Conuma Coal Resources Limited

2019 Annual Reclamation Report

Wolverine Mine

Prepared for

British Columbia

Ministry of Energy and Mines

Mines Act Permit Number: C-223

April 8, 2020

Executive Summary

The *2019 Annual Reclamation Report – Wolverine Mine* is a requirement of the Terms and Conditions under Mine Permit C-223. Submission of the report maintains compliance with the *Health, Safety and Reclamation Code for Mines in BC* (part 10, S10.4.4). Conuma Coal Resources (Conuma) has prepared this report for submission to the Ministry of Energy and Mines (MEM).

The Wolverine Mine is located in the eastern Rocky Mountains 27 kilometers (km) south west of Tumbler Ridge. Mine access is from Highway 29 via the existing Wolverine Forest Service Road (FSR). Conuma's Perry Creek Pit occupies Coal Lease 414696, with an area of 3,128 hectares, and is adjoined to the northwest by Coal Licence 391198, with an area of 296 hectares. The Mine was placed into care and maintenance in April 2014. Idling of the mine caused mining and reclamation activities to cease throughout 2015 and 2016. In December 2016, work commenced to re-open the pits. In January 2017, first coal was extracted, and mining activities continued through December 31, 2019.

This report describes the various mining and reclamation activities and management programs carried out during the 2019 calendar year as they relate to the requirements within the Health, Safety and Reclamation Code for Mines in British Columbia (the Code) as well as site specific requirements detailed in the BC Ministry of Energy, Mines and Petroleum Resources (EMPR) *Mine's Act* Permit C-223 most recently amended on May 17, 2019. This report summarizes completed mining, environmental protection, and reclamation activities to December 31, 2019 and describes the proposed five-year reclamation activities and future mine development.

The approved permit boundary, as of December 2019, encompasses 1047.7 ha with 986.2 ha disturbed, of which approximately 134 ha remain with native ground cover and have been allowed to regenerate naturally. Reclamation at the end of 2019 totaled 67.7 ha. A total of 17.7 million bank cubic meters (mBCM) of waste, and 1.68 million tonnes of Run-of-Mine (ROM) coal were mined in 2019. The 2019 reclamation program at Wolverine consisted of salvaging approximately 308 thousand tonnes of growth medium, 8.48 hectares (ha) of resloping CCR Pile, 10.3 ha of topsoil replacement and planting plugs. An assessment of invasive plant infestations was conducted and has led to success in identifying, mapping locations, and eradicating invasive plant species.

The Water and Air Quality Monitoring Programs at the Wolverine Mine, directed by the Terms and Conditions under Effluent Permit PE-17756 and Air Permit PA-17759, and the requirements outlined in *Mines Act* Permit C-223 and Environmental Assessment Certificate M04-01 (issued by the BC *Environmental Assessment Act*), forms a significant part of the reclamation program. The *2019 Annual Water Quality Report – Wolverine Mine* and *2019 Annual Air Quality Report – Wolverine Mine* include the results and interpretations of data collected from the required surface water, groundwater, flow monitoring, seeps and sumps, Environmental Effects Monitoring (EEM), sediment, and air monitoring sampling programs conducted at the Wolverine Mine as per Operational status during 2019 and is included as Appendix C and F, respectively.

In 2019, Metal Leaching/Acid Rock Drainage (ML/ARD) monitoring included the sampling of sumps, dump seeps, ARD Leachate Barrels, and the speciation of selenium from sediment ponds and pit sumps. A summary of the geochemical, water quality chemistry, and selenium speciation results are in Section 3.

The Water and Air Quality Monitoring Programs shall continue in 2020 as per the Terms and Conditions under Effluent Permit PE-17756 and Air permit PA-17759, and the mine and reclamation requirements outlined in *Mines Act* Permit C-223 and Environmental Assessment Certificate M04-01.

Management and persons responsible for environmental reclamation at the Wolverine Mine:

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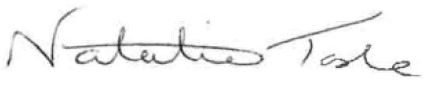
Qualified Professional Review

This document entitled *2019 Annual Report – Reclamation for Wolverine Mine* was reviewed by Natalie Tashe, a qualified professional for Stantec Consulting Ltd. ("Stantec") on behalf of Conuma Coal Resources, "Conuma". The 2019 spatial files, mapping, reporting and liability cost estimate were reviewed and compared to the EMPR standards outlined for 2019. The Wolverine mine has applied for an environmental certificate amendment and mines act and environmental management act permit amendments. Although the application has not yet received regulatory approval, the reclamation plan submitted in February 2020 contains the current reclamation plan and liability cost estimate, therefore it is referenced in the annual reclamation report as it accounts for the recently approved Perry Creek Pit Phase 5 expansion. The opinions in the document are based on conditions and information existing at the time the document was written and do not account for any subsequent changes. In reviewing the document, Stantec did not verify the mine operations information supplied to it by Conuma. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

I have authority to sign this document on behalf of Stantec Consulting Ltd.



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Introduction

1.1 *Project History*

Conuma is a privately-owned company headquartered in Tumbler Ridge, British Columbia, with offices in Vancouver, British Columbia. Conuma holds coal licenses for the Wolverine Group of properties which encompass the Perry Creek Pit and Coal Processing Plant, East Bullmoose and Hermann project areas.

In this document, "Conuma" is an umbrella term used to refer to the legal entity for permitting purposes and proponent corporate and operations personnel responsible for developing and operating the Project.

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The Wolverine Mine is under the management of Dudley Miller, Mine Manager. Executive direction provided by John Schadan, President. Implementation of the on-site environmental programs is the responsibility of Amanda Wamsteeker, Environmental Manager; Wolverine-Hermann.

The Wolverine Mine was originally permitted under the *Mines Act* for coal production of 1.4 million tonnes annually (Mt/a) in 2005. Coal production commenced in 2006. An amendment was granted in 2008 to increase coal production; thusly, Conuma operates the Wolverine Mine at 3.0 Mt/a. The Wolverine Mine began operations in 2005 under Western Canadian Coal. It transferred ownership to Western Coal Corporation in 2010, and then to Wolverine Coal Partnership (Walter Energy) in 2012. The mine was put into Care and Maintenance in 2014. Conuma purchased the mine in 2016 and resumed operations in 2017. The Wolverine Mine remained Operational from 2017 throughout 2019.

The following amendments to Mine Permit C-223 have been granted:

- March 31, 2005 Approving Work System
- March 31, 2005 Approving Reclamation Program
- June 13, 2005 Approving Borrow Pit on Coal License 410304
- September 27, 2005 Approving Construction of W6 Rock drain
- July 18, 2006 Approving Mine Expansion to 2.4 Mtpa
- October 4, 2007 Approving Upper Seam Pit
- November 2, 2007 Approving Construction of North Dump Upper to 1220 Bench
- January 8, 2008 Approving Pilot Wash of Trend Coal at Wolverine Plant
- June 30, 2008 Approving Mine Expansion to 3.0 MT/A
- August 14, 2008 Approving Pilot Wash of Brule Coal at Wolverine Plant
- January 16, 2009 Approving Follow-up Pilot Wash of Trend Coal at Wolverine Plant

- November 10, 2009 Approving Reclamation Liability Costing – Wolverine Coal
- January 6, 2010 Approving Incremental Wash of Brule Coal at Wolverine Plant
- January 6, 2010 Approving Name Change and Revision to Security Schedule
- June 27, 2011 Approving Changes to East Dump Construction
- January 31, 2012 Approving Coarse Coal Rejects (CCR) Management Plan
- April 23, 2012 Approving Revisions to Reclamation Security
- August 15, 2012 Approving Change of Name
- December 12, 2016 Approving Name Change
- May 17, 2019 Approving Phase 5 Perry Creek Pit Expansion

As of December 31, 2019, the Wolverine Mine consisted of the Perry Creek Pit. Current mine planning and permitting anticipates sequential development of the Hermann Disturbance Area (HDA) under C-223, PE-17756, and PA-17759 in 2020, coinciding with the final mining stages of the Perry Creek Pit. Implications of the HDA development include ongoing operations of the Wolverine processing plant, coal loading facilities, coal processing refuse disposal, and environmental effects monitoring within the Murray River Watershed. Potential environmental effects are detailed in the Wolverine-Hermann Amendment Project applications.

1.2 *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, 2020. Licence 391198 has similar rental and documentation requirements, and is subject to annual renewal, with current 'good standing' until December 11, 2020.

1.3 *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.

The Perry Creek Pit water management structures decant into the Wolverine River and Perry Creek, primary and secondary tributaries, respectively, to the Murray River.

1.4 *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.

Mine access roads will be constructed throughout the life of the project to facilitate soil salvage and equipment access to benches in the pit phases. These roads are shown on the respective annual mine plans and are primarily established as cut/fill balances on the same alignment that the main haul roads will be constructed. Depending on topography and nature and time frame of use, gradient would not typically exceed 10% and the running width would be 30 to 40 m. These roads will be reclaimed at mine closure, except any required to provide access for long term monitoring, inspection or maintenance.

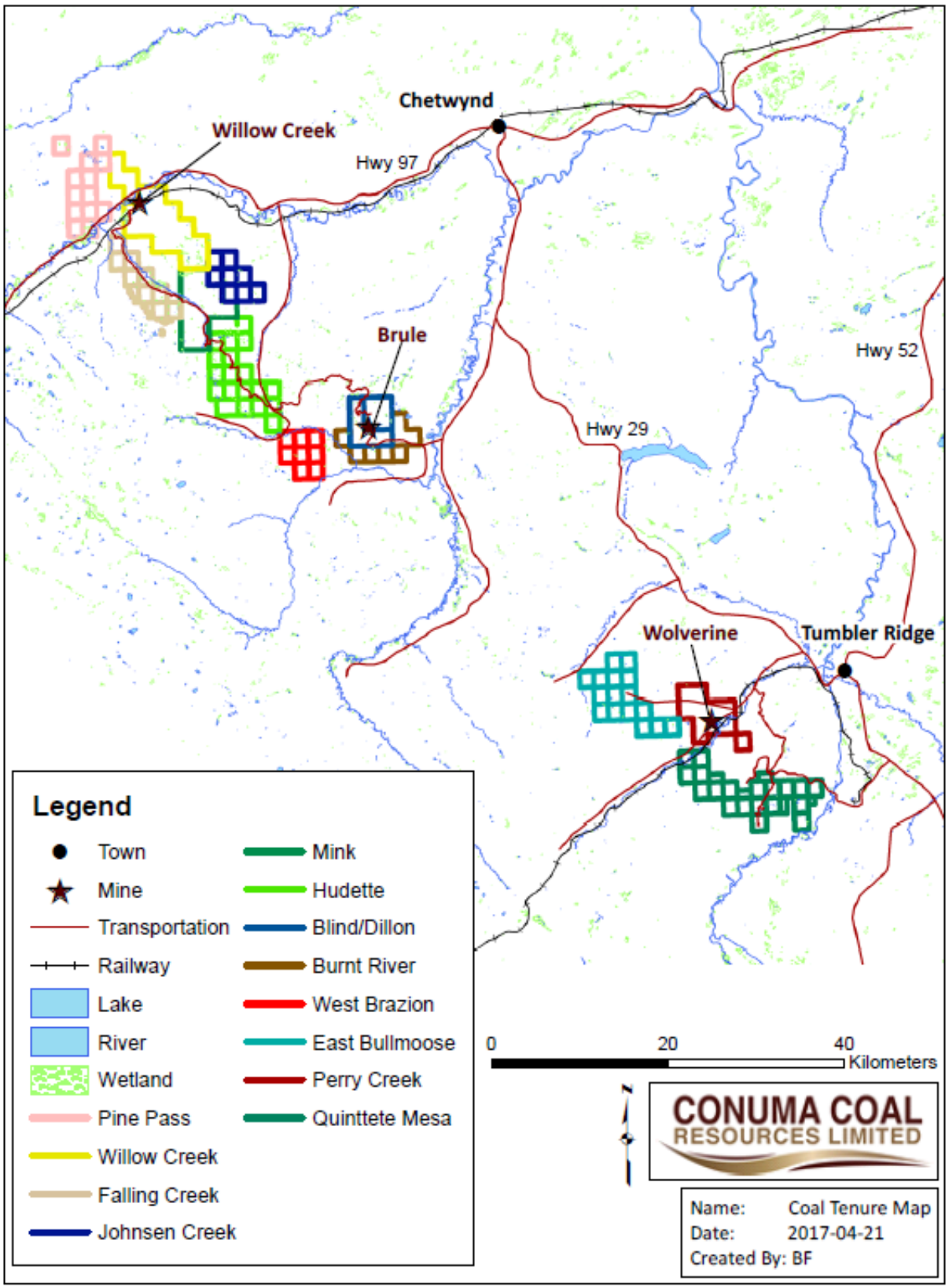

Figure 1: Mine Site Location

1.5 *Environmental Activities*

At the end of 2019, the Wolverine Mine environmental department consisted of a site Environmental Manager, site Environmental Technician and two site Environmental Samplers. Responsibilities of the environmental staff include 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
- Sediment monitoring and reporting
- Toxicity monitoring and reporting
- Overseeing Environmental Effects Monitoring
- Overseeing spill response
- Selenium Management
- Dustfall Management
- Waste Management
- Road and ditch inspections
- Wildlife Management
- Invasive Species Management
- Implementation of operational Best Management Practices.
- Ongoing reclamation activities, research and monitoring
- Oversight of soil salvage, storage and replacement

1.6 *Baseline Environmental Conditions*

Seasonal field programs were performed prior to and throughout construction of the mine to establish baseline information, and to monitor potential environmental effects created by natural resource development. The site monitoring program has evolved and expanded with the onset of mine operations. Studies specifically relating to selenium uptake and behavior in the receiving environment are in effect, as are sample collection practices to enhance and validate baseline results for the project and to monitor potential environmental effects. An appendix to the original Mine Permit report (1.8 Mt/a) provides results of 2004 baseline studies in the areas of wildlife habitat, climate, hydrology, surficial geology and terrain, groundwater, fish habitat, floodplains, wetlands characterization, forest productivity and vegetation metals.

Key conclusions related to environmental impacts are as follows:

- In general, the occupied land and surrounding environment is rich in wildlife resources. Wildlife mapping was completed on the project areas for identified key species and life stages. No unique habitats were identified. Protection and restoration of habitat values is a management priority and an end land use objective. Wildlife management practices and monitoring programs will continue to focus on reducing impacts, with emphasis on grizzly bear, caribou and other ungulates.
- Mine Development. Disturbance has remained limited to Perry Creek and Wolverine tributaries.
- Tributaries affected by development have low or no significant fish habitat values in the disturbance areas. Downstream fisheries values in lower Perry Creek and the Wolverine River are high, and water quality protection is an important objective. Routings of discharge from sedimentation ponds are

controlled to protect aquatic habitat values associated with downstream portions of floodplain wetland areas

- There is potential for mine run-off to cause increases in selenium concentrations in the Wolverine River. Expected increases are unlikely to impact aquatic resources; previous ownership conducted baseline aquatic and ML/ARD monitoring programs to address this issue, and Conuma proposes operational monitoring programs, as well as management programs and practices to control impacts.

1.7 *Regional Management Plans*

The mine acknowledges several regional programs and management plans, including:

- Peace River Regional District Invasive Species Program.
- Natural Resource Board Direction: Planning and Approval of Development Activities in the Peace Northern Caribou Plan Area.
- Peace River Regional District Solid Waste Management Plan.
- Mountain Caribou Recovery Implementation Plan (MCRIP) endorsed by the Government of B.C.
- Murray River Aquatic Cumulative Effects Assessment Framework.

Conuma maintains active participation on the steering committees of both the Peace River Region District Invasive Plant Species Program and the Murray River Aquatic Cumulative Effects Assessment Framework and works closely with governments regarding caribou recovery.

1.8 *Reclamation Program*

The purpose of the Wolverine Mine Reclamation Program is to utilize results from monitoring programs, including ML/ARD, seep and sump, groundwater, and surface water, to conduct appropriate progressive reclamation and ongoing reclamation to heavily disturbed sites. The goal of the Wolverine Mine Reclamation Program is to create a biologically diverse ecosystem capable of sustaining native vegetation throughout various life stages, allowing for the development of wildlife habitat and cultural areas of interest. The objective of both is to establish an end land use of high to moderate capability forestry ecosystems within the Engelmann Spruce- Subalpine Fir, moist very cold, Bullmoose variant ($ESSFmv^2$) ecosite.

The exception to this is topsoil stockpiles, which are maintained and protected as per the Wolverine Mine Soil Management Plan and Soil Conservation Standard Operating Procedure's (SOP's). Topsoil stockpiles are a finite resource meant to be exhausted as the mine continues to pursue reclamation efforts. End land use goals primarily focus on revegetation for suitable and sustainable wildlife habitat and Indigenous land use. Completion of mining operations in the Perry Creek Pit are estimated in Q4 2020, allowing for continued progressive reclamation efforts, excluding areas necessary for Hermann operations. Reclamation will include but is not limited to the re-sloping of areas to a 2H:1V slope, the placement of topsoil in 30-50 cm lifts as appropriate, and the seeding and installation of native plant plugs on waste dumps, roads and other inactive disturbed areas. Table 1 summarizes hectares of area disturbed by mining activities and reclamation of said areas. A key component to the reclamation program includes a strategy resulting in long term ecological restoration and revegetation.

The encroachment of highly adaptable invasive species and agronomics has resulted in the presence of several undesirable species including *Festuca rubra* (creeping red fescue), *Medicago spp.* (algonquin alfalfa), *Koeleria macrantha* (June grass), *Hordeum jubatum (*foxtail barley), *Poa pratentis* (Kentucky blue grass), and *Melilotus spp.* (yellow and white sweet clover). Introduced species can have a significant impact on natural ecosystems, decreasing the abundance of native plants and impacting the success of wildlife foraging efforts. Efforts are in

place to prevent encroachment, including the selection of quick establishing native species, high density plug installations and mechanical removal procedures for invasive species.

Conuma's reclamation program also includes a rich biodiversity of native plant species associated with First Nations traditions, including species intended for sustenance, cultural, medicinal and spiritual purposes. Conuma values these traditions and as such chooses to source all of our vegetation needs through Twin Sisters Native Plant Nursery (TSNPN) including seed collection, germination and vegetation plugs. TSNPN is owned exclusively by local Indigenous groups (Saulteau First Nation and West Moberly First Nation) and is based out of Moberly Lake, BC. To increase plug viability and reclamation success Conuma works in conjunction with TSNPN to ensure seed collection is conducted locally considering parameters such as sub species, elevation and aspect.

Mining Program

The Perry Creek Pit is based on the coals of the Gates Formation, one of the two major coal-bearing formations within the Peace River coalfield. The Gates coals are of Early Cretaceous age, formed in coastal-plain swamps approximately 110 million years ago. Gates Formation coal has been and continues to be mined extensively in the region. The coal being mined at Perry Creek Pit may be readily correlated with the coals being mined at nearby operations. The Gates Formation coal has been folded and faulted as a result of the post-depositional uplift of the Rocky Mountain Foothills. Folding and faulting has not significantly disrupted the original depositional layering of the coals and their interburden rocks. Gates coals at Perry Creek are systematically lettered from the top of the formation downward, with the shallowest mineable coal being the E2 and E3 zones, and the deepest mineable coal being the J zone. The mineable coals have a cumulative average vertical seam thickness of nearly 11.8 m.

1.9 *Mining Development*

Mining in the Perry Creek Pit takes place by conventional excavator/truck bench method to mine the deposits from top to bottom in phased push backs (Phases 1 through 5). Consolidated waste is drilled, blasted and loaded into trucks for hauling to external waste dumps of for use as pit backfill. Run-of-mine (ROM) coal is loaded and hauled to the processing plant. Most of the coal produced from the Perry Creek Pit is categorized as “hard coking coal,” similar in quality to other metallurgical coals produced and exported from western Canada.

1.9.1 Surface Development to Date

Mine construction at the Wolverine Mine - Perry Creek Pit and Coal Processing Plant location - began in April 2005 with the development of infrastructure to support 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.

Phase 1, 2, and 3 have been mined to completion, with the exposure of the J seam’s footwall. Phase 4a commenced in 2012 at the 1240 metres above sea level (masl) elevation and progressed to 981 masl in 2014. The Mine went into care and maintenance in April 2014 with the Plant processing the remaining stockpiled coal through to late May 2014. No mining activities occurred at Wolverine Mine until 2017. Mining activity in Phase 4a reconvened in January 2017 and continued throughout 2018 to varying elevations with the lowest bench reaching completion at 891 masl.

Conuma received an amendment to C-223 in May 2019 for the expansion of the Perry Creek Pit into Phase 5, adjacent to the existing Phase 4A, adding an additional 1.421 million tonnes of Run-Of-Mine (ROM) coal production. The expansion extended the life of mine of the Perry Creek Pit out to late-2020. The amendment allowed the extraction and processing of coal from the Phase 5 footprint, disposal of phase five waste materials, including a blending of coarse coal rejects (CCR), into an In-Pit Dump, and deposition of resulting tailings in the existing Tailings Storage Facility (TSF). Prior to and during mining activities of Phase 5, the excavation and reslope of a portion of the North Dump and the construction of buttresses on the north and west sides of Phase 5 was required to meet geotechnical stability acceptance criteria. Overburden above Phase 5 bedrock was salvaged for reclamation purposes, adding approximately 308,000 tonnes of suitable growth medium. These activities were completed in 2019.

In 2019, Phase 4b advanced at varying elevations with the elevation extents from 1,240 m to 1,120 masl, producing 1,669,413 ROM coal tonnes and 12.9 million Bank Cubic Meters (BCMs) of waste rock. In 2019, Phase 5 advanced at varying elevations with the elevation extents from 1,128 m to 1,031 m elevation in 2019, producing 14,162 ROM

coal tonnes and 4.82 million BCMs of waste material. Cumulative 2019 waste movement was 17.7 mBCM. Cumulative 2019 ROM coal production was 1.68 mtonnes.

To retain tailings produced with a minimum freeboard of two meters, the northern and southern portions of the TSF abutments were tied into original ground and raised to the final design elevation of 852 m in 2018.

Seepages from the North Dump report to the North Dump Drainage Ditch. This seepage daylights along the Perry Creek Road ditch. Freshet and storm events have historically washed out the Perry Creek Road due to inadequate, non-engineered ditching. A temporary large sump was dug into the dump adjacent to the Perry Creek Road to prevent erosions issues in the spring; however, while this seepage water permeated the waste dump and reported to the pit sump, geotechnical studies showed potential stability issues of the causeway if this continued. In 2018, the engineered Perry Creek Road Collector Ditch was constructed to collect this water and discharge over a final footwall and into the pit sump, bypassing road ditching and the causeway. It was anticipated that final construction of the ditch would be completed in spring 2019; however, during construction, the geomembrane liner was not tied in per design resulting in the mobilization of the liner. Corrective repairs commenced in 2019. Remaining repairs are scheduled for snow free conditions in 2020, following which, an As-Built report will be finalized and submitted to the EMPR.

The approved mine permit boundary for which disturbance is permitted, as of December 2019 was 1047.7 ha with 986.2 ha disturbed. Approximately 134 ha of the disturbance had tree cover removed but with intact native ground cover and have been allowed to regenerate naturally. Total reclaimed area with revegetation at the end of 2019 totalled 67.7 ha. There is 42.18 ha of ongoing reclamation with recontouring of slopes at the Wolverine Mine which are now prepped for soil placement and revegetation in 2021. A summary of areas disturbed, undisturbed, and reclaimed areas within the disturbance boundary to the end of 2019 at the Wolverine Mine is presented below. Hermann Disturbance Area is not included in the table as permit amendment approval is pending, no new disturbance has been conducted under Mine Permit C-223.

Table 1: Summary of Areas Disturbed and Reclaimed

	Mining		Reclamation								
Disturbance	Area Disturbed (ha)		Area Re-contoured (ha)		Area Seeded/Planted (ha)		Area Fertilized (ha) **		Area Re-vegetated (ha)		Land Use Objective
	2019	Total	2019	Total	2019	Total	2019	Total	2019	Total	
Mine Site Facilities	0	57.6	-	-	0	0	0	0	0	0	*
Water Management Structures	0	19.6	-	-	0.4	0.4	0	0	0.4	0.4	*
Waste Rock Dumps	0	428.4	0	94.4	9.9	60.3	0	0	9.9	60.3	*
CCR Pile	1.7	9.4	8.5	8.5	0	0	0	0	0	0	*
Tailings Storage Facility and Berms	0	25.0	0	7.0		7.0				7.0	
Topsoil Stockpiles	0	36.1	0	0	0	0	0	0	0	0	*
Linear (road/rail)	0	107.4	0	0	0	0	0	0	0	0	*
Disturbed, natural recovery	-	139.8	-	-	-	-	-	-	-	-	*
Pit Walls	-	70.6	-	-	-	-	-	-	-	-	*
Pit Lake	-	3.2	-	-	-	-	-	-	-	-	*
Pit Floors	0	29.9	0	0	0	0	0	0	0	0	*
Other	0	1.8	0	0	0	0	0	0	0	0	*
Previously reclaimed <2019	-	57.4									*
Total	**0**	**986.2**	**8.48**	**109.88**	**10.3**	**67.7**	**0**	**0**	**10.3**	**67.7**	

* Land Use Options include wildlife habitat, traditional use, forestry, and recreation

Values have been rounded for total

Exempt Area Total 118.3. Exempt categories are pit high walls, pit lake total 73.7 ha, , 19.2 ha pit floor and footwall r that exceed 19%, and 25.4 ha of Rail and Wolverine Forest Service Road that are permanent features that are not part of Conuma's reclamation responsibility.

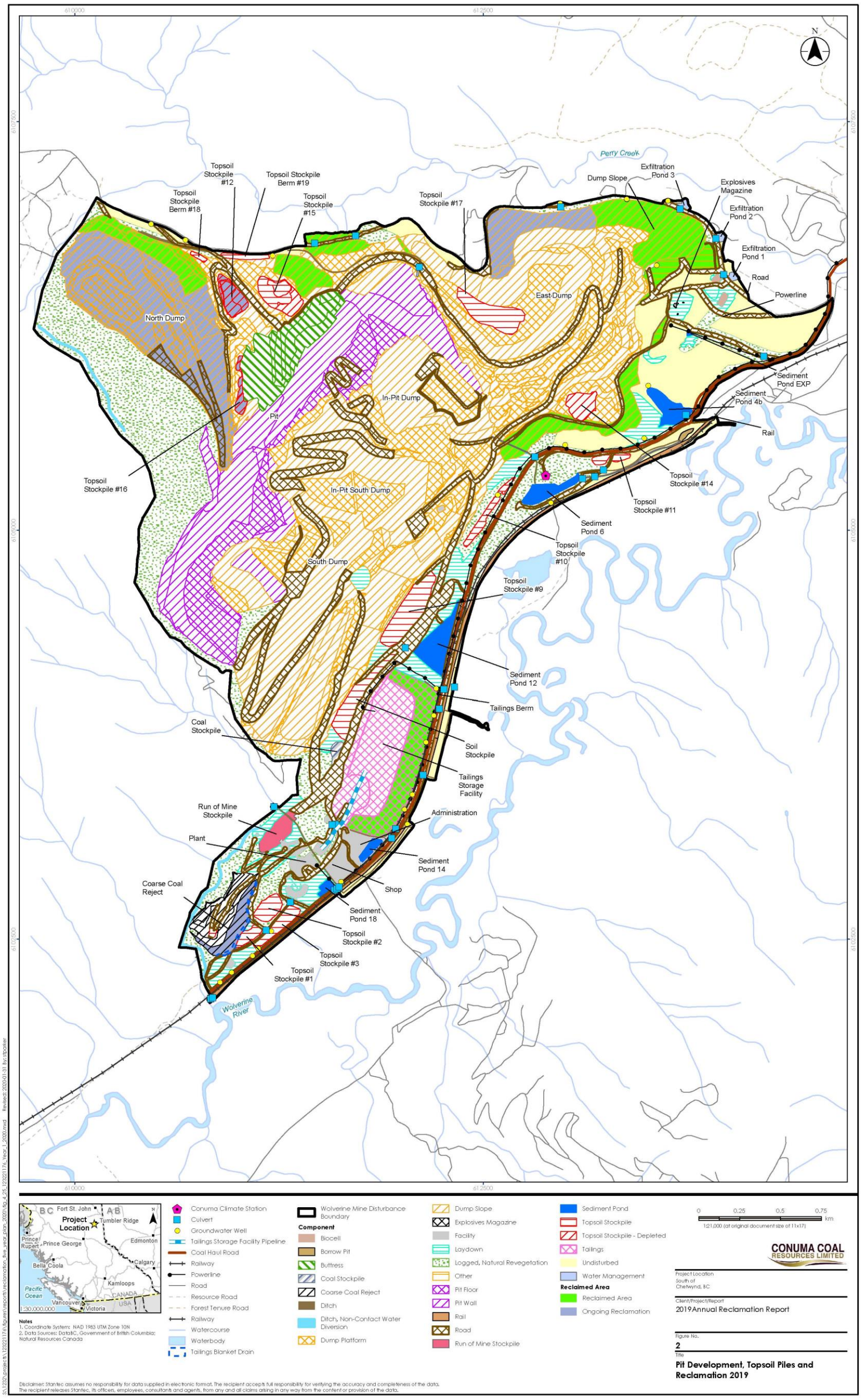

Figure 2: Pit Development and Topsoil Piles at the Wolverine Mine

1.9.2 Current Life of Mine Plan

Conuma has submitted a application to amend C-223 and associated *EMA* permits to begin development of a satellite pit (Hermann Disturbance Area) as operations ramp down at the Perry Creek Pit. Life of Mine Plan for the Hermann Distrtubance Area is included in the C-223 Five Year 2020-2024 submitted February 21, 2020 to EMPR with further detail in the Wolverine-Hermann Amendment Project Application. The following includes the Current Life of Mine at the Perry Creek Pit.

1.9.2.1 2020

In 2020, mining in the Phase 4b is continued from the 1,120 m bench to completion of the Phase 4B at 1,036 m elevation. 3.56M BCM of waste rock is placed in the South and In-Pit Dumps. 1.008M ROMt of coal is mined in year 2020. Phase 4b CCR produced in 2020 will be placed in the CCR Pile.

Phase 5 mining continued from the 1,031 m bench down to completion which is at approximately 901 m elevation. The waste is placed in the in-pit dumps. Approximately 13.0 million BCM of waste material and 1.47M ROMt is produced from Phase 5 in year 2020. Phase 5 CCR produced in 2020 will be co-disposed with waste rock and placed within the mined-out area. All the tailings produced in 2020 will be stored in the current TSF.

1.9.2.1 2021 and onwards

The mined-out Perry Creek Pit is used for storage of Hermann CCR moving forwards. CCR from the processing of Hermann ROM coal will be stored in the mined-out Perry Creek Pit, and the tailings will be stored in the existing Wolverine TSF and In-Pit Storage Complex as outlined in the Wolverine-Hermann Amendment Project Application.

1.9.3 Surface Development in the Past Year

The Wolverine Mine Processing Plant ran for 2959.96 hours in 2019, generating a total of 107,930 tonnes of fine rejects (tailings) which report to the Tailings Storage Facility as per C-223. The plant processed 1,698,956 tonnes of raw coal (Table 3 and 4), generating 1,115,654 tonnes of clean coal for an efficiency variance of 65.7%. A total of 494,113 tonnes of coarse coal rejects (CCR) were produced by the processing plant. A breakdown of plant-generated by-products is detailed in Table 2. The grizzly and breaker rejects (22,060 and 6,660 tonnes respectively) were incorporated in the in-pit dump as PAG material while coarse coal rejects were allocated to the CCR Pile as per C-223.

Phase 4b advanced at varying elevations with the elevation extents from 1,240 m to 1,120 masl in 2019, producing 1.67 million ROM coal tonnes and 12.9 million Bank Cubic Meters (BCMs) of waste rock. Prior to and during mining activities of Phase 5, the excavation and reslope of a portion of the North Dump and the construction of buttresses on the north and west sides of Phase 5 was required to meet geotechnical stability acceptance criteria. Overburden above Phase 5 bedrock was salvaged for reclamation purposes, adding approximately 308,000 tonnes of suitable growth medium. Phase 5 advanced at varying elevations with the elevation extents from 1,128 m to 1,031 m elevation in 2019, producing 14,162 ROM coal tonnes and 4.8 million BCMs of waste material.

Table 2: Quantity of Waste Rock, Tailings, Low Grade Ore, Course Rejects and Other Mine Waste in 2019

Name of Waste Pile or Pond	Acid Generating Waste (tonnes)		Potentially Acid Generating Waste (tonnes)		Non-Acid Generating Wast e (tonnes)	
	2019	Total	2019	Total	2019	Total
Waste Dumps						
South Dump	0	0	4,518,590	14,283,063	167,770	126,352,291
East Dump	0	0	0	33,926,292	1,110	86,607,630
North Dump	0	0	77,430	1,242,372	12,116,930	76,608,557
In-Pit	0	0	173,360	2,025,346	20,430,020	52,211,997
Roads as crush	0	0	14,360	30,684	894,190	1,363,256
Buttress	0	0	1,100	1,100	3,549,840	3,549,840
Total	**0**	**0**	**4,783,740**	**54,525,757**	**33,610,020**	**3,134,513,360**
Tailings Ponds						
1 Tailings	0	0	51,150	729,641	56,780	809,964
Total	**0**	**0**	**51,150**	**729,641**	**56,780**	**809,964**
Low Grade Ore/Coarse Reject/Other Mine Waste						
1 CCR Dam	0	0	0	2,036,034	0	544,055
CCR Dump	0	0	68,065	544,100	164,600	1,315,776
2 Overburden	0	0	14,885	256,961	293,116	5,060,275
3 Grizzly Rejects	0	0	22,060	215,068	0	0
4 Breaker Rejects	0	0	6,660	1,323,842	0	0
Total	**0**	**0**	**111,670**	**4,264,335**	**457,716**	**6,462,390**

Table 3: Monthly Mining and Milling Production in 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Mining Production (ROM tonnes)											
Phase 4a	166,132	182,482	153,647	119,044	147,792	85,929	144,321	99,639	199,462	145,664	118,245	107,056
Phase 5	-	-	-	-	-	-	-	-	-	-	1,127	13,035
	Plant Production (Clean coal tonnes)											
Clean Coal	103,181	140,272	130,604	75,363	74,079	116,823	43,758	93,908	124,806	91,519	35,591	85,750

Table 4: Monthly Custom Plant Production in 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Mill Feed Production (tonnes)											
Upper Seam	37,510	47,740	52,807	20,404	16,626	16,771	32,165	32,165	48,744	36,316	23,818	37,547
Lower Seam	106,225	144,746	156,372	106,037	96,000	148,494	41,395	109,039	137,991	115,864	28,530	105,650
	Plant Feed and Tailings Sampling – Number of MLARD Samples Collected											
Tailings from spigot						1	1	1	2	1		2

1.9.4 Surface Development Projected Over the Next Five Years

As of 2019, the Wolverine Mine consisted of the Perry Creek Pit. Current mine planning and upon permit approval would include the sequential development of the Hermann Disturbance Area under Mine Permit C-223, coinciding with the final mining stages and initial closure of the Perry Creek Pit. Implications of Hermann development include ongoing operations of the Wolverine Processing Plant, coal refuse stored at Perry Creek Pit, and environmental effects monitoring within the Murray River Watershed. Environmental effects monitoring will be updated and detailed upon acceptance of the Hermann Project application and the issuant of all amended permits.

Conuma plans to complete mining Phase 4b and Phase 5 in 2020.

The production budget is scheduled to produce 1.008 MtROM from Phase 4b and 1.47 MtROM from Phase 5. Mining will produce 3.56M BCM of waste rock from Phase 4b and 13M BCM of waste rock from Phase 5. Conuma intends to manage Phase 5 coarse coal rejects in pit after the completion of the current CCR pile .

Table 5: Perry Creek Pit Projected Cumulative Surface Development

Mine Feature	To Date (ha)	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)
Mine Site Facilities						
Administration Buildings	4.8	4.8	4.8	4.8	4.8	4.8
Explosives Magazine	0.1	0.1	0.1	0.1	0.1	0.1
Fuel Island	0.2	0.2	0.2	0.2	0.2	0.2
Gatehouse	0.0	0.0	0.0	0.0	0.0	0.0
Plant Site	3.9	3.9	3.9	3.9	3.9	3.9
Security	0.0	0.0	0.0	0.0	0.0	0.0
Shop	0.1	0.1	0.1	0.1	0.1	0.1
Laydown and ROM						
Acid Rock Drainage Pad	0.1	0.1	0.1	0.1	0.1	0.1
Laydown	37.4	37.4	36.0	36.0	36.0	33.3
Run of Mine Stockpile	2.9	2.9	2.9	2.9	2.9	2.9
Water Management Structures						
Biocell	0.5	0.5	0.5	0.5	0.5	0.5
Ditches	3.8	3.8	3.9	3.9	3.9	3.9
Exfiltration Basin	0.8	0.8	0.8	0.8	0.8	0.8
Non-Contact Water Diversion	1.7	1.7	1.3	1.7	1.7	1.7
Sediment Pond	12.8	12.8	12.8	12.8	12.8	12.8
Treated Water Tank	0.0	0.0	0.0	0.0	0.0	0.0
Water Tank	0.0	0.0	0.0	0.0	0.0	0.0
Water Treatment Facility	0.0	0.0	0.0	0.0	0.0	0.0
In-Pit Waste Dumps	109.2	112.8	94.4	96.0	95.3	92.1
Waste Dumps (Platforms and Slopes)	353.3	350.8	376.5	373.6	383.5	388.0
Waste Dumps (Rehandle)	0.0	0.0	2.9	2.9	2.9	2.9
Coarse Coal Reject (CCR) Pile (Platform, Slopes and Rock Drain)	9.7	10.5	10.5	12.1	12.1	12.1
In-Pit Coarse Coal Reject (CCR) Pile (Platform, Slopes and Rock Drain)	0.0	0.0	13.8	10.8	11.7	15.5
Tailings Storage Facility (TSF)						
Tailings Berm	22.7	22.7	22.7	22.7	22.7	22.7
TSF Platform	18.0	18.0	18.0	18.0	18.0	18.0
In-Pit	0.0	0.0	0.0	0.0	11.7	11.7
Cleared Areas	144.5	138.9	135.4	135.0	135.0	137.7
Roads	83.1	87.4	68.6	75.3	65.3	60.8
Soil Stockpiles						
Topsoil Stockpiles	25.4	28.2	4.9	4.9	7.3	4.9
Topsoil Stockpiles - Depleted	5.2	2.4	25.0	25.0	22.6	25.0
Pit	96.4	105.9	94.7	94.6	94.4	93.8
Pit Lake	3.2	0.1	11.7	11.7	0.0	0.0
Other Features:						
Borrow Pit	0.3	0.3	0.3	0.3	0.3	0.3
Buttress	26.2	19.2	19.2	19.2	19.2	19.2
Coal Stockpile	0.7	0.7	0.7	0.7	0.7	0.7
Dryer	0.1	0.1	0.1	0.1	0.1	0.1
Hazardous Waste Transfer Facility	0.2	0.2	0.2	0.2	0.2	0.2
Powerline	5.3	5.3	5.3	5.3	5.3	5.3
Rail	9.5	9.5	9.5	9.5	9.5	9.5

Mine Feature	To Date (ha)	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)
Truck Maintenance Area	0.3	0.3	0.3	0.3	0.3	0.3
Waste Rock	0.6	0.6	0.6	0.6	0.6	0.6
Disturbed Total	**983.2**	**983.2**	**982.9**	**986.5**	**986.5**	**986.5**
Undisturbed	64.4	64.4	64.8	61.2	61.2	61.2
Wolverine Mine Total	**1047.7**	**1047.7**	**1047.7**	**1047.7**	**1047.7**	**1047.7**

Environmental Protection Program

Environmental protection measures are verified through ongoing water and air quality monitoring, as defined under Mine Permit C-223, Environmental Assessment (M04-01) Commitments, Effluent Permit PE-17756, and Air Permit PA-17759, plus regular internal environmental inspections. ML/ARD leachate barrel water, groundwater and surface water quality sampling is conducted in accordance with the procedures described in the 2013 British Columbia Field Sampling Manual (BC ENV, 2013).

The Wolverine Mine Environmental Effects Monitoring (EEM) program is designed to facilitate a regional approach to monitoring, integrating aquatic monitoring activities for Conuma Coal Mines in the north east coal block and to increase efficiency in data collection as well as improve the ability to identify long term, regional trends. The program, including benthic invertebrate, periphyton, sediment, fish tissue and sediment, is undertaken every two years to assess potential mine related affects to overall stream health, per the monitoring requirements of PE-17756. In early 2016, the Ministry of Environment & Climate Change Strategy (ENV) changed the requirement for an EEM Program to every four years while the Mine is in a period of Care & Maintenance and every 2 years whilst in operation. Fish tissue collection and analysis was conducted in 2018 by Golder Associates. Benthic invertebrate, periphyton, fish tissue and sediment portions of the EEM program is scheduled to be conducted in 2020 to temporally compare results.

1.10 *Environmental Management System*

To ensure ongoing environmental protection, an Environmental Management System (EMS) for the Mine was developed to include EMPs, Operation, Management and Surveillance (OMS) Manuals and SOPs. As living documents, the EMS continues to be expanded upon to encompass changing operations and to ensure it accurately reflects the current practices and standards.

As Conuma reaches full operational capacity, it is essential to maintain the EMS. The EMS focuses on managing and mitigating chemicals and waste, water and air quality, soil, vegetation and reclamation activities. Conuma in 2019 updated a number of environmental management plans as per the Phase 5 permit approval and is currently updating the EMS including several management plans. Significant plans and programs utilized for the protection of the environment in 2019 include but are not limited to the following:

- EMS-4.1-MGT Archaeological Management Plan
- EMS-7.2-MGT Chemical Handling and Spill Prevention
- EMS7.3-MGT Waste Management
- EMS-7.4a-MGT Nitrogen Management Plan – Wolverine
- EMS-8.0-MGT Wolverine Emergency Response Plan
- EMS-9.1a-MGT Water Management Plan – Wolverine
- EMS-9.1.1-MP Surface Water Monitoring Program – Wolverine
- EMS-9.1.4-MP Groundwater Monitoring Program – Wolverine
- EMS-9.1.11-MP Environmental Effects Monitoring Program - Wolverine
- EMS-9.2-MGT Fugitive Dust Management Plan
- EMS-9.3-MGT Soil Management Plan
- EMS-9.4-MGT Erosion & Sediment Control
- EMS-9.5-MGT Vegetation Management Plan
- EMS-9.7-MGT Wildlife Management Plan
- EMS-9.7.1-MP Caribou Management & Mitigation Plan

- EMS-9.9-MGT Selenium Management Plan
- EMS-9.10a-MGT ML/ARD Management Plan
- EMS-9.10d-MGT Waste Rock Segregation
- EMS-9.10e-MGT Coarse Coal Rejects Management Plan

No formal audit of the EMS occurred in 2019; however, several plans were updated and included in the Wolverine-Hermann Amendment Project. Moving into 2020 with adequate manpower Conuma strives to update and maintain the EMS with adequate audits going forwards.

1.11 *ML/ARD Characterization and Mine Waste Management*

Conuma monitors potential ML/ARD through the determination of PAG and non-PAG in waste materials including Coarse Coal Rejects (CCR), Preshear (PS), Tailings (TA), Waste Rock (WR), and Wolverine Conglomerate (WC). Sampling of seeps is conducted twice a year and sample of ARD leachate barrels are checked on a monthly basis (at minimum) during non-winter conditions and a sample is taken when collection buckets contain enough water to sample. A comprehensive analysis was conducted by SRK Consulting in Appendix B.

WC varies between PAG and non-PAG. Samples are taken from drill/blast patterns, which contain WC, in order to determine whether the pattern can be considered PAG, non-PAG or a blend. This allows pit operations to dispose of in proper ratios on the dumps. All Wolverine Conglomerate was conservatively treated as PAG during 2019.

Three of the five material types testing of the ML/ARD monitoring program did not meet the required sampling frequencies as per C-223 and Standard Operating Procedure (SOP) commitments in 2019. While four of five requirements in frequency of sampling were met, there was a lack in proper analysis to determine whether samples are classified as NAG or PAG. Section 2 in Appendix B outlines sample frequencies and subsequent analyses. Missed samples were due to changes in collection methods; while discrepancies in proper analyses were due to staff manpower in the on-site lab, as well as infrequency of sample delivery and miscommunication with ALS Minerals Laboratory. Going forwards in 2020, Conuma intends to have improved communications with ALS Minerals Laboratory and better sample handling due to increased manpower.

Material type broken down into non-PAG and PAG is summarized in Table 6.

Table 6: Material Type Number of Samples and Classification

Material Type	No. of Samples		% Classification		
	Required	Collected	non-PAG	PAG	Not Classified
CCR	123	111	26%	5%	69%
Tailings	4	13	0%	0%	100%
Wolverine Conglomerate	10	88	15%	7%	78%
Waste Rock	125	155	29%	8%	63%
Pit Wall	26	99	71%	2%	27%

SRK determined that water chemistry in the drainages developed no new major trends; however, North Dump seepage showed a decreasing sulphate and trace metal trend, and the South, East and CCR dumps demonstrated a stable or variable trend.

Several groundwater monitoring wells demonstrated chemistry that indicated contact with mine wastes based on the sulphate anion composition. Presence of other parameters supported this conclusion.

Barrel leach testing continued into 2020 and completed its 14th year of monitoring. Leachate remained near-neutral and selenium was comparable to 2018.

Leach pad collection systems completed their 10th year of monitoring and showed near-neutral pH and low metal release rates consistent with previous years.

A review of the ARD monitoring program changed sampling frequencies in 2019. Conuma has demonstrated they will ensure compliance with sampling frequencies and include appropriate laboratory analyses. A more detailed investigation into mine contact water migration into groundwater will be essential in understanding the hydrology beneath the waste rock dumps and the influence the waste rock has on the groundwater.

1.12 *Chemical Reagents and Waste Storage*

The Wolverine Mine handles various chemical reagents and hazardous materials. For the protection of the environment, management plans were created to ensure the *Waste Management Act*, *Wildlife Act*, and the *Environmental Management Act* are considered before handling deleterious substances.

A comprehensive list of materials stored onsite is located at the Wolverine Mine gatehouse and warehouse. All Safety Data Sheets are updated and available online on any Conuma network upon request. More information is located in EMS-7.3-MGT Waste Management Plan. Bulk chemical and reagent storage inventory are summarized in the 2019 Annual Water Quality Report (Appendix C).

1.13 *Incidents*

No Lost Time Incidents occurred at the Wolverine Mine in 2019.

One unintentional releases of deleterious substances entered watercourses occurred at the Wolverine Mine in 2019: On October 29th, contact water west of the tie-in to the Perry Creek Road Collector Ditch (PCRCD) escaped the ditch due to a blockage of snow and ice. The PCRCD was installed to prevent contact water from discharging into the Perry Creek and conveys seepage from the North Dump to the pit sump and ultimately to SP6. Due to cold weather conditions, the contact water froze to the road and did not discharge into the Perry Creek. The blockage was removed within four hours of discovery, including the scraping of contaminated ice from the roadway. The unintentional bypass was completely remediated and reported day of discovery to ENV.

1.14 *Air Quality*

The *2019 Annual Air Quality Report – Wolverine Mine* (Appendix F) as per PA-17759 presents air emissions and fugitive dust observations and results from the 2018 Air Quality Monitoring Program for the Wolverine Mine and subsequent interpretations. Conuma compared air quality results to permit objectives and limits while accounting for weather conditions. Dust and emission trends and patterns were observed and reported within this document.

In 2019, the Air Quality Monitoring Program at the Wolverine Mine was under the direction of Air Permit PA-17759 originally issued on July 25, 2006 and amended on December 17, 2015. The mine operated under ‘normal’ operating

conditions with the Wolverine Processing Plant running for 2959.96 hours in 2019. Total mined waste in 2019 was 17.7 million bank cubic meters (BCM). Total run-of-mine (ROM) coal mined in 2019 was 1.7 million tonnes.

There were four condition numbers of PA-17759 where Wolverine Mine did not reach compliance:

- Two of 84 dustfall canisters resulted in a monthly average greater than the Total Dustfall Inorganic objective (Section 3.1; PA-17759)
    - Dust suppression measures included road watering during dry periods and following best practices during blasting, haul truck loading/unloading
    - Field observations indicate natural loadings from wildlife (i.e. scat)
- Two of 84 dustfall canisters were not analyzed for the combustible fraction of total dustfall particulate and total mass (Section 4.2; PA-17759)
    - Dustfall canister was cracked during transit to third party lab, thus sample was not representative of fugitive dust and not analyzed
    - Dustfall canister was found to be cracked and leaking when retrieved from field, thus the sample was not representative of fugitive dust and not analyzed
- One permit exceedance was not reported within 30 days of the occurrence (Section 5.1; PA-17759)
    - Reporting requirements were reviewed with the persons responsible for reporting exceedances and non-compliances
- One dustfall canister collected after 35 days in the field; historic BC Field Sampling Manual states 30 ± 2 days (Section 4.4; PA-17759)

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1.15 *Surface Water Quality and Quantity*

The *2019 Annual Water Quality Report – Wolverine Mine* (Appendix C) as per PE-17756 presents hydrological and effluent chemistry observations and results from the 2018 Water Quality Monitoring Program for the Wolverine Mine and subsequent interpretations. Conuma compared observed water quality results from 2018 to both historical and baseline results, as well as the Approved British Columbia Water Quality Guidelines and permit requirements. Effluent concentration trends and patterns were observed and reported within this document and details are contained in Appendix C.

The Water Quality Monitoring Program at the Wolverine Mine is directed by the Terms and Conditions under Effluent Permit PE-17756, and the requirements outlined in *Mines Act* Permit C-223 and Environmental Assessment Certificate M04-01 (issued by the BC *Environmental Assessment Act*). The *2019 Annual Water Quality Report – Wolverine Mine* includes the results and interpretations of data collected from the required surface water, groundwater, flow monitoring, seeps and sumps, Environmental Effects Monitoring (EEM) and sediment sampling program conducted at the Wolverine Mine as per Operational status during 2019.

Site water quality is influenced by waste rock weathering processes. Notably, concentrations of nitrate and sulphate consistently exceeded predicted Typical Effluent Concentrations (TEC) at Sediment Ponds 6, and seldomly exceeded TEC at Sediment Pond 12 (SP6 and SP12, respectively) throughout 2019. Total Selenium exceeded TEC at SP6 five times, SP12 two times. Conuma is investigating source control strategies and the use of bioreactors at other properties for the active treatment of selenium.

There were four permit conditions (PE-17756) that were not met in 2019.

Table 7: PE-17756 Non-Compliances 2019

Condition Number	Condition Description	Non-compliance
1.1.2	B) Total suspended solids must be less than, or equal to, 50 mg/L	Two samples indicated TSS >50mg/L. These samples were deemed non-representative of pond effluent.
3.10	Depth of Sediment Ponds	Bathymetric surveys completed. SP14 did not maintain a 1.2 meter fluid depth. Sediment removal conducted.
4	While the Mine is operational, the Permittee must collect the samples, perform the analyses and other requirements specified in Appendix A of PE-17756	Appendix A of PE-17756 specifies SP6 flow measurement location. This location varied from permit in 2019.
5.1	Non-compliance Reporting	Two monthly exceedances follow up reports were not submitted within 30 days.

PE-17756 restricts sediment pond effluent to be below 50mg/L of Total Suspended Solids. Two occurrences of pond effluent greater than 50 mg/L in 2019; however, both exceedances were not representative of the effluent and resulted from sampling procedures varying from Standard Operating Procedures. Discharges from sediment ponds remained below the designed discharge rate. Surface flow monitoring frequencies did not meet permit requirements at two sites for 2019.

Table 8: Sediment Pond Discharge TSS Exceedances in 2019

Site	Date of Exceedance	TSS (mg/L)
SP12	January 7, 2019	221.0
SP6	June 3, 2019	189.0

PE-17756 includes typical effluent concentration ranges for nitrate, sulphate and total selenium from sites SP6 and SP12. These are discussed in greater detail in the *2019 Annual Water Quality Report – Wolverine Mine.* Below is a summary of the number of exceedances of the maximum range of each parameter:

Table 9: Sediment Pond Discharge Typical Effluent Concentration Exceedances in 2019

Site	Total Selenium (mg/L)	Number of Occurrences > TFE in 2019	Nitrate (mg-N/L)	Number of Occurrences > TFE in 2019	Sulphate (mg/L)	Number of Occurrences > TFE in 2019
SP12	0.010 – 0.064	2	9 – 50	1	440 – 1100	2
SP6	0.013 – 0.040	5	30	11	375 – 640	10

PE-17756 includes site specific water quality performance objectives for nitrate, sulphate and total selenium at the sampling location downstream of all Wolverine Mine influence. These are discussed in greater detail in the *2019 Annual Water Quality Report – Wolverine Mine.* Below is a summary of the number of exceedances of the Site Performance Objectives of each parameter at the downstream sample location, WR-3:

Table 10: Downstream Receiving Environmental Site Performance Objective Exceedances in 2019

Parameter	SPO*	# of SPO Exceedances
Total Selenium	3 µg/L (0.003 mg/L)	1
Sulphate	175 mg/L	1
Nitrate, as N	1.5 mg/L	0

* maximum values recorded at any time

1.15.1 Selenium Speciation

Selenium Management at the Wolverine Coal Mine is treated separately from the general ML/ARD program as the natural abundance of the element in the geology of the Wolverine Valley makes selenium a contaminant of concern. For a detailed account of selenium management at the Wolverine Mine, EMP-9.9-MGT Selenium Management Plan is located with Appendix A.

Site management to reduce selenium loading has mainly been through the diversion of clean water away from waste rock dumps and CCR through the use of diversion ditches and strategic placement of waste rock. Finer grained waste rock lithologies that are known to have elevated selenium concentrations are placed in the core of the waste dumps to reduce the leaching of selenium. Conuma is developing an overarching selenium management strategy including passive treatment, with active work currently underway at the Brule Mine, including a biochemical reactor and saturated backfills. If applicable, results from the Brule Mine work will be used to guide selenium management planning at the Wolverine Mine.

The selenium monitoring program in 2019 included selenium speciation (Appendix H) and a comprehensive Environmental Effects Monitoring program including water, sediment, and three trophic levels (periphyton, benthic invertebrate, fish) of sampling (Appendix J) by Hatfield Consultants.

Cumulative Selenium Speciation

As per C-223, selenium speciation analysis was conducted on oxic surface waters: sediment pond effluents, downstream Wolverine River and key wetland sites. Samples were retrieved from SP6, SP12, SP14, and SP4b in 2018 and were analyzed at ALS Laboratories for selenate (Se(VI), SeO_4^{2-}), selenite (Se(IV), $HSeO_4^-$), and selenocyanate (SeCn).

Selenium within rocks and sediments are generally found in relatively low concentrations, whereas, coals and crude oils can contain concentrations significantly higher. Selenate tends to be the most abundant in well-oxidized waters, with selenite increasing as redox potential decreases towards the sediment and water interface (Ralston, 2008).

Selenium species presence varied, with the ratio of Se(VI) to Se(IV) slightly decreasing in SP6 and SP14, while slightly increasing in SP12 compared to species analysis in 2018. Selenate was the most prevalent species at all sites, with SeCn and unknown Se species being found to be below detection limits, which is consistent with findings from previous years. For laboratory results, see Appendix H. Cumulative selenium speciation is graphically represented for SP6, SP12, and SP14 in Figures 3 through 8.

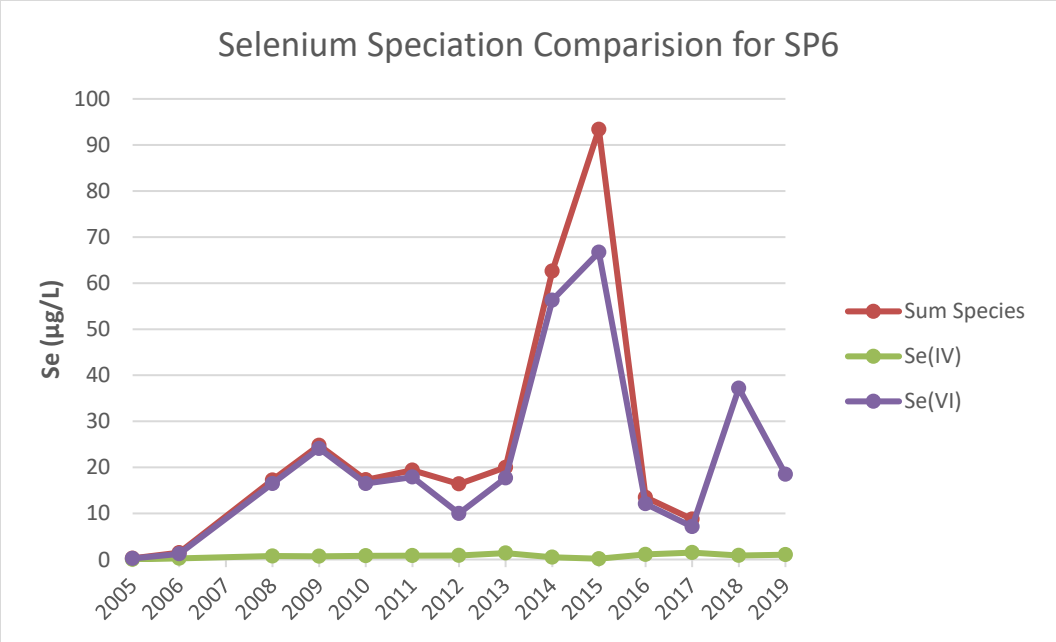

Figure 3: Cumulative Selenium Speciation at SP6

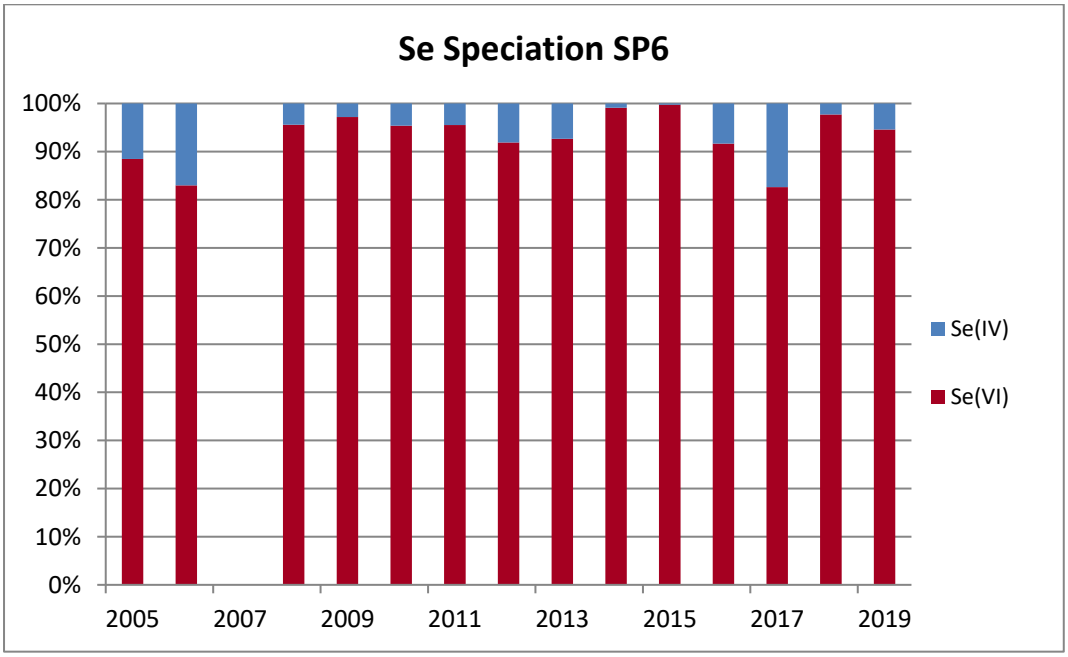

Figure 4: Cumulative Selenate:Selenite Ratio at SP6

Selenate rates have varied compared to relatively stable levels of Se(IV) since 2017 (Figure 3 & 4). Recent changes in the higher ratio of selenite in SP6 surface water may be related to continuous flow of water from the pit sump to SP6 which is the main source of water reporting to the sediment pond. The addition of rock material to the pit sump during north In-Pit Dump construction may affect the ratio of Se speciation due to Se being removed from the aqueous phase through adsorptive (Fe and Mn hydroxides) and bioreductive processes depending on cycling and retention times (Balistrieri and Chao, 1990; Lenz and Lens, 2009).

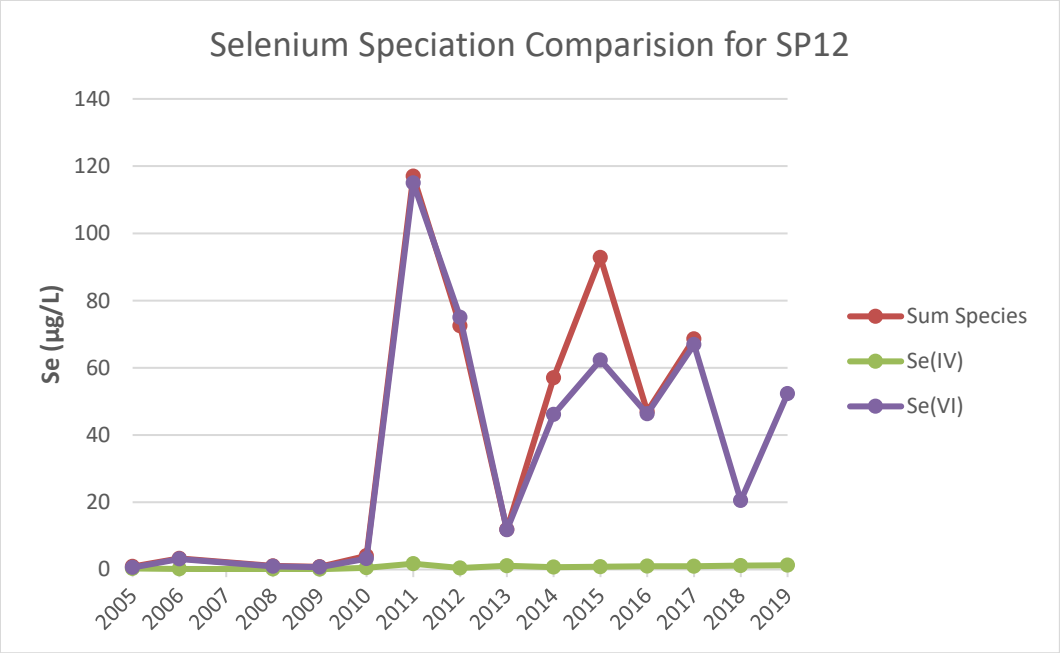

Figure 5: Cumulative Selenium Speciation at SP12

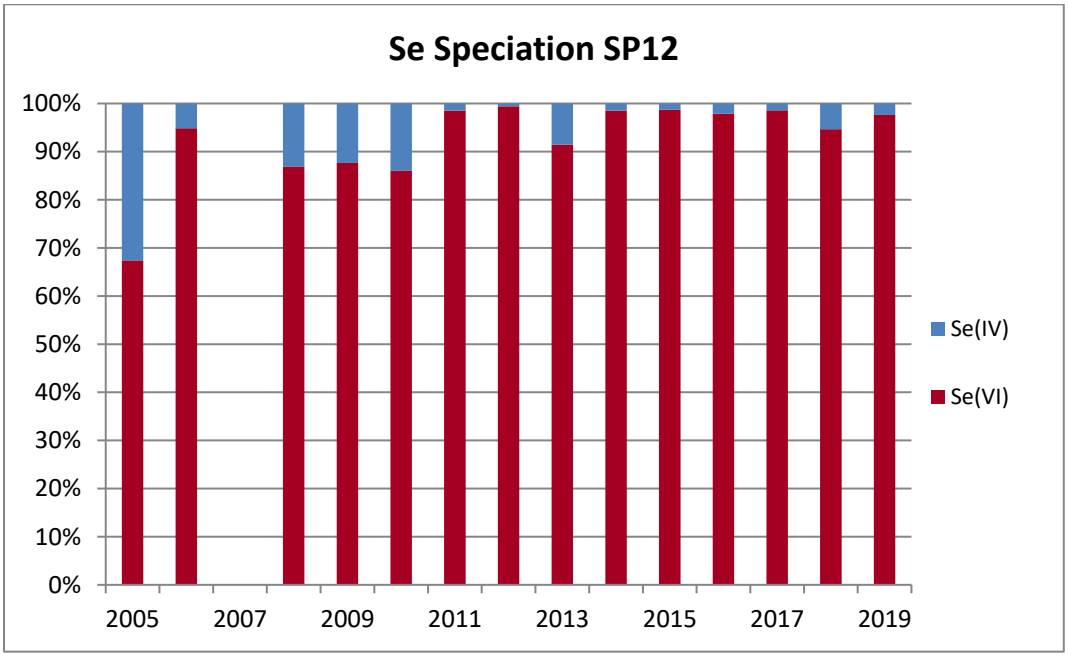

Figure 6: Cumulative Selenate:Selenite Ratio at SP12

Similarly, Se(VI) rates have varied since 2015 in SP12, with a much lower ratio of Se(IV) since 2010 (Figure 5 & 6). The higher rate of Se(VI) is likely the result of more oxygenated water inputs entering from road ditching and relatively uncompacted waste rock dump seeps.

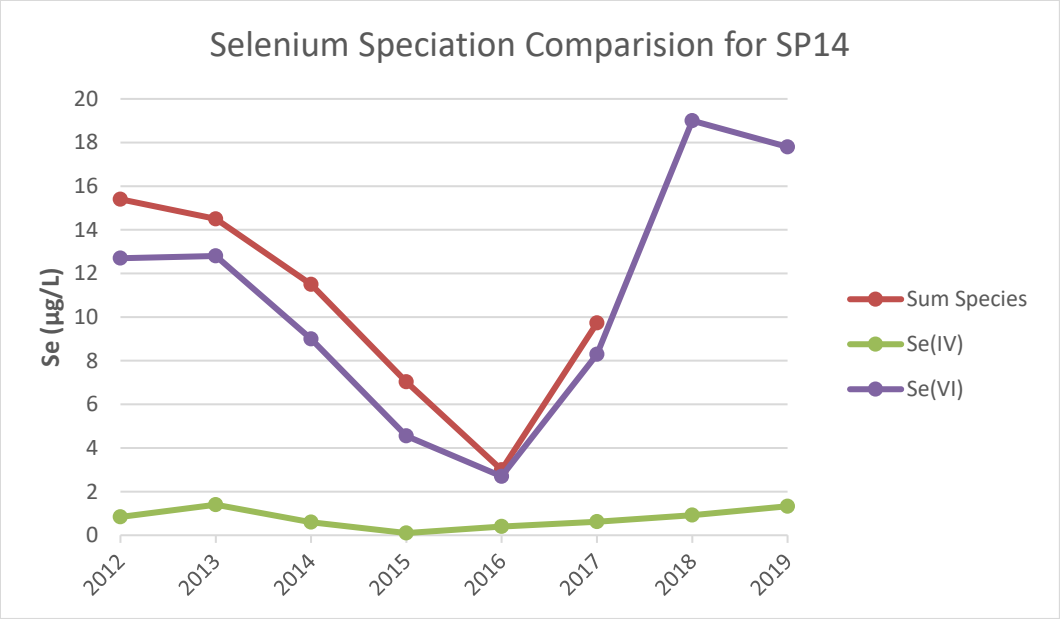

Figure 7: Cumulative Selenium Speciation at SP14

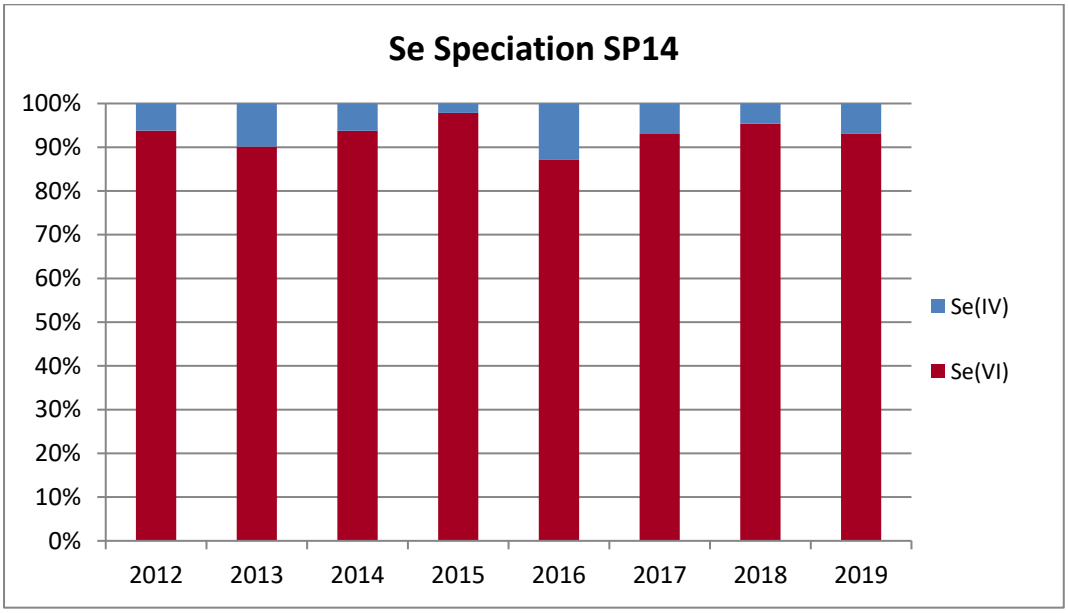

Figure 8: Cumulative Selenate:Selenite Ratio at SP14

The rate of Se(VI) has seen an overall increase in SP14 since 2016 with Se(IV) again staying relatively constant (Figure 7 & 8). SP14 has experienced high sediment loading from the maintenance and warehouse laydown which could be creating similar conditions in the pit sump, whereby Se(IV) is preferentially absorbed to clays, iron oxides, and other particles within the sediment (Frankenberger, 1994).

Overall the ratio of Se(VI):Se(IV) is typical for oxic surface waters with high pH values for all sediment ponds. Minor annual fluctuation in the ratios of Se species can also be linked to changes in the geochemistry of water inputs into sediment ponds. Higher rates and fluctuations Se(VI) could also be related to sulphate (SO_4^{-2}) concentrations in receiving water, do to limited sorption capabilities to oxides and clays at near neutral pH and competitive effects with SO_4^{-2}, allowing for continued oxidation (Torres et al., 2010; Frankenberger, 1994).

1.16 *Groundwater Quality and Quantity*

The *2019 Annual Water Quality Report – Wolverine Mine* (Appendix C) as per PE-17756 presents observations and results from the 2018 Water Quality Monitoring Program for the Wolverine Mine and subsequent interpretations. Conuma compared observed water quality results from 2018 to both historical and baseline results.

Elevated turbidity and total suspended solids were seen in many groundwater samples in 2018. A review of all existing monitoring water wells and sampling Standard Operating Procedure (SOP) at the Wolverine Mine was conducted in 2019. The review's objectives were to verify that each monitoring water well had been properly completed, is in good working condition, and the appropriate sampling method is being used. The review assisted 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. Turbidity levels measured were reduced as sampling methods were improved.

Chemistry within groundwater is discussed in further detail in Appendix B and C.

1.17 *Water Quality Prediction, Mitigation and Treatment*

A water quality update to the 2007 model was conducted to address additional tonnage of waste rock and CCR from Phase 5 was prepared by Lorax Environmental Services Ltd for the Phase 5 permit amendment application in August 2018 (Appendix C). As with previous assessments of the watershed, parameters of potential concern continue to be nitrate, sulphate and selenium. Sediment pond discharges from the Wolverine Mine reporting to the Wolverine River have shown signatures and progressive increases of all three parameters. Lorax states that the previous water quality model may have under predicted loadings of sulphate, nitrate and selenium from Sediment Ponds 6 and 12, potentially due to lower than predicted flows resulting in higher concentrations of specific parameters. Lorax predicted Phase 5 would have slight changes on previous water quality predictions with slightly higher concentrations at WR-4 and WR-3 sampling locations. Conuma submitted updated model results related to the Hermann Disturbance Area and effect on the Perry Creek Pit in the Wolverine-Hermann Amendment Project, currently in the permitting process.

1.18 *Water Management*

The Water Management Plan (EMS-9.1a-Water Management Plan – Wolverine) is located in Appendix A. To provide an overview of this plan, water management at the Wolverine Mine can be summarized as the:

1. Diversion of runoff from undisturbed catchments, around or through areas that are disturbed by mining, and
2. The collection of runoff from disturbed areas into sediment ponds for storage, settling, and possible treatment, prior to discharge.

Most of the features discussed were built in the construction/pre-production phase of the Mine and are designed to service specific areas of the site through construction and operations up to the time of closure. The key management considerations reflected in final system design are:

- Sediment control,
- Diversion of clean water away from the Mine footprint,
- Control of metal loadings to surface water,
- Minimizing process water makeup requirements and maximizing recycling of water to the extent practical,
- Protection of sensitive habitats,
- Monitoring programs to confirm expected system performance, and

- Contingency plans to address potential non-performance.

The layout of the Wolverine Mine site is illustrated on Figure 9.

As much as practicable, water has been diverted around the Pit. The un-diverted catchment area above the Pit is managed by the Pit Sump and the existing SP6 and SP12 Sediment Ponds.

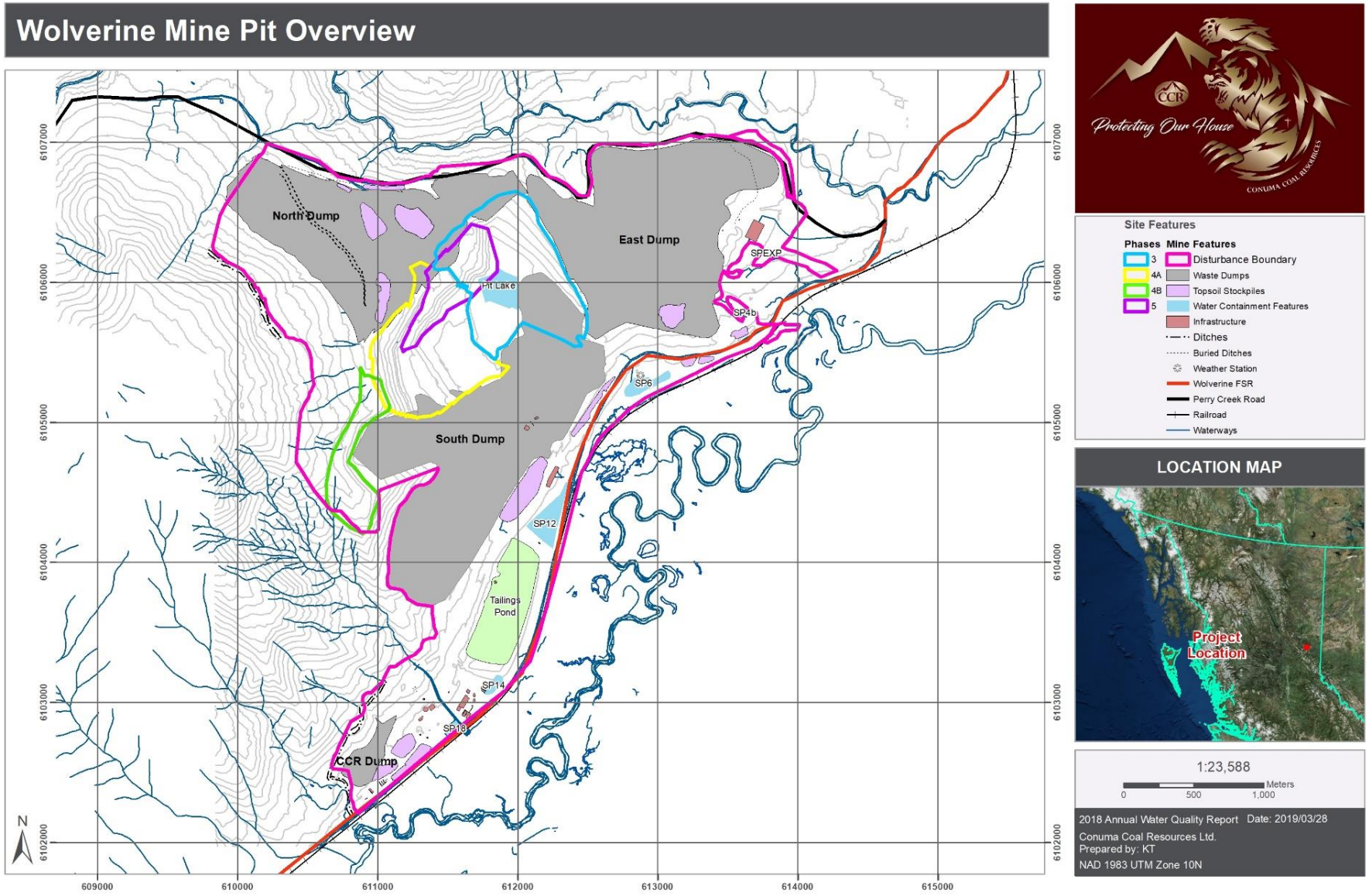

Figure 9: Wolverine Mine Site Layout

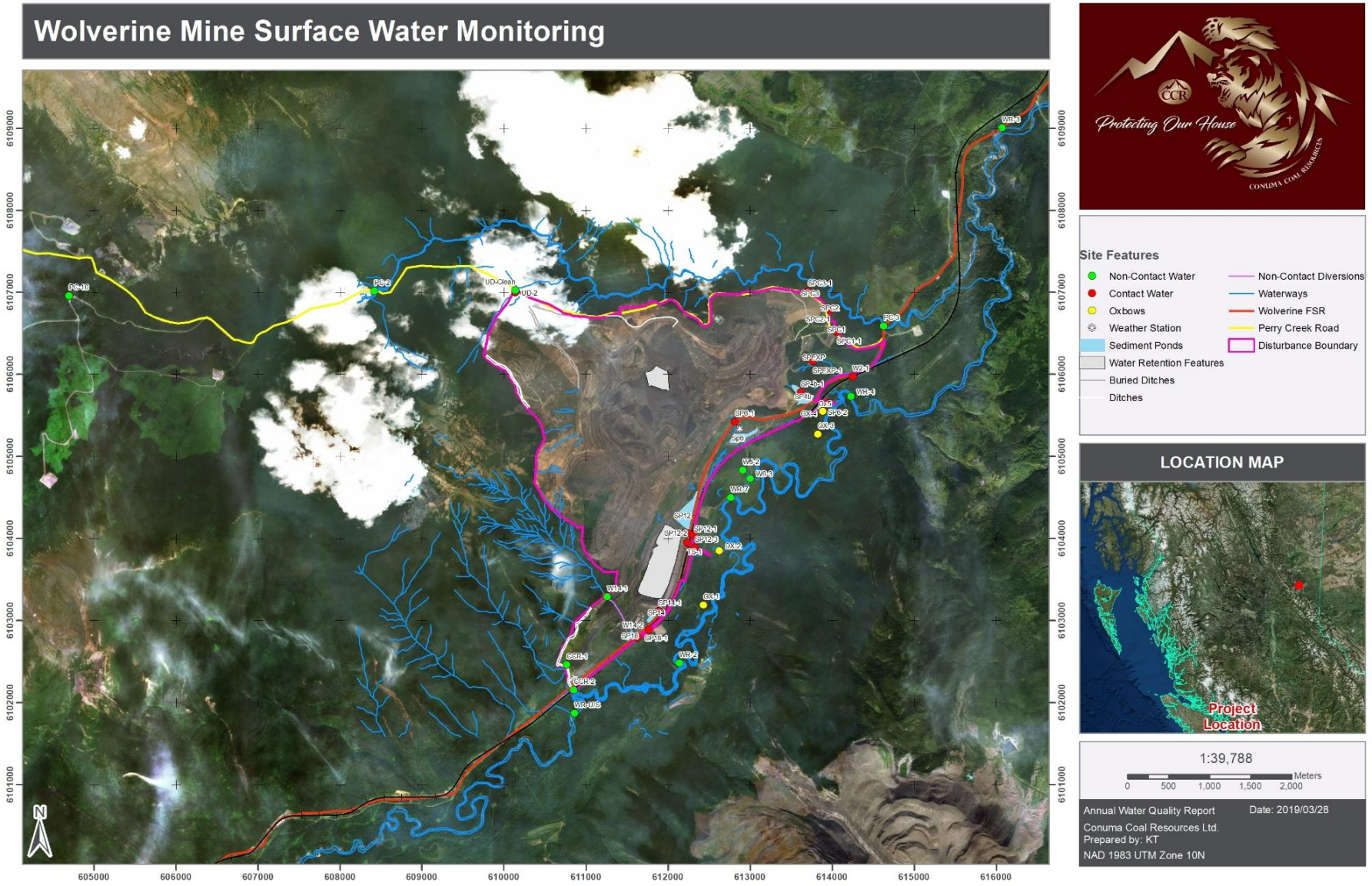

Figure 10: Surface Water Quality Monitoring Sites (Discharge and Receiving Environment)

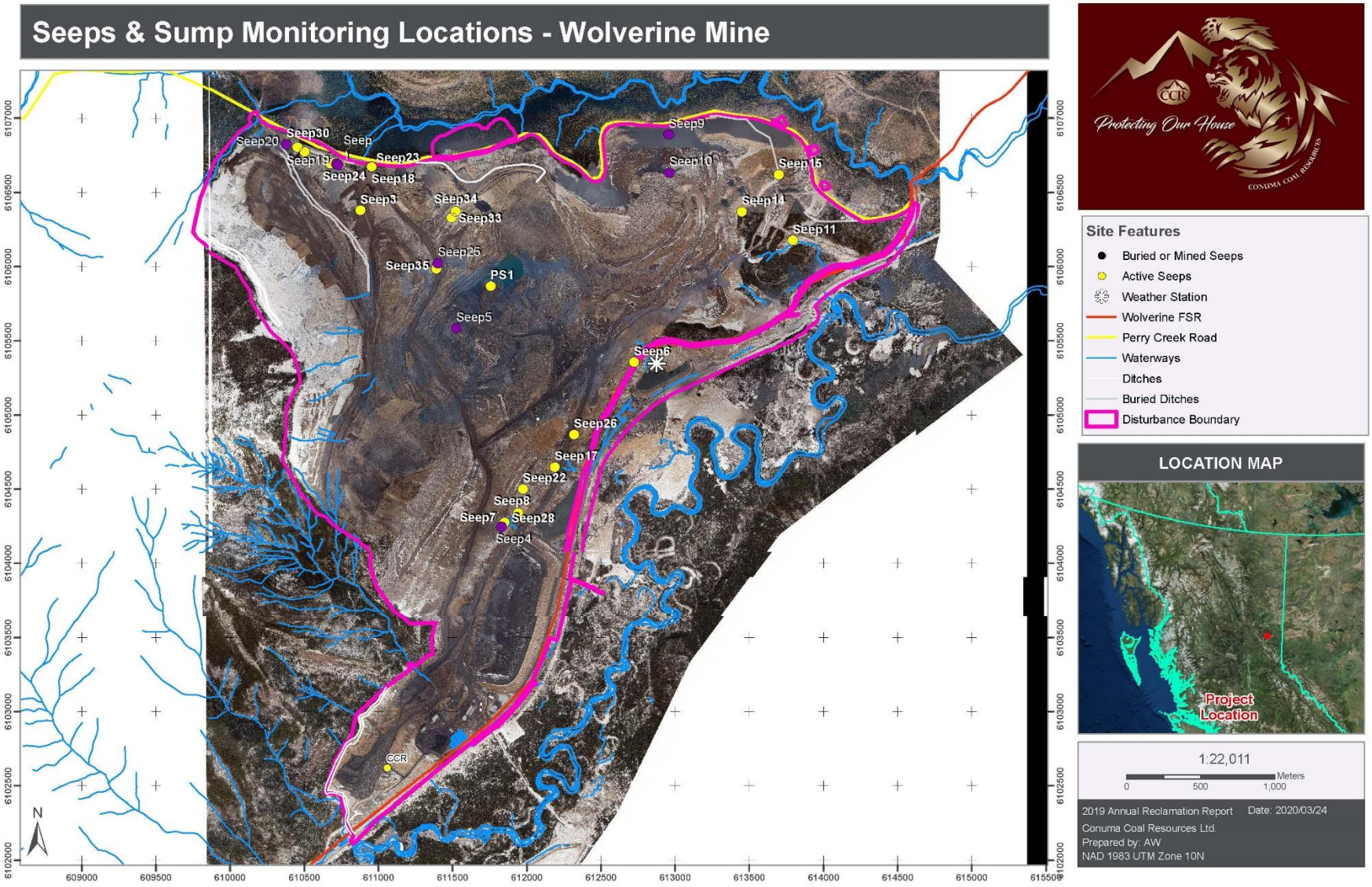

Figure 11: Surface Water Quality Monitoring Sites (Seepages)

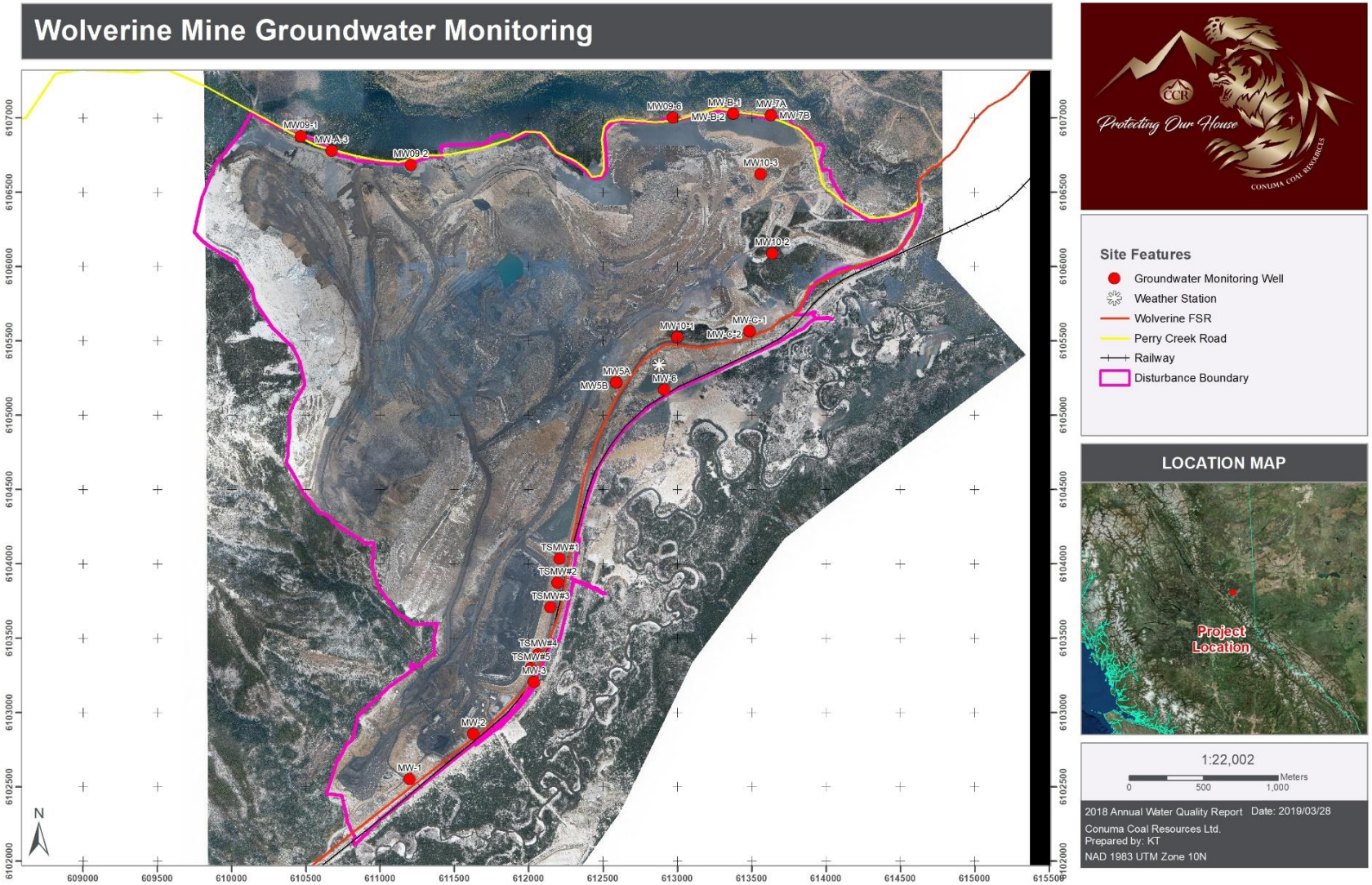

Figure 12: Groundwater Quality Monitoring Sites

1.18.1 Sediment Ponds

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 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 Storage Facility
- SP12 Sediment Pond—located northeast of the Tailings Storage Facility
- 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

It was discovered in 2017 that the low level decant gate valve on SP6 was seized closed causing water levels to broach the mid-level decant, decreasing freeboard. The gate valve was replaced in Quarter 1, 2018. As per Effluent Permit PE-17756, correspondence was initiated with the ENV to notify of process modifications. SP4b and SP12 pond proper gate valves appear to have seized as well. In order to maintain the ponds' functionality and freeboard, pond maintenance is scheduled for replacement in 2020. Recommendations to repair SP18 inlet resulted from annual water management structure geotechnical inspections. This is scheduled for 2020.

1.18.2 Diversion & Collection Ditches

Clean runoff water and base flows from undisturbed catchments is diverted around or through the plant site and open pit areas. Three primary diversions are:

- Coarse Coal Reject Diversion – upslope of the CCR dump.
- W14 Conveyance Channel – through the plant site.
- Upper Diversion – around the Perry Creek pit and North Dump areas.

The original Upper Diversion Ditch was decommissioned in 2013 to allow for expansion of the North Dump above the ditch. A New Upper Diversion Ditch was commissioned in 2011; however, the functionality of this ditch is in question as surficial water from above the disturbed area is not captured in this ditch and is noted to report at the north (downstream) portion of the decommissioned Upper Diversion on the downstream portion of the ditch plug. The water was also recorded to flow through the North Dump and collected as seepage water. Three ditches were constructed to divert water flow upstream of the decommissioned ditch's plug and into the North Dump Drainage Ditch which reports to the Pit Sump. The appropriate authorities within ENV were notified of the works. Effectiveness of the diversion was assessed following 2018 freshet and determined the ditches were successful in rerouting water into a contact water ditch and into the Pit Sump.

1.18.3 North Dump Water Management

Historically, water flows to the Perry Creek Road ditch from the Mine (approximately 4.5 km), travelled along the ditch to the Phase 3 highwall are and then infiltrated to the bedrock that directed the water back to the Mine area. Currently several culverts along the Perry Creek Road are open, allowing water to flow straight down to Perry Creek. The gas company occupying the wells along the Perry Creek Road maintains the road. The work performed on the culverts was completed by the gas company in attempts to remediate erosion being caused by flash rain events.

To address road washouts during periods of high flow such as freshet and rain events, a temporary sump was dug into the dump adjacent to the Perry Creek Road to prevent erosions issues in the spring; however, while this seepage water permeated the waste dump and reported to the pit sump, geotechnical studies showed potential stability issues of the causeway if this continued.

To replace the road ditch and sump, Conuma and consultants engineered the Perry Creek Road Collector Ditch which was constructed in 2018 to collect this water and discharge over a final footwall and into the pit sump, bypassing road ditching and the causeway. It was anticipated that final construction of the ditch would be completed in spring 2019; however, during construction, the geomembrane liner was not tied in per design resulting in wind damage to liner. Corrective repairs commenced in 2019. Remaining repairs are scheduled for snow free conditions in 2020, following which, an As-Built report will be finalized and submitted to the EMPR.

1.18.4 East Dump Water Management

The 148 ha East Dump is located primarily in the W4 catchment, with about 30% of its area located in the W6 catchment and 23 ha located in the Perry Creek watershed.

Two collector channels run along the north side of the East Dump and are directed under the dump to the W4 drainage. A perimeter collection channel around the east extent of the Dump that conveyed runoff back to W4 has been replaced with a French drain directing the water from four of the seven existing culverts beneath the Perry Creek Road. This flow is collected in SP4b. Three small infiltration basins have been constructed at the outlets of the three remaining Perry Creek Road culverts.

The three exfiltration basins (SPC1, SPC2 and SPC3) are sized to detain a 1:10 storm event volume and to exfiltrate it over a five to ten-day period following the storm event. Flows in excess of the design storm would decant through culverts into natural drainage courses.

All East Dump water management structures functioned as designed in 2019.

1.19 *Erosion and Sediment Control*

The mine employs several BMP and techniques for sediment and erosion control to minimize the potential for water quality to be adversely affected. A detailed program is provided in EMS-9.4-MGT Sediment & Erosion Control Management Plan, updated Q1, 2019. The majority of the effort in this regard is related to water management and the effective transport of water from one end of site to the receiving environment. In 2019 Conuma employed several of the described BMP's including rolled erosion control products, check dams, spring berms, vegetation, the addition of organic material as a surface protectant (i.e. certified weed free straw), ditch maintenance and sediment removal. Effective sediment control in event of a storm event includes installing spring berms or certified weed-free straw bales into channels, coconut matting along exposed banks and seeding of banks following the storm. In 2019 an update of water management operations, maintenance and surveillance manual was completed.

Several storm events in the past decade have caused increased natural erosion due to wind and water abrasion and soft, unstable embankments. During freshet and rain events, the soft embankments and previously eroded areas introduce easily mobilized particulate to the watershed, increasing turbidity unrelated to mining activities.

The Wolverine Mine did not experience severe sedimentation issues in 2019.

1.20 *Soil Salvage and Stockpiling*

The soil stockpiles locations are identified in Figure 2, and locations are described as the following:

- Back 40

- Original ROM Road
- Adjacent to Topsoil Stockpile #15
- 910 m East Dump
- Eastern North Dump
- Southern North Dump
- 1080 m East Dump
- In pit (overburden)

Two areas within the mine boundary were salvaged in 2019: existing original ground above the current CCR Dump and rehandled overburden (till) material from Phase 5. Topsoil stockpile areas are clearly marked in the field to ensure that they are protected during mine operations. Due to inadequate record keeping during previous ownerships, accurate topsoil salvage volumes are unknown. Based on historical and current topographical information, Conuma has calculated the approximate volumes of topsoil in all known stockpile locations. The Wolverine Mine has stockpiled approximately 3.03 million bank cubic meters (mBCM) of topsoil to date, with 0.311 mBCM's of topsoil and overburden salvaged in 2019. No Topsoil was used for reclamation in 2019; TSP#1 was altered in 2019 to allow for the resloping of the CCR Dump. Some TSP#1 volume was relocated to the south side of the CCR Pile, outside of the reslope boundary.

Table 11: Quantities of Soil and Overburden Salvaged and Stockpiled for Reclamation Use in 2019

Salvage Source	Area Salvaged (Ha)	Location of Stockpile	Volume Salvaged (m^3)	Number of Samples Analyzed for Suitability	Reclamation Suitability
CCR Dump footprint	1.7	CCR Dump	3,345	2	Fair - Good
Phase 5		1020 Dump	0.308 M	4	Poor - Fair
Note: In 2019 the toe of East Dump that will require future salvage and had one sample tested and rated as Good to Fair reclamation suitability. The future salvage area along Perry Creek Road had one sample taken and it was rated as Fair. All soil analysis was completed by a Qualified Professional Agrologist.					

Table 12: Calculated Topsoil Stockpile Salvage Volumes

Topsoil Stockpile	Stockpile Locations	Total Salvage Volumes
Topsoil Stockpile #1	Back 40	Approximately 3.03 mBCM[1]
Topsoil Stockpile #2	Back 40	
Topsoil Stockpile #3	Back 40	
Topsoil Stockpile #9	Original ROM Road	
Topsoil Stockpile #10	Original ROM Road	
Topsoil Stockpile #11		
Topsoil Stockpile #12	Adjacent to #15	
Topsoil Stockpile #14	910 m East Dump	
Topsoil Stockpile #15	Eastern North Dump	

[1] Stockpiles will undergo a stockpile survey and analysis to calculate the total salvaged growth medium for reclamation use in 2020.

Topsoil Stockpile #16	Southern North Dump	
Topsoil Stockpile #17	1080 m East Dump	
Topsoil Stockpile #18	Berm	
Topsoil Stockpile #19	Berm	
1020 Dump Overburden	In-Pit 1020 Dump	
CCR Topsoil Stockpile	CCR Pile Lift	

Stantec was contracted in Q2 2019 to assess undisturbed areas within the mine boundary for topsoil salvage suitability. Three salvage locations were deemed to have 'Good' reclamation suitability, 8 were deemed 'Fair' and to 2 were deemed 'Poor'. Approximately 3,345 m^3 of growth medium was salvaged from above the CCR Pile footprint as a direct result of Stantec's findings.

Conuma conducted independent testing on 8 out of 13 of the major stockpiles, as well as on a temporary stockpile (ID: CCR Stockpile) created November 2019. Stockpiles placed below the CCR dump and its influence had slightly elevated concentrations of Al, B, Cd, Cr, Li, Mo, Se, and U in the upper 50 cm of soil in comparison to other existing stockpiles and potential salvage areas (Figure 2).

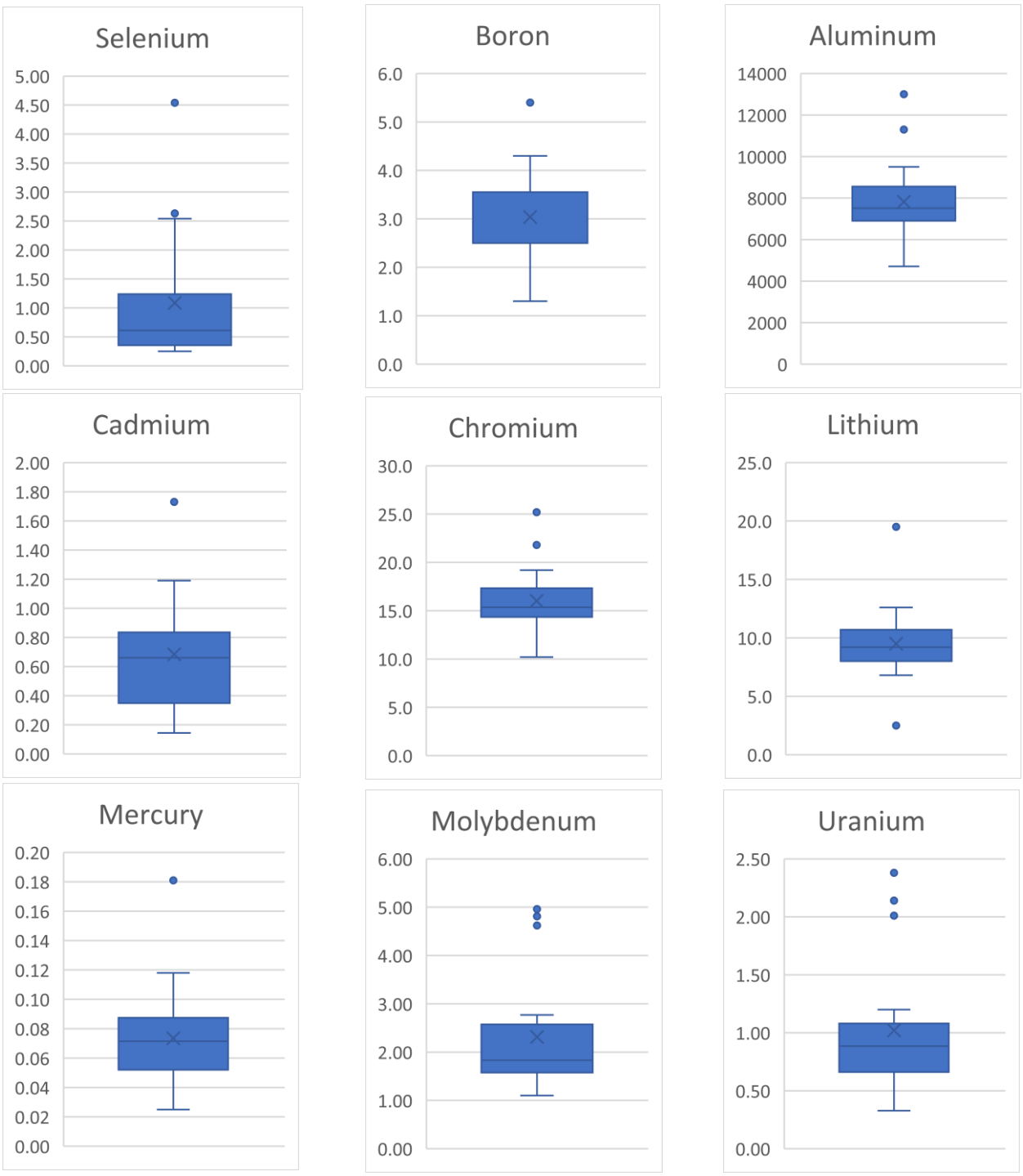

Figure 13: Mean metal concentrations (mg kg-1) across all sample locations and depths.

1.21 *Vegetation Management*

The EMS-9.5-MGT Vegetation Management Plan serves to reduce adverse effects on vegetation, particularly with respect to its role as wildlife habitat. The plan maps riparian setbacks and vegetative buffers and describes BMP and measures that are to be implemented to protect those setbacks and buffers. Examples of protection measures extend to:

- Flagging boundaries of vegetation clearing,
- Implement invasive species mitigation and management,
- Clearing limited to the area provided in the permit,
- Woody debris salvaged for reclamation usage,
- Maintain riparian zone integrity by limiting work in area,
- Prevent deleterious substances from entering watercourses, and
- Minimize disturbances to riparian areas.

The vegetation plan describes a vegetation monitoring program for evaluating metal uptake in exposed terrestrial and aquatic ecosystems, which specifies sampling requirements and performance criteria. It is designed to evaluate the success of revegetation, soil development and erosion control. The monitoring program includes specific sampling parameters and performance criteria.

1.21.1 Invasive Species Mitigation

Environmental Staff at Wolverine Mine survey the mine and surrounding area for invasive species throughout the growing period. Scentless Chamomile and Canada Thistle (regional noxious species) have been identified adjacent to the Wolverine FSR. Scentless Chamomile was found adjacent to the Perry Creek Road, and Canada Thistle was identified on the banks of the Wolverine River. Scentless chamomile was noted in large amounts adjacent to and within the areas that were planted in the 2013 revegetation program. Due to the sensitivity of newly reclaimed areas, chemical and extreme mechanical controls were not viable options for invasive control in 2019. Previous controls implemented by the Wolverine Mine includes hand pulling, herbicide use and the targeted release of a biocontrol agent, *Omphalapion hookeri* (Seed weevils). Initial populations were released August 28, 2012 in two locations: along the Wolverine FSR and in the Back 40 warehousing area. It is difficult to determine from previous owners' record keeping if assessments were performed on the weevils' success.

Invasive plant mitigation in 2019 was limited to mechanical control (i.e. hand-pulling) due to weather constraints. The Wolverine Mine experienced a wetter-than-normal growing season and as such mechanical controls were used in an approximate 2.5 ha section of 2014 reclamation adjacent to the Perry Creek Road and Perry Creek Road Collector Ditch. The Wolverine Mine plans to control invasive populations adjacent to the Wolverine FSR and Perry Creek road using chemical controls in 2020, utilizing the commercially available herbicide. Herbicides, in conjunction with hand-pulling, allows Conuma staff to focus on the Scentless Chamomile populations around site and along both the Wolverine and Perry Creek FSR rights-of-way.

The Wolverine Mine was and will continue to be an active participant in the Peace River Regional District Invasive Plant Council (PRRDIPC) Monitoring Committee. Attendance at the biannual strategic planning meetings will be essential in receiving and providing up-to-date information on best management practices. In 2019 only one meeting occurred, which was attended by two Conuma staff members.

1.22 *Wildlife Protection*

The Wildlife Management Plan (WMP) provides all workers and contractors a comprehensive list of the general restrictions and mitigation measures to minimize the Mine's residual effect on wildlife and wildlife habitat. The information provided includes the rationale, background and context for these restrictions, requirements and recommendations. Wildlife protection measures in place include:

- General restrictions for wildlife protection,
- Wildlife attractants
- Garbage management

- Preventing problem wildlife
- Dealing with problem wildlife
- Bears (wildlife awareness program and bear safety)
- Wildlife and vehicles
- Wildlife habitat use
- Wildlife health
- Reporting wildlife observations and incidents

A wildlife sighting program was started in July 2005. A logbook for recording wildlife sightings is located at the mine office. Information collected includes date, time and location of sighting, species sighted, and information related to sex, age and number of species observed. Mortalities are also tracked in the wildlife sighting logbook. Wildlife observations are recorded in Appendix D.

The Wolverine Mine endeavours to be an attractant free workplace. Periodically, environmental staff will present wildlife awareness education to Conuma employees with the focus being on preventing wildlife from habituating the mine site, reducing impacts on wildlife habitat and increasing reporting efforts.

A herd of elk utilize the Terry Ranch as part of their home range and are often observed along the Wolverine FSR gaining sustenance from previous planted agronomic species and conifer seedlings. Mine traffic are aware of the herd and tend to reduce speeds when approaching areas favoured by elk and communicate on the radio when elk are alongside the road.

For several years, a small trip of mountain goats has been ranging along the higher elevations of Phase 4b. Operators are made aware of the herd in the area and announce on the radio if they encroach on the active mining area. The goats tend to observe the mining and remain unaffected in areas above the active mining.

Animal tracks observed within the TSF indicated wildlife were entering the TSF and as a result an electric fence was installed in Spring 2019. Following minor maintenance activities and SOP distribution, the fence is scheduled to be electrified in Q2 2020.

With the education of the Wolverine Mine crews and contractors, the wildlife management plan is effective with little to no affect on wildlife in the immediate vicinity. Problem wildlife is communicated to the Environmental department who will contact the local trapper and Conservation Officer based on the severity. One dangerous wildlife incident occurred in 2019, with one Conuma staff member and two contractors closely encountering a sow grizzly and two cubs at the base of the East Dump Conservation Office Services was contacted and followed up on the incident. A safety notification to all Conuma staff to be wary of the presence of the sow and cubs was issued and the area remained off limits to staff for the remainder of the summer.

Two motor vehicle – wildlife collisions occurred in 2019:

- Light duty pickup struck an elk on the Wolverine FSR; elk walked away uninjured
- Moose ran into travelling light duty pickup box on Wolverine FSR; moose walked away uninjured

A Wildlife Reporting flow chart will be created for Loss Prevention Officers for procedures to notify the Conservation Office Services of wildlife-human contact in 2020.

1.23 *Archaeological Resources*

The mine is within the Treaty No. 8 boundary and is understood to occupy Crown land holdings within the Traditional Territories of West Moberly First Nations, Saulteau First Nations, McLeod Lake Indian Band, Halfway River First Nation, Horse Lake First Nation, Doig River First Nation and Blueberry First Nation under Treaty No. 8, British

Columbia/Alberta. The area is also within the traditional territory claimed by the Aboriginal communities at Kelly Lake (Kelly Lake Cree Nation, Kelly Lake First Nation, and Kelly Lake Métis Settlement Society).

The EMS-4.1-MGT Archaeological Management Plan provides details on specific supporting management controls or programs Conuma utilizes to ensure protection of archaeological and cultural heritage resources and adherence to relevant regulation for the duration of mine operations. The plan outlines the existing regulatory framework, provides a brief summary of results of the archaeological and cultural heritage resource investigation studies that were undertaken prior to project development, and describes awareness training for mine personnel. In the unlikely event that archaeological features or remains are discovered, Conuma will cease work, in the area of the materials, and contact the Ministry of Tourism, Culture and the Arts, Archaeology Branch immediately.

Cultural resources staff from Landsong Heritage Consulting, with assistance from participants from West Moberly First Nations, Kelly Lake Cree Nation, Kelly Lake First Nations, Saulteau First Nations, Kelly Lake Metis Settlement and McLeod Lake Indian Band, conducted a traditional use assessment across the mines during 2001/2002 at Wolverine. McLeod Lake Indian Band conducted a traditional use assessment of the HDA in 2019. West Moberly First Nations and Saulteau First Nations conducted a joint assessment of the HDA in 2019.

The assessment work consisted of a literature review and background study, preliminary field reconnaissance, and detailed field inspections consisting of in-field assessments of each area and landform likely to contain cultural resources. Areas that were evaluated to have a moderate to high potential to contain cultural resources were inspected and shovel tested.

The assessment of the Perry Creek Pit areas in 2001/2002 identified no previously recorded archaeological sites within the proposed footprint of the project. Conuma anticipates conclusions of the 2019 assessments in 2020.

In 2017, ankylosaur and theropod tracks were discovered in blasted material. The Peace Region Palaeontology Research Center was notified, and two of three specimens were transported to the research facility. The third specimen remains on display at the entrance to the mine site.

No archaeological sites were recorded in 2019.

Reclamation Program

The following sections describe the reclamation program over the previous year. A detailed conceptual projection of reclamation over the next five years is described in the Wolverine-Hermann Phase 5 Five Year Plan, submitted to EMPR on February 21, 2020.

1.24 *End Land Use and Land Capability*

End land use and capability objectives for the Wolverine Mine are discussed generally throughout this section, and in detail for specific components below. Where end land use and capability objectives diverge between the Perry Creek Pit and the HDA the details for each location will be presented separately.

The targeted end land use and capability objectives are based on characterization of pre-development site conditions. The pre-disturbance landscape is predominantly a forested ecosystem supporting an assortment of values including wildlife habitat, traditional use, forestry, and recreation.

Reclamation will be undertaken with the end land use goals of (1) re-establishing the average land capability to pre-disturbance conditions and (2) fostering the return of appropriate self-sustaining forested ecosystems (ecosystems common in the pre-disturbance local landscape) that provide wildlife habitat that supports wildlife. By accomplishing these two primary goals, supporting a variety of other compatible end land uses (such as traditional use, forestry, and recreation) will be a secondary benefit.

Key principles incorporated into this reclamation plan that are critical for achieving end land use capability objectives are:

- Creating geotechnically and geochemically stable landforms at closure
- Managing water quality through maintenance and monitoring of non-contact water (NCW) diversions and treatment of contact water (CW)
- Implementing soil salvage and replacement strategies and re-vegetation strategies that will achieve ecological conditions that are similar to pre-mining conditions
- Targeting post-closure ecosystems that re-establish wildlife habitat capable of supporting a diversity of wildlife at various successional stages including caribou, grizzly bear, black bear, elk, moose, furbearers (e.g., marten), grouse, woodpeckers, raptors, ground-nesting songbirds, and forest songbirds
- Selecting plant species for revegetation that have Indigenous traditional use value and support the diversity of plant species that are native to the area

Defining end land use objectives to support closure requirements is critical to effective reclamation and closure planning since these objectives influence the development of management plans and activities that are both achievable and economically viable.

1.25 *Long-Term Stability*

Annual safety inspections are conducted on waste rock dumps, the tailings impoundment, and sediment ponds, including Dam Safety Inspections (DSI) for the TSF, SP4b, SP6 and SP12. Mine engineers conduct piezometer monitoring and dump and pit monitoring in keeping with the requirements of the Mine Permit. Wolverine Mine retains Stantec (formerly Norwest Corporation) as well as Piteau Associates Engineering Ltd. (Piteau) to provide geotechnical stability services advising the management of Wolverine waste dumps, pit slopes, sediment ponds, ditches and the tailings storage facility to complete annual inspections. Thel geotechnical reports are located in Appendix G.

Geotechnical Dump Inspection:
Waste rock dumps, in-pit backfill areas and the CCR Pile were inspected by Stantec in September 2018. Results from the inspection concluded the following recommendations for 2020: consistent documented field inspections of the Conuma Engineering Department, replace instrumentation where needed, meet minimum requirements of OMS instrumentation monitoring frequencies, construct the W6 Rock Drain Extension, and inspect the Perry Creek Road on weekly inspections. Overall, observed dump construction is following design recommendations within permits and subsequent design updates.

Tailings Storage Facility:
The Tailings Storage Facility Dam Safety Inspection (DSI) was conducted in October 2019 by EOR Richard Dawson, Stantec. It was determined that most of the 2018 inspection recommendations remain outstanding. Surveillance measurements and processing monitoring data was deemed deficient and continuous monitoring is critical for dam safety. A summary of high priority recommendations are as follows:

- Temporary CCR stockpile within the dam will have a plan developed for removal in 2020.
- Assess and maintain monitoring instrumentation.

Pit Slope Inspection:
The Pit Slopes at Wolverine Mine were inspected by Piteau in August 2019. The level of wall control and scaling is similar to observations in 2018. Catch benches are filled with debris in some areas due to overspill, limiting catchment. Bench face angles were less than 65° in both active phases, posting a concern for suitable bench width. Due to spatial constraints, trim blasting is infrequently, if ever, utilized for final wall blasting. Good effort has been made for scaling; however, some areas of scaling are inadequate. Scans indicated there are no widespread areas of instability, but continued scanning should be conducted.

Water Management Structure Inspection:
The water management facilities at the Wolverine Mine were inspected by Piteau in October 2019. Areas inspected included: CCR Diversion, W14 Diversion, SP18, SP14, SP EXP, East Dump Collector Ditch, East Dump Exfiltration Basins, and the New Upper Diversion. Generally, sediment removal is a reoccurring theme in recommendations, as well as the ongoing maintenance of inlets and outlets of culverts and ponds.

Sediment Pond DSIs:
A DSI was completed at SP6, SP12, and SP4b in October 2019.

SP4b DSI: Locally inadequate freeboard was labeled as deficient in the report with recommendations to increase the embankment to reach elevation dictated in OMS.

SP6 DSI: Inadequate freeboard, emergency spillway decant channel varying from the design, beaver activity, decant channel vegetation accumulation, pipe blockage at decant were listed as deficiencies at SP6 in 2019. Recommendations to add fill to increase embankments, armour the emergency channel, relocate beaver and remove dams, remove vegetation and check the decant pipe and clean mesh screen were included in the report.

SP12 DSI: Inadequate freeboard, damaged floating baffle, sediment accumulation was listed as deficiencies. It was recommended to add fill to the embankment, repair the baffle and remove accumulated sediment.

1.26 *Revegetation*

The re-establishment of the ecosystems will be supported by the replacement of salvaged soil, coarse woody debris, and the planting of native shrubs and trees. A seed collection list was provided to Twin Sisters Native Plant Nursery (TSNPN) in Q2 2018, the species on which are collected locally by TSNPN to provide the best chance of survival for seedlings. TSNPN is contracted to clean, stratify and store seed as necessary for growth and implementation in Q3 2019. Seedlings are then ordered based on nursery availability and plant suitability. In 2019 Conuma contracted Aski Reclamation ltd. (Aski) to implement an ecocultural planting program at the Wolverine mine including site assessments, vegetation review, stock assessment, aspect planting, innovative planting techniques and monitoring plots.

Tree, shrub, grass and forb species (Table 13 and 14) are used in mine reclamation to increase biodiversity and allow Conuma to reach its end land use objectives. Opportunistic seed collection is conducted in nearby analogue areas as seeds from sites with similar elevations and site conditions are expected to increase success of propagation and survival in reclaimed areas. Stocking rates of revegetation efforts will be 1,500 to 5,000 stems per hectare with increased densities on slopes expected to see higher probabilities of erosion and as deemed appropriate. Plant/shrub prescriptions vary with each targeted ecosystem and aspect at various locations in the reclaimed area and are created by Conuma staff with the assistance of Aski and their subcontractors. A detailed list of reclamation efforts conducted by Aski and a detailed list of species used in 2019 is provided in Appendix E.

Table 13: Tree, Shrub and Forb Planting Mix for Permanently Reclaimed Mine Features in ESSFmv2 at Perry Creek Pit

Species[1]		**Planting Density (stems/ha)**			
Common Name	**Scientific Name**	**Xeric to Subxeric (Dry) Sites (0[2])**	**Submesic—Mesic Sites (01)**	**Moist to Wet Sites (06)**	**Shrub Sites**
hybrid white spruce or Engelmann spruce	*Picea engelmannii or Picea engelmannii x glauca*	-	200	600	
subalpine fir	*Abies lasiocarpa*	-	200	200	
lodgepole pine	*Pinus contorta*	1,400	1,000	-	
Sitka alder/green alder	*Alnus viridis*	750	700	800	
western mountain-ash	*Sorbus scopulina*	-	100	-	
soapberry/soopolallie	*Shepherdia canadensis*	200	100	-	1,000
prickly rose	*Rosa sp.*	125	-	-	
currents or gooseberries	*Ribes lacustre; Ribes oxyacanthoides*	125	100	250	
black huckleberry	*Vaccinium membranaceum*	200	250	250[4]	1,000
thimbleberry	*Rubus parviflorus*	-	-	250	
red raspberry	*Rubus ideaus*	-	-	250	
fireweed[2]	*Epilobium angustifolium*	250	250	-	
goldenrod[2]	*Solidago canadensis*	125	100	-	
kinnikinnick[3]	*Arctostaphylos uva-ursi*	125	-	-	500
crowberry[3]	*Empetrum nigrum*				500
cow-parsnip[2]	*Heracleum lanatum*	-	100	200	
wild strawberry[2]	*Fragaria virginiana*	-	-	-	
Total trees		**1,400**	**1,600**	**800**	**-**
Total shrubs		**1,400**	**1,250**	**1,800**	**2,000**
Total dwarf shrubs and herbs		**500**	**450**	**200**	**1,000**
Total Plants		**3,300**	**3,300**	**2,800**	**3,000**
NOTES:					

Species[1]		Planting Density (stems/ha)			
Common Name	**Scientific Name**	**Xeric to Subxeric (Dry) Sites (0[2])**	**Submesic—Mesic Sites (01)**	**Moist to Wet Sites (06)**	**Shrub Sites**

[1] Plant species identified by the Halfway River First Nations and McLeod Lake Indian Band are included in this list.
[2] Herbaceous plant (increase diversity, when other plants are an option)
[3] Dwarf shrub
[4] Substitute black huckleberry with other shrubs (alder, red raspberry or gooseberries) on wet sites

Table 14: Tree, Shrub and Forb Planting Mix for Permanently Reclaimed Mine Features in SBSwk2 at Perry Creek Pit

Species		Planting Density (stems/ha)				
Common Name	**Scientific Name**	**Xeric—Subxeric (Dry) Sites (02)**	**Submesic Sites (03)**	**Mesic Sites (01)**	**Moist to Wet Sites (04/06)**	**Shrub Patches**
hybrid white spruce	*Picea engelmannii x glauca*	-	400	1,000	1,000	-
subalpine fir	*Abies lasiocarpa*	-	-	300	200	-
lodgepole pine	*Pinus contorta*	1,400	1,200	300		-
balsam poplar	*Populus balsamifera*	-	-	-	400[5]	-
Sitka alder/green alder	*Alnus viridis*	750	500	400	400[6]	-
western mountain-ash	*Sorbus scopulina*	-	100	100	-	-
soapberry/soopolallie	*Shepherdia canadensis*	200	100	-	-	750
currents or gooseberries	*Ribes lacustre; Ribes oxyacanthoides*	-	100	100	100	
black huckleberry	*Vaccinium membranaceum*	200	150	200	-	750
Saskatoon	*Amelanchier alnifolia*	150	-	-	-	750
highbush cranberry	*Viburnum edule*	-	150	200	100	
rose (prickly rose)	*Rosa spp.*	100	-	150	150	
thimbleberry[4]	*Rubus parviflorus*		-	150	150	
black twinberry[4]	*Lonicera endeavors*	-	-	-	200	
red osier dogwood[7]	*Cornus stolonifera*	-	100	100	150	
red raspberry	*Rubus ideaus*	-	-	-	150	
fireweed[2]	*Epilobium angustifolium*	250	250	250	-	
goldenrod[2]	*Solidago canadensis (S. multiradiata)*	125	125	150	-	
showy aster[2]	*Aster endeavors (Eurybia conspicua)*	-	125	-	-	
yarrow[2]	*Achilliea millefolium*	-	-	-	-	
kinnikinnick[3]	*Arctostaphylos uva-ursi*	125	-	-	-	750
cow-parsnip[2]	*Heracleum lanatum*	-	-	-	200	
false Solomon's-seal or wild sarsaparilla[2]	*Smilicina racemose or Aralia nudicaulis*	-	-	-	200	
wild strawberry[2]	*Fragaria virginiana*	-	-	-	-	
Total trees		**1,400**	**1,600**	**1,600**	**1,200**	**-**
Total shrubs		**1,400**	**1,200**	**1,400**	**1,400**	**2,250**
Total dwarf shrubs and herbs		**500**	**500**	**400**	**400**	**750**
Total plants		**3,300**	**3,300**	**3,400**	**3,000**	**3,000**

Table 14: Tree, Shrub and Forb Planting Mix for Permanently Reclaimed Mine Features in SBSwk2 at Perry Creek Pit

Species		Planting Density (stems/ha)				
Common Name	**Scientific Name**	**Xeric—Subxeric (Dry) Sites (02)**	**Submesic Sites (03)**	**Mesic Sites (01)**	**Moist to Wet Sites (04/06)**	**Shrub Patches**
NOTES: [1] Plant species identified by the Halfway River First Nations and McLeod Lake Indian Band are included in this list. [2] Herbaceous plant [3] Dwarf shrub [4] Use thimbleberry on moist sites and black twinberry on wet sites [5] Plant balsam poplar on moist riparian sites in place of subalpine fir (reduce spruce density) [6]Alder on moist sites; substitute with willow on wet sites [7] Plant red-osier dogwood at toe of slopes when used on dump slopes						

A native seed mix (Table 15) has replaced all agronomic seed applications for both erosion control and reclamation at the Wolverine Mine. An annual species (for example, annual ryegrass) can be added to the mix for immediate germination success for erosion control. The typical seed application rate is 55 kilogram per hectare (kg/ha), however in areas with harsh site conditions, such as wind-swept slopes, dry sites or for erosion control, the rate may be increased by 10 to 15 kg/ha. A fertilizer formula of 11N:48P:3K can be applied at up to 200 kg/ha at time of seeding, as required by site conditions. Additional remedial fertilizer applications are applied where appropriate as determined by site and vegetation assessments. If seeding by hand is not appropriate or effective in an area, other remedial activity is employed (e.g. hydroseed, mulching, other).

Table 15: Perry Creek Pit Area Seed Mix

Species Name		Proportions	
Scientific Name	**Common Name**	**% by wt.**	**% by seed count**
Elymus glaucus	Smooth wild rye	15	11.2
Elymus canadensis	Canada wild rye	20	12.8
Elymus trachycaulus	Slender wheatgrass	19	16.8
Elymus sp. (lanceolatus)	Northern wheatgrass	13	11.5
Deschampsia caespitosa	Tufted hairgrass	2	16.6
Agrostis scabra	Tickle grass	0.5	13.9
Calamagrostis canadensis	Canada bluejoint	0.5	10.6
Annual Species			
Lolium multiflorum	Annual ryegrass	7	4.3
Secale cereale	Fall rye	23	2.3
Totals		**100**	**100**

NOTES:
Short-lived non-native annual species are used to create a temporary vegetation cover to control erosion and invasive species while perennial species establish.
Species and/or proportions may be substituted or altered depending on seed availability.

*Subject to change due to availability

Some live staking activity was started on the topsoil piles near the clean coal stockpile on a trial basis in 2010 in an attempt to develop a live windbreak in the area to prevent aeolian erosion in the area. This trial was deemed successful, and in fall of 2011 additional live stakes were placed in strategic areas on topsoil piles around site. This technique was utilized to prevent erosion on the 920 m elevation on the East Dump after topsoil placement. In 2019, Aski installed approximately 500 live willow stakes on a portion of the North Dump in and around vegetation islands. Live willow stakes were used to indicate various features throughout the slope to guide planting efforts including elevations and island placement. Conuma will continue to be utilize live staking when appropriate, as the results of the work completed to date have been promising.

Some areas along the East Dump were affected by the heavy rainstorms in 2016 and 2017 and resulted in eroded channels through the topsoil. Plant growth was apparent with little dieback. The North Dump areas are adjacent to the Perry Creek Road succumbed to a Scentless Chamomile infestation due to vehicle traffic along the road from both tourism and industry. A hand pulling regimen occurred in 2019 as described in Section 3.12. An inspection of its effectiveness was completed in 2019 and findings show a more expansive mechanical management program may be necessary. Conuma plans to continue monitoring and management throughout 2020.

1.27 *Growth Medium*

During reclamation, managing runoff and controlling sediment release will be primary objectives of soil management as outlined in the updated Erosion and Sediment Control Management Plan. These objectives will be achieved through prompt revegetation of exposed soils, in conjunction with appropriate water management and sediment control measures. Soil salvage, storage and replacement will be implemented according to the soil SOP outlined in the Soil Management Plan for the Wolverine Mine and using the site-specific practices described within this plan. The soil management strategy is guided by the surficial materials and overburden present within the HDA and Wolverine Mine components. Existing conditions for soil quality and quantity and reclamation suitability are summarized in the Wolverine-Hermann Amendment Project Application.

The soil handling and replacement approach is based on a number of factors including the amount of material available for salvage, the type of substrate that has to be covered, and target ecosystems to be established to meet land use objectives (e.g., rooting depths; soil moisture). Soil replacement depths were selected to support the primary end land use objectives of wildlife habitat, and on probable post-closure ecosystem unit development based on land capability. Soil replacement depths and soil stockpile allocations may vary.

Site preparation and soil replacement treatments during the reclamation of the Perry Creek Pit and HDA mine components are outlined in the Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan (2020-2024). Based on the total area requiring soil replacement (approximately 627 ha), approximately 3.00 Mm^3 of soil will be required for reclamation. Capping depths range from 0.4 to 0.5 meters on prepared surfaces and are detailed in the Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan (2020-2024).

To meet capping requirements both soil and salvaged, suitable overburden will be used once available surface soil on site has become depleted. Soil replacement depths and soil stockpile allocations may be required to vary.

1.28 *Landform*

The overall approach to closure landform design is to promote flatter, geotechnically stable landforms, limit water quality issues by reducing contact water and erosion potential and restore the overall landform to that typical of the ESSFmv2.

To aid in creating stable landforms in closure that limit the creation of elevated plateaus (waste rock dumps) and depressions (pit) that extend too far beyond the natural landscape, pits will be filled with waste materials as included in the mine plan. The outcome of these activities is a more level and stable landform, reducing vertical relief over the entire site.

Throughout operations, the slopes on unconsolidated materials (i.e., waste dumps, soil stockpiles, overburden sections of pit wall) will be maintained at the angle of repose (37°) to maintain stability. At closure, these same structures will be regraded to 2H:1V slopes (26.6°), capped with topsoil and revegetated.

Landforms will be constructed and maintained to limit erosion potential along sloped areas. Final landforms will be re-contoured with implementation of sediment control structures (e.g., silt fences, brush barriers, coarse rock and/or woody debris) on sloped surfaces to help reduce erosion. Final landforms will be revegetated with either the tree, shrub and orb mixture or native grass seed mix described in Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan (2020-2024). The Erosion and Sediment Control Plan and Water Management Plan will be implemented throughout the closure and reclamation phase of the HDA.

Prior to final revegetation treatments being carried out, site decommissioning and site preparation treatments will be implemented on reclamation-ready areas in order to support revegetation success long-term stability of

reclamation areas to prevent erosion and water management. Treatments will include, as applicable, the following:

- Removal of infrastructure and removal of debris
- Deactivation of haul roads and access roads
- Landform grading (re-contouring) – landforms will be re-sloped and re-shaped to a variety of terrain features and slopes, to appear similar to and blend into adjacent natural landforms. The resulting variable terrain provides diversity of topographic conditions for vegetation establishment and wildlife habitat and control of soil surface erosion
- Regrading of waste rock dump slopes to minimum 2H:1V slope angles. Dumps will be contoured at their interfaces with undisturbed land to enable movement and dispersal of animals and plants and to blend in with the surrounding topography
- Creation of undulating topography on dump platforms
- Creating rough and loose or low mounded surfaces on capped waste dump slopes
- Grading of waste rock to be rough and loose to maximize the bonding of soil to these materials
- Ripping of compacted waste rock sites such as platforms and haul roads to provide additional growth (rooting) media at depth and to improve soil adhesion
- Capping of prepared areas with stockpiled soils to specified depths
- Spreading of stockpiled coarse woody debris on soil capped areas if sufficient volumes are available
- Building rock/boulder piles on exposed, windswept spoil platform areas to provide small animal habitat and wind and snow protection for vegetation
- Establishment of post-mine watercourses

As of December 31, 2019, approximately 94.4 ha of waste rock dumps have been re-sloped at the Wolverine Mine.

1.29 *Pit Structures and Equipment*

The Mine is not at the point of demolishing structures or equipment for closure. Demolition will be carried out according to the Mine Permit and other related regulations and plans, once the mine enters its Closure stage.

1.30 *Waste Dump Reclamation*

Once a dump has reached design or is determined to be no longer active, reclamation plans will be enacted. Approximately 10.3 hectares of revegetation occurred in 2019, with 8.48 hectares of CCR Pile reslope (Appendix L).

1.31 *Watercourse Reclamation*

Watercourse reclamation will be conducted at mine closure and will focus on the deactivation of sediment control structures and non-essential diversion channels and the revegetation and erosion stabilization of these structures. Where possible, drainages will be re-established into original creek channels. At mine closure some diversion channels will remain in place and provisions will be made for the long-term maintenance on these structures. No reclamation of watercourses occurred in 2019. However, a small collection of seeps runs seasonally along the base of the reclaimed north dump. This area received vegetation tailored to site specific conditions in an effort to increase the diversity of the area and prevent topsoil erosion and downstream deposition.

1.32 *Open Pit Reclamation*

Any pit structures and in-pit dumps will be reclaimed in a manner similar to that defined for the East, South, and North Dumps. The in-pit waste dumps will be resloped at 2H:1V and capped with 50 cm of soil. High walls will be

exempt of reclamation but will serve as habitat to mountain goats and several species of birds. No reclamation of open pit areas occurred in 2019.

1.33 *Tailings Storage Facility and CCR Pile Reclamation*

Following mine closure, the Tailings Storage Facility (TSF) will be allowed to dry out and will not contain a pond. At closure a spillway will be constructed in the TSF dam to assist in dewatering the structure. Drainage ditches will be maintained to divert uphill slope drainage around the containment structure. A spillway and channel will be constructed using competent rock on the north side of the berm to provide post-closure drainage. After mine closure when the tailings have been sufficiently dewatered, the tailings surface and un-capped portions of the dam will be capped with a minimum of 40 cm of competent rock material; alternatively, the non-channel and spillway may be capped with 30 cm of overburden. The berm of the TSF has been constructed at 2H:1V and has undergone soil capping (30 cm surface soil) and planting of shallow rooted vegetation in 2013. Contingency planning provides for use of a cover on portions of the dam if needed for control of ML/ARD.

The CCR Pile is located south of the Plant site on the lower slopes of the valley and toes out onto the valley floor. The pile is founded mainly on the valley slope and terrace soils, with a portion of the toe of the slope located on the valley floor at the projected perimeter of the deep lacustrine clay zone. The design included placement of coarse breaker reject and Wolverine road crush at the base of the pile to aid basal drainage. The design for the CCR Pile was submitted in January 2018 to the Ministry of Energy and Mines and approved in February 2018. The design incorporated higher than expected pore water pressures in the structure's foundations soils.

The CCR Pile was to have a blanket drain constructed and to be resloped by the end of December 2019 as per Amendment #17 of C-223. Due to the design, the blanket drain construction and reslope of 8.48 hectares took longer than anticipated and was completed in January 2020 but reported within the 2019 Annual Reclamation Report. The As-built report is included in Appendix L.

At mine closure the CCR Diversion Ditch will be maintained to divert uphill slope drainage around the CCR Pile area. The CCR placed in the CCR Pile after 2019 will be constructed at 2H:1V to 3.2H:1V slope and therefore will not require recontouring prior to placement of surface soil material. The entire CCR Pile will be capped with a 30 cm of surface soil material and revegetated as recommended in the conceptual final reclamation plan.

1.34 *Road Reclamation*

At mine closure, roads which are associated with major structures will be reclaimed as part of the structure. For example, roads located within waste dumps will be reclaimed as part of the dump; roads associated with the plant office complex will be reclaimed as part of that structure. It is planned that these roads will be capped with overburden material as part of the reclamation procedure for the major structures.

Roads not associated with the major structures such as haul roads between the pit and dumps, general access roads, exploration roads and road to the explosives site will be treated with similar reclamation treatments. If the road is no longer needed after closure the road surface will be ripped to decompact the surface, culverts and bridges will be removed, and creek drainage crossings will be re-established to their original channel. Roads built on side hills will undergo pullback of the sidecast material and will be capped with overburden material, if needed, and revegetated for erosion stabilization.

If any road access is necessary within the mining areas after closure, these roads will be left in semi-permanent deactivated condition. Semi-permanent deactivation will allow the road to remain in place and useable but also environmentally stable. Semi-permanent deactivation measures which will be carried out include removal of culverts and replacing them with cross-ditches; installation of ditch blocks at cross ditch locations; installation of waterbars

across the road to direct road surface water off the road; removal or breaching of windrows along the road edge; outsloping/insloping of the road surface as appropriate and revegetation of exposed soil surfaces for erosion control.

No reclamation of access or mine haul roads occurred in 2019.

1.35 *Infrastructure Decommissioning/ Reclamation*

No decommissioning of infrastructure occurred in 2019. The Wolverine Mine is expected to maintain buildings throughout the life span of mining Phase 5. The regulatory approval of the Hermann project would further extend the need for maintaining some of the mine infrastructure.

1.36 *Securing Openings*

All road access to the active mining areas of the Wolverine Mine are controlled using locked gates and signs. Mine site access is controlled through the Wolverine Loss Prevention Office, located at the main gate at 17.3 km on the Wolverine FSR. Wolverine personnel patrol all access points, verifying that gated areas are locked, and barriers are intact. Loss Prevention Officers also control access to the Terry Ranch area. In 2019 one access gate was replaced due to disrepair at the entrance to SP12.

1.37 *Disposal of Hazardous Materials, Chemicals and Reagents*

The Mine decommissioned a temporary storage hazardous waste facility (BCG00754) in 2017. A short-term waste transfer station for hazardous waste materials contains numerous storage bins or containers for the different types of hazardous waste. A disposal company picks up waste at regular intervals.

This area incorporates the following components to facilitate proper handling of most site-generated waste:

- Hazardous waste and recyclables storage and segregation
- Waste transfer area for batteries, refuse and other waste
- Several steel and plastic disposal bins for proper waste segregation

Inspections ensure proper handling, labeling and storage of hazardous waste and that excess volumes do not accumulate. Used or expired chemicals and reagents are returned to the vendor/manufacturer where possible. All other hazardous wastes are transported and disposed of in compliance with applicable statutes at a certified facility. Further detailed information is located in EMP-7.3-MGT Waste Management Plan. Conuma no longer maintains a hazardous waste yard.

1.38 *Reclamation Research Program*

As per the Phase 5 permit amendment approval, Conuma in 2019 further developed the reclamation research program. Ongoing and new research includes ML/ARD management, revegetation including metal uptake, native plant trials and lichen transplant trials. There are also studies related to understanding selenium inputs into Wolverine River wetlands.

Ongoing research has been focused on predictive studies for ML/ARD leachate barrels. Research includes the collection of ML/ARD barrel leachate samples. Details are included in Section 3.2.

Beginning in 2012, research has been conducted on metal uptake in plants whereby samples were taken for a baseline of metal uptake in vegetative species from the Wolverine River and were sampled periodically in following years. This study was conducted by Walter Energy in conjunction with Spectrum Resources.; however, due to network issues, Conuma is unable to locate reports from these studies and is unable to summarize results.

To address metal uptake in vegetation and survival rate of revegetated areas moving forward, Conuma developed a heavy metals uptake program in 2019, attached in Appendix I. Eleven monitoring plots were installed on 2019 reclamation areas. No data was collected due to the season and plant life stage. Data will be monitored in spring 2020, and the implementation of monitoring sites on previous reclamation and background sites will be established.

Stock allocation until and including 2012 included either plugs or live stakes of twelve species, eight of which were previously unused in reclamation activities within the region. A greater diversity was utilized in 2013 and 2014. A survey of each planted species and its survival rate will determine the success of the planted species within the area. From this review Conuma can determine whether the species will continue to be feasible in future reclamation. Conuma will endeavor to partake in a species survey to determine dieback on the East Dump from the 2013 planting.

Beginning in 2019, Conuma began implementing research into establishing (transplanting) terrestrial and arboreal lichen from nearby donor sites on recently reclaimed receiving sites through a study conducted by the Applied Conservation Ecology Lab, University of Alberta (University of Alberta. 2019, Appendix K). The 2019 program included the salvage and drying of terrestrial lichen mats and arboreal lichen. The 2020 program includes exploring application techniques for use in reclamation. Further activities will be included in 2020 Annual Reclamation Reports.

An investigation will be conducted to better understand the impact of the North and East Dumps on the receiving environment via groundwater pathways. A detailed summary report of the investigation results and mitigation measures will be submitted to the BC EMPR by March 31, 2021.

Conuma also intends to conduct soil capping depth cover research is to determine the effects of soil capping depth on vegetation growth and end land use objectives. The success of the revegetation treatments is dependent on nutrient pools, organic carbon content and the ability of the plants to gather enough of those components through their root systems. Rooting depth will vary with species as well as site conditions. The soil capping depths will vary both in depth and location on the mine site to capture effects of elevation (BEC unit), and site-specific conditions such as aspect. The measurable indicator of success will be plant productivity as indicated by growth and vigour.

Reclamation research conducted by Stantec Consulting Limited (Stantec) and Dr. Wallschläger from Trent University was completed under a 2018-2019 Natural Sciences and Engineering Research Council (NSERC) Engage Grant and Stantec research funds. Stantec is listed as the industrial partner in this Engage Grant Proposal working at Conuma Coal Brule and Wolverine Mine Properties along with Dr. Dirk Wallschläger and his team from Trent University. The full details of the research findings specific to Wolverine Mine is listed in Appendix K. A summary of the purpose and key findings is as follows

- The research allows further understanding of how selenium in natural wetland systems is volatized into the atmosphere as part of understanding the mass balance of selenium.
- In 2019, Stantec Trent University and the Conuma Environment team tested selenium volatilization analytical methods in the natural wetlands adjacent to the Wolverine River that receive water from the mine.
- Selenium volatilization can be measured. Two methods were tested and proved that selenium volatilization could be measured and used to support the mass balance of selenium in a natural wetland.

1.39 *Five Year Reclamation Plan*

Perry Creek Pit development and surface disturbances are anticipated to occur from Year 1 (2020) to Year 2 (2021), and reclamation activities (e.g., resloping, capping and revegetation) are assumed to continue through the Plan period (2024). The largest development areas and surface disturbances will be in the waste dump slopes and platforms and the pit areas. Total disturbed area will slowly decrease over five years resulting from completed

reclamation. At the end of 2024, all major waste dumps, except the In-Pit Dump, and the ex-pit CCR Pile stockpile are assumed to be sloped, capped and revegetated.

The Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan was updated by Conuma Coal Resources Ltd. (Conuma) for the Ministry of Energy, Mines and Petroleum Resources (MEMPR) per the Terms and Conditions of the May 17, 2019 C-223 permit amendment and submitted February 21, 2020. The Environmental and Reclamation Programs will be continued in 2020 to 2024 per the Terms and Conditions of C-223. Details on the next five years of reclamation are included in the Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan (February 2020). Although the Hermann Disturbance Area has not yet received regulatory approval it represents the most current reclamation plan that incorporates the approved Perry Creek Pit Phase 5 expansion.

Reclamation Liability Cost Estimates

A reclamation liability cost estimate (RLCE) for future reclamation costs for the was part of the Wolverine-Hermann Amendment Project Application which included 2019 reclamation costs that were current to June 2019 (Stantec 2019) . An updated RLCE was submitted to the BC MEMPR in a separate confidential document on January 31, 2020 (Stantec 2020) which supersedes the Wolverine-Hermann Amendment Project Application Wolverine Mine RCLE submission. The updated RCLE (January 2020) included the updated mine disturbance current to December 31,2019. The total liability cost estimate for 2019 is [redacted]

The RLCE was prepared in accordance with the British Columbia Ministry of Energy and Mines and Petroleum Resources (BC MEMPR) requirements under *Mines Act* Permit C-223 (Section E, Subsection 1) (BC MEMPR 2017b) for liability costing to maintain a reclamation security. The costs also reflect requirements for proposed water quality mitigations as detailed in Permit C-223 (Section C, subsection 5) (BC MEMPR 2017b). The RLCE describes the total costs of remaining reclamation obligations if the mine ceases operations at the end of any year, during the plan period from 2020 to 2025 for Perry Creek Pit. Liability estimates also include provision for the implementation of water quality protection measures.

Detailed costs were prepared by a qualified third-party reclamation professional as required by the MEMPR guidelines. The RLCE was guided by the MEMPR Mine Reclamation Costing and Spreadsheet Guidebook (MEMPR 1994) and the Joint Application Information Requirements for Mines Act and Environmental Management Act Permits (MOE, MEMPR 2016) in estimating reclamation liability costs.

Reclamation cost projections are based on the reclamation prescriptions detailed in the standalone report and include the following:

- Site preparation (resloping, recontouring, mounding, ripping, road deactivation, scarification/disc trenching, soil/overburden replacement, wood debris spreading)
- Revegetation (native grass seed application, native tree, shrub, and forb seedlings planting)
- Maintenance of reclamation vegetation
- Removal of culverts and decommissioning of wells
- Decommissioning of mine infrastructure
- Contaminated soil/materials remediation
- Long-term post-closure monitoring and maintenance programs
- Mobilization and demobilization
- Contingencies

Definitions and Acronyms

ABA	acid base accounting
AMP	Archaeological Management Plan
BC	British Columbia
BCM	bank cubic metres
BCWQG	British Columbia Water Quality Guidelines
BMP	Best Management Practices
EEM	Environmental Effects Monitoring
EMS	Environmental Management System
ENV	BC Ministry of Environment
FSR	Forest Service Road
ha	hectare
km	kilometre
LOM	Life of Mine
masl	metres above sea level
MCRIP	Mountain Caribou Recovery Implementation Plan
MEMPR	Ministry of Energy and Mines and Petroleum Resource
ML/ARD	Metal Leaching/Acid Rock Drainage
Mt	million tonnes
Mtcc	Million tonnes of clean coal
NEIPC	North East Invasive Plant Council
OMS	Operation, Management and Surveillance
PCRCD	Perry Creek Road Collector Ditch
QA/QC	Quality Assurance/Quality Control
RPD	relative percent difference
RWQM	Regional Water Quality Model
SOP	Standard Operating Procedure
SRK	SRK Consulting Inc.
Se	selenium
TSF	Tailings Storage Facility
Walter	Walter Energy Canada

WMP	Wildlife Management Plan

References

Balistrieri, L. and Chao, T. (1990). Adsorption of selenium by amorphous iron oxyhydroxide and manganese dioxide. *Geochimica et Cosmochimica Acta*, 54(3), pp.739-751.

British Columbia Ministry of Energy and Mines and Petroleum Resources (EMPR). January 2019. Mines Act Permit Annual Reclamation Report Format Requirements Addendum Shapefile Data Submission Standards3.0. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/reclamation-and-closure/annual-reclamation-reports-supporting-files/2018_12_05_arr_shapefile_data_standards.pdf

British Columbia Ministry of Energy and Mines and Petroleum Resources (EMPR). January 2019. Ministry of Energy and Mine's Excel Costing Spreadsheet (Version 3.5.1). https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/permitting/reclamation-closure/annual-reclamation-reports

British Columbia Ministry of Energy and Mines and Petroleum Resources (EMPR). (2017). *Health, Safety and Reclamation Code.* EMPR. https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia

Conuma Coal Resources Ltd (Conuma). 2020. Wolverine-Hermann Phase 5 Five Year Mine and Reclamation Plan

Conuma Coal Resources Ltd. (Conuma). 2019 and resubmission in 2020. Wolverine-Hermann Amendment Project Mines Act Permit Amendment Application

Government of British Columbia. (n.d.). *Water Quality Guidelines Reports.* Retrieved 3 19, 2013, from Environment Protection Division: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

Lenz, M. and Lens, P. (2009). The essential toxin: The changing perception of selenium in environmental sciences. *Science of The Total Environment*, 407(12), pp.3620-3633.

Lorax Environmental. (2013, January 4). Technical Memorandum: Wolverine Mine Water Quality Update- Observations versus Predictions. Vancouver, BC, Canada.

Ministry of Environment. (2001, August 7). *Water Quality- Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthic Sediments*. Retrieved February 22, 2013, from Environmental Protection Divistion: http://www.env.gov.bc.ca/wat/wq/BCguidelines/turbidity/turbidity.html

Ministry of Environment., S. H. (1988). *Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthis Sediments.* British Columbia: Environmental Protection Division, Ministry of Environment.

Nagpal, P. S. (2006, August). A Compendium of Working Water Quality Guidelines for British Columbia. British Columbia.

Ralston, N. U., Unrine, J., Wallschlager, D. (2008). *Biogeochemistry and Analysis of Selenium and its Species.* Washington DC: North American Metals Council.

Stantec Consulting Ltd. (2019) Wolverine-Hermann Amendment Project Mines Act Permit Amendment Application. Reclamation Liability Cost Estimate Report For Wolverine Mine

Stantec Consulting Ltd. (2020) . Wolverine-Hermann Phase 5 Five Year Mine And Reclamation Plan Reclamation Liability Cost Estimate Report For Wolverine Mine

Walter Energy. (2012). *Five Year Plan 2013-2018 - Wolverine Mine.* Tumbler Ridge.

Water Air and Climate Change Branch - Ministry of Water, Land and Air Protection - Province of British Columbia. (2003). British Columbia Field Sampling Manual. Water, Air and Climate Change Branch Ministry of Water, Land and Air Protection Province of British Columbi.