

# Chapter 2 - Project Alternatives

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

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# 2. Project Alternatives

## 2.1 Introduction

Alternatives considered for the Project include Alternatives to the Proposed Project as well as Alternative Means of Carrying out the Project (i.e., Alternative Means). Alternative Means are defined as the various technically and economically feasible ways that the Project could be implemented in developing the Crown Mountain coal resource. Separately, Alternatives to the Project include the functionally different alternative scenarios that could meet the Project objective, purpose, and need if technically and economically feasible.

Since 2013, NWP has evaluated numerous Project design decisions on how to develop and implement the Project throughout all its phases: Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure. These decisions were based on Project economic, technical, environmental, Indigenous community input, and socio-community and economic considerations. The alternative means analysis and decision-making process that has led to the preferred Project design is reported in Chapter 2. Consistent with regulatory guidance, the preferred Project design elements described in Chapter 2 are identified as Preferred Means<sup>1</sup>, and these are further elaborated in Chapter 3.

## 2.2 Regulatory Conformance

The Project alternatives assessment is intended to satisfy the requirements of the Canadian Environmental Assessment Act, 2012 (CEA Act 2012), the Operational Policy Statement Addressing “Purpose of” and “Alternative Means” under CEA Act 2012 (CEA Act OPS; Canadian Environmental Assessment Agency [CEAA], 2015a); and the British Columbia (B.C.) Environmental Assessment Act (EAA; 2002). In addition, the alternatives assessment meets the information requirements as outlined in the B.C. Environmental Assessment Office (EAO) 2018 Application Information Requirements (AIR) and the Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act (2012) for the Crown Mountain Coking Coal Project (CEAA, 2015b). On May 3, 2023, the Project was transitioned to the EAA (2018) through a Transition Order under Section 78(7) of

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<sup>1</sup> Operational Policy Statement Addressing “Purpose of” and “Alternative Means” under CEA Act 2012 (CEA Act OPS).

the 2018 Act. The Application/EIS includes additional information requirements described in Section C of Schedule A of the Transition Order.

## 2.3 Method of Assessing Alternatives

As defined in the Operational Policy Statement Addressing “Purpose of” and “Alternative Means” under CEA Act 2012, “...alternative means considered in a project must be technically and economically feasible” (CEA Act OPS). Therefore, alternative means that do not meet this primary threshold of feasibility are not detailed in this Environmental Assessment (EA) Application.

NWP has evaluated numerous concepts and designs for undertaking the Project. This includes two primary categories of alternatives: Alternatives to the Project (e.g., No Project Alternative) and Alternative Means (e.g., Rail Loadout (RLO) Location). The methodology that NWP has used to assess alternatives, determine technical and economic feasibility, and identify preferred means are detailed below (Table 2.3-1). The criteria underpinning this methodology is supported by the various technical studies that have been completed for the Project, including a pre-feasibility study (PFS), revised PFS, and a bankable feasibility study (BFS).

Table 2.3-1: Alternatives Assessment Methodology

Alternatives Assessment Criteria and Approach					
Category of Alternative	Category of Alternative	Category of Alternative	Category of Alternative	Category of Alternative	Category of Alternative
a) Alternative to the Proposed Project	Assessment of Technical Feasibility	Assessment of Economic Viability	Assessment of Environmental Effects	Identification of Indigenous Communities' Considerations	Consideration of Effect on Social, Community, and Economic Conditions
b) Alternative Means					

Depending on the context and intensity of the alternative assessed, the evaluation criteria listed above was applied stepwise or in combination. For alternatives that NWP identified as not technically or economically feasible, the level of subsequent criteria analysis was scaled appropriately. During assessment of environmental effects, NWP screened alternative means for relevance to the Elk Valley Water Quality Plan (EVWQP). Where applicable, NWP considered the implications of the alternative means on the EVWQP. While NWP’s plans exceed the requirements of the EVWQP, consideration was given to whether an alternative could lead to increasing calcite or other water quality trends that the EVWQP is intended to manage. Assessment of environmental effects during alternatives analyses included an identification of key Valued Components (VCs) potentially affected by each alternative. Chapter 5 and subsequent chapters provide more in-depth analysis of VCs.

## 2.4 Alternatives to the Project

Alternatives to the Project are comprised of the technically and economically feasible pathways that would meet the project objective, purpose, and need but are wholly distinguishable from the project’s preferred

development scenario. NWP evaluated Alternatives to the Project as described in Table 2.4-1 and Table 2.4-2.

Table 2.4-1: No Project Alternative

Alternatives Evaluated	Discussion	Conclusion
No Project Alternative	<p>Technical Assessment: While the No Project alternative would be technically feasible, it would not meet the Project purpose to supply metallurgical coal to the seaborne market.</p> <p>Project Economic Assessment: The No Project alternative would result in negative economic conditions for the Project and its investors, and would not realize the economic benefits of the Project. When considering Project economics and the positive Project economic potential under a Build Alternative, the No Project alternative is not an economically feasible alternative.</p> <p>Environmental Assessment: The No Project alternative would avoid the potential contributions of the Project to environmental impacts. Similarly, the No Project alternative would avoid the potential positive contributions to the environment that would otherwise be implemented by the Project, including but not limited to management and mitigation practices described in this Application/EIS.</p> <p>Indigenous Communities' Considerations: Several Indigenous communities have concerns about environmental impacts of past, present, and future projects and activities in the Elk Valley, including coal mining. Some of them have expressed a reluctance to approve any new development until impacts from past and present operations are better managed. A No Project alternative would likely appease these concerns. NWP intends to address concerns by designing and operating the Project to have minimal environmental impact and to actively support regional environmental stewardship initiatives.</p> <p>Socio-Community and Economic Considerations: The No Project alternative would not realize the local and regional social, community, and economic benefits of this Project, including but not limited to diversifying the employer base, expanding opportunities for local suppliers, and enabling the skilled labour necessary to develop this project.</p>	This alternative does not meet the Project Objective, Purpose and Need (Not considered further)

Table 2.4-2: Alternative Resource Development

Alternatives Evaluated	Discussion	Conclusion
Alternate Resource Development	<p>Technical Assessment: There are no viable, technically feasible Alternate Resource Development projects available to NWP, as Crown Mountain is NWP's only coal asset.</p> <p>While it might be technically possible for NWP to obtain alternate resources to provide metallurgical coal to the seaborne market, the additional time required to obtain the leases, explore the resource, complete feasibility studies, and begin permitting would not meet the timing window for the Project need.</p> <p>Project Economic Assessment: As there are no technically feasible options currently available, an economic assessment for Alternate Resource Development was not fully advanced.</p> <p>Environmental Assessment: As there are no technically feasible options currently available for Alternate Resource Development, an environmental assessment was not fully developed.</p> <p>Indigenous Communities' Considerations: Several Indigenous communities have concerns about environmental impacts of past, present, and future projects and activities in the Elk Valley, including coal mining. Some of them have expressed a reluctance to approve any new development until impacts from past and present operations are better managed. An Alternate Resource Development in another coal mining region would possibly appease these concerns for the Elk Valley; however, an Alternate Resource Development in another coal mining region would require engagement with the potentially impacted Indigenous groups in that region and other Indigenous considerations relevant to that region and those groups.</p> <p>Socio-Community and Economic Considerations: As there are no technically feasible options available for Alternate Resource Development, a socio-community and economic assessment for this alternative was not fully developed.</p>	<p>This alternative does not meet the Project Objective, Purpose, and Need (Not considered further)</p>

As described in the previous tables, NWP has evaluated Alternatives to the Project. These Alternatives to the Project would not meet the Project's objective, purpose, and need. In accordance with CEA Act 2012, guidance, these alternatives would not be considered technically and economically feasible, as outlined above. Therefore, they are not considered further in this Application/EIS.

## 2.5 Alternative Means of Carrying Out the Project

Responsible development of a coal resource requires a project applicant to thoroughly evaluate the various activities necessary during all Project phases. While Chapter 1 and Chapter 3 provide specific details about the activities proposed within each Project phase, this section presents a brief, general

overview of how the various Alternative Means of Carrying out the Project relate to how a coal mining resource is designed, developed, and operated.

For the Crown Mountain Coking Coal Project, a series of primary decision evaluations were necessary. Many of these primary decision evaluations resulted in secondary, and sometimes other subsequent, decisions. These decisions and associated Alternative Means analyses have been organized as follows.

**Mining Design:** Mining Design is the category of Project components related to how the mine is designed, operated, and ultimately reclaimed. Mine Design elements include mining method (e.g., surface vs. underground), location and design of the Mine Rock Storage Facility (MRSF), how Run of Mine (ROM) coal moves across the site (i.e., from the pit to the wash plant), sequencing of extraction and reclamation activities, mine equipment selection, explosives usage, and mine operatorship. Mining Design Alternative Means are described in Section 2.5.1.

**Energy Source:** Energy Source relates to how the mine is powered. Alternative Means for energy sources include connection to the electrical grid, B.C. Hydro connection, natural gas supply, and alternative electrical power sources (e.g., solar or wind). Energy Source Alternative Means are described in Section 2.5.2.

**Major Facilities and Components:** Major Facilities and Components include location and design decisions related to the Coal Handling and Preparation Plant (CHPP), the Rail Loadout (RLO), and the Clean Coal Stockpile. As these facilities and components are inter-related, they have been grouped under Section 2.5.3.

**Site Access:** Site Access includes Alternative Means associated with how the site is accessed and how clean coal moves across the site (i.e., from the wash plant to the RLO). Site Access Alternative Means are covered in Section 2.5.4.

**Water Use:** Water Use is a category of Project components including water sources (supply) and disposal (management). Alternative Means for Water Use are described in Section 2.5.5.

**Tailings Disposal:** Tailings Disposal involves the siting and treatment method for fine tailings. Alternative Means for Tailings Disposal are covered in Section 2.5.6.

## 2.5.1 Mining Design

This section describes alternatives associated with the mining design. NWP has improved the current mining design from decisions made and conclusions initially reached dating back to 2013. NWP has evaluated mining design alternatives including the following:

- Mining method;
- MRSF location;
- MRSF design;
- Mine sequence;
- Reclamation sequence;
- Mine equipment;
- Explosives usage; and

- Mine operatorship.

In addition to the major mining design components listed above, design assessments for supporting infrastructure and utilities focused on key objectives of reducing Project footprint, using resources wisely, and reduced trucking. Examples include selecting on-site sewage treatment, which avoids trucking sewage off-site, and sourcing potable water locally rather than trucking to site.

#### 2.5.1.1 Mining Method

NWP has evaluated surface (open pit) and underground mining methods to determine technical suitability for the Crown Mountain coal deposit. The Project's mine plan is based on open-pit mining methods, as the Project is not amenable to a widespread application of underground mining techniques because the deposit is near the ground surface. The clean coal strip ratio (the volume of overburden material that must be removed release a unit weight of clean coal) is favourable to most operating coal mines in Western Canada. The selected open pit mining method is consistent with other coal mines currently operating in the Elk Valley.

As part of the mining method determination for a surface mine, NWP evaluated optimal pit sizes to design an economic pit shell. Given the geology at the mine site and coal location near the surface, the mine development plan is based on pits that would dig to the bottom of the ore in three directions. Smaller pits within the mine area would not recover the full potential of ore available, and larger pits would not be possible as NWP proposes to mine to the feasible extent of the available coal resource. Table 2.5-1 summarizes the evaluation of mining method alternatives.

Table 2.5-1: Mining Method Alternative Analysis

Alternatives Evaluated	Discussion	Preferred Means
Surface Mining (Open Pit) vs. Underground Mining	<p>Technical Assessment: Both mining options considered the following geologic factors: depth of cover, seam dip, seam recovery, and seam interburden.</p> <p>A review of the Crown Mountain coal deposit geometry appears to leave little opportunity potential for mining by highwall mining and/or underground mining methods for extraction. Both mining methods are similarly affected by the gradient of the coal seams and depth of cover. Coal seams that slope less than 12° are considered preferable, and a slope of 12-20° is much less desirable. Any slope that is greater than 20° degrees is not considered mineable by either method. Generally, consideration for underground mining would require a minimum seam thickness of 1.2 m and an interburden thickness of 9 m between coal seams. Based on the geometry of the Crown Mountain deposit, the underground mining options were not considered feasible from a technical perspective.</p> <p>The geometry of the Crown Mountain deposit and depth of cover are consistent with other surface coal mines currently in operation in the Elk Valley, Western Alberta, and Northeast B.C.</p>	Open Pit Mine

Alternatives Evaluated	Discussion	Preferred Means
	<p>Project Economic Assessment: The low mining production rate and low coal recovery from an underground mining option would lead to economic conditions that would not be feasible for Project development.</p> <p>The clean coal strip ratio for an open pit mine, which is the amount of rock removed divided by the amount of clean coal recovered, is favourable to most of the currently operating mines in the region. The clean coal strip ratio is a key metric to determine the cost to recover the coal and the majority of the mining costs are associated with rock removal.</p> <p>Environmental Assessment: As NWP determined underground mining is not technically feasible, a detailed analysis of environmental effects was not performed for underground mining. For the preferred means of an open pit mine, this Application/EIS identifies and assesses the Valued Components potentially affected.</p> <p>Indigenous Communities' Considerations: NWP did not assess Indigenous communities' considerations for underground mining as underground mining is not considered technically or economically feasible.</p> <p>Social, Community, and Economic Considerations: There are no operating underground coal mines in western Canada. An underground coal mine would require new skill sets not readily available in western Canada and provide little employment opportunities for the local workforce. An underground mine would require attaching skilled operators from other parts of North America/the world and therefore not add to the employment of locals.</p>	

### 2.5.1.2 Mine Rock Storage Facility Location

Based on the selection of the open pit method of mining, the next key design decision involves the location of the MRSF. In addition to location, additional design considerations include waste type, tailings treatment, and tailings disposal which are described elsewhere in Chapter 2. To help explain the relationship between these Project components, the following decision list is provided:

- Decision One: Should mine rock placement occur within the pit, within the valley, or a combination?
- Decision Two: If mine rock placement should occur within the valley, then where should that valley fill placement be located (e.g., West Alexander Creek or Alexander Creek drainage)?
- Decision Three: Should mine rock (coarse material), CHPP rejects, and tailings be disposed of together (combined) or separately?

- Decision Four: If mine rock and fine tailings should be disposed of separately, then where (i.e., tailings disposal by Elk River if that is where the CHPP is located; mine rock disposal at the mine in a separate pile)?
- Decision Five: Should tailings treatment be based on a wet or dry system? Should tailings disposal occur in a separate slurry pond or combined disposal including CHPP rejects and tailings?

The preferred means established through this decision process include the following: A combination of pit backfill and valley fill (Decision One); West Alexander Creek drainage valley fill while maximizing pit backfill (Decision Two); Combined disposal of mine rock, CHPP rejects, and tailings (Decision Three); Combined disposal using Layer Cake Method (Decision Four); and, dry tailings management with combined disposal (Decision Five).

Regarding MRSF location, NWP considered the following primary options:

- West Alexander Creek drainage (preferred means);
- Hybrid option (i.e., a combination of various drainages);
- Saddle between Alexander Creek and Grave Creek drainage; and
- Grave Creek drainage.

All four mine rock storage facility options are based on the layer cake method of MRSF design, which limits a single lift of the mine rock storage facility to 50 m and then a layer of coal process rejects. The Project would maximize pit backfilling. All four options would backfill North, East, and South pits to the same extent. Waste would be placed for in-pit backfill as mining is completed and then delivered to the MRSF. Conventional MRSF and spoil pile design heights can go as high as 300 m. This is a base case assumption and impacts the economics of the MRSF options.

NWP assessed MRSF location alternatives as part of the pre-feasibility engineering work, qualitatively screening options. The MRSF location options are shown in Figure 2.5-1 and described below.

#### West Alexander Creek Drainage

The West Alexander Creek design option (preferred means) will place mine rock across the West Alexander Creek basin; however, placement will begin at the head of the West Alexander Creek basin and progress southwards. North and East Pits would also be backfilled.

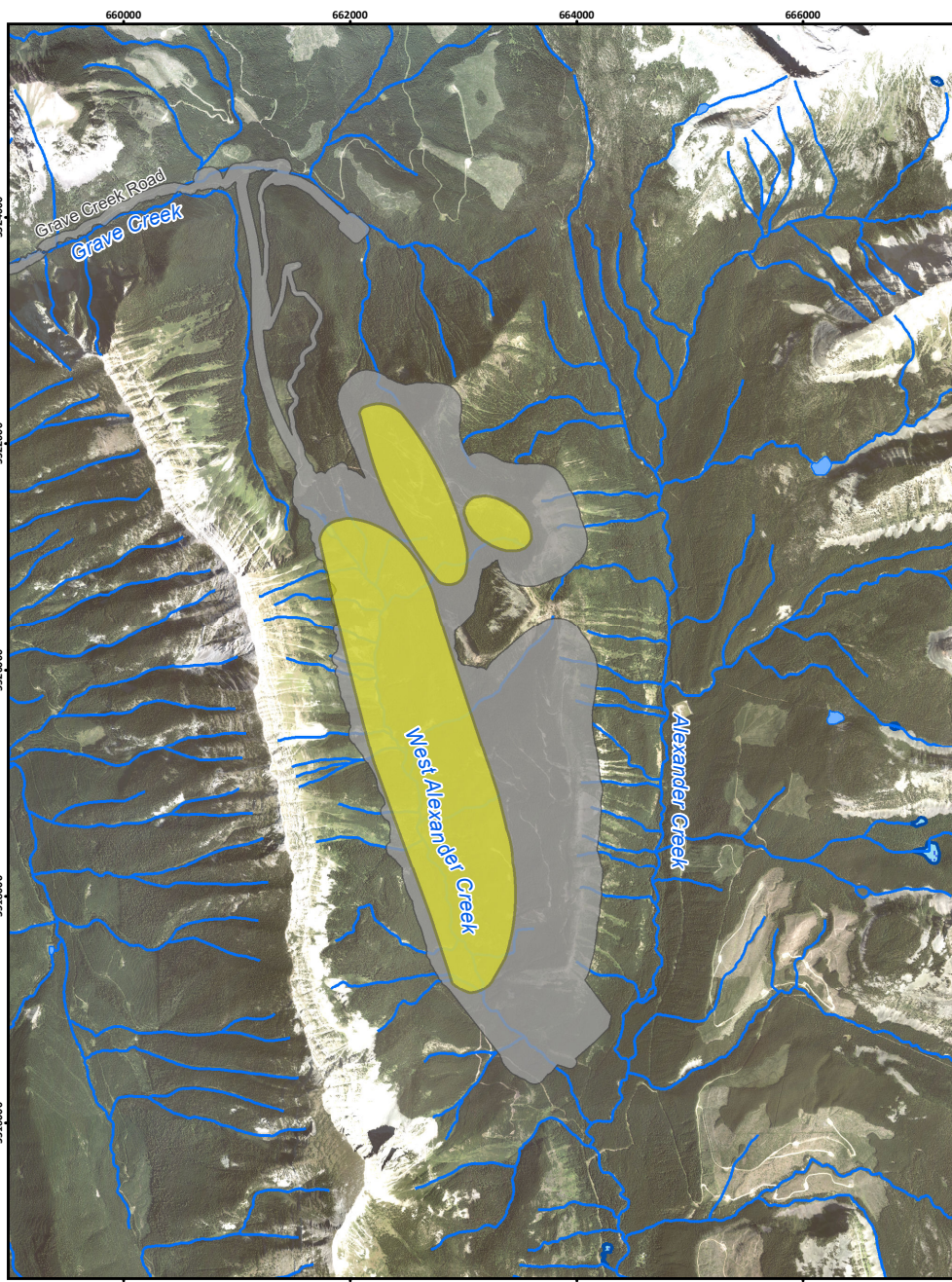
#### Hybrid Option

The Hybrid Option would require placement of mine rock in the Grave Creek, West Alexander Creek, and Alexander Creek catchments, with the majority of the waste placed in Grave Creek. The West Alexander portion of this MRSF design would be consistent with the first four years of the West Alexander Creek option.

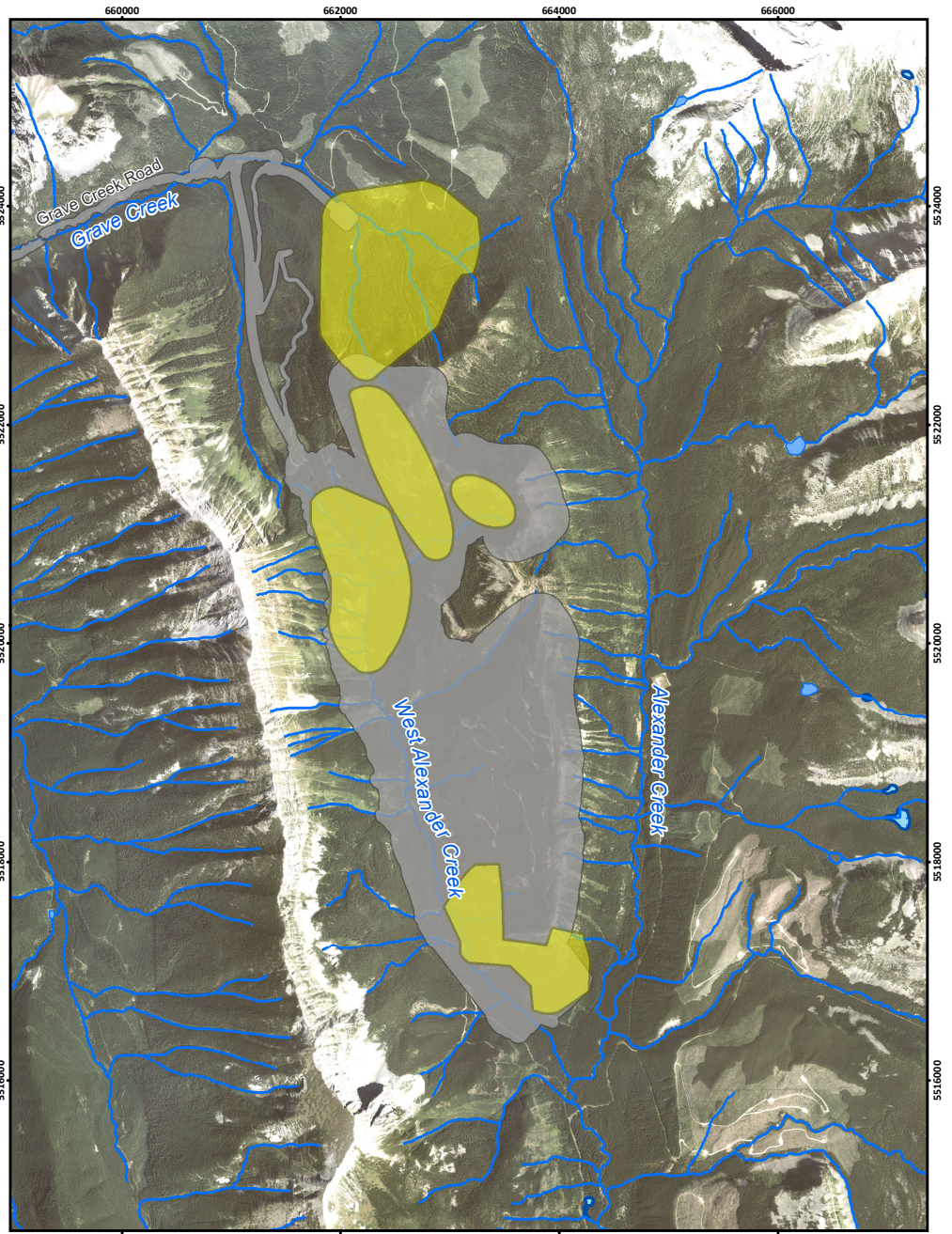
#### Saddle between Alexander Creek and Grave Creek

The Saddle between Alexander Creek and Grave Creek concept is based on placing mine rock northeast of the East Pit. This option would involve building the MRSF from the bottom up to meet the layer cake design requirements. This would require an extensive road network to be constructed to the northeast of East Pit.

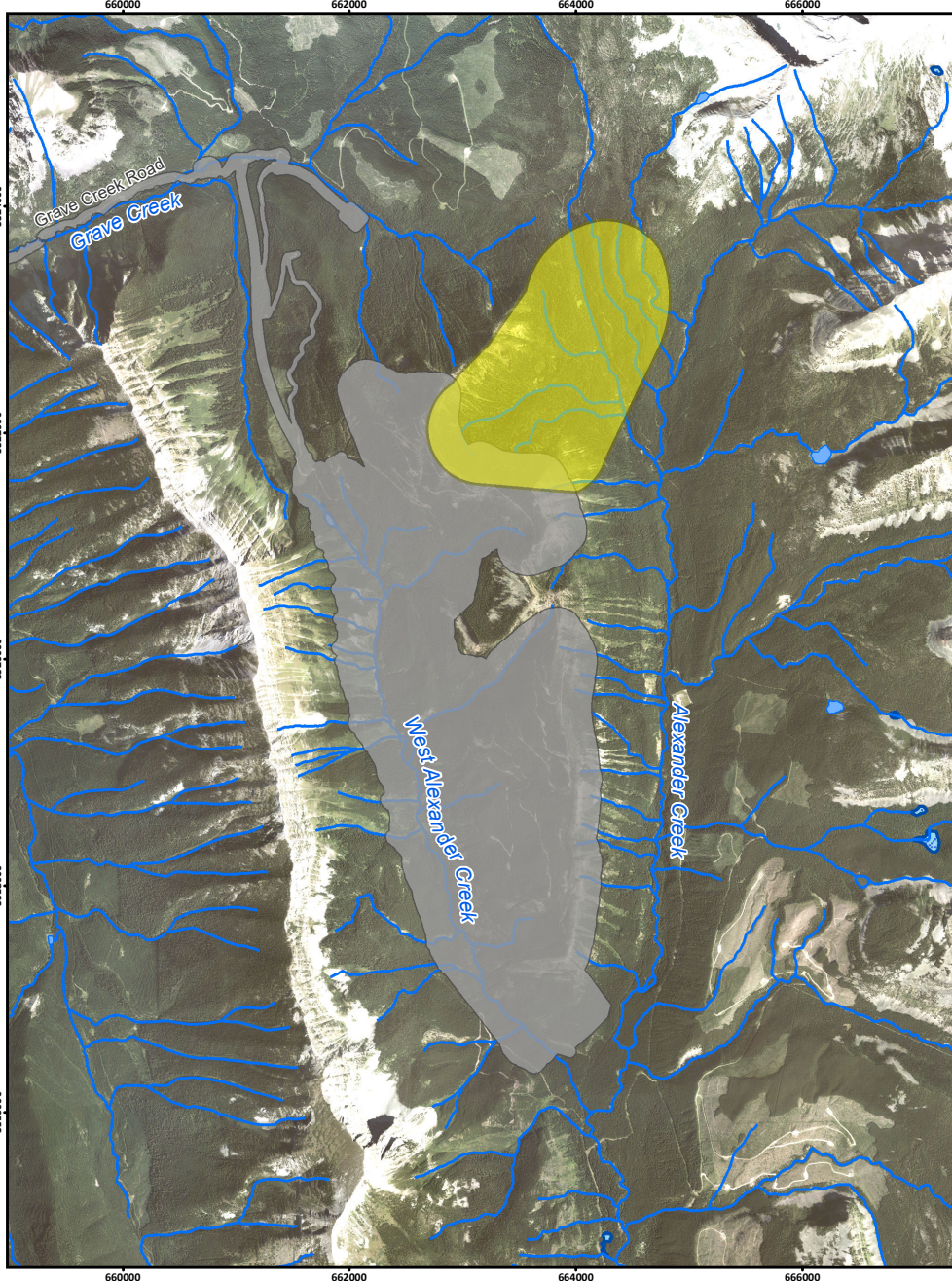
West Alexander Drainage



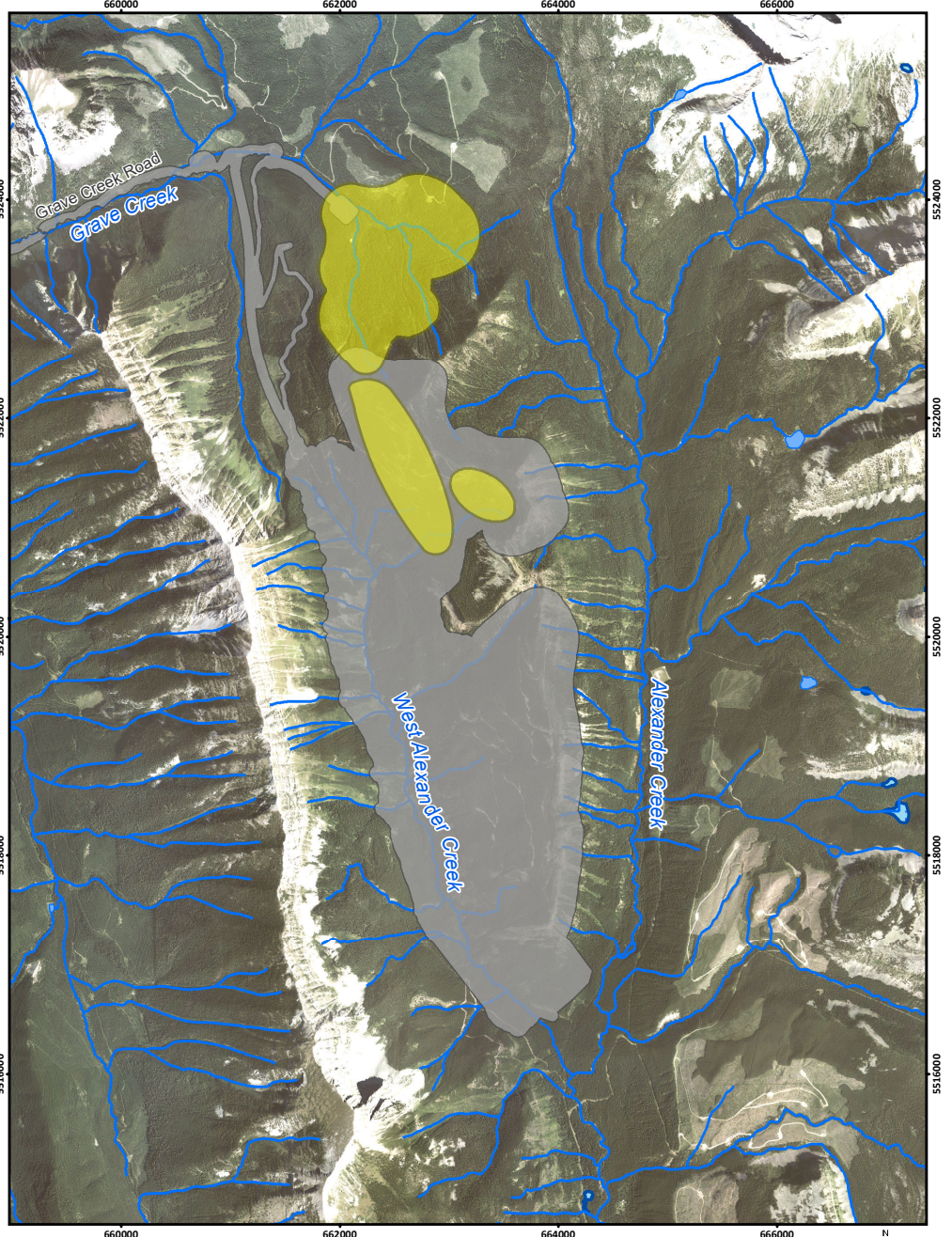
Hybrid Option



Saddle Between Alexander and Grave Creek



Grave Creek

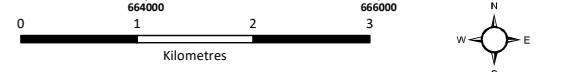


Crown Mountain Coking Coal Project

LEGEND

- MRSF Area Location Alternatives
- Project Footprint
- Watercourse
- Waterbody
- Wetland

Figure 2.5-1  
MRSF Location Alternatives



Scale 1:65,000

Map Drawing Information:  
Data Provided by NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, 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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Status: FINAL  
Date: 2022-03-07

## Grave Creek

The Grave Creek MRSF concept is based on placing mine rock to the north of North Pit. This option would involve building the MRSF from the bottom up to meet the layer cake design requirements. This would require an extensive road network to be constructed to the north of North Pit.

Key VCs potentially affected by the MRSF location alternatives include all selected environmental VCs identified in Chapter 5 as well as land-use and access and recreation. Table 2.5-2 summarizes the alternatives analysis for MRSF Location.

For disposal method considerations and refuse alternatives, separate spoil and refuse piles would be problematic. Elk River could offer an option for separate refuse disposal if the CHPP were located at the river and spoils would be disposed of at the mine; however, this separate pile method would not support NWP's water management objectives. Additional discussion is provided in Section 2.5.6 (Tailings Disposal), describing the challenges of slurry pond (wet tailings) and the preferred means of combined spoil and refuse, which has selenium mitigation benefits.

Table 2.5-2: MRSF Location

Alternatives Evaluated	Discussion	Preferred Means
West Alexander Creek Drainage vs. Hybrid Option	<p>Technical Assessment: Conceptual designs were completed for each of the four options; conceptual designs used the following design parameters:</p> <ul style="list-style-type: none"> <li>• Mine rock swell factor of 30%;</li> <li>• Angle of Repose of 37°;</li> <li>• Overall design slope of 2 to 1;</li> <li>• 50 m maximum lift of mine rock storage facility; and</li> <li>• Store 351 million m<sup>3</sup> of mine rock.</li> </ul>	West Alexander Creek Drainage
Saddle between Alexander Creek and Grave Creek Drainage vs. Grave Creek Drainage	<p>Based on these design parameters, all four options were technically feasible. Access to the bottom lifts of the Saddle between Alexander Creek and Grave Creek Drainage concept and Grave Creek concept was technically challenging and not efficient. This assessment was based on the regional understanding of the foundation conditions for the conceptual designs reviewed.</p> <p>Project Economic Assessment: The primary economic consideration is the proximity of the MRSF to the pits, to minimize travel distance and for effective operations. The proposed MRSF configuration is the most optimal, as the MRSF are located adjacent to the pits and the majority of the mine rock hauls are downhill. The other three options increased the haul distances and elevation gained for the mine rock, which has implications for both operating and capital costs. Longer haul distances require additional mine rock trucks to be purchased at \$6 million per truck and operated at a cost of \$2.5 million per year. The Saddle between Alexander Creek and Grave Creek Drainage concept and Grave Creek concept were the most expensive options based on the access to the bottom lift and distance from South Pit.</p>	

Alternatives Evaluated	Discussion	Preferred Means
	<p>Environmental Assessment: A key consideration in the Layer Cake method for the reduction of selenium release are the exposed portions of the MRSF. A key ratio for determining the effectiveness of this method of selenium reduction is the percentage of the external or exposed faces of the overall dump volume.</p> <p>The West Alexander Creek Drainage option would have lower percentages of exposed faces than the other three options. This would lead to lower selenium release relative to the other options. The West Alexander Creek Drainage option would avoid placing mine rock in the Grave Creek catchment, and the other three options would therefore increase the selenium levels in Grave Creek relative to the West Alexander Creek MRSF design which avoids the Grave Creek drainage. The Grave Creek drainage is already impacted from Harmer Creek, which exceeds water quality guidelines.</p> <p>The West Alexander Creek Drainage location would impact more avalanche chutes, riparian zones and wetlands than the other three options; however, the other options would create extended footprints potentially impacting terrestrial wildlife and habitat in other drainages as well as impact wildlife movement in a manner that would exceed the impacts to these VCs from the single-drainage West Alexander Creek Drainage approach. Placing the MRSF outside the West Alexander Creek Drainage and into a separate drainage from the mine would increase the reach of mine-influenced water into those other drainages. Keeping the MRSF in the same drainage as the mine would result in a more contained system for management and mitigation.</p> <p>Indigenous Communities' Considerations: NWP did not directly engage with Indigenous communities regarding MRSF location; however, during engagements, Indigenous communities have expressed interest in NWP reducing the Project footprint and reducing impacts to terrestrial VCs. The MRSF options with footprint outside of West Alexander Creek Drainage would not minimize footprint and might not optimally reduce impacts to terrestrial VCs. Therefore, MRSF options outside of West Alexander Creek Drainage are considered less preferable.</p> <p>Socio-Community and Economic Considerations: The MRSF options with footprint outside of West Alexander Creek Drainage would have a larger impact on recreational land use and other land users compared to options with the MRSF located within the same drainage as the mine. Relative to land use and community interests, the West Alexander Creek Drainage option is preferable.</p>	

### 2.5.1.3 Mine Rock Storage Facility Design and Methods

NWP considered two design methods for the MRSF:

- Conventional MRSF Design; and
- Layer Cake MRSF Design (preferred means).

In summary, the Conventional MRSF Design typically involves construction of a MRSF along a slope near the active mine pit. This conventional design is created by placing material from the top, which results in a topographic feature that would require future contouring to establish a stable surface. A Conventional MRSF Design could result in a significant side slope or filling of an entire drainage in a manner that limits future reclamation and use. In contrast, the Layer Cake MRSF Design is a bottom-up layering of mine rock and plant rejects. This layering process results in a flatter configuration during and after active use. Based on NWP analysis, it is anticipated that a conventional Layer Cake MRSF Design would outperform a Conventional MRSF Design in meeting Project objectives related to footprint, selenium management, and landform design and reclamation.

The primary VCs potentially affected by the MRSF design alternatives are surface water quality and quantity. Table 2.5-3 summarizes the alternatives analysis for MRSF Design.

Table 2.5-3: MRSF Design Alternatives

Alternatives Evaluated	Discussion	Preferred Means
Conventional MRSF Design  vs.  Layer Cake MRSF Design	<p>Technical Assessment: Both the Conventional MRSF Design and Layer Cake MRSF Design options are based on the same design parameters used for MRSF location except for one, MRSF maximum lift height. The maximum MRSF lift height for the Layer Cake method is 50 m, and up to 300 m for a Conventional MRSF Design. Based on these parameters, both design options are technically feasible. The key factor for the MRSF design decision was to have a self-sustaining landform, which is offered by the Layer Cake MRSF Design.</p> <p>Project Economic Assessment: The MRSF maximum lift height has significant implications on the overall economics. The higher the MRSF maximum lift height decreases the haul distance and average time of travel for the mine rock trucks. Longer travel times require additional mine rock trucks to be purchased at \$6 million per truck and operated at the cost of \$2.5 million per year. Based on high-level assessments, Conventional MRSF Design requires a third fewer mine rock trucks. This would reduce annual operating costs by \$12.5 million per year and capital costs by \$30 million. This reduction in costs doesn't account for the increased costs of selenium treatment as a conventionally designed MRSF would have up to 10 times the selenium release, which would have to be treated to meet acceptable discharge limits.</p> <p>Environmental Assessment: The Layer Cake MRSF Design method of selenium reduction has been shown to reduce selenium release by up to 90% compared to a conventionally designed MRSF. The Layer Cake MRSF Design also has the benefit of achieving a self-sustaining landform as the selenium reduction technology is based on creating</p>	Layer Cake MRSF Design

Alternatives Evaluated	Discussion	Preferred Means
	<p>a low oxygen environment within the MRSF. Layer Cake MRSF design limits the oxygen ingress and slows down the flow pathways, which is a process that is aided through the reclamation activities and the natural weathering of the mine rock. In contrast to the Conventional MRSF Design which would require active treatment, the Layer Cake MRSF method is a form of source control. As a self-sustaining control of selenium at the source within the MRSF layers, active treatment is not required.</p> <p>Indigenous Communities' Considerations: The decision to adopt the Layer Cake MRSF method of selenium treatment was influenced by numerous discussions with the KNC Lands department and KNC's public correspondence on the Elk Valley Water Quality Plan to have a sustainable long-term solution for selenium treatment.</p> <p>Socio-Community and Economic Considerations: Economic conditions across the MRSF design alternatives are nominally equivalent, negligible, and not individually discernible when assessing potential Project interactions and economic effects across the entire Project. Similarly, the potential effects to social conditions between the two alternatives would be negligible. The Layer Cake MRSF method will enable a self-sustaining landform and is central to NWP's Landform Design and Reclamation Plan. While this is not anticipated to effect change in day-to-day life at a community level, the environmental outcomes of the Layer Cake MRSF method are anticipated to have a net-positive effect on the community.</p>	

NWP completed an in-depth assessment to look at the layering of process plant rejects with the mine rock in the MRSF. Effectively, this would result in a layer-cake like structure. The Layer Cake MRSF Design would include a combined pile (spoil and refuse). The Layer Cake structure is intended to simultaneously mitigate both nitrate and selenium in a similar manner to other treatment methods, where the focus of the Layer Cake is in reducing selenium release more effectively than a conventional MRSF. Figure 2.5-2 shows the Layer Cake MRSF method. The convection zones of the MRSF are illustrated by the brown arrows and represent zones of the MRSF that would have higher oxygen levels. Higher oxygen levels would be associated with selenium release in the MRSF.

Phase 1 and 2 modelling studies using mine rock from the Sukunka Coal Project combined with modelled plant rejects from the Project confirmed the conclusions established in preliminary test work. Test work and modelling have resulted in the following design considerations:

- Construction of a controlled full-scale test facility at the start of the mine life to test the on-site effectiveness of the Layer Cake MRSF method; and
- Nitrate potential in mine rock pore waters will be limited through explosives management mitigation.

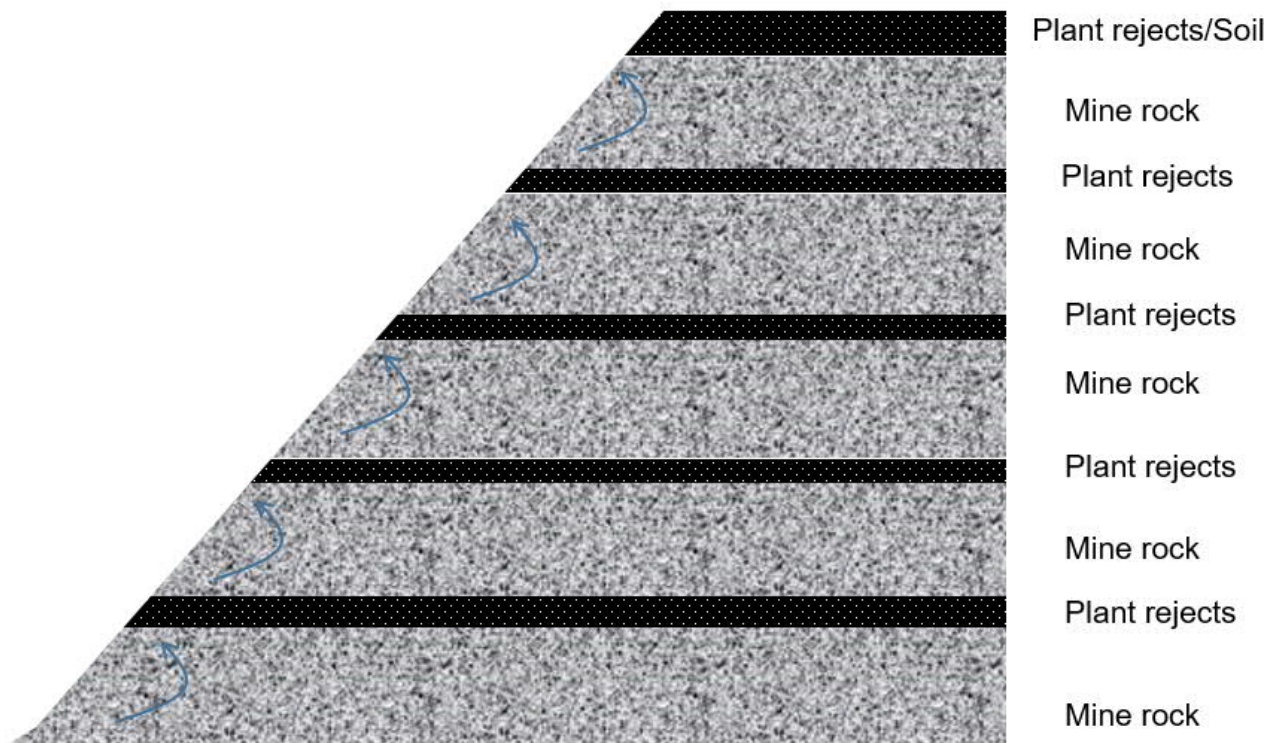


Figure 2.5-2: Conceptual Cross Section of the Layer Cake Design  
 Crown Mountain Coking Coal Project  
 Application for an Environmental Assessment Certificate / Environmental Impact Statement

#### 2.5.1.4 Mine Sequence

There were two mine sequences investigated as part of the mine design process (Table 2.5-4):

- South Pit to North Pit; and
- North Pit to South Pit (preferred means).

Primary VCs potentially affected by the mine sequence alternatives include soil quality and quantity as well as terrain. The following table summarizes the alternatives analysis for the mine sequence options.

Table 2.5-4: Mine Sequence

Alternatives Evaluated	Discussion	Preferred Means
<p>North Pit to South Pit</p> <p>vs.</p> <p>South Pit to North Pit</p>	<p>Technical Assessment: Both mine sequences are based on the West Alexander MRSF design, CHPP location, infrastructure and the same pit designs. The North Pit to South Pit mine sequence is the mined sequence presented in the Application/EIS. The South Pit to North Pit mine sequence would require the construction of the main sediment pond prior to the development of the South Pit, which would have increased the initial footprint of the mine. In addition to this, the South Pit to North Pit sequence would have required the development of a Run of Mine (ROM) coal haul road from the southern end of the South Pit to the ROM stockpile. Both mine sequences are technically feasible.</p> <p>Project Economic Assessment: The two mine sequences have significantly different economics. The North Pit has lower strip ratio, higher yield, and produces a Tier 1 Coking Coal. This results in significantly higher cash flow than starting the mine plan in South Pit. In addition to these factors, the North Pit to South Pit mining sequence results in lower start-up capital requirements resulting from reduced development costs. The North Pit to South Pit mine sequence was selected based on the superior economic case of this mining sequence. This resulted in a smaller initial footprint and allowed for the soil salvaged from South Pit to be stockpiled on the initial MRSF.</p> <p>Environmental Assessment: The Project Site Water Management Plan is based on layering 1.5 m coal process rejects over a maximum MRSF height of 50 m per lift. The North Pit to South Pit mine rock placement sequence continues the sequence established for North and East Pit, generally continuing in a southern direction from the northern part of the West Alexander Valley. The South Pit to North Pit mine rock placement sequence would jump to the southern end of the West Alexander Valley and then progress in a northern direction. The North Pit to South Pit sequence provides a year gap between the initial five years of waste. This gap will provide a period where this portion of the dump will not be expanded. In the South Pit to North Pit mine rock placement sequence, the MRSF is continually expanded, providing no gap to assess the Layer Cake MRSF method. The test work completed for the Layer Cake MRSF method showed that most of the selenium would be removed from solution within</p>	<p>North Pit to South Pit</p>

Alternatives Evaluated	Discussion	Preferred Means
	<p>one year, which would provide a clean full-scale test of the Layer Cake MRSF method during this period.</p> <p>Most of the available soil for salvaging is in and associated with the development of South Pit. The North Pit to South Pit mining sequence allows for the establishment of platforms on the initial MRSF that could be used to stockpile salvageable soil until the soil is required for reclamation.</p> <p>Indigenous Communities' Considerations: NWP selected the North Pit to South Pit mine sequence to minimize the initial Project footprint. This aligns with Principle 1 of the Ktunaxa Perspectives on, and Principles for, Reclamation and Restoration in qukin ʔamakʔis and the Elk Valley with the reduction of initial disturbance and providing earlier opportunities for salvaging and stockpiling soil for reclamation proposes as most of the soil in Landform Design and Reclamation Plan is salvaged from South Pit.</p> <p>Socio-Community and Economic Considerations: Economic conditions across the Mine Sequence alternatives are nominally equivalent, negligible, and not individually discernible when assessing potential Project interactions and economic effects across the entire Project. Differences in potential effects to social and community conditions for both alternatives would be negligible.</p>	

#### 2.5.1.5 Reclamation Sequence

The sequencing of reclamation has been influenced by one key decision point in the Landform Design and Reclamation Plan (Chapter 33, Section 33.4.1.6), which had the following two options:

- Stockpiling Soil on Initial MRSF Platform; or
- Early Reclamation of Initial MRSF Platform.

Primary VCs potentially affected by the reclamation sequence alternatives include soil quality and quantity as well as terrain. Table 2.5-5 summarizes the alternatives analysis for these two reclamation sequence options.

Table 2.5-5: Reclamation Sequence

Alternatives Evaluated	Discussion	Preferred Means
<p>Stockpiling Soil on Initial MRSF Platform</p> <p>vs.</p> <p>Early Reclamation of Initial MRSF Platform</p>	<p>Technical Assessment: Both options are technically feasible, but Early Reclamation of the Initial MRSF Platform would pose operational challenges. Stockpiling Soil on the Initial MRSF Platform allows for a large, flat soil stockpile designed to meet the soil stockpiling requirements. By not using the initial MRSF platforms to stockpile soil, this would require the use of smaller soil stockpiles on steeper foundations within the South Pit footprint. These stockpiles are more susceptible to erosion and operational impact. Both erosion and operational impact would reduce the amount of soil available for the</p>	<p>Stockpiling Soil on Initial MRSF Platform</p>

Alternatives Evaluated	Discussion	Preferred Means
	<p>reclamation process. Soil retention for the reclamation process is a key part of the reclamation plan. The larger Stockpile on the Initial MRSF Platform allows for the maintenance/aeration of the soil while being stored.</p> <p>Project Economic Assessment: There is no difference between the two options in terms of capital or operating costs, and therefore, economics is not a factor in the decision.</p> <p>Environmental Assessment: Early Reclamation of the Initial MRSF Platform would result in greater potential impact to soils, with increased susceptibility to erosion. Stockpiling Soil on the Initial MRSF Platform will enable consistent maintenance opportunities carrying through to final reclamation that meets contouring and landform topography objectives.</p> <p>Indigenous Communities' Considerations: The soil stockpile on the initial MRSF platform allows for the stockpile to be maintained and aerated prior to application to reclaimed portions of the mine. This aligns with Principle 2 of the Ktunaxa Perspectives on, and Principles for, Reclamation and Restoration in qukin ʔamakʔis and the Elk Valley, where soil is incorporated in the Landform Design and Reclamation Plan.</p> <p>Based on the operational challenges of the early reclamation of the initial MRSF and the alignment with the Ktunaxa's Perspectives and Principles for Reclamation and Restoration in qukin ʔamakʔis and the Elk Valley, Stockpiling Soil on the Initial MRSF Platform was incorporated into the Landform Design and Reclamation Plan as the primary soil stockpile.</p> <p>Socio-Community and Economic Considerations: Economic conditions across the Reclamation Sequence alternatives are nominally equivalent, negligible, and not individually discernible when assessing potential Project interactions and economic effects across the entire Project. Similarly, the difference in potential effects to socio-community conditions between the alternatives would be negligible.</p>	

### 2.5.1.6 Mine Equipment Selection

The mine equipment selection process looked at the equipment fleets at other coal mines in the Elk Valley in addition to coal mines in northeast B.C. The primary Project decision for mine equipment focuses on how the shovels and drills are powered. There are two primary means to power drills and shovels, and both were considered as part of the evaluation (Table 2.5-6):

- Electrically Powered Drills and Primary Shovels; and
- Diesel Powered Drills and Primary Shovels (preferred means).

The other mines in the Elk Valley operate electric shovels as their primary mine rock loading machines, whereas the mines in northeast B.C. operate diesel shovels. The other coal mines in the Elk Valley are significantly larger than the coal deposits in northeast B.C. and have longer planned production lives and can support the increase to the associated infrastructure to operate electric shovels. NWP recognizes that there is significant research and development ongoing in alternative methods for powering mining equipment. NWP will look to evaluate new technologies for incorporation in the Project as this evolves.

Primary VCs potentially affected by the mine equipment selection alternatives include landscapes and ecosystems; vegetation; wildlife; visual aesthetics; air quality; greenhouse gas emissions; land use and access; and recreation. The following table describes the alternatives analysis for mine equipment selection.

Table 2.5-6: Mine Equipment Selection

Alternatives Evaluated	Discussion	Preferred Means
<p>Diesel Powered Drills and Primary Shovels</p> <p>vs.</p> <p>Electrically Powered Drills and Primary Shovels</p>	<p>Technical Assessment: As an industry standard, diesel powered drills and primary shovels are technically feasible.</p> <p>Electrifying Crown Mountain's pits to support electric drills and shovel would require additional power sourced from B.C. Hydro. There is limited additional electrical capacity in the Elk Valley sourced from B.C. Hydro. NWP understands that there is insufficient capacity in the regional system to support mine equipment electrification currently. Therefore, electrically powered mine equipment is not considered technically feasible.</p> <p>Project Economic Assessment: If grid power from B.C. Hydro was available to support electrification, the mine plan would have to be altered to accommodate the mining of narrow mine rock headings with electric equipment. This would lead to less efficient use of the electric shovels relative to the diesel-powered shovels which would result in more mine rock loading equipment required to meet the same production targets. Electric drills and shovels would result in higher capital costs and lower operating costs. The higher capital costs are associated with the increased electrical demand, lower productivities from the shovels, and electrification of the pits. The increased capital costs are not offset by the lower costs of operating electric shovels and drills.</p> <p>Environmental Assessment: Electrification of the equipment would require increasing to a larger capacity power line and a larger transmission line right-of-way to connect to the grid. The utility corridor is through steep, rugged terrain where installing a large capacity line would take up more land, increasing the effects to landscapes and ecosystems and vegetation. This creates the potential for additional disruptions to wildlife movement and the potential for additional disruption to recreational land use. The larger transmission line footprint would increase the effects to</p>	<p>Diesel Powered Drills and Primary Shovels</p>

Alternatives Evaluated	Discussion	Preferred Means
	<p>visual aesthetics. The use of diesel-powered drills would result in direct effects to air quality and greenhouse gas emissions.</p> <p>Indigenous Communities' Considerations: NWP did not receive specific input from Indigenous communities regarding mine equipment selection; however, NWP has weighed a general understanding of Indigenous communities' concerns about Project footprint, emissions, and water quality into its environmental considerations in choosing preferred means.</p> <p>Socio-Community and Economic Considerations: Increasing demand for the limited electrical capacity from B.C. Hydro could have a Low to Medium negative effect on economic conditions in the community. The potential effects to social conditions between the alternatives would be negligible. General public concern about potential for electrical system instability could be increased by the electric powered equipment alternative, and any additional stresses to the grid resulting in power outages to the community would have a negative effect.</p>	

#### 2.5.1.7 Explosives Usage

In open pit coal mining operations, there are a few common methods for exposing the coal resource for mining. These options are generally categorized in two groups: explosives, and mechanical ripping with mining equipment. NWP considered the following options (Table 2.5-7):

- New Conventional Explosive Agents (preferred means);
- Conventional Explosive Agents;
- Bagged Explosive Agents; and
- Ripping Rock as Opposed to Using Explosive Agents Where Possible.

Table 2.5-7: Explosives Usage

Alternatives Evaluated	Discussion	Preferred Means
New Conventional Explosives	<p>Technical Assessment: Breaking rock with explosive agents is technically feasible and has been employed in western Canadian coal mines for the last 40 years. Other mines operating in the area currently employ bagged explosives in an effort to reduce nitrate loading in the environment.</p> <p>In evaluating the ripping of rock, NWP concluded that there were limited areas that the ripping of rock would be applicable in North Pit. South Pit had limited geotechnical data at that time to draw any definitive conclusions; however, other coal mining operations in the area have not employed the method of breaking rock on a wide-scale basis, and it has been discounted as not technically feasible for this Project.</p>	New Conventional Explosives
vs.		
Conventional Explosives		
vs.		
Bagged Explosives		
vs.		
Ripping Rock		

Alternatives Evaluated	Discussion	Preferred Means
	<p>Project Economic Assessment: Employing bagged explosive agents is more labour intensive, which increases labour costs. This increase in labour cost is partially to fully offset by using lower cost explosive agents. This difference would be dependent on labour costs and explosive agent costs at the time of purchase as explosive agent costs are impacted by input commodity pricing. The net effect is anticipated as slightly higher overall cost to the Project for the bagged explosive agent solution.</p> <p>Environmental Assessment: The type of explosive agents used are directly linked to nitrate levels in mine-affected water quality. Nitrate is one of the elements of concern identified in the Elk Valley Water Quality Plan. The use of conventionally loaded explosive agents result in higher nitrate levels in the mine-affected water, as demonstrated at other operating mines in the area. Nearby operators have since moved away from this practice and now use bagged explosive agents. The mitigation inherent in new conventional explosives systems, including advanced detonation, fit-for-hole loading techniques, and thicker emulsion are anticipated to result in lower nitrate levels than bagged or conventional explosives systems and is therefore environmentally preferable.</p> <p>Indigenous Communities' Considerations: NWP did not receive specific input from Indigenous communities regarding explosives alternatives; however, NWP has weighed a general understanding of Indigenous communities' concerns about Project footprint, emissions, and water quality into its environmental considerations in choosing the New Conventional Explosives alternative.</p> <p>Socio-Community and Economic Considerations: Economic conditions across the Explosives Usage alternatives are nominally equivalent, negligible, and not individually discernible when assessing potential Project interactions and economic effects across the entire Project. The difference in potential effects to socio-community conditions between the alternatives would be negligible.</p>	

Explosives usage is directly linked to nitrate levels in mine-affected water quality. Lowering the explosives usage lowers nitrate levels. The type of explosive also impacts the nitrate levels. New Conventional Explosive Agents are a system that relies on redundant initiation of explosives to better control misfiring while also employing testing capability prior to blasting. This allows the blasting team the opportunity to correct issues prior to blasting. New Conventional Explosives also incorporate a thickened emulsion to prevent migration into cracks, thus reducing potential levels of residual nitrates. The New Conventional Explosives system does not preclude the use of liners when deemed appropriate or beneficial in extreme

conditions as an additional mitigation used in conjunction with advanced detonation, testing, and thicker emulsion.

Conventional Explosive Agent usage is based on using a combination of Ammonium Nitrate and Fuel Oil (ANFO) and emulsion explosive agents based on groundwater conditions. ANFO is used in dry groundwater conditions. Combinations of ANFO and emulsion are used in varying ratios based on groundwater conditions.

Bagged Explosive Agents is a method of preventing soluble portions of the explosive agents from entering the mine affected water. This is achieved by placing a plastic bag down the blast hole prior to the loading of the explosive agents. The same explosive agents are used in this process, but cheaper mixes can be used when bags are employed.

Ripping rock is based on bulldozers using their rippers to break the rock. This method of breaking rock eliminates the use of the explosives where employed.

There are explosive agents in development to reduce nitrate levels in the mine-affected water. Several manufacturers are looking into developing products for use specifically at coal mines. Orica's Fortis 70 is currently being trialed at metal mines in B.C. NWP will evaluate new products as they become commercially available.

Given NWP's consideration for water quality, NWP has selected New Conventional Explosives as the preferred means in order to achieve a lower selenium release than may be feasible with conventional or a site-wide bagged explosives program.

Primary VCs potentially affected by the Explosives Usage alternatives include surface water quality and quantity. The following table describes the alternatives analysis for Explosives Usage.

#### 2.5.1.8 Mine Operatorship

In Australia, where one of NWP's parent companies is from, contractors frequently operate either an entire mine or large portions of the mine on behalf of the owners. This is called Third Party Mine Operatorship. In western Canada, the contract mining model is not practiced. Instead, the company-operated mine model is used. Due to the absence of locally or regionally available Third Party Mine Operators, Third Party Mine Operatorship is not technically or economically feasible for this Project, and the preferred means is a company-operated mine.

## 2.5.2 Energy Source

The Project requires 11.6 MW of electrical power to operate the CHPP, maintenance facilities, RLO, and office space. A continuous power supply would be required to meet the electrical demand since the Project is planned to operate 24 hours per day and seven days per week. There were three primary sources of power considered for the Project:

- Connect to BC Hydro grid (preferred means);
- Natural gas / diesel generators on-site; and
- Alternative electrical sources.

Based on the economic and potential environmental impacts, NWP has selected connecting to the BC Hydro grid as the preferred means. Connecting to the BC Hydro grid will provide the lowest operating cost with lower GHG emissions. The required powerline has been incorporated into the Project footprint and economics.

Primary VCs potentially affected by the energy source alternatives include air quality; greenhouse gas emissions; landscapes and ecosystems; land-use and access; recreation; and visual aesthetics. Table 2.5-8 describes the alternatives analysis for energy source.

Table 2.5-8: Energy Source

Alternatives Evaluated	Discussion	Preferred Means
<p>Connect to BC Hydro Grid</p> <p>vs.</p> <p>Natural Gas / Diesel Generators On-site</p> <p>vs.</p> <p>Alternative Electrical Sources</p>	<p>Technical Assessment: Natural Gas / Diesel Generators On-site are technically feasible as there are commercially available generators that can meet the Project's power demand of 11.6 MW. The diesel generator would require an additional 40,000 litres of diesel fuel delivered to site per day, on average. Natural gas could be delivered via the natural gas line already in the Project design. The diameter of the natural gas line would have to be increased by between 5 cm and 10 cm to accommodate the increased demand of natural gas. This increase would not affect the Project's footprint. Both generators could be accommodated in the site's footprint and would not affect the Project's footprint.</p> <p>Alternative sources of energy such as solar and wind power struggle to provide a constant supply of base load power, and typically require energy storage solutions or alternative back up power sources to supply stable energy when wind and solar are not producing. The site topography limits solar exposure and sustained wind speeds. Wind and solar have been ruled out as a primary power source due to technical challenges.</p> <p>A 15 km powerline would be required to connect to BC Hydro's 1L274 power line. In 2019, BC Hydro confirmed that this line has the capacity to supply 11.6 MW of electrical power. The powerline would cross the Elk River and then parallel the existing Grave Creek Road to the clean coal haul loadout and then parallel the clean coal conveyor to the site. There is also a second option to connect to BC Hydro's 1L275 powerline.</p> <p>Project Economic Assessment: The operating costs for both the Natural Gas and Diesel generators are 3 to 7 times the operating cost compared to connecting to the BC Hydro grid. The capital costs are similar and would not have a material impact on the economic justification of the power line.</p> <p>Environmental Assessment: Diesel and natural gas generators would have higher greenhouse gas (GHG) output relative to sourcing</p>	<p>Connect to BC Hydro Grid</p>

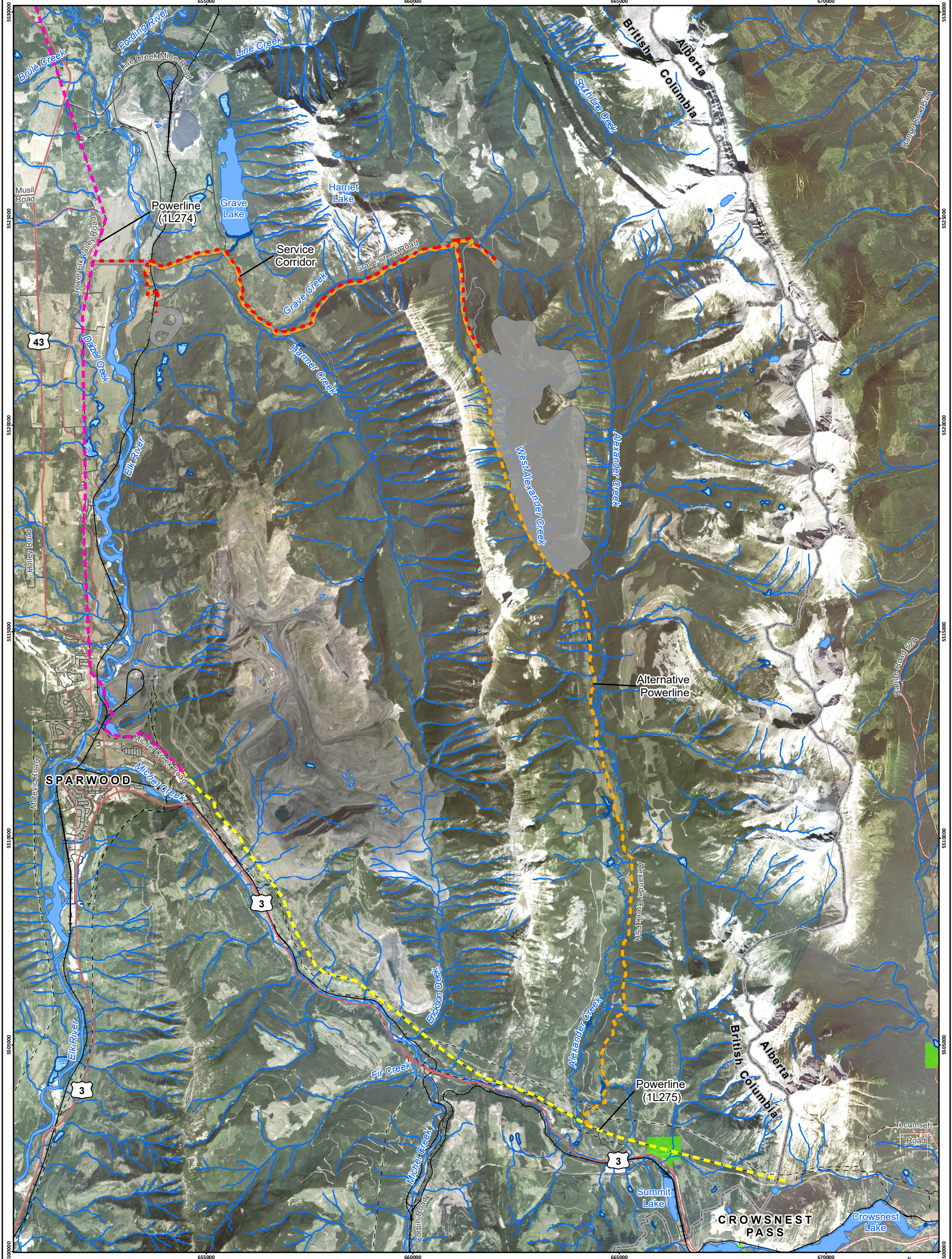
Alternatives Evaluated	Discussion	Preferred Means
	<p>electrical power from B.C. Hydro as 97% of BC Hydro's electrical power is generated from renewable sources.</p> <p>Diesel generators would require incremental delivery of one highway legal transport truck carrying 40,000 litres of diesel 350 days per year; fuel delivery trucks would use the proposed mine access road. A natural gas power generator would source the gas from the proposed natural gas lines, which would have no impact on the size of the excavation. Generator options would have the smallest spatial footprint as a powerline would not be required for the Project.</p> <p>Indigenous Communities' Considerations: NWP did not receive specific input from Indigenous communities regarding Energy Source alternatives; however, NWP has weighed a general understanding of Indigenous communities' concerns about Project footprint, emissions, and water quality into its environmental considerations in choosing the preferred means.</p> <p>Socio-Community and Economic Considerations: NWP recognizes public interest in shared access for recreational use and traffic safety. A diesel power option would increase traffic and the potential for interactions between trucks and recreational users.</p>	

### 2.5.2.1 BC Hydro Connection

There are two major powerlines that interconnect to Alberta's power grid, 1L274 and 1L275, which are near the Project. 1L275 parallels the Crowsnest Highway and 1L274 parallels Highway 43 in the Project area; both powerlines are 138 kV. The 1L274 powerline currently supplies three of Teck Resources' (Teck) operations in the region: Line Creek, Greenhills, and Fording River. There is a third powerline that is farther from the Project, 60L287, which supplies other industrial users including the closed Coal Mountain operation.

Connecting to the 1L274 powerline is the Project's preferred means. This option would require a 15 km powerline to connect to the mine site. In 2019, BC Hydro confirmed that this line has the capacity to supply 11.6 MW of electrical power. The powerline would cross the Elk River as shown in Figure 2.5-3 and then parallel the existing Grave Creek Road to the clean coal haul loadout and then parallel the clean coal conveyor to the site.

The second option would connect to BC Hydro's 1L275 powerline. This option would require 18 km of powerline to connect to the mine site. The alignment of this option would follow the Alexander Creek Forest Service Road to the main sediment pond location and then through the mine area to the plant site. BC Hydro investigated the capacity of the 1L275 powerline to supply power to the Project, and the preference was to connect to the 1L274 as the 1L275 powerline didn't have sufficient capacity to supply 11.6 MW.



**Crown Mountain Coking Coal Project**

**LEGEND**

- |  |                                |  |                                 |
|--|--------------------------------|--|---------------------------------|
|  | Existing Powerline (1L274)     |  | Transmission Line               |
|  | Existing Powerline (1L275)     |  | Watercourse                     |
|  | Proposed Alternative Powerline |  | Waterbody                       |
|  | Proposed Service Corridor      |  | Wetland                         |
|  | Project Footprint              |  | Provincial Park/Protected Area  |
|  | Highway                        |  | British Columbia/Alberta Border |
|  | Arterial/Collector Road        |  |                                 |
|  | Local/Resource Road            |  |                                 |
|  | Railway                        |  |                                 |

0 2 4  
Kilometres

Scale 1:85,000

Map Drawing Information:  
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.  
Imagery Provided By Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

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

**Figure 2.5-3**  
Powerline Alignment Alternatives



Project: 12-6231  
Status: FINAL  
Date: 2022-03-07

As there was only one option which was deemed technically feasible by BC Hydro, no other assessments were completed as part of the alternative evaluation process.

#### 2.5.2.2 Natural Gas Supply

The Project is estimated to require an annual natural gas load of approximately 355,000 GJ per year. The breakdown of the consumption requirement is summarized as follows:

- Heating shop and office complex: 92,400 GJ/year;
- CHPP heating consumption: 30,800 GJ/year; and
- Hyperbaric disc filter: 232,000 GJ/year.

NWP considered three options for natural gas supply as part of the alternatives assessment:

- Grave Creek Natural Gas Pipeline (preferred means):
  - Alignment along the Grave Creek Forest Service Road (same alignment as the proposed powerline); and
  - Connecting to the existing natural gas pipeline that runs from Sparwood to Elkford;
- Alexander Creek Natural Gas Pipeline:
  - Alignment along the Alexander Creek Forest Service Road; and
  - Connecting to the existing natural gas infrastructure on the south side of Highway 3;
- Liquefied Natural Gas (LNG) Trucking:
  - Commercial trucking of LNG to the mine site from an off-site source.

All three natural gas supply options are technically feasible and could supply the required natural gas.

The existing natural gas transmission pipeline runs between Sparwood and Elkford and is owned by Fortis BC. The existing pipeline is a 240 mm high-pressure line that operates close to 1,000 psi. Based on the natural gas consumption, the distribution pipeline is assumed to be 250 mm in diameter High Density Polyethylene (HDPE) pipe. Approximately 14.5 km of new pipeline construction would be required to support the plant and coal handling operations for the Grave Creek pipeline alternative.

There is an existing natural gas pump station located south of Highway 3. Natural gas could be sourced from this location. Approximately 20 km of new pipeline construction would be required to support plant and coal handling operations if taking gas from this pump station under the Alexander Creek pipeline alternative.

There are suppliers that can truck LNG to remote sites. NWP has received a proposal from one such supplier to provide this service, which would involve trucking LNG from one of their existing LNG plants to the Project site. The LNG transportation costs were significantly higher than that of connecting to the Fortis pipeline. This option was ruled out based on operating costs as the cost of the LNG onsite storage was equivalent to that of building a natural gas pipeline to site. There was no advantage in terms of capital costs. Trucking LNG to site would have higher GHG emissions than either of the two pipeline routes.

Given that the Grave Creek pipeline option would have the same alignment and use the same corridor as the preferred means for powerline alignment, the Alexander Creek pipeline option would increase the Project footprint as it would require a new right-of-way. Based on this increased footprint, the Alexander Creek pipeline option was ruled out.

Considering the increased economics and GHG emissions from the LNG option as well as the potential environment effects of the Alexander Creek alternative, NWP selected the Grave Creek Pipeline as the preferred means.

### 2.5.3 Major Facilities and Components

The following sections describe alternative means evaluated for the location and design of Major Facilities and Components including CHPP, RLO, and Clean Coal Stockpile.

#### 2.5.3.1 CHPP Location

Numerous alternatives were investigated to determine the selected location for the CHPP and associated infrastructure. The selection of the CHPP was influenced by the proposed Layer Cake MRSF method of treating selenium, thus limiting the overall disturbance and Project footprint, as well as commercial discussions with third parties. The following options were investigated:

- Grave Prairie near the Elk River RLO;
- Alexander Creek near Highway 3;
- Adjacent to the mine (preferred means); and
- Contract or third party CHPP.

The preferred means for CHPP location is adjacent to the mine. This location has impacts on other key decisions, and vice versa. CHPP location was selected based on the economics, Indigenous community input, and the overall desire to reduce the Project footprint.

Primary VCs potentially affected by the CHPP location alternatives include all selected environmental VCs identified in Chapter 5; land-use and access; and recreation. Table 2.5-9 describes the alternatives analysis for CHPP location and design.

Table 2.5-9: CHPP Location Alternatives Analysis

Alternatives Evaluated	Discussion	Preferred Means
Grave Prairie, Near the Elk River RLO	Technical Assessment: All options were considered technically feasible based on the information available to NWP except Contract (third party CHPP).	CHPP Adjacent to the Mine
vs.		
Alexander Creek Near Highway 3	A contract-operated CHPP would result in a third party processing coal from the Project. NWP explored the potential for hauling coal to an existing nearby plant as an input stream to the existing operator’s process. NWP approached another operator in 2019 to discuss this option. The operator rejected this inquiry, and NWP has not pursued any further discussions with them regarding coal processing. Another option could include a third party building and operating a CHPP on-site. While this model is applied in other countries, there are no known vendors able to provide this service to the Project in B.C. Therefore, NWP has determined the third Party CHPP option is not technically feasible.	
vs.		
Adjacent to the Mine		
vs.		
Contract or Third Party CHPP		

Alternatives Evaluated	Discussion	Preferred Means
	<p>Project Economic Assessment: The key economic impact in the decision of the location of the plant was the cost to haul ROM coal to the plant location. Both the Grave Prairie location and the Alexander Creek location would require hauling ROM coal significant distances, up to 15 km. This would double the transportation costs for the ROM coal relative to the clean coal costs, as two tonnes of ROM coal compared to one tonne of clean coal would have to be hauled off-site. This would increase operating costs as twice the amount of highway legal trucks would have to be operated for the life of the operation.</p> <p>The Alexander Creek CHPP option would require upgrading the Alexander Creek Forest Service Road and extending the natural gas and powerlines to this site or sourcing additional power source from the 1L275 power line. This would have added additional capital costs to construct compared to the preferred means adjacent to the mine.</p> <p>The proposed selenium management method is based on blending plant coarse coal rejects and fine tailings with mine rock. Alexander Creek and Grave Prairie locations would require backhauling plant rejects to the mine site, which would increase the cost of the coal haul.</p> <p>Siting the CHPP adjacent to the mine site location has the lowest overall operating costs of the technically feasible options.</p> <p>Environmental Assessment: Both the Alexander and Grave Prairie locations would have led to a larger and more spread-out Project footprint. The Grave Prairie option would have to be located adjacent the proposed RLO, expanding the footprint near the RLO.</p> <p>The Alexander and Grave Prairie CHPP locations would increase road traffic on the respective access roads. For the Grave Prairie option, there would be a significant increase in traffic along the Grave Creek corridor. The Alexander Creek plant site option would expand the Project's footprint down the valley with the ROM coal hauled down the valley.</p> <p>Indigenous Communities' Considerations: Any expanded footprint in the Grave Prairie area was ruled out based on feedback from the KNC. This direction from the KNC was not specific to the CHPP location but more generally with regards to minimizing the potential impact from the Project to the Grave Prairie area. This understanding was taken into account in identifying the preferred means adjacent to the mine site.</p>	

Alternatives Evaluated	Discussion	Preferred Means
	Socio-Community and Economic Considerations: Economic conditions across the CHPP Location alternatives are nominally equivalent, negligible, and not individually discernable when assessing potential project interactions and economic effects across the entire project. Similarly, the potential difference in effects to socio-community conditions between the alternatives would be negligible. The third party CHPP option would have a negligible effect on economic conditions at a community scale.	

### 2.5.3.2 CHPP Design: Fine Product Coal Drying

Project design for the CHPP is based on a dried tailings system, which would avoid the need for a slurry pond or other conventional tailings management infrastructure. NWP investigated two options for drying the fine coal product:

- Fluidized bed thermal dryer; and
- Hyperbaric disc filters (preferred means).

The fluidized bed thermal dryer is used at coal mines across western Canada and more specifically at Teck’s operations in the Elk Valley. Hyperbaric disc filters are in wide use around the world and have not been employed at an operating mine in western Canada.

Fluidized bed thermal dryers involve passing coal over a heat source. The coal is elevated by a suction fan that keeps the coal suspended over the heat source. Natural gas is used for a heat source in the evaluated option for this Project.

Hyperbaric disc filters are based on a combination of filtering inside a high-pressure chamber with steam assistance to further lower surface tension, reduce the viscosity of the filtrate, and provide some minor thermal drying that can result in filtered fines with surface moistures well below 10 percent. With the inclusion of the hyperbaric disc filter in the CHPP process, the screenbowl centrifuges were also reconfigured to dewater only the relatively coarser small coal. The net effect of this option is a lower product moisture is achieved with fewer screenbowl centrifuges required.

Both options are technically feasible based on the test work that NWP has completed. The fluidized bed thermal dryer is more energy intensive. The hyperbaric disc filter uses 40% of the natural gas compared to the fluidized bed dryer, resulting in an environmental benefit. The hyperbaric disc filters result in significant moisture reduction thus eliminating inefficient old-technology thermal dryers and the increased GHG emissions. Fine product coal drying alternatives are not anticipated to have differences in socio-community and economic or Indigenous considerations. Based on environmental attributes and technical feasibility, hyperbaric disc filters are the preferred means for this Project.

### 2.5.3.3 RLO Location and Design

The Project’s proximity to established rail infrastructure is an advantage; however, transporting clean coal from the plant site down to the existing rail line in the valley over a relatively short distance has required extensive design consideration and alternatives analysis. This analysis has investigated the entire clean

coal handling system in two segments. The first segment consists of an overland conveyor system to a bin and stockpile area at the start of the clean coal haul road. The second segment of the clean coal transport system consists of trucking the clean coal to the RLO at the proposed Grave Creek location.<sup>2</sup>

The key RLO design parameter is to accommodate a standard Canadian Pacific (C.P.) Railway unit coal train consisting of 4 locomotives and 160 aluminum rail cars with a total train length of 2,675 metres. The entire train must be clear of the C.P. rail line before, during, and after loading. The maximum grade and curvature of the track is a limiting factor due to concerns regarding potential runaways and locomotive power requirements. The base case assumed a standard unit coal train like the ones currently used at the Teck operations.

The RLO location and design configuration has gone through numerous iterations, with design considerations including archaeological conditions, land ownership, and existing infrastructure. Initial concepts included a single segment method with trucking only and no conveyor. Feedback from project stakeholders about Grave Creek Road helped NWP improve its design to the current conveyor plus trucking system. A total conveyor option (no trucking) was not fully developed for analysis due to topographic constraints and associated hazards. Similarly, a slurry pipeline to move coal with water instead of trucking was not fully advanced as an alternative. A slurry pipeline would require: a large diameter pipeline; large volume of input water; ability to remove and manage water prior to rail loading; and substantial infrastructure that would increase the Project footprint. Additional drawbacks of a slurry pipeline would include potential for pipeline leaks, spills, and potential impacts to water quality. Like the conveyor concept, topographic constraints and associated hazards would be limiting factors for a slurry pipeline concept.

The following sections describe the iteration of design options dating from 2013 to the current, preferred means of a "Figure 8" design at the Grave Creek location.<sup>3,4</sup> Primary VCs potentially affected by the RLO location and design alternatives include all selected environmental VCs identified in Chapter 5; land-use and access; recreation; visual aesthetics; and archaeological resources.

Figure 2.5-4 depicts the leading RLO option that NWP carried from 2013 to 2017, known here as the PFS Option.

Tembec, a forestry company, owned the proposed PFS Option RLO location and a large surrounding area. During 2012 and 2013, NWP approached Tembec about securing access to what would become the RLO proposed in the PFS. Tembec indicated in these discussions they would be amenable to allowing NWP to construct the RLO subject to receiving fair value for the area to be disturbed.

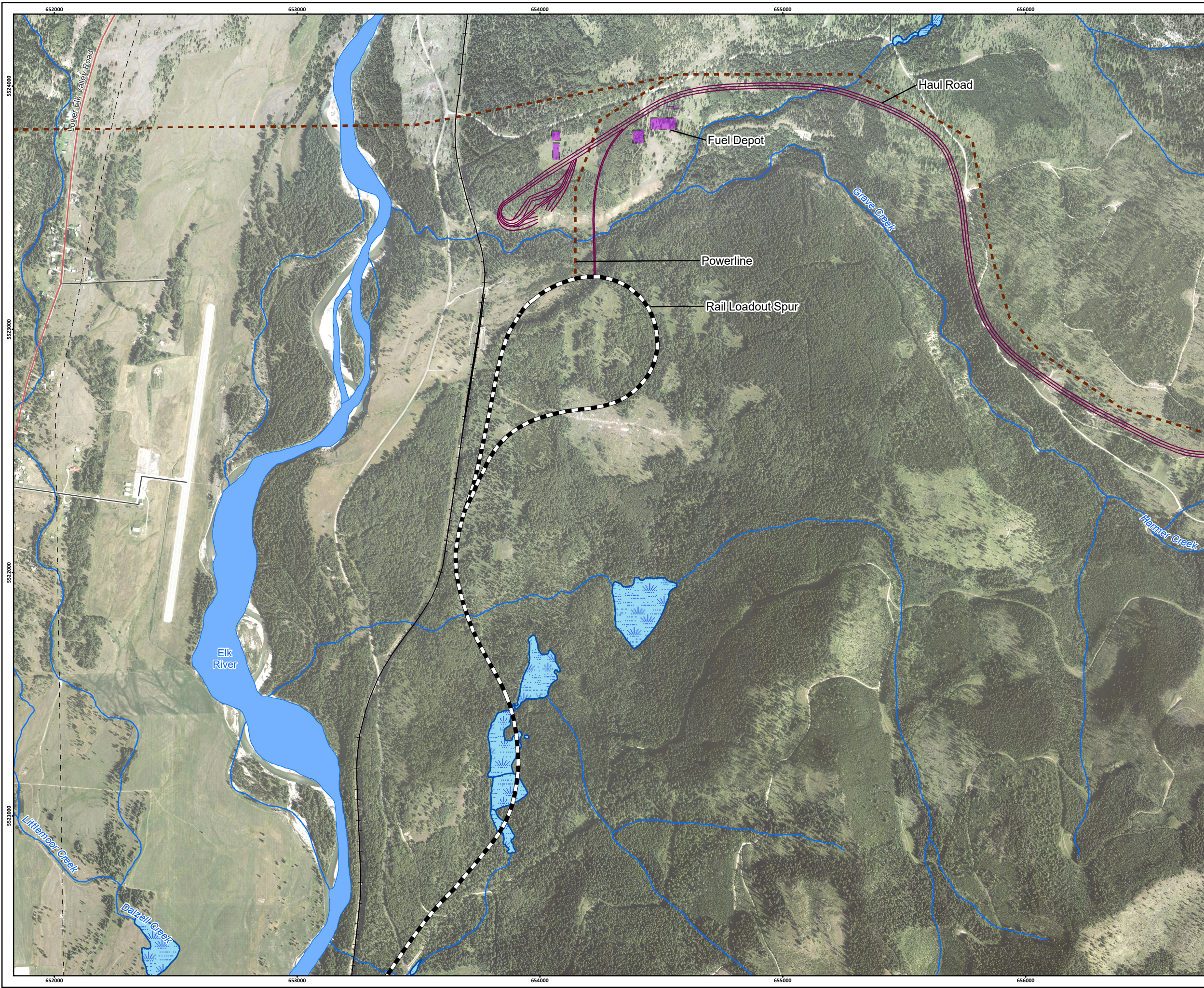
In October 2013, Teck purchased a large block of land from Tembec, including the proposed RLO location. Teck consolidated a group of land holdings, including the Tembec purchase, into what Teck refers to as the Teck Conservation Lands.

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<sup>2</sup> RLO Location and Design alternatives are described in narrative format (not tabular) to assist readers in understanding the iterative development of the alternatives considered.

<sup>3</sup> Prior names used for RLO location options may differ from what is represented in this Application/EIS. Efforts have been made to maintain consistency.

<sup>4</sup> All RLO options are considered off-site (off NWP lease property).















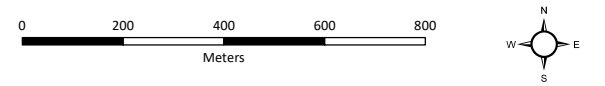
**Crown Mountain Coking Coal Project**

**Figure 2.5-4**  
PFS Facilities Configuration

**LEGEND**

**PFS Project Components**

-  Haul Road
-  Powerline
-  Rail Spur
-  Buildings
-  Arterial/Collector Road
-  Local/Resource Road
-  Railway
-  Transmission Line
-  Watercourse
-  Waterbody
-  Wetland
-  British Columbia/Alberta Border



Scale 1:15,000

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 Orthomagery (Aug 2016).

Map Created By: PAR  
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Map Coordinate System: NAD 1983 UTM Zone 11N



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Following Teck's acquisition of the Tembec land NWP negotiated a Road Use Agreement with Teck followed by an Access Agreement that allowed certain activities to be conducted in the Grave Prairie area, which encompassed the proposed RLO site. Despite allowing NWP to evaluate the Grave Prairie area for the RLO, Teck indicated it did not support locating the RLO on its conservation lands and objected to constructing any Crown Mountain infrastructure (e.g., access roads, power line, natural gas line, etc.) in this area.

The KNC expressed deep concerns regarding the RLO site, as it was believed to contain grave sites and represented certain special historical and spiritual values. KNC did not object to the proposed access road or power/gas lines.

In 2018, a comprehensive archaeological site investigation was completed for the PFS RLO location as part of the Environmental Assessment Application baseline archaeological activities. While previous work identified the existence of potential grave sites, the extent of the burial sites was not well defined. The archaeological investigation determined that there were numerous graves and other cultural findings within the proposed rail loadout location. These findings were more numerous than anticipated and were shared with the KNC's Representatives. Following the NWP/KNC discussions, this RLO location was determined to be unacceptable, and an evaluation was conducted to locate an acceptable alternative site.

Although Teck objected to placing any infrastructure on its conservation land, it was NWP's understanding Teck would consider alternatives off the conservation land but still on Teck-owned property. Teck is the largest landowner in the area, surrounding the Crown Mountain leases. In May of 2019, NWP personnel met with Teck officials to discuss location alternatives, some of which avoided Teck conservation land altogether.

In July of 2019, NWP met with the archaeology consultant for the Project to discuss the RLO options considering input from C.P., Teck, and KNC. The archaeology consultant provided a low potential archaeology polygon to use for the design of the RLO. Figure 2.5-5 illustrates the low archaeology potential polygon (shown in white outline) relative to the initially proposed PFS design (in black). This polygon provided a buffer to the known archaeology sites in the Grave Prairie area. In October and November of 2019, the consultant completed an archaeological site investigation which confirmed that there were no significant archaeological findings within the low archaeology potential polygon.

The following sections provide details about additional RLO options evaluated.

### South of Highway 3

NWP considered two locations south of Highway 3:

- East of Summit Lake; and
- Along Coal Mountain Spur Line.

The haul route reviewed for these options would be along the Alexander Creek Forest Service Road. From there, both options would require interacting with Highway 3 traffic. This haul route would increase the haulage distance by 20 kilometres. It would also limit the coal haul truck load to 40 tonnes and therefore double the traffic volume compared to the PFS Option.

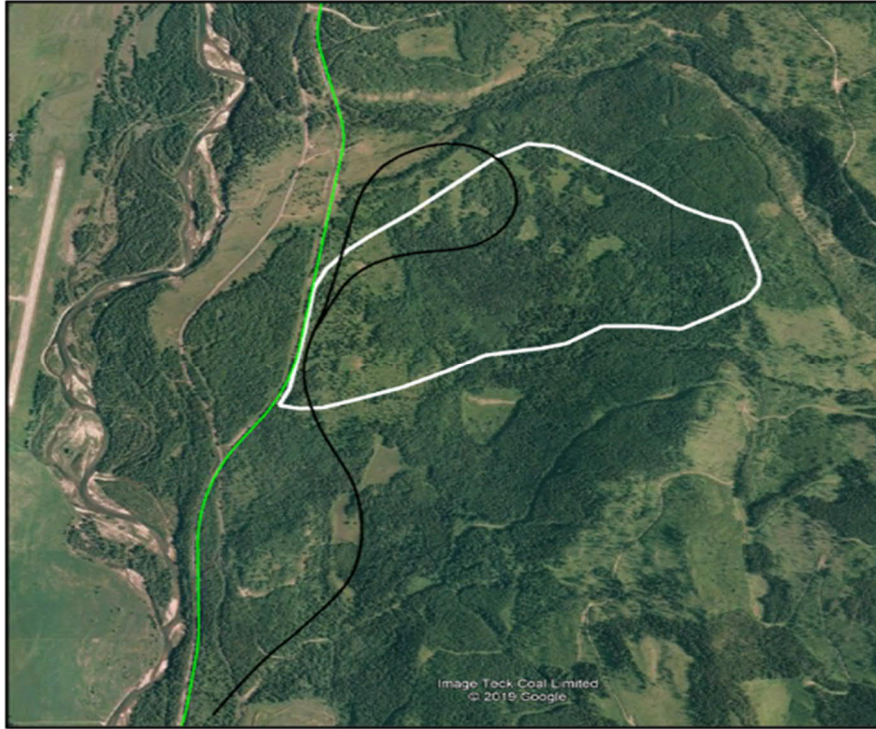


Figure 2.5-5: Low Potential Archaeology Polygon

#### West of Grave Lake

There were a series of RLO configurations developed on what is referred to as the Northern RLO option. All these configurations were based on building an RLO facility west of Grave Lake and off Teck's conservation lands. The area west of Grave Lake is not known to contain graves. Despite not encroaching on the conservation lands, Teck objected to these locations for several reasons: the western shore of Grave Lake has numerous cabins which are typically inhabited during the summertime; the southern shore of Grave Lake has a campground which is also used during the summertime; and there are wetlands west of Grave Lake. Teck's objections to the area west of Grave Lake shifted the focus back onto the conservation land area, with a focus to avoid burial sites and reduce potential effects.

#### Parallel Main Line

NWP developed a Parallel Main Line option to parallel the C.P. Fording Sub rail line. A train would have to be able to clear the rail line and park prior to the loading bin. This would require a full train length before the loading bin. As the train is loaded, it would have to remain clear of the mainline, and therefore would require another full train length after the loading bin as there is no opportunity to double back on the inbound RLO track. This option would cross the Teck conservation lands and would be located within the existing C.P. right of way. A portion of this option would be located on a previously built and then removed siding which would require minimal work to return to use. A track parallel to the rail line would be built, which would mirror the main line's grade. The grade poses the biggest obstacle for this option as portions of the parallel option would require loading the train at grades greater than 1.5%.

## Southern Loadout Options

The Southern Loadout options presented were versions of the PFS Option shifted south to avoid the known sensitive archaeological sites located on the Grave Prairie (Figure 2.5-6). Both the options illustrated below are a standard loop configuration for the RLO. The area south of Grave Prairie has two key wetlands and one mineral lick, which are sensitive habitats and were considered during selection of locations.

Based on the low potential archaeology polygon, there were several configurations considered to meet the physical constraints of the Southern Options. The refined configuration was based on a “Figure 8” style design, which is a similar design to that of Greenhills Mine’s RLO and the formerly proposed Grassy Mountain project’s RLO. The initial Figure 8 concept lead-in track came from south of the Figure 8. NWP completed a simulation study for this option, and this design did not meet the operating requirements for a standard unit train configuration.

NWP then developed the design illustrated in Figure 2.5-6 which had the lead-in track coming in from the northern side of the Figure 8. This concept had the advantage of a higher elevation starting point, which resulted in a shallower grade of the lead-in track and a flatter grade around the Figure 8. NWP completed an updated simulation study for this configuration, which demonstrated that a standard unit train could be loaded without additional power units added. To bring a fully loaded train into the loop, this would require the train be to split into 2 segments, one consisting of 3 locomotives and up to 96 cars, and the second segment consisting of 2 locomotives and up to 66 cars.

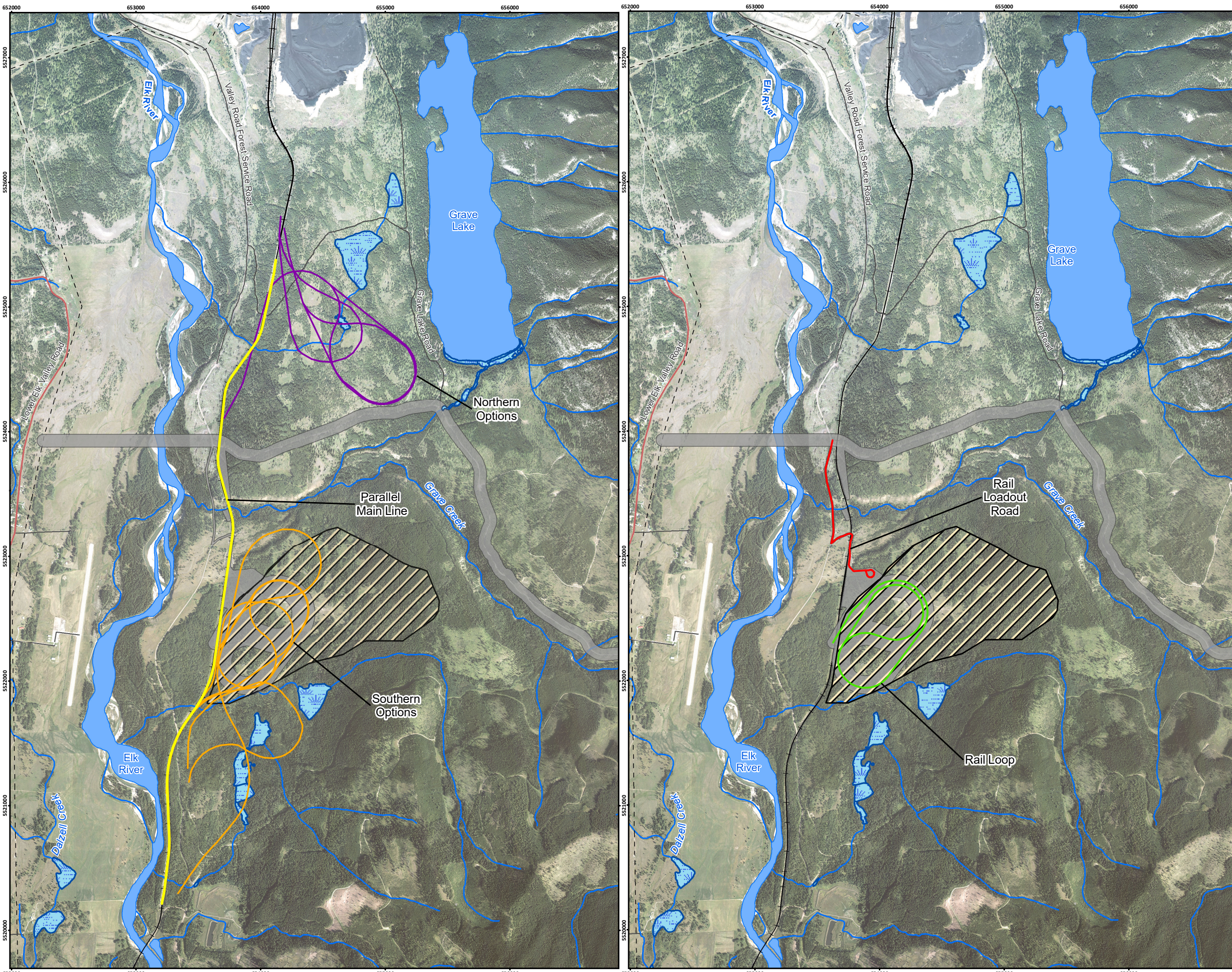
For this configuration cut and fill volumes were calculated based on 2 (horizontal) to 1 (vertical) side slopes for both cut and fill.

NWP met with C.P. in late June 2019 and again in October of 2019 to review the most recent designs presented to Teck. The northern options were not C.P.’s preference based on their operating practices with regards to not backing a train into a rail loop (which would have been required to avoid elevated grades). They also provided guidance on the curve and grade of the rail line, which ruled out the proposed northern options. C.P. requested a rail simulation study be completed for their review with any proposed RLO option. Initially, it was proposed that NWP would be able to build the parallel line alternative within the C.P. right-of-way under the premise that C.P. would be allowed to store other user’s trains when NWP is not loading a train on the parallel track. The parallel track option required further offset than originally envisioned as C.P. wanted to maintain the option of building a siding within their right-of-way. Upon further engineering evaluation, this was ruled out due to track grade.

The preferred means for RLO design, as illustrated in Figure 2.5-6, has been cleared of culturally significant findings by archaeologists, has a balanced cut and fill design, and avoids sensitive wildlife habitat (i.e., wetlands to the south and mineral lick to the east). In addition to those vital considerations, the simulations demonstrate that a standard train set configuration can successfully negotiate the Figure 8 design loaded and unloaded.

**Alternative Rail Options**

**Proposed Rail Option**



**Crown Mountain Coking Coal Project**

**Figure 2.5-6**  
RLO Location and Design Alternatives

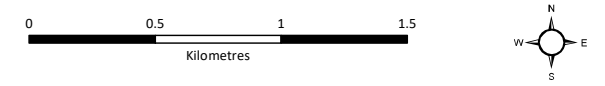
**LEGEND**

**Alternative Rail Options**

- Northern Rail Options
- Southern Rail Options
- Parallel Main Line

**Proposed Rail Option**

- Rail Loadout Road
- Rail Loop
- Low Archaeology Potential
- Project Footprint
- Arterial/Collector Road
- Local/Resource Road
- Railway
- - - Transmission Line
- Watercourse
- Waterbody
- Wetland
- British Columbia/Alberta Border



Scale 1:30,000

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



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#### 2.5.3.4 Clean Coal Stockpile

NWP investigated two locations investigated for the clean coal stockpile location (Table 2.5-10):

- North of Grave Creek; and
- Adjacent to the RLO (preferred means).

Both clean coal stockpile alternatives are illustrated on Figure 2.5-7. Based on the input from the KNC, NWP selected the clean coal stockpile adjacent to the RLO as preferred means. The initial design proposed a clean coal stockpile access road that would be newly constructed. A follow up archaeology program was completed in October of 2020 to assess archaeology potential along the initial alignment. The findings of the program were reviewed in the field with KNC staff, which ruled out the initial option of constructing a clean coal stockpile access road. KNC staff then proposed using an existing road. NWP has adopted the KNC recommendation to use an existing road for accessing the clean coal stockpile.

Key VCs potentially affected by the clean coal stockpile location alternatives include all selected environmental VCs identified in Chapter 5; land-use and access; and recreation. The following table describes the alternatives analysis for the clean coal stockpile.

#### 2.5.4 Site Access

This section describes the alternative analyses performed for site access route alignment and access road design. Presented here are three cases that the NWP Team has evaluated:

- Upgrade existing access road in Grave Creek valley (preferred means);
- Upgrade existing access road in Alexander Creek valley; and
- New access road in Grave Creek valley.

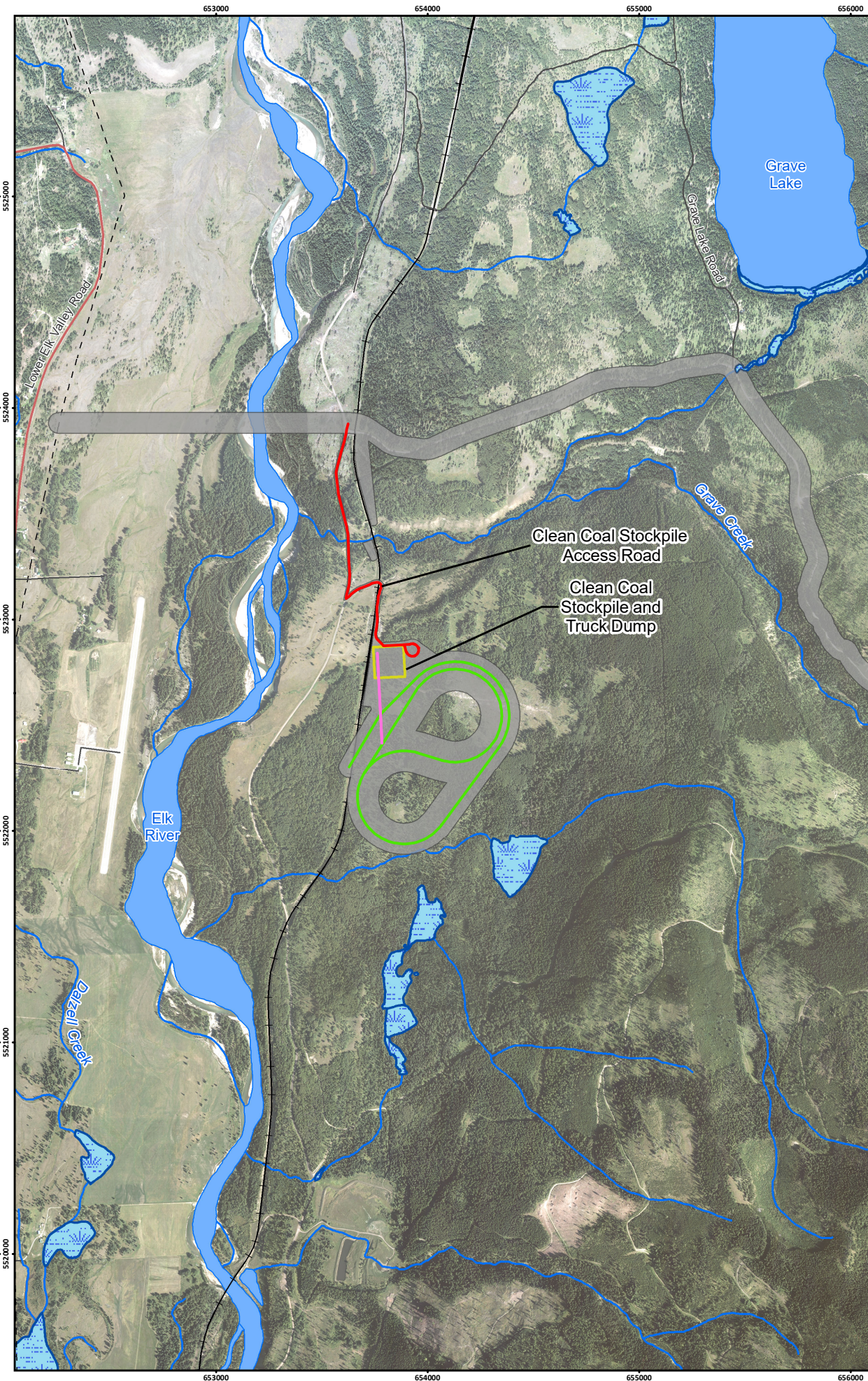
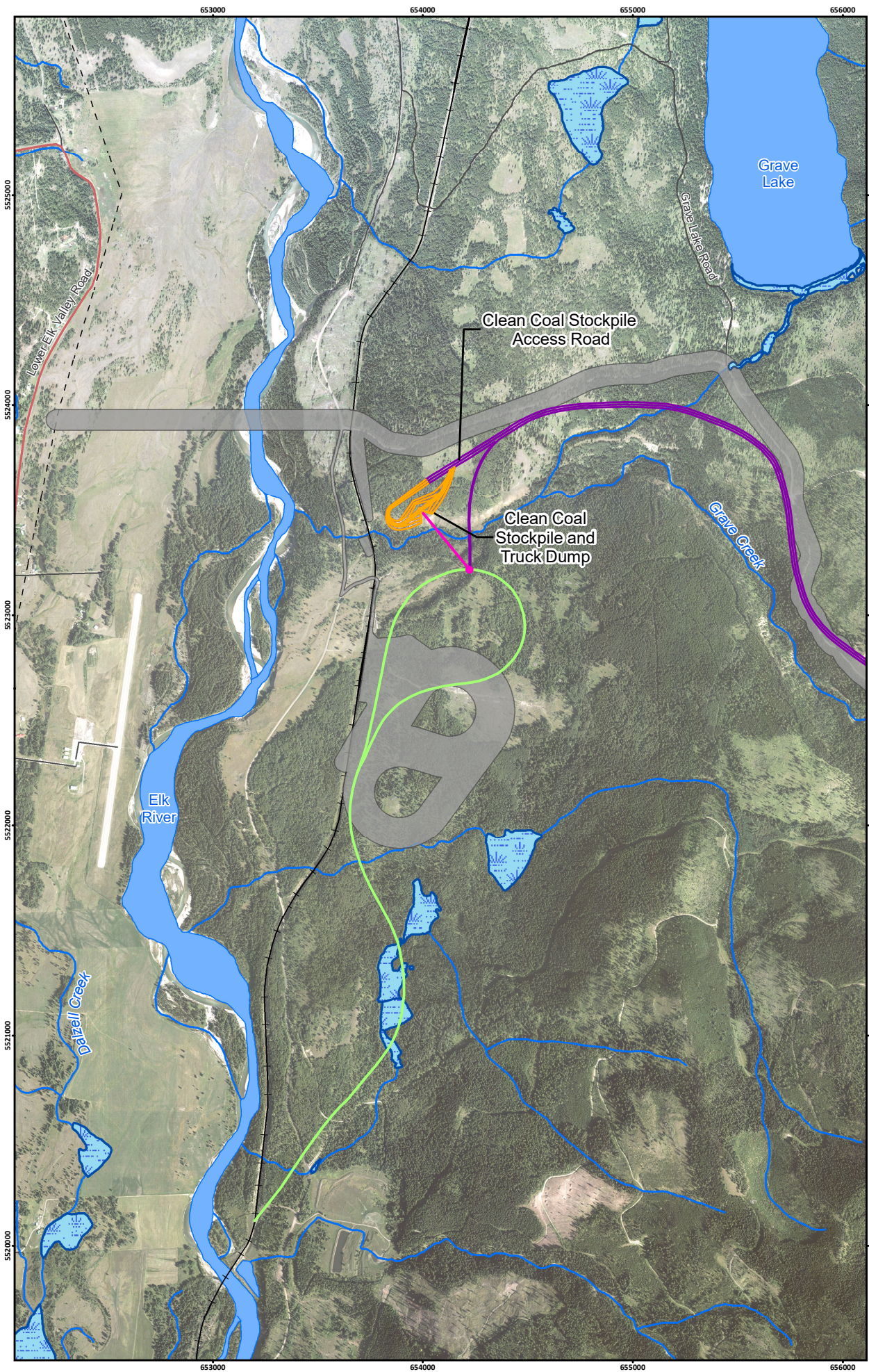
Existing forestry roads (for a length of 18.3 km) currently provide access to the Project area on a seasonal basis. Upgrading portions of these forestry roads, combined with a new clean coal haul road, could provide a shortened route and good year-round access for the life of the Project. The entrance to the forestry roads is off a high-quality gravel road which runs between the Line Creek Mine and the Elkview Mine. Another forestry road follows along Grave Creek and its tributaries to the Crown Mountain mine site.

Figure 2.5-8 shows the access routes evaluated. Access potential is limited based on topography of the Project location. The access route options developed for upgrading existing roads in Alexander Creek and Grave Creek valleys are considered technically feasible as there are existing access roads that have been used by recreational users, other industrial users, and NWP. Options to upgrade existing access routes would require enhancements to the existing alignments and widths to meet the increased demand of supporting the Project. While a new access road in the Grave Creek valley was considered technically feasible, strong opposition by the KNC to building a new road in the Grave Creek valley has helped NWP steer away from its further consideration as a viable alternative.

Key VCs potentially affected by access route alignment and design alternatives include all selected environmental VCs identified in Chapter 5; land-use and access; recreation; and GHG emissions.

**Alternative Dump Design Option**

**Proposed Dump Design Option**



**Crown Mountain Coking Coal Project**

**Figure 2.5-7**  
Clean Coal Stockpile Location Alternatives

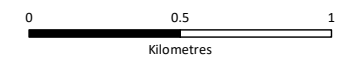
**LEGEND**

**Alternative Dump Design Option**

- Clean Coal Stockpile Access Road
- Rail Loop
- Train Loadout Conveyor
- Clean Coal Stockpile and Truck Dump

**Proposed Dump Design Option**

- Clean Coal Stockpile Access Road
- Rail Loop
- Train Loadout Conveyor
- Clean Coal Stockpile and Truck Dump
- Project Footprint
- Arterial/Collector Road
- Local/Resource Road
- +— Railway
- - - Transmission Line
- Watercourse
- Waterbody
- Wetland
- British Columbia/Alberta Border



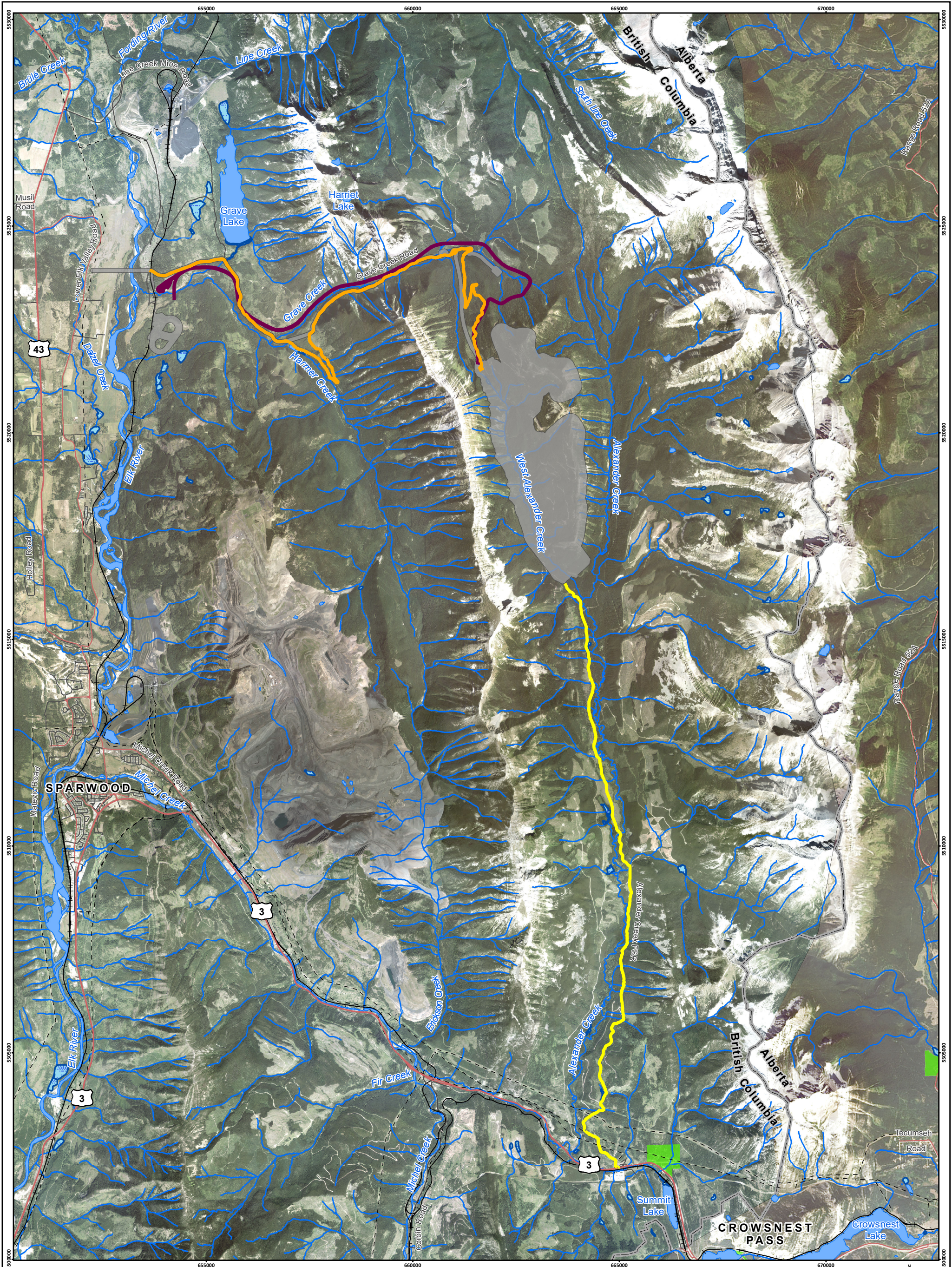
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Map Drawing Information:  
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Province of British Columbia  
GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.  
Imagery Provided By GeoBC OrthoImagery (Aug 2016).

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**Crown Mountain Coking Coal Project**

**LEGEND**

- Upgrade Grave Creek Valley Road
- Build New Road in Grave Creek Valley
- Upgrade Alexander Creek Valley Road
- Project Footprint
- Highway
- Arterial/Collector Road
- Local/Resource Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Wetland
- Provincial Park/Protected Area
- British Columbia/Alberta Border

**Figure 2.5-8**  
Access Route Alternatives

0 2 4  
Kilometres

Scale 1:85,000

Map Drawing Information:  
Data Provided By NWP Coal Canada Ltd, Dillon Consulting Limited, Keefer Ecological Services Ltd, Province of British Columbia GeoBC Open Data, Government of Alberta Open Data, Natural Resource Canada.  
Imagery Provided By Landsat 8 (Aug 2018), and GeoBC Ortho Imagery (Aug 2016).

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



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Table 2.5-10: Clean Coal Stockpile

Alternatives Evaluated	Discussion	Preferred Means
<p>North of Grave Creek</p> <p>vs.</p> <p>Adjacent to the RLO</p>	<p>Technical Assessment: The designs completed for both clean coal stockpile locations confirmed the technical feasibility of both options. The option North of Grave Creek would involve conveying clean coal across Grave Prairie to the RLO. The clean coal stockpile adjacent to the RLO would involve trucking the clean coal an additional 2 km. NWP completed a detailed risk assessment on the clean coal stockpile adjacent to the RLO as this option would require crossing the C.P. line twice.</p> <p>Project Economic Assessment: NWP completed a detailed assessment of the capital and operating costs of both alternatives, including costs for trucking, conveyor system, extended power, and at-grade rail line crossing. This assessment concluded that placing the clean coal stockpile adjacent to the RLO would have a higher operating cost and lower capital cost, resulting in positive economic conditions compared to the North of Grave Creek option.</p> <p>Environmental Assessment: The North of Grave Creek clean coal stockpile would impact Grave Prairie and the conveyor associated with the design would act as a wildlife barrier. This option would involve trucking the coal 15% less and would result in lower GHG emissions. The clean coal stockpile adjacent to the RLO reduces the overall footprint of the Project by 1 ha.</p> <p>Indigenous Communities' Considerations: Potential effects to archaeological resources from the North of Grave Creek option would likely have a negative impact if implemented. Based on the input from the KNC, NWP selected the clean coal stockpile adjacent to the RLO as preferred means.</p> <p>Socio-Community and Economic Considerations: Economic conditions across the alternatives are nominally equivalent, negligible, and not individually discernible when assessing potential Project interactions and economic effects across the entire Project. Similarly, the potential effects to socio-community conditions between the alternatives would be negligible.</p>	<p>Adjacent to the RLO</p>

NWP has selected the option to upgrade the existing access road in the Grave Creek valley as the preferred means for site access based on multiple factors, including input from the KNC; smaller project footprint; lower road density; and lower capital cost. Generally, the alignment of the existing Grave Creek valley access road would be retained, but the road driving width would be widened and grades improved where feasible to allow for efficient haulage. The portion of the existing road upgraded for clean coal haulage is approximately 12 km in length and would run from the RLO to the truck loadout. The road would be generally 12 m wide to support two-way traffic (coal haulers and light vehicles). Given the existing topographical constraints of the road alignment, two road sections would require the construction of lock-block retaining walls to allow for the construction of steeper cut slopes. These retaining wall structures are necessary to maintain the width for two-way traffic, and their construction will require additional site investigation and engineering as part of detailed engineering.

In some areas, the steep topography makes the widening of the road impracticable. Approximately 2 km would be constructed to 8.5 m wide and support single lane traffic only. These single lane road sections will be signal controlled to mitigate traffic interactions. The excavation associated with the total length of the road upgrade is estimated to total approximately 170,000 bank cubic metres (BCM), of which 21,000 BCM is assumed to require blasting. Based on initial site surveys, it is expected the portions of the cut material will be suitable for use as engineered fill where required; however, the final road grade aggregate layer would likely have to be sourced from a local aggregate supplier.

As part of the road upgrades, additional culverts would be installed under the road to allow drainage of the adjacent slopes and natural drainages that cross the road alignment. Installation of additional culverts reduces possible ponding on the roads as well as the risk of washouts during higher precipitation events. No water impounding structures (ponds, sumps) are planned for sediment control along the road; however, temporary sediment control and water management would be employed during construction, and erosion control best management practices (BMPs) would be maintained during operations.

Along the current access road, there are three bridges. Two bridges are wooden decked and the third has a concrete deck. These bridges were designed to support L-75 or L-100 off highway logging trucks. NWP evaluated the existing bridges to assess their ability to carry the proposed loads and found them not suitable. All three bridges would be upgraded to support the clean coal haul truck selected for the Project. The upgrades are assumed to only be applied to the bridge structure. At the next level of design, the foundation/abutments will also need to be assessed to determine if additional reinforcement is required.

Additional details about the site access route alternatives analysis are provided in Table 2.5-11.

Table 2.5-11: Access Route and Road Design

Alternatives Evaluated	Discussion	Preferred Means
Upgrade Grave Creek Valley Road vs. Upgrade Alexander Creek Valley Road	Technical Assessment: The Alexander Creek and Grave Creek valley upgrade options are technically feasible as there are existing access roads along both creeks. Both access routes would require upgrades to the existing alignments and widths to meet the increased demand of supporting the Project. While the option to build a new road in Grave Creek valley was also considered technically feasible, NWP has rejected the option to build a new road in Grave Creek valley in consideration of KNC concerns and due to the relative environmental and economic considerations.	Upgrade Grave Creek Valley Road
vs. Build a New Road in Grave Creek	Project Economic Assessment: The location of the RLO was one of the deciding factors for which of the route access road alignment options was selected. Given the location of the RLO, the Alexander Creek access road was ruled out as this road would have to be upgraded while still requiring upgrades to the Grave Creek access road. This would increase capital and operating costs. The option to build a new road in Grave Creek valley would have a significantly higher capital cost with a lower operating cost.	

Alternatives Evaluated	Discussion	Preferred Means
	<p>Environmental Assessment: The Grave Creek valley new road option would have an increased footprint in building a new road. The option to upgrade the Alexander Creek valley road would have a larger footprint than upgrading the Grave Creek valley road, as both access roads would have been included in the required upgrades.</p> <p>Indigenous Communities' Considerations: Strong opposition to building a new road in Grave Creek valley helped steer NWP away from doing so. As a result of KNC input, NWP advanced an option that would upgrade the existing Grave Creek valley access road.</p> <p>Socio-Community and Economic Considerations: Input from Indigenous communities resulted in a road plan that uses an existing and publicly accessible road. Potential for interaction between Project and public vehicles exists and will be mitigated through active planning, controls, and communication with the community. Using a publicly accessible, upgraded Grave Creek valley access road has the effect of reducing the size of truck used for the clean coal haul, limiting the size of the coal haul trucks to a highway legal width.</p>	

## 2.5.5 Water Use

This section describes the alternatives NWP considered for water use.

NWP considered three primary options for water supply to the CHPP (Table 2.5-12):

- Sole source the process make-up water from Grave Creek;
- Sole source the process make-up water from West Alexander Creek; and
- Primary source from West Alexander Creek / secondary source from Grave Creek (preferred means).

Table 2.5-12: Water Supply Alternatives

Alternatives Evaluated	Discussion	Preferred Means
<p>Sole Source from Grave Creek</p> <p>vs.</p> <p>Sole Source from West Alexander Creek</p> <p>vs.</p> <p>Primary Source from West Alexander Creek / Secondary Source from Grave Creek</p>	<p>Technical Assessment: Sole Source from Grave Creek</p> <p>Under this option, fresh water supply would be withdrawn from Grave Creek to support plant water requirements, resulting in an off-channel excavated storage reservoir, not impounding the creek. Direct pump from Grave Creek was dismissed due to instream flow needs. Withdrawal of water from Grave Creek is subject to minimum in-stream flow requirements to maintain aquatic health downstream. Only a portion of the flow from Grave Creek could be diverted for mine use. Minimum in-stream flow was estimated and the maximum volume of water available for mine use was determined. Approximately 160,000 m<sup>3</sup> of storage would be</p>	<p>Primary Source from West Alexander Creek / Secondary Source from Grave Creek</p>

Alternatives Evaluated	Discussion	Preferred Means
	<p>required to maintain an adequate water supply for the plant throughout the year. NWP determined that diversion of water is not possible from January through April.</p> <p>Technical Assessment: Sole Source West Alexander Creek The option of sourcing water solely from West Alexander Creek was discounted due to the limited initial water storage options. A critical part of the mine plan is to minimize the initial footprint, and there are no good options for additional water storage in the West Alexander Creek drainage.</p> <p>Technical Assessment: Primary Source from West Alexander Creek/ Secondary Source Grave Creek Under this option, the primary source of water would be from the West Alexander Creek drainage supplemented by water withdrawn from the Grave Creek drainage. Within the West Alexander Creek watershed, an interim sediment pond (Years 1-4) would be displaced (buried) by the MRSF in Year 5. In Years 5-15, the option exists of using the North Pit as a saturated rock fill water quality mitigation facility. Also in Years 5-15, a main sediment pond would be constructed once the interim sediment pond has been displaced (buried) by the MRSF. While the main sediment pond is farther from the plant than the North Pit location and requires more infrastructure to complete, using this main sediment pond water could allow for mitigation and control of released water quality. Under this option, a smaller off-channel excavated reservoir would be required in Grave Creek to support the water requirements of the CHPP and mine operations. Grave Creek withdrawal would be limited to 7% of the flow.</p> <p>Project Economic Assessment: The blended approach to using both West Alexander Creek (primary) and Grave Creek (secondary) offers more flexibility and is economically preferred. In Years 5-15, the Grave Pond (off-channel reservoir) and North Pit use would require less infrastructure and less pumping. And the main sediment pond can be retained as a future option if needed for water management.</p> <p>Environmental Assessment: The sole source from Grave Creek option was discounted based on the flow data and water quality information collected; there was not sufficient flow to support the Project water requirements and could add to cumulative impacts in lower Grave Creek. Similarly, using only the single source of West Alexander Creek would concentrate and potentially increase the risk of water quality</p>	

Alternatives Evaluated	Discussion	Preferred Means
	<p>and quantity impacts. Using multiple sources reduces the risk of impacting water quantity or ecological flow needs for Grave Creek. This has the potential to reduce effects to fish and fish habitat, aquatic resources, and wildlife.</p> <p>Indigenous Communities Considerations: NWP did not receive specific input from Indigenous communities regarding water supply sources; however, NWP has weighed a general understanding of Indigenous communities' concerns about Project footprint, emissions, and water quality into its environmental considerations in choosing the preferred means.</p> <p>Socio-Community and Economic Considerations: Socio-community and economic considerations related to water are described in Chapter 18. NWP has based its decision criteria for water supply predominantly on environmental considerations, which are supportive of socio-community and socioeconomic considerations related to water supply.</p>	

Additional information on water management infrastructure is provided in Chapter 3. In summary, NWP plans to recirculate water on-site to the extent feasible. Additionally, NWP anticipates that approximately 435,000 to 530,000 m<sup>3</sup> of make-up water would be required annually during Years 1-5. As mining transitions to the South Pit, water usage could increase to 600,000 m<sup>3</sup> / year. In addition to CHPP process water requirements, the Project would require water for various activities including potable water usage, dust suppression, vehicle wash down, and fire suppression. Potable water would be supplied from groundwater wells drilled near the CHPP. Water for dust suppression would be withdrawn from the interim sediment pond in Years 1-4, followed by withdrawal from North Pit. Non-process water used for activities including dust control would vary seasonally during construction and operations, while CHPP process water would follow plant production levels.

Groundwater wells for CHPP process water supply were dismissed from early consideration, as water re-use and sourcing from settling ponds would meet plant water needs. Therefore, additional information about total and supplemental supply from groundwater wells to support the CHPP has not been developed.

While an interim sediment pond is proposed in the Alexander Creek drainage, Alexander Creek is not proposed for ongoing water withdrawal to support Project water needs. Therefore, an evaluation of Alexander Creek for direct pumping, storage scenarios, and supply and demand quotas for water extraction has not been developed.

NWP has selected the primary water source from West Alexander / secondary water source Grave Creek as preferred means based on its technical and environmental merits. Key VCs potentially affected by water supply alternatives include surface water quality and quantity; fish and fish habitat; aquatic resources; and wildlife. The following table describes the alternatives analysis for water supply.

## 2.5.6 Tailings Disposal

In 2013, NWP completed a study that reviewed possible alternatives for the disposal of fine tailings. Key VCs potentially affected by tailings disposal alternatives include surface water quality and quantity. With the increased environmental requirements and concerns regarding tailings impoundments, NWP determined that filter presses with combined disposal would provide the most desirable outcome. NWP has selected belt filter press with combined disposal as preferred means. Table 2.5-13 describes the alternatives considered.

Table 2.5-13: Tailings Disposal

Alternatives Evaluated	Discussion	Preferred Means
<p>Conventional Tailings Pond</p> <p>vs.</p> <p>Belt Filter Press with Combined Disposal</p> <p>vs.</p> <p>Plate Press Filtration with Combined Disposal</p>	<p>Technical Assessment: NWP evaluated tailings disposal alternatives generally characterized as dry tailings disposal versus wet tailings (slurry or thickened) disposal in a separate tailings pond facility. Dry tailings disposal is complex, and co-disposal to mix fine and coarse waste streams is operationally intensive. While tailings dams can present technical challenges, NWP determined that both wet tailings and dry tailings disposal options would be technically feasible.</p> <p>Project Economic Assessment: Dry tailings and combined disposal are capital and operationally expensive. Wet tailings management with a conventional tailings pond and dam is operationally less expensive but carries much greater risk if the tailings dam fails. An economic analysis was completed which illustrated the favourable economics of the belt filtered tailings option. The economic analysis did not consider the increased costs of operating a tailings facility. These estimated higher costs are a result from the Mount Polley tailings storage facility failure.</p> <p>Environmental Assessment: Blended (combined) disposal of tailings is a critical part of NWP's selenium management, which is discussed in Project's Site Water Management Plan. Dry and combined disposal options are integral to water management. Combined disposal also has the added benefit of no separate tailings facilities.</p> <p>Indigenous Communities' Considerations: NWP did not receive specific input from Indigenous communities regarding tailings disposal alternatives; however, engagements on water management and water quality are supportive of dry tailings and combined disposal. NWP has weighed a general understanding of Indigenous communities' concerns about Project footprint, emissions, and water quality into its environmental considerations in choosing the preferred means.</p> <p>Socio-Community and Economic Considerations: The environmental benefits of water management and selenium management for dry tailings and combined disposal would benefit socio-community and economic considerations around water and waste. A tailings storage facility failure could have significant impacts, supporting the conclusion that a conventional tailings pond is not preferred.</p>	<p>Belt Filter Press with Combined Disposal</p>

## 2.5.7 Water Management

NWP's water management strategy is based on the avoid, minimize, mitigate hierarchy to establish a layered defense intended to protect water quality by segregating contact and non-contact waters from each other as much as possible. The Landform Design and Reclamation Plan and Site Water Management Plan (Chapter 33) provide detailed information about the proposed site water management program, as well as additional information about potential future mitigations and contingencies. This section summarizes the alternatives for water management assessed by NWP.

To avoid the interaction of contact with non-contact waters, NWP will establish clean water diversion controls and methods. NWP will use the natural topography and geologic configuration in its design of water management control structures including diversion channels. An example of the benefits and challenges related to these topographic and geologic factors include the suitability of any drainage channel along the west side of the MRSF where geotechnical suitability and upslope permeability is a concern. Additional examples include installing rock drains; diversion ditches where feasible; appropriate placement of mine rock; and mine sequencing that avoids potential challenges to effective water management.

In addition to avoidance, NWP will implement measures to minimize potential water management related issues. Minimization methods will establish positive source control while reducing volumes using the Layer Cake MRSF method and co-disposal of mine rock and tailings; effectively using covered systems as a form of source control incorporated into MRSF design and rapid submergence via controlled flooding. Additionally, NWP will minimize water volumes through recycling site water for the first four years; this effectively reduces water releases to zero. In Years 5 to 15, water will be sourced from the North Pit.

NWP believes that proper implementation of its avoidance and minimization measures will be effective in meeting water management goals for the Project. However, adaptive management is necessary if during the life of the Project monitoring data conclusively show that water management objectives may not be met. NWP could then seek to implement a mitigation phase to identify the best contingency measures for rectifying the situation in consultation with regulatory agencies and Project stakeholders. Examples of contingency measures could include installation of a gravel bed reactor system, implementing an active saturated rock fill system in addition to the already planned saturation of the lower portions of rock fill, or installing an active treatment system. Noting that an active treatment system may be technically challenging, costly, and be challenging to permit, NWP is reserving it as a potential future contingency. Detailed assessment, evaluation, permitting, and design would occur only if water management objectives were not otherwise met by the preferred means of water management. If it is determined after Operations commence that an active treatment system is necessary, NWP could seek to pump water from the Main Sediment Pond back up to the plant for Years 5 to 15. This contingent extension and expansion of recycling site water would enable the time needed to evaluate, design, permit, and build an active treatment plant.

Primary VCs potentially affected by water management alternatives include surface water quality and quantity; groundwater quality and quantity; fish and fish habitat; vegetation; and wildlife. Table 2.5-14 summarizes the preferred means and primary alternatives for water management.

Table 2.5-14: Water Management

Alternatives Evaluated	Discussion	Preferred Means
<p>Site Water Management Program (Primary Plan)</p> <p>vs.</p>	<p>Technical Assessment: Based on qualitative assessments during pre-feasibility design as well as awareness of water management programs at nearby active mines, NWP believes that saturated storage, gravel bed reactors, and active treatment systems are all technically feasible as alternative contingencies that could be implemented as additional mitigation if the proposed site water management program is not meeting objectives; however, the technical readiness of these contingencies is not as high as the preferred means (primary plan for site water management program). The Site Water Management Plan (SWMP) in Chapter 33 identifies the relative Technology Readiness Levels (TRLs) of the primary plan and contingencies. Site water management methods included in the primary plan such as selective mining, MRSF siting, co-disposal of mine wastes, submergence, diversions, and rock drains are all designated as proven technologies (TRL 8+). For the contingency options the saturated rock backfill reactor, gravel bed reactors, and active water treatment are identified as advanced technologies with a TRL 7, all lower than the primary plan measures.</p>	
<p>Active Saturated Rock Fill (Contingency)</p> <p>Vs.</p>	<p>Project Economic Assessment: A detailed economic assessment has not been completed for the potential contingency options. Based on industry data, active treatment is assumed as the most expensive of the contingencies. Cost assessments would be evaluated during future mitigation planning and design.</p>	<p>Site Water Management Program (Primary Plan)</p>
<p>Gravel Bed Reactors (Contingency)</p> <p>vs.</p> <p>Active Treatment (Contingency)</p>	<p>Environmental Assessment: The primary program for site water management reduces potential for environmental impact; this includes limiting the mine disturbance footprint through progressive reclamation and avoiding impact to drainages beyond Grave Creek and West Alexander Creek. Similarly, the creation of granular rock drains at the base of the slope and the west side of the MRSF will mitigate groundwater ingress into the MRSF. If implementation of a contingency measure would be needed, environmental impacts would be assessed in greater detail. At this stage, it is projected that active treatment would result in additional footprint and related impacts.</p> <p>Indigenous Communities' Considerations: A stated purpose of the Site Water Management Plan is to align with Indigenous communities. NWP has openly engaged with Indigenous communities regarding water management, partaking in dialogues and meetings to discuss concerns related to water management challenges associated with the Project. NWP has weighed a general understanding of Indigenous communities' concerns about water quality, fish and fish habitat, wildlife, and related concerns into its environmental considerations in choosing the primary site water</p>	

Alternatives Evaluated	Discussion	Preferred Means
	<p>management program. If future mitigation planning is needed for implementation of active treatment or other major contingency development, NWP would engage Indigenous communities throughout the mitigation development process.</p> <p>Socio-Community and Economic Considerations: Effective water management that avoids, minimizes, and mitigates issues of concern would be beneficial to socio-community and economic considerations. NWP believes that the primary program for site water management will achieve its objectives. If needed during the Project's life, NWP in consultation with regulators and stakeholders may pursue adaptive management approaches potentially including contingent alternatives. Socio-community and economic considerations would be evaluated during future planning stages if contingency measures are needed.</p>	

## 2.6 References

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