Location: 12.1 km of the Wolverine FSR, then take Perry Creek Road, at 7.5 km, there is a bridge. The sample location is down the embankment, 10 meters upstream of the bridge.	E 0608463 N 6107008

Table 1 continued: Location Description of Surface Water Sample Sites

Site ID	Location Description	UTM Coordinates
UD-1	Upper Diversion Ditch above North Dump. No longer exists. Was reclaimed.	E 0610156 N 6107019
UD-2	Upper Diversion Ditch runoff directed to small drainage that culverts under Perry Creek Road. Near continual flow throughout the summer. Sampling Location: 12.1 km up the Wolverine FSR, then take Perry Creek Road. At culverts at 5 km, site is on the sowstream side of the culvers.	E 0610156 N 6107019
SPC1	Perry Creek Road exfiltration basin, collects East Dump drainage. Sampling location: on the east side of Perry Creek road at 0.8 km sampled on the downstream side of the decant culvert.	E 0614055 N 6106555
SPC2	Perry Creek Road exfiltration basin, collects East Dump drainage. Sampling location: on the east side of Perry Creek road at 1.1 km sampled on the downstream side of the decant culvert.	E 0613981 N 6106795
SPC3	Perry Creek Road exfiltration basin, collects East Dump drainage. Sampling location: on the east side of Perry Creek road at 1.4 km sampled on the downstream side of the decant culvert.	E 0613752 N 6106998
PC-3	Perry Creek downstream of all Wolverine operations and groundwater inputs associated with Wolverine Mine. Sampling Location: 12 km up the Wolverine FSR, at the Perry Creek bridge. The sample location is on the upstream side of the bridge on the north bank.	E 0614654 N 6106617
WR-3	Wolverine River, downstream of confluence of Perry Creek and upstream of Mast Creek. Isolates the influence of Perry Creek inputs from Mast Creek inputs. Sampling Location: 8.6 km up the Wolverine FSR, on the south side. The sample location is along base of the Wolverine River.	E 0616176 N 6109008

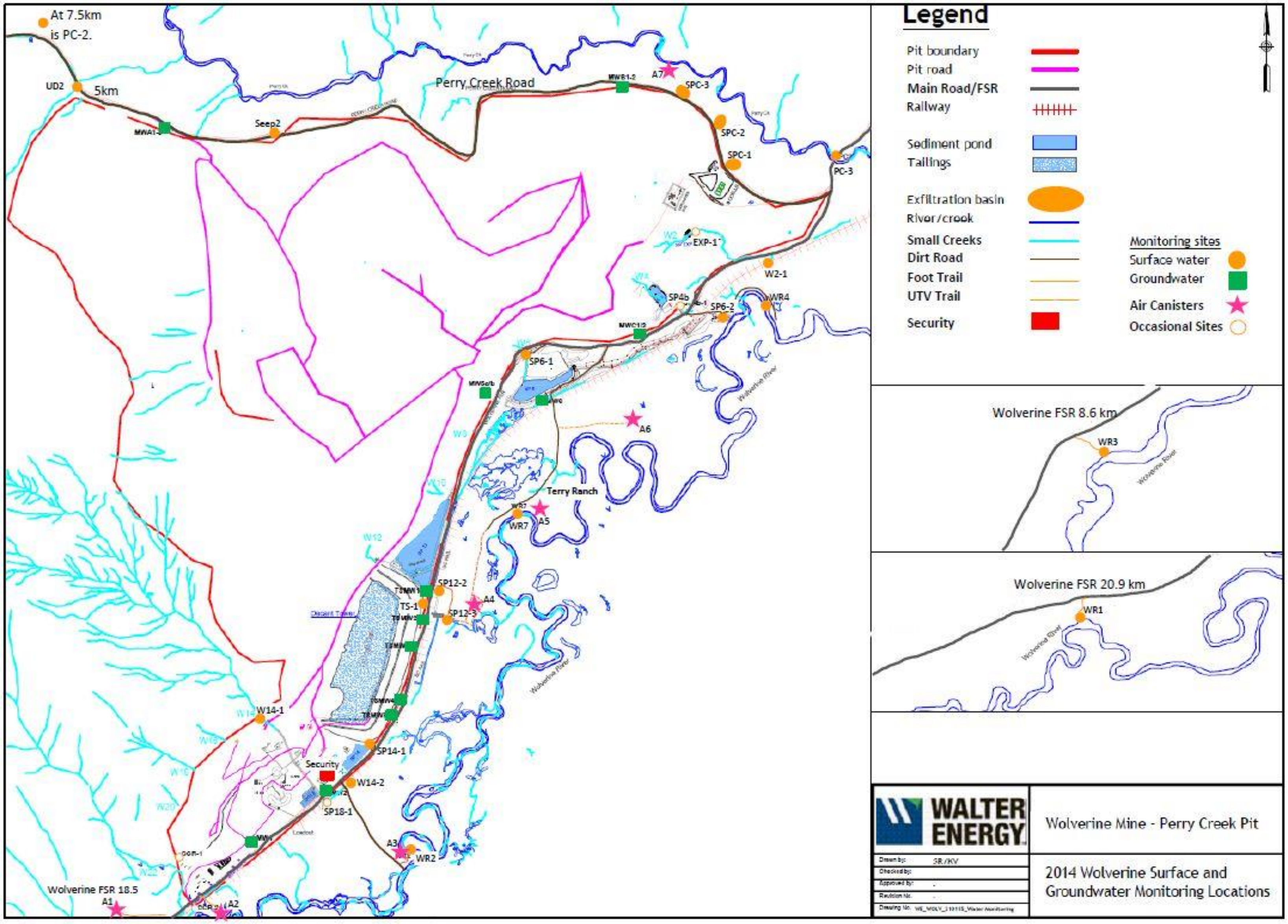

Figure 1. Locations of Surface Water Sampling Sites

2.1.2 Clean Water Diversion Ditches

The Course Coal Rejects Diversion and the Upper Diversion Ditches were designed to divert clean water away from the Mine. The Course Coal Rejects Diversion directs surface water to the Wolverine River between WR-US Mine Site and WR-2, while the Upper Diversion directs surface water to Perry Creek between PC-2 and PC-3.

Coarse Coal Rejects Diversion

Seasonally limited flow was seen at the Course Coal Rejects Diversion Ditch in 2017.

Upper Diversion Ditches

The Upper Diversion Ditch (UD-1) was originally located within the footprint of the future North Dump; therefore, a new diversion ditch was constructed in 2011 to replace it. The Upper Diversion was decommissioned in early spring 2014, due to logging and topsoil removal above the ditch as part of the extension work on the North Dump and the continuation of mining in Phase 4. The decommissioning involved plugging the ditch and filling it with coarse rock as a road for topsoil hauling from the logged area. An outlet was constructed in the side of the ditch, allowing drainage of any remaining surface water into the North Dump Drainage Ditch, which directs contact water from the North Dump vicinity into the Perry Creek pit.

The New Upper Diversion Ditch (UD-3) was informally assessed and it was determined that not all the surface water was being captured by the diversion. The uncaptured water continued down to the old diversion, and as the plugging of the ditch had not stopped all of the water, it resulted in re-establishing sample site, UD-2, next to the Perry Creek Road at kilometer five where the diversion water flows towards Perry Creek. In fall 2017, temporary ditching within the Wolverine lease boundary was completed to cut off access to UD-2 and redirect the surficial water into the North Dump Drainage Ditch. Assessments in spring 2018 will determine the effectiveness of the new ditching and will assist with developing a long term solution for the New Upper Diversion Ditch.

W14 Clean Water Diversion

The W14 stream was altered to start at W14-1 (above the plant) to allow clean water from above the Mine site to be conveyed through the plant and administrative area. The water in this channel is then redirected back to its original watercourse through Oxbow 1. The W14 channel is sampled both above the plant (W14-1, as background) and below the administrative area (W14-2). The W14-2 site captures water from SP18-1; however, SP18-1 did not discharge during 2017.

W2 Sample Location

W2 stream is an ephemeral stream with natural drainage designed to drain to SP-EXP. W2 is sampled downstream of the sedimentation pond and downstream of the culvert across the Wolverine FSR (W2-1). Although no flow was seen from SP-EXP in 2017, the significant area below this pond and the runoff from the Wolverine FSR, resulted in seasonal flow at W2-1.

2.1.3 Tailings Seepage Ditch

The MoE authorized discharge of the Tailings Ditch Seepage water through culverts under the Wolverine FSR, which eventually combines with the discharge from SP12 and water flow from the surrounding areas. It is believed groundwater, unrelated with no interaction with the tailings pond, is seeping up through the ditch and captured at TS-1. Continued monitoring and analysis is required for confirmation. Discharge began on October 3, 2014 and the authorization became permanent when the May 2016 Permit amendment was issued.

In the authorization for discharge of the Tailings Seepage Ditch, sampling for a full parameter suite on a monthly basis is required at TS-1.

2.2 *Groundwater Quality Monitoring Program*

Conuma monitored groundwater quality in eighteen monitoring wells at the Mine in 2017. Nine wells are permitted by PE-17756 while the remaining ten are requirements of C-223 for East and North Dump monitoring. Coordinates for the monitoring water wells are listed below in Table 2. Groundwaters are tested for concentrations of general parameters, total metals and dissolved metals quarterly as part of the Operational Sampling Program.

Groundwater sampling is conducted by lowering an electronic pump down the casing of the monitoring water well and purging three times the wellbore storage volume prior to collecting a sample. During winter conditions and during mechanical failures of the electronic pump, Waterra tubing fitted with a foot valve is inserted down the casing and the required volumes are purged by hand priming. Both methods can cause vigorous mixing of the well, which can result in the introduction of suspended particulates into the groundwater samples. Low-flow methods (peristaltic pump) were adapted when conditions allowed; however, where water levels were too deep to utilize this method, Conuma utilized the electronic pump system. Groundwater samples for dissolved metal analysis are filtered in the field using inline filters or syringe filters with 0.45 micrometer (µm) pores. In the event that groundwater samples are unable to be filtered due to extreme turbidity of the water, they are shipped to the laboratory for filtering. Each sample site is labelled with the sample site name, date of collection and time of collection with the corresponding information recorded on the Chain of Custody.

Field measurements are taken during the same time as the groundwater sampling for temperature, conductivity, pH and turbidity. Field measurements are taken using a YSI 556 or Oaklan PCTestr35 Multi-parameter unit (weather depending) and a Hach 2100p turbidity meter. The samples for the laboratory are packed with ice and a Chain of Custody and shipped to the laboratory for analysis, within the holding time limit. Composite samples are requested by Conuma on laboratory Chain of Custodies for precise mixing in the commercial laboratory. Requests vary depending on the composition percent required from those particular sample sites. In 2017, the Tailings Seepage Monitoring Wells (TSMW2, 3, 4, and 5) were the only composite samples required at the Wolverine Mine. The samples were mixed in the lab at a 1:1 ratio of TSMW2:TMW3 and TSMW4:TSMW5 as per PE-17756.

A summary of groundwater chemical analyses results for 2017 are provided in Appendix C. Location and frequency of the groundwater sampling required by the Permit is presented in Table 2.

Table 2: Monitoring Water Well Locations and Sampling Frequencies

Site Name	Regulatory Office	UTM Easting (m)	UTM Northing (m)	Water Level Frequency	Field Parameters * Full Suite** Frequency	Notes
MW-1	MoE			Q	Q	Re-established in August 2017
MW-2	MoE	611625	6102854	Q	Q	
MW-5A	MoE	612589	6105217	B	B	
MW-5B	MoE	612587	6105217	B	B	Frozen at ground level in cold temperatures
MW-6	MoE	612913	6105170	Q	Q	Re-established in August 2017
TSMW 2***	MoE	613890	6105028	Q	Q, A EPH	
TSMW 3***	MoE	614216	6104981	Q	Q, A EPH	
TSMW 4***	MoE	614542	6104934	Q	Q, A EPH	
TSMW 5***	MoE	614868	6104886	Q	Q, A EPH	
MW-B-1	MEM	613376	6107026	UD	UD	
MW-B-2	MEM	613376	6107028	UD	UD	
MW-7A	MEM	613567	6107054	UD	UD	Dry
MW-7B	MEM	613567	6107054	UD	UD	Dry
MW-09-1	MEM	610466	6106875	UD	UD	
MW-09-2	MEM	611208	6106681	UD	UD	
MW-09-6	MEM	612969	6107002	UD	UD	
MW-10-1	MEM	612999	6105523	UD	UD	
MW-10-2	MEM	613638	6106088	UD	UD	
MW-10-3	MEM	613560	6106622	UD	UD	Frozen tubing in cold temperatures

* field turbidity, pH, conductivity, temperature
** includes non-metals, total metals, and dissolved metals package. Details in PE-17756, C-223
*** composite samples: TSMW-2/3, TSMW-4/5
A – Annual
B – Bi-annual
EPH – Extractable Petroleum Hydrocarbon
Q – Quarterly
UD - Undefined

2.3 *Seep and Sump Monitoring Program*

Seeps and sumps are sampled twice annually in freshet and fall as per C-223. A survey of dump toes is conducted in the spring when flows are heaviest. Seeps are sampled following the same method as surface water and are field filtered using 0.45 micron syringe filters. If channels are shallow, a syringe is utilized to sample without disturbing the channel bed. In 2017, seeps 23 through 26 were discovered in the spring.

In spring, the pit sump (PS-1) is sampled from the largest body of water on the north side of the In-Pit Dump. Access to the sump is down a steep path that has been covered with boulders continuously falling from the surrounding dump. The instability of the dump required the area to be off limits to personnel on foot, resulting in a sample being taken from the south side of the In-Pit Dump directly upstream of the W6 Rockdrain.

Dump locations, frequency of sampling in 2017, and changes to seep sampling are described in Table 3. Locations are displayed in Figure 2.

Table 3: Waste Rock Seep Sampling Locations, Frequencies and Changes

Waste Rock Dump	Start of Dump Construction	Seep Name	2017 Samples	Changes to Seeps
North Dump Previously drained to Perry Creek; Ditch rerouted to drain to Pit Sump into Wolverine River	06-Dec	Seep 1	23-May-17	Ditch routed seeps into Pit Lake
			31-Oct-17	Ditch routed seeps into Pit Lake
		Seep 2	23-May-17	Ditch routed seeps into Pit Lake
			31-Oct-17	Ditch routed seeps into Pit Lake
		Seep 18	31-Oct-17	Dry; Ditch routed seeps into Pit Lake
North Dump Draining to Wolverine River	06-Jun	Seep 3	23-May-17	
			31-Oct-17	
		Seep 4	23-May-17	Rediscovered May 2014
			31-Oct-17	Reports to the pit sump
		Seep 5	-	Now within pit footprint
		Seep 12	-	Now within pit footprint
		Seep 16	-	Source not found in 2016
		Seep 20	23-May-17	Discovered in November 2016; dry in May 2017; source identified as natural seep in October 2017 (NW Natural Seep)
		Seep 21	23-May-17	Discovered in November 2016
			31-Oct-17	
		Seep 23	23-May-17	Discovered May 2017; dry in October 2017
		Seep 24	23-May-17	Discovered May 2017
			31-Oct-17	
		Seep 25	23-May-17	Discovered May, 2017; ~20 m north of Seep 4
			31-Oct-17	

Table 5: Waste Rock Seep Sampling Frequencies and Changes

Waste Rock Dump	Start of Dump Construction	Seep Name	2017 Samples	Changes to Seeps
East Dump	07-Sep	Seep 9	-	Buried in 2011, captured in Seep 14
		Seep 10	-	Buried in 2010, captured in Seep 14
		Seep 11	11-Apr-17	
			31-Oct-17	
		Seep 13	-	Source identified as unrelated to East dump
		Seep 14	11-Apr-17	
			31-Oct-17	
		Seep 15	11-Apr-17	
			31-Oct-17	
South Dump (Southwest)	06-Apr	Seep 7	11-Apr-17	
			31-Oct-17	
		Seep 8	11-Apr-17	
			31-Oct-17	
South Dump (Northeast)	06-Apr	Seep 6	-	
		Seep 17	11-Apr-17	Pit construction in area, source not found in Q4 2017
		Seep 26	21-Jun-17	Discovered June 2017
			31-Oct-17	
Pit Sump	07-Jun	PS-1	19-Jun-17	
			19-Dec-17	
CCR Dump	12-Jun	CCR Seep	11-Apr-17	Discovered in May 2014
			31-Oct-17	

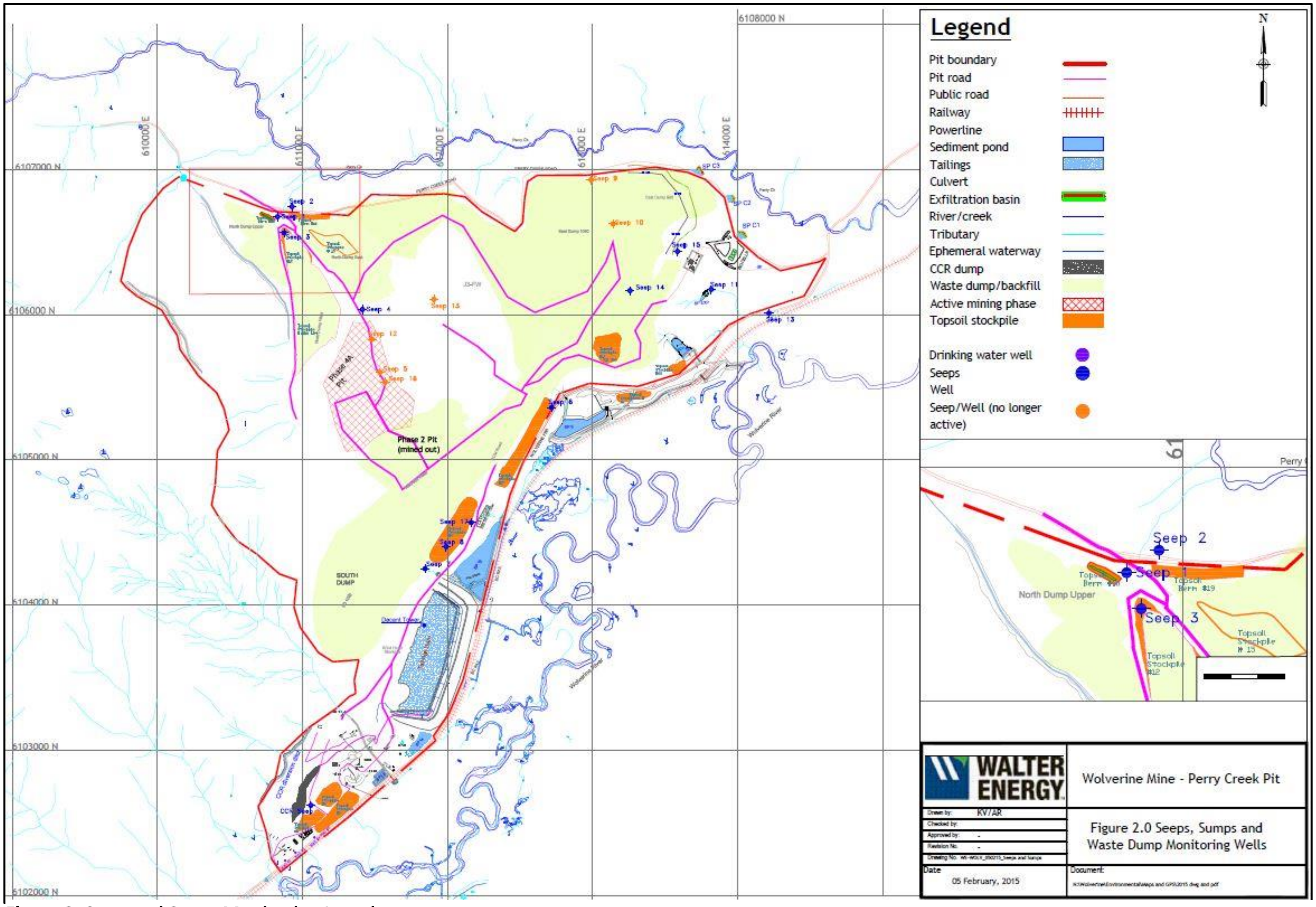

Figure 2: Seep and Sump Monitoring Locations

2.4 *Environmental Effects Monitoring Program*

The Environmental Effects Monitoring (EEM) Program is conducted every two years during operations by a third party consultant and evaluates periphyton biomass, benthic invertebrate community structure, fish tissue, and amphibian eggs with corresponding water and sediment data to support interpretations. The program is designed to facilitate a regional approach to monitoring, integrating aquatic monitoring activities for Conuma, and improving the ability to identify long term regional trends. In 2017, a study of periphyton and benthic invertebrates was conducted at the Wolverine Mine. Results are included in Appendix J. In 2018, fish tissue analysis will be conducted for selenium bioaccumulation. Following these studies, the next EEM study will take place in 2020 and will incorporate all aspects of the EEM during a single year.

2.5 *Cumulative Effects Monitoring Program*

The Murray River Aquatic Cumulative Effects Assessment Framework (MRACEWAF) is coordinated by a Steering Committee of which Conuma is an active participant. The purpose of the MRACEWAF is noted in the MRACEWAF Terms of Reference: “To assess and better understand the aquatic ecosystem of the Murray River watershed and cumulative effects of development in order to inform management actions required to improve sustainability of the watershed”. Historical data along the Perry Creek and Wolverine River were organized and submitted to a consultant chosen by the Steering Committee for analysis and identify parameters of concern. Conuma committed to the MRACEWAF to conduct monthly samples of the mouth of Coldstream Creek and Murray River to bridge gaps in the entire watershed’s database.

Wolverine Mine cumulative effects are monitored at surface water sampling sites within the Wolverine watershed to determine the impact of industry within the watershed as per M04-01 (sites described in Table 4). The majority of the Perry Creek pit contact water discharges into oxbow lakes in the Wolverine River flood plain, before entering the Wolverine River. Oxbows are lentic environments and may assist in the attenuation of mine loadings such as selenium, nitrate and sulphate. Oxbows are sampled for water chemistry three times per year and sediment once per year. In addition to oxbows, strategically located sites upstream and downstream of multiple industrial activities along the Wolverine River and Murray River are sampled three times per year.

In 2017, staff turnover and understanding of the EA Commitments resulted in fewer samples taken than the monitoring program details.

Table 4: Location Description of Cumulative Effects Surface Water Sample Sites

Site ID	Location Description	UTM Coordinates
Ox-1	Oxbow lake between rail line and Wolverine River.	E 0612433 N 6103189
Ox-2	Meander scar located ~800 m downstream of Oxbow-1.	E 0612625 N 6103850
Ox-3	Isolated oxbow between rail line and Wolverine River near W4 tributary, south of Oxbow-4	E 0613826 N 6105270
Ox-4	Isolated oxbow between rail line and Wolverine River near W4 Creek, and adjacent to discharge routing from sediment ponds SP6 and SP4b.	E 0613889 N 6105548
W6-2	Wetland adjacent to Terry Ranch situated downgradient of Tailings Pond and SP12.	E 0612910 N 6104830
WR-0	Upstream site on the Wolverine River. Upstream of all industrial activities.	
WR-5	Wolverine River, directly upstream of Bullmoose Loadaout and Bullmoose Creek.	E 0622100 N 6111656
WR-6	Mouth of Wolverine River before it enters the Murray River.	E 0625100 N 6111828
MR-1	Downstream of Wolverine River influence on the Murray River.	E 0625201 N 6112281

2.6 *Baseline Monitoring Program Overview*

Baseline monitoring was established at selected sites in 2001 and continued until 2005. Construction of the plant facilities began in June 2005, with pre-stripping commencing in January 2006, and plant production commencing in July 2006. Site construction activities overlapped with pre-production and production; construction activities were completed in December 2007 with the commissioning of the maintenance facility. Surface water sampling locations were established with the intention of monitoring mining impacts in the receiving environments at various locations. Additional sites have been added to the Water Quality Monitoring Program to enable further isolation of mine related point sources to the Wolverine River and Perry Creek. These data will enable the environmental staff to better identify the need for mitigation measures.

2.7 *Development and Production Phase*

2.7.1 Surface Development to Date

Construction at the Wolverine Coal Mine began in April 2005, with the development of infrastructure to support open-pit mining. Pre-production stripping of the Perry Creek Pit began in October 2005, followed by coal mining in April 2006. Coal processing commenced in July 2006, with the loading of the first railcar of coal in August 2006. Surface soil material is salvaged from all areas disturbed by mine construction and operations and stored in the various stockpile locations.

The Mine was placed on idle status April 2014, with the plant processing the remaining stockpiled coal until late May 2014, at which time the Mine went into Care & Maintenance. No mining activities occurred at the Mine during 2015 or 2016. Pit production resumed January 2017.

The development of Phase 4a advanced from an elevation of 981 meters above mean sea level (masl) to varying elevations with the lowest bench reaching completion at 864 masl. Phase 4b advanced from an elevation of 1,398 masl to 1,174 masl. The cumulative total disturbance of 987 hectares (ha) as of December 31, 2016 remains unchanged from the previous reports. The total permitted disturbance for life of mine is 995.1 ha; therefore, as of December 2017 the total disturbance is 99.2% of the permitted total

2.7.2 Future Plans

Conuma plans to continue mining as per the current Mine Permit C-223. A Five Year Plan is scheduled to be submitted to the government in quarter one of 2019. The Water Quality Monitoring Program will be maintained as per the Terms and Conditions of Effluent Permit PE-17756. A project description of the EB Project, an expansion of the Wolverine Mine approximately 13 km west of the Perry Creek Pit, was filed with the Ministry of Energy and Mines (MEM) in October 2017.

3.0 Data Quality Assurance

A comprehensive Quality Assurance/Quality Control (QA/QC) program was incorporated into the field and laboratory components of the 2017 Water Quality Monitoring Program. QA/QC data are presented in Appendix A. The purpose of a QA/QC program is to verify the reliability of field and laboratory monitoring processes through the implementation of procedures for controlling and monitoring collections and measurements. The QA/QC program provides information for the evaluation of analytical procedures and for analysis of possible issues pertaining to contamination both in the field and in the analytical laboratory. The QA/QC program is conducted at all stages of the sampling program in both the field and laboratory.

3.1 *Field Meters*

Various field meters are used at the Mine to measure in-situ turbidity, conductivity, temperature, pH, dissolved oxygen, oxidation-reduction potential (ORP) and flow. All field equipment is regularly calibrated and maintained by the environmental staff. Equipment that cannot be calibrated by the environmental staff is sent to the manufacturer or equipment suppliers for calibration. The turbidity and YSI units are sent to third parties for annual calibration. The turbidity, YSI and multi-meter units are calibrated in-house per the manufacturer's recommendations. The flow tracker is calibrated in-house during each usage.

Field turbidity is obtained using a Hach 2100p turbidity meter that has a range of 0-1000 nephelometric turbidity units (NTU). In weather above freezing, a YSI 556 unit is used to measure conductivity, temperature, pH, dissolved oxygen and ORP. For weather below freezing, the YSI unit will not function so an Oaklan PCTestr35 Multi-parameter unit is used but is limited to conductivity, temperature and pH.

The portable flow meter used is a Sontek Flowtracker or Hach FH950 velocity meter. The Sontek Flowtracker utilizes sonar to measure the velocity of water flowing past the sensor and converts that into a flow measurement. Calibration and troubleshooting are performed using "Beamcheck" software, included with the instrument. The Hach FH950 velocity meter measures velocity using an electromagnetic sensor across multiple distances along a channel cross-section. The real-time velocity is allowed to stabilize while distance and depth of a cross-section are recorded. This cross-sectional data are calculated to determine volumetric discharge along the channel.

3.1 *QA/QC Sample Types*

3.1.1 Field Blanks

Field blanks, consisting of de-ionized (DI) water, are exposed to the same conditions and treatments as the water samples collected and are intended to monitor contamination that occurs during sample collection and handling (e.g. sample preservation or filtering). Two types of field blanks are generated: 1) travel blank; and 2) filter blank. Travel blanks are prepared as follows: DI water from the laboratory is shipped in four liter bottles and decanted into the appropriate bottles in the Conuma environmental office on the day of sampling and preserved with acids, if needed, immediately before going into the field. The sample bottles are placed in a cooler with ice packs and taken into the field by the sampling staff. The blank samples are returned unopened to the office and shipped to the analytical laboratory with the remainder of the samples for analysis.

In contrast, filter blanks are prepared as follows: In the field, DI water is passed through the filtration apparatus in the same manner as the sample. Analysis of the filtrate provides an indication of the types of contaminants that may have been introduced through contact with contaminated filtration surfaces (filtration apparatus and the filters) or exposure to dust sources. For surface water, samples for dissolved metal analysis are filtered by the laboratory. For groundwater and seeps, samples are filtered in the field using inline filters or syringe filters with 0.45 micrometer (µm) pore spaces. In the event samples are unable to be filtered due to extreme turbidity of the water, they are shipped to the laboratory for filtering.

3.1.2 Field Duplicates

Duplicates are intended to evaluate the QA/QC surrounding the sampling methods. Duplicates are prepared by collecting two full sample suites from one randomly selected location, the first labeled with the correct sampling location name (e.g. WR-2) and the second with an anonymous name (e.g. Melon). When the results are reported back from the analytical laboratory, relative percent differences (RPDs) are calculated to identify the differences between the replicate and sample. In low flow conditions, or when sampling groundwater, side-by-side sampling is not always possible. When samples are not collected side by side, they are collected sequentially (i.e. WR-2 total metal sample, Melon total metal samples, WR-2 dissolved metal sample, Melon dissolved metal sample, etc.).

Field duplicates provide a measure of the overall precision of the methods used, including the combined precision of field methods, laboratory methods and the environmental variability over the time-scales (approximately 10 minutes for a full suite of replicate sample collection). An RPD of no greater than twice the laboratory precision criteria was defined in the Permit as the Data Quality Objective (DQO) used to identify significant differences between duplicate and sample, where the RPD is defined as:

RPD (%) = (Value 1 – Value 2)/mean x 100

Some degree of environmental variability can be expected in duplicate samples for parameters associated with Total Suspended Solids (TSS), and RPDs are expected to be high at values near the method detection limit (MDL). Duplicate samples that return a large RPD for high concentrations of parameter when compared with MDL are potentially indicative of a problem with sampling methodology and may warrant further investigation and/or training. The converse is true when samples return a large RPD for low concentrations of parameters, close to the MDLs of the analytical procedures employed. In these situations, the large RPD is less indicative of potential methodological problems and does warrant further scrutiny with future sampling efforts. The acceptable level of RPD exceedances that is considered problematic is three times the MDL: if a large RPD is observed for sample results below this limit, it is noted, but does not represent a problem in the data collection methods. Slight variations at very low concentrations can also result in high RPD values. For this reason, where the parameter is within two times the detection limit, RPD was not used as a measure of QA/QC. RPDs greater than 40% when the parameter levels are greater than three times the MDL are highlighted in Appendix A.

In 2017, AGAT did not supply Conuma with laboratory precision criteria for each individual sample in 2017. Because of this, results were highlighted when RPDs exceeded 40% and the specific parameter was at least two times greater than the standard detection limit provided.

3.2 *Field Quality Assurance Results and Discussion*

Field QA results are summarized below in Tables 5 through 10. For duplicate results, RPDs exceeding 40% are presented. All QA/QC data are provided in Appendix A. Within the tables of Appendix A, values that exceeded 40% RPD and were greater than two times the MDL were highlighted in yellow, while values that exceeded 40% RPD but were below two times the MDL were shaded orange.

3.2.1 General Parameter Duplicates

Field Duplicates – Surface Water

Seventeen full suite field and nineteen TSS/Turbidity duplicates were collected in 2017 as part of the surface water monitoring program; the results for these samples are shown in Appendix A.6, which contains the data for the original sites and field duplicates. Slight variations at very low concentrations can also result in high RPD values. For this reason, where the parameter is within two times the detection limit, RPD was not used as a measure of sample precision.

Permit requirements state that duplicate sampling must result in no more than twice the laboratory precision limits for RPD between the duplicate and its associated regular sample. Because the laboratory did not supply Conuma with specific precision data, samples were compared to 40% RPDs. In total, there were four samples sets where a total of six general parameters were greater than 40% RPD and greater than two times the MDL:

Table 5: Surface Water Duplicate General Parameters Showing >40% RPDs

	March	May	August	November
Parameters >40% RPD and 2x above Detection Limit.	True Colour (126%)	Total Phosphorus (49%)	Total Suspended Solids (55%)	Turbidity (61%)
	Total Kjeldahl Nitrogen (40%)			
	Dissolved Phosphorus (59%)			

Field Duplicates – Groundwater

Full suite field duplicate comparisons for groundwater are presented in Appendix A.2. For the four full suite duplicate samples taken in 2017, no general parameters were greater than 40% RPD and greater than two times the MDL.

Groundwater samples sets that are associated with the largest number of RPD's over 40% are generally associated with high turbidity values. Groundwater sampling can result in vigorous mixing of well waters, which in turn can increase turbidity if the wells contain sediment. This in turn can bias sample results for parameters dominantly associated with particulate fractions (e.g., total metals),. Work was done in early 2012 to re-develop existing water wells to minimize water well disturbance and the introduction of particulates; however, further development is required as TSS issues persist.

Field Duplicates – Seeps and Sumps

Full suite field duplicate comparison for seeps and sumps are presented in Appendix A.4.

For the three full suite duplicate samples taken in 2017 during seep monitoring, two general parameters were greater than 40% RPD and greater than two times the MDL:

Table 6: Seeps and Sumps Duplicate General Parameters Showing >40% RPDs

	April	May
Parameters >40% RPD and 2x above Detection Limit.	Dissolved Phosphorus (151%)	Hardness (48%)

Seep sample sets that are associated with the largest number of RPDs over 40% are generally associated with high turbidity values. Specifically, exceedances of 40% RPDs are often observed during freshet, when higher water velocities can result in the resuspension of sediments and increased turbidity in water samples. This general scenario, however, cannot be used to explain RPD exceedances in 2017, since these were limited to dissolved parameters (dissolved phosphorus and hardness).

Field Duplicates – Sediment

Duplicate comparisons for sediment are presented in Appendix A.7.

For the one sediment duplicate sample taken in 2017, no general parameters were greater than 40% RPD and greater than two times the MDL.

3.2.2 Total and Dissolved Metal Duplicates

Field Duplicates – Surface Water

Seventeen full suite field duplicates were collected in 2017 for surface water monitoring; the results for these samples are shown in Appendix A.6, which contains the data for the original sites and field duplicates.

Slight variations at very low concentrations can also result in high RPD values. For this reason, where the parameter is within two times the detection limit, RPD was not used as a measure of sample precision.

Permit requirements state that duplicate sampling must result in no more than twice the laboratory precision limits for RPD between the duplicate and its associated regular sample. In total, there were three samples sets in 2017 where eight metals were greater than 40% RPD and greater than two times the MDL:

Table 7: Surface Water Duplicate Metals Showing >40% RPDs

	January	May	November
Parameters >40% RPD and 2x above Detection Limit.	Total Titanium (80%)	Total Cadmium (50%)	Total Aluminum (45%)
		Total Iron (55%)	
		Total Lead (46%)	
		Total Lead (51%)	
		Total Silver (191%)	
		Dissolved Titanium (47%)	

Field Duplicates – Groundwater

Full suite field duplicate data for groundwater are presented in Appendix A.2.

For the four full suite duplicate samples taken in 2017 during groundwater monitoring, the following metals were greater than 40% RPD and greater than three times the MDL:

Table 8: Groundwater Duplicate Metals Showing >40%

	February	June	September	December
Parameters >40% RPD and 2x above Detection Limit.	Total Copper (91%)	Total Iron (46%)	Total Titanium (100%)	Total Aluminum (40%)
	Dissolved Copper (67%)	Dissolved Copper (67%)		Dissolved Lead (73%)
				Dissolved Tin (44%)

There were two additional parameters that were greater than 40% RPD, but less than 300% of the MDL, including Total tin (52.1%) in March and Total cadmium (50.3%) in November.

Groundwater samples sets that are associated with the largest number of RPD's over 40% are generally associated with high turbidity values. Groundwater sampling can result in vigorous mixing of well waters, which in turn can result in the resuspension of sediments in the well, and associated increases in turbidity and parameters associated with particulate phases. This could contribute to the differences noted in the duplicate samples. Work was done in early 2012 to re-develop existing water wells to minimize water well disturbance and the introduction of particulates; however, further development is required as TSS issues persist.

Field Duplicates – Seeps and Sumps

Full suite field duplicate comparison for seeps and sumps are presented in Appendix A.4. For the three full suite duplicate samples taken in 2017 during seep monitoring, eight metals were greater than 40% RPD and greater than two times the MDL:

Table 9: Seeps and Sumps Duplicate Metals Showing >40% RPDs

	April	May	October
Parameters >40% RPD and 2x above Detection Limit.	Total Titanium (83%)	Dissolved Copper (64%)	Total Copper (67%)
	Dissolved Aluminum (62%)	Dissolved Manganese (50%)	
	Dissolved Beryllium (86%)		
	Dissolved Cobalt (43%)		
	Dissolved Iron (85%)		

Seep sample sets that are associated with the largest number of RPDs exceeding 40% are generally associated with high turbidity values, as per the rationale outlined previously for general parameters.

Field Duplicates – Sediment

Duplicate comparison for sediment is presented in Appendix A.7. For the one sediment duplicate sample taken in 2017 during sediment monitoring, one metal was greater than 40% RPD and greater than two times the MDL:

Table 10: Sediment Duplicate Metals Showing >40% RPDs

	April
Parameters >40% RPD and 2x above Detection Limit.	Total Cobalt (41%)

3.2.3 Field Blanks

Field travel blanks measure contamination arising from sample collection and sample handling (filtration, preservation, and transport). Field blanks were submitted along with weekly, monthly and quarterly sample sets for analysis in 2017.

Surface Water

Full suite field blank data, from monthly and quarterly sample sets, for nineteen blank samples are presented in Appendix A.5. Several parameters demonstrated a reoccurrence of detection limit exceedances within the field blanks, including Total Suspended Solids, Turbidity, Dissolved Orthophosphate, Dissolved Phosphorus, and Dissolved Copper.

Groundwater

Full suite field blank data, from quarterly sample sets, for nineteen blank samples are presented in Appendix A.1. Several parameters demonstrated a reoccurrence of detection limit exceedances within the field blanks, including Total Suspended Solids, Dissolved Orthophosphate, Dissolved Phosphorus, Total Phosphorus, Dissolved Molybdenum, and Dissolved Thallium.

Seeps and Sumps

Full suite field blank data, from bi-annual sample sets, for nineteen blank samples are presented in Appendix A.3. Detection limit exceedances within the seep and sump field blanks was limited to Turbidity and Total Phosphorus.

3.3 *Laboratory QA/QC Data*

Laboratory quality control samples included duplicates, Method Blanks (MBs), Certified Reference Materials (CRMs) and Laboratory Control Samples (LCS). MBs are free of target analytes or possible interferences and are used to calibrate laboratory equipment. The blanks also monitor analyte recovery and potential loss during the analytic process. LCS analyses verify the accuracy of instruments with respect to anions, and the DQO is ±10% of the known concentration, with the exception of bromide and ammonia which have DQOs of ±15%. AGAT Laboratories did not supply Conuma with LCS data in 2017. Conuma has since changed from AGAT to ALS Laboratories and this information will be included within the results.

CRMs verify the accuracy of instrumentation and analytical methods. CRMs are standards with known concentrations, certified by a technically valid procedure and are traceable to a certificate or other documentation issued by a certified distributor. The DQO for CRMs are based on percent recovery and are set by the laboratory for each parameter and each matrix. The DQO for most metals in water samples is ±20% of the known concentration. The laboratory reports multiple CRM results for each parameter in each data report. All reported CRM values were within the acceptable level of accuracy, indicating a high level of quality assurance.

CRMs – Surface Water, Groundwater, and Seeps

AGAT performed the water analysis for Conuma in 2017 and maintains strict guidelines for quality assurance and control. There were no exceedances of DQOs for groundwater samples in 2017.

3.4 *Control Sites*

WR-U/S of Mine Site, situated upstream of mine-related inputs from the Wolverine Mine and partially downstream of mine related inputs from Teck's Quintette, is designated as the control site for comparison with sites downstream of effluent discharges from the Wolverine Mine. Concentrations in the Wolverine River at monitoring stations downstream of WR-U/S of Mine Site reflect the cumulative effect of Wolverine and Teck Mines.

PC-2 is the control site on Perry Creek, located above all possible Mine inputs. PC-10 (also known in the past as PC-1) is located further upstream on Perry Creek, located above predicted inputs from the yet unpermitted East Bullmoose Pit. Both Perry Creek control sites are downstream of oil/gas and logging activities.

4.0 Water Flow

4.1 *Discharges*

In overview, water is collected and diverted by ditches in the plant site, open pit, waste dumps and explosive storage areas and conveyed to six sediment ponds for storage, sediment settling and possible treatment (flocculation) prior to discharge. The six sediment ponds are designated as:

- SP18 Sediment Pond – located at the south edge of the plant site area.
- SP14 Sediment Pond – located along the western toe of the tailings embankment.
- SP12 Sediment Pond – located northeast of the tailings impoundment.
- SP6 Sediment Pond – located south of the common point between South dump and East dump and between the Wolverine FSR and railway.
- SP4b Sediment Pond – located in the East dump area.
- SP-EXP Sediment Pond – located west of the explosives storage site.

Sediment ponds SP18, SP4b and SP-EXP rarely decant and are generally empty. Flows are measured when there is discharge. Sediment Pond SP14 infrequently decants, where flow is measured from a downstream outflow channel. This pond is maintained at a lower level using the low-level valves to ensure adequate surge capacity during high-flow events. Settling Ponds SP6 and SP12 receive most of the water from the active mine and dump areas and decant frequently. SP12 is used for dust suppression activities within the mine’s boundary. Specific considerations are discussed below.

4.1.1 SP6 Sediment Pond

Mining is completed in Phase 3 and there is a reduced demand for the SP6 Sediment Pond relative to the original design as the Pit Sump now intercepts most of the runoff flow in the W6 basin. A future concern with this pond will be to limit decant from the Pit to less than the 7.3 m^3/s design inflow for this structure. This pond receives 100% of the pit water decant into the W6 rock drain and surface runoff water via ditching along the Wolverine FSR into an inlet on the south side of the W6 rock drain.

4.1.2 SP12 Sediment Pond

The mean annual inflow for this pond is predicted to vary from 31 to 56 L/s for most of its operating life. Decant during early operations will therefore be limited to the freshet period and peak storm events, as flows outside of this period will likely be less than the exfiltration rate from this pond. This pond is outfitted with a silt curtain in addition to an automated flocculant plant already installed on this pond to mitigate suspended solid loading.

4.2 *Staff Gauges*

Staff gauges are installed at SP12 and SP14 gate valves at the Wolverine Mine. To create a more comprehensive flow monitoring program, Conuma will be installing staff gauges at SP6, W14-2, and PC-3 in 2018.

4.3 *Discharge Measurements*

Discharge and flow measurements were performed as outlined in Appendix A of PE-17756 based on the requirements of the Care & Maintenance Sampling Program for the Mine from March 2016 through October 2016. Flow measurements for January, February, November and December were as per the Operational Sampling Program, but due to the winter conditions for those months, no flow measurements were taken. Discharge measurements were taken by two methods: 1) a triplicate bucket method and 2) a SonTek FlowTracker Handheld ADV. A FlowTracker creates a cross-section and measures velocity resulting in a calculated discharge rate., Table 11 below, displays permitted flow measurement frequencies, the number of flow measurements conducted in 2017 and any variances in 2017 from PE-17756.

SP6 effluent was discharged through an underground pipe, from the sediment pond into a burrow pit, which then flows into Oxbow 5. When the water level in Oxbow 5 rises above the outlet the effluent water flows through a discharge channel to the Wolverine River. It is also believed that effluent water infiltrates the subsurface of this area. Historically, flow measurements were performed in the discharge channel, which would not represent the discharge through the channel and subsurface. The May 2016 Permit amendment changed the flow measurement location to the pipe outlet at the borrow pit.

SPC1 and SPC3 demonstrated flow for a short period in the spring and SPC2 for approximately one week in April. All flows were measured using the ‘bucket method’.

No monitored discharges exceeded the Design Discharge Rate stated in PE-17756. All monitoring results are summarized in Appendix B

Table 11. Permitted and Conducted Flow Measurement Frequency

Site	Operational Requirements	Sampled 2017	Variances from Permit Requirements
SP EXP-1	Weekly if flowing	No flow	
SP4b-1	Weekly if flowing	Weekly when flowing	
W2-1	NA	NA	
SP6-2	Weekly if flowing; then Monthly	13 from April to October	Elevated velocities from pipe prevented accurate readings. Once flows decreased, weekly measurements were taken. Conuma will be researching automated measuring systems in 2018. Winter conditions at pipe prevented safe flow monitoring.
SP12-2		Estimated 29 from April to October	Unsafe work conditions in fall due to access into weir. Visually estimated flows were taken - estimating time to fill a 20L bucket.
TS-1		35 from April to October	
SP18-1	Weekly if flowing	No flow	
SP14-1	Weekly if flowing	1 from April to October	Discharged one week in 2017.
W14-1	NA	NA	
W14-2	Weekly	25 from April to October	Wolverine River flooded the site in freshet - unsafe conditions for flow measurement.
SPC1-1	Weekly if flowing	12 from April to October	Remaining weeks were not flowing.
SPC2-1		2 from April to October	Remaining weeks were not flowing.
SPC3-1		6 from April to October	Remaining weeks were not flowing.
CCR-2	NA	No flow	Discharged May through July.
UD-2/UD-Clean	3x Week	4 from April to October 13 from April to August	Flows too low for equipment or no flow.
PC-3	1x Freshet 2x Fall	1 Fall	Unsafe work conditions due to low manpower.
WR U/S Mine Site	NA	NA	
WR-2		NA	
WR-3	Monthly	1 in April 5 from June to October	High water levels prevented flows during freshet and winter conditions prevented flows during winter months.
WR-4	NA	NA	
Tailings Flow to Tailings Pond	Daily	Daily	Daily flow averaged from monthly water volumes.

4.4 *Automated Flow Measurement Stations*

Automated flow measurement stations are not required at the Wolverine Mine under PE-17756; however, M04-01 requires continuous water level monitoring within Perry Creek, W14 Tributary, SP6 and SP12. These were removed midway through care and maintenance due to a misunderstanding Walter's commitments within the M04-01. As soon as conditions allow in 2018, these flow monitoring stations will be re-established.

4.5 *Hydrology Summary*

Annual hydrographs of WR-3 and PC-3 were constructed with available data. Unsafe work conditions prevented flow measurements during freshet and following rain events that caused the water levels to rise to the point of unsafe work conditions. Flow measurements are usually possible starting in April and continue until freeze up, which may occur as early as late September.

Seasonal weather patterns had an impact on flow rates in 2017 as shown by an increase in flow during freshet, followed by a decrease in flow during the summer and a subsequent increase in flow in mid-fall, usually resulting from either an increase in rainfall or a minor melting event. As depicted from the graphed data, there are few annual fluctuations observed. An annual representation of manual flow measurements is presented in Appendix B.

The flow rates in natural water bodies (Wolverine River, Perry Creek, and W14 channel) demonstrated a similar pattern across all flow monitoring stations: lower flows in late winter, increasing in the spring in concert with snow melt (freshet), decreasing in the summer and increasing once more in the fall. Although freshet represents the dominant driver of seasonal flows, large rain events can also have a pronounced effect in governing flow variability.

4.1 *Meteorological Data*

As required under Wolverine's Air Permit PA-17759, a meteorological station was installed at the Wolverine Mine in July 2006 to monitor and record ambient air temperature, wind speed, wind direction and precipitation. The Wolverine meteorological station is located northeast of the coal processing plant, at approximately 14.3 km on the Wolverine FSR, adjacent to the inlet channel of SP6 sediment pond; UTM coordinates E 0612880, N 6105324. Unfortunately, meteorological data were not collected from the Wolverine Mine weather station in 2017, as parts for the weather station are not readily replaceable due to the age of the station. A new weather station was installed in December 2017. 2017 climate data for temperature, wind speed and precipitation (**Error! Reference source not found.** 12) were obtained from Teck Resources Limited (Teck) Quintette Mine meteorological station, which is located south of the Mine (coordinates N 54.99592, E 12.98714, elevation 914 AMSL). A detailed description of long-term climate conditions in the region is presented as part of the 2017 Water Quality Update for the Wolverine Mine (Appendix K).

Environment Canada records 440.6 mm precipitation as an averaged climate normal at the Environment Canada Chetwynd Station. By using Chetwynd as a reference station, it can be concluded that 2017 was wetter on average (2017 precipitation = 503.5 mm).

Table 12: Meteorological Data Summary for 2017 – Quintette Mine Weather Station

	Temperature (°C)			Wind Speed (km/hr)			
2017	Minimum	Maximum	Average	Average	Maximum	Direction	Precipitation (mm)
January	-28.8	9.7	-5.7	11.5	82.1	WSW	15.8
February	-29.7	12.6	-7.2	7.4	95	WSW	11.0
March	-27.3	8.4	-5	6.6	74	WSW	15.4
April	-7.9	13.1	2.6	8	56.3	WSW	30.0
May	-0.7	26.1	10.4	9.4	72.4	WSW	49.4
June	0.2	28.4	13	9.7	70.8	WSW	50.0
July	3.5	26.4	15.3	9.2	61.2	WSW	28.0
August	5.2	31.3	15.6	8.6	66	WSW	25.2
September	-3.2	29.6	10.5	7.6	67.6	WSW	78.8
October	-7.3	18.3	4.3	11.4	90.1	WSW	112.8
November	-23.6	6.8	-7.4	6.5	67.6	WSW	86.1
December	-33.7	13.5	-6.0	11.8	86.9	WSW	1.0
2017	**-33.7**	**31.3**	**3.36**	**8.97**	**90.1**	**WSW**	**503.5**
Climate Normals[1]	**-15.3**	**22.2**	**3**	**8.2**	**78**	**SW**	**440.6**

[1] Environment Canada: Canadian Climate Normals (1981-2010) Station Data at station Chetwynd A (Latitude: 55°41’14.000 N, Longitude: 121°37’36.000 W, Elevation 609.6 m)

5.0 Water Quality

The Wolverine Mine's PE-17756 mandates 50 mg/L Total Suspended Solids at the discharge locations of sediment ponds. Exceedances are shown in Table 15. Maximum Typical Effluent Concentrations for nitrate, sulphate and selenium are also dictated in PE-17756 at sediment pond discharges SP12-2 and SP6-2. Tables 16 through 18 show exceedances of these concentrations. Site Performance Objectives (SPO) for nitrate (1.5 mg/L), sulphate (175 mg/L) and selenium (0.003 mg/L) for the downstream Wolverine River site (WR-3) are listed in PE-17756. It was determined that no parameters exceeded these objectives in 2017.

5.1 *General Parameters*

5.1.1 Turbidity

TSS/Turbidity comparison

The Ministry of Environment (MoE) has requested that laboratory TSS and Field NTU data are compared to determine the strength of association between the two variables. Because the relationship between TSS and turbidity is dependent on site conditions, site-specific calculations are required. The most common correlation coefficient, the Pearson product-moment correlation coefficient, was used to measures the strength of the linear association; the greater the absolute value, the stronger the linear relationship. Analysis of a decade long dataset showed moderately weak linear relationships at SP6-2, SP12-2, and W14-1, indicated by a correlation coefficient ranging from 0.65 to 0.76. Data showed a weak linear relationship at SP14-1 and W14-2, indicated by correlation coefficients 0.18 and 0.25, respectively.

A weak correlation does not mean zero relationship between the two variables; it is possible the two variables have no linear relationship, but rather a strong curvilinear or other relationship. Conuma will continue to investigate the relationship between laboratory TSS values and observed field turbidity measurements to aid in the reduction of response time to a high TSS sample.

Based on the results of a 10-year data set, excluding a few outlying measurements caused by sampler error and situational conditions, the comparison between turbidity and TSS for discharging ponds, remains limited for accurate estimation of TSS values. Despite this, it can be concluded that all three sites demonstrate a positive relationship, with generally high turbidity values more likely to yield TSS measurements of concern.

Turbidity

Seeps displayed a seasonal trend with elevated turbidity evident during the freshet period. The North Dump seeps exhibit significantly higher turbidity, as the area above the dump was logged in 2013, creating erosional conditions. These seeps are directed into the pit sump which allows for settling before entering SP6, which offers further retention and settling prior to effluents entering the receiving environment.

Portions of the South Dump abut a steep rock face with minimal topsoil and vegetation, reducing the exposure to loose mobilized soil and therefore reducing the occurrence of elevated turbidity readings. Seeps originating from the East Dump were consistently low, as demonstrated by low turbidity in SP12. Turbidity levels at SP12 triggered daily sampling in March; however, due to new staffing and management, daily sampling did not occur. Based on field notes, however, it appears the sample (that triggered daily sampling) was taken from between layers of ice from the polishing pond and therefore not representative of SP12-2 discharge.

W14-2 showed slightly elevated turbidity during March, May, June, July and October, and can be attributed to natural erosion processes in the channel.

In May 2017, PC-3 showed elevated turbidity readings. It was determined that the Upper Diversion Ditch was not fully decommissioned and contact water from a logged area with unstable soil was being released into Perry Creek. UD-2, which captures the unauthorized discharge from the decommissioned Upper Diversion Ditch, also displayed elevated turbidity. Mitigation strategies, including additional ditches within the lease boundary redirecting the surficial flow into the North Dump Drainage Ditch and into the pit sump, were in place by the fall of 2017, with an assessment to occur during freshet in 2018.

During freshet in May 2017, elevated turbidity was seen at WR-3. All mine loadings, however, were below 3 NTU. Elevated turbidity at this time is therefore assumed to reflect natural enrichment associated with high flows (e.g., bed resuspension and bank erosion).

There were some instances were turbidity readings at several groundwater wells were high. This can be attributed to the resuspension of sediments in the wells during sampling. Further development of problematic wells, including MW-2, MW-5A and-5B, MW-6, MWB1 and 2, MW9-1, MW9-6, and MW10-1 will be conducted in 2018.

5.1.2 Conductivity

Conductivity within the seeps generated from the North Dump appear to be decreasing over time. Further monitoring will confirm the downward pattern. Conversely, conductivity within the seeps originating from the East Dump is significantly higher than North Dump seeps and show an increase over time.

Seeps 14 and 15, originating from the East Dump, appear to be infiltrating the subsurface resulting in continually increasing conductivity at MW-10-2. Currently, these elevated conductivity signatures are not reflected in data for SP4b surface water. SP6-2 conductivities are steadily increasing from baseline figures following the increasing conductivity at PS-1.

Seeps originating from the South Dump continue to contribute to the elevated conductivity shown in SP12-2.

Consistently, conductivity readings in surface water are elevated during periods of low flow, when compared to periods of high flow.

5.1.3 Total Suspended Solids

Total Suspended Solids (TSS) is a measure of the particulate matter (namely, silt, clay, fine particles of organic and inorganic matter, and microscopic organisms) that is suspended within a water column. Elevated concentrations can restrict light penetration for photosynthetic activity, damage aquatic gills, and impair spawning habitat. TSS often follows seasonal fluctuations with increases during freshet or precipitation events (Caux, 1997). Sediment pond discharges have a maximum TSS limit of 50 mg/L as dictated in PE-17756.

As noted in Table 13, TSS exceeded permit limits during March 2017 at SP12-2. Because of unsafe access to the discharge location, the sample was taken from the polishing pond directly beside the discharge weir, where the sample appears to have been taken from between layers of ice and therefore not representative of SP12-2 discharge. Downstream of SP12-2, the TSS reading was 14 mg/L at SP12-3. Conuma is in the process of updating Standard Operating Procedures including Surface Water Sampling which will reflect sampling in all weather conditions.

Table 13: Permit Exceedances (TSS)

Month Sampled	EMS#	Discharge Site	Maximum Permitted TSS	Exceeding Concentration
March 2017	E260797	SP12-2	50 mg/L	237 mg/L

TSS seen in the seeps generated from the North Dump followed a similar pattern to turbidity readings due to the easily mobilized soil from the logged area above the dump. In contrast, seeps from the East Dump and South Dump showed relatively low TSS readings throughout the year. Seep 26 showed increasing readings from spring through to fall. This is assumed to be attributable to road maintenance. Overall, TSS readings from the East Dump area of the mine site are negligible.

As with the occurrence of elevated turbidity levels in some groundwater wells, similar patterns were observed for TSS. Further development of these wells is required to ensure that site is collecting a representative sample.

During freshet May 2017, elevated TSS was seen at PC-3 and WR-3. These sites were sampled during a storm event and elevated TSS is assumed to be a result of high flows during this period. All other permit limits for TSS were met.

5.1.4 pH

The Wolverine watershed is observed to be naturally alkaline, where all water samples showed pH results consistent with naturally occurring background ranges.

In spring 2017, it is noted that the laboratory pH from all spring seep samples decreased from historically stable figures and increased back to consistent values in the fall. Field pH levels, however, remained reasonably consistent between 7.2 and 8.6 across all seep locations.

No trends are evident in ground or surface water samples.

5.1.5 Hardness

Hardness and conductivity tend to follow the same patterns and was observed across all water quality monitoring programs for seeps, groundwater and surface water. Hardness values in seeps from the North Dump appear to be decreasing over time. Further monitoring will confirm the downward pattern. Hardness within seeps originating from the East Dump is significantly higher than North Dump seeps and shows an increase over time. Seeps originating from the South Dump are contributing to the elevated hardness evident at SP12-2. Seasonal hardness trends are also evident in surface water receiving environments, where low hardness is observed during freshet in response to the incursion of dilute melt waters.

5.1.6 Alkalinity

Alkalinity values followed the same pattern as hardness values for seeps. Groundwater values remained relatively stable in 2017.

5.1.7 Sulphate

Sulphate occurs naturally when sulfide minerals undergo weathering in the presence of water. This is exemplified during coal mining as the ore and surrounding rock is exposed during extraction. The fragmentation of rock from blasting increases the mineral surface area available for oxidation. Seepage and precipitation then mobilizes sulphate into the water courses (Meays, 2013).

Permit PE-17756 states Typical Effluent Concentration ranges for sulphate levels predicted at SP12 and SP6. Exceedances above the maximum range are reported to the MoE and summarized in Table 14.

Table 14: Typical Effluent Concentrations (Sulphate) Exceedances

Month Sampled	EMS#	Discharge Site	Maximum Typical Effluent Concentration	Exceeding Concentration
February 2017	E260797	SP12-2	1110 mg/L	1520 mg/L
May 2017	E261280	SP6-2	640 mg/L	653 mg/L
August 2017	E260797	SP12-2	1110 mg/L	1390 mg/L
August 2017	E261280	SP6-2	640 mg/L	634 mg/L
September 2017	E260797	SP12-2	1110 mg/L	1540 mg/L
September 2017	E261280	SP6-2	640 mg/L	644 mg/L
October 2017	E260797	SP12-2	1110 mg/L	1480 mg/L
November 2017	E260797	SP12-2	1110 mg/L	1420 mg/L

Data collected from the East Dump seeps tend to show an increase over time. In contrast, a decrease in sulphate values has been observed at the seeps originating from the North Dump, similar to selenium. .

At SP6-2, sulphate has shown a progressive increases in concentration over the period of record (2005-2017). A gradual increase in sulphate concentration in the pit sump may be contributing to the elevated sulphate concentrations at SP6.

Sulphate has shown a progressive increase in concentration over the period of record at SP12-2. Elevated levels of sulphate from Seep 7 from the South Dump are contributing to elevated levels of sulphate at SP12-2. Concentrations at both TS-1 and SP12-2 were above the hardness-based BCWQG for the majority of the year, however concentrations at the Oxbow 2 outlet (downstream of both sites and discharges directly to the Wolverine River) in August were well below the guideline. In November (798 mg/L), sulphate concentrations increased at the Oxbow 2 outlet (August 109 mg/L) significantly. Further monitoring in 2018 will determine if this is an upward trend or just coinciding with low flows. WR-3, the downstream site of all mine site activities, show sulphate levels below the SPO throughout the year.

TSMW2-3 monitoring has shown increasing sulphate values within the last 12 months. This increase in sulphate is also seen at the tailings seepage ditch surface water site TS-1. It is believed groundwater, unrelated with no interaction with the tailings pond, is seeping up through the ditch and captured at TS-1. Continued monitoring and analysis is required for confirmation. High concentrations of sulphate were also seen at groundwater monitoring wells MWB-1 and MWB-2; however, the downgradient receiving environment in Perry Creek did not reflect these concentrations.

Mining practices at the Wolverine Mine follow strict waste rock management protocols, with blending conducted to mitigate localized acid generation. Conuma has dedicated plans to perform progressive reclamation to reduce oxidation and infiltration through waste rock dumps to minimize contaminant mobilization, thereby managing loadings into the sediment ponds and receiving environment.

5.1.8 Nitrogen

Permit PE-17756 states Typical Effluent Concentration ranges for nitrate levels predicted at SP12 and SP6. Exceedances above the maximum range are reported to the MoE and summarized in Table 15.

Table 15: Typical Effluent Concentrations (Nitrate) Exceedances

Month Sampled	EMS#	Discharge Site	Maximum Typical Effluent Concentration	Exceeding Concentration
February 2017	E260797	SP12-2	50 mg/L	66.2 mg/L
September 2017	E261280	SP6-2	30 mg/L	30.5 mg/L
October 2017	E260797	SP12-2	50 mg/L	50.1mg/L
November 2017	E260797	SP12-2	50 mg/L	53.0 mg/L

Nitrate (NO_3^-) is a measure of the most oxidized form of nitrogen in a water body and the most common form of nitrogen in natural receiving environments. Plants utilize nitrate as a nutrient for growth; however, high concentrations may result in a proliferation of phytoplankton or macrophytes. Little to no absorption occurs in sediment, perpetuating highly mobilized nitrate within groundwater systems. In mining operations, the greatest source of nitrate is explosives. Loading practices and blasting efficiency control the amount of nitrate that enter the water system (Nordin, 1986). The management of nitrogen loading and mitigation is detailed in EMS-7.4-MGT Nitrogen Management Plan (Appendix H).

North dump seeps showed a downward pattern in nitrate concentration over time in 2017. However, the pit sump, to which the North Dump seeps report, shows an upward trend. This may reflect the effect of precipitation and infiltration within road ditches and broken blast material, resulting in the mobilization of nitrogen away from blasting areas. The pit sump impacts SP6, where nitrate levels at SP6-2 exceed the 30 day BCWQG throughout the year. However, only one month demonstrated concentrations above the Typical Effluent Concentration (Table 17).

East Dump seeps also display elevated nitrate concentrations. Seeps downgradient of the East Dump show an exponential increase in nitrate values at MW-10-2; however, these concentrations are not reflected in the downstream surface water at SP4b or WR-4.

South Dump seeps show elevated concentrations of nitrate which is illustrated in the surface water in SP12-2. Several months characterized by low flow conditions experienced nitrate concentrations above the BCWQG 30 day. SP12-3, directly downstream of SP12-2, demonstrated significantly lower concentrations of nitrate; however, three months exceeded the maximum BCWQG in 2017.

5.1.9 Nutrients

In lotic and lentic environments, dissolved phosphorous (P) typically represents the limiting nutrient for algae growth. Generally low P levels observed in sediment pond discharges suggests that loadings from the Wolverine Mine do not promote enhanced algal growth in the Wolverine River or Perry Creek.

5.1.10 Chlorophyll a

Summary and interpretation are included in the EEM report produced by Golder, located in Appendix K.

5.2 *Metals*

5.2.1 Dissolved Aluminum

Aluminum is the most abundant metal in the earth's crust and exists in a variety of minerals. In solution, the mobility of Al is strongly influenced by pH and the solubility of $Al(OH)_3$ (aluminum hydroxide) (Butcher, 1988). "Dissolved" aluminum can also include colloids that pass through a 0.45 micron filter. As a result, dissolved values are often correlated with turbidity.

Dissolved aluminum exceeded the BCWQG maximum limit of 0.1 mg/L at W14-2, UD-2 and UD-Clean during freshet in 2017, possibly reflecting the inclusion of colloids in the filtered sample. These three sites receive waters from natural, unbroken ground. PC-2, the upstream site in Perry Creek, demonstrated elevated levels during this sampling period with a slight decrease observed downstream at PC-3. Overall, elevated levels in Perry Creek and other water courses can be linked to periods of increased sediment loading, implying a strong colloidal influence.

5.2.2 Copper

The copper BCWQGL results from a hardness-based calculation. The results in 2017 revealed a high total to dissolved copper ratio due to it's typically insoluble nature under neutral to alkaline pH conditions (Singleton, 1987). SP6-2 (0.0129 mg/L) exceeded the BCWQGL maximum of 0.0014 mg/L during March 2017, although the subsequent sample showed values below the detection limit. From historical data, no upward trending is observed. WR-2, downstream of Quintette's Mesa Sediment Pond, saw elevated total copper levels in June 2017, coincident with high flows and elevated turbidity. Receiving environment results of total copper in the Perry Creek watershed behaved similarly to dissolved aluminum, with elevated concentrations seen during freshet, both upstream and downstream of the Wolverine Mine and within the UD-Clean and W14 tributaries. This is consistent with historical data, that demonstrate total Cu values are strongly influenced by turbidity and the presence of particulate Cu fractions. .

5.2.3 Iron

Iron is associated with the chemical weathering of iron sulfide minerals within the waste rock dumps. The aerobic conditions allow iron to oxidize (forming ferrous oxide) which precipitates within the dump environment (Phippen, 2008). Elevated levels of iron will generally be predicted to be associated with high flow events which results in the suspension of iron-bearing particulates.

SP12 demonstrated one exceedance of total iron (2.85 mg/L) above the maximum BCWQG of 1.0 mg/L in March 2017. Sampling techniques are thought to have caused this occurrence, as the total suspended solids increased significantly, mobilizing several parameters. An axe was used to open a hole in the ice as opposed to an auger. This method may have resulted in sediment disturbance. Overall, it is unclear if the March 2017 sample is representative of pond conditions at the time.

Elevated total iron was also observed at SP12-3 in January and December 2017. As the iron was not elevated at either the TS-1 or SP12-2 upstream sites, it is hypothesized that the act of axing through ice caused particulates to become introduced into the sample.

Surface water sampling in May 2017 was divided between several days. The WR-3 sample was retrieved amidst a large rain event near the end of the month causing several parameters such as aluminum, copper and iron to increase in concert with suspended sediments.

5.2.4 Zinc

Elevated levels of dissolved Zn in site discharges (SP6-2 and SP12-2) demonstrate that zinc is mobilized through waste rock weathering. However, exceedances of the hardness-dependent BCWQG was limited to a few isolated samples in 2017, most of which occurred in conjunction with elevated turbidity. UD-2, for example, showed elevated total zinc in May 2017, most likely resulting from the elevated total suspended solids (3970 mg/L). This signature is not reflected in Perry Creek, as downstream Zn values at PC-3 remained below detection limit. UD-2 is the downstream portion of a decommissioned diversion ditch. Works have been completed to reroute any water entering this area into the North Dump Drainage Ditch which is directed into the Pit Sump. This allows the contact water to receive adequate retention time within the Pit Sump and SP6 before discharging into the Wolverine River.

As demonstrated for other parameters above, total zinc was elevated at WR-3 (0.028 mg/L) during May 2017. The site was sampling during a rain event, resulting in uncharacteristically high suspended solids levels and particulate metal concentrations. flows. Manganese

No exceedances of the hardness-based guidelines occurred for manganese in 2017; however, the manganese levels in TS-1, thought to be non-contact groundwater below the tailings dam coming to surface, impact the surface waters in the SP12 channel which are directed into the Wolverine River. Given the neutral pH of TS-1, the elevated Mn values are predicted to reflect suboxic conditions resulting in the reductive dissolution of Mn oxides. A slight increase at WR-7 (downstream of SP12 input) from WR-2 (upstream of SP12 input) may illustrates the effect of elevated manganese levels within the SP12 channel. This will be monitored going forward with a more in-depth analysis of the origins of TS-1.

5.2.5 Lead

No exceedances of lead were observed in 2017; however, the year did see spikes of elevated concentrations in May, occurring in conjuction with elevated levels of TSS.

5.2.6 Selenium

Permit PE-17756 states Typical Effluent Concentration ranges for total selenium levels predicted at SP12 and SP6. Exceedances above the maximum range are reported to the MoE and summarized in Table 16.

Table 16: Typical Effluent Concentration (Selenium) Exceedances

Month Sampled	EMS#	Discharge Site	Maximum Typical Effluent Concentration	Exceeding Concentration
February 2017	E260797	SP12-2	0.064 mg/L	0.0849 mg/L
August 2017	E260797	SP12-2	0.064 mg/L	0.0910 mg/L
September 2017	E260797	SP12-2	0.064 mg/L	0.0821 mg/L
October 2017	E260797	SP12-2	0.064 mg/L	0.0790 mg/L
November 2017	E260797	SP12-2	0.064 mg/L	0.0719 mg/L

Given that British Columbia mostly derives from marine sedimentary deposits, its soils are found to be naturally rich in selenium. Coinciding with these marine deposits are coal deposits. As rock and coal are exposed in the process of mining, weathering occurs over a greater surface area, increasing selenium loadings to the surrounding environment. Aquatic environments, particularly lentic ecosystems, have a tendency to have greater sensitivity to selenium due to natural bioaccumulation within sediments and biota. Selenium is an essential nutrient required to support life; however, because of its capacity for bioaccumulation under certain conditions, selenium poses a risk to egg-laying vertebrates such as fish, birds and amphibians. Selenium within the mine site and receiving environments is present almost exclusive as dissolved phases, indicating high potential bioavailability (Beatty, 2014).

At the Wolverine Mine, selenium is found in elevated concentrations in the water seeping from the dump toes. A main source of f selenium to SP12 is Seep 7 of the South Dump, which has sustained relatively consistent concentrations since 2012. Flows at this seep are seasonally consistent throughout the year. When conditions allow, Seep 7 flow measurements will be conducted to determine the volume of water entering SP12. The elevated concentration of nitrate, sulphate and selenium at this locations make this site a possible candidate for a semi-passive treatment system.

East Dump Seep 15 showed a peak selenium concentration of 0.772 mg/L in June 2016. The elevated concentrations in this seep are reflected in the downgradient groundwater monitoring well, MW-10-2. Seep 15 is located at the exposed downstream end of the East Dump Collector Ditch, a French drain that runs beneath the reclaimed lobe of the eastern most part of the East Dump. As this dump was reclaimed in 2013, Conuma expects to see a decrease in selenium loading as less precipitation is allowed to infiltrate the dump. Although this seep exhibits low flows, the flow is consistent much of the year. This seep will continue to be monitored and if concerning parameters such as nitrate, sulphate and selenium do not decrease, it may be a candidate for semi-passive treatment.

The majority of water entering SP6 originates from the pit sump which is a collection point for a significant amount of contact water from mined or active mining areas within the Perry Creek Pit, including North Dump seeps, exposed groundwater from high walls, road runoff, and remnants of the W6 tributary. Seeps 1 and 2 show a downward trend in selenium concentrations as the North Dump continues to mature. Several new North Dump seeps were discovered in 2017, and further monitoring will be required to determine trending.

Most background concentrations in Canadian surface waters range from 0.00001 to 0.0004 mg/L of selenium (Beatty, 2014). Based on background data for the Wolverine River at WR-U/S Mine Site (0.0007 to 0.0024 mg/L total selenium), it can be concluded that this drainage is characterized by naturally higher concentrations as compared to the nationally averaged background ranges. With the input from industrial activities into the Wolverine River, including oil/gas, forestry, and two metallurgical coal mines, selenium concentrations are expected to increase, particularly in low flow conditions. Indeed, the data indicate that selenium increases below the Wolverine Mine are more pronounced during periods of low flow. Overall, selenium concentrations across all Wolverine River sampling sites appear to remain consistent with historical values, with the major influence being variation in loadings emanating from upstream of the Wolverine Mine (associate with Quintette Mine).

Selenium levels within the Perry Creek remain historically consistent and were below or within two times the laboratory's detection limit.

As described above for sulphate, Conuma has dedicated plans to perform progressive reclamation to reduce the oxidation and infiltration through waste rock dumps, thereby minimizing loadings to sediment ponds and receiving environment.

5.2.7 Molybdenum

Molybdenum is essential in the natural process of nitrogen fixing, including the reduction of nitrate (Swain, 1986). Molybdenum concentrations within the receiving environments remain consistent with historical values. Sediment pond values tend to fluctuate with no distinct pattern, although concentrations are higher than the Wolverine River and Perry Creek, indicating sources stemming from the exposure of the sedimentary waste rock. All concentrations in sediment ponds and receiving environments are well below both the BCWQG maximum and 30 day average.

5.2.8 Cobalt

Although cobalt is a relatively rare element within the earth's crust, it can be found in sulphide containing rock and released into the environment with sulphate and selenium. Cobalt can be considered toxic to both terrestrial and aquatic vegetation and wildlife at high concentrations (Nagpal N. , Technical Report - Water Quality Guidelines for Cobalt, 2004). Total cobalt saw concentrations exceeding the BCWQG 30 day in 2017 at TS-1, SP12-3, and SP6-2. TS-1 saw five exceedances towards the end of 2017.

6.0 Sediment Monitoring

PE-17756 requires that sediment samples be collected once per year from the bottom sediments of SP18, SP14, SP12 and SP6. Due to turnover in staff, samples were collected in August but were not sent to the laboratory for analysis until January 2018, causing sample integrity issues with regards to hold times. Because of the sample integrity issues, the sample analysis may not be representative of the sediment. The results of sediment monitoring in 2017 are provided in Appendix F.

6.1 *Metals*

6.1.1 Arsenic

The concentration of arsenic in SP12 and 14 was above the Canadian Council of Ministers of the Environment (CCME) guideline in 2017.

6.1.2 Cadmium

The concentration of cadmium at SP6 was above the CCME guideline in 2017.

6.1.3 Chromium

No sites were above the CCME guideline in 2017.

6.1.4 Copper

No sites were above the CCME guideline in 2017.

6.1.5 Mercury

No sites were above the CCME guideline in 2017.

6.1.6 Silver

The concentration of silver at SP14 was above the CCME guideline in 2017.

7.0 Conclusion

The 2017 Annual Water Quality Report presents observations and results from the 2017 Water Quality Monitoring Program for the Wolverine Mine and subsequent interpretations. Conuma Coal Resources Limited was able to compare observed water quality results from 2017 to both historical and baseline results, as well as the Approved British Columbia Water Quality Guidelines.

Elevated turbidity and total suspended solids were seen in many groundwater samples in 2017. The environmental staff will conduct an internal review of all existing monitoring water wells at the Wolverine Mine. The review will be conducted to ensure that each monitoring water well has been properly completed and is in good working condition. The review will also assist in a better understanding of which aquifers are currently being monitored and if this monitoring is capturing all affected groundwater environments at the mine site.

Continuing from previous years of erosion and sediment prevention and control practices to reduce the total suspended solids, 2018 will focus on better understanding the sources of sediment in the Upper Diversion area, which increase during periods of melting or significant rainfall. As total metal concentrations coincide with suspended particulate matter, metal concentrations are predicted to decrease in concert with reduced suspended solids.

Water chemistry within the East Dump and South Dump seeps have shown increasing concentrations of parameters of concern (e.g., sulphate and selenium), particularly Seep 15 and Seep 7. Conuma will research the possibilities of passive research at these sites in 2018 while continuing to follow the ML/ARD Management Plan to ensure best practices with waste rock segregation and blending are followed. Progressive reclamation, as Conuma has committed to, will reduce dump infiltration, and hence reduce seepage through the dump.

During the 2017 monitoring year, technical difficulties were experienced at the Wolverine weather station. The station was replaced in December 2017.

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