

Chapter 3 – Project Description

Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate /
Environmental Impact Statement

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3. Project Description

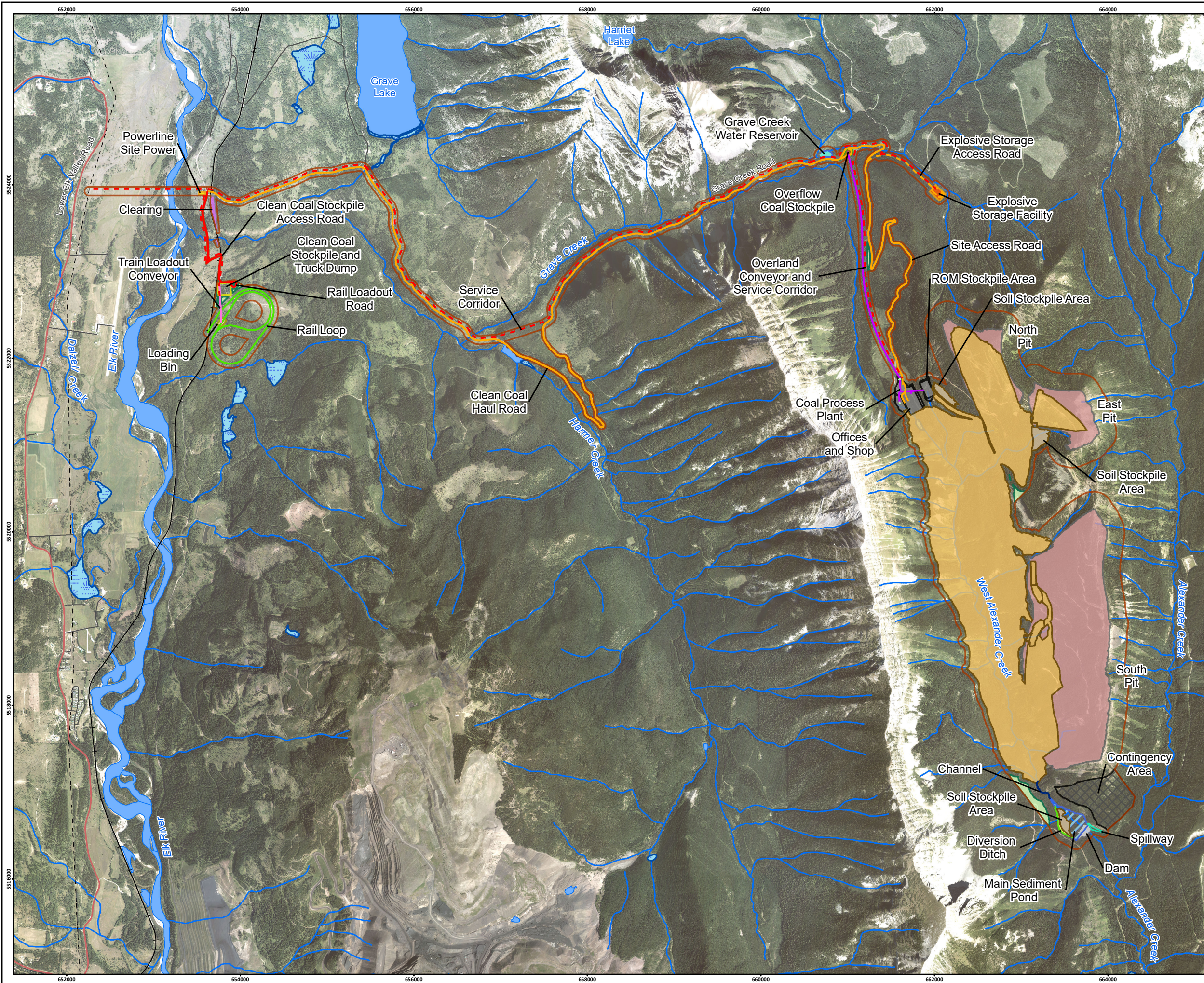
3.1 Introduction

The Project Description describes the various components of the Crown Mountain Coking Coal Project (the Project). The information presented in this chapter provides summary information on the geologic and engineering design work completed. While the focus of this chapter is on Project components, Chapters 6 to 19 describe features of the natural and human environment, land status and use, archaeological resources, and how the Project may interact with these elements. As an example, atmospheric emissions are assessed in Chapter 6. Throughout this Application for an Environmental Assessment Certificate/Environmental Impact Statement (Application/EIS), the potential benefits this Project may have to the pillars of assessment for Environment, Economy, Social, Health, and Heritage are documented. Specifically, within this chapter, the economic benefits are detailed in Section 3.10 and further detailed in Chapter 17. Benefits to the environment may be found in Chapters 6 through 15. Heritage, social, and health benefits may be found in Chapters 16, 18, and 22, respectively.

The Project is a proposed open pit metallurgical coal project with the capacity to mine and process up to 4.0 million tonnes per year of run of mine (ROM) coal. The Project would produce on average approximately 1.8 million tonnes of coal per year over an operating mine life of 15 years. The anticipated product mix is 86% high quality low volatile hard coking coal and 14% low volatile pulverized coal for injection (PCI). Figure 3.1-1 shows the general site layout, including the proposed three primary mine pits (i.e., North Pit, South Pit, and East Pit) and other key Project components.

The target market for both the metallurgical coal and PCI coal from the Project is steelmakers in the Asia-Pacific region. A combined ROM surface mineable reserves for the Project have been estimated at 57.5 million tonnes (combined proven and probable reserves). The total clean coal tonnes for the Project have been estimated at 26.3 million tonnes, with an average yield of 48.7% over the mine life.

The coal measures of interest at the Project are contained in the Jurassic-Cretaceous Kootenay Group, which includes, from uppermost to lowermost or youngest to oldest, the Elk Formation, the Mist Mountain Formation, and the Morrissey Formation. The major coal bearing formation in the Kootenay Group is the Mist Mountain Formation. The Kootenay Group conformably overlies the Fernie Formation.

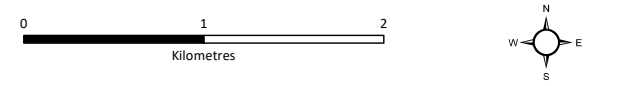


Crown Mountain Coking Coal Project

Figure 3.1-1
General Site Layout

LEGEND

Project Footprint	Water Reservoir
Channel to Ultimate Pond	Main Sediment Pond
Clean Coal Haul Road\Site Access	Dam
Explosive Storage Access\Facility Road	Spillway
Rail Loadout Road	Diversion Ditch
Rail Loop	Clearing
Service Corridor	Additional Area
Coal Process Plant Conveyor	Contingency Area
Coal Process Plant Duct	Arterial/Collector Road
Train Loadout Conveyor	Local/Resource Road
Waste Dump	Railway
Mined Area	Transmission Line
Clean Coal Stockpile and Truck Dump	Watercourse
Overflow Coal Stockpile	Waterbody
Soil Stockpile Area	Wetland
Explosive Storage Facility\Pad	British Columbia/Alberta Border
Loading Bin	
Plant Site\ROM Stockpile Area	
Powerline-Site Power	



Scale 1:42,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia
GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.
Imagery Provided By GeoBC Orthoimagery (Aug 2016).

Map Created By: PAR
Map Checked By: HEB/JR
Map Coordinate System: NAD 1983 UTM Zone 11N



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The coal quality aspects of the Project were reviewed using public data from the 2018 exploration program as well as from regional quality studies and data from adjacent coal mines. The coal is consistent with coal produced by Teck Coal’s adjacent operations. Coal quality studies have concluded that the Crown Mountain coking coals are high rank, low volatile metallurgical coals, with exceptional ash chemistry and petrographic characteristics.

Chapter 2 details the major alternatives considered for the Project. Through the alternatives assessment and development process and other progressive design efforts, NWP has improved Project components to enhance benefit to the environment, Indigenous communities, and the public since the original Project Description was proposed in 2014. Additional details are provided in Appendix 3-A and Chapters 23 to 31.

3.2 Mineral Tenure and Exploration History

3.2.1 Mineral Titles

The Project consists of ten contiguous coal licences which are held by NWP and which cover a combined area of 5,630 hectares (ha). Table 3.2-1 shows a reproduction of the government records concerning these titles.

Table 3.2-1: Coal Licence Tenure Data

Title Number	Owner	Title Type	Title Sub Type	Map Number	Issue Date	Good To Date	Status	Area (ha)
418150	147488 (100%)	Coal	License	082G087	2012/MAY/02	2020/DEC/20	GOOD	334
418151	147488 (100%)	Coal	License	082G077	2012/MAY/02	2020/DEC/20	GOOD	1,001
418152	147488 (100%)	Coal	License	082G087	2012/MAY/02	2020/DEC/20	GOOD	167
418153	147488 (100%)	Coal	License	082G087	2012/MAY/02	2020/DEC/20	GOOD	251
418154	147488 (100%)	Coal	License	082G087	2012/MAY/02	2020/DEC/20	GOOD	835
418966	147488 (100%)	Coal	License	082G087	2016/DEC/12	2020/DEC/20	GOOD	974
419272	147488 (100%)	Coal	License	082G087	2018/DEC/20	2020/DEC/20	GOOD	779
419273	147488 (100%)	Coal	License	082G087	2018/DEC/20	2020/DEC/20	GOOD	705
419274	147488 (100%)	Coal	License	082G077	2018/DEC/20	2020/DEC/20	GOOD	334
419275	147488 (100%)	Coal	License	082G086	2018/DEC/20	2020/DEC/20	GOOD	250
Total								5,630

3.2.2 Exploration History

The history of exploration and development of this coal property extends back to coal development activities in southern Alberta and southeastern British Columbia (B.C.) in the late nineteenth century. In 1897, the Crow's Nest Pass Coal Company was established to develop the coal resources on the British Columbian side of the Crowsnest Pass. Several subsidiaries were created to operate ancillary activities; they included the Morrissey, Fernie, and Michel Railways, and the Crow's Nest Pass Electric Light and Power Company. Various mines were opened at Coal Creek, Natal, Michel, and Morrissey. After the Second World War, demand for coal dropped and the company diversified through a subsidiary, Crow's Nest Pass Oil and Gas Company. As the 1950s and 1960s progressed, the mines were closed, and the company moved into forest products.

In 1965, the name of the company was changed from Crow's Nest Pass Coal Company to Crows Nest Industries Limited (Crows Nest Industries). In 1968, the company's coal resources were sold to Kaiser Steel (Kaiser) and the assets of Crow's Nest Pass Electric Light and Power Company were sold to BC Hydro. However, there are existing historic references to coal drilling exploration in the Crown Mountain area being completed in 1969 by Crows Nest Industries, and data from that exploration program have been used to support current analyses.

In 1976, increased demand for coal resulted in Crows Nest Industries re-acquiring some coal lands from Kaiser. In 1977, Shell Canada Limited (Shell) purchased the company and renamed it Crows Nest Resources Limited (Crows Nest Resources). In 1991, Shell sold that company, and ownership and responsibility for at least some of its coal assets were transferred with the sale.

Crows Nest Resources explored the property for three field seasons from 1979 through 1981. In 1979, the property was mapped and drilled; the drilling included both core and cuttings sampling of different holes. The 1980 program was relatively minor and included only geological mapping. The 1981 program consisted of additional mapping, hand-trenching of seam exposures, and the construction of a mechanically excavated pit and the collection of a bulk sample. These activities appear to be the last exploration work performed on the property during the Crows Nest Resources/Shell tenure. Eventually, the property was relinquished and later acquired by Morris Geological.

NWP conducted three separate drilling programs on the property. In 2012, the 5,707 metre (m), 45-hole drilling program focused primarily on the North Block and South Block of the property with 617 m drilled in the South Extension area. Both coring and reverse circulation methods were used during this drilling program, but sample recovery was poor, and the laboratory results were of limited value. All holes were geophysically logged through the reverse circulation pipe, and all drill holes were logged open-hole where possible. In 2013, NWP drilled an additional 1,653 m in the North Block and South Block areas of the property, which consisted of seven 150 millimetre (mm) large diameter core holes and six 95 mm reverse circulation drill holes. In 2018, NWP conducted a 4,711 m drilling program that focused on collecting coal quality and geotechnical information.

3.2.3 Exploration Drilling Programs

Between 1969 and 2018, five coal exploration drilling programs were conducted at the Project site. A total of 104 drill holes were completed with total meterage of 14,625 m.

The five coal exploration drilling programs and the year the programs were completed are as follows:

- Crows Nest Industries Limited in 1969;
- Crowsnest Resources Limited in 1979;
- NWP Coal Canada Ltd in 2012;
- NWP Coal Canada Ltd in 2013; and
- NWP Coal Canada Ltd in 2018.

In addition to the extensive exploration drilling activities, NWP drilled seven holes with a cumulative total drilled meterage of 1,101 m to support geotechnical investigations and project design. These geotechnical drill holes were cased and then cored from the casing to the basal sandstone unit, using 75 mm (3-inch) coring equipment. These geotechnical drill holes were terminated in the basal sandstone. All holes drilled during the 2018 drilling program were geophysically logged through the drill pipe, as well as geophysically logged open hole, wherever the hole conditions permitted.

3.3 Geology

The development of the geology model and definition of the resource model has included information from recent drilling and testing programs as well as reference to work carried out by previous owners. Geology is described in the following sub-sections, with a summary table of geologic formation descriptions (Figure 3.3-1), regional geology map (Figure 3.3-2), regional geology vertical stratigraphy profile (Figure 3.3-3), Project geology map (Figure 3.3-4), and geologic cross-sections (Figure 3.3-5 to Figure 3.3-8).

3.3.1 Regional Stratigraphy

The formations within the Jurassic-Cretaceous Kootenay Group include, from uppermost to lowermost or youngest to oldest, the Elk Formation, the Mist Mountain Formation, and the Morrissey Formation (Grieve and Ollerenshaw, 1989). The major coal bearing formation in the Kootenay Group is the Mist Mountain Formation. The Kootenay Group conformably overlies the Fernie Formation.

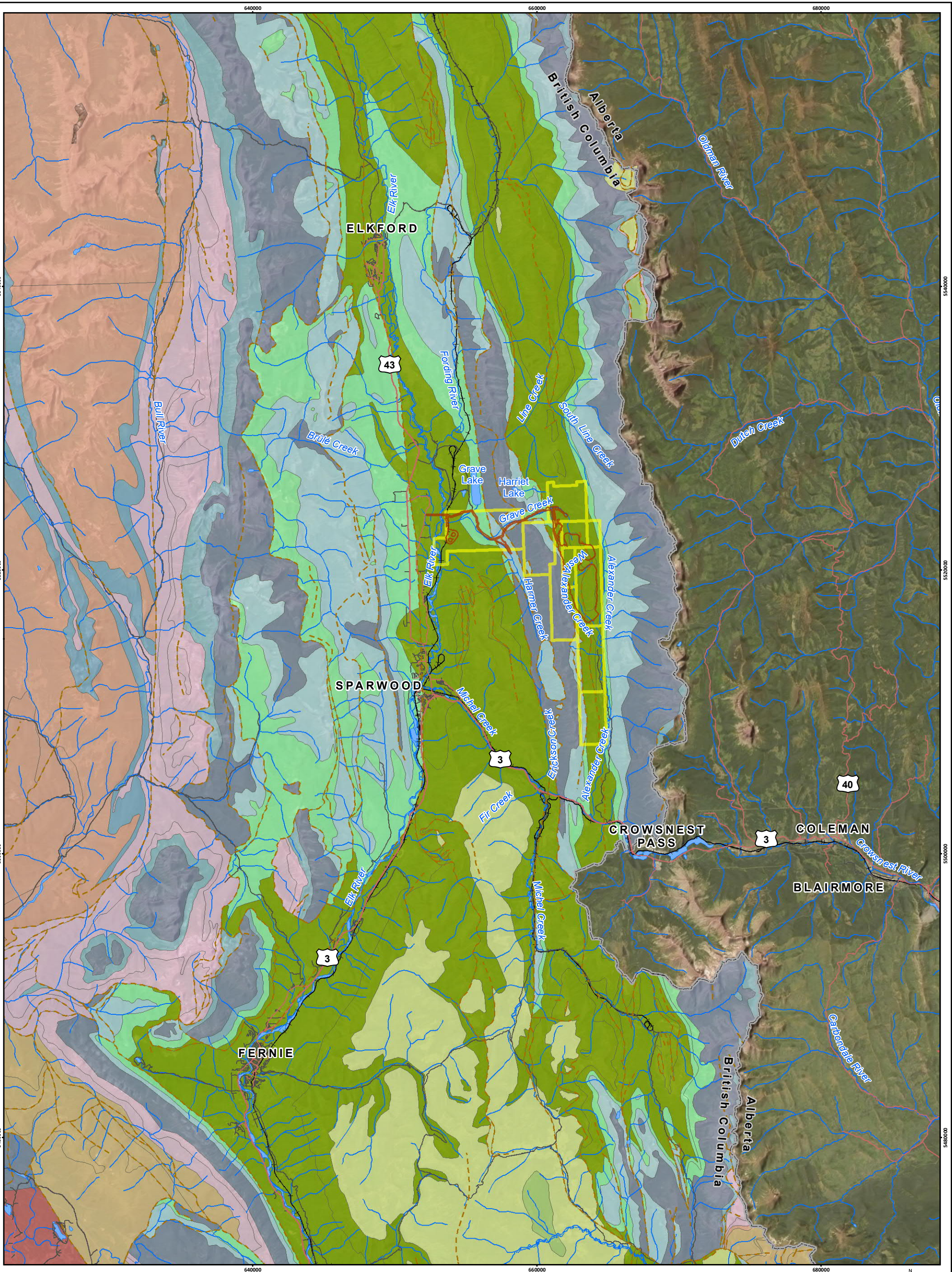
3.3.1.1 Fernie Formation

Grieve and Kilby (1989) state that:

The marine Fernie Formation, of Jurassic age, is the oldest stratigraphic unit in the block. It is primarily a recessive unit, in contrast to the overlying Kootenay Group. Its base is marked by a thin band of phosphorite and phosphatic shale, which gives way to dark gray shale, overlain by the Rock Creek Member, which is composed of brownish silty shale with thin black limestone beds. The overlying Grey Beds consist of medium brownish grey shale with interbeds of calcareous sandstone and impure limestone (Price, 1962, as cited in Stantec, 2020). A glauconitic sandstone or shale unit (Green Beds) immediately underlies the uppermost unit, the Passage Beds, which is a coarsening-upward sequence of interbedded shale and sandstone transitional to the Morrissey Formation of the overlying Kootenay Group (Grieve and Kilby, 1989).

PERIOD	GROUP	FORMATION MEMBER	ROCK TYPES
Lower Cretaceous	BLAIRMORE GROUP	Upper Blairmore (Undivided)	Massive bedded sandstones and conglomerates
		Cadomin Formation	
Lower Cretaceous to Upper Jurassic	KOOTENAY GROUP	Elk Formation	Sandstone, siltstone, shale, mudstone, chert pebble conglomerate and minor coal seams.
		Mist Mountain Formation	Sandstone, siltstone, shale, mudstone, and coal seams.
		Morrissey Formation	Medium to coarse grained, slightly ferruginous quartz-chert sandstone.
Jurassic	FERNIE GROUP	Fernie Formation	Shale, siltstone, fine-grained sandstone.

Figure 3.3-1: Geologic Formations
 Crown Mountain Coking Coal Project
 Application for an Environmental Assessment Certificate / Environmental Impact Statement



Crown Mountain Coking Coal Project

Figure 3.3-2
Regional Geology

LEGEND

- Fault
- Geological Unit**
- Cretaceous Alberta Group (uKA)
- Cretaceous to Tertiary: Blairmore Group Crowsnest Formation (IKTBC)
- Jurassic: Fernie Formation (JFe)
- Jurassic to Cretaceous: Kootenay Group (JKK)
- Mississippian: Banff and Exshaw Formations (MBE)
- Mississippian: Rundle Group (MRE)
- Pennsylvanian to Permian: Rocky Mountain Group (PnPR)
- Triassic: Spray River Group (TrSRsf)
- Devonian
- Ordovician
- Cambrian
- Proterozoic
- Unknown
- Project Footprint
- Coal License Boundary
- Highway
- Arterial/Collector Road
- Local/Resource Road
- + Railway
- Watercourse
- Waterbody
- British Columbia/Alberta Border

0 5 10
Kilometres

Scale 1:250,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada. Imagery Provided By ESRI

Map Created By: PAR
Map Checked By: HEB/JR
Map Coordinate System: NAD 1983 UTM Zone 11N

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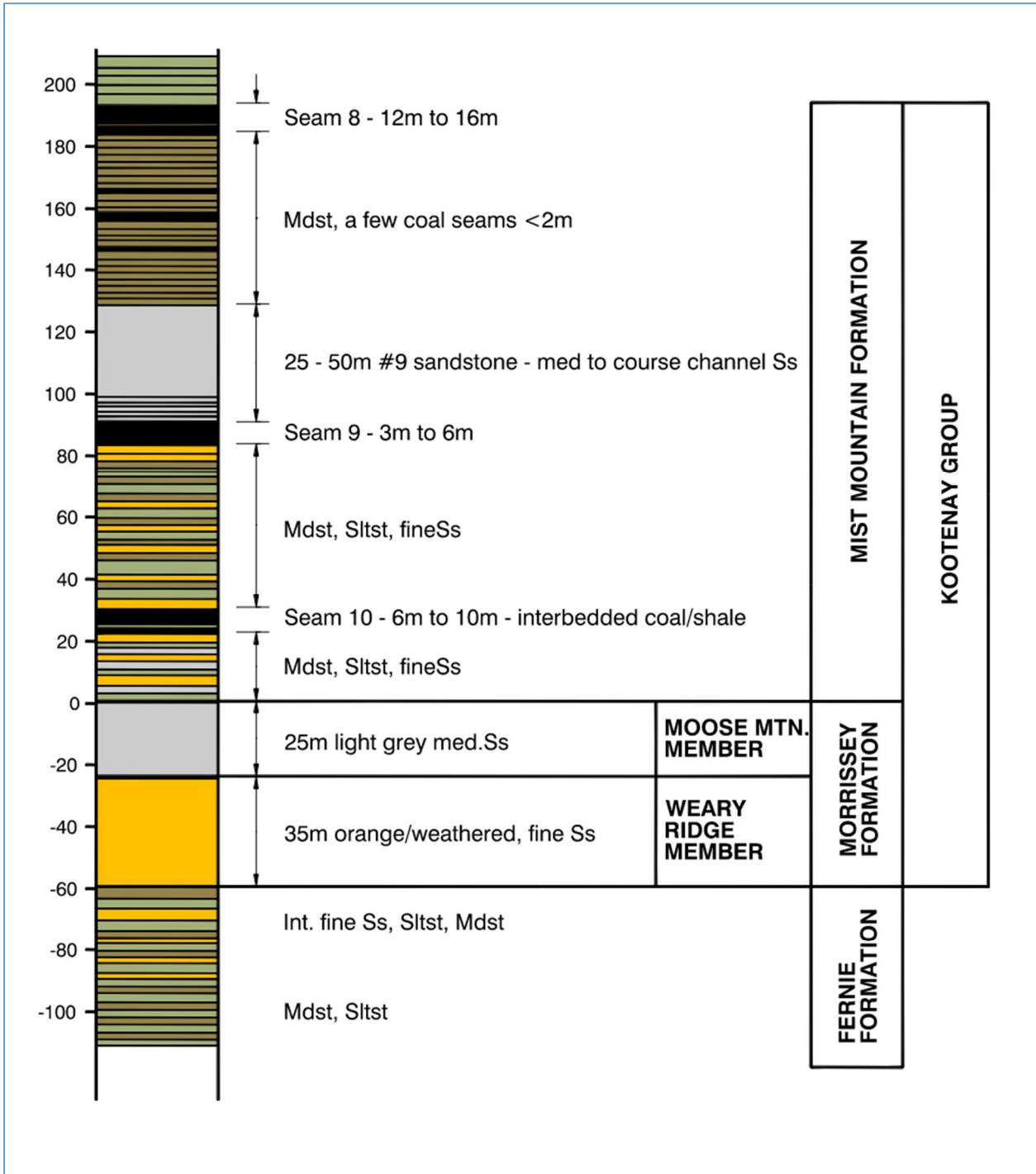
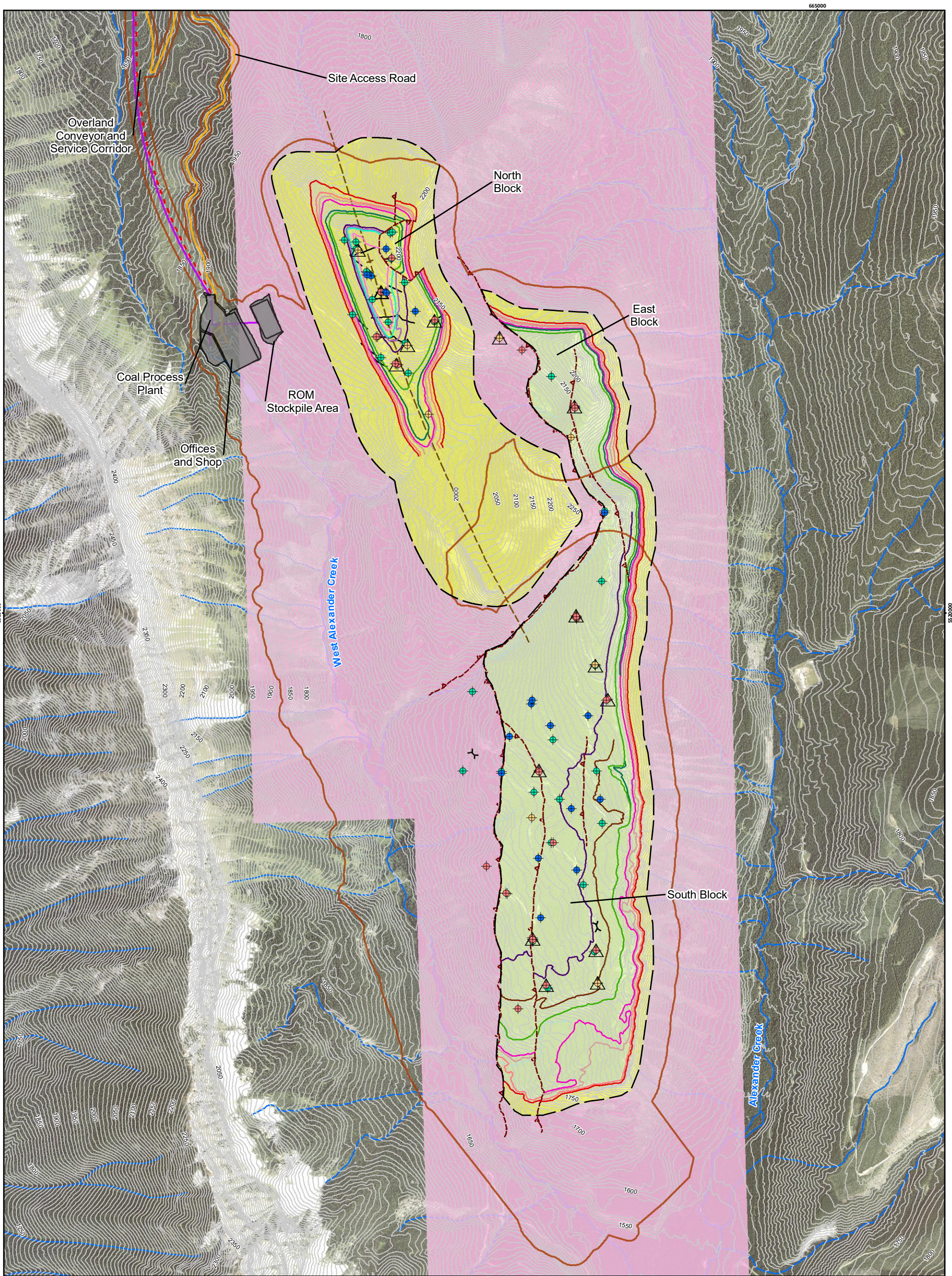


Figure 3.3-3: Coal Seam Stratigraphy



Crown Mountain Coking Coal Project

Figure 3.3-4
Project Geology

- | | | | |
|---------------------------|--------------------|---------------------------------|------------------------------------|
| ◆ 1969 & 1979 Drill Hole | — Seam 8A | — Seam 10 Middle | — Clean Coal Haul Road/Site Access |
| ◆ 2012 Drill Hole | — Seam 8 Upper | — Seam 10 Lower | — Service Corridor |
| ◆ 2013 Drill Hole | — Seam 8 Middle | — Syncline Axis | — Coal Process Plant Conveyor |
| ◆ 2018 Drill Hole | — Seam 8 Lower | — Fernie Formation | — Coal Process Plant Duct |
| △ Coal Quality Drill Hole | — Seam 8 Rider2 | — Mist Mountain Formation | — 10 m Contours |
| — Formation Contact | — Seam 9 | — Morrissey Formation | — Watercourse |
| — Thrust Fault | — Seam 9 Rider | — Project Footprint | — Waterbody |
| — Trench | — Seam 10 Upper-AB | — Plant Site/ROM Stockpile Area | |
| | — Seam 10 Upper-CD | | |

0 500 1,000
Metres

Scale 1:20,000

Map Drawing Information:
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia GeBC Open Data, Government of Alberta Open Data, Natural Resource Canada. Imagery Provided By GeoBC OrthoImagery (Aug 2016).

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Map Coordinate System: NAD 1983 UTM Zone 11N



Project: 12-6231
Status: FINAL
Date: 2022-03-17

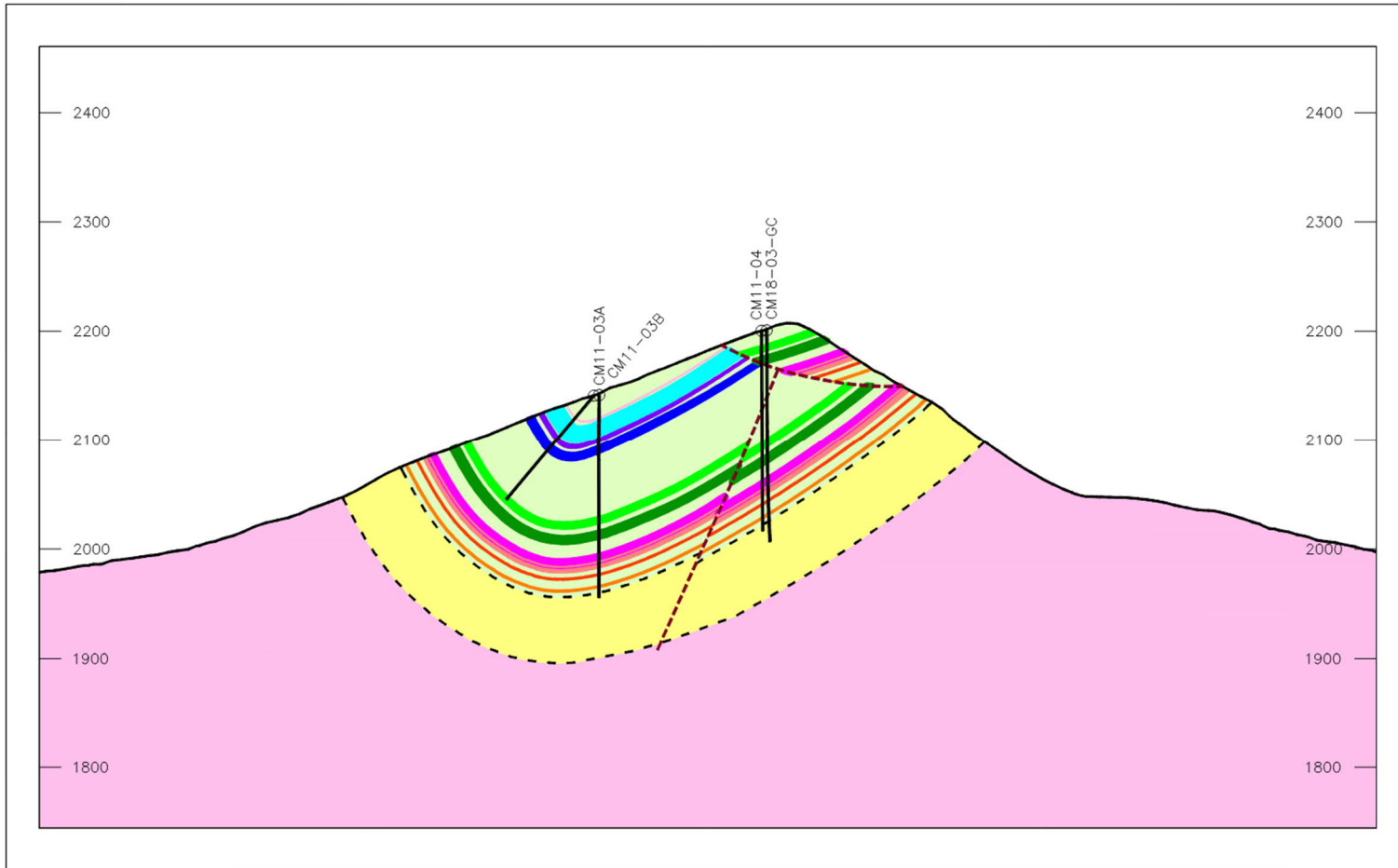


Figure 3.3-5: Cross Section A-A'
Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate / Environmental Impact Statement

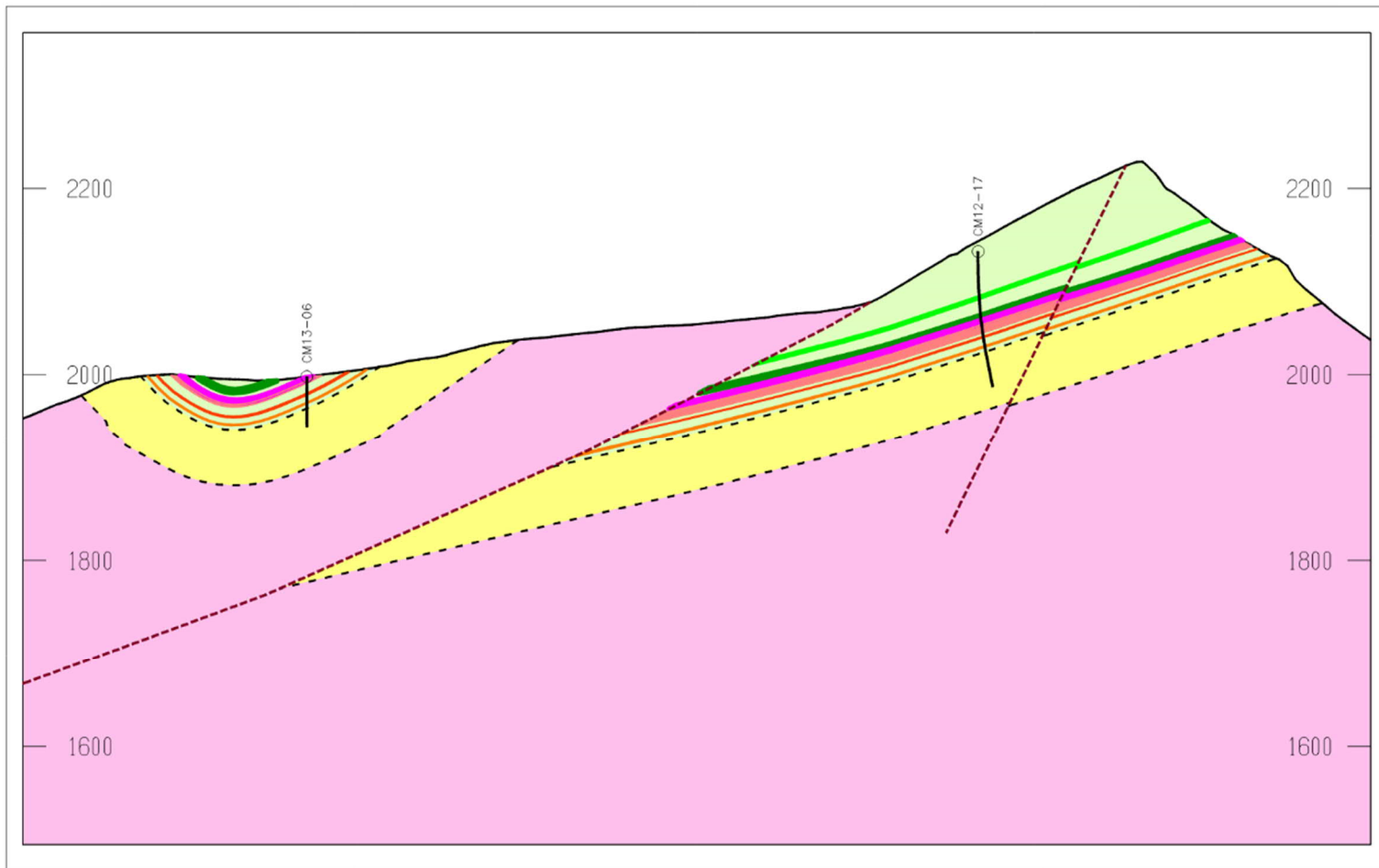


Figure 3.3-6: Cross Section B-B'
 Crown Mountain Coking Coal Project
 Application for an Environmental Assessment Certificate / Environmental Impact Statement

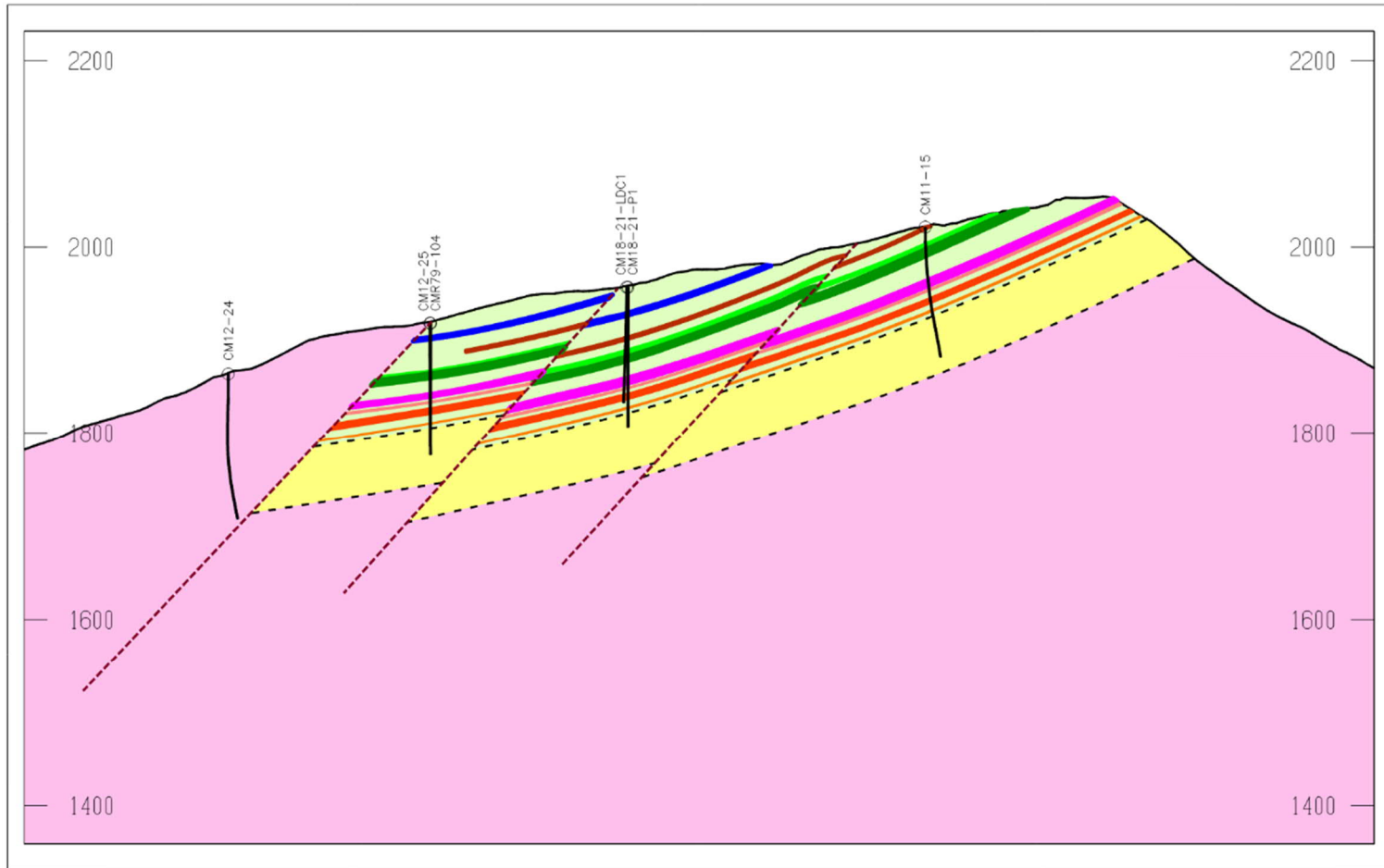


Figure 3.3-7: Cross Section C-C'
 Crown Mountain Coking Coal Project
 Application for an Environmental Assessment Certificate / Environmental Impact Statement

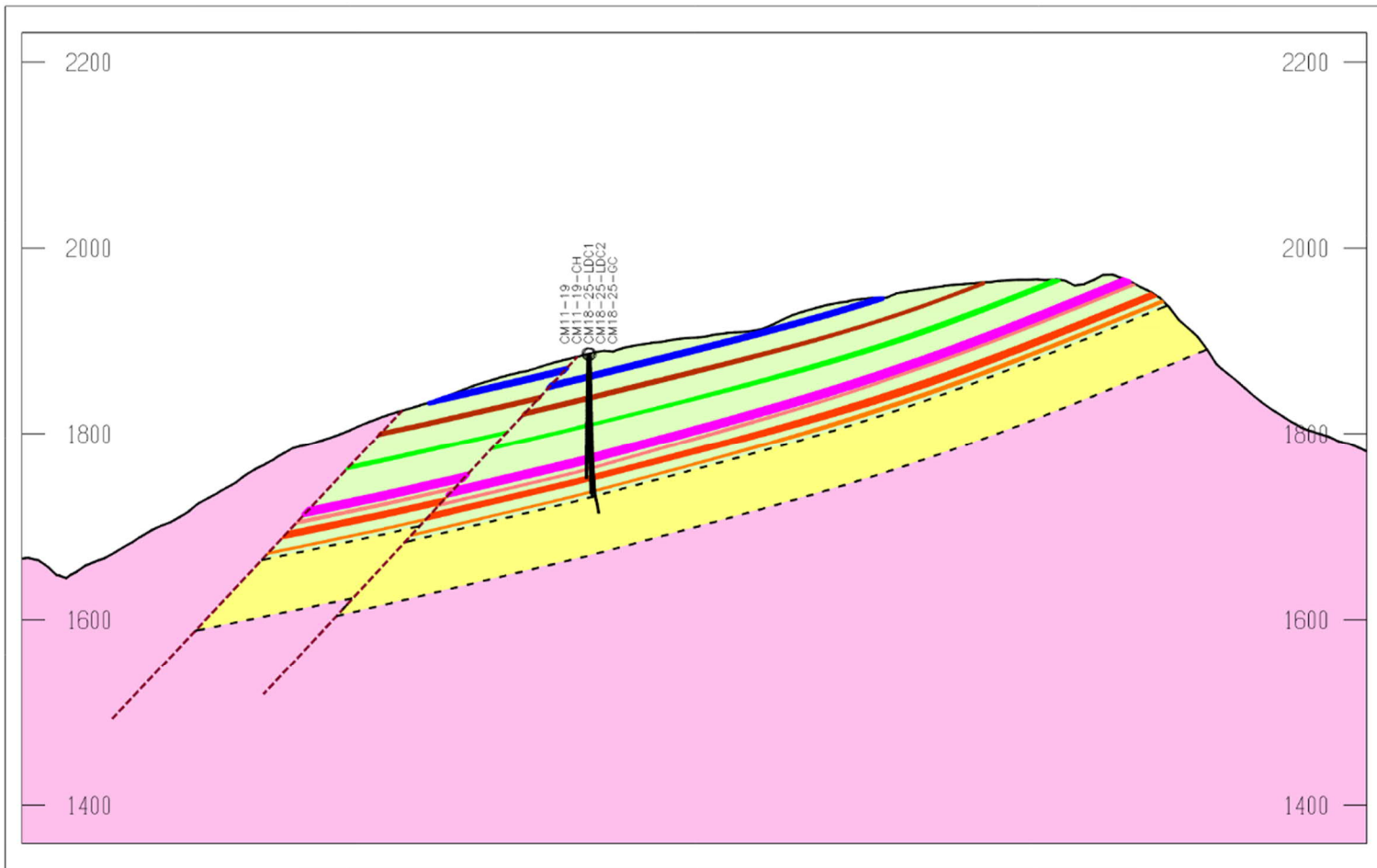


Figure 3.3-8: Cross Section D-D
 Crown Mountain Coking Coal Project
 Application for an Environmental Assessment Certificate / Environmental Impact Statement

3.3.1.2 Morrissey Formation

The base of the overlying Late Jurassic to Early Cretaceous Kootenay Group is marked by the Morrissey Formation which is resistant and easily mapped in most areas of its occurrence. The Morrissey Formation averages 40 m in thickness in the area and consists of two members: the Weary Ridge Member and the Moose Mountain Member (Gibson, 1985, as cited in Stantec, 2020). The lower Weary Ridge Member is predominantly a fine-grained, quartzose, argillaceous, calcareous and ferruginous sandstone. The upper Moose Mountain Member is the more resistant and consists predominantly of medium-grained quartz-chert sandstone. Thin interbeds of carbonaceous shale and coal occur locally within the Moose Mountain Member.

3.3.1.3 Mist Mountain Formation

The economically important Mist Mountain Formation conformably overlies the Morrissey Formation. The Mist Mountain Formation is moderately recessive to moderately resistant depending on the proportion of resistant sandstone or conglomerate beds it contains. This formation averages 500 m in thickness in the Crowsnest coalfield. The Mist Mountain Formation in the Crowsnest coalfield consists of an interbedded sequence of siltstone, sandstone, mudstone, shale, coal and conglomerate of predominantly non-marine origin. Fine-grained clastic rocks tend to be dark grey because of their carbonaceous content, while the sandstones, which contain grains of quartz, chert, and quartzite (Gibson, 1985), tend to be somewhat lighter in color.

The depositional environment for the Mist Mountain Formation is that of an interbedded sequence of sandstone, siltstone, mudstone, shale, and coal, with rare conglomerate zones. It represents sediment deposition on a non-marine delta plain which pro-graded eastward into the inland Fernie Sea, and which received terrigenous clastic material eroded from tectonically active uplands to the west (Gibson, 1977 and Jansa, 1972, as cited in Stantec, 2020). Sediments are believed to have been deposited on lower delta coastal plains and upper delta alluvial plains, with the former being restricted to the basal part of the section (Gibson, 1977; Jansa, 1972). Deposition in alluvial channels and flood plains is generally inferred, with the latter environment represented by deposits typical of levee, crevasse, splay, flood-basin, and swamp or marsh settings (Gibson and Hughes, 1981, as cited in Stantec, 2020). No marine or brackish water deposits have been identified within this formation.

3.3.1.4 Elk Formation

The Elk Formation, which gradationally overlies the Mist Mountain Formation, is the uppermost formation in the Kootenay Group. It is a relatively resistant non-marine unit dominated by coarse clastic rocks and in the Crowsnest coalfield it varies in thickness from a maximum of 482 m on Sparwood Ridge (Gibson, 1985, as cited in Stantec, 2020) to 155 m near McLatchie Creek (Grieve and Ollerenshaw, 1989). Thicknesses of 327 m (Grieve and Ollerenshaw, 1989) and 254 m (Gibson, 1985, as cited in Stantec, 2020) have been recorded at Flathead Ridge and Mount Taylor, respectively. In general, the Elk Formation decreases in thickness from west to east. This formation is composed of sandstone, siltstone, mudstone, shale, coal and, locally, conglomerate. Sandstone deposits tend to be more numerous and laterally continuous than those in the Mist Mountain Formation. Conglomerate deposits are associated with the sandstone deposition, and the conglomerate deposits are greatest in concentration and thickness within the thickest sections, that is, at the western edge of the coalfield. Siltstone present in the Elk Formation is generally similar to the siltstone present in the Mist Mountain Formation, with the exception of the light

grey weathering, well-indurated "needle siltstones" (Gibson, 1977, as cited in Stantec, 2020) present in the Elk Formation.

3.3.1.5 Blairmore Formation

The contact with the overlying Lower Cretaceous Blairmore Group occurs at the base of the Cadomin Formation, the basal unit of the non-marine Blairmore Group. In the Crowsnest coalfield, this contact is abrupt and scoured, but may be conformable, at least in the western part of the coalfield (Gibson, 1979, and Ricketts and Sweet, 1985, as cited in Stantec, 2020). The Cadomin Formation in the Crowsnest coalfield consists of one or more thick cliff-forming chert-pebble to cobble conglomerate beds separated by recessive greenish and maroon mudstone units with a locally developed thin bed of light grey, nodular-weathering micrite. The Cadomin Formation is gradationally overlain by the lower Blairmore, which in the Crowsnest coalfield is a 455 m thick recessive sequence of greenish grey, grey and maroon mudstone, with interbedded siltstone, cherty sandstone, conglomerate and minor limestone (Ollerenshaw, 1981a, as cited in Stantec, 2020). The conformably overlying Beaver Mines-Mill Creek Formation in the Crowsnest coalfield is a sequence of greenish grey and maroon mudstone, sandstone and conglomerate 1,875 m thick. Unconformably overlying the Blairmore Group are two marine shale sequences of the Blackstone and Wapiabi Formations. These are separated by non-marine sandstone and shale of the Cardium Formation of the Alberta Group.

The regional geology described above is shown on Figure 3.3-2 with vertical stratigraphy shown in Figure 3.3-3.

3.3.2 Crown Mountain Coking Coal Project Geology

The following sections describe Project geology, which is also shown on Figure 3.3-4; cross-sections are shown on Figure 3.3-5 to Figure 3.3-8.

3.3.2.1 Coal Occurrences and Properties

According to Grieve and Kilby (1989), within a complete stratigraphic section:

Coals in the Mist Mountain Formation are almost exclusively humic. Original banding has often been destroyed by shearing associated with Laramide deformation. They form an average of 10 percent of the total thickness of the formation in seams which range from less than one to greater than 15 metres in thickness. Coal seams do not tend to cluster in any part of the stratigraphic section, and the only horizon which is consistently coal-bearing is the basal 20 to 25 metres of the formation (Grieve and Kilby, 1989).

However, it must be noted that the Mist Mountain Formation section in the Crown Mountain area is an erosional remnant. The whole of the section is not present on this Project. The sequence on the Project is known to include, in the most complete stratigraphic section, Seam 8, at the top, Seam 9 below Seam 8, and Seam 10 at the base. Seams 8 and 10 are composed of various plies and splits. According to Grieve (1993), and based on a measured section in their publication:

Trenches and exploration roads expose the lowest 72.4 m of the Mist Mountain Formation. Of this thickness, 5.8 m is represented by three coal seams, ranging in thickness from 1.3 m to 3.0

m. A very prominent channel sandstone unit immediately overlies the thickest coal seam and is the uppermost unit in the section (Grieve, 1993).

3.3.2.2 Regional Structural Geology

The tectonic history of this region has produced structural deformation on every scale. Southeast British Columbia coalfields are part of the Lewis Thrust plate. This plate is characterized by features associated with the compressional Laramide tectonic regime which occurred during deformation of the Rocky Mountain front ranges in the late Cretaceous and early Tertiary time, namely flexural slip folds with north to northwest trending axes, and west-dipping thrust faults. A period of extensional faulting followed in late Eocene and early Oligocene time (Price, 1965, as cited in Stantec, 2020), some of which occurred on earlier thrust fault surfaces.

According to Grieve (1993):

The Lewis Thrust Sheet in the Elk Valley Coalfield is bounded to the east by the outcrop of the Lewis Thrust Fault and to the west by the Bourgeau Thrust Fault. The plane of the Lewis Thrust Fault has been folded by movement on a younger underlying thrust. Outcrop expressions of subsurface folds in the Lewis Thrust include the Alexander Creek Syncline and the Fording Mountain Anticline. The Alexander Creek Syncline underlies the entire length of the coalfield and encompasses the Line Creek Mine and the Eagle Mountain component of the Fording Coal Operation.

The Alexander Creek Syncline is the dominant structure in the Elk Valley Coalfield as it underlies the main body of the coalfield throughout its entire 97 kilometre (km) length. The syncline is generally upright but is locally steeply inclined. It is mainly an asymmetric fold, with the west limb being shorter in most cases (Grieve, 1993).

Grieve maps the Alexander Creek Syncline as being the large syncline that forms the mineable structure on the North Block of Crown Mountain.

A second significant structure on the Crown Mountain Coking Coal Project appears to be the Ewin Pass Fault. Again, according to Grieve (1993):

The Ewin Pass Fault occurs in the east limb of the Alexander Creek Syncline throughout much of the south half of the coalfield. It may also continue southward from Line Creek to Crown Mountain, assuming that the Crown Mountain Fault is the same structure, although there is no direct evidence for this. Throughout its length it has had the effect of thickening the east limb by causing a repetition of strata. The Ewin Pass Fault has been depicted in the subsurface by Price and Grieve as a listric, west-dipping splay of the Lewis Thrust.

The Crown Mountain Fault has placed west dipping Fernie formation strata in the east limb of the Alexander Creek Syncline over west dipping strata of the lower part of the Mist Mountain Formation (Grieve, 1993).

3.3.2.3 Project Structural Geology

As described, Grieve (1993) has suggested that the major geological structures, the Alexander Creek Syncline and the Ewin Pass Fault, both extend south onto the Crown Mountain Coking Coal Project. The presence of the syncline on the Project has been recognized for a long time and the Crown Mountain Fault, Grieve's suggestion for the extension of the Ewin Pass Fault, has been well located by historic mapping of the Project, as well as relatively recent exploration activities conducted by NWP from 2011 to 2019. These features cause the Project to be broken into separate structural domains each with separate mining attributes or geological characteristics. These domains are referred to as the North Block and the South Block. The North Block lies west of the Crown Mountain Fault and occupies the Alexander Creek Syncline axial region. The South Block is located on the east side of the Crown Mountain Fault and is generally located further south than the North Block.

The location of the North Block is west of the Crown Mountain Fault. The North Block is thus situated on the hanging wall side of the fault. At the Project, the syncline is asymmetric with the west limb having a steeper dip than the east limb. The dip of the west limb is typically 55 degrees (°) while the dip of the east limb is 35°. The fold axis has a north-northwest trend.

The South Block is on the east side of the Crown Mountain Fault. The South Block is thus located in the footwall sequence below this fault. In the past, the structure of this part of the Project was interpreted to be that of a monocline. However, 2012, 2013 and 2018 drill hole data and re-examination of the outcrop data show that the dip of the beds "flatten-out" as they approach the fault toward the southwest. This indicates that the original structure of these beds was a syncline that has been truncated by the thrust fault and only the east limb of the syncline remains. This interpretation is consistent with the regional observation of Grieve referred to previously. Small scale thrust faults have been identified in the South Block during the 2012, 2013 and 2018 drilling programs. These faults appear to be parallel to the Crown Mountain Fault and likely formed during the same compression regime that created the Crown Mountain Fault.

In previous studies, the north portion of the South Block is referred to as the "East Block". The East Block is a small area that was a specific target for exploration in 2013 and 2018 and was a focus for mine and coal quality evaluation. This area has the potential to be developed as a separate mining pit or merged together with the pit in the south portion of the South Block.

3.3.2.4 Stratigraphy

The Mist Mountain Formation of the Jurassic-Cretaceous Kootenay Group is the primary coal-bearing unit of the Project and encompasses all the economic coal seams. It conformably overlies the Moose Mountain Member of the Morrissey Formation. The Morrissey Formation conformably overlies the Fernie Formation; these units are separated by a transitional zone of interbedded shale and sandstone with the former having the same characteristics as those of the Fernie Formation. A marker bed, normally found 5 m to 10 m below the base of the Moose Mountain Member, was found in all drill holes on the Project that penetrated to that depth.

Based on results from the 2012, 2013 and 2018 drilling campaigns, the North Block has a preserved thickness ranging from 40 m to 170 m in the Mist Mountain Formation strata. The equivalent thickness values for the South Block range from 70 m to 180 m.

The top of the underlying Morrissey Formation is located from about 2.0 m to 13.0 m below the Seam 10 Lower which is the deepest coal unit at the Project. The contact is readily identifiable because the Morrissey Formation is a distinct, weathering-resistant unit. Above the Seam 10 is the Seam 9, and the roof of this seam in the North Block, and occasionally in the South Block, is a weathering-resistant blocky unit of fine-to-medium grained sandstone that commonly displays an orange weathering colour; it is locally referred to as the Ridge Sandstone. Both the Ridge Sandstone and the sandstone of the Moose Mountain Formation are mapped at the surface at various locations throughout the Project.

3.3.3 Coal Seam Development and Correlation

The coal seam descriptions for the Project are based on drill hole data from the area. The seam nomenclature that is used corresponds with the nomenclature used at the Line Creek Mine to the north. Drilling has penetrated three principal seams at the Project. The principal seams are named Seam 8, Seam 9, and Seam 10, but Seam 8 and Seam 10 have been found to consist of three plies in each case. These plies are generally persistent across the Project and each ply has thus been recognized as a separate seam. The term “Major Seam” has been defined to include all seven of these seams in order to distinguish them from other coal horizons, referred to as “Rider Seams” which also occur in the sequence. Thus, there are a total of seven major seams, and these are named Seam 8 Upper, Seam 8 Middle, Seam 8 Lower, Seam 9, Seam 10 Upper, Seam 10 Middle, and Seam 10 Lower. These names are presented in descending stratigraphic order. Table 3.3-1 is a summary of the net coal average thicknesses for the major seams.

The 2018 drilling provided more geological information for the Project and improved the correlation of the individual plies within the seam zones. Five different coal plies have been correlated within the Seam 10 Upper, named 10 Upper 1 (10U1), 10 Upper a (10Ua), 10 Upper b (10Ub), 10 Upper c (10Uc) and 10 Upper d (10Ud), listed here in descending stratigraphic order. Based on the proximity of these individual plies to each other and their thicknesses, Seam 10Ua and 10Ub, as well as 10Uc and 10Ud, have been evaluated together as 10Uab and 10Ucd.

In addition to the coal plies within Seam 10 Upper, correlation of individual coal plies was completed for selected drill holes within Seam 8 Middle (8Ma, 8Mb, 8Mc and 8Md), Seam 8 Lower (8La and 8Lb), and Seam 9 (9a and 9b). Although, individual plies have been identified for the above-mentioned coal zones, they have been evaluated as one major coal zone for the purposes of this study due to the limited thickness of the partings between these coal plies. As Table 3.3-1 shows, there is a significant difference in the combined net coal thickness for the North and South blocks. This is due to the upper plies of Seam 8 being eroded in the South Block.

Table 3.3-1: Summary of Major Seam Average Net Coal Thickness

Seam Name	North Block Average Thickness (m)	South Block Average Thickness (m)
Seam 8 Upper (8U)	10.4	-
Seam 8 Middle (8M)	2.2	-
Seam 8 Lower (8L)	3.0	1.7
Seam 9	4.1	3.2
Seam 10 Upper ab (10Uab)	1.4	1.7

Seam Name	North Block Average Thickness (m)	South Block Average Thickness (m)
Seam 10 Upper cd (10Ucd)	4.7	2.8
Seam 10 Middle (10M)	0.9	3.8
Seam 10 Lower (10L)	1.3	1.3
Combined Average	28.0	14.5

The differences in the coal thicknesses between the North Block and the South Block, for the Seam 10 Upper and the Seam 10 Middle, are due to some of the lower plies within the Seam 10 Upper in the North Block separating from Seam 10 Upper coal zone to become part of the Seam 10 Middle coal zone in the south end of the South Block. This separation is due to an increase in interburden thickness within the 10 Upper plies, which is evident in the south end of the South Block. Note, the combined thicknesses of the Seam 10 Upper and the Seam 10 Middle seams, within the North and South blocks, remain similar.

The differences in the coal thicknesses for the Seam 8 Lower, between the North Block and the South Block, are interpreted to be due to the fact that the seam in the South Block splits into Seam 8 Lower and Seam 8 Rider. The thickness of the Seam 8 Lower in the North Block is very similar to the combined thickness of the Seam 8 Lower and the Seam 8 Rider seams in the South Block.

Several of the seams have splits or “Rider Seams” associated with them. These riders are typically thinner and usually not as laterally continuous as the seams with which they are associated; the rider seams have been named with a prefix according to their overlying or underlying seam. Table 3.3-2 shows the typical average net coal thickness for the rider seams on the Project, in descending stratigraphic order.

Table 3.3-2: Summary of Rider Seam Average Net Coal Thickness

Seam Name	North Block Average Thickness (m)	South Block Average Thickness (m)
8 A (above Seam 8 Upper)	0.9	-
8 Rider (below Seam 8 Upper)	-	0.4
8 Rider2 (below Seam 8 Rider)	-	1.2
9 Rider (below Seam 9)	1.7	1.4
Combined Average	2.6	3.0

As described in other sections within this chapter, studies and site investigations have concluded there is low probability of PAG and ML/ARD beyond selenium. The PAG zones are well known in the Morrissey Formation, which has been confirmed by geochemical data collected for this Project, and other Elk Valley mines have demonstrated there is overwhelming neutralization to offset any potential for acid generation (Stantec, 2020). Metal leaching considerations relative to selenium management are discussed elsewhere in this chapter. Static test results generated as part of the Project Geochemical Baseline (SRK Consulting, Inc. [SRK], 2021) are shown in Table 3.3-3 and Table 3.3-4.

Table 3.3-3: Static Test Results for Morrissey Formation

Rock Type	Sample ID	Paste pH	Total Carbon (%)	TIC (kg CaCO ₃ /t)	Total S (%)	Sulphate S (HCl Method) (%)	ICP-MS S (%)	ICP Sulphide (%)	AP (ICP Sulphide) (kg CaCO ₃ /t)	Mod. NP (kg CaCO ₃ /t)	Mod. NP/AP	Se (mg/kg)
ST	CM18-03-GC-61	7.5	55	4.3	0.48	0.01	0.13	0.12	3.8	2	0.53	1.1
ST/CDB	CM18-05-GC2-43	8	49	4.3	0.57	0.01	0.21	0.2	6.3	2.3	0.37	1.1
SST	CM18-03-GC-62	6.5	0.69	1.8	0.03	0.01	0.03	0.02	0.63	1.8	2.9	0.1
SST	CM18-03-GC-63	5.6	0.56	3.2	0.14	0.03	0.13	0.1	3.1	4.3	1.4	0.2
SST	CM18-27-GC-43	7.8	3.5	1.8	0.15	0.03	0.11	0.08	2.5	2.5	1	0.1
SST	CM18-27-GC-44	6.2	0.72	5	0.31	0.03	0.27	0.24	7.5	4.8	0.64	0.2
SST	CM18-05-GC2-45	6.7	1	3.4	0.06	0.01	0.04	0.03	0.94	3.5	3.7	0.1
ST/SLT	CM18-27-GC-42	9	38	5.9	0.52	0.01	0.23	0.22	6.9	2.5	0.36	0.7
SST	CM18-16-LDC3-40	7.1	0.84	7.1	0.27	0.01	0.25	0.24	7.5	3.3	0.44	0.2
SST	CM18-16-LDC3-41	7	1.2	39	0.38	0.02	0.37	0.35	11	9.5	0.87	0.2
SST	CM18-16-LDC3-42	8.1	58	57	1.26	0.01	0.97	0.96	30	6.5	0.22	0.5
SST	CM18-16-LDC3-43	7	0.67	8	0.08	0.02	0.08	0.06	1.9	6.8	3.6	0.2

Notes:

(1) For values below detection limit, the detection limit was used for statistical calculations.

(2) SST – Sandstone; ST – Stoney Coal; SLT – Siltstone; CST – Claystone; CCST – Carbonaceous Claystone; MDST – Mudstone; CARB – Carbonaceous; CBD – Dull Banded; MIX Mixed rock type.

Table 3.3-4: Static Test Results for Fernie Formation

Rock Type	Sample ID	Paste pH	Total Carbon (%)	TIC (kg CaCO ₃ /t)	Total S (%)	Sulphate S (HCl Method) (%)	ICP-MS S (%)	ICP Sulphide (%)	AP (ICP Sulphide) (kg CaCO ₃ /t)	Mod. NP (kg CaCO ₃ /t)	Mod. NP/AP	Se (mg/kg)
Not recorded	TP18-MD6	8.3	0.78	23	0.02	0.01	0.02	0.01	0.31	33	110	0.1
Not recorded	BH18-MD2	8.8	4.8	360	0.34	0.01	0.29	0.28	8.8	370	42	0.1
Not recorded	BH18-12	8.7	3.3	160	0.22	0.01	0.18	0.17	5.3	170	32	1
Not recorded	BH18-MD1	8.7	3	130	0.47	0.01	0.42	0.41	13	140	11	1.3
Not recorded	BH-18-PP2	8.5	5.1	340	0.52	0.03	0.44	0.41	13	360	28	0.6

Notes:

(1) For values below detection limit, the detection limit was used for statistical calculations.

(2) SST – Sandstone; ST – Stoney Coal; SLT – Siltstone; CST – Claystone; CCST – Carbonaceous Claystone; MDST – Mudstone; CARB – Carbonaceous; CBD – Dull Banded; MIX Mixed rock type.

3.4 Mineral Resources and Reserves

3.4.1 Deposit Type

The definition of “Deposit Type” for coal properties is different from that applied to other types of geologic deposits. Criteria applied to coal deposits for the purposes of determination of coal resources and reserves include both “Geology Type” as well as “Deposit Type”. For coal deposits, this is an important concept because the classification of a coal deposit as a particular type determines the range of limiting criteria that may be applied during the estimation of Reserves and Resources.

“Geology Type” for coal deposits is a parameter that is specified in the Geological Survey of Canada (GSC) Paper 88-21 (Hughes et al., 1989). The GSC Paper 88-21 provides the framework for classifying coal deposits as referenced in the Canadian National Instrument (NI) 43-101 Standards of Disclosure for Mineral Projects document. Coal “Geology Type” is a definition of the amount of geological complexity, usually imposed by the tectonic history of the area, and the classification of a coal deposit by “Geology Type” determines the approach to be used for the Resource/Reserve estimation procedures and the limits to be applied to certain key estimation criteria. The identification of a particular “Geology Type” for a coal Project defines the confidence that can be placed in the extrapolation of data values away from a particular point of reference such as a drill hole.

The classification scheme outlined within GSC Paper 88-21 is similar to many other international coal reserve classification systems, but it has one significant difference. The difference being that the classification scheme outlined within GSC Paper 88-21 is designed to accommodate differences in the degree of tectonic deformation of different coal deposits in Canada. The four categories of “Geology Type” are as follows:

- “Low”, which is for deposits of the Plains-type with low tectonic disturbance;
- “Moderate”, which is for deposits affected to some extent by tectonic deformation;
- “Complex”, which is for deposits subjected to relatively high levels of tectonic deformation; and
- “Severe”, for Rocky Mountain type deposits which have been subjected to extreme levels of tectonic deformation.

The coal deposits of the Elk Valley Coalfield are typical of those for Inner Foothills and Rocky Mountain areas which have been subjected to a relatively high level of tectonic deformation. From place-to-place coal deposits of this type may be characterized by tight folds, some with steeply inclined or overturned limbs. These features can be seen in different parts of the coal field, but they are far from being universal.

The Crown Mountain Coking Coal Project is divided into two distinct structural domains separated by a northerly trending thrust fault that is named the Crown Mountain Thrust Fault. These two domains exist as two distinct “Geology Types”.

On the northwest side of the thrust fault, located in an area of the Project that is referred to as the North Block, an asymmetrical syncline is evident. The axis of this fold is oriented at a shallow angle to the fault trend such that the fold axis and fault approach each other from the north boundary of the Project in a

southerly direction. The structure of this area is clearly more disturbed tectonically than other parts of the Project and as a result is categorized as a Complex “Geology Type”.

The structure on the east side of the thrust fault is significantly different from the North Block structure discussed above. On the east side of the thrust fault, the same syncline was truncated and only the east limb of the syncline remains. In the past the geological structure in this area was interpreted as a westerly dipping monocline. This area is referred to as the South Block. The relatively lower level of tectonic disturbance for this area allows it to be categorized as a “Moderate Geology Type”. There is a third portion of the Project that is the strike extension of the South Block. This area is referred to as the Southern Extension. At present, the Southern Extension area has been explored to a much lesser extent than the other two blocks and is not a subject of this study.

The “Deposit Type”, as defined in GSC Paper 88-21, refers to the probable extraction method that would be used to recover coal. The four categories of “Deposit Type” are:

- Surface;
- Underground;
- Non-conventional; and
- Sterilized.

3.4.2 Mineral Resource Estimates

The following is a discussion of the criteria and results obtained for coal resource estimation for the Crown Mountain Coking Coal Project in the Elk Valley Coalfield of southeast British Columbia. The estimates presented in this section of the report have been prepared in accordance with the requirements of the NI 43-101 and the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards. The GSC Paper 88-21 A Standardized Coal Resource/Reserve Reporting System for Canada (Hughes et al., 1989) was referenced during the classification, estimation, and reporting of coal resources.

GSC Paper 88-21 was written in 1989 and is now obsolete with respect to certain numerical parameters. As a result, this paper was used only as a guideline during resource estimation. NI 43-101 (Canadian Securities Administrators, 2011) is the Canadian equivalent of the 2012 Joint Ore Reserves Committee (JORC) Standard. The categories of resources, identified as Measured, Indicated, and Inferred, are the same in both the NI 43-101 and the JORC standards of disclosure documents. In fact, the descriptions of these categories are almost identical.

3.4.3 In-Place Coal Resource Estimation

With respect to the in-place coal resource, the term “resource” is used to quantify coal contained in seams occurring within specified limits of thickness and depth from surface. The term “resource” refers to the in-place inventory of coal that has ‘reasonable prospects for economic extraction’. Coal resources are always reported as an in-place tonnage and are not adjusted for mining losses or recovery. However, minimum mineable seam thickness and maximum removable parting thickness are considered. For in-place coal that is considered to be suitable for surface mining, GSC Paper 88-21 suggests that the maximum depth limit for inclusion of in-place coal tonnages as resources should be defined by a maximum overburden ratio. The maximum ratio suggested by GSC Paper 88-21 is 20:1 cubic metres per tonne

(m³/tonne). However, this geological limit should not be taken as a technical and economic limit for mining.

The in-place resources suitable for consideration for surface mining on the Crown Mountain Coking Coal Project with a minimum coal thickness of 0.5 m are summarized in Table 3.4-1. This estimate covers an area of approximately 461 ha.

Table 3.4-1: In-Place Coal Resources Suitable for Surface Mining as of December 31, 2019

Area	Seam	ASTM Group	In-Place Coal Resources (kilotonnes [ktonnes])		
			Measured	Indicated	Inferred
North Block	Seam 8 A	Low to Medium Volatile Bituminous	0	56	0
	Seam 8 Upper		1,335	0	0
	Seam 8 Middle		0	244	0
	Seam 8 Lower		758	0	0
	Seam 9		2,199	242	0
	Seam 9 Rider		881	213	0
	Seam 10 Upper ab		685	259	0
	Seam 10 Upper cd		3,016	1,236	0
	Seam 10 Middle		530	298	0
	Seam 10 Lower		663	483	0
North Block Total			10,067	3,031	0
South Block	Seam 8 Lower	Low to Medium Volatile Bituminous	1,652	337	0
	Seam 8 Rider2		0	1,375	0
	Seam 9		9,844	2,167	0
	Seam 9 Rider		1,251	1,005	0
	Seam 10 Upper ab		5,698	600	0
	Seam 10 Upper cd		9,491	2,251	0
	Seam 10 Middle		9,774	2,262	0
	Seam 10 Lower		3,312	2,358	0
South Block Total			41,027	12,355	0
Total			66,480		0

The resources shown in Table 3.4-1 are inclusive of the reserves discussed in Section 3.4.4. Average in-situ (raw) coal quality estimated for the Measured plus Indicated coal resource is presented in Table 3.4-2.

The accuracy of resource estimates is, in part, a function of the quality and quantity of available data and of engineering and geological interpretation and judgment. Given the data available at the time this report was prepared, the estimates presented herein are considered reasonable. However, they should be accepted with the understanding that additional data and analyses available after the date of the estimates may necessitate revision. These revisions may be material.

Mineral resources are not mineral reserves and there is no assurance that all mineral resources will ultimately be reclassified as proven or probable reserves. Mineral resources which are not mineral reserves do not have demonstrated economic viability. Mineral reserve evaluation is discussed in Section 3.4.4.

Table 3.4-2: In-situ Coal Quality (Dry Basis)

Area	Seam	Ash Content (%)	Volatile Matter (%)	Fixed Carbon (%)	Total Sulphur Content (%)	Specific Gravity	Free Swelling Index
North Block	Seam 8 A	38.0	---	---	---	1.65	---
	Seam 8 Upper	15.6	19.2	65.2	0.34	1.42	4.5
	Seam 8 Middle	37.6	---	---	---	1.65	---
	Seam 8 Lower	36.8	15.9	47.3	0.47	1.64	1.5
	Seam 9	22.1	16.0	61.9	0.40	1.49	1.6
	Seam 9 Rider	33.2	13.6	53.2	0.56	1.60	1.7
	Seam 10 Upper ab	19.2	17.8	63.1	0.53	1.46	5.4
	Seam 10 Upper cd	25.3	17.5	57.2	0.44	1.52	4.6
	Seam 10 Middle	28.2	15.3	56.5	0.66	1.55	6.5
	Seam 10 Lower	21.3	17.1	61.6	0.58	1.48	5.3
South Block	Seam 8 Lower	28.7	15.7	55.6	0.55	1.55	2.9
	Seam 8 Rider2	38.3	13.1	48.5	0.51	1.66	2.5
	Seam 9	20.4	16.2	63.4	0.40	1.47	1.3
	Seam 9 Rider	39.1	12.2	48.7	0.35	1.66	1.3
	Seam 10 Upper ab	26.9	14.3	58.8	0.57	1.54	2.7
	Seam 10 Upper cd	33.1	13.2	53.7	0.53	1.60	2.4
	Seam 10 Middle	36.4	12.7	50.9	0.43	1.64	1.4
	Seam 10 Lower	22.0	15.5	62.5	0.60	1.48	3.2

3.4.4 Mineral Reserve Estimates

The following section discusses the criteria and results obtained for coal reserve estimation for the Crown Mountain Coking Coal Project. These estimates have been prepared in accordance with the Australasian Code for Reporting Results, Mineral Resources and Ore Reserves (JORC Code, 2012 edition) and the CIM Standards on Mineral Resources and Reserves (2014).

The JORC definition of a mineral reserve, which is also applicable to coal, states "... is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined". In addition, the JORC code notes that "The reference point at which Reserves are defined, usually the point where the ore is delivered to the processing plant, must be stated." Note: The CIM Standards uses a similar Coal Reserves definition.

Reserves estimates are based on the ROM tonnage and a marketable coal product tonnage (also referred to as “clean” coal). The reference point for Marketable Coal Reserves is upon exiting the coal handling process plant.

The JORC code requires that at a minimum, a preliminary feasibility study or feasibility study be completed as the basis for the definition of reserve quantities. A feasibility study has been completed for the Crown Mountain Coking Coal Project.

The pits have been designed using the following minimum mining criteria for definition of the reserve tonnage:

- Minimum coal seam thickness = 0.5 m;
- Maximum included diluting material (rock parting in coal) = 0.5 m;
- Coal loss, variable but averages 0.31 m (seam roof + floor contacts);
- Dilution thickness, variable but averages 0.22 m (seam roof + floor contacts); and
- Bulk density as determined by seam ash % relationship.

Table 3.4-3 shows the ROM Coal Reserves. As noted, this is ROM material, and the reference point is at the ROM truck dump feeding the rotary breaker at the plant. PCI coal reserves have been classified based on the drillholes and in situ coal quality information used to define the oxidized coal zones.

Table 3.4-3: ROM Coal Reserve

Area	Calculated ROM Coal Reserves ('000 tonnes)					
	Coking			PCI		
	Proven	Probable	Total	Proven	Probable	Total
North Pit	9,603	3,924	13,527	429	1,068	1,496
East Pit	2,271	532	2,803	135	46	180
South Pit	27,975	4,828	32,803	3,218	3,514	6,731
Total	39,848	9,284	49,132	3,781	4,627	8,408

3.5 Geochemical Characterization

NWP has established a geochemical baseline to support analyses related to potential effects to water from processes including metal leaching. A summary is provided in this section. Additional details may be found in the Site Water Management Plan (Chapter 33, Section 33.4.1.8).

Chemical weather rates are increased during the mining process due to the exposure of minerals in the mine rock and coal rejects to oxygen and water. Chemical weathering reactions can include oxidation of sulphide minerals and dissolution of silicate and carbonate minerals. Sulphide mineral oxidation can result in the development of acidic and/or metal-rich and/or sulphate-rich contact waters. When carbonate minerals dissolve, the reaction products can neutralize the acidity generated by sulphide oxidation. Acidic drainage will result if the rate of acid generation is greater than the rate of neutralization, or if all neutralizing minerals in a material have been depleted. Geochemical characterization is performed to evaluate the acid rock drainage (ARD) and metal leaching (ML) potential of waste materials.

The purpose of the Crown Mountain geochemical program was to describe the geochemical characteristics of the area impacted by the Project and to provide sufficient information to other disciplines to complete the Application/EIS including:

- Evaluate the geochemical characteristics of mine wastes for the Project;
- Provide input to mine waste management for the Project; and
- Predict water quality as an input into mine planning.

NWP's Site Water Management Plan (Chapter 33, Section 33.4.1.8) addresses leaching of regulated components of the rock into water, leaching of explosives residues (nitrogen forms), and leaching of rock components leading to the formation of carbonate precipitates (calcium and alkalinity).

3.5.1 Geochemical Characteristics

3.5.1.1 Background

Several decades of work to determine the geochemical characteristics of mine wastes in the Elk Valley have been carried out. During the late 1990s and into the mid-2000s, this work was undertaken collaboratively by the operators of the five mines (prior to consolidation under Teck Coal Limited), the University of British Columbia (UBC) and the Ministry of Energy, Mines and Petroleum Resources. The work focussed on selenium content and leaching characteristics due to the observed upward trend in concentrations of selenium in the Elk River at the Highway 93 bridge. In late 2006, Teck Coal Limited initiated a process that was designed to lead to the development of a source leaching model that could be used to predict selenium leaching. The overall approach was developed in consultation with the Elk Valley Selenium Task Force and resulted in the initiation of detailed mineralogical, bulk chemical and kinetic leaching studies on the occurrence and release of selenium by weathering of rock in the Elk Valley (SRK, 2008, as cited in SRK, 2021). Those studies continued under the Applied Research and Development (AR&D) Program that was implemented by Teck Coal Limited in 2011 in response to the findings of the Strategic Advisory Panel on Selenium Management (Swanson, 2010, as cited in SRK, 2021). The following sections summarize the main findings from research activities relating to the geochemical characteristics of mine wastes in the Elk Valley. Findings from the ARD program were not published and are not described in this assessment.

3.5.1.2 Acid Rock Drainage Potential

Historically, a number of studies have looked at the ARD potential of rocks and mine wastes associated with the Elk Valley coal mines. The studies have shown that the total sulphur content of the rocks varies by rock type but is relatively low, approximately 0.2% on average. The mines in the region have no reported history of ARD from the mine rock as a result of the low sulphide content coupled with excess carbonate minerals dominated by dolomite and ankerite. Sulphur occurs as the iron sulphides pyrite and marcasite and bound with carbonaceous materials. It should be noted that some mine rock units within the Elk Valley have been classified as Potentially Acid Generating (PAG), such as the moisture-free (MF) at Coal Mountain (Teck Resources Limited, 2017, as cited in SRK, 2021). However, sufficient non-PAG mine rock (with sufficient neutralization potential) exists that has been co-mingled (both intentionally and simply due to mine sequencing), and ARD does not usually develop. An acidic pit was discovered at Teck's Coal Mountain Operations in 2014 (Teck, 2017, as cited in SRK, 2021).

Based on these studies and wider knowledge of the geochemistry of the Elk Valley coal mines, it is evident that ARD is typically of low concern. However, these studies have all identified metal leaching, specifically relating to the release of selenium of principal concern.

3.5.1.3 Selenium

Studies by provincial geologists (Ryan and Dittrick, 2001, and Ryan et al., 2002, as cited in SRK, 2021), the University of British Columbia (Lussier, 2001, as cited in SRK, 2021) and Kennedy et al. (2012, as cited in SRK, 2021) show that selenium concentrations are correlated with rock type. The lowest concentrations of selenium and sulphur occur in sandstones (typically near 1 milligram per kilogram [mg/kg]) and higher concentrations in mudstones (2 to 4 mg/kg) (Ryan and Dittrick, 2001; Ryan et al., 2002). Concentrations in siltstones range between these values. Maximum selenium concentrations typically do not exceed 10 mg/kg.

The mineralogical occurrence of selenium was investigated by SRK (2008, as cited in SRK, 2021), Kennedy et al. (2012, as cited in SRK, 2021) and Hendry et al. (2015, as cited in SRK, 2021). It has been shown that the main reactive host for selenium is iron sulphide, but it was also found to be associated with other sulphur-bearing minerals (barite and gypsum).

Sulphur and selenium concentrations are commonly correlated, confirming the overall link to the occurrence of sulphur. In addition to the work described above, monitoring data from other Elk Valley mine sites was interpreted to better understand selenium release from coal mine rock dumps (SRK Consulting, 2014a, as cited in SRK, 2021). It was found that selenium and sulphate loading from mine rock dumps spans a relatively narrow range throughout the Elk Valley, despite differences in mine rock volume. This implies that sulphide oxidation rates are similar throughout the Elk Valley and that a consistent proportion of the rock mass is contributing to selenium loadings regardless of mine rock dump scale. Seasonal patterns of release of sulphate and selenium show no detectable lag between high flow events and high loading release implying that selenium is leached from components of the mine rock dumps via a piston flow mechanism. A further study into the effects of scaling was conducted (Kennedy et al., 2012) and found that sulphate and selenium release under field conditions is at least an order of magnitude lower than under laboratory conditions.

3.5.1.4 Other Metals

Villeneuve et al. (2017, as cited in SRK, 2021) indicates that in addition to sulphate (associated with the oxidation of pyrite), cadmium, chloride, and nitrate can also be present at elevated concentrations. However, they are typically of short-term concern and are associated with the initial flushing of solutes. Nitrate is typically associated with mine blasting activities and is, therefore, a common parameter of concern at mining operations, and management measures are commonplace to minimize this. Recent geochemical studies have also identified arsenic and iron in Elk Valley dump solutes and showed that these solutes are associated with the oxidation of primary sulfides (Biswas et al., 2017; Essilfie-Dughan et al., 2017, as cited in SRK, 2021). However, these studies note that the sorption of arsenic onto secondary iron oxyhydroxides provided a control on the release of both elements.

3.5.2 ML/ARD Conclusions

3.5.2.1 Comparison with Regional Characteristics

Geochemical data obtained from the Project was compared to other sites in the Elk Valley for the purpose of confirming the geochemical characteristics observed at the Project are consistent with those observed elsewhere for the same geological setting. By establishing similarity, expectations for the geochemical performance of the Project can be assumed to be comparable to existing mining operations. Kinetic testing was performed on mining waste samples using standard humidity cell leaching, which is 0.5 L/kg.

Key predictors that have been used to assess the ML/ARD potential in the Elk Valley (Mist Mountain Formation in particular) are sulphide sulphur, modified neutralization potential (NP), NP/AP (acid generation potential), selenium, and cadmium. Based on a visual review of results presented on box and whisker plots in SRK (2014b, as cited in SRK, 2021) for each of these key predictors, the following statements can be made generally for Elk Valley coal mines in comparison to the Crown Mountain results (for Mist Mountain Formation):

- Average sulphide sulphur contents for both Mist Mountain Formation coal and mine rock for other mines in the Elk Valley are approximately between 0.04 and 0.20%. This is very similar to the results for Crown Mountain, with average concentrations of sulphide sulphur being 0.12% across all samples in this study;
- Average values of modified NP for coal in the Elk Valley are between 10 and 100 kilograms (kg) calcium carbonate (CaCO_3) per tonne (t), while mine rock is generally higher than this being between approximately 30 and 200 kg CaCO_3 /t. In comparison, modified NP for coal at Crown Mountain was 6.56 kg CaCO_3 /t, while average values for mine rock were between 21.2 and 90.3 kg CaCO_3 /t. Therefore, the modified NP values for the Crown Mountain coal samples are lower than the regional average, whilst the mine rock data are broadly within range;
- Average NP/AP ratios for coal in the Elk Valley are between approximately 8 and 50, while mine rock is generally higher than this being between approximately 10 and 200. For Crown Mountain, the data shows average NP/AP for coal was 6.36, slightly lower than the average values for coal in the wider Elk Valley. Average NP/AP values for mine rock at Crown Mountain ranged between 14.2 and 69.1 and are comparable to the results for Elk Valley. The Mist Mountain Formation is dominantly non-PAG;
- Average selenium in coal and mine rock is similar and typically between 0.4 mg/kg to 3 mg/kg. The selenium data for Crown Mountain are comparable to this, showing that the average selenium content in coal is 2.13 mg/kg, and for mine rock, it is between 0.80 and 2.15 mg/kg; and
- Average cadmium is between 0.2 mg/kg and 3 mg/kg for coal, with mine rock typically a little higher, between approximately 1 mg/kg and 4 mg/kg. The data for Crown Mountain shows that the average cadmium concentration in coal is 1.56 mg/kg, and for mine rock, it is between 0.99 and 2.15 mg/kg.

Regionally the Morrissey Formation has been classified as mostly PAG. The data presented herein are broadly consistent with that, with many samples associated with Morrissey Formation classified as PAG.

3.5.2.2 Acid Drainage Potential

3.5.2.2.1 Mine Rock

Acid-base accounting for the Project indicated a generally low potential for ARD in Mist Mountain Formation and Fernie Formation mine rock due to an overall low sulphur content combined with excess NP. Isolated potentially ARD generating strata and/or samples have been identified (i.e., near seam 10U) but the sulphur content is only marginally above 0.1% at 0.12%.

The overall conclusion is that ARD potential for mine rock is low is supported by the lack of acid drainage throughout the Elk Valley, despite the long history of coal mining in the area and a significant amount of monitoring that has taken place over the past 40 years or so.

3.5.2.2.2 Overburden

No samples of overburden were collected for geochemical characterization. Overburden is thin in the area of the proposed open pit developments and consists of locally derived colluvial materials formed by physical weathering of bedrock. The characteristics of rock are considered to be an appropriate indicator of the characteristics of overburden.

3.5.2.2.3 Plant Rejects

Two samples of plant rejects were tested. One sample was classified as non-PAG, while the other was classified as having an uncertain acid generating potential. The Project will not generate separate tailings and coarse rejects. The process wastes will be combined into a single stream. NWP produced raw coal composites representing the coal quality for the North and South Blocks. Multiple coal seams will be mined at any time during Operations, so it is appropriate to produce composites. The Humidity Cell Testing (HCT) results were very similar to the mine rock samples, and the pH results were circum-neutral between 7.1 and 8.0. HC-15 (CM South plant reject) showed a gradual decline in pH between from 8.0 to 7.1. There was no indication that a decline in pH was associated with accelerated sulphide oxidation or metal leaching. The decline in pH may reflect slowing and low oxidation rates with corresponding less dissolution of carbonate minerals resulting in the greater effect from the de-ionized water (pH near 6).

The results suggest the samples can sustain non-acidic conditions while sulphide oxidizes, which is consistent with the presence of acid neutralizing minerals despite the lack of detection by X-ray Diffraction (XRD). The South Reject sample has NP/AP of 1.8 and sulphide sulphur of 0.17%, which indicates that residual sulphide content when NP is depleted will be below 0.1%. Generation of acid by rejects appears unlikely, particularly under the disposal conditions which are designed to restrict oxygen availability.

3.5.2.2.4 Trace Elements

Trace element characterization for the Project indicated a similar potential for leaching from mine rock compared to other sites in the Elk Valley, with the primary constituent of concern being selenium. Other elements were elevated in the mine rock, such as antimony, barium, molybdenum, copper, nickel, zinc, nickel, cobalt, arsenic, mercury, and cadmium. However, HCT results did not indicate any significant upward trends in release rates for these.

3.5.2.3 Short Term Leaching

Short term leaching reflects the dissolution of readily soluble components of waste materials and dissolution of explosives residuals. Readily soluble minerals (such as gypsum) are not naturally present but will form by oxidation when the rock is exposed by mining. Recent interpretation of kinetic test data for sedimentary rocks also shows that ammonia is present in an ion exchangeable form which will leach. The two sources of soluble chemical load (rock weathering and explosives) dissolve in pore water as meteoric waters contact the rock due to infiltration of rainfall and snowmelt. This occurs as soon as the rock is exposed to oxygen in pit walls and blasted rock before being hauled to the Mine Rock Storage Facility. Tables and plots of the kinetic test data used to assess short-term leaching of all potential exchangeable ions are provided in Appendix A2 of Appendix 3-B.

The processes for leaching of oxidizing mine rock and flushing of explosives residuals are inherently accounted for by the Water Quality Prediction Model source term methodology (Appendix 11-E). Oxidation of rock is assumed to occur immediately as it is released as indicated by the mining schedule, and that load is immediately available to contribute to pore water chemistry with attenuation effects resulting from reaction with rock and formation of secondary mineral precipitates.

The effect of leaching of exchangeable ammonia was not specifically considered in the surface water quality assessment (Chapter 11). Under the layered configuration, exchangeable ammonia can be expected to be converted to nitrogen as is anticipated to occur for ammonia in explosive residuals. If the layering configuration does not perform as expected, nitrate formed by nitrifying (oxidizing) ammonia will leach from the mine rock.

Estimates of the average monthly predicted quantity of leachate from the reject material and mine rock contained within the Mine Rock Storage Facility are provided in Table 3.5-1. Additional leachate quantity estimates under different climate change projections are provided in Appendix B2 of Appendix 3-B.

3.5.2.4 Study Conclusion

The main conclusions from this study include:

- The Mist Mountain Formation in the Project footprint has a comparably low ARD potential to Mist Mountain Formation elsewhere in the Elk Valley. It is classified as non-PAG. Isolated zones of PAG material are generally associated with near seam material, which represents a small volume of waste;
- Morrissey Formation is classified as PAG, also comparable with other results in the Elk Valley, where Morrissey Formation material is typically managed by blending with non-PAG Mist Mountain Formation;
- Coal rejects are not expected to be acid-generating, based on the presence of low levels of sulphide minerals and carbonate minerals which appear to provide sufficient buffering of low levels of acidity, and the disposal configuration which is designed to limit oxidation;
- Selenium concentrations in the Project footprint rocks are consistent with valley-wide experience, which shows concentrations varying from 0.80 to 2.2 mg/kg on average, with lower concentrations in sandstones and higher concentrations in mudstones. These results are very similar to academic studies in the Elk Valley; and
- Trace element concentrations in the Mist Mountain Formation are comparable to those observed in the Mist Mountain Formation elsewhere in the Elk Valley.

Table 3.5-1: Average Monthly Predicted Leachate Quantity (m³/day) from the Mine Rock Storage Facility

Year	Average Monthly Leachate Flow Rate (m ³ /day)											
	January	February	March	April	May	June	July	August	September	October	November	December
1	6.22	18.86	31.16	43.87	57.63	70.91	83.88	95.63	108.00	121.11	138.17	156.28
2	288.33	286.22	280.53	280.10	286.58	290.72	291.49	291.43	295.20	303.29	324.47	340.85
3	488.04	492.36	494.35	503.08	517.35	533.29	538.91	538.26	537.41	544.92	567.17	581.69
4	646.75	644.32	641.14	647.84	657.58	672.51	681.09	685.41	688.50	692.69	713.84	717.22
5	796.81	789.97	779.00	781.31	792.27	806.34	810.68	812.68	816.17	822.27	843.57	848.50
6	925.01	916.83	904.92	909.14	924.32	935.24	962.46	971.95	990.91	1,009.58	1,041.68	1,052.76
7	1,318.13	1,302.72	1,295.49	1,302.78	1,321.90	1,338.44	1,368.23	1,384.93	1,397.11	1,406.94	1,424.70	1,429.15
8	1,497.50	1,485.80	1,477.11	1,486.20	1,499.41	1,510.25	1,538.23	1,545.18	1,547.86	1,542.44	1,550.94	1,546.08
9	1,531.64	1,524.96	1,523.72	1,539.57	1,560.13	1,580.83	1,611.64	1,617.48	1,608.67	1,587.91	1,580.98	1,561.91
10	1,518.15	1,513.65	1,516.64	1,534.96	1,557.37	1,579.12	1,601.51	1,597.88	1,578.01	1,547.95	1,535.38	1,525.78
11	1,542.11	1,545.66	1,550.00	1,571.02	1,591.50	1,608.31	1,628.82	1,618.07	1,598.25	1,572.96	1,568.45	1,561.62
12	1,630.93	1,624.57	1,614.33	1,625.07	1,643.97	1,659.61	1,690.25	1,695.81	1,703.33	1,702.94	1,728.60	1,732.35
13	1,749.97	1,741.83	1,725.52	1,728.41	1,739.88	1,749.47	1,766.53	1,765.65	1,755.49	1,744.48	1,748.02	1,731.96
14	1,716.65	1,684.84	1,660.75	1,653.04	1,659.71	1,657.36	1,672.07	1,670.86	1,671.90	1,676.27	1,694.58	1,696.81
15	1,666.65	1,639.47	1,615.30	1,607.99	1,610.73	1,615.02	1,626.81	1,625.14	1,623.42	1,630.40	1,646.66	1,646.56
16	1,724.91	1,694.79	1,675.26	1,670.12	1,671.19	1,674.59	1,687.43	1,692.46	1,703.10	1,716.47	1,734.80	1,745.91
17	1,714.29	1,702.77	1,701.47	1,702.76	1,705.13	1,709.38	1,716.49	1,721.77	1,723.83	1,720.12	1,710.19	1,693.16
18	1,671.77	1,652.17	1,636.93	1,627.34	1,621.60	1,620.08	1,622.97	1,625.91	1,628.42	1,630.13	1,630.65	1,627.77
19	1,621.33	1,613.23	1,605.04	1,598.44	1,592.86	1,589.88	1,591.04	1,592.30	1,594.49	1,597.06	1,600.79	1,602.22
20	1,600.75	1,597.75	1,593.33	1,589.36	1,585.35	1,583.09	1,584.85	1,586.94	1,590.06	1,594.02	1,599.07	1,602.29
21	1,602.15	1,599.80	1,595.71	1,591.45	1,585.99	1,581.87	1,581.14	1,580.23	1,579.99	1,580.72	1,582.41	1,581.94
22	1,578.97	1,573.58	1,566.33	1,558.83	1,550.28	1,543.32	1,540.15	1,537.29	1,535.97	1,536.46	1,538.39	1,539.23
23	1,537.93	1,534.63	1,529.44	1,523.87	1,517.37	1,512.29	1,510.69	1,509.71	1,510.34	1,512.61	1,516.93	1,519.79
24	1,520.41	1,519.03	1,515.53	1,511.56	1,505.96	1,501.51	1,500.35	1,499.56	1,500.42	1,503.03	1,507.55	1,510.81
25	1,511.95	1,511.17	1,507.93	1,503.92	1,498.22	1,493.33	1,491.98	1,490.88	1,491.13	1,493.41	1,497.54	1,500.61

Year	Average Monthly Leachate Flow Rate (m ³ /day)											
	January	February	March	April	May	June	July	August	September	October	November	December
26	1,501.46	1,499.82	1,496.47	1,491.77	1,485.57	1,480.12	1,478.10	1,476.05	1,475.68	1,477.16	1,480.78	1,483.49
27	1,484.22	1,482.55	1,478.79	1,474.33	1,468.13	1,462.62	1,460.25	1,458.06	1,457.56	1,459.13	1,462.80	1,466.11
28	1,467.41	1,466.74	1,464.22	1,460.47	1,455.13	1,450.24	1,448.50	1,446.97	1,447.22	1,449.46	1,454.05	1,458.06
29	1,460.09	1,460.37	1,458.53	1,455.78	1,451.01	1,446.78	1,445.69	1,444.71	1,445.33	1,448.05	1,453.00	1,457.22
30	1,459.50	1,460.07	1,458.48	1,455.87	1,451.46	1,447.45	1,446.46	1,445.83	1,446.71	1,449.41	1,454.58	1,458.57
31	1,461.15	1,460.96	1,459.14	1,456.38	1,451.87	1,447.80	1,446.90	1,446.13	1,447.05	1,449.71	1,455.03	1,458.70
32	1,461.37	1,461.38	1,460.00	1,457.15	1,452.75	1,448.78	1,447.93	1,447.23	1,448.22	1,451.25	1,456.53	1,461.12
33	1,463.77	1,464.50	1,463.06	1,460.47	1,456.18	1,452.10	1,451.37	1,450.64	1,451.72	1,454.62	1,460.15	1,464.42
34	1,466.96	1,467.63	1,466.43	1,464.02	1,459.70	1,456.03	1,455.29	1,454.59	1,455.63	1,458.34	1,463.62	1,467.71

3.5.3 Metal Leaching and Acid Rock Drainage Management and Mitigation

The Project preliminary Metal Leaching and Acid Rock Drainage Management Plan (ML/ARD Plan) is included in the Site Water Management Plan (Chapter 33, Section 33.4.1.8). The primary objective of mine rock placement is to blend PAG and non-PAG materials such that the resulting mixture performs as non-PAG. As a result, NWP will undertake the following activities to achieve this outcome:

- Placement of PAG and non-PAG mine rock in engineered mine rock storage facilities and pit backfills;
- PAG walls could be submerged where the pit spill results in inundation;
- PAG walls could be covered in non-PAG backfill resulting in continually flushing by dissolved alkalinity and in-situ neutralization;
- Non-PAG rock could be placed along flow paths to result in neutralization of acidity either by direct contact with non-PAG rock or by mixing of alkaline and acidic water;
- Unless characterized differently during operational testing, Plant Refuse will be assumed to be non-PAG and will be disposed of in the mine rock storage facilities;
- The classification of Plant Refuse ARD potential should occur regularly during Operations;
- Ongoing planning should incorporate Plant Refuse placement into the plan for mine rock placement;
- Saturated backfilled pits will be the main design feature to limit selenium leaching; while selenium removal from contact waters has not been demonstrated directly, selenium concentrations in groundwater and outflows from saturated backfills are much lower than observed for comparable mine rock in conventional ex-pit mine rock at several operating mines; and
- When NWP defines quarry locations, they will aim to avoid PAG units and the rock will be characterized and monitored.

3.6 Project Phases

The life of the Project is approximately 34 years, including the Reclamation and Closure and Post-Closure phases. It is expected that the Construction and Pre-Production Phase will last approximately 19 months. The Operations phase will continue for approximately 15 years. Table 3.6-1 summarizes the Project phases.

Table 3.6-1: Project Phases, Timing, and Key Activities

Phase	Project Year	Length of Phase	Description of Activities
Construction and Pre-Production	Year 1 to Year 2	19 months	Construction of the following infrastructure: <ul style="list-style-type: none"> • Road upgrades • Coal Handling Process Plant (CHPP) • Run-of-Mine (ROM) stockpile • Grave Creek Reservoir • Water management and water management structures • Interim Sediment Pond • Office/Shop complex • Powerline

Phase	Project Year	Length of Phase	Description of Activities
			<ul style="list-style-type: none"> Natural gas line Explosives factory Overland conveyor Rail loadout Waste materials facility <p>Other activities:</p> <ul style="list-style-type: none"> Clearing and grubbing of vegetation Soil salvaging Stockpiling of wood waste Logging of merchantable timber Quarrying for construction materials Transportation along Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road
Operations	Year 3 to Year 17	15 years	<p>Production of:</p> <ul style="list-style-type: none"> 270 bank cubic metres (bcm) of waste 57.5 million metric tonnes (Mt) of ROM coal 26.3 Mt of clean coal 31.2 Mt of plant rejects <p>Construction of:</p> <ul style="list-style-type: none"> Additional shop in Year 1 Main Sediment Pond in Year 4 Mine roads, as necessary <p>Other activities:</p> <ul style="list-style-type: none"> Use of water from the Interim Sediment Pond, contact water from North Pit and as necessary backup reservoir at Grave Creek Use of on-site facilities and equipment Coal processing Sewage treatment Management of Main Sediment Pond discharge Transportation along Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road Progressive reclamation
Reclamation and Closure	Year 17 to Year 19	2 years	<p>Decommissioning of the following infrastructure:</p> <ul style="list-style-type: none"> CHPP ROM Stockpile Grave Creek Reservoir Construction Water Management Office/Shop Complex Powerline Natural Gas Line Explosives Manufacturing Site <p>Reclamation of the following infrastructure:</p>

Phase	Project Year	Length of Phase	Description of Activities
			<ul style="list-style-type: none"> • ROM Stockpile • Plant/Office Complex Pad • Pit and mine rock storage facility areas not reclaimed at end of mine life <p>Other activities:</p> <ul style="list-style-type: none"> • Reclamation, geotechnical, and aquatic effects monitoring and implementation of follow-up and monitoring programs • Management of the Main Sediment Pond discharge • Transportation along Highway 43, Line Creek Mine Road, Valley Road, and Grave Creek Road
Post-Closure	Year 19 through Year 34	15 years	<p>Activities include:</p> <ul style="list-style-type: none"> • Decommissioning of the Main Sediment Pond • Reclamation, geotechnical, and aquatic effects monitoring and implementation of follow-up and monitoring programs

3.7 Project Components

The components of the Project as currently conceived are described in this section.

3.7.1 Project Component Overview

The development of the Project, as proposed, includes the following major Project components:

- Open pit surface mining operation using conventional truck and shovel mining methods with capacity for production of up to 4.0 million tonnes per year (Mtpa) ROM coal. The surface mine has been sequenced to limit the creation of external mine rock storage facilities (MRSF) and allow for on-going progressive reclamation;
- The Coal Handling Process Plant (CHPP), with a nominal capacity of 546 to 570 tonnes per hour, is capable of producing up to 2.2 Mtpa clean coal product with a target ash of 9.5% for coking coal and 10% for PCI coals with a total moisture of 9% or less. The CHPP includes coarse, fine, and ultrafine coal washing circuits. The Project will produce dewatered coal wastes and does not require a conventional tailings impoundment;
- The primary water source will be supplied from the Interim Sediment Pond for the first four years of the operation, and then the primary water source will be the mined out North Pit. There will be a backup water supply source from a pond in the Grave Creek catchment and will be pumped to the site facilities for use at the site. Potable water will be sourced from a well;
- A series of two sedimentation ponds are proposed for managing the combined run-off from the mine footprint and undisturbed ground as the mine development advances. These ponds will be placed downstream of the main mine rock dump and will be decommissioned and reconstructed through the mine life to accommodate the advancing mine rock placement. Sedimentation ponds were sized for two phases of mining: an Interim Sediment Pond for Operations up to the end of Year 4 (EOY 4) and a Main Sediment Pond for the full mine footprint into Post-Closure;
- Maintenance, warehouse, office and dry complex to support the operation and personnel; and

- A clean coal handling and rail loadout system will be built to convey product coal from the site via a 2.7 km overland conveyor system to a transfer bin where coal is then loaded on to highway legal trucks. The trucks will haul the coal on the upgraded Grave Creek Road to a rail loadout system with 2 x 25,000 ton capacity stockpiles to load the trains. Coal would be railed to one of the existing coal terminals on the west coast of British Columbia. Based on publicly available information, existing coal terminals will have sufficient uncontracted capacity for the estimated coal production from the Project.

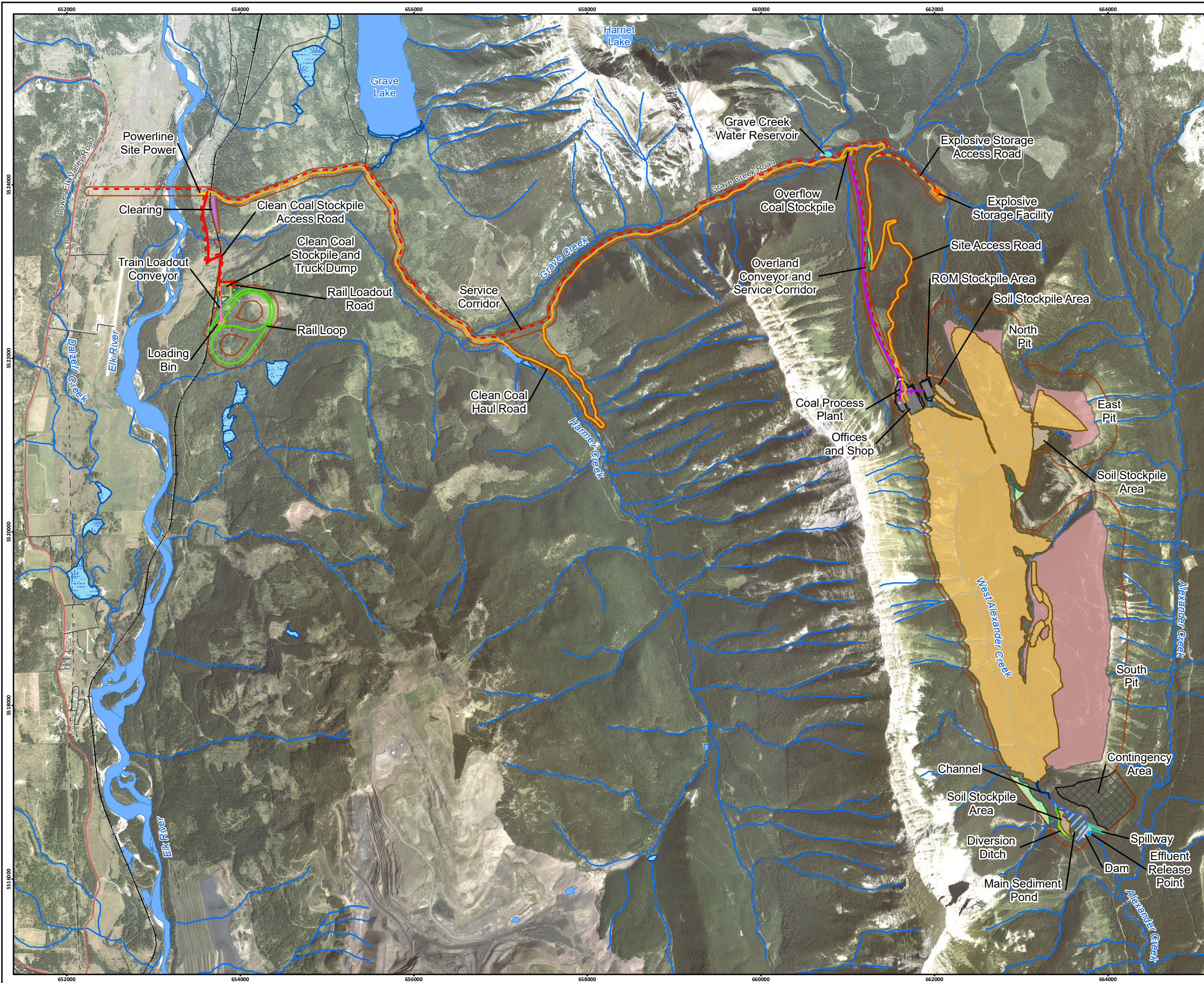
The Project is in close proximity to important infrastructure, which include major roads, rail service, access to power, and a mining town site. These features will be important for the development of the Project. Due to the nature of the terrain and the geology of the area, surface mining methods are suitable for the planning and development of the Project.

Major Project infrastructure components are shown in Figure 3.7-1 and progressive layouts of the development plan are contained in Figure 3.7-2 to Figure 3.7-8.

3.7.2 Surface Extraction Area (Pit Design)

In support of pit design, NWP advanced a geohazard evaluation including terrain stability (e.g., slopes) and geohazards mapping. This effort provided an inventory of landslide geohazards, and “knowledge of the location of geohazards and potentially unstable terrain was used to inform the terrain stability assessments and landslide risk assessments (BGC Engineering, 2019)” for the Project. Stability classes have been identified with corresponding potential for instability within the upper few metres of in-situ material. North, East, and South Pits would be located on till, colluvium, weathered bedrock, and bedrock that intersect both landslide and Terrain Stability Class IV (potentially unstable) and Class V (unstable) terrain. The Terrain Stability Classes are based on potential for instability from development activities within the upper few metres of the land surface. The pit design basis includes removal of potential zones of instability within the Surface Extraction Area to mitigate the potential for geohazard influence to the pits. Instrumentation and monitoring of pit walls during Operations would act as a measure of engineering control to evaluate the effectiveness of mitigation strategies and performance. Pit design guidelines for the Project have been developed based on preliminary investigations about materials at site; pit design guidelines specify the bench face angle, maximum unbenched height, and bench width for the pits. Factors of safety have been established for pit sections, and highwall stability analyses have been developed (Stantec, 2020). Additional information about soils and terrain assessment, including geohazards, is contained in Chapter 8.

The hydrogeological baseline environment and potential for Project interaction relative to the surface extraction areas, pit design, and soil and terrain assessment is described in Chapters 8 and 9. NWP’s knowledge of the hydrogeological environment has been informed by the establishment of 25 monitoring wells and 6 seepage monitoring stations to document the groundwater conditions. The potential for Project impacts to groundwater quantity and quality over both time and space (i.e., effects forecasting) are further described in Chapter 9 and the Site Water Management Plan (Chapter 33, Section 33.4.1.8), along with proposed mitigation strategies and plans to avoid or reduce potential impacts. NWP has gathered (directly and indirectly) short-term and long-term meteorological data to better understand and evaluate the relationship between climate and hydrological conditions at the site. Additional discussion about climate and hydrology is found in Chapter 10.

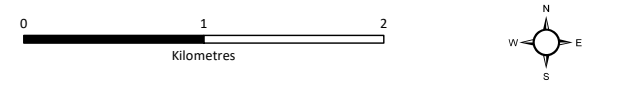


Crown Mountain Coking Coal Project

Figure 3.7-1
Infrastructure Layout

LEGEND

	Project Footprint		Powerline-Site Power
	Effluent Release Point		Water Reservoir
	Channel to Ultimate Pond		Main Sediment Pond
	Clean Coal Haul Road\Site Access		Dam
	Explosive Storage Access\Facility Road		Spillway
	Rail Loadout Road		Diversion Ditch
	Rail Loop		Clearing
	Service Corridor		Additional Area
	Coal Process Plant Conveyor		Contingency Area
	Coal Process Plant Duct		Arterial/Collector Road
	Train Loadout Conveyor		Local/Resource Road
	Waste Dump		Railway
	Mined Area		Transmission Line
	Clean Coal Stockpile and Truck Dump		Watercourse
	Overflow Coal Stockpile		Waterbody
	Soil Stockpile Area		Wetland
	Explosive Storage Facility\Pad		British Columbia/Alberta Border
	Loading Bin		
	Plant Site\ROM Stockpile Area		



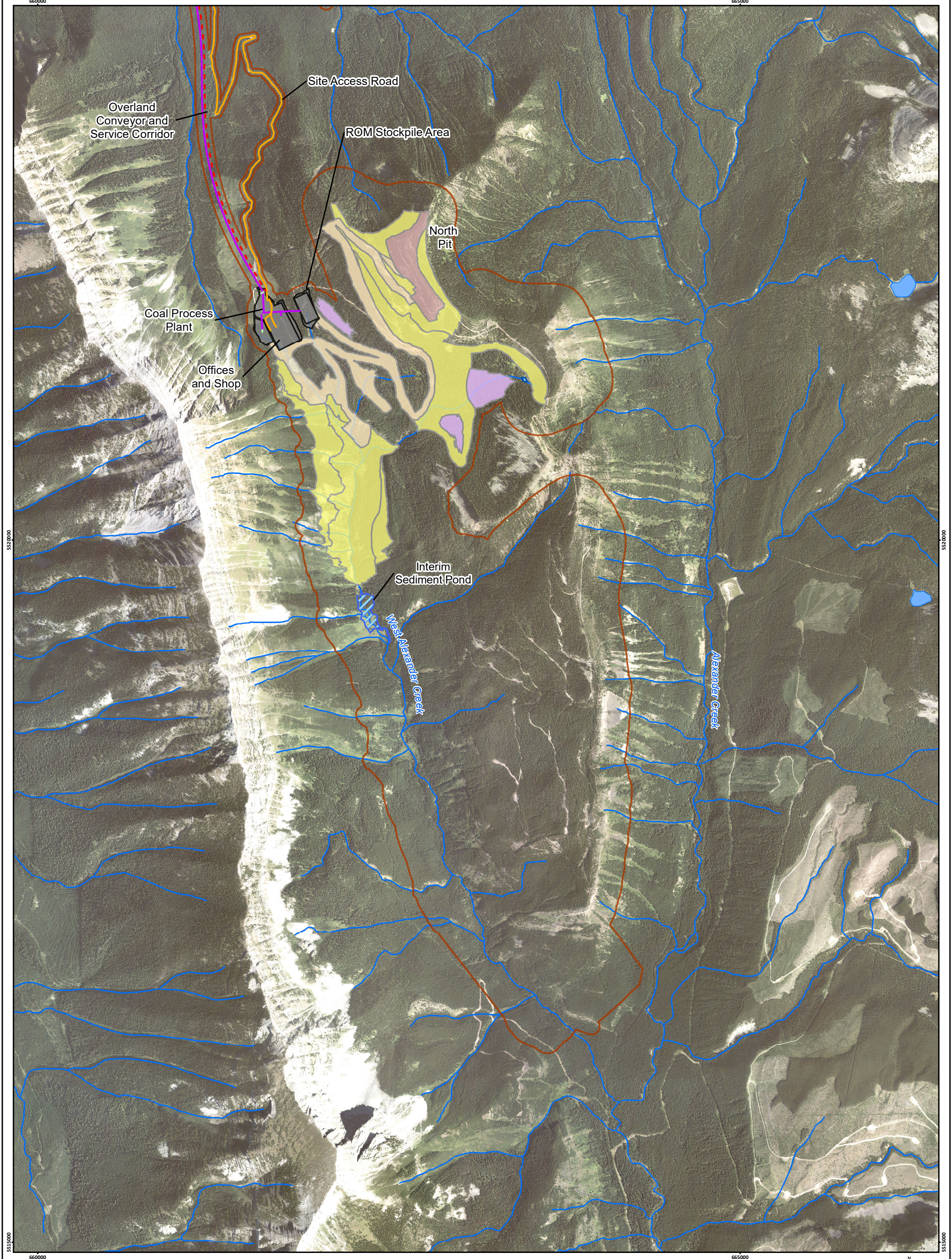
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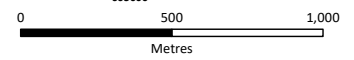


Crown Mountain Coking Coal Project

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Clean Coal Haul Road\Site Access | British Columbia/Alberta Border |
| Clearing and Grubbing Area | Service Corridor | |
| Design Dump and Road Area | Coal Process Plant Conveyor | |
| Design Pit Area | Coal Process Plant Duct | |
| Soil Stockpile Area | Watercourse | |
| Plant Site\ROM Stockpile Area | Waterbody | |
| Interim Sediment Pond | Wetland | |

Figure 3.7-2
Pre-Production Layout



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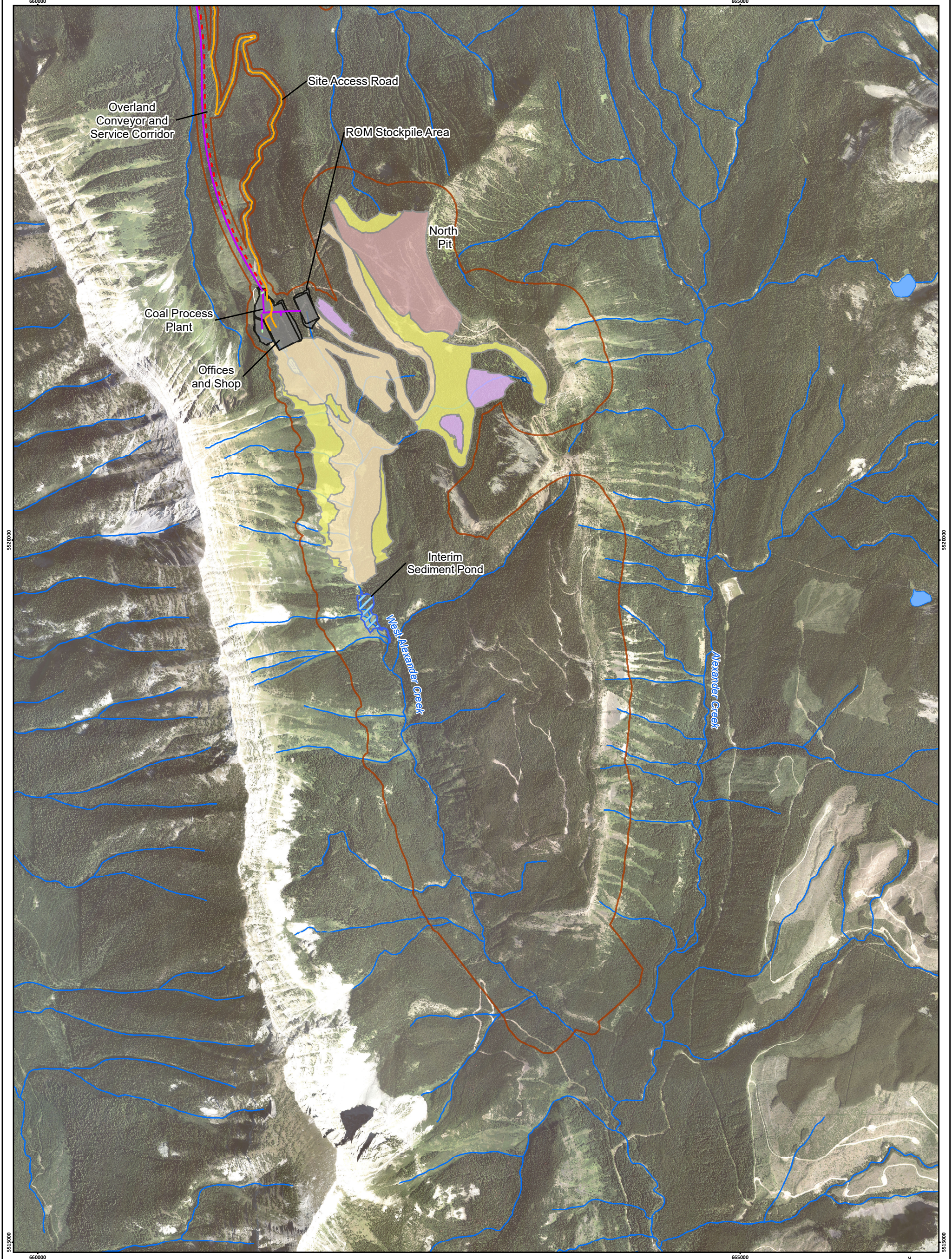


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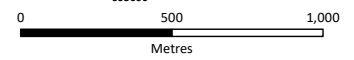


Crown Mountain Coking Coal Project

Figure 3.7-3
Year 1 Layout

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Clean Coal Haul Road\Site Access | British Columbia/Alberta Border |
| Clearing and Grubbing Area | Service Corridor | |
| Design Dump and Road Area | Coal Process Plant Conveyor | |
| Design Pit Area | Coal Process Plant Duct | |
| Soil Stockpile Area | Watercourse | |
| Plant Site\ROM Stockpile Area | Waterbody | |
| Interim Sediment Pond | Wetland | |



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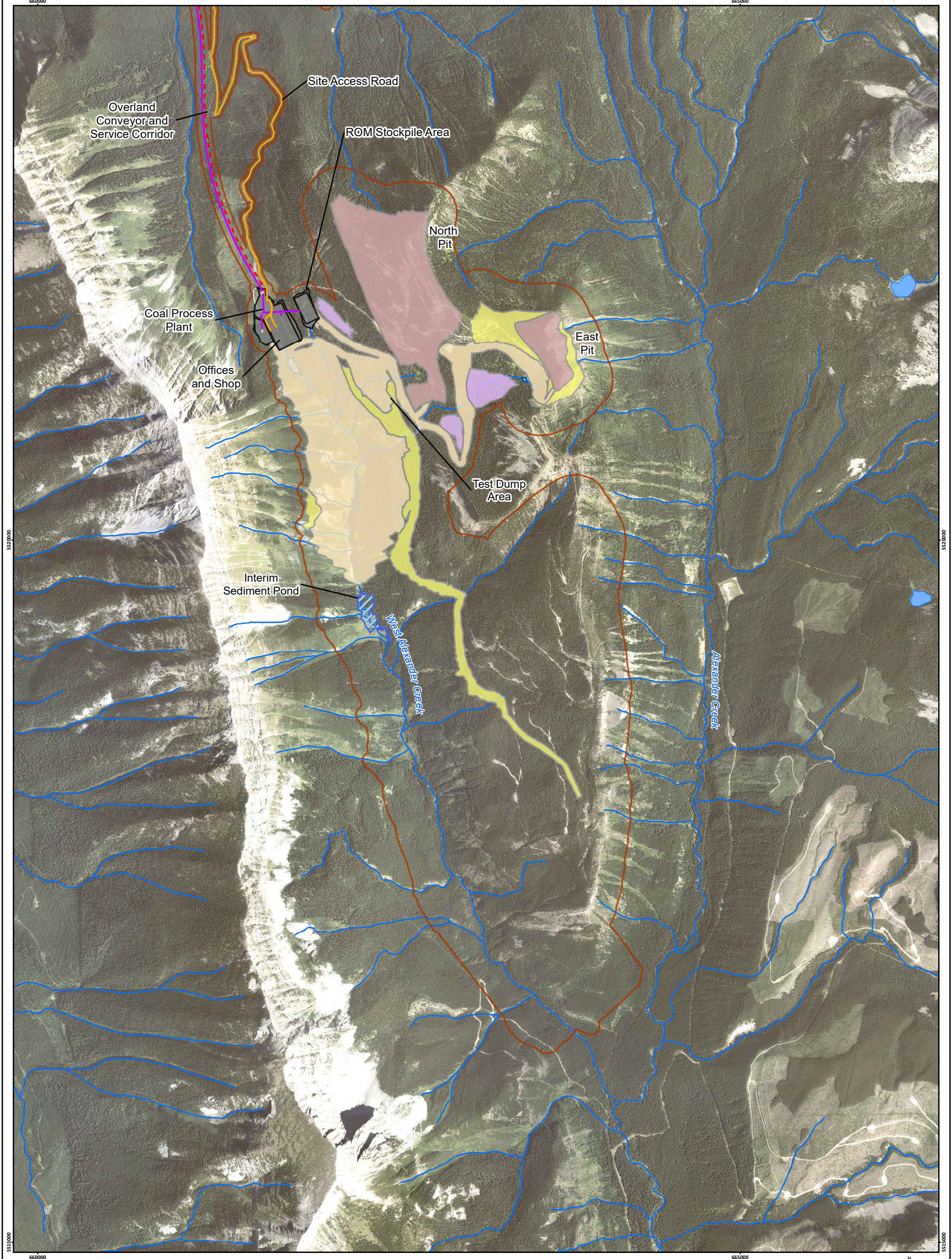


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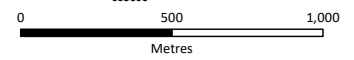


Crown Mountain Coking Coal Project

Figure 3.7-4
Year 3 Layout

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Clean Coal Haul Road\Site Access | British Columbia/Alberta Border |
| Clearing and Grubbing Area | Service Corridor | |
| Design Dump and Road Area | Coal Process Plant Conveyor | |
| Design Pit Area | Coal Process Plant Duct | |
| Soil Stockpile Area | Watercourse | |
| Plant Site\ROM Stockpile Area | Waterbody | |
| Interim Sediment Pond | Wetland | |



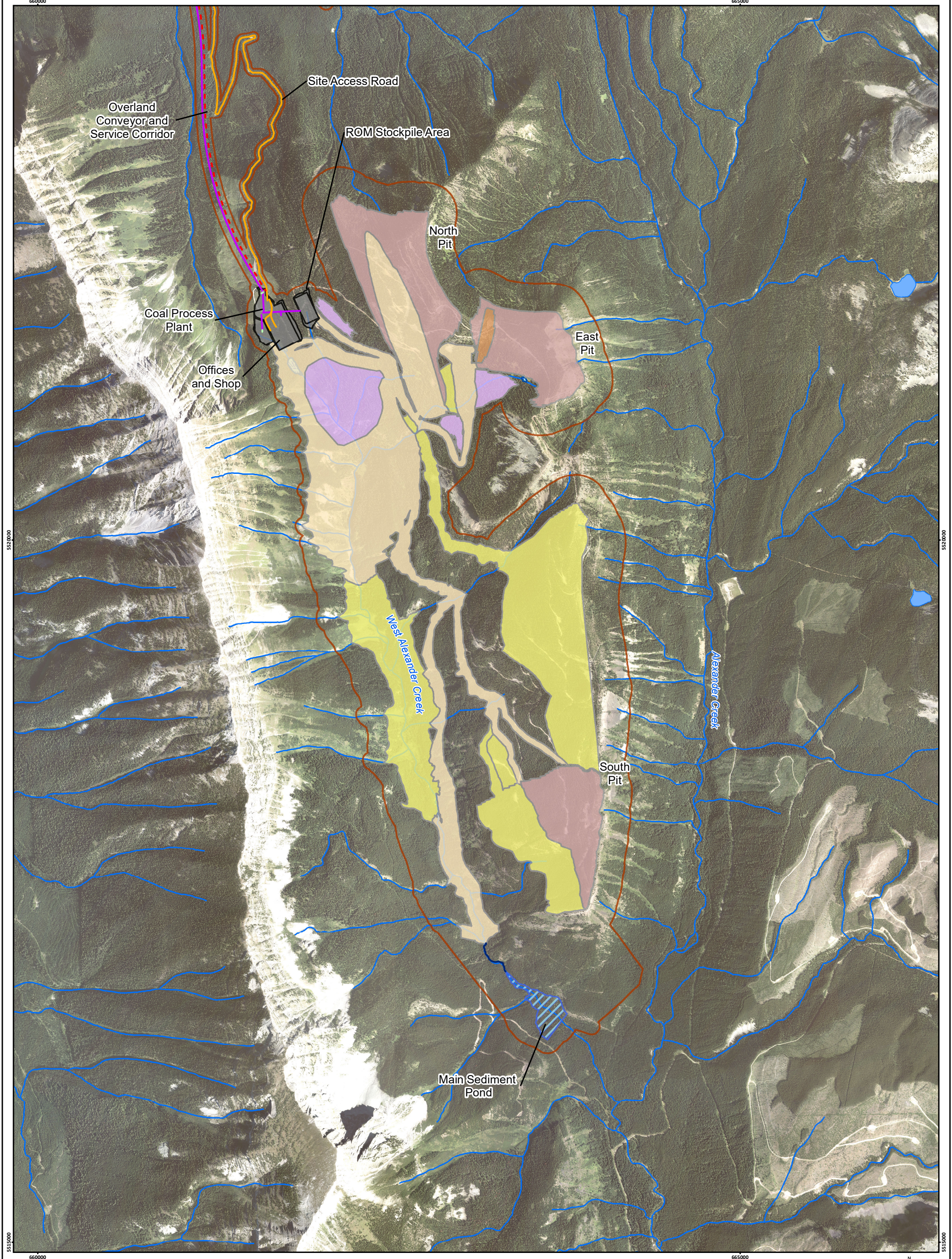
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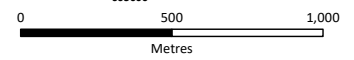


Crown Mountain Coking Coal Project

Figure 3.7-5
Year 5 Layout

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Main Sediment Pond | Wetland |
| Clearing and Grubbing Area | Channel to Ultimate Pond | British Columbia/Alberta Border |
| Design Buttress Area | Clean Coal Haul Road\Site Access | |
| Design Dump and Road Area | Service Corridor | |
| Design Pit Area | Coal Process Plant Conveyor | |
| Soil Stockpile Area | Coal Process Plant Duct | |
| Plant Site\ROM Stockpile Area | Watercourse | |
| | Waterbody | |



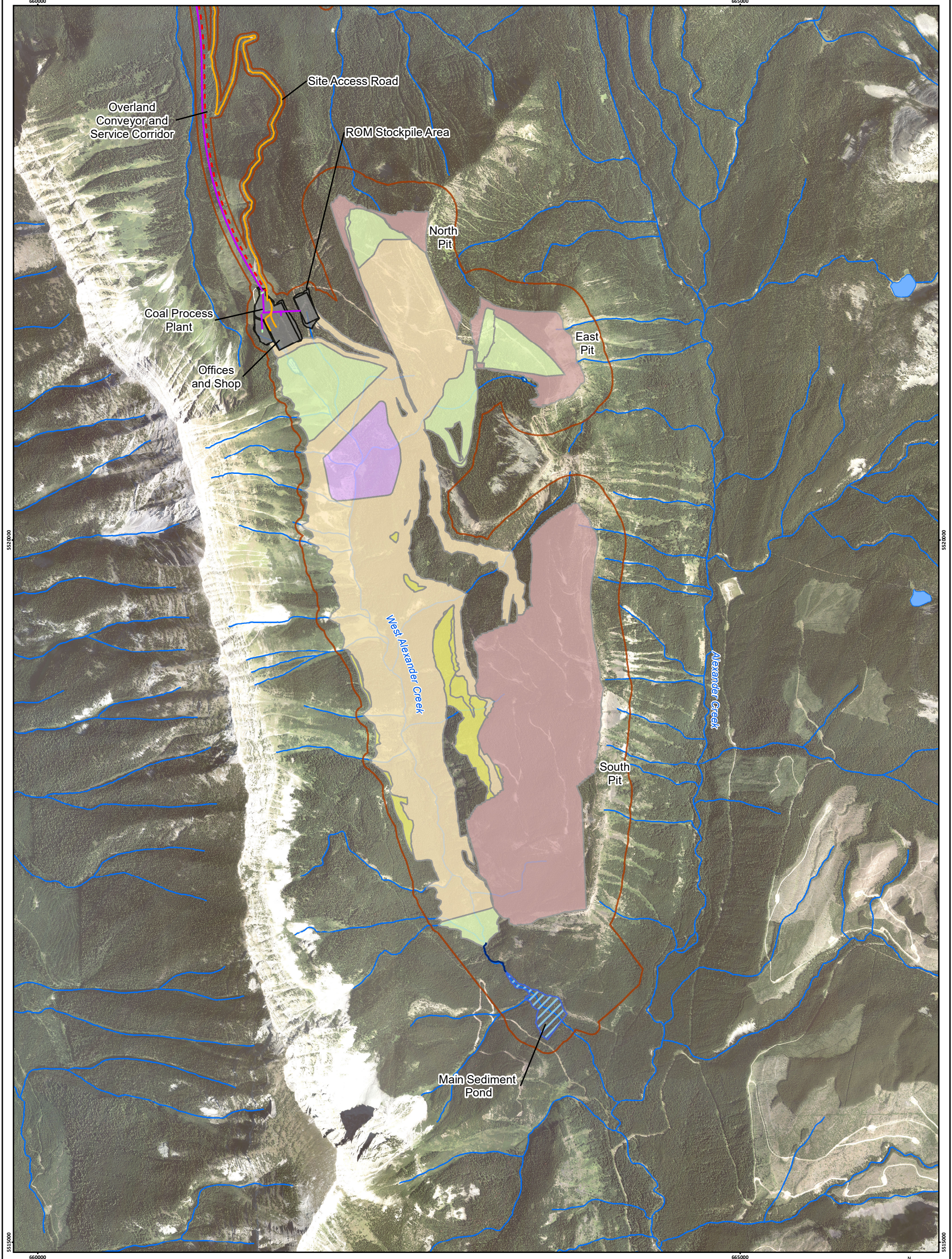
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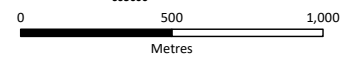


Crown Mountain Coking Coal Project

Figure 3.7-6
Year 10 Layout

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Main Sediment Pond | Wetland |
| Clearing and Grubbing Area | Channel to Ultimate Pond | British Columbia/Alberta Border |
| Design Dump and Road Area | Clean Coal Haul Road\Site Access | |
| Design Pit Area | Service Corridor | |
| Reclaimed Area | Coal Process Plant Conveyor | |
| Soil Stockpile Area | Coal Process Plant Duct | |
| Plant Site\ROM Stockpile Area | Watercourse | |
| | Waterbody | |



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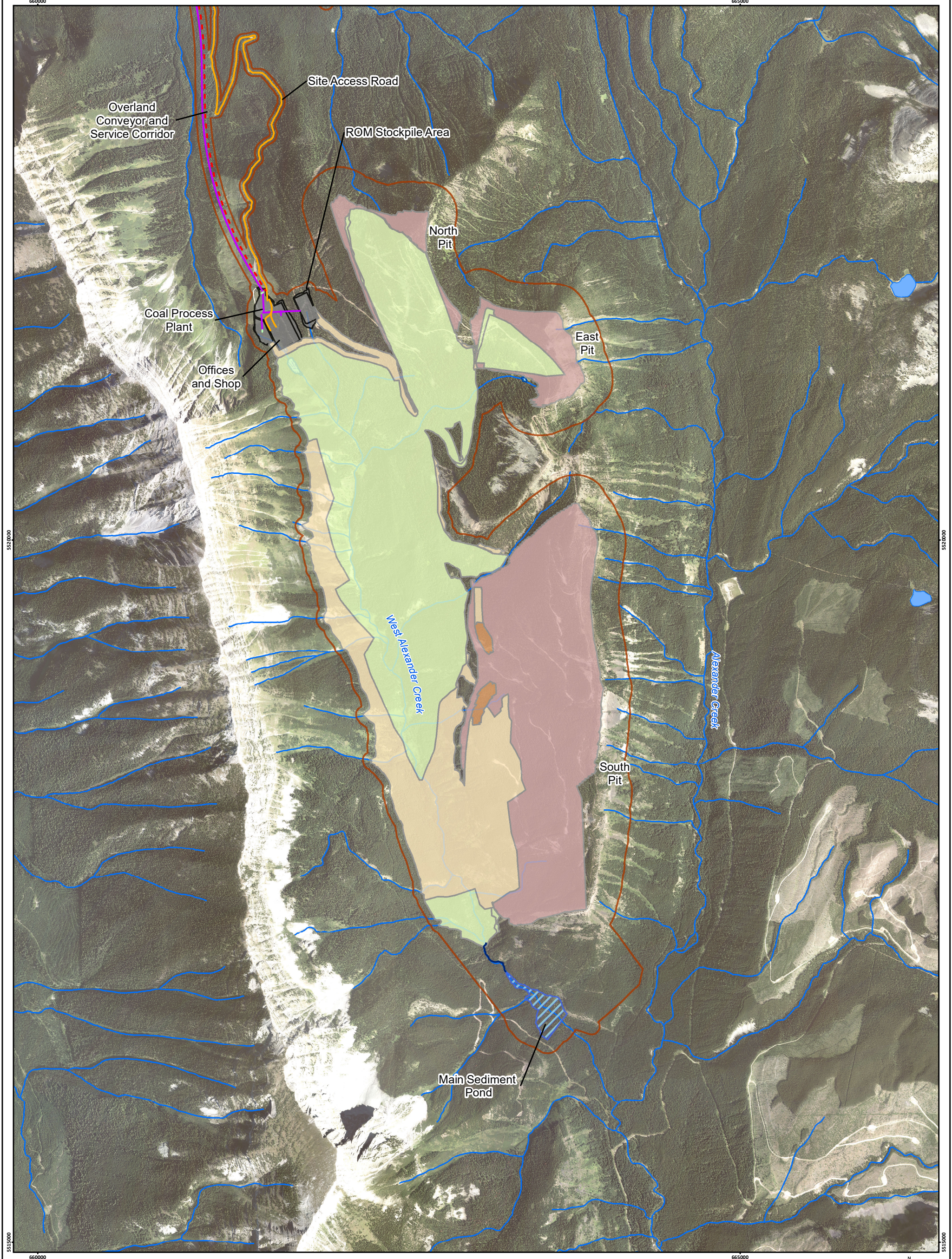


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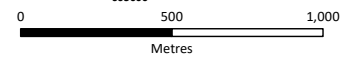


Crown Mountain Coking Coal Project

Figure 3.7-7
Year 15 Layout, Ultimate Pit Design

LEGEND

- | | | |
|-------------------------------|----------------------------------|---------------------------------|
| Project Footprint | Clean Coal Haul Road\Site Access | British Columbia/Alberta Border |
| Design Buttress Area | Service Corridor | |
| Design Dump and Road Area | Coal Process Plant Conveyor | |
| Design Pit Area | Coal Process Plant Duct | |
| Reclaimed Area | Watercourse | |
| Plant Site\ROM Stockpile Area | Waterbody | |
| Main Sediment Pond | Wetland | |
| Channel to Ultimate Pond | | |



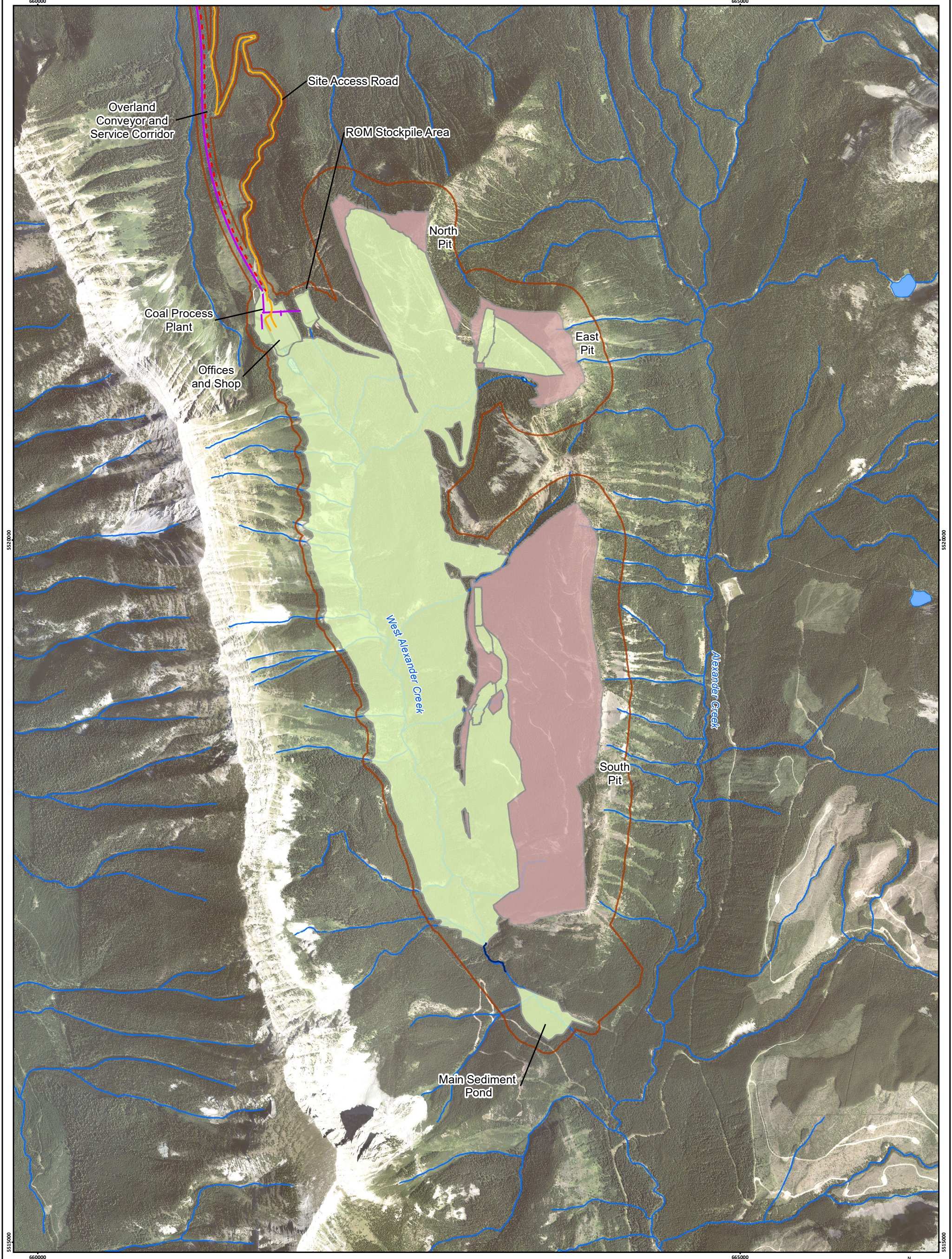
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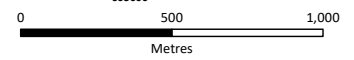


Crown Mountain Coking Coal Project

Figure 3.7-8
Final Closure Layout

LEGEND

- | | |
|----------------------------------|---------------------------------|
| Project Footprint | Coal Process Plant Conveyor |
| Reclaimed Area | Coal Process Plant Duct |
| Design Pit Area | Watercourse |
| Plant Site\ROM Stockpile Area | Waterbody |
| Channel to Ultimate Pond | Wetland |
| Clean Coal Haul Road\Site Access | British Columbia/Alberta Border |
| Service Corridor | |



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Project: 12-6231
Status: FINAL
Date: 2022-03-17

Pit seepage and groundwater inflow analysis has been completed and used to inform pit design. Baseline groundwater investigations provided input data to support modeling. While each pit will experience a few years when there is no inflow from groundwater sources because the water table is below the base-of-pit elevation, the estimated pit groundwater inflow is anticipated to ultimately range from a low-side minimum of 240 m³/day in East Pit to a high-side maximum of 1,100 m³/day in South Pit (Stantec, 2020).

As described in the following sections, pit wall design follows the Guidelines for Open Pit Slope Design (Read and Stacey, 2009, as cited in Stantec, 2020). An example of the application of this guideline includes limit equilibrium (L-E) analysis and establishment of Factors of Safety (FOS), which is detailed in the Project Pit Wall Design Guidelines (Stantec, 2022a).

The following sections describe the surface extraction area pit design developed for the Project feasibility study. Surface extraction area design is being refined as the Project advances.

3.7.2.1 Footwall Guidelines

The Crown Mountain footwall bench face angles will be controlled by bedding dips, as is typical in this type of deposit. Bedding dips in some areas of the North Pit are as steep as 60° and are generally shallower in the South and East Pits (<30°). Recommended footwall design guidelines for the Seam 10L footwall, which is the base of the coal seam sequence, are presented in Table 3.7-1.

Table 3.7-1: Seam 10L Footwall Guidelines

Bedding Dip (°)	Bench Face Angle (°)	Maximum Unbenched Height (m)	Minimum Bench Width (m)
<25	Follows bedding dip slope	-	-
25-30		120	8
30-40		60	12
40-50		30	10
50-60			10
60-70			8

These guidelines are specific to the footwall being located immediately below Seam 10L. Additional analyses would be required if the stratigraphic location of the final footwall changes as the rock mass strength of the footwall has a significant effect on the unbenched slope height.

3.7.2.2 Highwall Guidelines

In the absence of adversely dipping faults, the Crown Mountain highwalls will be controlled by overall rock mass strength and the location and orientation of coal seams forming part of the wall. Highwall guidelines are based on typical bench configurations and L-E analyses. An important note is that some of the highwalls will require a buttress of in-situ material to be left in place to satisfy global design stability criteria. In some cases, this buttress of in-situ material may contain a significant tonnage of mineable coal. Where stability conditions permit, the buttress will be panel mined, and the highwall toe area immediately backfilled with mine rock to restore the buttress stabilizing effect. Recommended highwall design guidelines are presented in Table 3.7-2. Figure 3.7-9 shows the buttress requirement for the high wall.

Table 3.7-2: Highwall Guidelines

Bench Face Angle (°)	Maximum Unbenched Height (m)	Minimum Bench Width (m)
65	30	10
Buttressing Requirements		
Northing (from: to)	Buttress Crest Width	Buttress Crest Location is 5 m above:
5,521,800 : 5,521,200	50	Seam 9 and/or fault
5,521,200 : 5,519,980	80	Seam 9 and/or fault
5,519,980 : 5,518,200	50	Seam 9 and/or fault
5,518,200 : 5,517,280	Not required.	

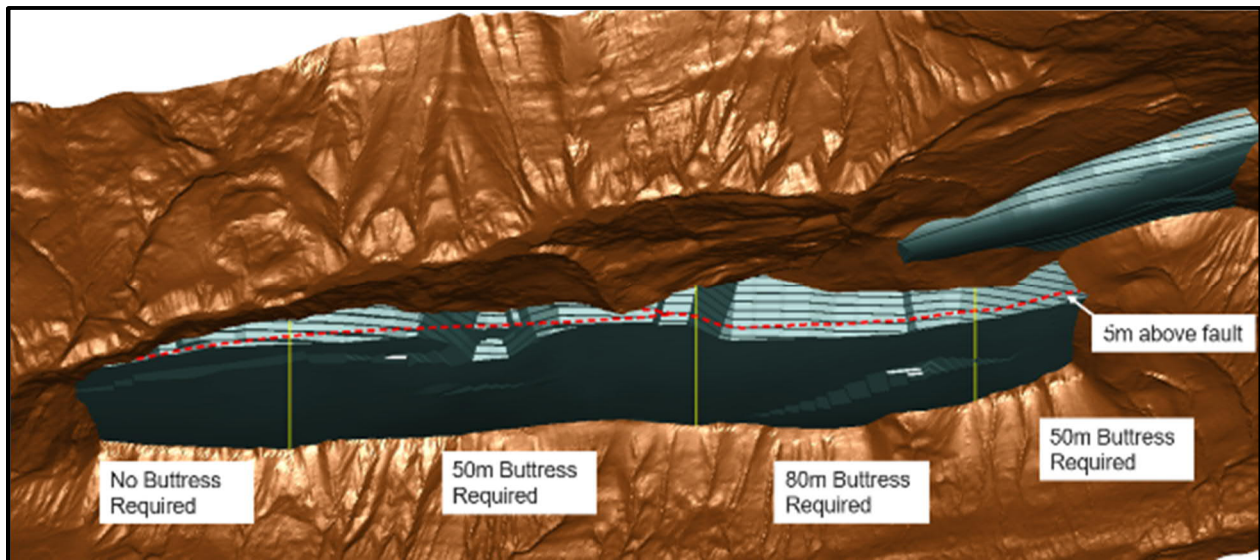


Figure 3.7-9: Buttress Requirement for South Pit

3.7.2.3 Endwall Guidelines

The current mine plan has endwalls as part of the pit design in the East Pit and the South Pit, as the north and south areas are expected to be mined while leaving Crown Mountain between them. Similar to the highwall, endwall stability will be controlled by overall rock mass strength and the location and orientation of coal seams forming part of the wall. Due to the configuration of the pit bottom, dip of daylighting coal seams, and height of the remaining wall and mountain, shallow overall slopes for endwalls are used rather than steeper walls with buttressing used for highwalls. Recommended endwall design guidelines are presented in Table 3.7-3.

Table 3.7-3: Endwall Guidelines

Bench Face Angle (°)	Maximum Unbenched Height (m)	Bench Width (m)	Maximum Overall Slope Angle (°)
55	10	10	32

3.7.2.4 Pit Design

The final pit designs were generated using the base case pit shell limits and the application of geotechnical pit slope design guidance. The plan view of the base case pit designs is shown in Figure 3.7-10 along with the CA\$175/t pit shell and CA\$220/t pit shell limits.

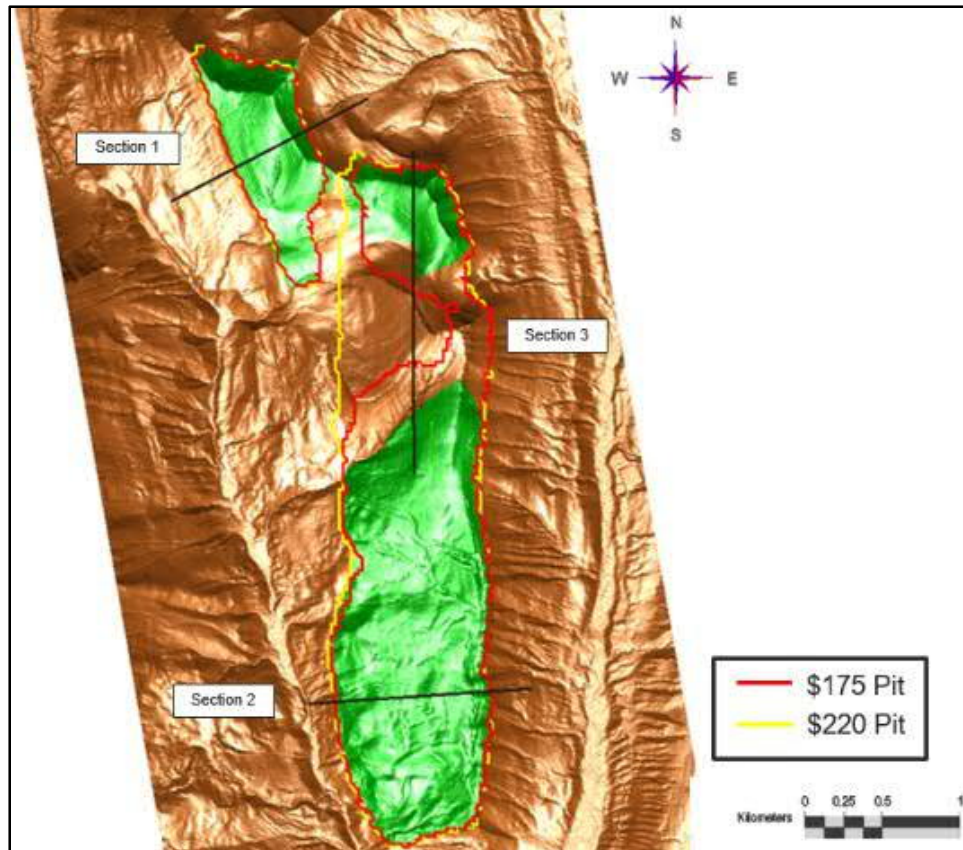


Figure 3.7-10: Plan View of Base Case Design Pit and Pit Shells

Figure 3.7-11 to Figure 3.7-13 show representative cross-sections of the pit areas. Figure 3.7-11 shows that the synclinal structure of the North Pit results in the pit design being governed by the footwall pit slope guidelines. Figure 3.7-12 looking through the South Pit also shows the effect of the footwall design guidelines; however, the highwall does increase in overall height as the pit moves north towards Crown Mountain.

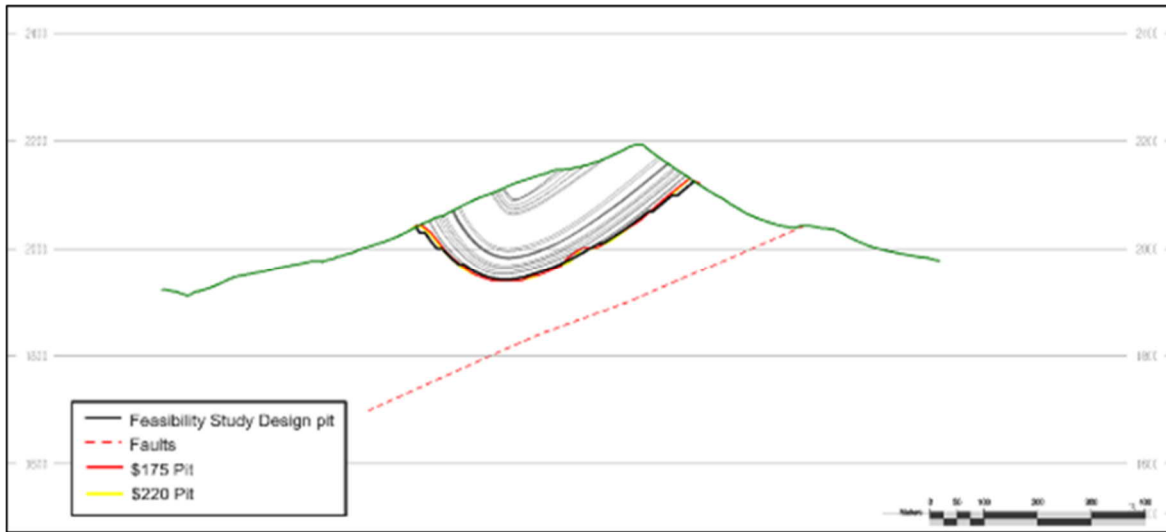


Figure 3.7-11: Section 1 looking towards the Northwest through North Pit

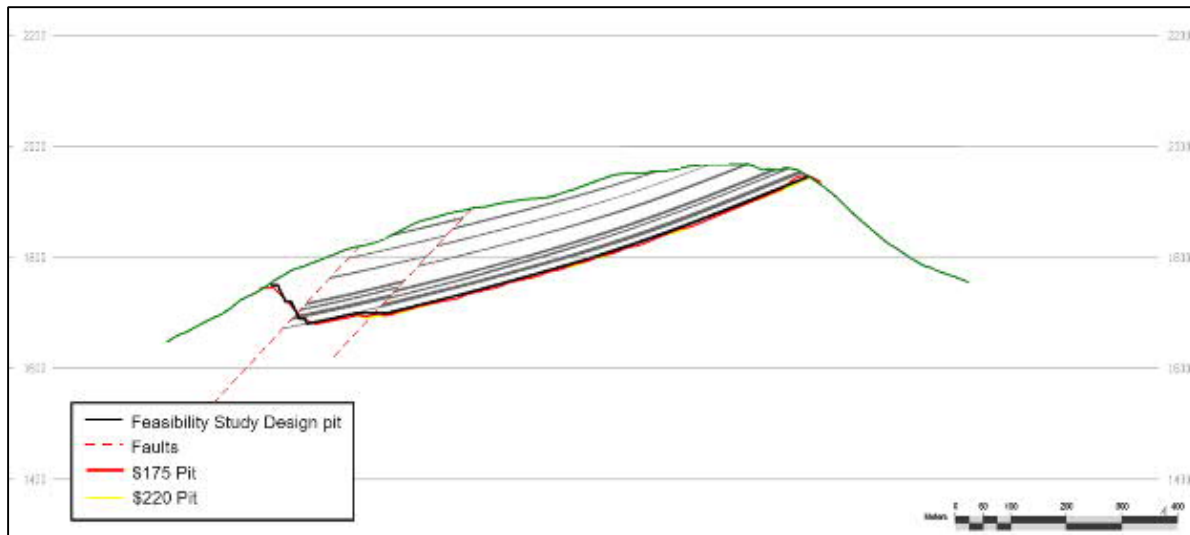


Figure 3.7-12: Section 2 looking towards the North through South Pit

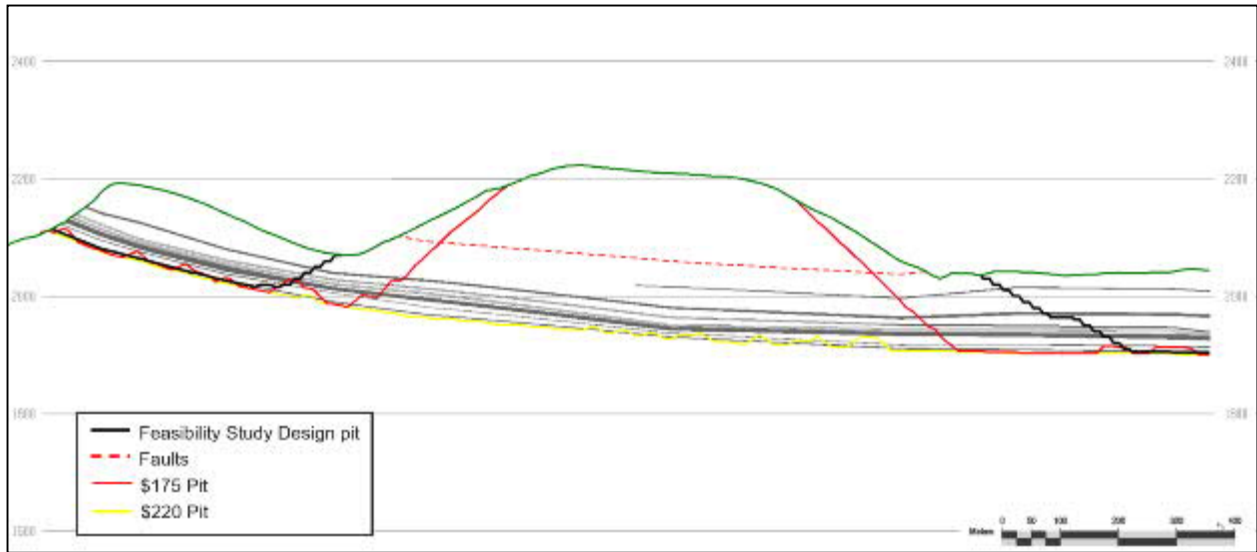


Figure 3.7-13: Section 3 looking towards East

The pit design follows the CA\$175 pit shell closely except for the end walls adjacent to the Crown Mountain area. The two end walls have been stepped in from the selected pit shell for the following reasons:

- Constrain the overall height of the end walls in order to satisfy slope stability criteria;
- Maintain a suitable mining width for efficient loading/hauling productivity;
- Allowance for water management and diversions around the pits; and
- Access constraints related to upper bench development (i.e., development of small initial benches above 2,100 m would be high cost).

3.7.2.5 Air Quality and Dust Control

The Air Quality and Greenhouse Gas Management Plan (AQGHGMP; Chapter 33, Section 33.4.1.1) provides a framework for the appropriate Project-wide prevention, response, and management of air quality and dust control management. The AQGHGMP also outlines the monitoring programs that will be implemented to assess the performance of air quality and dust control measures for all phases of the Project, including activities associated with Surface Area extraction development and operations. The AQGHGMP identifies specific mitigation measures that will be applied as mitigation in controlling fugitive dust.

3.7.3 Mine Rock Management

The Project mine rock management strategy is aligned with NWP corporate philosophy and Project-wide strategies as reflected throughout this Application/EIS. A core concept of the mine rock management strategy is to effectively manage mine rock on-site so that it does not present a long-term liability to future generations. This is a key element of enabling the Project's vision of keeping water clean, protecting sensitive aquatic habitat, and providing an acceptable post-closure landscape that meets the needs of local Indigenous communities and other people in the region. The mine rock management strategy intends to limit the mine disturbance footprint through progressive reclamation activities and avoid impacts to drainages outside of West Alexander and Grave Creeks. This will be achieved by limiting the placement of mine rock to within the West Alexander Creek basin only. To effectively manage mine rock

on-site, NWP is proposing a Layer Cake method (Chapter 2) within the Mine Rock Storage Facility (MRSF), which intends to mitigate both selenium and nitrate simultaneously while reducing selenium release.

Segregation of mine rock is not a major feature of mine rock management for the Project. Currently, PAG rock requiring active management is clearly identified as part of the Morrissey Formation. Due to the clear association of PAG mine rock with a well-defined stratigraphic unit rather than being defined by geochemical testing, the risk of imperfect segregation is considered to be very low. The current source term method considers the range of weathering rates as indicated by kinetic tests which sufficiently accounts for uncertainty in mine rock characteristics and weathering conditions.

The Site Water Management Plan (Chapter 33, Section 33.4.1.8) details the baseline conditions, potential effects, and mitigation measures for surface and groundwater from mine rock management and other Project activities. The plan outlines a proposed monitoring and response process, including the proposed types and frequency of measurement. For the proposed Layer Cake method, bench scale testing indicates that the sequestering of selenium and abatement of nitrate is possible (Enviromin, Inc., 2022; Appendix 3-C). Confirmation at scale will be assessed through a controlled, full scale test dump facility at site at the start of mine life. The test dump is an integral part of source control at site; it will be constructed using layering techniques in a controlled setting and rigorously instrumented and monitored; and, it will provide performance data that NWP will then use to refine and calibrate geochemical source-control models and enable assessment about whether future mine rock storage areas will be modified. Examples of instrumentation and monitoring likely implemented at the test dump include mine rock monitoring station with standpipe and gas ports; a cover monitoring station; a climate station; remote sensing; streamflow monitoring; and visual monitoring.

As described in Appendix 3-C, Chapter 2, the Site Water Management Plan, and the Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6), the Layer Cake method for mine rock management establishes source control by creating suboxic zones that form within the structure and creating a series of low permeability layers through strategic placement of coarse coal rejects and mine tailings. This is “becoming more common at metal mines.” (Meiers et al, 2018). NWP acknowledges that while the Layer Cake method is becoming more common, limited publicly available data currently exists. In a state of practice review for Selenium management for Alberta coal mines, Gilron and McKenna (2021) note that “observations at mines internationally, and numerical modelling, indicate promising results” while also noting that “there are often few details on results of technology development / field data.” In their state of practice review, Gilron and McKenna (2021) substantiate that combining mine rock and coarse coal rejects “together or in layers can also be part of a source-control strategy,” with benefits documented for building from the bottom up in lifts to enhance geotechnical stability while limiting the chimney effect apparent in other methods.

Additional details about the selenium sequestration and management strategy and plans; mine rock management and the proposed Layer Cake method; contingency management measures; and water quantity, quality, and monitoring associated with mine rock management features and activities may be found in the Selenium Management Plan and Metal Leaching and Acid Rock Drainage Management Plan described in the Site Water Management Plan (Chapter 33, Section 33.4.1.8), the Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6), and associated plans.

The following sections describe mine rock management design.

3.7.3.1 Waste Dump Design and Management

The mine plan is estimated to produce approximately 270 million cubic metres (m³) (in-situ or bank) of mine rock, or approximately 351 million m³ of placed mine rock assuming an overall swell factor of 30%. The majority of the waste mine rock will be placed as a valley fill located on the west side of the mined out South Pit in the valley of West Alexander Creek. This external dump has been designated as the Main Dump. Where the mining sequence allows, mine rock will be backfilled in the North, East, and South Pits safely and economically in order to reduce the disturbance area of the Project.

The proposed waste dump design and development sequence is based on the following information, design criteria, and constraints:

- Foundation conditions;
- Geotechnical considerations (e.g., global and bench scale stability, flowslide risk mitigation);
- Selenium Management Plan (included within the Site Water Management Plan, Chapter 33, Section 33.4.1.8);
- Dumping arrangement and sequence considerations to meet regulatory constraints; and
- Metal leaching considerations (i.e., selenium management).

3.7.3.2 Foundation Conditions

The proposed mine rock dumps will be founded both on existing natural soil and overburden that is underlain by competent bedrock and/or on mined-out pit walls and floors. The natural foundations within the dump footprints were characterized in a 2019 site investigation that included eight boreholes and six test pits. The foundation overburden is generally described as silty, sandy till, with thicknesses in the range of 1 m in the northern dump footprint area and upper valley side slopes. Thicker overburden depths (>30 m) are encountered at lower elevations in the valley towards the southern end of the valley where multiple drainages converge. There is a trend of generally increasing in thickness from north to south in the base of the natural drainages. Standard Penetration Testing (SPT) advanced through the overburden soil indicated averaged normalized, corrected blow count (N₁)₆₀ values from 7 to 46, indicating generally competent foundation conditions. The material properties of the overburden and depth to bedrock were used to develop waste dumping guidelines and for geotechnical analysis.

3.7.3.3 Geotechnical Considerations

Waste dump guidelines have been developed to assist with waste dump layout and development plan. Table 3.7-4 summarizes the waste dump design guidelines that guided mine planning. The waste dumps are designed to satisfy both static and pseudo-static (seismic) limit equilibrium FOS design criteria of 1.5 and 1.15, respectively. The design criteria are adopted from the Guidelines for Mine Waste Dump and Stockpile Design (Hawley and Cuning, 2017) and consistent with the British Columbia regulatory guidance, including the Interim Guidelines for Mine Waste Rock (BCMWRPRC, 1991, as cited in Stantec, 2020). The Main Dump will be constructed within the existing valley, south of the plant site to an ultimate crest elevation of 1,960 m, an overall crest-to-toe height of around 370 m. Individual dump lifts will be no higher than 50 m and dump development headings not less than 50 m wide. The North Dump, to be constructed in the North Pit area, will have an ultimate crest elevation of 2,120 m with an overall height of 180 m, and with lift heights not more than 20 m high and dump development headings not less than 25 m wide (narrower headings due to constrained development widths for some lifts). Lifts for the dumps will initially be constructed at the natural angle of repose for the dumped mine rock (approximately

1.3H:1V or 37°). Overall slopes (multiple lifts with catch berms) are limited to 2.3H:1V (23 degrees) or shallower to meet regulatory requirements and allow for efficient resloping. A rock dump stability assessment has been completed (Stantec, 2020), including a failure mode effects analysis.

Table 3.7-4: Summary of Mine Rock Dump Design Guidelines

Item	Design Guideline
Mine Rock Swell Factor	30% as placed in dump
Maximum Lift Height	<ul style="list-style-type: none"> • 30 m above areas with down-slope exposure to personnel • 40 m for non-critical areas with shallow foundation slopes • 50 m for non-critical areas with shallow foundation slopes in relatively narrow and confining valleys (i.e., where the dump progresses downstream along West Alexander Creek. Note: Dumps will require specific flowslide assessment as part of permit preparation.)
Catch Berm Height	<ul style="list-style-type: none"> • 2 m high for lifts < 30 m • 3 m high for 30 m to 50 m lifts
Catch Bench Width	<ul style="list-style-type: none"> • 35 m wide for 30 m lifts • 50 m wide for 40 m lifts
Angle of Repose for Mine Rock	37°
Overall Slope	2.33H:1V (approx. 23 degrees)
Maximum Dump Foundation Slope (Initial Lift)	Maximum foundation slope of 15°. Road-fill construction across steeper foundations require specific foundation preparation which could include stripping to competent foundation material or keying-in the toe of the fill slope.

The dumps will require ongoing maintenance to maintain roads, berms and water management/sediment control features. Progressive reclamation of available dump areas has been integrated into the overall mine schedule and Soil Management Plan (Chapter 33, Section 33.4.1.9). The dump lifts will require resloping to no steeper than 2H:1V prior to final soil cover placement and revegetation. Resloping is typically carried out by larger track dozers (D10 or equivalent).

3.7.3.4 Dumping Arrangement and Sequence Considerations

The dumping arrangement is such that access is maintained between mining areas and the haul road network linking the ROM pad and plant site. The mine rock placement plan ensures that all economic coal can be recovered and that the efficient waste haul distances are maintained over the mine life.

The dump arrangement and phasing plans were influenced by the following key factors:

- Avoiding encroachment on identified grizzly bear habitat by pulling the western edge of the West Dump back from the western valley wall;
- The hazards related to the avalanche chutes on the western slopes of the valley along the edge of the dump prompted the final access road to be moved up onto the dump to provide a vertical offset from the valley slope;
- Prioritizing backfill of the North Pit to create a saturated zone within the mined-out pit for selenium management/mitigation; and
- Achieve early construction of a separate trial test dump to verify the effectiveness of the proposed coal rejects/filtered process waste layering strategy for selenium mitigation.

The dumping arrangements shown in the sequence layout figures were designed to complement the base case pit designs and the mining cost inputs that were a basis for the economic pit shells with consideration to balance haul distances over the life of mine so that haul truck requirements would not vary significantly from year to year.

3.7.3.5 Cross-valley Considerations

Mine rock at Crown Mountain will be placed across the West Alexander Creek basin; however, placement will begin at the head of the West Alexander Creek basin and progress southwards. This strategy mitigates major concerns related to typical cross-valley fill placement because, in this way, runoff and seepage flowing into the mine rock dump are minimized. Normally cross-valley placement intercepts runoff and seepage generated in upstream catchment areas. The proposed mine rock dump intercepts less runoff and seepage because the dump is situated at the highest point in the catchment basin.

The North Pit and East Pit will be suitable for placement of mine rock with high levels of selenium because the mine rock will be contained inside the pits. Water accumulating inside the pits will saturate the lower portions of the mine rock fill, limiting oxidation and subsequent selenium release. Mine rock dumps will also be reclaimed progressively to limit exposure time after mine rock has been placed to final grade and resloped.

3.7.3.6 Rejects Layering

Mine rock dumps will be designed to limit oxygen and water infiltration by interlayering and capping mine rock with plant rejects and filtered process waste material. A key consideration for the location of the CHPP site is the need to haul the coal process wastes for disposal and placement. The location of the plant will provide material that is expected to be suitable for layering/capping as well as being near the mine rock dump and available for economical placement in sequence with the mining process. In addition, the layering plan eliminates the need for a separate coal process wastes storage facility (i.e., a conventional tailings dam or filtered waste pile is not required).

It is expected that the mixture of coarse rejects and fine rejects from the plant will contain a sufficient proportion of fine-grained material to permit its use as a planned hydraulic barrier between successive lifts of mine rock and be included as part of the final cover for the mine rock dump piles once they have been placed to grade. Hydraulic barriers can be to a specified thickness (typically minimum 1 m for Crown Mountain) and graded slightly to limit infiltration of water into the underlying mine rock lifts. Based on calculated mine rock and rejects volumes, it is estimated that several hydraulic barriers can be placed through a given waste dump profile. An effective hydraulic barrier will also impede the movement of oxygen through the rock matrix. The potential for selenium release from the mine rock dumps has been modeled to be substantially reduced by the creation of effective hydraulic barriers because they will reduce water and oxygen movement through the mine rock dumps. A low permeability layer of stockpiled plant rejects will be used to cap the mine rock, which will be overlain with topsoil to provide a growing medium for vegetation.

NWP has assessed deformations and the potential effect of those deformations on objectives of the coarse coal rejects and mine rock layering strategy. For the proposed mine rock layering, NWP recognizes that preferential pathways at the edge of waste dumps will report directly to the toe seepage much faster than through the remainder of the dump. A portion of the infiltration into the dump is assumed to report

to the waste dump toe through such preferential pathways and is assumed take on the water quality of oxidizing mine rock. The amount of water reporting through these suboxic pathways is based on the areas of the waste dump perimeters as well as an allowance for 5% of other infiltration amounts.

NWP assumes that while best efforts will be made to maintain continuity of plant reject layers, the possibility remains that pathways could form. All modelling assumes the potential for some pathways to form. However, the construction sequencing and multiple layers should minimize the potential for full depth pathways to occur.

Instrumentation and monitoring will provide information that allows dump designs and construction techniques to be modified should pathways be identified as a problem prior to the development of negative environmental impacts. Similarly, other efforts to manage and mitigate water from entering the dump can also be adjusted based on monitoring of the suboxic zone behaviors and how that relates to toe of dump water quality.

In summary, potential effects from deformation would be managed through lifts less than 50 m with a compacted plant reject layer on top; management of geotechnical stability for the entire design to avoid settling or movement; monitoring; the incorporation of non-preferred water movement in early modeling; and retaining flexibility throughout the waste dump management process to adjust the process if monitoring shows deformation or preferential pathways before there are environmental effects.

Figure 3.7-14 to Figure 3.7-20 show plan and cross-section profile views of the Mine Rock Storage Facility. Figure 3.7-21 and Figure 3.7-22 show the general construction sequence of the reject layering coordinated with the dump development.

In order to verify the effectiveness of the reject layering, a Test Dump area has been planned. The Test Dump, constructed during the pre-production period to Q2, Year 1, is placed in a separate area, not connected to the main body of the West Dump. This will allow the collection of seepage and run-off water downstream of the Test Dump for monitoring of selenium and other elements as required. No active placement will take place on this dump from Q3, Year 1 to late Year 3 to allow a sufficient testing and monitoring period. In Year 4, dumping will resume, and the Test Dump will merge with the larger West Dump. The top of the Test Dump will be used as back-up stockpile location to facilitate multi-seam feed blending to the plant. See Figure 3.7-3 to Figure 3.7-5 for Test Dump area and merging with West Dump.

The coal wastes will be hauled by the production haul trucks from the CHPP to the designated dump platform. This allows the placement plant to take advantage of the haul trucks that would otherwise be returning empty from the plant to the production face. Coal wastes will be end dumped into free-dump piles which will then be spread by a large track dozer (D10 or equivalent), which is the same capacity track dozer used in normal dumping operations. A key component of the layering strategy is to schedule dump lift development such that platform areas are always available for layer placement. As shown in Figure 3.7-14 to Figure 3.7-22, this requires that dump development is sequenced to allow for 1 to 2 active dump headings while an open platform is available for layer placement. The geotechnical requirement for bottom-up dump construction with controlled lift heights supports the development of multiple low dump lifts with available platforms. Therefore, the layering strategy becomes another variable in the dumping sequence but did not require a wholesale change in the Project's dumping plan.

Plan View

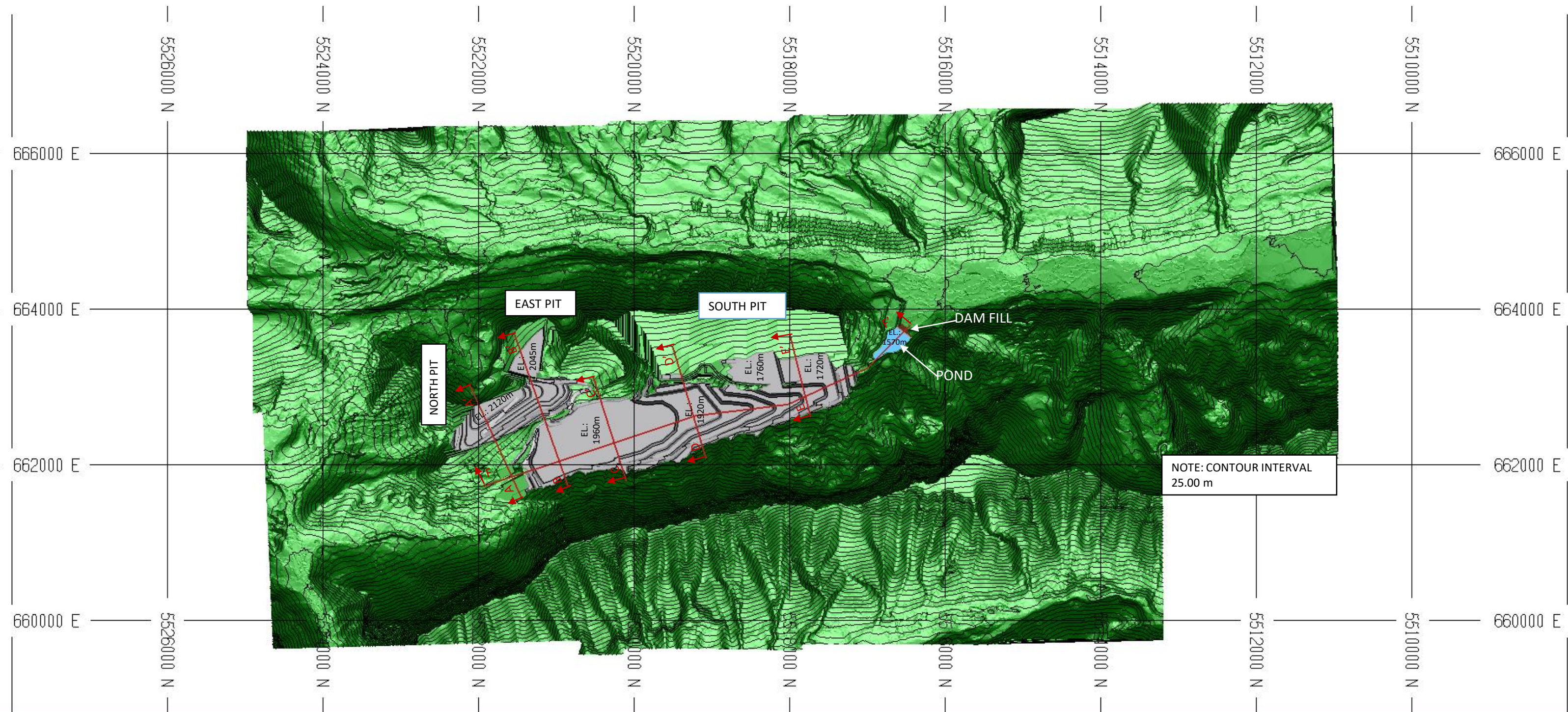


Figure 3.7-14: Plan View, Mine Rock Storage Facility
Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate / Environmental Impact Statement

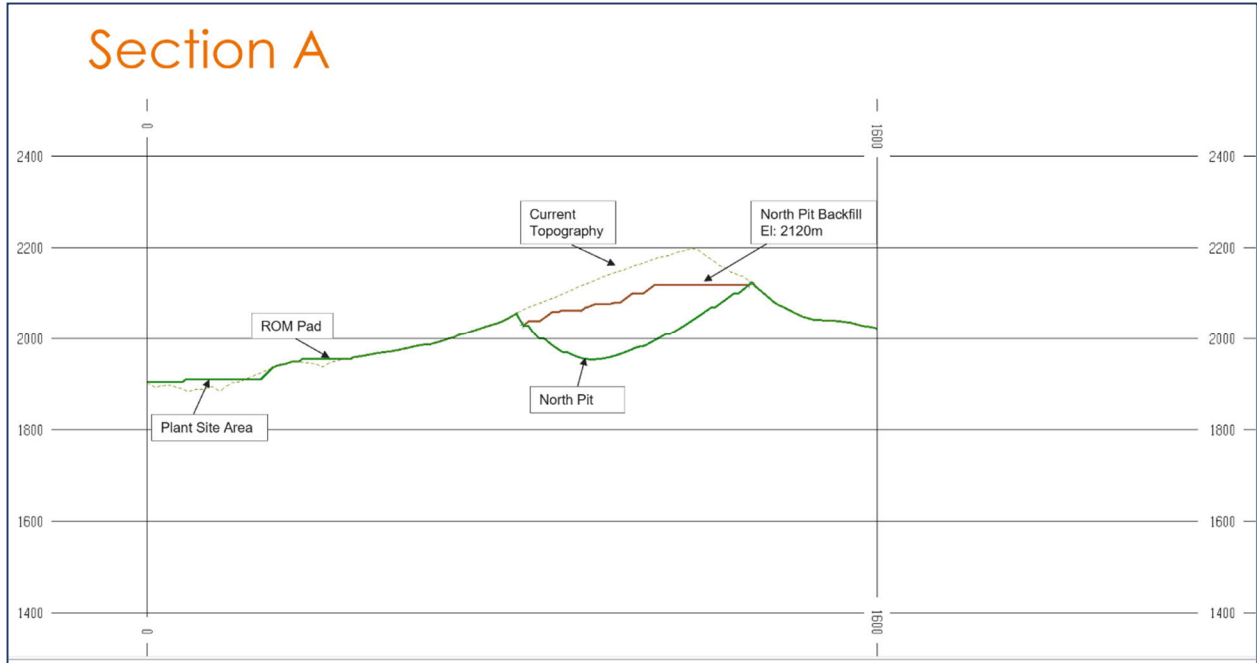


Figure 3.7-15: Cross-Section A, Mine Rock Storage Facility

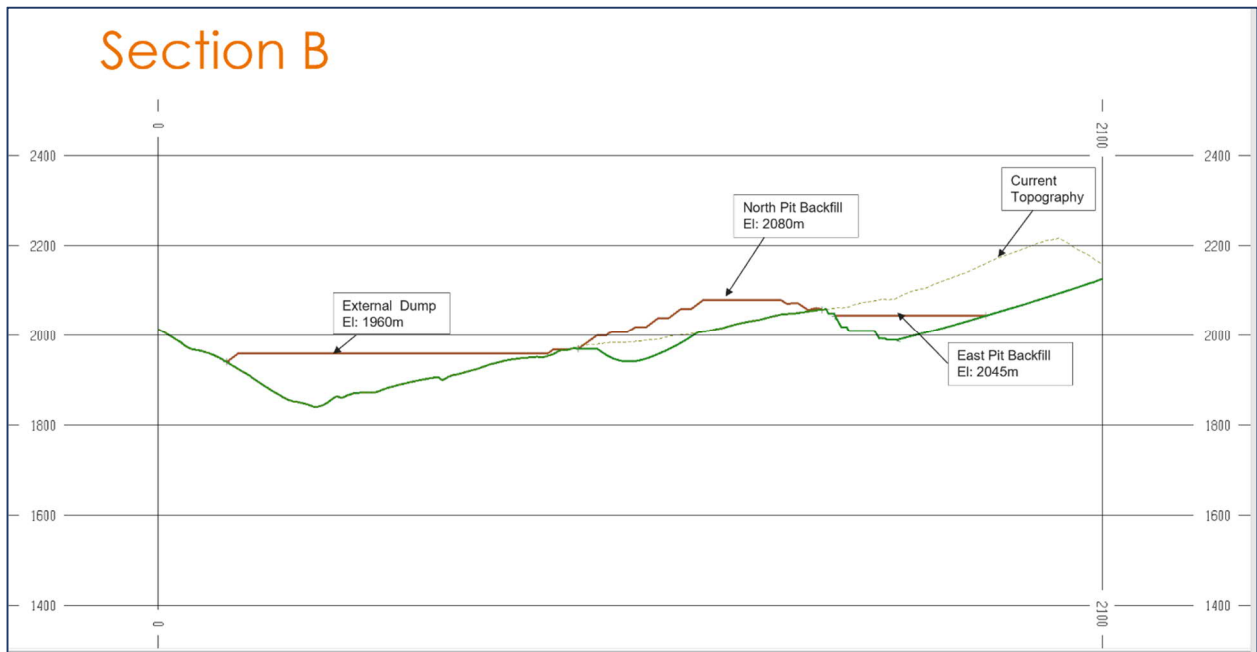


Figure 3.7-16: Cross-Section B, Mine Rock Storage Facility

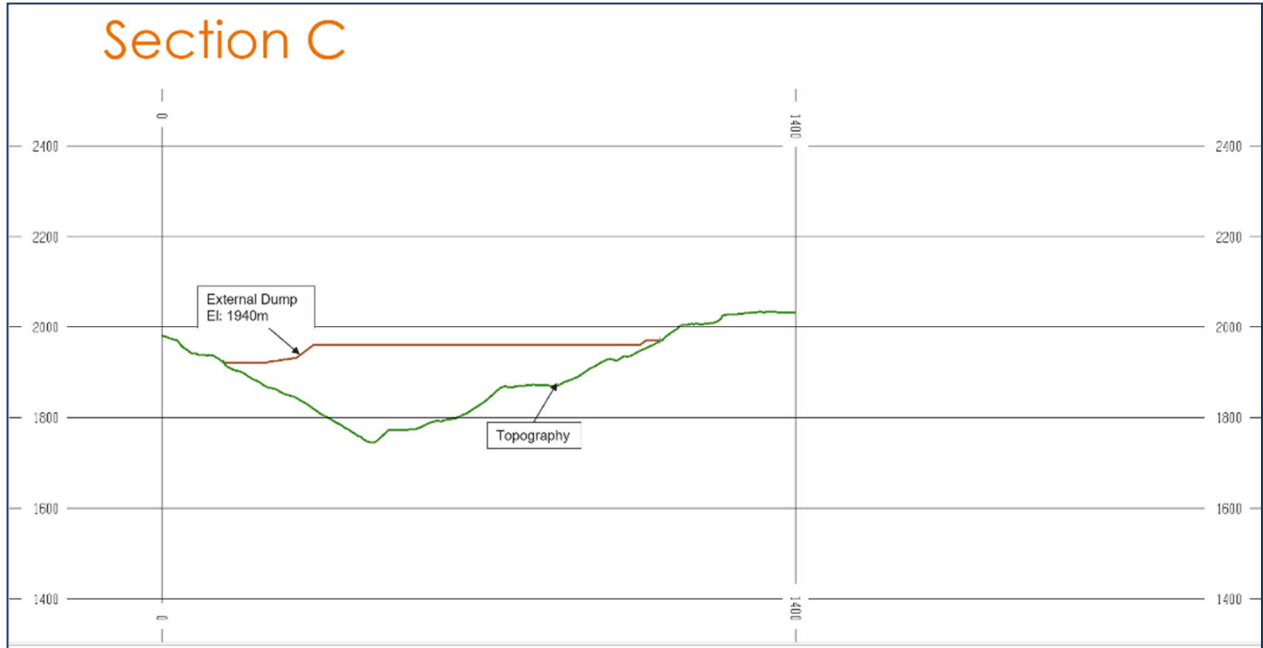


Figure 3.7-17: Cross-Section C, Mine Rock Storage Facility

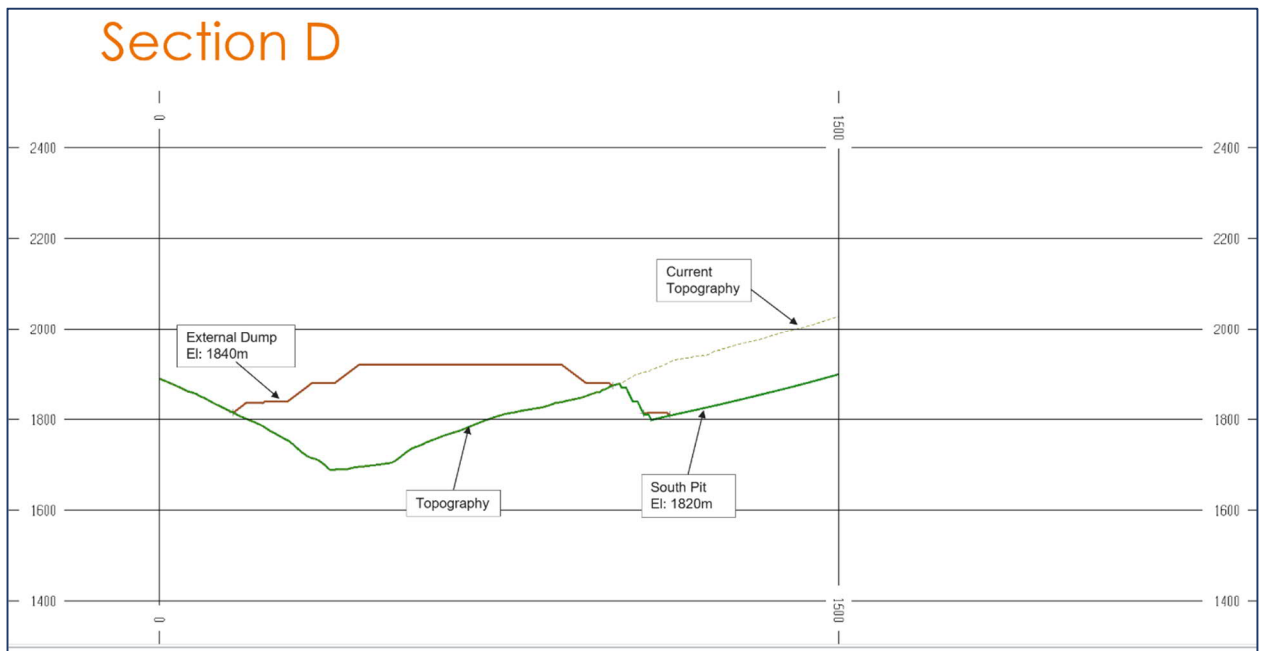


Figure 3.7-18: Cross-Section D, Mine Rock Storage Facility

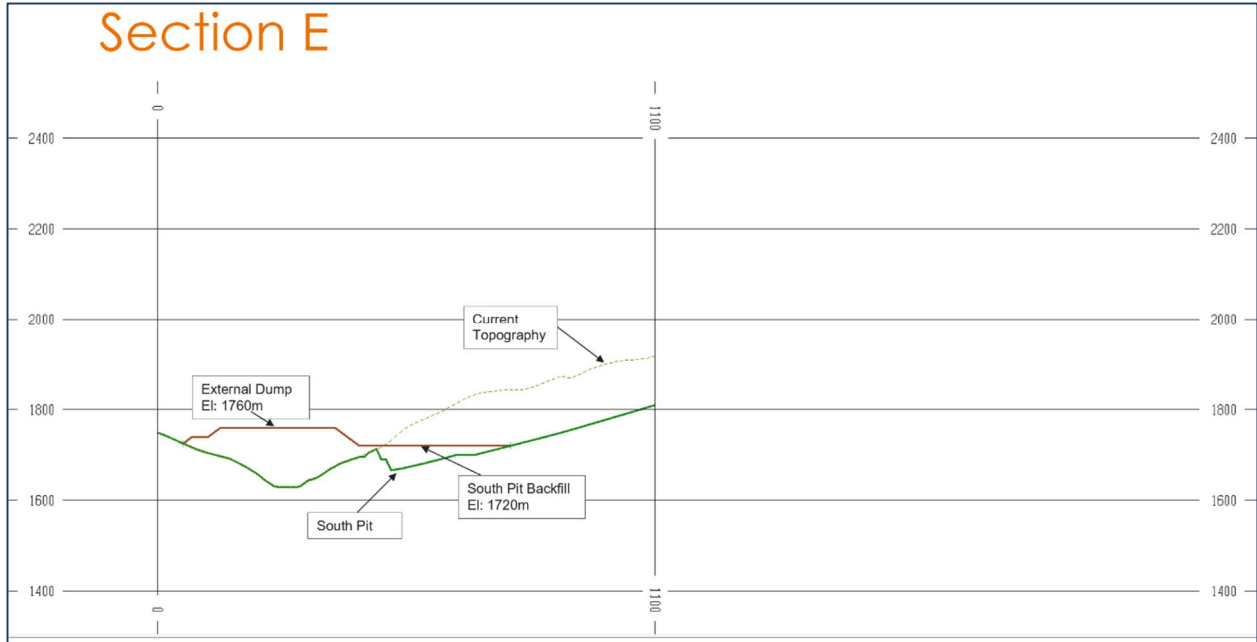


Figure 3.7-19: Cross Section-E, Mine Rock Storage Facility

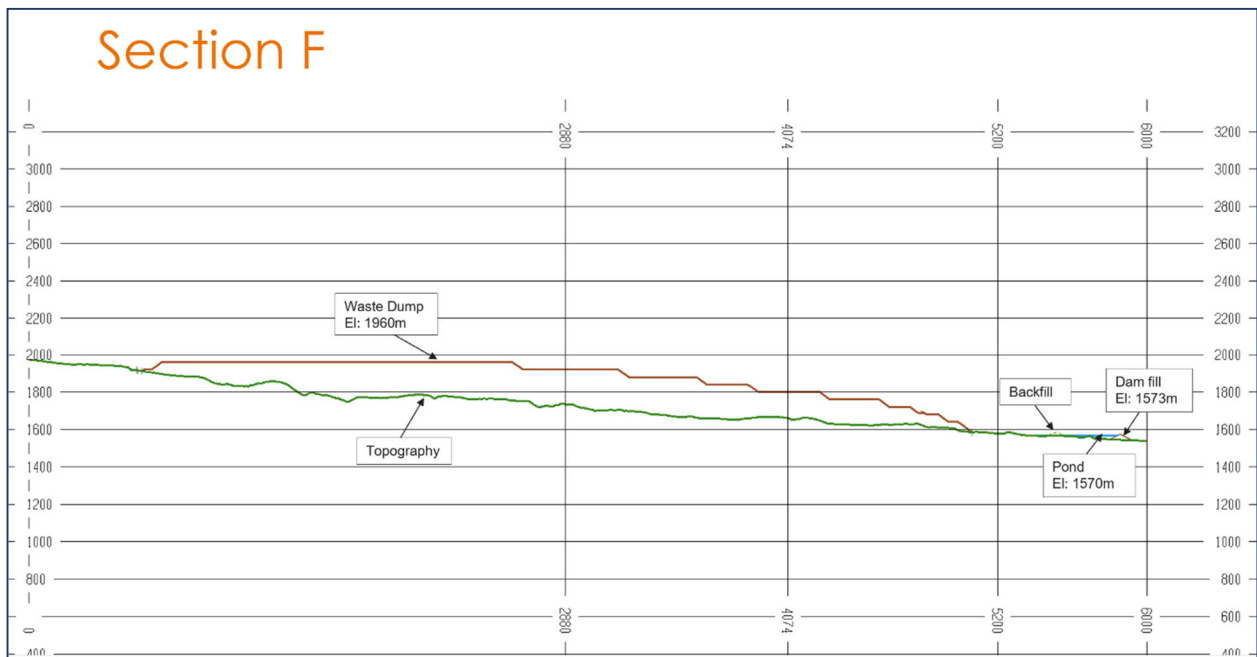


Figure 3.7-20: Cross Section-F, Mine Rock Storage Facility

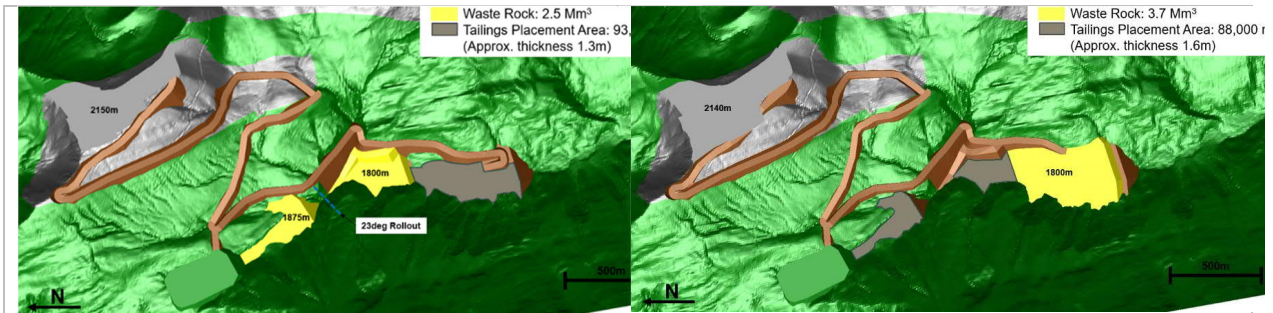


Figure 3.7-21: Reject Layering Approximately Y1Q1 (lower left) and Q2 (lower right)

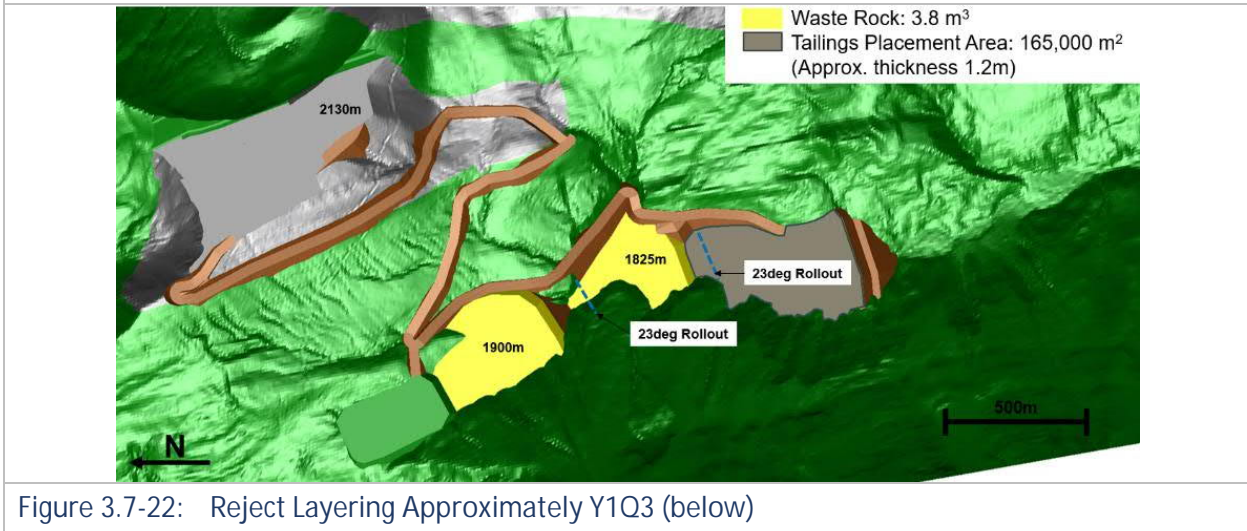


Figure 3.7-22: Reject Layering Approximately Y1Q3 (below)

The Crown Mountain coal rejects stream consists of breaker rejects, and coarse and fine plant rejects (dewatered tailings material). The plant rejects handling plan has the breaker rejects stockpiled on a pad adjacent to the rotary breaker. Approximately 250,000 tonnes of breaker rejects are estimated to be produced per year, on average. This tonnage is calculated by assuming 40% of the external dilution material will be caught by the breaker. The breaker rejects will be loaded by a wheel loader (CAT994 or equivalent) into a haul truck and co-disposed with the mine rock material.

The plant rejects will be stored in a bin located just south of the coal handling process plant, direct loaded into haul trucks, and hauled to designated dump platforms or stockpiled, if a dump platform is unavailable. As noted above, the plant rejects will be free-dumped on a constructed dump lift platform and spread out to 1 m thick lift using a production dozer. The thickness of the rejects layer has been developed as part of the mine's selenium mitigation layered dump lift strategy. The plant rejects are also placed as part of the final capping material on the waste dumps to comprise a low permeability layer. This will be overlain with topsoil to provide a growing medium for vegetation establishment NWP is not proposing an engineered cover system. The Mine Rock Storage Facility (MRSF) design, including layering of plant reject material throughout and as a cap, along with closure designs, will meet mine closure water quality objectives.

Table 3.7-5 shows the estimated plant rejects on an annual basis for the life of the mine.

Table 3.7-5: Annual Breaker and Plant Reject Volumes

Mine Year	Breaker Rejects (in 000s, Placed Volume)	Plant Rejects (in 000s, Placed Volume)	Total Rejects (in 000s, Placed Volume)
Pre-Production	15	82	97
1	103	545	648
2	110	694	804
3	108	723	831
4	109	803	912
5	98	917	1,015
6	97	965	1,063
7	102	978	1,080
8	100	1,015	1,115
9	100	1,013	1,113
10	100	980	1,080
11	99	973	1,072
12	98	971	1,069
13	98	978	1,076
14	99	878	977
15	57	676	733
Total	1,492	13,192	14,684

3.7.4 Mining

The Project will have three open pit areas where surface mining will take place (See Figure 3.1-1, Site Layout). The Project will use a conventional open pit, truck and shovel mining method to provide a nominal production rate of 3.7 Million Run of Mine tonnes (ROMt)/year. Annual mine production of waste is to peak at 24 Million bank cubic metres (Mbcm)/year with an average stripping ratio of 4.7 bank cubic metres (bcm)/ROMt.

The mine production schedule, shown in Table 3.7-6, followed the sequence of North Pit and then transitions to the East Pit followed by mining the South Pit, from the southern end of the South Pit towards the north. The mining sequence was selected for the following reasons:

- The North and East Pits have better Hard Coking Coal quality when compared with the South Pit as well as a lower proportion of PCI coal. Mining these two areas first can provide a consistent Hard Coking Coal product for the first 5 years of Operations;
- The North Pit being mined out first allows for short waste and coal hauls and allows for backfilling from East Pit; and
- The operational advantages of mining up-dip based on the geometry of the South Pit allows for a more straightforward backfill sequencing and reduces the frequency/duration of dumping above active mining areas. Dumping above active mining areas is a geotechnical and operational risk and would require mitigation measures under British Columbia mine safety regulations.

Table 3.7-6: Overall Mine Material Release Schedule

Year	ROM Coal			Clean Coal			Total Waste (Kbcm)	PAG Waste (Kbcm)	ROM Strip Ratio (bcm/tonne)	CC Strip Ratio (bcm/tonne)
	Total (Ktonnes)	Coking (Ktonnes)	PCI (Ktonnes)	Total (Ktonnes)	Coking (Ktonnes)	PCI (Ktonnes)				
Pre-Production	538	176	362	337	94	242	2,054	25	3.8	6.1
1	3,669	2,989	681	2,328	1,864	464	11,935	698	3.3	5.1
2	3,907	3,648	259	2,241	2,089	152	16,329	817	4.2	7.3
3	3,833	3,662	170	2,111	2,022	89	14,627	712	3.8	6.9
4	3,964	3,795	170	2,049	1,972	78	17,569	450	4.4	8.6
5	3,859	2,925	934	1,680	1,284	396	18,022	81	4.7	10.7
6	3,864	2,656	1,208	1,586	1,134	452	18,056	0	4.7	11.4
7	4,066	2,688	1,378	1,744	1,193	551	17,784	0	4.4	10.2
8	3,983	3,009	974	1,597	1,234	363	17,907	0	4.5	11.2
9	3,958	2,737	1,221	1,577	1,038	539	17,786	0	4.5	11.3
10	3,973	3,293	680	1,656	1,370	286	23,603	0	5.9	14.2
11	3,920	3,806	114	1,621	1,578	43	24,051	0	6.1	14.8
12	3,889	3,813	76	1,599	1,565	33	23,874	0	6.1	14.9
13	3,887	3,843	45	1,583	1,566	17	18,280	0	4.7	11.5
14	3,954	3,841	113	1,841	1,768	73	18,306	0	4.6	9.9
15	2,227	2,252	25	723	713	10	9,838	0	4.3	13.6
Total	57,540	49,123	8,408	26,272	22,484	3,788	270,021	2,785	4.7	10.3

Note: Kbcm = kilo bank cubic metre.

The southern end of the South Pit has lower strip ratio when comparing with the northern end of the South Pit. The lower strip ratio allows for smaller dump footprint, which allows additional time to demonstrate the effectiveness of the Layer Cake dumping sequence prior to increasing the dump footprint in West Alexander Creek. Additional details about the Layer Cake method are provided in Chapter 2.

Annual mine rock tonnages by lithology and formation from the mining block model are provided in Table 3.7-7. The formation information is based on regional geological information, which is illustrated in Figure 3.3-5. The lithology information was developed based on statistical estimation based on available data from the drillholes.

3.7.4.1 Mining Equipment

The proposed mining fleet was developed to meet the coal production requirements of the mine plan and associated strip ratio while also using equipment that is suitable for the mountain coal mining environment. The mining fleet will be owner-operated and the capital costs for the equipment are based on quotes from the equipment vendors. The Elk Valley area has a number of active mines and is well serviced by the major mining vendors; therefore, delivery of equipment, access to parts and qualified service support is not expected to be an issue for the Crown Mountain operation. It is NWP's intention to lease or purchase the mining fleet from one of the local vendors.

3.7.4.1.1 Drill and Blast

Drill and blast operations will be carried out on a continuous basis as part of the normal mining operation. Once full mine production levels are reached drilling and blasting of approximately 2.0 to 2.1Mbcm per month will be required to maintain targeted production levels. Appendix 7-A (Noise and Vibration Assessment) provides details about anticipated blasting conditions during Operations. It is anticipated that Year 4 and Year 10 of Operations would require the highest use of blasting, estimating 0.99 blasts per day on average in Year 4 (North Pit) and 0.89 blasts per day (South Pit) in Year 10. A similar class of drills, 80,000 pounds (lbs) pull-down, has been used at other operations in northeastern British Columbia coal operations and is considered suitable for meeting the production targets for this Project.

NWP has adjusted drill and blast standard parameters to better match regional standards. With the Crown Mountain mine design using the same bench height as the other operations in the southeast coal field, similar blast design parameters will be used for the Project. Table 3.7-8 details these parameters for a 251 mm size drill bit. Additional information about explosives usage is provided in Chapter 2, including a description of the New Conventional Explosives Type proposed for use, and also contained in Chapter 33.

Table 3.7-7: Annual Mine Rock Tonnages Separated by Formation and Lithology

	Mist Mountain Formation						Morrissey Formation	Fernie Formation	Buttress (Kbcm)	Total (Kbcm)
	Sandstone (Kbcm)	Shale (Kbcm)	Carb Shale (Kbcm)	Siltstone (Kbcm)	Shale Dominated Alternations (Kbcm)	Sandstone Dominated Alternation (Kbcm)	Sandstone (Kbcm)	Shale (Kbcm)		
Pre-Production	391	407	186	134	513	373	41	9	-	2,054
Year 1	2,169	2,258	1,034	745	2,847	2,069	772	43	-	11,935
Year 2	3,034	3,158	1,447	1,042	3,983	2,894	663	108	-	16,329
Year 3	2,771	2,884	1,321	952	3,638	2,643	372	45	-	14,627
Year 4	3,166	3,296	1,510	1,088	4,157	3,020	147	1,184	-	17,569
Year 5	3,113	3,241	1,485	1,070	4,087	2,969	0.05	2,057	-	18,022
Year 6	3,475	3,618	1,658	1,194	4,563	3,315	0.06	233	-	18,056
Year 7	3,365	3,503	1,605	1,156	4,417	3,210	0.04	528	-	17,784
Year 8	3,366	3,505	1,606	1,157	4,420	3,211	0.05	643	-	17,907
Year 9	3,370	3,508	1,607	1,158	4,424	3,214	1.0	502	-	17,786
Year 10	4,458	4,641	2,126	1,532	5,853	4,252	0.0	741	-	23,603
Year 11	4,332	4,510	2,066	1,488	5,687	4,132	0.1	1,835	-	24,051
Year 12	3,936	4,097	1,877	1,352	5,167	3,754	142	3,549	-	23,874
Year 13	3,186	3,317	1,519	1,095	4,182	3,039	30	1,913	-	18,280
Year 14	3,405	3,545	1,624	1,170	4,471	3,248	0.6	843	-	18,306
Year 15	1,522	1,584	726	523	1,998	1,451	5.4	1,247	782	9,838
Total	49,059	51,072	23,397	16,856	64,406	46,795	2,173	15,481	782	270,021

Table 3.7-8: 251 mm Drill Bit Typical Blast Design Parameters

Parameter	Value
Borehole Diameter	251mm (9 7/8in.)
Explosive	70% ANFO / 30% Emulsion
Pattern	7.3 x 7.3 meters staggered
Bench Height	10 meters
Sub-drill	1.5 meters (no sub-drill at coal)
Collar Stemming	4.0 meters
Powder Factor	0.6 kilograms per bcm

3.7.4.1.2 Waste Loading Equipment

The waste loading equipment proposed for the Project is consistent with other equipment used at other mining operations in the Elk Valley and B.C. The loading equipment consists of two diesel powered hydraulic shovels and one front end loader. Additional information about mine equipment selection may be found in Chapter 2.

3.7.4.1.3 Coal and Waste Hauling Equipment

The coal and waste hauling equipment proposed for the Project is consistent with other equipment used at other mining operations in the Elk Valley and B.C. There will be a single fleet of 227 t mine trucks to haul waste from the pits to the mine rock storage facilities, coal from the pits to the ROM, and rejects from the CHPP to the mine rock storage facilities. The size of the haul truck is matched with the loading equipment. The haul truck requirements per mine year are estimated in Figure 3.7-23.

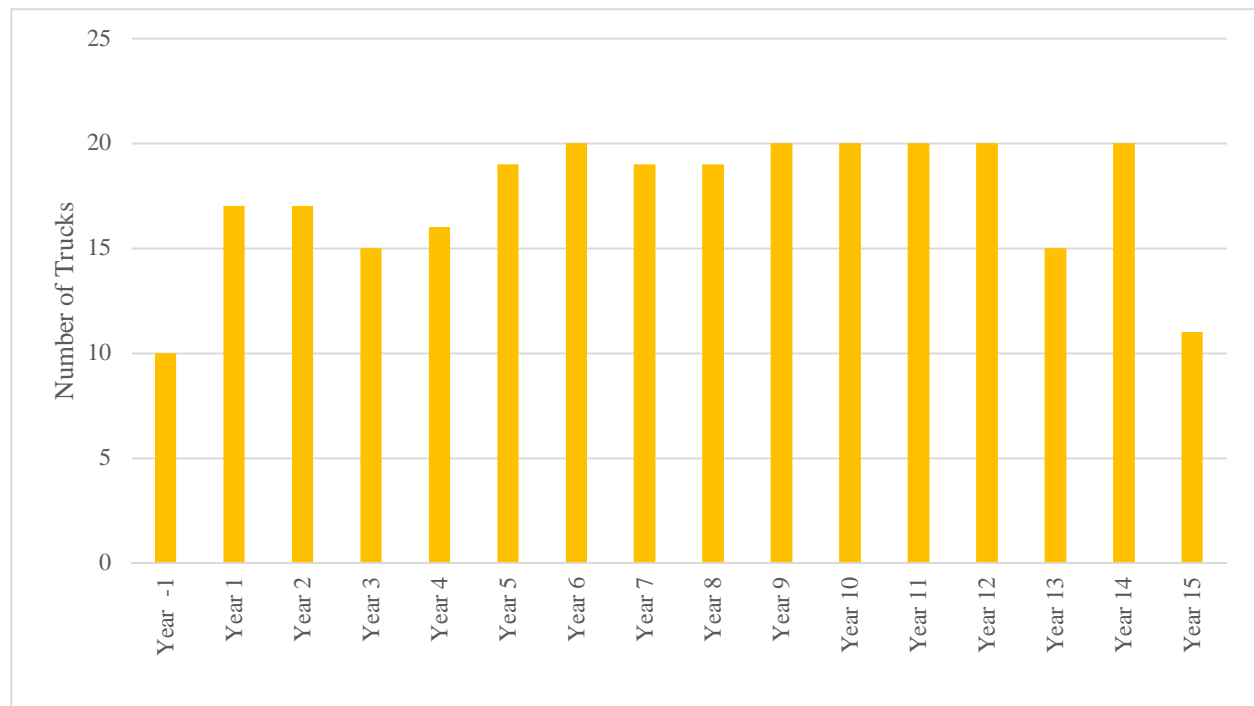


Figure 3.7-23: Estimate Haul Truck Requirement per Year

3.7.4.1.4 Support Equipment

The support equipment fleet is based on regional experience at other Elk Valley coal mines. Support equipment is required for the following support tasks:

- Clean-up and support for in-pit waste and coal loading;
- Resloping of mine rock and soil dumps;
- Maintenance of active mine rock dumps;
- Blending of PAG material on mine rock dump;
- Maintenance of haul roads;
- Service and maintenance of mining equipment;
- Soil removal prior to production mining;
- Haul road dust suppression; and
- Support for drilling and blasting operations.

Table 3.7-9 provides a summary listing of the support equipment estimated requirements. The current equipment list assumes a third-party tire contractor supplies smaller equipment related to tire servicing.

Table 3.7-9: Support Equipment Requirements

Equipment Type	Capacity	Average Requirements (# units)
CAT D10T	580 horsepower	9
CAT 16M		3
Fuel / Fuel and Lube Truck	15,000 litre (L)/ 5,000 L	1 / 2
Water Truck (777G)	91 t	2
Sanding Truck	40 t	1
Wheel Loader	5 m ³	1
Stemming Truck	20 t	1
Pumps	200 mm	
Skid Steer		2
Blaster / Pump Trucks	F-550	3

3.7.5 Water Management Infrastructure

The following sections provide information about NWP's proposed water management infrastructure and water management planning. Clean water diversion infrastructure is not planned at site. A high-level summary of the key proposed water management infrastructure components follows:

- Temporary Construction Ponds: As-needed control structures during early construction to manage Total Suspended Solids (TSS);
- Interim Sediment Pond: Captures all site mine affected water during Years 0 to 4. Water from pond recycled for use in CHPP;
- Main Sediment Pond: Captures all site mine affected water during Years 5 to closure. Water from pond released if it meets release criteria;
- North Pit: Water from North Pit recycled for use in CHPP;
- Grave Creek Reservoir: Supply reservoir as alternate/make-up during Years -1 to closure;

- Contingency only: May pump water from Main Sediment Pond to CHPP if water quality challenges exist; and
- Contingency only: May treat water from Main Sediment Pond if water quality challenges exist.

The main, interim, and temporary construction sediment ponds will be constructed with mine rock fill to create embankments across the natural drainage flow direction combined with the surrounding natural slopes for containment. Liners will be used in each pond to retain water and decant water will be routed to the West Alexander Creek via spillway and outlet channel structures. The Grave Creek Reservoir will be excavated, and a rock fill berm will be constructed on the western edge to provide containment. The reservoir will be lined, with flows exceeding capacity directed to Grave Creek. Mine rock fill for construction will be sourced from nearby road coats or mine rock. No deleterious materials will be placed as fill. The rock fill would be placed in thin lifts and compacted. Experience at other nearby mines has shown the mine rock and glacial till to be suitable for use in embankment construction. Prior to construction, the fill materials would be tested for PAG and metal leaching characteristics. A feasibility level geotechnical stability assessment, including preliminary factors of safety, has been developed for the impoundments (Stantec, 2021).

A conceptual plan for a geotechnical instrumentation and monitoring program for the sediment ponds has been developed, including the main objectives of confirming design assumptions and performance; additionally, the monitoring program would provide data for future optimizations and provide early warning of potential defects or impending failure (Stantec, 2021). Key items to monitor include:

- Horizontal movement of embankment or foundation soils;
- Vertical settlements;
- Porewater pressures; and
- Seepage rates.

NWP would develop a detailed instrumentation and monitoring program at a later design stage. The detailed program is likely to include the following instruments to assist in monitoring:

- Slope inclinometers;
- Piezometers;
- Monitoring wells;
- Staff gauge; and
- Survey monuments.

During design, guidelines including the B.C. Ministry of Environment (2015) Assessing the Design, Size and Operation of Sediment Ponds Used in Mining have been used as applicable in addition to the Canadian Dam Association (2013) Dam Safety Guidelines for the Main and Interim Sediment Ponds. These references were used in guiding design relative to consequence classification, seismic design criteria, inflow design flood, and factors of safety (Stantec, 2021).

Effluent release points will be located at the outlet of the temporary construction ponds, the Interim Sediment Pond, and the Main Sediment Pond. Figure 3.7-1 shows the Main Sediment Pond effluent release point. Additional details on proposed design and mitigation planning including water monitoring may be found in Chapter 33, including the Site Water Management Plan (Section 33.4.1.8), as well as Chapter 9 and Chapter 10. An assessment of potential geophysical events and their effect on the Project

is contained in Chapter 20, and a description of prior geohazard assessments influencing early water management infrastructure design may be found in the following sections. Potential impacts to groundwater from the Project and discussion of related modelling may be found in Chapter 9 and the Site Water Management Plan. Five groundwater monitoring wells have been installed near the proposed sediment pond structures. Average depth to groundwater as measured from 2018 to 2020 indicates depths ranging from 3.2 to 18.4 m (Stantec, 2021).

Design details for water management infrastructure presented here is predominantly based on feasibility level engineering completed in 2021. Certain design components will continue to be updated as investigative work advances in an effort to improve site design.

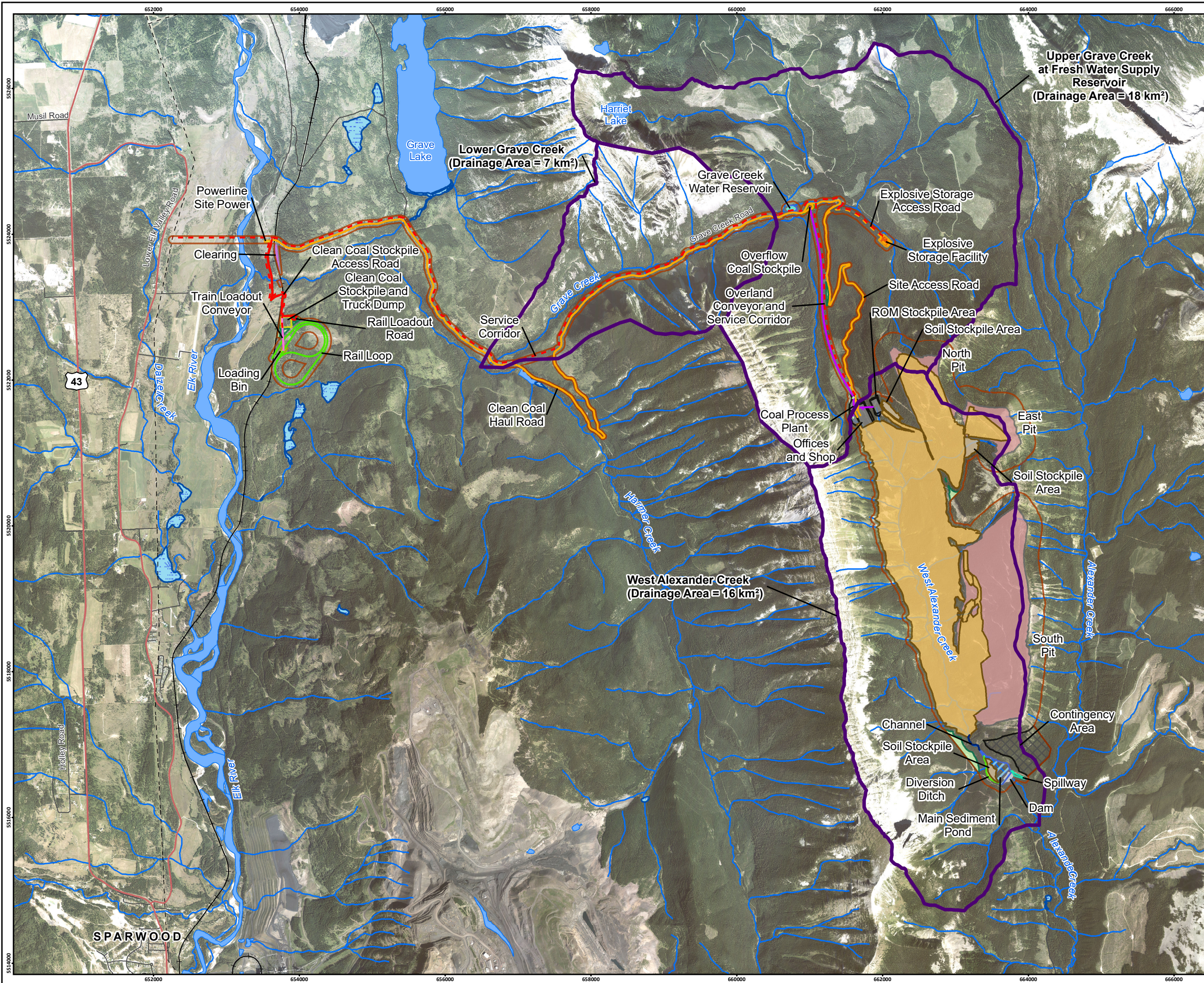
3.7.5.1 Non-Contact Runoff Water Management Plans

Surface water diversions to divert non-contact runoff from undisturbed areas into West Alexander Creek were initially proposed as part of the runoff water management system (Norwest, 2014, as cited in Stantec, 2020). For example, a non-contact water diversion channel (West Diversion) was proposed for the upper western slopes of West Alexander Creek above the main mine rock dump. The goal of this diversion was to intercept non-contact runoff around the mine rock dump area and divert and discharge it downstream into West Alexander Creek. However, following further evaluation of the upper slopes area, several challenges were identified for the construction and operation of the West Diversion channel, including geotechnical stability of the channel side slopes, high exposure to avalanche risk, presence of bedrock outcroppings, and other issues which rendered channel construction unfeasible. In consequence, the design and operation of water management structures will consider the contributions of surface runoff from these upper slope undisturbed areas, as well as from mine disturbed areas, such as the mine rock dumps and haul roads.

NWP's site strategy for surface water includes limiting the mine disturbance footprint and avoiding affecting additional drainages beyond West Alexander and Grave Creeks. A key part of this strategy is to limit placement of mine rock dumps to within the West Alexander Creek basin. In addition, grading and site drainage around the CHPP, maintenance/office complex, and ROM pad will be designed such that runoff from these areas will also drain to the West Alexander Creek catchment. This infrastructure includes haul roads, the plant and warehouse/shop site, coal transfer, and stockpile areas. Further to the north of the Grave Creek / West Alexander Creek drainage divide, runoff will be directed to small catchment sumps prior to release or managed with localized erosion mitigations for small, isolated areas of disturbance (i.e., minor road cuts). Figure 3.7-24 shows Grave Creek and West Alexander Creek watershed areas relative to the proposed full buildout of mine infrastructure.

3.7.5.2 Mine Water Management

The mine water management system will control runoff water herein referred to as "mine site drainage" that comes into contact with mine disturbed areas and infrastructure, including access and haul roads, laydown areas, stockpile and transfer areas, mine pits, plant areas, and mine rock dumps. Portions of the captured runoff can be used to supply mine operations including the CHPP.

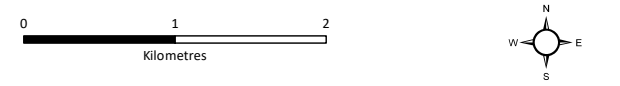


Crown Mountain Coking Coal Project

Figure 3.7-24
Watershed Areas

LEGEND

Watershed Area	Powerline-Site Power
Project Footprint	Water Reservoir
Channel to Ultimate Pond	Main Sediment Pond
Clean Coal Haul Road\Site Access	Dam
Explosive Storage Access\Facility Road	Spillway
Rail Loadout Road	Diversion Ditch
Rail Loop	Clearing
Service Corridor	Additional Area
Coal Process Plant Conveyor	Contingency Area
Coal Process Plant Duct	Highway
Train Loadout Conveyor	Arterial/Collector Road
Waste Dump	Local/Resource Road
Mined Area	Railway
Clean Coal Stockpile and Truck Dump	Transmission Line
Overflow Coal Stockpile	Watercourse
Soil Stockpile Area	Waterbody
Explosive Storage Facility\Pad	Wetland
Loading Bin	British Columbia/Alberta Border
Plant Site\ROM Stockpile Area	



Scale 1:50,000

Map Drawing Information:
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3.7.5.3 Mine Site Drainage

Mine site drainage typically has elevated TSS concentrations, turbidity, and possibly other substances entrained from contact with mine disturbed areas. Runoff from these areas will require retention in sedimentation ponds (i.e., passive sedimentation) as described in the following sections prior to being discharged into the environment to comply with approval conditions for TSS, turbidity, and other parameters determined during the Project permitting process. These have not been fully confirmed for the Project but are expected to be similar to those for the adjacent Teck operations, and the water management system has been designed to standards similar to those operations and in compliance with provincial regulations for mine water management and water impoundments.

3.7.5.4 Pre-Production Construction Sedimentation Basins

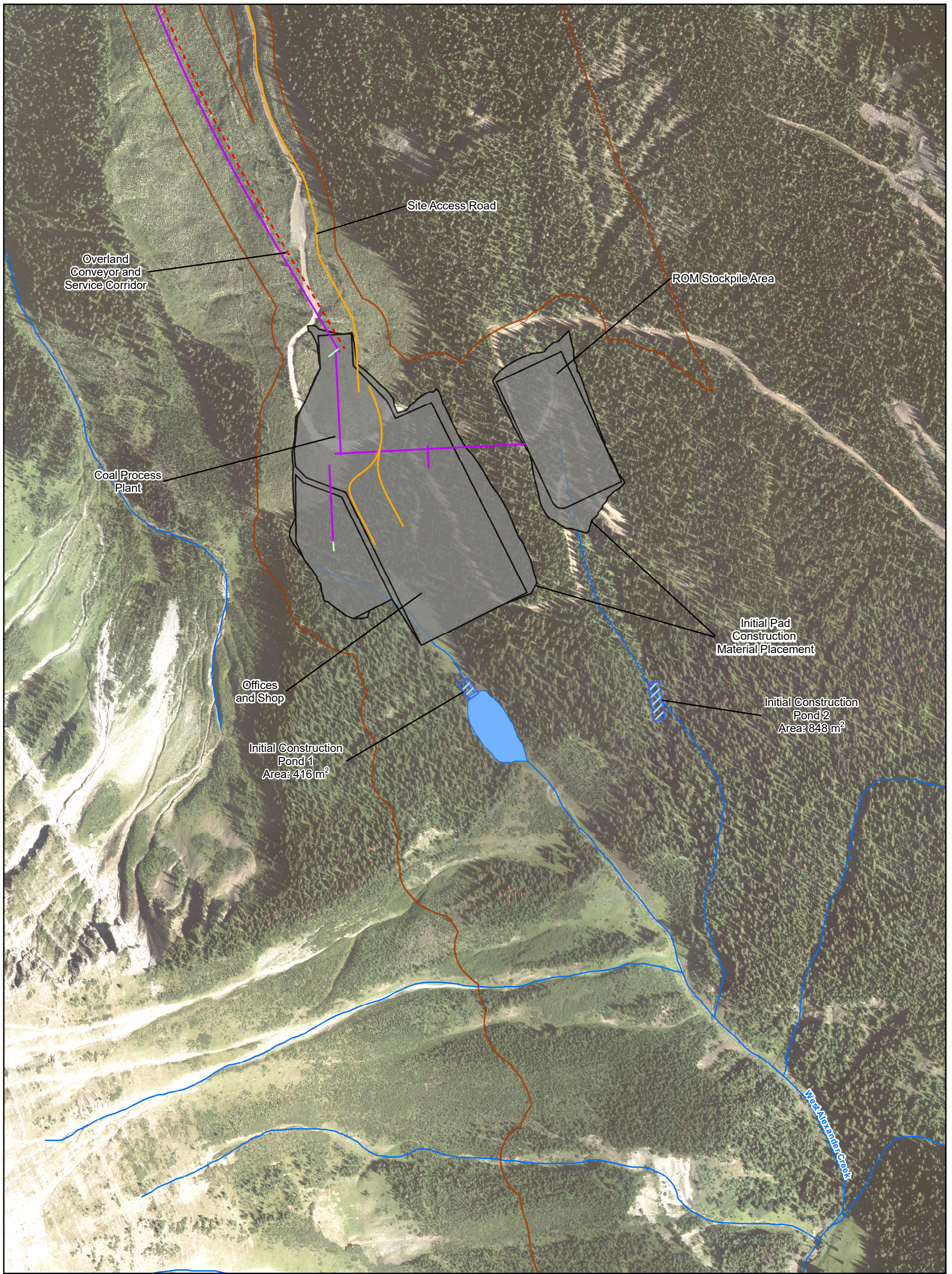
Two smaller sedimentation basins are proposed for managing the drainage originating from the area associated with the pre-production construction of the mine. The pre-production construction tasks include clearance of vegetation, stripping and stockpiling of topsoil, construction of the run-of-mine (ROM) and facilities pad, mine roads, water supply reservoirs, overland conveyor, and services corridors. The sediment basins were sized according to guidelines provided by the Government of Alberta (Alberta Transportation, 2011, as cited in Stantec, 2020), which recommend that sediment basins have a minimum storage volume of 250 m³ per ha of disturbed land and a maximum depth of 1.5 m. The dimensions of the proposed pre-production construction sedimentation basins are presented in Table 3.7-10 and their location is presented in Figure 3.7-25. These basins are intended for short-term water management and sediment control and will be replaced by the Interim Sediment Pond as soon as that impoundment is completed. In addition to the sedimentation basins, localized best management practices (BMPs) will be incorporated into all construction activities to limit localized erosion and divert runoff away/around construction affected areas.

Table 3.7-10: Pre-Production Construction Sedimentation Basins Sizing

Pond No.	Volume (m ³)	Width (m)	Depth (m)	Length (m)
1	499	16	1.2	26
2	1272	16	1.5	53

3.7.5.5 Sediment Ponds

A series of two sediment ponds are proposed for managing the combined run-off from the mine footprint and undisturbed ground as the mine development advances. These ponds will be placed downstream of the main mine rock dump and will be developed through the mine life to accommodate the advancing mine rock placement. The impact of surface water management strategies on the water quality of the pond discharge may be approximated through water quality models and will be presented as a separate stage of the regulatory process. Although sediment ponds provide a means to collect and temporarily contain mine-affected water discharged from the mine rock dumps, other mitigation methods for mitigating metal leaching and acid rock drainage (ML/ARD) will be implemented at the Crown Mountain site. Ongoing monitoring of the water quality in discharge from the sediment ponds will be required as part of the mine's environmental program.

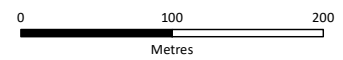


Crown Mountain Coking Coal Project

Figure 3.7-25
Construction Sediment Basins

LEGEND

- Project Footprint
- Initial Construction Pond
- Plant Site\ROM Stockpile Area
- Clean Coal Haul Road\Site Access
- Service Corridor
- Coal Process Plant Conveyor
- Coal Process Plant Duct
- Watercourse
- Waterbody



Scale 1:5,000



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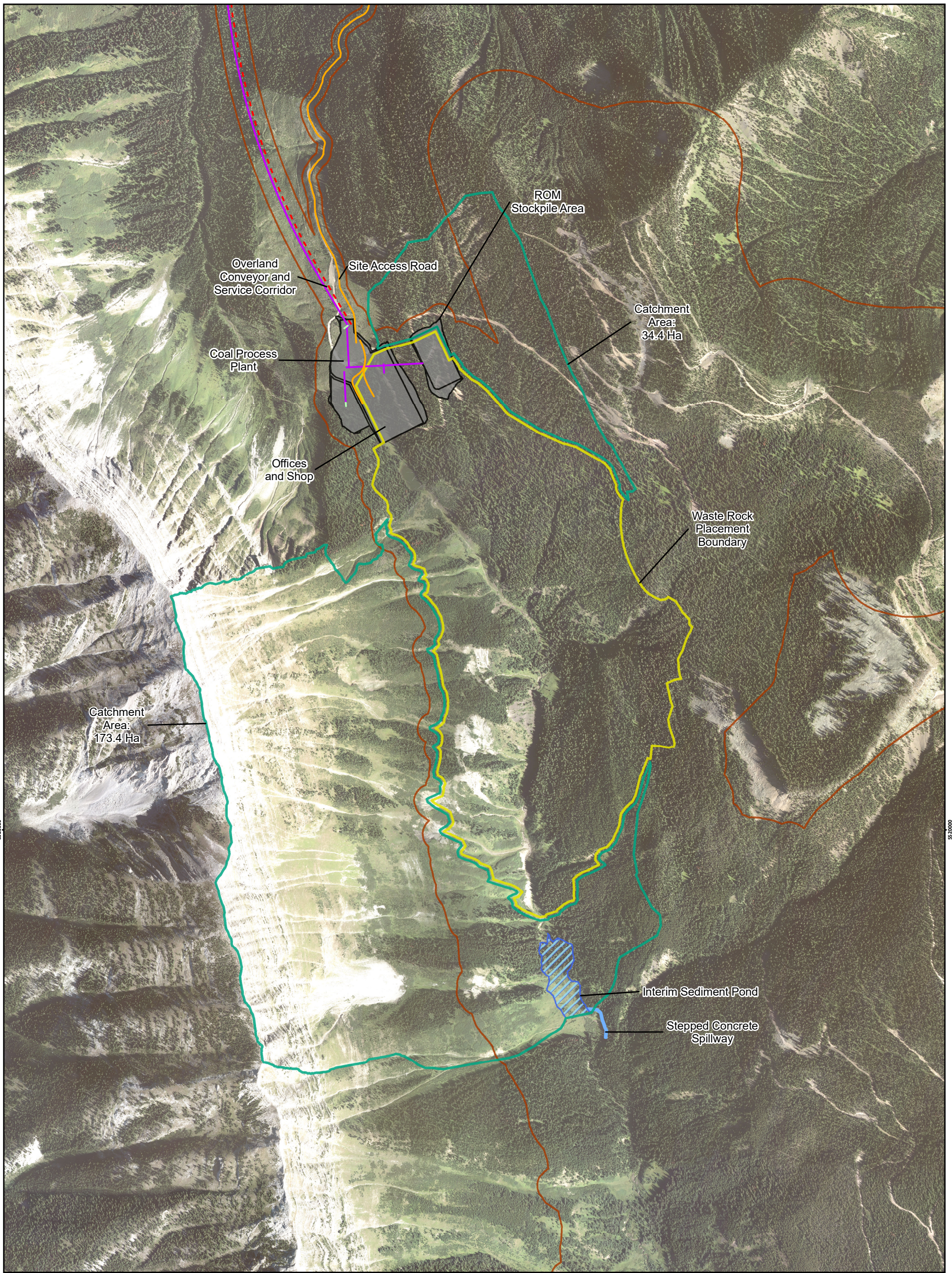
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A feasibility level geotechnical investigation to support impoundment design has been completed (Stantec, 2022b). The most recent site investigation was completed in November 2021 and included the drilling and logging of five boreholes with the objective of improving the foundation characterization of sediment pond footprint including the embankment and cut slopes above the pond. The previous site investigation, completed in 2018, included drilling eight boreholes, digging six test pits, and installing four instruments. Foundation conditions are summarized in factual reports completed subsequent to the site investigation and pond design efforts and summarized here. The proposed sediment ponds will be founded on existing overburden soil underlain by competent bedrock, with general foundation conditions specific to each sediment pond area detailed by Stantec (2021) and outlined below:

- Main Sediment Pond: Overburden underlying the main pond location generally consists of a mix of silt, sand, and mixed rock fragments deposited in a glaciofluvial or active fluvial setting. Typical natural foundation slope angles at the impoundment toe are very low (approximately 3 degrees);
- Interim Sediment Pond: Foundation information is very limited; available terrain mapping indicates the area is composed of surficial colluvial fans and active fluvial sediments, and the closest borehole (500 m east and 120 m upslope) suggests the area is composed of a thick accumulation of glacial till. Typical down valley foundation slope angles at the impoundment toe are very gentle (approximately 1 degree);
- Construction Ponds: Based on a 2017 terrain evaluation, surficial material may consist of a thin lacustrine veneer in the Construction Pond 1 area and a till blanket in the Construction Pond 2 area. Typical foundation angles at the impoundment toe are very low at Pond 1 (less than 1 degree) and somewhat steeper for Pond 2 (approximately 7 degrees); and
- Grave Creek Reservoir: The 2017 terrain evaluation indicates that the surficial material is composed of active fluvial sediments. Typical foundation slope angles at the impoundment toe range from approximately 3 to 7 degrees.

Sediment ponds were sized for two phases of mining: an Interim Sediment Pond for Operations up to the end of Year 4 (EOY 4), and a Main Sediment Pond for the full mine footprint into Post-Closure, as presented in Figure 3.7-26 and Figure 3.7-27, respectively. Both sediment ponds were sized according to the guidelines of the B.C. Ministry of Environment (B.C. MOE) for the design of sediment ponds (B.C. MOE, 2015), which recommends the settling of particles with a diameter of 5 to 10 microns or greater during conveyance of runoff resulting from the 10-year, 24-hour storm event.

Runoff flows corresponding to the 10-year, 24-hour storm event were estimated using the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) software. This model can carry out hydrologic simulations based on inputs for a basin model, meteorological model, and control specifications (CEIWR-HEC, 2018, as cited in Stantec, 2020). Drainage areas reporting to the sediment ponds were determined based on the proposed mine plan for Operations at EOY 4 and full mine disturbance footprint. Losses within the catchments were estimated using the United States (U.S.) Natural Resources Conservation Service (NRCS) curve number (CN) method (USDA, 1986), which applies a curve number to each soil type. Time of concentration (t_C), which is the time that a drop of water takes to go from the furthest point of a catchment to the outlet, was calculated for all the contributing catchments. In turn, t_C was used to calculate the lag time for each catchment as required by HEC-HMS. Drainage areas and curve numbers used in the hydrological model for each pond are presented in Table 3.7-11.

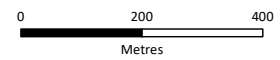


Crown Mountain Coking Coal Project

Figure 3.7-26
End of Year 4 Sediment Pond

LEGEND

- Project Footprint
- Interim Sediment Pond
- Waste Rock Placement Boundary
- Catchment Boundary
- Plant Site\ROM Stockpile Area
- Stepped Concrete Spillway
- Clean Coal Haul Road\Site Access
- Service Corridor
- Coal Process Plant Conveyor
- Coal Process Plant Duct



Scale 1:12,500

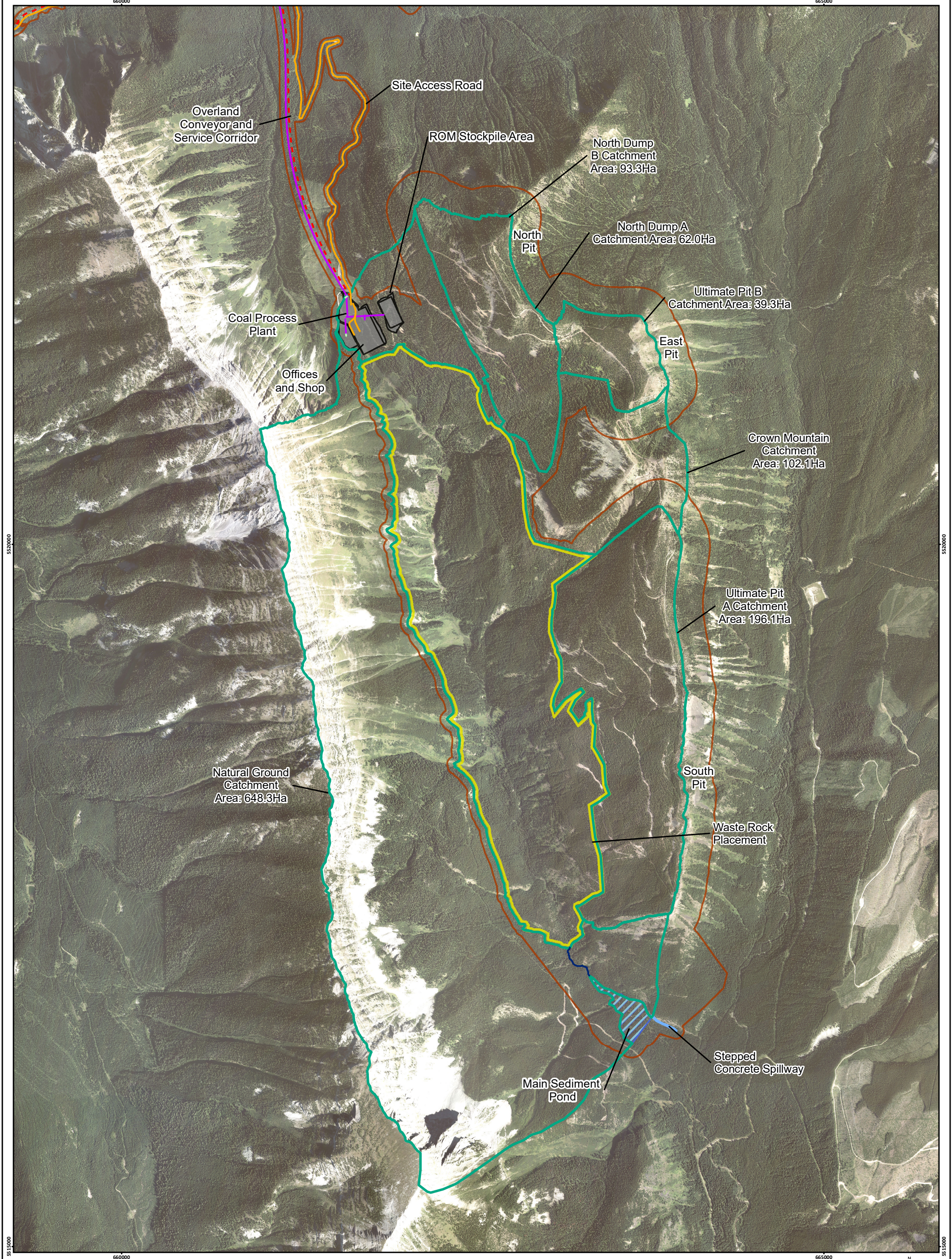


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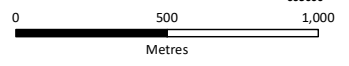
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Crown Mountain Coking Coal Project

LEGEND

- Project Footprint
- Catchment Boundary
- Waste Rock Placement Boundary
- Main Sediment Pond
- Plant Site\ROM Stockpile Area
- Stepped Concrete Spillway
- Channel to Ultimate Pond
- Clean Coal Haul Road\Site Access
- Service Corridor
- Coal Process Plant Conveyor
- Coal Process Plant Duct



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Figure 3.7-27
 End of Year 15 Sediment Pond

Table 3.7-11: Sediment Ponds Sizing Parameters

Sediment Pond Mine Area	Interim Sediment Pond			Main Sediment Pond		
	Drainage Area (ha)	CN	Lag Time (min)	Drainage Area (ha)	CN	Lag Time (min)
Natural Ground – West	173	60	67.9	648	60	102.1
Natural Ground – North	35	60	20.3	102	60	40.8
Mine Rock Piles – Main	137	70	71.7	366	70	98.8
Mine Rock Piles – North A	-	-	-	62	70	43.6
Mine Rock Piles – North B	-	-	-	94	70	48.1
Pits – South	-	-	-	196	70	62.2
Pits – North	-	-	-	39	70	22.1

A precipitation amount of 55.3 mm, corresponding to the 10-year, 24-hour event, was estimated based on intensity-duration-frequency (IDF) curves derived by Environment and Climate Change Canada (ECCC) for Sparwood, B.C., and adjusted for elevation and orographic effects (i.e., when an air force moves over rising terrain and is forced from low elevation to higher elevation). A Soil Conservation Service (SCS) Type 2 storm distribution was selected since it is characteristic of interior regions such as the Project area.

As mentioned above, the sediment ponds were sized to settle particles having a diameter of 5 to 10 microns or greater, assuming a settling velocity (V) of 2×10^{-5} m/s. The required pond area (A) results from dividing the outflow rate of the pond (Q) by V ($A = Q/V$). Other assumptions for pond sizing included control of the pond outflow with a spillway and the associated attenuation of peak runoff flows. In this context, attenuation refers to the reduction in the peak hydrograph that results in a broader, flatter hydrograph (HEC, 2000, as cited in Stantec, 2020). Pond outflows were obtained with the HEC-HMS software, using area-elevation relationships derived for candidate pond locations and a minimum spillway width of 4 m, as described in the next section. A factor of 1.2 was applied to the pond area to account for irregularities and deviations of particle shapes from the spherical shape. With this approach, settling times were greater than the minimum of 20 hours recommended by the Technical Guidance for 1.5 m deep ponds, since the proposed sedimentation ponds will be deeper than 1.5 m. Table 3.7-12 summarizes the sizing of sediment ponds. It is important to note that limited geotechnical data are available for the proposed pond locations, which may mean the configuration of the cut slopes or embankments may be revised to deal with ground conditions.

Table 3.7-12: Sediment Ponds Sizing

Sediment Pond	Peak Flow Rate (m ³ /s)		Pond Area (m ²)	Volume (m ³)	Required Dam Height (m)
	Inflow	Outflow			
Interim Sediment Pond	0.84	0.43	25,800	110,000	12
Main Sediment Pond	3.54	1.40	84,000	695,000	30

Assumptions used in the sizing of the dams required for impoundment included side slopes at 2:1 (H:V), 5 m wide crest and 1 m of freeboard. Because of the large required area for the Main Sediment Pond, other alternatives were explored to reduce the size of the area draining to the pond, including diversions

and in-pit storage. The great majority of the area draining into the ponds is from the mine rock dump footprint. A diversion of flows from the undisturbed area was estimated not to significantly reduce the required pond size. Additionally, as mentioned earlier, there are multiple challenges to implementing non-contact diversions west of the main rock dump. In-pit storage refers to the temporary or permanent storage of surface runoff in mined out pits to help reduce the peak flow reaching a sedimentation pond or any other water management structure. However, given the planned development sequence for the mine, it is not feasible to store water in the South Pit during Operations. Water storage is not feasible either in the North Pit as it is planned to be backfilled at EOY 5.

3.7.5.6 Inlet Works and Outlet Spillway

The proposed sediment ponds include structures that safely convey the design runoff event, which normally corresponds to a 200-year, 24-hour event (B.C. MOE, 2015). A precipitation depth of 92.3 mm, corresponding to the 200-year, 24-hour event, was estimated based on precipitation depths for 10 and 100 years derived from the intensity-duration-frequency (IDF) curves for Sparwood using Gumbel distribution and adjusting for elevation and orographic effects. Runoff flows corresponding to the 200-year, 24-hour storm event were estimated using the HEC-HMS software as well. Typically, a surface runoff collection system will be constructed on the mine rock pile footprint, discharging into a perimeter channel that conveys the runoff to the sediment pond inlet. The inlet structure to the sediment pond will be an excavated channel, or other similar structure, lined with riprap for protection from erosion. Assuming a riprap lined, trapezoidal channel, Table 3.7-13 presents the estimated dimensions of the inlet structure for the Interim and Main Sediment Ponds.

Table 3.7-13: Sizing of Inlet Structures to Sediment Ponds

Sediment Pond	Shape	Flow Rate (m ³ /s)	Bottom Width (m)	Side Slopes (xH:1V)	Depth (m)	Freeboard (m)
Interim Sediment Pond (SP-1)	Trapezoidal	5.2	5	3	0.8	0.5
Main Sediment Pond (SP-2)	Trapezoidal	19.4	5	3	1.1	0.5

The overflow spillway will be designed to at least withstand a design runoff event of 1 in 200 years with a minimum freeboard of 0.5 m and a greater freeboard during normal operations (B.C. MOE, 2015). It should be noted that a larger design runoff event may need to be accommodated depending upon the consequence classification of the impounding dam structure which will be completed as part of the detailed dam design and permitting process. The need to design for a larger peak flow event would result in increases to the size and capacity of the inlet and spillway. The storage capacity of the impoundment would not need to be increased. According to the B.C. Dam Safety Guidelines, the minimum width of the overflow spillway must be 4 m for a normal freeboard (corresponding to the elevation difference between the dam crest and the spillway sill) of at least 1 m (B.C. Ministry of Forests, Lands, and Natural Resource Operations, 2016). An energy dissipation structure will be constructed downstream of the overflow spillway to allow the discharged flows to enter West Alexander Creek without causing unacceptable erosion to the natural creek bed. Initially, the energy dissipation structures were assumed to be trapezoidal channels lined with riprap; however, the complex excavation works required make this option unfeasible. Therefore, the dissipation structures will consist instead of rectangular concrete channels armoured with steps. Table 3.7-14 presents the characteristics and estimated sizing of the outlet

structures for the Interim and Main Sediment Ponds. Monthly minimum, average, and maximum outflow from the Interim and Main Sediment Ponds is provided in Table 3.7-15. Effluent chemistry predictions for the Interim and Main Sediment Ponds are provided in tabular form in Appendix B1 of Appendix B-3. Additional details about the design and management of water conveyances at site may be found in the Site Water Management Plan (Chapter 33, Section 33.4.1.8).

Table 3.7-14: Preliminary Sizing of Outlet Structures from Sediment Ponds

Sediment Pond	Spillway			Freeboard		Energy Dissipation Structure				
	Design Flow (m ³ /s)	Width (m)	Inlet Elevation (m)	Minimum (m)	Normal (m)	Shape	Bottom Width (m)	Depth (m)	Step Height (m)	Step Length (m)
Interim Sediment Pond (SP-1)	3.1	4	1,706.8	0.5	1.2	Rectangular	4	0.8	0.25	2.0
Main Sediment Pond (SP-2)	9.4	4	1,569.5	0.6	2.0	Rectangular	4	0.9	0.25	1.5

Table 3.7-15: Monthly Minimum, Average, and Maximum Outflow from the Interim and Main Sediment Ponds

Months	Discharge (m ³ /s)					
	Interim Sediment Pond			Main Sediment Pond		
	Min.	Avg.	Max.	Min.	Avg.	Max.
1	0.0083	0.0092	0.0568	0.0549	0.0596	0.0686
2	0.0030	0.0084	0.1082	0.0605	0.0645	0.0881
3	0.0033	0.0491	0.4402	0.0618	0.0723	0.1943
4	0.0051	0.1130	0.9771	0.0509	0.1490	1.5118
5	0.0055	0.0754	0.6900	0.0011	0.4637	11.8966
6	0.0052	0.0418	0.4261	0.0331	0.3918	8.9984
7	0.0045	0.0317	0.3139	0.0672	0.1552	1.3806
8	0.0044	0.0262	0.2646	0.0627	0.1228	0.8283
9	0.0028	0.0227	0.2154	0.0277	0.1178	0.7994
10	0.0012	0.0244	0.2439	0.0000	0.0968	0.7837
11	0.0017	0.0276	0.3179	0.0212	0.0799	0.3801
12	0.0030	0.0132	0.1484	0.0533	0.0622	0.0911

3.7.6 Mine Infrastructure and Supporting Facilities

For the truck maintenance shop and wash bay facility, NWP has decided to include the pre-fabricated modular structure as the base case. This decision was influenced by the ability to construct the modular facilities in phases, which resulted in capital savings in the initial capital period. In addition, the delivery and construction time for the modular units is shorter than for conventional, stick-built structures.

The mine site support facilities include the following:

- Maintenance shop, service bays, tool storage, and tire shop;
- Warehousing;
- Offices;
- Mine dry (i.e., changing and shower facilities);
- First aid area, emergency vehicle enclosed parking; and
- Other support requirements for the mine operation (includes site security, light vehicle washing and parking, major parts laydown and tire storage area, explosives storage, and fuel storage and dispensing).

Feasibility level design of mine infrastructure and support facilities includes the Health, Safety and Reclamation Code for Mines in B.C. and the Engineering Manual prepared by the Forests, Lands, Natural Resource Operations & Rural Development, with codes and standards outlined in the facilities basis of design (Stantec, 2020).

Many of the mine support facilities will be located near the CHPP area. The lower facilities are located near the Harmer Road turnoff, which will provide security/access control and support for Project operations in this area.

The upper facilities buildings are all situated on a single bench area immediately to the east of the CHPP and include:

- Office and Dry: The main office and dry building is designed as a two-level modular building containing washrooms, showers, change rooms, and lockers on the lower floor and administrative areas including private offices and open workstations, conference and meeting rooms, file storage and printing area, kitchenette, and washrooms on the upper floor. The building is approximately 25 m x 19 m x 9 m high;
- Light Vehicle Shop: The light vehicle shop will house emergency response vehicles, a first aid room, an emergency medical responder room, a mine rescue equipment room, two offices, a large lunchroom, one maintenance bay for light vehicles, a warehouse, and associated tool storages and cribs. The building is approximately 63 m x 24 m in footprint with a building (ridge) height of approximately 14 m. The light vehicle shop will be designed as a pre-engineered steel frame building; and
- Haul Truck Maintenance Facility: The maintenance shop structures and wash bay for the haul trucks facility will be modular structures constructed out of components included shipping containers and tensioned fabric over engineered steel arch trusses. The installation of these modular structures will be phased. In pre-production, there will be one maintenance shop building with one wash bay facility. After the pre-production stage, an additional maintenance shop building will be added. Each maintenance shop building has an approximately 31 m x 24 m in footprint which includes the additional areas required for buttress containers. The height of the buildings is approximately 19 m. Each shop structure has room for two haul trucks, so a total of four heavy equipment maintenance bays will be available during full mine production. The maintenance shop complex will also include the following:
 - Auxiliary Facilities;
 - Septic Field;
 - Water Storage (Potable and Non-Potable);
 - Generator;

- Fuel Storage (Diesel and Gasoline); and
- Reagents/Consumables Storage – Magnetite, Methyl Isobutyl Carbinol, Flocculants.

The fueling stations have been laid out with the diesel filling station for heavy mine equipment having four 45,000 litre tanks (double-walled) and two fueling stations. The light vehicle station has a single 7,000 litre tank and a single fueling station. Both stations are located on the southern edge of the main shop pad area. Service fluid tanks are located adjacent to the maintenance shop on a bermed secondary containment pad. Bulk fuel and fluid delivery to site would be carried out by existing suppliers located in Sparwood.

Facilities outside of the main mine facilities area include a site security building and explosives storage facilities.

3.7.6.1 Coal Handling Process Plant

The design and application of an appropriate CHPP is essential for the successful recovery of high-value, metallurgical-grade coal products. For this Project, an appropriately designed CHPP is especially important because of:

- The attendant high volumes of dilution material expected in the ROM coal;
- The need to minimize ROM coal breakage to minimize yield losses and product coal moisture;
- Highly variable size and yield envelopes for the ROM coal;
- The need to deal with variable and sometimes difficult to float Hard Coking Coal and non-floating PCI coal;
- Relatively high content of near gravity material in the coal;
- The need to operate the small coal circuit at low densities to meet product ash;
- Variable flotation response from ROM coals; and
- The need to maximize the yield of high-quality coking coal from the fines circuit to maximize product coking properties.

The raw coal treatment and wet-processing systems have been designed to collectively consider the above factors, and at the same time, meet CHPP production requirements and maximize the recovery of coking and PCI coal products that achieve targeted market quality specifications.

The CHPP construction plan will be refined during later Project stages. Currently, the high-level CHPP construction strategy includes the following:

- Completing CHPP concrete works in Construction Year 1, followed by prefabricated building installation;
- CHPP construction will be sub-contracted to discipline construction specialists;
- Reinforced Earth (RE) wall construction can proceed through the winter months;
- Multiple constructions and installation teams will work concurrently; and
- Multiple construction crews will assemble the structure, stations, and bins into large pre-assembled sections that will then be erected.

3.7.6.1.1 Run-Of-Mine Raw Coal Handling

Run-of-Mine (ROM) coal will be received into a 450 t ROM dump hopper, fitted with a grizzly screen to prevent oversize coal and rock from entering the hopper. An oversized hopper will substantially reduce potential issues due to ROM coal availability at the feed point which is typically caused by equipment availability. ROM coal will be reclaimed beneath the hopper by a feeder breaker reducing the top size coal to about 250 mm and then discharge onto the raw coal conveyor. The raw coal conveyor will have a tramp iron magnet and a metal detector to prevent damage to downstream equipment in the CHPP. The conveyor will also include a belt weigher to control the feeder breaker discharge rate.

Figure 3.7-28 shows a 3D rendering of the CHPP ROM handling system while Figure 3.7-29 is a simplified flow diagram.

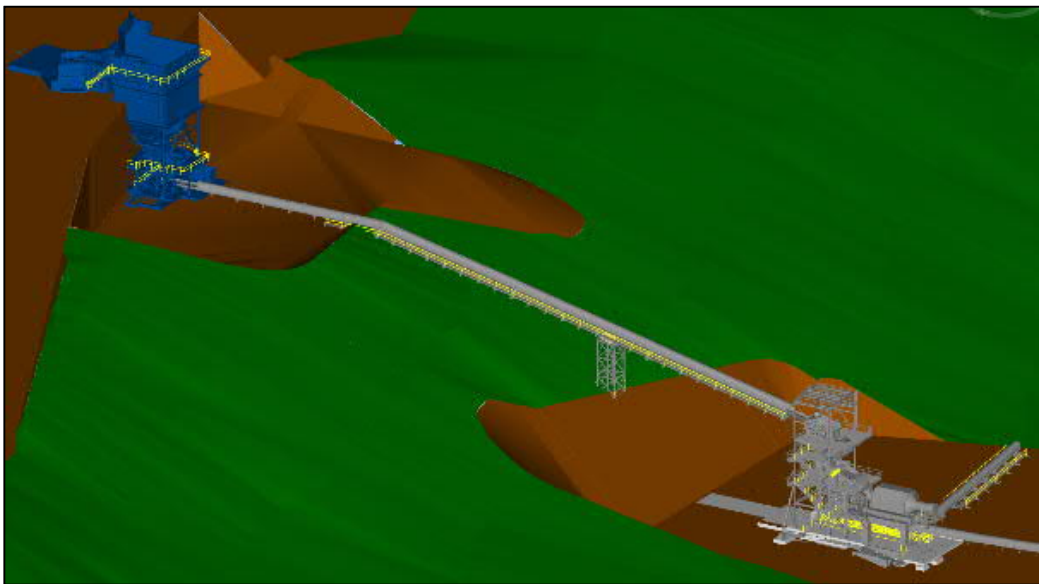


Figure 3.7-28: ROM Coal Handling Area View (Sedgman)

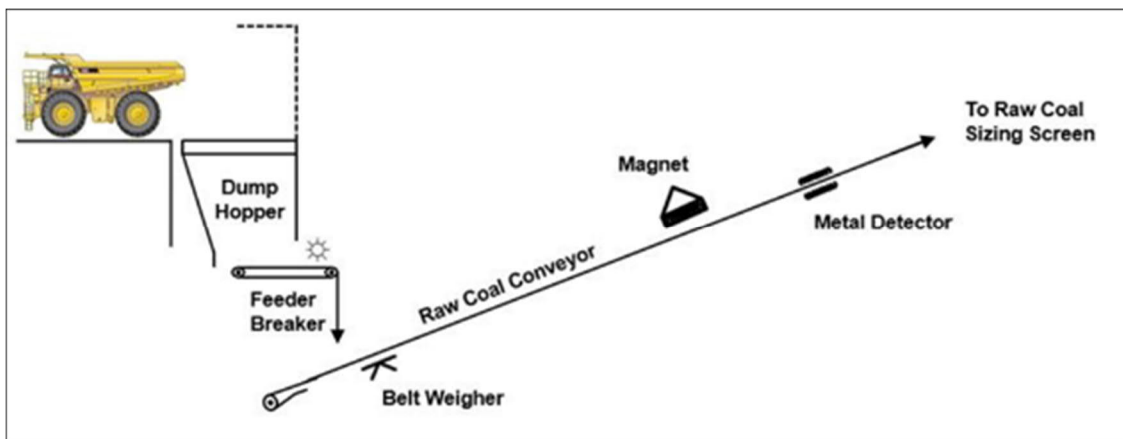


Figure 3.7-29: ROM Coal Dump

The raw coal will be screened with the oversized raw coal (+50 mm) reporting to a rotary breaker. The rotary breaker will reduce the raw coal to a nominal top size of 50 mm, while the harder rock will be rejected. The selection of a rotary breaker is appropriate for these local friable coals due to the significant differential with the stronger dilution rock. Additionally, the rotary breaker typically produces less fines than other means of crushing and is also less affected by foreign objects present in the ROM than other types of crusher or sizer.

Actual plant experience will allow the optimization of separation apertures, lifter geometry, and breaker speed, and consequently the top size of the material to the CHPP. Optimization will also result in processing savings and increased throughput when processing ROM from South Pit which contains more dilution material.

The CHPP feed conveyor will have a primary sampler, a belt weigher, tramp-iron magnet and a metal detector. Figure 3.7-30 shows a simplified overview of the breaker station and plant feed conveyor.

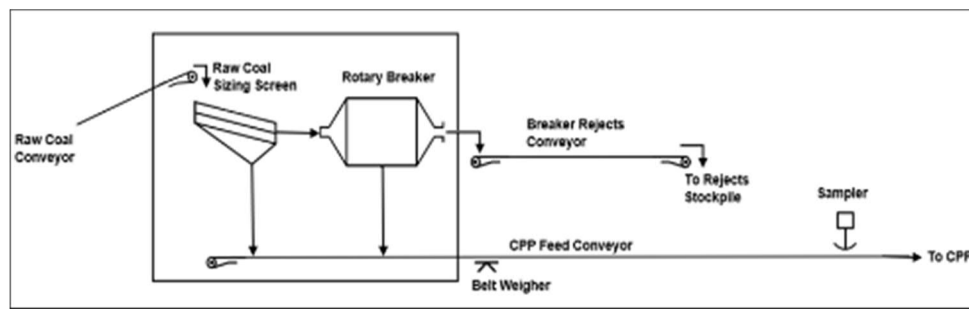


Figure 3.7-30: Rotary Breaker and Plant Feed

3.7.6.1.2 Coal Handling Process Plant Design Basis

The Crown Mountain CHPP has been developed around the following size-specific processes:

- Dense Medium Cyclone (DMC) 50 mm x 1.4 mm (1.0 mm weight/weight (w/w));
- Teetered bed separators (TBS) 1.4 mm (1.0 mm w/w) x 0.15 mm; and
- Froth Flotation 0.15 mm x 0.

Ultrafine tailings will be dewatered with plate and frame filters and combined with coarse and fine rejects for co-emplacement back in the pit. NWP has completed feasibility level design for CHPP processes including:

- Plant feed, deslime, and coarse coal circuit;
- Fine coal circuit;
- Correct medium circuit;
- Small coal circuit;
- Tailings thickening and dewatering;
- Oxidized PCI coal handling; and
- Dewatering and product moisture control using hyperbaric disc filters.

3.7.6.1.3 Reject Handling

The plant rejects will be placed as 1 m layer on the waste dump as part of the selenium management plan. To be efficiently hauled and placed, plate and frame filters were used to reduce the moisture content of the plant rejects down to 18%. Coarse, fines and ultrafine reject material will be combined on the reject conveyor and will be elevated from the CHPP into a 200 t rejects bin. A pneumatically operated rejects gate will control the discharge of rejects into the trucks for haulage back to the pit. A reject bin overflow chute will allow rejects to be directed to a rejects bunker in the event of trucking fleet delays. The rejects conveyor and bin above the first floor will be fully enclosed and the rejects bin will be heated. The enclosed rejects conveyor will be single-sided walkway and will provide the primary access to the top of the bin. The top of the rejects bin can also be accessed from the ground floor via a ladder.

3.7.6.1.4 Product Coal Handling

Coarse, small and fine product coal will be combined on the product conveyor and will be elevated from the CHPP into a 50t overland conveyor (OLC) feed bin. An ash analyser, belt weigher, and cross belt sampler will be installed on the product conveyor to allow for product coal sample collection, ash content, instantaneous product rate, and cumulative tonnes to be monitored and recorded. The product conveyor will be a single-sided open style truss conveyor with hinged covers over the belt. A bin overflow chute will allow product coal to be directed to a product bunker in the event of a downstream equipment stoppage. Overflow coal will be reclaimed by a front-end loader (CAT IT38 or equivalent size) and fed to a small hopper which will direct the coal onto the OLC. It is anticipated that the front-end loader will discharge product coal onto the belt during a plant down day to clear the stockpile. The OLC bin will discharge coal at a controlled rate onto the overland conveyor via a vibrating feeder. The OLC will convey the coal approximately 2.7 km before feeding into a truck loading bin.

Schematics of the product coal handling layout are shown in Figure 3.7-31.

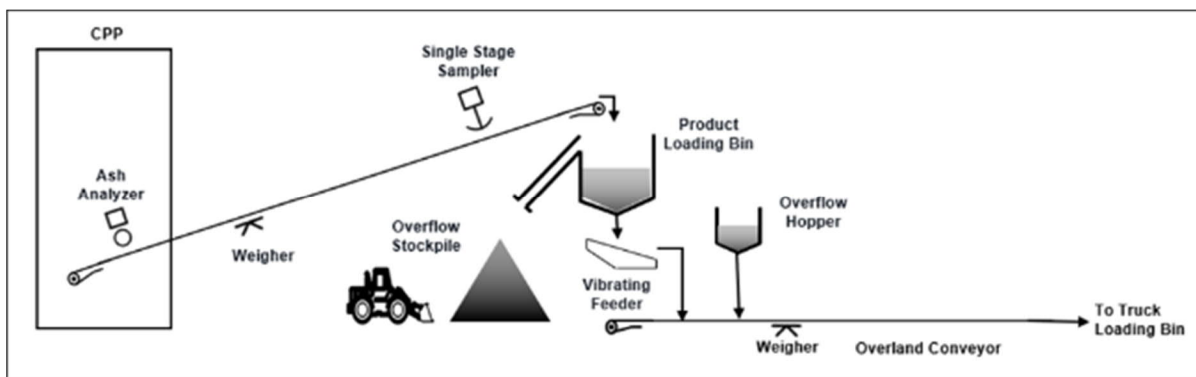


Figure 3.7-31: Product Coal Handling Schematic

3.7.6.2 Consumables

3.7.6.2.1 Flocculant

Both anionic and cationic flocculant will be dosed at the following CHPP locations for Coal and Tailings thickener. The anionic and cationic dosing plants will be vendor package plants which will be delivered skidded and assembled on-site. The make-up and dosing units will be supplied with on-board electrics and control panels. The flocculant dosing equipment will be stored within a stand-alone make-up building

which will be fully enclosed and heated. Anionic flocculant will be a dry make-up system and will be delivered to site in 750 kg bulk bags. Anionic polymer solution will be made up as required in preparation and solution tanks and dosed via a dedicated progressive cavity pump to each thickener. Cationic flocculant will be delivered to site as a liquid in 1 m³ totes. Cationic flocculant solution will be diluted and dosed to each thickener via a dedicated progressive cavity pump.

3.7.6.2.2 Reagents

Flotation reagents will be stored inside double-walled 25,000 L capacity steel tanks located adjacent to the tailings and coal thickeners. The reagents include the following: diesel (used as a flotation collector) and Methyl Isobutyl Carbinol (used as a flotation frother [surfactant]). Maximum annual usage of diesel (collector) is anticipated at approximately 568,000 kg per year; maximum annual usage of Methyl Isobutyl Carbinol is anticipated at approximately 483,000 kg per year. Dosing pumps will transfer the reagents from the storage tanks to the rougher, scavenger and cleaner flotation circuits. The storage area and associated distribution networks are classified as hazardous areas and will be designed and installed in accordance with Canadian standards.

3.7.6.2.3 Magnetite

Bulk magnetite will be trucked to site and stored adjacent to the CHPP in an open containment area. A front-end loader would be used to transfer the magnetite from this open containment area to the magnetite make-up sump located inside the CHPP building. A directional water cannon will be included to help slurry the magnetite within the make-up sump. The magnetite pump will pump the slurried magnetite into the DMC circuit.

3.7.6.2.4 Truck Loadout (TLO) Rail Car Dosing Systems

The TLO wagon dosing system will be a vendor supplied package with all dosing pumps and equipment supplied within a self-contained and heated 40-foot container. The system is fitted with an air compressor to clear and purge the dosing lines and spray bars after the last rail car is filled to apply the anti-freeze and dust binder systems. A dust binder chemical solution will be applied to the rail cars after filling to effectively seal the top layer of coal and mitigate dust during the mine to port journey. Dust binder chemical will be delivered to site by road tanker and will be stored in a Fibreglass Reinforced Plastic (FRP) tank with a 37,500 L storage capacity. Maximum annual usage of dust binder solution is anticipated at approximately 175,000 kg per year. The tank will be heated and insulated to prevent freezing during the winter months.

During the colder months, an anti-freeze solution will be applied to the empty rail cars prior to filling to prevent coal freezing and sticking to the rail car during unloading at the port. The anti-freeze chemical will be delivered to site by road tanker and will be stored in a FRP tank with a 37,500 L storage capacity. Maximum annual usage of anti-freeze solution is anticipated at approximately 351,000 kg per year. The tank will be heated and insulated as the solution can become difficult to pump at below zero temperatures.

3.7.6.3 Clean Coal Transportation Route

The existing Grave Creek Valley Access Road is the main access to the Project site but will require upgrading and expansion from its current configuration to handle both coal haulage and vehicles traveling

to the site. During mining operations, vehicles such as pick-up trucks, crew buses, fuel delivery trucks, and clean coal haul trucks will be traveling on the access road. The road will be upgraded to accommodate Western Star 6900XD class tractors, which are a ruggedized version of conventional highway type tractors. These tractor units would tow 95 t end dumping trailers. Additional details about the clean coal transportation route which aligns with the proposed site access is contained in Chapter 2.

3.7.6.4 Rail Loadout and Rail Siding

Haul trucks will dump the product coal onto two 25,000 t stockpiles located on the west side of the proposed rail loop location. Two clean coal stockpiles will allow for the stockpiling of both coking and PCI products. Two fabric covers will cover each stockpile to provide protection from rain, snow, and wind as well as minimize potential dust emissions. The stockpiles will be managed by a dozer and the product coal will be pushed onto reclaim feeders, which will direct the product onto the train loadout conveyor. Product will be discharged from this conveyor into a 350 t train loadout bin for loading trains.

A cross-belt sampler will be installed on the train loadout conveyor to allow for product coal sample collection. A belt weigher will be installed on the train loadout conveyor downstream of each reclaim feeder to control the reclaim rate of each feeder and to record the instantaneous product rate and monitor cumulative tonnes.

Each reclaim feeder will have a breaker head fitted to break up any large chunks of coal which freeze on the stockpile.

The rail loadout (RLO) bin feed conveyor will be an open style truss conveyor with a single-sided walkway and hinged cover over the carry side of the belt.

A schematic of the RLO system is shown in Figure 3.7-32.

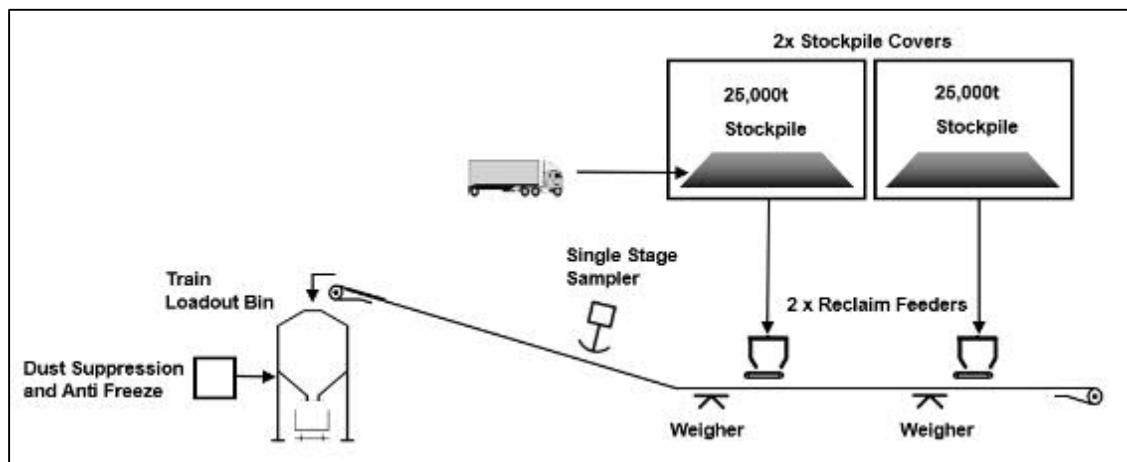


Figure 3.7-32: Rail Loadout Schematic

The RLO bin will be enclosed above the first floor and heated. A hydraulic gate at the bottom of the bin will open and close using an electronic control system. The product coal will flow through the opened gate into a chute that will form the correct profile of coal into the railcars below.

Sensors installed next to the rail tracks will detect the position of the railcars and provide feedback for the opening and closing of the loading gate and to ensure the railcars will have the correct coal profile. Weighing of the wagons will be via a Meridian type weigh scale system to enable the automatic loading of the train.

3.7.6.5 Primary Power Supply

3.7.6.5.1 Background

The purpose of this section is to outline the proposed feasibility design and the basis for the cost estimate for the Crown Mountain power supply infrastructure. The design and cost estimates were prepared to include all power supply infrastructure from the point-of-interconnect with BC Hydro's 138 kilovolts (kV) transmission line 1L274 to the feeder cables running to each facility's main electrical room.

3.7.6.5.2 Power Supply Basis of Design

Electrical power for the Project will be solely supplied from BC Hydro's nearby 138 kV transmission line (1L274). This design adopts the recommendation of the power flow study and motor starting evaluation, which recommended the use of 34.5 kV as the main RLO. Approximately 900 m of 138 kV transmission line will be required to connect the primary step-down substation to the BC Hydro transmission line (1L274). 34.5 kV will be distributed from the primary step-down substation to feed step down substations or transformers (SUB-2, SUB-3 & SUB-4) near each facility. The length of line required from the down valley substation to the upper mine substation is 13.8 km.

3.7.6.6 Natural Gas Supply

As described in Chapter 2, the Project is estimated to require an annual natural gas load of approximately 355,000 gigajoules (GJ) per year. The natural gas supply will be constructed to primarily run along the alignment of the clean coal haul road (site access road) within the service corridor to the TLO loop, and then along the clean coal conveyor alignment to the plant site. UTM coordinates for the natural gas pipeline are provided in Table 3.7-16. The natural gas pipeline deviates from the clean coal haul road alignment at approximately 4.7 km from the truck dump in order to shorten the line by 2.5 km. To avoid deformation from settlement, the pipe will be buried along the uphill side of the road where it can be located in cut, or an area of shallow fill. From the RLO loop, the pipeline will run just to the north of the clean coal conveyance system to the plant site.

Table 3.7-16: UTM Coordinates for the Natural Gas Pipeline

Description	Easting	Northing
Start	652255	5523930
To Rail Loadout	653619	5523931
Existing Railway	653661	5523928
Intersection to Grave Creek Road 1	655441	5524184
Intersection to Wetland/Watercourse of Grave Lake	655449	5524174
Intersection of Grave Creek Watercourse 1	656650	5522258
West Diversion from Road	656949	5522224
East Diversion from Road	657509	5522403

Description	Easting	Northing
Intersection of Watercourse Offshoot 1	658410	5523413
Intersection of Watercourse Offshoot 2	658757	5523451
Intersection of Grave Creek Watercourse 2	659264	5523694
Intersection of Watercourse Offshoot 3	659407	5523798
Intersection of Grave Creek Watercourse 3	660482	5524254
Grave Creek Reservoir	660751	5524303
Joins Back to Main Road	661037	5524274
Pipeline Intersection	661061	5524433
End (Plant Site)	661612	5521764

Projected Coordinate System: NAD83 UTM Zone 11 N

3.7.6.7 Explosives Storage

Explosive storage will meet Natural Resources Canada explosives safety and other applicable requirements. An explosives factory will be built on a site located northeast of the plant site. On a separate access off the Grave Creek Road, the ammonium nitrate silo and emulsion silo will be located 110 m apart from each other and 1,000 m from the nearest site infrastructure. An explosive factory will consist of:

- Ammonium nitrate silo;
- 40 t emulsion silo;
- Facility to wash explosive contractor's equipment; and
- Small shop.

NWP would be responsible for access and clearing of suitable land for the explosives factory and magazine, while relocation and construction of the facilities would be the responsibility of the selected blasting contractor. The explosives contractor is responsible for environmental, health, and safety design requirements for the operation of the explosives factory, including management of any specialty wastes associated with the explosives manufacture, storage, and usage. Total explosives usage, including ANFO and emulsion, is anticipated to range from 1.3 million kg/year during construction up to a peak of 14.8 million kg/year during operations.

3.7.6.8 Fuel Storage

The fueling stations have been laid out with the diesel filling station for heavy mine equipment having four 45,000 litre tanks (double-walled) and two fueling stations. The light vehicle station has a single 7,000 litre tank and a single fueling station. Both stations would be located on the southern edge of the main shop pad area. Service fluid tanks would be located adjacent to the maintenance shop on a bermed secondary containment pad. Bulk fuel and fluid delivery to site would be carried out by existing suppliers located in Sparwood, B.C.

3.7.6.9 Sewage Treatment and Waste Management

Sewage from the CHPP and heavy vehicle/warehouse facilities will flow via gravity to a sewage treatment plant located adjacent to the office and mine dry buildings. The sewage treatment building will handle all sewage from these buildings. Treated solids will be removed by a qualified contractor and disposed off-site at an approved local disposal site. Treated effluent will be directed to a disposal field located adjacent

to the mine office building. The specific effluent release point to the onsite disposal field will be determined during detailed design.

3.7.6.9.1 Refuse and Recycling

The Project Waste Management Plan (Chapter 33, Section 33.4.1.12) provides a strategic framework for how NWP will effectively manage non-mining waste at site. Detailed plans for non-mining waste management would be developed at later Project stages. Approaches to waste management will be based on the philosophy that solid waste will be first managed as a potential resource. In preferential order, NWP will evaluate for prevention, reduction, reuse, and recycling where feasible prior to disposal off-site. It is anticipated that the hauling of refuse and recyclables off-site will be performed by contracted services. All waste materials will be managed to reduce potential for interaction with wildlife or the natural environment.

3.7.6.10 Water Supply and Rates

The Crown Mountain Coking Coal Project aims to minimize water consumption by recovering water from the coal washing process to the extent practical. Makeup water is required for the following:

- Coal processing and pumping requirements within the plant;
- Pump gland water requirements;
- Tailings and coal filter cloth wash water;
- Flocculant make-up requirements;
- Dust control for stockpiles and conveyor handling; and
- Generate steam for hyperbaric disc filters.

The process water supply requirement is estimated to be in a range of 85-95 litres/ROMt. In order to establish a baseline for make-up water requirements, an evaluation of the effect of varying yields through the process plant was completed. The results of the water usage for processing only are summarized in Table 3.7-17. It is expected that as yields decrease, a greater proportion of higher moisture rejects will be generated. For reference, average yields by pit area are as follows: North Pit plant yield = 61.5%, East Pit plant yield = 49.8%, South Pit plant yield = 43.8%.

Table 3.7-17: Annual Process and Site Water Requirements

Plant Yield	Rejects Total Moisture (%)	Process Water Required (m ³)	Other Water Usage (m ³)	Annual Water Requirement (m ³)
60%	15	305,000	130,000	435,000
50%	17	395,000	130,000	525,000
40%	19	510,000	130,000	640,000

3.7.6.11 Other Water Requirements

In addition to plant water requirements, water is required for various activities including dust suppression, vehicle wash down, fire suppression, and potable water usage at the plant site and the dry/office area. Water for dust suppression will be withdrawn from the Interim Sediment Pond and Grave Creek Reservoir for the first four years of mine operation. After that, it will be supplemented from the North Pit sumps when the pit will hold a sufficient volume of water. Installation of a seasonal pumping station at the

reservoir for filling of water trucks will be part of mine dust control operations. Water for fire suppression will be stored in a large tank above the plant site. Potable water for the plant site will be withdrawn from wells drilled near the plant site, with standard treatment methods applied as needed to meet water quality standards for intended use.

3.7.6.11.1 Fresh Water Supply System

As described in Chapter 2, the primary source of water for processing operations will be from West Alexander Creek and secondary source from Grave Creek.

In order to provide surge capacity for pumping as well as a water supply during low flow months, an excavated water supply reservoir is proposed near the clean coal truck loadout area in the Grave Creek drainage. The reservoir will have a maximum water depth of approximately 15 m and a minimum freeboard of 1 m and a capacity of 100,000 m³. Reservoir capacity will be supported by the construction of low perimeter berms. The total footprint area of the water supply reservoir will have approximate dimensions of 170 m x 70 m, including berms.

Water will be withdrawn from the off-channel reservoir using a vertical turbine pump (pumping capacity 55-60 m³/hour) housed on a floating platform. A second pump will be included for backup. Water will be pumped from the reservoir to the plant site using a heat-traced/insulated 15 centimetre (cm) diameter pipe. UTM coordinates for the water pipeline are provided in Table 3.7-18. The pipeline will be placed parallel to the conveyor right-of-way from the clean coal transfer area to the plant site within the service corridor. The reservoir pumping system will supply the common water tank located adjacent to the plant/shop area.

Table 3.7-18: UTM Coordinates for the Water Pipeline

Description	Easting	Northing
Start\Grave Creek Reservoir	660751	5524303
Pipeline Intersection	661061	5524433
Joins Back to Main Road	661037	5524274
End (Plant Site)	661612	5521764

Projected Coordinate System: NAD83 UTM Zone 11 N

The Interim Sediment Pond in the West Alexander drainage has a water capacity of approximately 84,000 m³ when full. Allowing for sediment storage and minimum water inventory, it is estimated 50,000 m³ of water from this pond is available for use in dust control, washing, and coal processing.

The common water tank is supplied by two different primary water sources supplemented by the Grave Creek off-channel reservoir throughout the life of mine. For the first five years, the common water tank is supplied with water from the Interim Sediment Pond and Grave Creek off-channel reservoir. The Interim Sediment Pond is deactivated after Year 5 of mining. After Year 5, the common water tank will need a replacement source to keep up with makeup water demand, this supplemental source will be extracted from supply wells located in the mined out the North Pit which will collect run-off water from the area surrounding the pit. As the North Pit fills, its stored water capacity will exceed 200,000 m³ even when backfilled, as void space will exist within the backfilled mine rock.

The combined stored water capacity of the Interim Sediment Pond and the Grave Creek Reservoir when both are at full capacity (i.e., during spring freshet or high flow periods) is in the range of 150,000 m³. This volume of water is sufficient to meet mine requirements for up to four months without supplemental inputs during the first five years of mining, allowing the mine to continue operating even during low flow periods in Grave Creek. Once the mined out North Pit becomes available as a source of supplemental water, it is expected that the pit's water capacity will be such that pumping from Grave Creek to the reservoir during winter months will not be required.

3.7.6.12 Lighting

Light pollution, or artificial light at night, is the excessive or poor use of artificial outdoor light, which may result in negative effects to wildlife, plants, and humans. There are no federal or provincial regulations or guidelines governing light emissions from mining operations in Canada; however, the Commission Internationale de L'Éclairage (CIE) has developed a Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations (CIE, 2017). The guidelines include five environmental zones differentiated by the ambient brightness of the environment to be experienced within each zone (Table 3.7-19). The Bortle Dark Sky Scale is another classification for light impacts and describes the amount of light pollution in a night sky. It includes nine classes ranging from natural dark sky sites (Class 1) to inner city skies (Class 9; Bortle, 2006; Table 3.7-19).

Table 3.7-19: Commission Internationale de L'Éclairage (CIE) Environmental Zones and Corresponding Bortle Dark-Sky Classes (from CIE, 2017 and Bortle, 2006)

Zone	Surrounding	Lighting Environment	Examples	Bortle Dark-sky Scale Class
E0	Protected	Dark	Dark-sky preserve	Class 1. Excellent dark sky.
E1	Natural	Dark	Relatively uninhabited rural areas, national parks, etc.	Classes 2-3. Dark and rural skies with small amounts of lighting.
E2	Rural	Low district brightness	Sparsely inhabited rural areas, village, or relatively dark outer suburban locations	Classes 4-5. Rural transition and suburban with little lighting.
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations	Classes 6-7. Bright suburban sky and suburban/urban transition.
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity	Classes 8-9. City centre and inner-city skies. Very bright.

The Project footprint and its adjacent surroundings fall within the E1 (natural) zone because it is a relatively uninhabited rural area. Although baseline ambient light levels were not measured at the Project site, existing ambient light levels are expected to be consistent with ambient light conditions for the region and thus no significant changes in light variation are expected to occur in this area year-round beyond seasonal changes expected at a latitude of 49° north. Teck's Line Creek Operations is visible from the top of Crown Mountain but based on its size and distance from the Project, effects to existing ambient light levels at the Project location are anticipated to be minimal. No lights from the Elk Valley are anticipated to be visible due to the presence of tall mountain ridges (e.g., Erickson Ridge) between the Project and populated areas of the Elk Valley (e.g., Sparwood). Baseline sky brightness information from the 2015

World Atlas global light pollution map (lightpollutionmap.info) indicates that for the locations of the Project plant site and rail loadout (the areas anticipated to have the greatest levels of nighttime illumination within the Project footprint), the existing Bortle Dark Sky Class is Class 3 (Table 3.7-20). Sky brightness for Teck’s Elkview and Line Creek Operations was compared to the Project location to gain an understanding of artificial light levels for coal mining operations in the Elk Valley (Table 3.7-20). Given the scale of these operations relative to the Project, the change in sky brightness at the Project site is anticipated to be of a lesser magnitude. Values representative of natural sky brightness (i.e., without influence of artificial light) are also presented for comparison.

Table 3.7-20: World Atlas 2015 Sky Brightness Information for the Project Footprint and Teck’s Line Creek and Elkview Operations (Light Pollution Map, 2022)

Location	Zenith Sky Brightness (magnitude/arc second ²)	Total Brightness (millicandelas per square metre [mcd/m ²])	Artificial Brightness (microcandelas per square metre [μ cd/m ²])*	Artificial Brightness: Natural Brightness Ratio **	Bortle Dark Sky Class
Crown Mountain Plant Site	21.87	0.194	22.6	0.132	Class 3
Crown Mountain Rail Loadout	21.81	0.204	33.2	0.194	Class 3
Elk View Operations	21.59	0.249	78.0	0.456	Class 4
Line Creek Operations	21.61	0.246	74.8	0.438	Class 4
Natural Sky Brightness	22.0	0.171	0.000	0.000	Class 1

* Artificial brightness of skies degraded to the zenith (point in the sky directly above the observer) is 8-50% above natural light (14 to 87 μ cd/m²).

** A ratio of 1.0 would indicate that anthropogenic light was 100% brighter than natural light from the night sky

An artificial brightness to natural brightness ratio of 0.33, or skies 33% brighter than natural conditions, was proposed as the threshold for national parks with significant natural resources and ecosystems by the National Park Service in the United States (Moore et al., 2013). This value corresponds with the point at which portions of the sky become bright enough that humans cannot fully adapt to the dark when looking towards them. Above this threshold, humans lose visual sensitivity and require time under dark conditions to re-adapt their eyes. This attribute of human night vision is likely similar in other mammals, although certain mammals may be more or less sensitive (Moore et al., 2013). The ratio of 0.33 also corresponds with the transition between Bortle Class 3 (rural and dark) and Class 4 (suburban) skies (Moore et al., 2013). The Project site is currently below this threshold (ratio of 0.132 and 0.194 at the plant site and rail loadout locations, respectively; Table 3.7-20), but is anticipated to approach or slightly exceed this level during the Construction and Pre-Production and Operations phases based on sky brightness levels at other coal mining operations in the Elk Valley. It is important to note that the Project will be smaller in size than the currently operating coal mines in the Elk Valley. A recent meta-analysis addressing a wide variety of biological impacts of artificial light at night (ALAN) found no evidence for a systematic increase in effects sizes with increased levels of ALAN (Sanders et al., 2021, as cited in Gaston et al., 2021). As such, given that night-time light levels are already elevated above natural conditions at the Project site (Table 3.7-20), moderate increases to brightness levels similar to those at Teck’s nearby operations are unlikely to have significant effects on wildlife within the Project study areas.

An outdoor lightning evaluation baseline study (Dillon Consulting Limited, 2021; Appendix 3-D) was conducted for the Project to identify potential locations predicted to have nighttime outdoor lightings effects as a result of the Project's activities occurring 24 hours a day. This study used the analysis from the baseline visual impact assessment as a starting point, as excessive artificial light can pollute the visual environment and have negative environmental consequences for humans and wildlife.

Project nighttime lighting will consist of area-specific portable and permanent lighting used throughout the Construction and Pre-Production and Operations phases, and more intensively during times of the year when daylight hours are shorter. This lighting will be required to maintain a safe, secure and productive environment during construction and operations. Project operations lighting will be required within the open pits and throughout the facility site including the plant site, parking lots, and walkways. In addition, equipment required for mining activities will have headlights and operation lights and will contribute to the amount of light generated during Operations. Nighttime illumination levels during different weather conditions and season will not vary significantly, as the majority of light fixtures will be stationary (i.e., along pathways, conveyors, the plant site, etc.) and nighttime illumination levels will not change at these stationary locations. The locations of lighting from mobile equipment and flood lights used during extraction will change as mining progresses; however, differences between seasons or during weather events is not planned. The primary change between seasons will be the duration for which nighttime illumination occurs, as longer periods of artificial lighting will be necessary during the winter due to decreased daylight hours.

The visibility mapping for outdoor lighting demonstrates that the Project is screened from view and on-site lighting consisting of light fixtures (flood lights, spotlights, and area lights) on poles or light fixtures mounted on the plant buildings or conveyors will not be visible. This finding is a consequence of the location of the Project, which is situated between Erickson Ridge and the Continental Divide along the B.C.-Alberta border. Due to these elevations, the Project and any potential outdoor illumination are screened from the west and east. The likelihood of having discernible views from the north and south are also very low because of the dense evergreen forests in the valleys and the relatively low profile of Crown Mountain. The clean coal haul road will be unlit, and the visibility mapping demonstrated that the outdoor illumination at the rail loadout area would not be visible due to nearby forest cover and the local landscape screening.

Mitigations to address potential skyglow will include full cut-off fixtures and shields to avoid light above a horizontal plane, and using adaptive controls to reduce ambient light where it is not needed. Because the rail loadout is the closest facility to Sparwood, the outdoor lighting for nighttime operation of the loading facility should implement full cut-off fixtures to ensure that the light sources are dark sky compliant and do not contribute to skyglow. The use of dark sky compliant luminaires extend to all outdoor illumination for the plant, the operations yard, and portable floodlights in the extraction areas. All outdoor lighting fixtures will be removed during Reclamation and Closure.

3.8 Project Activities

The activities that are anticipated to be carried out during each phase of the Project are briefly described in this section. As assessed in subsequent chapters, the type, intensity, and duration of interactions between Project activities and the environment will vary across the Project phases. For example, land disturbing activities will be greater during Construction and Pre-Production and lessen during operations.

3.8.1 Construction and Pre-Production

The following major earthworks would be completed during the Construction and Pre-Production phase:

- Upgrade the existing Grave Creek Road from the upper clean coal transfer and stockpile areas down to the proposed rail load-out clean coal stockpile area. This will serve as the clean coal transportation corridor during Operations as well as the site access road. The existing road from the upper clean coal transfer area to the plant site will be upgraded in order to bring major equipment on site during construction and to provide road access for daily traffic to the mine office/dry/warehouse and plant complex;
- Construct two temporary sedimentation ponds to capture construction run-off water during the construction of the ROM pad and facilities pad;
- Construct an initial pioneer access haul road from the plant site to the top of North Pit; this is required to gain access to the upper benches of the North Pit. The initial access road will be used by 40-ton articulated trucks (CAT 740 or equivalent) and will meet British Columbia Health, Safety and Reclamation Code (HSRC) standards;
- Pre-stripping of 0.8 million bank cubic metres (Mbcm) from the upper benches of the North Pit will be required to establish the first mine production bench. This first production bench will be at the 2,140 m elevation. Pre-strip material from these upper development benches, which is suitable for construction fill will be used to construct the facility and ROM pad. The unsuitable waste material (saturated, frozen, compressible, or high fines soils) will be placed in a waste pile, which is located just below the first switch back of the main haul road;
- The initial pioneer access haul road will be widened to full road width using either the waste mine rock from the pre-strip area or road cut material along the access road right-of-way; and
- Construct the main ROM stockpile and facility pad areas, including the clean coal conveyor alignment. These areas will involve cut and fill construction to reach a suitable final grade. It is expected that the pads can be constructed using local cut material supplemented with pit run material as required.

These earthworks activities would be completed by a third-party contractor as part of the site development. Regional experience has shown that activities related to water management structures and placement of compacted earth fills should be carried out during the summer-fall construction season (roughly May through late October).

To meet the proposed production schedule, the successful completion of these pre-production activities is critical. In addition to the earthwork activities summarized above, the following tasks would need to be completed before mining begins in the North Pit:

- Logging (salvageable timber will need to be hauled off-site for the holder of the site's timber rights);
- Clearing and grubbing;
- Soil stripping and stockpiling; and
- Construction of smaller, local water management structures (e.g., sumps) and best management practices (BMPs) for localized sediment control installed.

3.8.2 Operations

Operational planning for mine production has been developed. Operations are generally divided into 16 periods, one for each year of planned operations in addition to end of pre-production and end of mining phases. A material balance has been developed for each year of planned operations which provide a summary of waste mining and dumping locations during each interval. The material balance is shown in Table 3.8-1.

The waste materials, including plant and breaker rejects, would be placed in the dumps and/or backfills. The Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6) includes soil salvage, as well as the capping of waste dumps with the plant rejects as part of the selenium management strategy.

Table 3.8-1: Material Balance

Year	Waste (000s loose cubic metres (lcm))				To Dump Area (000s lcm)			
	North Pit	East Pit	South Pit	Rejects	West Dump	North Pit Backfill	East Pit Backfill	South Backfill
Pre-Production	2,671	-	-	97	2,768	-	-	-
1	15,516	-	-	648	16,164	-	-	-
2	21,228	-	-	804	22,032	-	-	-
3	16,199	2,816	-	831	19,845	-	-	-
4	8,775	14,065	-	912	23,752	-	-	-
5	729	12,760	9,938	1,015	17,397	7,046	-	-
6	-	867	22,606	1,063	23,669	867	-	-
7	-	-	23,119	1,080	18,108	6,092	-	-
8	-	-	23,279	1,115	13,478	10,916	-	-
9	-	-	23,121	1,113	9,862	11,393	2,978	-
10	-	-	30,684	1,080	23,479	8,285	-	-
11	-	-	31,266	1,072	32,338	-	-	-
12	-	-	31,036	1,069	32,105	-	-	-
13	-	-	23,765	1,076	24,840	-	-	-
14	-	-	23,798	977	24,775	-	-	-
15	-	-	12,789	733	-	-	-	13,522
Total	65,118	30,508	255,402	14,684	304,612	44,599	2,978	13,522

3.8.3 Reclamation and Closure

The Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6) consists of a number of phases. The initial phase, during pre-production and preparation of the pit and dump footprints, will involve clearing and soil salvage followed by haulage and placement in soil stockpiles. As areas become available, resloping and/or grading and progressive reclamation activities will be carried out during Operations. Following the completion of mining, the major portion of the resloping and reclamation of the Crown Mountain area will be completed. The final reclamation process includes resloping and

reclaiming the disturbed footprint of the North, East and South Pits and the West Dump of the Crown Mountain area.

3.8.3.1 Reclamation Requirements

The Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6) is designed to meet British Columbia reclamation and closure regulations that require that the owner prepare a reclamation and closure plan showing specific end-land uses and that it be updated at regular intervals (five years) over the life of mine. NWP plans to retain ownership, control, and responsibility for all Project components throughout the life of the mine. The Landform Design and Reclamation Plan provides conceptual discussion on how decommissioning could occur for major permanent facilities and serves as a preliminary framework to guide the refinement of future decommissioning and reclamation planning. Post-Operations, the major landforms on the Crown Mountain Property will include resloped dumps, exposed pit walls with benches, and reclaimed roads and infrastructure footprints. No end-pit lakes are currently planned in the Post-Closure landscape. A saturated rock fill is expected to form within the mined out North Pit footprint.

Each post-operational major landform type is discussed here:

- **Waste Dumps:** After active mining, the dumps will be resloped to 2:1 (Horizontal(H):Vertical(V)) slope or flatter, according to B.C. mine reclamation requirements, and the soil will be replaced and revegetated by seeding with a native vegetation mixture and planting tree seedlings. The mine plan has accommodated the stripping and stockpiling of soil. The resloped West Dump and the North and South In-Pit Dumps are shown on Figure 3.7-8 (Final Closure Layout). As noted elsewhere, the current water management plan does not include actively treating water through the North Pit saturated rock fill. Drainage channels will be developed alongside haul roads at specified intervals to manage surface runoff and to mitigate erosion. Drainage channels will also be developed along the outer slopes of the waste dumps. Final platforms will be graded to slope gently (1% to 2%) outwards to direct flow away from the waste dump surface and outer slope faces and towards the drainage channels. Most areas are anticipated to shed water by sheet flow; where needed, a surface water drainage system may be established and armoured, and some areas may see coarse rock soakaways to direct surface water into the rockdrain system under the dump;
- **Pit Walls and Benches:** The pit walls and benches will be left in their post-mining configuration to provide escape terrain for ungulate species, which can take advantage of the steeper terrain to avoid predators. The exposed, gently sloping pit floors will be covered with soil and revegetated. Water management channels within the Post-Closure pit will be developed, where required, to minimize erosion;
- **Roads and Shop/Laydown Areas:** As part of the closure plan, buildings, power lines, steel structures, tanks and other infrastructure will be dismantled or demolished. Concrete foundations will be broken up or buried under a suitable depth of cover. Roads and shop/laydown areas will be ripped by dozers and regraded prior to soil placement in order to manage runoff. Soil will be replaced on these areas and they will be revegetated. Larger areas will require the construction of drainage channels to control runoff and mitigate erosion; and
- **Water Management Infrastructure:** After mine closure, the water management structures, including the remaining sediment ponds, will remain in place until the reclamation earthwork activities have been completed; these include resloping dump faces and re-establishing

vegetation to prevent surface erosion. Once the reclamation activities have been completed, the ponds will be regraded, and any impoundments will be breached to prevent the accumulation of runoff water. This will allow surface waters to flow along the natural local drainage systems. Depending on potential selenium management requirements, portions of the existing water management system can be left in place for an extended period.

3.8.3.2 Soil Salvage

Soil will be cleared from the mining area and mine rock dump areas prior to excavation or backfilling of mine rock. The soil will be dozed into windrows, then loaded by excavators into haul trucks and placed in soil stockpiles located around the Project area. Based on baseline data collection, it is estimated that 50% of the topsoil excavated will be suitable for reclamation. With a swell factor of 10%, there will be approximately 1.49 million loose cubic metres of topsoil that will need to be handled over the life of mine. The water management section (Section 3.7.5) describes measures to limit erosion from the soil stockpiles.

3.8.3.3 Final Reclaimed Period

The remaining angle of repose dump slopes are resloped to an overall angle of 2H:1V. Remaining reclamation material is re-handled from stockpiles and placed on the designated dump surfaces for reclamation and revegetation. The selenium mitigation strategy considers including a layer of plant rejects as part of the final cover. Stockpiled rejects would be used for this final cover construction.

3.9 Project Schedule

The Project schedule has been developed to highlight key milestones, established goals, and significant scopes of work and duration of performance. The Schedule describes Year 1 as the start of mine production. Activities prior to mine production are denoted as Year -1, Year -2, and Year -3. From EA submission to first commercial production is nominally a 35-month period. Table 3.9-1 summarizes the Project execution schedule.

Table 3.9-1: Key Project Milestones

Milestone	Date
EA Submitted	Year -3, Q2
EA Approved	Year -2, Q3
Mine Permit Submitted	Year -2, Q2
Key Supply Contracts Negotiation Starts	Year -2, Q2
Mine Permit Approved	Year -2, Q4
Site Construction Starts	Year -2, Q4
Key Hires	Year -2, Q4
Mine Pre-strip	Year -2, Q4
Plant Commissioning	Year 1, Q1
Commercial Production	Year 1, Q1
Reclamation and Closure	Year 15-19

Milestone	Date
Post-Closure	Year 20-35

3.10 Economic Benefits of the Project

Capital (CAPEX) and operating cost (OPEX) estimates were calculated for mine operations, plant and coal handling, pre-development work, planning and permitting, and the reclamation activities that are associated with the mining of the Project.

3.10.1 Capital Costs

Table 3.10-1 summarizes the level of accuracy for each capital cost items along with the cost and contingency percentage applied. The overall CAPEX summarized in Table 3.10-1 also includes contingency and indirect costs.

Table 3.10-1: Project CAPEX Summary

Category	Cost Item	Initial Canadian Dollar (CAD)\$ Millions
Direct	Pre-Development Cost (Roads, Clearing)	\$23
	ROM Pad Construction	\$2
	Mine Buildings	\$29
	Mine Infrastructure & Facilities	\$26
	Plant and Coal Handling Facilities	\$135
	Rail loadout and Rail Siding	\$29
	Water Management	\$7
	Surface Mine & Support Equipment*	\$205
	Sub-total	\$455
Indirect	Capital Period General & Administrative	\$13
	Engineering, Procurement, and Construction Management	\$14
	Office supplies, furniture equipment spare parts	\$12
	Owner's Cost (Exploration drilling, technical studies, and permitting)	\$22
	Reclamation and Closure	\$3
	Sub-total	\$64
Subtotal	without contingency	\$520
	Contingency**	\$41
Total	with contingency	\$561

*Note: Surface Mining & Support Equipment includes equipment purchased in the first year of production.

**Note: Contingency cost is based on a level of accuracy of the cost estimates.

To establish the Project, the development plan requires capital investment in infrastructure, mine equipment, and mine development. The start-up capital cost for direct and indirect costs including

contingency, is estimated to be CAD\$561 million. Life of mine capital costs are estimated at CAD\$684 million, including the salvage allowance, but exclusive of the capital contingency. The life of mine capital costs including capital contingency is estimated to be CAD\$741 million. In-progress reclamation activities during the active mine phase results in a distribution of reclamation costs across multiple OPEX years.

Contingency costs were applied to all the capital cost items in a range of 5 to 30% depending on the level of confidence in the estimate and its inputs. A 5% contingency cost was applied to mining equipment where recent vendor quotes were available. Contingency costs of 10 to 15% were applied to items such as building construction costs, which have a slightly lower estimate level of accuracy. A 15 to 30% range for contingency costs were applied to items that involved infrastructure earthworks. These items include the clean coal haul road, mine pre-development area, water management structures, and rail siding construction costs.

3.10.2 Operating Costs

Table 3.10-2 summarizes the level of accuracy for operating costs along with the life of mine OPEX and the unit costs expressed as dollars per ROM coal tonnes.

Table 3.10-2: Operating Costs

Cost Center	(CAD\$ / clean metric tonne (cmt) 9%)
Waste	\$42.59
ROM Coal Production	\$9.03
Coal Handling Process Plant	\$13.36
Clean Coal Handling	\$3.13
Reclamation (Topsoil removal and resloping)	\$0.19
Minor Equipment Operating Costs	\$1.33
Rail and Port Cost	\$39.00
Marketing & Corporate	\$1.35
Administration	\$7.87
Average Operating Cost	\$117.85
Cost Center	(CAD\$ / cmt 9%)
Waste	\$42.59

The cost estimates and resulting cash flow analysis were prepared in constant 2019 Canadian dollars (CAD), and the following factors were used:

- Major mining equipment capital and hourly equipment operating costs were based on equipment vendor quotes. The minor mining equipment operating costs were based on a combination of vendor quotes and Stantec's internal costing database;
- Labour costs were developed in 2019 dollars, and the costs were based on current local labour agreements;
- Management and staff salaries were based on current industry salaries in Western Canada and referencing professional association salary data;

- Ancillary equipment, office furniture, computers and engineering costs were estimated using internal cost databases;
- Diesel fuel costs were assumed to be \$0.97/L based on a supplier quote in October of 2019;
- Exchange rate (CAD:U.S. Dollars (USD)) was assumed to be \$1.00:\$0.75; and
- Rail and port cost estimates were developed with reference to publicly available coal transportation costs and capacity information projections.

Unit operating costs average CAD\$36.00/ROMt, ranging from CAD\$31.40/ROMt to CAD\$40.18/ROMt, over the 15-year life of the Project excluding rail and port costs. This equates to an average operating cost of CAD\$78.85/cmt. The rail and port charges are estimated at CAD\$39.00/cmt for a total average cost of CAD\$117.85/cmt freight on board (FOB). This amounts to an average cost of US\$.88.39/cmt FOB.

3.10.3 Employment

The personnel estimates for the Project have been based on the following assumptions in regard to how NWP will operate the Project as well as on the Project schedule.

Site and head office management, technical, supervisory and administrative staff will be NWP employees paid on a salaried basis, as follows:

- Surface mine operations personnel will be NWP employees paid on an hourly basis;
- Mine maintenance personnel will be NWP employees paid on an hourly basis;
- Coal handling process plant operations personnel will be NWP employees paid on an hourly basis; and
- Contractors will perform explosive loading, and selected support services.

For discussions in this section, the designation “salary staff” will be used to refer to the positions paid on a salary basis (i.e., management, professional, administrative) and “hourly personnel” will refer to personnel paid on an hourly basis as listed above.

Based on the experience of existing mine operations in the area, the use of contract personnel for supporting roles such as initial access development, sediment pond construction and clearing is a reasonable assumption, with several existing local and regional contractors capable of undertaking the work.

The Project personnel requirements are consistent with other coal mining operations in Western Canada and specifically the Elk Valley. Currently, there are four active coal mines in the immediate Project area. The focus for the Crown Mountain Coking Coal Project is to attract a core group of experienced supervisors, technical staff, and hourly personnel from existing operations. Given the proximity to Sparwood and the population of the surrounding area, the local communities should provide a sufficient pool of people to draw on for the Crown Mountain Coking Coal Project’s workforce and housing for experienced coal miners moving to this region from other parts of British Columbia and Alberta. Market conditions within the western Canadian oil and gas sector may also free up qualified service personnel (e.g., mechanics, electricians) to support a new coal development.

As described in this section, employment and labour needs will increase as the Project progresses from Construction to Operations and decrease during the reclamation phase. It is anticipated that pioneer

construction crews would lodge in nearby communities at existing accommodations (i.e., local hotels). During the construction of the key Project facilities, it is anticipated that construction crews would lodge in nearby community hotels or commercial lodging. During the Operations phase, personnel would lodge in private residences, hotels, or other accommodations in nearby communities. During all Project phases, hiring local employees and contractors that live in nearby communities will reduce potential effects on the local hospitality sector. Additional details about the socio-community aspects of workforce lodging may be found in Chapter 18.

The transportation of work crews will be guided by NWP’s commitment to respect the Grave Creek Road as a multi-user, publicly accessible road. NWP would look to maximize the transportation of workers via crew busses. Parking and/or pick-up locations in nearby communities would be determined in consultation with local municipalities. Specialty supply service and short-term contractors may need to access the site via their company vehicles but will be encouraged to reduce the number of vehicles brought to site through shared carpooling and other vehicle reduction initiatives. As the Project advances, NWP will continue looking at opportunities to evaluate workforce transportation solutions that meet Project objectives while improving operational and environmental performance.

3.10.3.1 Direct Construction Employment

The baseline Project execution plan is based on a two-year construction window to complete all the site preparation, access improvements, CHPP and infrastructure erection, mine pre-development activities, and commissioning of the open pit and CHPP. The Project execution schedule is discussed separately, while this section contains the estimates for personnel required during the pre-development, construction, and mine production ramp-up periods.

It is expected that NWP will build up its management and construction management/execution team personnel during the mining permitting and pre-development phase, which would include consideration of detailed design stages of the Project and also early contractor involvement to ensure risks are adequately managed and addressed. Key lead personnel in all the major aspects of the Project (e.g., permitting, geology, mine operations, process and coal handling, infrastructure, coal marketing, construction) will be part of the permitting and pre-development phase, including detailed design process in order to ensure continuity leading into construction. The personnel numbers for NWP during the Project development, construction, and ramp-up phases are summarized in Table 3.10-3. This table does not list consultants who will support the work, but third-party consultant costs have been applied to the Project.

Table 3.10-3: Pre-Operations Phases NWP Personnel

Category	Permitting to Pre-Construction	Construction	Ramp-up to Operations
EA and Permitting	1	-	-
Mine Permitting & Exploration	4	4	-
Construction & Ramp-up	-	11	-
Project Management	-	12	-
Mine Management, Technical & Admin Staff	-	-	75
Total	5	37	75

It is expected that the development and construction team would consist both of NWP employees and contractor/consulting team members with specialized Project development experience. The reliance on third-party engineering, procurement and construction (EPC) personnel versus NWP employees will be a strategic corporate decision that NWP will need to consider during the next stage of the Project. The base case assumes an NWP construction team supported by contractors. Roles and responsibilities are laid out as follows:

- NWP Project Team roles and responsibilities:
 - Project Controls / Management Systems;
 - Engineering Records System;
 - Construction Management and Contract Plan;
 - Environmental Management Plan (input from prime contractor/consultants); and
 - Labour Relations Plan.
- Prime Contractor roles and responsibilities:
 - Health and Safety Plan;
 - Procurement System; and
 - Quality Assurance/Quality Control System.

The Project construction plan will require on-site construction activities to occur over approximately 20 months targeted to capture two summer construction seasons. The first summer season would be dedicated to access road improvements, construction of surface water management structures and site excavation and grading. Logging, clearing and grubbing would be carried out as part of the initial site development.

Work packages for specific Project construction components would be developed and bids solicited for each. Some work packages (e.g., earthworks, water management) could be completed by local contractors; however, more specialized work packages (rail loop and loadout, coal handling process plant) would require the services of larger contractors able to bring in skillsets from a national or international talent pool. Table 3.10-4 summarizes the major work packages and scopes along with the numbers of contractor personnel associated with each for the two development years.

Table 3.10-4: Major Work Packages with Scope and Contractor Personnel

Work Package	Scope	# Personnel Year -2 (Peak)	# Personnel Year -1 (Peak)
Earthworks	Branch C Upgrade	33	-
	Grave Creek Road Upgrade		
	Plant site foundation excavation & preparation	28	-
	Grave Creek water storage sump	-	18
	Rail loadout and clean coal stockpile grading	10	25
	Site and initial mine area water management	25	20
Plant / Mine Facilities	Coal handling and processing facilities & loadout	90	232
	Site facilities and support structures/utilities	20	65

Work Package	Scope	# Personnel Year -2 (Peak)	# Personnel Year -1 (Peak)
	Office / maintenance-warehouse / dry complex	40	40
Off-site Infrastructure	Power line and substation	20	30
	Natural gas line	12	45
	Rail loadout track and switches/controls	8	27
EPC Management Team	On-site EPC Management	11	11

3.10.3.2 Direct Operations Employment

All process plant and mine maintenance crews would consist of four crews working on a seven days on, seven days off, 12 hour shift alternating between day shift and night sets. The mine operations personnel will have the same schedule, but the shifts will be 13 hours long to minimize equipment down-time during shift change (i.e., allow for hot seat changes on major mobile equipment). This type of shift arrangement is typical of the operations in the region including the mountain coal operations as well as other large-scale mining operations (i.e., oil sands surface mining operations).

The majority of salary staff will work a five-day week with their shift length varying between 8 – 10 hours per day depending upon their role. Staff working the longer daily shift will have rotating shorter weeks (i.e., four-day week once per four-week rotation) in the monthly schedule plus overtime compensation to manage their overall working time. This will provide sufficient management coverage beyond direct operations supervisors. Plant, mine maintenance and mine supervisors will work a seven days on, seven days off shift rotation similar to their respective crews. The mine maintenance and mine operations General Foremen will have a 12-hour shift on dayshift only.

Table 3.10-5 provides estimates of the Crown Mountain Coking Coal Project hourly and management personnel required for the Project. The numbers shown below are the average requirements over the life-of-mine.

Table 3.10-5: Average Personnel Requirements

Category	Hourly Staff ¹	Management Staff ¹	Total Staff ¹
Plant Management	-	7	7
Plant + Clean coal transport Hourly	49	-	49
Surface Mine Operations Management	-	16	16
Surface Mine Operations Hourly	137	-	137
Surface Mine Maintenance Management	-	13	13
Surface Mine Maintenance Hourly	74	-	74
Site Management	-	33	33
Site Total	260	69	329

¹Personnel requirements are estimates developed for feasibility level planning and may change as engineering and operational plans are refined.

3.10.4 Labour Estimates

The average hourly manpower requirement over the life of the Project is estimated at 250 persons. Chapter 17 provides details about labour categorization, including estimates and discussions on full-time, part-time, and temporary/seasonal employment. Salaried labour estimates were developed with reference to industry standard levels for an operation of this capacity. Staffing costs for the Project were categorized as administration in the operating costs. The salary allotment averaged \$120,000/year in salary plus a 25% loading for benefits. The average salary labour requirement over the life the Project is estimated at 78 personnel. Table 3.10-6 provides a salaried labour estimate.

Table 3.10-6: Salaried Labour Estimate

Category	Base Salary (CAD\$/year)	Benefits (CAD\$/year)
Plant Management	120,000	30,000
Plant + Clean Coal Transport Hourly	98,000	22,000
Surface Mine Operations Management	120,000	30,000
Surface Mine Operations Hourly	103,000	24,000
Surface Mine Maintenance Management	120,000	30,000
Surface Mine Maintenance Hourly	106,000	25,000
Site Management	120,000	30,000
Site Total	787,000	191,000

3.10.4.1 Indirect and Induced Employment

Chapter 17 provides details about potential economic effects from the Project, including indirect and induced employment, in relation to an Economic Conditions (LSA) and Regional Study Area (RSA). The Economic Conditions LSA and RSA are the local and regional areas in which direct and indirect economic effects of the Project would be expected to occur. Chapter 17 provides estimates on where labour will be drawn from, with the majority of labour drawn from the Economic Conditions LSA. Table 3.10-7 and Table 3.10-8 identify the anticipated indirect and induced employment in Full Time Equivalents (FTEs) during Construction and Pre-Production and Operations phases within the Economic Conditions LSA and RSA.

Table 3.10-7: Indirect and Induced Employment during Construction and Pre-Production within the Economic Conditions LSA and RSA

		Indirect Employment		Induced Employment	
		Jobs (FTEs)	Income	Jobs (FTEs)	Income
Economic Conditions LSA	Cumulative	166	\$14.18 million	38	\$2.53 million
	Annual Average	55	\$4.73 million	13	\$0.84 million
Economic Conditions RSA	Cumulative	831	\$70.88 million	384	\$25.25 million
	Annual Average	277	\$23.63 million	128	\$8.42 million

Note: Cumulative refers to the total number of jobs over the construction period while annual average divides the cumulative employment over the construction period.

Table 3.10-8: Employment and Income Effects during Operations

		Indirect Employment		Induced Employment	
		Jobs (FTEs)	Income	Jobs (FTEs)	Income
Economic LSA	Cumulative	709	\$59.59 million	433	\$28.48 million
	Annual Average	47	\$3.97 million	29	\$1.90 million
Economic RSA	Cumulative	7,088	\$595.89 million	2,888	\$189.87 million
	Annual Average	472	\$39.73 million	193	\$12.66 million

Notes: Cumulative refers to the total number of jobs over the operation period (15 years) while annual average divides the cumulative employment over the Operations period.

3.10.5 Contractor Supplier Services

NWP has developed a feasibility level Project execution plan, inclusive of preliminary contracting and procurement strategies. As there is a well-developed supplier network in the Elk Valley, NWP's contracting strategy for supplier services will focus on engaging with suppliers in the Elk Valley. NWP has sought to engage local contractors and consultants, where possible, for the site investigation work completed to date and the development of the Application/EIS. Similar to NWP's approach to labour sourcing, this procurement strategy is based on the following principles:

- Project is located in an area with a well-established mine services industry;¹
- NWP's objective is to use local vendors and suppliers as much as practicable;
- NWP's objective is to hire locally as much as practicable;
- NWP believes that there is an available local workforce that could support most of the Project's needs; and
- NWP's contracting, procurement, and hiring will also engage with Indigenous communities. NWP anticipates having agreements in place with those communities prior to start of construction.

As described in Chapter 17, most of the major industrial construction materials, goods, and services are sourced from outside the Economic Conditions LSA due to the fact that many of these industrial construction supplier industries are not represented locally. Table 3.10-1 provides information about the anticipated CAPEX costs for the Project. From CAPEX data previously presented, the value of major contractor supplier services may be determined (e.g., \$14M for Engineering, Procurement, and Construction Management Services). While CAPEX spend will predominantly occur during the Construction and Pre-Production phase, supplier services will be needed through Operations, Reclamation and Closure, and Post-Closure phases; related cost data is contained within the OPEX cost data provided in Table 3.10-2.

¹ While the Project is located in an area with a well-established mine services industry, some specialized industrial services and supplies are not available locally. For example, the coal handling and process plant components will likely need to be sourced outside the local area.

The following list identifies services/suppliers that NWP will have to engage prior to commercial operation:

- Canadian Pacific (CP) Rail / CN Rail: Transportation of clean coal to one of the coal terminals to access the seaborne market;
- Coal Terminal: Storage and ship loading of clean coal on sea-going vessels;
- Explosives: To provide explosives and on-site storage and handling;
- Mining Equipment: To purchase and support the equipment fleet;
- Diesel: To supply and delivery;
- Fortis: For natural gas supply and delivery;
- BC Hydro: For electrical power supply; and
- Magnetite Supply.

3.10.6 Government Revenues

The government revenue presented in this section is based on Project economics completed in July 2020.

3.10.6.1 Currency Assumptions

Coal revenue is converted to Canadian dollars at a long-term exchange rate of CAD:USD 1.00:0.75 based on the 2019 average exchange rate published by Bank of Canada.

The economic analysis is calculated using constant 2019 Canadian dollar revenues and costs.

3.10.6.2 Metallurgical Coal Price

NWP retained the services of an independent coal marketing consultant to provide an opinion on coal quality and updated coal pricing for the Project. Table 3.10-9 summarizes the price estimates for coking and PCI coal. Table 3.10-10 summarizes the average coal price used in the economic analysis.

Table 3.10-9: Coal Selling Price US\$/tonne (Constant 2019 \$)

Pit Area	Coal	(US\$/cmt)
North and East Pits	Coking	148-180
	PCI	102-132
South Pit	Coking	129-166
	PCI	99-128

Table 3.10-10: Coal Selling Price for Economic Analysis, After Quality Discount Adjustments

Pit Area	Coal	(US\$/cmt)
North and East Pits	Coking	164
	PCI	115
South Pit	Coking	148
	PCI	112

3.10.7 Mineral Tax

A mineral tax has been applied to the cost estimate. The British Columbia Mineral Tax is a two-part royalty payment to the Provincial Government and is calculated on a mine-specific basis; therefore, these payments are specific to the revenues and costs of the Crown Mountain Coking Coal Project. The tax is 2% of the Net Current Proceeds, which is essentially annual revenue from coal sales less annual operating costs. The second part requires a payment of 13% of Net Revenue. This second tier is only payable after all initial capital, a new mine allowance, and a return on investment have been recovered. In addition to those deductions and operating costs, Net Revenue allows the additional deduction of annual capital. The reader is referred to the British Columbia Ministry of Finance website for further details on the British Columbia Mineral Tax regulations. The estimated B.C. Mineral Tax for the Project is \$121M over the life of the Project.

3.10.8 Income Tax

Canadian Federal and British Columbia Provincial income taxes were calculated using the operating cash flow before tax as the starting point. The Capital Cost Allowance (CCA), the Canadian Development Expense (CDE), and Canadian Exploration Expense (CEE) were deducted from the operating cash flow before tax to arrive at taxable income. In addition, a Loss Carryforward (LCF) was deducted from the taxable income in the first year of operation when taxable income was at a level sufficient to allow its deduction.

Canadian Federal and British Columbia Provincial income tax rates of 15% and 12%, respectively, were applied to the taxable income in each year to arrive at the annual income tax payable.

The income tax calculation assumes that a Qualified Environmental Trust is established for final reclamation costs. Annual contributions are made to the trust based on estimated final closure costs for each year. The contributions to the trust are deducted each year in arriving at taxable income.

The Project's total estimated corporate income tax is CAD\$234 million, of which CAD\$104 million is payable to the Province of B.C. and CAD\$130 million is payable to the Government of Canada. Chapter 17 provides additional information about government revenue for all phases of the Project.

3.11 References

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