Westslope Cutthroat Trout in the Fish and Fish Habitat LSA. As shown in the EV-CEMF, an increase in road development is directly linked to increased recreational pressure on popular angling species.

Potential effects on fish and fish habitat as a result of the Project that are carried forward in the discussion of potential effects are summarized in Table 12.5-2.

Table 12.5-2: Summary of Potential Effects on Fish and Fish Habitat

Potential Effect	Rationale for Selection of Environmental Effect
Fish Mortality	Any activity in or near streams that could alter or impact the aquatic environment could lead to fish mortality. These activities include, but are not limited to: transportation, construction, maintenance, and demolition of any sort occurring in or near aquatic habitats.
Change in Fishing Pressure	Changes in fishing pressure in Alexander Creek due to increased access from road development/upgrades.
Instream Habitat Loss Due to Mine Design and Development	The Project design and development will result in direct fish habitat loss in West Alexander Creek. Instream habitat loss may have an aggregate effect on the aquatic food web in the Fish and Fish Habitat LSA through both bottom-up effects on benthic invertebrate communities and top-down effects on fish populations.
Habitat Loss Due to Changes in Water Quantity	A reduction in flows as a result of the Project could potentially impact the availability of suitable fish habitat in the Fish and Fish Habitat LSA.
Changes in Water Quality	Changes in water quality could pose threats to fish and fish habitat, including fish health. The water quality assessment provided in Chapter 11 identified cobalt, cadmium, nickel, nitrate, selenium, and sulphate as contaminants of potential concern. A bioaccumulation assessment was completed for cadmium and selenium and excluded other contaminants as they are not considered bioaccumulative substances.
Change in Fish and Fish Habitat Due to Blasting	Mine pit blasts produce vibrations that could pose serious threats to fish and fish habitat. Blasting in or near water produces shock waves that can damage fish swim bladders and rupture internal organs, may kill or damage fish eggs or larvae, and can have effects on fish and fish habitat through altering spawning habitat/gravel.
Changes in Streambed Structure	Physical changes to streambed structure have the potential to change the instream characteristics that fish need to spawn, and for food resources, such as benthic invertebrate communities, to survive in. Drivers of these physical changes are often Total Suspended Solids (TSS), sediment deposition, and calcite concretion of the substrate due to increased calcite loads. Physical changes in streambed structure could make an aquatic habitat unsuitable for certain life stage of fish, such as the removal of spawning habitat by substrate concretion caused by calcite. The same could be caused by excessive sediment deposition in gravel spawning areas and holding pools.

Potential Effect	Rationale for Selection of Environmental Effect
Functional Riparian Disturbance	A loss in riparian habitat abundance and an alteration in the riparian composition has the potential to affect fish and fish habitat through removal of valuable nutrient inputs, shade, and cause increased erosion and sediment deposition. Riparian disturbance also has the potential to impact water temperature and consequently oxygen concentrations, which is important for different life stages of fish.

12.5.2.2 Discussion of Potential Effects

The potential effects identified in Table 12.5-2 are discussed in the context of each Project phase (Construction and Pre-Production, Operations, Reclamation and Closure, and Post-Closure) in the following subsections.

12.5.2.2.1 Fish Mortality

As outlined in Section 34.4 of the *Fisheries Act*, proponents are responsible for planning and implementing works, undertakings, or activities in a manner that avoids harmful impacts, specifically the death of fish. Any activity in or near a stream than could alter or impact the aquatic environment or comes into contact with fish, could potentially lead to fish mortality. Presented below is a summary of the activities with the potential to cause fish mortality during different Project phases.

Construction and Pre-Production

During the Construction and Pre-Production phase, there is the potential for fish mortality to occur due to machinery operating near or in streams while excavating, transporting, or constructing infrastructure required for Project operations. Apart from machinery, increased TSS caused by erosion, logging, excavating, increased dust and dispersion, construction runoff, soil movement, transportation, and relocation of materials has the potential to impact fish and fish habitat. Increased suspended particles and increased sediment deposition have the potential to clog fish gills and affect growth rates (Kemp et al., 2011).

Operations

Loading, hauling, and stockpiling of soil in or near a streambed could cause fish mortality by resulting in increased TSS concentrations or altering streambed structure.

Reclamation and Closure

During reclamation works, increased TSS and use of machinery associated with reconstructive instream reclamation, if found necessary, may cause fish mortality. However, these works are anticipated to occur in streams where fish populations may be lower due to degraded habitat, which would lower the risk of fish deaths in the immediate area.

Post-Closure

No potential adverse effects to fish and fish habitat resulting in fish mortality are anticipated during Post-Closure, as all activities with the potential to result in fish mortality will be completed prior to mine closure.

12.5.2.2.2 Change in Fishing Pressure

Increased fishing pressure could arise due to greater accessibility to the Project area resulting from upgrades to the Line Creek Mine Road, Valley Road, Grave Creek Road, and Branch C Road. These roads will require upgrading and expansion from their current configurations during Construction and Pre-Production to handle both coal haulage and vehicles travelling to the site. Access roads entering the Project site will be secured with gates attended by security personnel to restrict unauthorized access. In collaboration with regulators and key stakeholders, NWP will establish No Unauthorized Entry (NUE) areas in order to ensure worker and public safety within and near the Project. The NUE areas will be demarcated by signs to restrict unauthorized access to the mine site, rail loadout, and surrounding areas included within the NUE boundary. Further details on NUE areas are provided in Chapter 19, Section 19.5.3.1.2. Public use of the mine site lands will not be permitted for the duration of all Project phases prior to Post-Closure (19-year period). In addition, angling will not be permitted by NWP employees on site.

Development of the mine site will result in the removal of approximately 5.5 km of West Alexander Creek, which may be used for recreational angling activities. The extent to which West Alexander Creek is used for angling could not be confirmed; however, as described in Section 12.4.2.2.1, the lower reaches of the creek support both Westslope Cutthroat Trout and Bull Trout. While there is potential for angling use of West Alexander Creek, it is anticipated to be relatively minimal and to a lesser extent compared to the mainstems of Alexander Creek, Michel Creek, and the Elk River. During Operations, use of Alexander Creek for fishing will be permitted, unless blasting activities are occurring. It is important to note that blasting restrictions will not affect access to the entire length of Alexander Creek, only those sections in close proximity to the pit undergoing blasting. Section 19.5.3.3 describes the potential changes to access due to blasting activities.

Grave Creek Road and Branch C Road will remain as permanent access roads Post-Closure for future commercial and recreational use. However, given that the majority of West Alexander Creek will be removed due to the Project and that access to angling in Alexander Creek is already provided via the Alexander Creek Forest Service Road from the south, no changes to fishing pressure due to increased site access are anticipated to occur following Reclamation and Closure. Finally, changes to the use of Elk River for fishing activities due to Project activities, including from the development of the powerline, are considered to be negligible for the duration of the Project. Changes to fish populations due to increased fishing activities resulting from increased public access to West Alexander Creek, Alexander Creek, or the Elk River are therefore not anticipated.

While Indigenous fisheries and harvesting have not been identified in West Alexander Creek or Alexander Creek, Indigenous peoples could potentially exercise their Aboriginal and Treaty rights to fish within these systems in the future. Both Westslope Cutthroat Trout and Bull Trout are valued as traditionally important fish species by several Indigenous communities. While the number of Indigenous peoples who may choose to fish within the Alexander Creek watershed in the future is unknown, is it not expected to pose a significant risk to local fish populations. Subsequently, there is limited evidence to suggest that there will be changes to fishing pressure in the vicinity of the Project due to future Indigenous fisheries.

12.5.2.2.3 Instream Habitat Loss Due to Mine Design and Development

As outlined in Section 35 of the *Fisheries Act,* proponents are responsible for planning and implementing works, undertakings, or activities in a manner that avoids the HADD unless they obtain an authorization to do so from the Minister of Fisheries and Oceans. However, some Project activities will lead to unavoidable instream habitat loss due to the mine design and its development.

Construction and Pre-Production

During the Construction and Pre-Production phase, instream habitat loss is expected to be caused by construction of the Interim Sediment Pond in the upper reaches of West Alexander Creek. These reaches are not fish bearing; however, this activity has the potential to reduce downstream transport of benthic invertebrates, an important food source for fish including Westslope Cutthroat Trout, and therefore may lead to an imbalance in the food web.

Operations

During the Operations phase, instream habitat loss is expected to be caused by:

- Construction of the Main Sediment Pond in Year 4 in West Alexander Creek;
- Loading, hauling, and stockpiling of soil in West Alexander Creek; and
- Loading, hauling and dumping of mine rock in West Alexander Creek.

The construction of the Main Sediment Pond and expansion of the Mine Rock Storage Facility is expected to result in additional loss of fish habitat in West Alexander Creek and its non-fish bearing tributaries. With continued potential loss of habitat, sources of benthic invertebrates for downstream transport as a food source for fish may be reduced and could lead to an imbalance in the food web.

Reclamation and Closure

No potential adverse effects to fish and fish habitat are anticipated during Reclamation and Closure, as all activities with the potential to result in direct habitat loss as a result of mine design and development will be completed.

Post-Closure

No potential adverse effects to fish and fish habitat are anticipated during Post-Closure, as all activities with the potential to result in direct instream habitat loss as a result of mine design and development will be completed prior to mine closure.

12.5.2.2.4 Habitat Loss Due to Changes in Water Quantity

If fish are present in a stream, it is because they are able to withstand the flow regime there or are specifically adapted to it. The most logical strategy therefore is to preserve the key features of a stream's natural hydrograph, which affect fish both directly (e.g., hydraulically suitable habitat) and indirectly (e.g., geomorphology, riparian habitat). This logic is widely supported by the scientific literature (Lewis et al., 2004). Low flow periods are a common bottleneck to fish production in streams. For example, low flows during summer may limit available rearing habitat, and low flows during winter may limit availability of overwintering habitat and ice-free refuges. These periods should therefore be targeted for the greatest relative level of protection against reductions in available water quantity. Flows additional to those during the low flow period may be directly beneficial to fish, but the benefit does not accrue in a linear relationship. For this reason, naturally low flow periods should receive greater protection against reductions in water quantity than naturally high flow periods. Following these principles from the B.C. Instream Flow Guidelines (B.C. IFG) for Fish (2004), an assessment on the potential effects of the Project to fish and fish habitat availability and suitability was completed, and instream flow thresholds developed to protect fish and fish habitat downstream of the Project.

Instream habitat loss due to changes in water quantity (both through surface water and groundwater losses) could lead to reduced habitat availability and suitability for certain life stages of fish. Habitat availability can be impacted directly through habitat destruction, for instance through infrastructure development, as described in Section 12.5.2.2.3 (Instream Habitat Loss Due to Mine Design and Development), or indirectly through the loss or reduction in habitat availability as provided through flow or water quantity. A reduction in water quantity could also impact fish habitat connectivity. Potential effects to fish habitat and benthic invertebrate communities could occur due to changes to surface water quantity as a result of site construction activities, water withdrawals, operational activities, and site reclamation and closure activities.

Instream habitat loss due to changes in water quantity could also be seen due to substantial increases of flow as a result of the decommissioning of the Main Sediment Pond during the Post-Closure Project Phase. Substantially increased flows has the potential to alter fish habitat permanently and beyond the stream's natural resilience threshold, lowering geomorphological complexity and ultimately altering habitat suitability for different fish life history usability. Overall, a change in amount of water could alter the wetted width, depth, natural hydrological regime, substrate carrying capacity, natural geomorphological processes and the concentration of substances released into the to receiving environment from the Project. It could also lead to reduced accessibility and lower concentrations of oxygen and higher temperatures during summer periods, and less suitable habitat previously used for overwintering purposes.

Groundwater does interact with the creeks and drainages within the Project footprint and based on the conceptual model of the groundwater system and field observations, drainages and creeks in the area are expected to be both gaining (i.e., groundwater is entering the system and contributing to baseflow) and losing (i.e., surface water from watercourses goes sub-surface, resulting in reduced baseflow) along their lengths. The inflow and outflow of groundwater is expected to more or less balance out, on average, and net flow to/from groundwater along the length of the drainages is assumed to be negligible compared to the flows conveyed in the channel under normal conditions. A flow accretion survey conducted in 2018 indicated that West Alexander Creek is a gaining stream (i.e., groundwater discharges to surface water) in its upper reaches where overburden thickness is the least, and transitions to a losing stream (i.e., surface water is lost to groundwater) in the lower reaches just upstream of the Main Sediment Pond, where overburden becomes greater. Upper Alexander Creek includes both gaining and losing reaches, and transitions to a losing stream slightly upstream of the confluence with West Alexander Creek. Additional details are provided in Chapter 9, Section 9.3.3.

The recommended flow threshold is a minimum instream flow release equivalent to the median monthly flow during the low flow month. This value represents the minimum instream flow requirement through the flow reduction section at all times of the year. Calculations must be based on a minimum of 20 years of continuous natural daily flow records, and maximum diversion rates are less than or equal to the 80^{th} percentile of daily flows over the period of record. The low flow month is defined as the calendar month with the lowest median flow, based on natural mean daily flows. This threshold does *not apply* where data requirements cannot be met. In such cases, appropriate assessment methodologies must be employed, as detailed in Lewis et al. (2004). This flow threshold is intended to maintain connectivity through the diversion section, to maintain invertebrate production (which may, among other values, be a food source for fish bearing reaches downstream) and to provide occasional high flow events to maintain gross stream morphology. Lewis et al. (2004) summarizes the potential pathways through which changes in water quantity can impact fish. These include changes in behavioural cues through life history phase timing; channel structure maintenance, which affects fish growth and reproductive success; egg survival rate due to changes in velocity post spawning; changes in fish growth and survival caused by changes in flood pulse and floodplain connectivity and food availability; and reduced survival due to changes in light penetration, concentration in oxygen, water depths, riparian inputs and tributary access for rearing and potential entrapment.

Changes in flow can also alter the ecological integrity of fish habitat. A summary of these effects is also presented in Lewis et al. (2004) and outlines how increased sedimentation and erosion can lower egg-fry and benthic invertebrate survival rate. Changes in flood pulse and habitat connectivity could impact key life history windows which leads to reduced survival rate for fish.

Construction and Pre-Production

The Construction and Pre-Production and Operations phases involve activities that will influence the hydrologic characteristics within portions of the Grave Creek and West Alexander Creek/Alexander Creek watersheds. These activities include the removal of trees (timber), clearing and grubbing, site grading, and the construction of mine site facilities and transportation and drainage infrastructure, which will alter local topography and cause localized changes to surface water hydrology.

The Grave Creek Reservoir is proposed to be constructed during the Construction and Pre-Production phase.

The initial Project phase will involve the construction of water management infrastructure to collect, convey, and divert surface runoff along transportation infrastructure (mine roads and railway lines), mine facilities, and operational areas including excavation, stockpile, and mine rock placement areas. Two temporary sediment ponds will be constructed to capture construction runoff water during the construction of the ROM pad and facilities pad, and construction of smaller, local water management structures (i.e., ditches and sumps will commence prior to mining begins in the North Pit. Discharge from the temporary sediment ponds will join a drainage ditch adjacent to the lower haul road and discharge to the West Alexander Creek catchment (Chapter 11). In addition, the Interim Sediment Pond will be constructed for surface water quality purposes and to provide a source of process water, thereby sequestering water for use by the Project that could reduce downgradient streamflow. Outflows from the Interim Sediment Pond will discharge via a controlled outlet structure to West Alexander Creek. For further details on the Project design, refer to Chapter 3.

Site reclamation activities will be ongoing and involve several changes within the Project footprint, including site grading and surface cover modifications within the Mine Rock Storage Facility area. In addition, mine site infrastructure and water management facilities will be decommissioned. Additional details are provided in Chapter 10 and Chapter 3.

No potential adverse effects to water quantity as a result of interactions with groundwater are anticipated during Construction and Pre-Production, as groundwater effects are anticipated to be limited to changes in local groundwater flow patterns due to construction of the quarry, Interim Sediment Pond, and Grave Creek Reservoir. Additional details are provided in Chapter 9.

Operations

Surface water withdrawals from Grave Creek will occur on an ongoing basis during the Operations phase to provide a source of process water. Withdrawals of surface water from Grave Creek will cease at the end of the Operations phase. There is a potential for streamflow within the Alexander Creek system to be affected by site reclamation and decommissioning activities during the Reclamation and Closure and Post-Closure phases.

Drainage and water management infrastructure will continue to be constructed and modified to collect, convey, and divert surface runoff within the mine area, along linear infrastructure, and around mine facilities. The Main Sediment Pond is scheduled to be constructed in Year 4, after which the Interim Sediment Pond will be decommissioned. During the remaining period of the Operations phase, contact water from the North Pit will serve as the primary source of process water. Outflows from the Main Sediment Pond will discharge via a controlled outlet structure to West Alexander Creek, partially restoring streamflow that would otherwise result from sequestering water in the pond.

Reclamation and Closure

Following the end of operational mining activities, the drainage and water management infrastructure will be modified and decommissioned as part of the reclamation works in preparation for site closure. Drainage pathways will be established to reflect the final layout and grading plan within the Project footprint. The Main Sediment Pond will continue to operate during this phase of the Project, and will continue to outlet to West Alexander Creek.

Post-Closure

Much of the drainage and surface water management system implemented during the Reclamation and Closure phase will continue to operate in a similar manner with respect to drainage pathways and boundaries. The primary change during the Post-Closure phase is the decommissioning of the Main Sediment Pond. Water that would otherwise be sequestered in the pond will partially restore streamflow in downgradient watercourses.

12.5.2.2.5 Changes in Water Quality

Changes in water quality could pose substantial threats to fish and fish habitat, particularly fish health. Potential effects on surface water quality are assessed in Chapter 11. In general, changes to surface and groundwater quality have the potential to affect fish and fish habitat through the pathways presented in Table 12.5-3.

Table 12.5-3: Potential Pathways through which Changes in Surface Water Quality Could Affect Fish and Fish Habitat

Potential Effect	Rationale for Selection of Environmental Effect
Increased TSS and Turbidity	Erosion and sedimentation during site clearing, construction, maintenance, and reclamation activities could result in elevated levels of TSS and turbidity in nearby watercourses. Project activities such as on-site transportation of personnel, construction materials, and raw and clean coal; mine rock movement; blasting; and coal processing may generate dust.
Increased metal concentrations	During active mining of the pits, it will be necessary to dewater each pit through the use of drainage ditches, berms, sumps, and pumps. Mine dewater released to the receiving environment may contain elevated concentrations of metals and nutrients, which could bioaccumulate and have an effect on fish and fish habitat VCs.

These two pathways could alter the chemical water quality and thereby reduce the habitat suitability for fish and benthic invertebrates, as the input of metals, organic and inorganic substances could alter the health of fish and fish habitat VCs.

Increased TSS and Turbidity

Sediments occur naturally and are integral components of aquatic systems. Nearly all waters have some solid matter in suspension that may be of physical, chemical, or biological origin, and the quantities of this material usually vary with season (DFO, 2000). However, excessive sediment load could have an effect on fish and fish habitat. The shape of suspended sediment particles has also been found to affect physiological stress and could, in extreme cases, lead to mortality in fish. The survival of fish depends upon many factors such as: successful feeding, predator avoidance, and maintaining immune system health and reproduction (Birtwell, 1999). For salmonids, sediment load or increased TSS has the potential to affect all of these factors. The nocturnal habit of certain species of juvenile salmonids during winter, and their use of inter-cobble substrate habitat, emphasizes the need to prevent stream-beds from becoming embedded and the interstitial spaces filled with fine sediment (Anderson et al., 1996).

Increased sediment and TSS can increase the absorption of heat energy, thereby raising water temperatures (Ellis, 1936, Reid, 1961, Ryder and Pesendorfer, 1989). Increased turbidity, which is often the case in streams with elevated TSS, can reduce light transmission through the water and decrease photosynthesis by aquatic plants, consequently affecting fish food source and DO levels (Berry et al., 2003). Suspended solids also have the potential to clog fish gills, either killing them or, in the long-term, reducing their growth rate (Kjelland et al., 2015).

Increased TSS can cause a range of effects from behavioural changes to mortality. The severity of the impact may depend on several factors, including sediment concentration, duration or frequency of exposure, particle size and shape, associated pollutants, species, and life stage at time of exposure (Collins et al., 2011; Kemp et al., 2011). Elevated levels of TSS can impact fish by physically damaging tissues and organs or by decreasing light penetration and visual clarity in the water.

Invertebrate populations depend upon primary production, which could be adversely affected by elevated levels of sediment. Certain benthic invertebrates are grazers and depend on periphyton for food, while others may be filter feeders that could have their feeding structures clogged by sediment, thereby reducing feeding efficiency and reducing growth rates. Some direct effects of sediment on aquatic invertebrates include physical habitat change due to the scouring of streambeds and the dislodgment of individuals, smothering and clogging of the interstices between substrate components which affects their microhabitat, and abrasion of respiratory surfaces and interference of food uptake for filter-feeders (British Columbia Ministry of Environment, Lands, and Parks [BCMELP], 1998).

Construction and Pre-Production

The Interim Sediment Pond will be built during the Construction and Pre-Production phase which, due to sedimentation, could affect the water quality. This sediment pond is designed to manage the flow from the first five years of the Project's footprint and resulting sediment load. This pond is designed to meet all regulations regarding sediment control and geotechnical constraints, which are described in Chapter 3.

Operations

Discharge from the Interim and Main Sediment Ponds has the potential to contain elevated levels of TSS. Flows entering West Alexander Creek from the sediment ponds also have the potential to result in erosion of the natural creek bed, causing additional TSS loads downstream.

Reclamation and Closure

The Main Sediment Pond will continue to operate during the Reclamation and Closure phase, with the potential for similar effects to occur as described for Operations. Ongoing monitoring of the discharge water quality from the Main Sediment Pond will be required throughout the Reclamation and Closure phase.

Post-Closure

Management of the Main Sediment Pond discharge will continue Post-Closure until all water quality objectives have been met. The Main Sediment Pond will then be decommissioned to re-establish flows in West Alexander Creek. Decommissioning will require the removal of sediment from the dam structure, constructing additional spillways, and breaching the main dam. Sediment removed from the pond will be placed in the Mine Rock Storage Facility for disposal.

Decommissioning of the Main Sediment Pond has the potential to affect surface water quality in the receiving environment by increased levels of TSS and turbidity, and may result in erosion to the natural creek bed, causing additional TSS loads downstream.

Increased Metal Concentrations

It is generally accepted that as selenium concentrations in water increase, so does the risk of increased selenium concentrations in biota, even if the absolute relationship is not well understood. Strong relationships between selenium concentrations in water and fish tissue have been demonstrated, providing a reasonably good predictor of selenium accumulation in fish and an important assessment tool (Golder, 2010). However, the bioaccumulation and toxicity of selenium to organisms cannot always be predicted consistently from the concentration of selenium in water, and some advise against the sole use of a water column guideline when assessing the potential impacts to aquatic life (Stewart et al., 2010). Toxicological substances, such as selenium, are known to bioaccumulate when levels increase above provincial benchmarks and local thresholds established for maintaining aquatic health. The B.C. WQG of 2 µg/L (microgram/litre) is considered protective of all aquatic life. Exceedances could lead to reduced reproductive and physiological health and survival rate of fish and benthic invertebrate communities.

Selenium in suspended and bed sediments is an important exposure route for organisms at the base of the food web (Fan et al., 2002). Mechanisms present in most aquatic systems effectively mobilize sediment selenium into food chains and thereby cause long-term dietary exposure to fish (Lemly and Smith, 1987). Nagpal and Howell (2001) developed a sediment selenium quality guideline (2 µg/g [microgram/gram]), but it was classified as interim due to limited available data at that time. Unfortunately, no new primary literature was available to update the selenium sediment guideline at this time. Because of the uncertainty associated with the existing information, the status of the guideline has been changed from an interim guideline to an alert concentration. No uncertainty factor was applied to this value since it is not a guideline. For most environments, the sediment alert concentration is considered protective and, along with data from other ecosystem compartments, provides an early indication of the increased risk of impacts to aquatic organisms. Where sediment selenium concentrations are >2 µg/g, key ecosystem compartments should be measured to ensure selenium bioaccumulation is not resulting in exceedances of guidelines (B.C. MOE, 2014).

The bioaccumulation of selenium in tissues is important in determining toxicity. Tissue-based guidelines provide a more direct link between selenium exposure and toxic effects. While dietary exposure is the predominant route of selenium uptake (DeForest and Adams, 2011), exposure to selenium in the water column also accounts for some uptake in fish. Therefore, both exposure routes should be considered in assessing the potential effects of selenium concentrations in tissue.

Selenium concentrations in the tissue of prey organisms of fish and birds provides another compartment of the ecosystem to monitor selenium bioaccumulation. Evaluations cited in B.C. MOE (2014) suggest that dietary selenium concentrations above 4 µg/g dw constitute a risk for excess bioaccumulation, resulting in reproductive and non-reproductive effects to sensitive receptor fish, such as Westslope Cutthroat Trout in the Fish and Fish Habitat LSA. For the protection of fish species, the chronic egg/ovary tissue guideline is 11 µg/g dw. The chronic whole-body and muscle tissue guideline for the protection of fish is 4 µg/g dw.

Thresholds for dietary selenium toxicity in fish are easily reached and exceeded in contaminated aquatic systems. Excessive selenium can cause a wide variety of toxic effects at the biochemical, cellular, organ, and system levels. Bioaccumulation that exceeds the protective thresholds for aquatic life and particularly fish, could lead to deformities and lesions, lower reproductive success in fish and fish habitat VCs.

In addition to selenium, cadmium is another contaminant of potential concern due to its risk of bioaccumulation, guideline exceedances, and identification as an Order constituent under the EVWQP. Cadmium is a naturally occurring and rare element with its environmental fate and behaviour dependent upon ambient abiotic conditions such as other water quality parameters (e.g., hardness, alkalinity, pH). As a non-essential metal in freshwater biota, cadmium toxicity at low levels of exposure result in acute and chronic effects. The toxic effects of cadmium include calcium deficiency (hypocalcaemia) through inhibiting calcium uptake (Kumar and Singh, 2010; CCME, 2014). Although data regarding bioaccumulation in aquatic biota is variable, salmonids are generally more sensitive to cadmium levels than other species (Kumar and Singh, 2010; CCME, 2014).

Other contaminants of potential concern identified consisting of cobalt, nickel, nitrate, and sulphate do not meet the criteria of a bioaccumulative substance in aquatic biota (Appendix 12-F: Response to Information Request on Fish Health Effects Associated with Bioaccumulative Substances; AECOM, 2023).

Construction and Pre-Production

No effects associated with the Construction and Pre-Production phase are anticipated to contribute to metal leaching into receiving waters.

Operations

During Operations, all mine site drainage will be collected in the sediment ponds, either the Interim Sediment Pond during the first four years of Operations or the Main Sediment Pond beyond Year 4. Water in the sediment ponds will be monitored (as described in the Site Water Management Plan, Chapter 33, Section 33.4.1.8) to verify it meets approved discharge limits and released into the West Alexander drainage where it will flow to the confluence with Alexander Creek. Alexander Creek joins Michel Creek downstream near Highway 3, which subsequently discharges into the Elk River upstream of Sparwood. Water quality impacts downstream of the Project in the Fish and Fish Habitat LSA have the potential to affect Westslope Cutthroat Trout, Bull Trout, Mountain Whitefish, and benthic invertebrates, and water quality impacts in the Aquatic RSA, particularly downstream of Elko, have the potential to affect Burbot and Kokanee.

Performance monitoring of the sediment pond will provide information necessary to determine if the design is functioning optimally (Chapter 33, Section 33.4.1.8). As described in the Site Water Management Plan, if conditions arise that lead to the mobilization of selenium and other harmful trace elements or constituents, the placement of a low permeability barrier downslope from the initial Mine Rock Storage Facility area and upgradient of the Interim Sediment Pond would facilitate retention of the affected water, much like a saturated rock fill. The expected effect would be for redox conditions to form where selenium is transformed from selenate (SeO_4^-) to selenite (SeO_3^{2-}) and finally elemental selenium (Se^0), while nitrate (NO_3) is converted to nitrogen (N_2). Such effects would need to be confirmed by a properly configured monitoring system (Chapter 33, Section 33.4.1.8).

Two temporary sediment ponds will be constructed to capture construction runoff water during the construction of the ROM pad and facilities pad. Construction of smaller, local water management structures (i.e., ditches and sumps) will commence prior to mining begins in the North Pit. Discharge from the temporary sediment ponds will join a drainage ditch adjacent to the lower haul road and discharge to the West Alexander Creek catchment. Where possible, non-contact water runoff will be directed away from the active mining areas by means of small catchment sumps and dedicated drainage ditches draining to the natural catchment watercourses. However, due to localized challenges such as geotechnical stability and avalanche risks, channel construction is not feasible in all areas of the site, such as the upper western slopes of West Alexander Creek above the Mine Rock Storage Facility. As a result, it is expected that water management structures will intercept some surface runoff from undisturbed areas, as well as runoff from mine disturbed areas at these locations.

Two larger sediment ponds are proposed for managing the combined runoff from the mine footprint and non-contact water from the upper western slopes of West Alexander Creek. These ponds will be placed downstream of the Mine Rock Storage Facility and will be developed through the mine life to accommodate the advancing mine rock placement. These ponds are meant to collect and temporarily retain mine affected water to meet Technical Guidance 7 *Environmental Management Act* requirements (B.C. MOE, 2015). Initially, the Interim Sediment Pond will capture seepage and runoff from the mine rock piles up until Year 4. During Year 5, the Main Sediment Pond will be built downstream of the advancing Mine Rock Storage Facility structure. Both the Interim Sediment Pond and the Main Sediment Pond will be lined to prevent infiltration of collected waters into the local groundwater.

In addition, grading and site drainage around the Coal Handling Process Plant, maintenance/office complex, and ROM pad will be designed so that runoff from those areas will also drain to the West Alexander Creek catchment. This infrastructure includes haul roads, the plant and warehouse/shop site, and coal transfer and stockpile areas. During Year 5, the Interim Sediment Pond will be decommissioned. Contingency plans for the site drainage will include as-needed responses to events that may circumvent the established drainage controls. This may include the development of temporary drainage control features during unanticipated runoff events, but attention will be given to the possibly of such events through the monitoring of snowpack and seasonal storm activity. If such contingencies are needed, they will be deployed in an adaptive management style during site development and closure (Chapter 33, Section 33.4.1.8).

Reclamation and Closure

The Main Sediment Pond will continue to operate during the Reclamation and Closure phase, with the potential for similar effects to occur as described for Operations. Ongoing monitoring of the discharge water quality from the Main Sediment Pond will be required throughout the Reclamation and Closure phase.

Post-Closure

Management of the Main Sediment Pond discharge will continue Post-Closure until all water quality objectives have been met. The Main Sediment Pond will then be decommissioned to re-establish flows in West Alexander Creek. Decommissioning of the Main Sediment Pond has the potential to affect surface water quality in the receiving environment by the continued leaching of metals into the receiving environment.

The Main Sediment Pond will remain active throughout the life of the mine into the Post-Closure phase, until site reclamation activities are complete, and water quality objectives are met. Specific details on the sediment pond designs are provided in Chapter 3.

12.5.2.2.6 Change in Fish and Fish Habitat Due to Blasting

The potential for effects to fish and fish habitat as a result of blasting may occur during two Project phases: Construction and Pre-Production and Operations. DFO has established guidelines for determining setback distances for blasting effects on fish due to pressure (acoustic) effects as well as peak velocity (Wright and Hopky, 1998). These formulas take into account the density and acoustic impedance of the water and substrate on site, as well as the predicted charge size. During Construction and Pre-Production, any explosive charges that may be required will be limited to 75 kg, which results in setbacks of 43 m (pressure) and 131 m (peak velocity).

Blasting in or near water produces shock waves that can damage the swim bladders and rupture internal organs of fish, may kill or damage fish eggs or larvae, and can have effects on fish and fish habitat, even when detonated from a considerable distance from the aquatic habitat (Wright, 1982; Wright and Hopky, 1998; DFO, 1995).

An assessment of mine pit blast vibration was conducted and described in Chapter 7. This assessment estimated the vibration levels to occur at certain receptor points along the West Alexander and Alexander Creeks. The receptor points were selected based on baseline results indicating fish bearing status, and location. The location of these nodes on fish bearing sections were taken from end mine pit extent to the nearest points on the stream to assess the worst-case scenario with regards to potential vibration impacts on fish and fish habitat caused by blasting.

Recommended setback distances to achieve 100 kilopascals (kPa) and peak particle velocity (PPV) of 13 mm/s (millimetre/second) are presented in Table 12.5-4 and Table 12.5-5 for fish habitat and spawning habitat, respectively.

Table 12.5-4: Setback Distance (m) from Centre of Detonation of a Confined Explosive to Fish Habitat to Achieve 100 kPa Guideline Criteria for Various Substrates (Wright and Hopky, 1998)

Substrate Type	Weight of Explosive Charge (kg)							
	0.5	1	2	5	10	25	50	100
Rock	3.6	5.0	7.1	11.0	15.9	25.0	35.6	50.3
Frozen Soil	3.3	4.7	6.5	10.4	14.7	23.2	32.9	46.5
Ice	3.0	4.2	5.9	9.3	3.2	20.9	29.5	41.8
Saturated Soil	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Unsaturated Soil	2.0	2.9	4.1	6.5	9.2	14.5	20.5	29.0

Table 12.5-5: Setback Distance (m) from Centre of Detonation of a Confined Explosive to Spawning Habitat to Achieve 13 mm/s Guideline Criteria Across Substrate Types (Wright and Hopky, 1998)

	Weight of Explosive Charge (kg)						
	0.5	1	5	10	25	50	100
Setback Distance	10.7	15.1	33.7	47.8	75.5	106.7	150.9

Vibration impacts due to mine pit blasting are not anticipated to have any potential effect on fish and fish habitat. At end pit extent and at the shortest distance from fish bearing aquatic habitat, the PPV was found to remain below the recommended guideline of 13 mm/s (Table 12.5-6).

Table 12.5-6: Summary of Anticipated Peak Particle Velocities (PPV) Caused by Mine Pit Blast

Aquatic Receptor ID	UTM Coordinates		Closest Distance between Pit and Waterbody	Max Charge per delay	Substrate Vibration PPV	Induced Pressure in Water
	Easting	Northing	(m)	(kg)	(mm/s)	(kPa)
AQR1*	5518396	662700	2,461	2,300	2	2.4
AQR2	5516285	663965	1,080	2,300	7	9.1
AQR3	5515900	664119	1,490	2,300	4	5.4
AQR4	5519044	664742	735	2,300	13	16.8
AQR5	5524122	660960	4,785	2,300	1	0.8
				Criteria	13 mm/s	100 kPa

*For AQR1, analysis is based on blasting at the North Pit in Year 4. All other receptor impacts were based on blasting in the South Pit from Year 10.

Construction and Pre-Production

No effect from blasting is anticipated to occur during this Project phase.

Operations

During Operations, vibration is expected to be generated by the following activities:

- Detonating explosives in blastholes.

Reclamation and Closure and Post-Closure

No potential adverse effects to fish and fish habitat resulting from vibration caused by mine pit blasts is anticipated during Reclamation and Closure or Post-Closure, as all blasting activities will be completed prior to mine closure.

12.5.2.2.7 Changes in Streambed Structure

Physical changes in streambed structure have the potential to change the instream characteristics that fish need to spawn and for food resources such as benthic invertebrate communities to survive in. Drivers of these physical changes are often increased sediment deposition, changes in stream geomorphology, and calcite concretion of the substrate due to increased calcite loads. More detailed assessment of these potential effects was conducted in the geomorphology assessment (Appendix 12-A), Calcification Assessment (Appendix 11-D), and the air quality assessment (Chapter 6).

A summary of pathways through which the Project could potentially impact streambed structure is presented in the following subsections.

Increased Sediment and Dust

Road construction and maintenance could potentially affect fish and fish habitat through increasing dust and sediment. Change in air quality due to increased TSS, dust, and emissions from Project activities could contribute to changes in streambed structure and water quality in receiving environments. Increased dust can cause increased fine sediment deposition in streams, and in extreme cases, alter stream paths and connectivity (more details on sediment-related impacts are discussed in the context of changes in geomorphology below). Dust deposition may occur during all phases of the Project, resulting in elevated levels of dustfall, or total particulate matter (TPM) in waterbodies within, adjacent to, and downstream of the Project footprint. Many of the activities conducted within the surface extraction areas, access and haul roads, rail loadout, and supporting infrastructure have the potential to generate dust, potentially resulting in elevated TSS within nearby waterbodies.

The direct effects of increased sediment and dust caused by the scouring and abrasive action of suspended particles, which damages gill tissues or reduces respiration by clogging gills, leads to decreased resistance to infection or disease, reduced growth, and can lead to mortality (Wood and Armitage, 1997). The indirect effects of increased TSS to fish and fish habitat is through decreased water clarity, which can alter movement or migration patterns, feeding success, and the availability of habitat quantity and quality. Both direct and indirect effects can cause decreased growth rates and changes in community structure and population sizes (Kemp et al., 2011). Wood and Armitage (1997) found that many fish tend to avoid turbid waters by temporarily seeking refuge or moving to unimpacted stream reaches. Frequent exposure to increased TSS or exposure over extended periods of time may therefore result in changes in fish distribution and community structure (Henley et al., 2000; Richardson and Jowett, 2002).

Construction and Pre-Production

The Project has the potential to affect fish and fish habitat during the Construction and Pre-Production phase through increased dust and consequently increased TSS by means of these activities:

- The transportation of personnel and materials;
- Land clearing activities;
- Road construction and upgrading;
- Excavation of the quarry for construction materials;
- Excavations for foundations; and
- Construction of water management infrastructure such as the Grave Creek Reservoir and Interim Sediment Pond.

Dust deposition generated by these activities could lead to increased TSS concentrations in the receiving environment, which also has an effect on surface water quality. Dust, as it relates to water quality, is discussed in more depth in Chapter 6 and Chapter 11. Increased dust could also contribute to increased sediment in aquatic environments in the Fish and Fish Habitat LSA.

Operations

Where possible, non-contact water runoff will be directed away from the mine disturbed areas by means of small catchment sumps and drainage ditches, and routed to the natural catchments draining watercourses. However, due to localized challenges such as geotechnical stability and avalanche risks, channel construction is not feasible in all areas of the site such as the upper western slopes of West Alexander Creek above the Mine Rock Storage Facility. As a result, it is expected that water management structures will intercept both surface runoff from undisturbed areas, as well as from mine disturbed areas at these locations.

During site Operations, dust is expected to be generated by the following activities:

- Blasting;
- Transportation of personnel and materials;
- Loading, hauling, and dumping of mine rock and coal;
- Mine road construction;
- ROM coal sizing;
- Conveying clean coal; and
- Progressive reclamation activities.

Dust deposition generated by these activities could lead to increased TSS concentrations in the receiving environment. Apart from having an impact on surface water quality, the increased dust could also contribute to increased sediment in aquatic environments in the Fish and Fish Habitat LSA.

Reclamation and Closure

During Reclamation and Closure, some localized erosion and sedimentation may occur from the decommissioning of mine site infrastructure and reclamation of remaining disturbed areas. During Reclamation and Closure, some dust is expected to be generated through the decommissioning of mine site infrastructure and reclamation of remaining disturbed areas. Dust suppression will continue as required during reclamation activities, specifically the transportation of materials offsite.

Post-Closure

During Post-Closure, the Main Sediment Pond will be decommissioned. No increase in dust during this phase is anticipated; however, there is a potential for an increase in TSS during decommissioning of the sediment pond.

Changes in Stream Geomorphology

The hydrologic regime of a watershed, which is characterized by runoff, influences the transport of sediment and stream channel evolution in-channel processes. A decrease in surface water quantity and changes to flood frequency and intensity will affect fluvial geomorphology and consequently stream condition below the Project footprint. Channel structure and pattern develop as a function of discharge timing and volume, which carries sediment and woody debris. These factors, combined with the physical channel character such as bank materials, confinement, gradient, and substrate, gather in the stream channel.

Construction and Pre-Production

During Construction and Pre-Production, some erosion and sedimentation is expected from land clearing activities including logging of merchantable timber and clearing and grubbing of the infrastructure and pre-production development footprint. Excavation of the quarry for construction materials and foundations for mine infrastructure, construction of the Interim Sediment Pond and Grave Creek Reservoir, and soil salvage may similarly result in the disturbance, transport, and relocation of surficial materials to the receiving environment.

During Construction and Pre-Production, the Branch C Road and Grave Creek Road will be upgraded, which will require clearing and grubbing of vegetation to allow for road widening, culvert installation, and bridge upgrades, all of which may result in excess sedimentation in nearby creeks. The use of heavy machinery within or adjacent to creeks and associated drainage channels may lead to localized erosion, resulting in additional sedimentation to watercourses. A new road will also be constructed off the Valley Road to access the rail loadout.

Two temporary sediment ponds will be constructed to capture construction runoff water during the construction of the ROM pad and facilities pad, and construction of smaller, local water management structures (i.e., ditches and sumps will commence prior to mining begins in the North Pit). Discharge from the temporary sediment ponds will join a drainage ditch adjacent to the lower haul road and discharge to the West Alexander Creek catchment. These activities could increase sediment input and affect stream bank stability in WAL1 and Alexander Creek downstream of the confluence.

Operations

The Project has the potential to impact fish and fish habitat geomorphology during construction and operation of the sediment ponds, which will detain all coarse sediment and potentially increase inputs of fine sediment. The Main Sediment Pond will discharge via a controlled outlet structure (spillway) to West Alexander Creek, which could affect the channel geomorphology, potentially causing aggradation.

Additionally, during site Operations, some localized erosion and sedimentation is expected from activities including:

- Mine road development;
- Construction of the Main Sediment Pond;
- Loading, hauling, and stockpiling of soil;
- Removal of unconsolidated materials from the pits; and
- Reclamation activities.

Reclamation and Closure

The Project has the potential to impact fish and fish habitat geomorphology during Reclamation and Closure with the sediment ponds detaining all coarse sediment and potentially increasing inputs of fine sediment. During Reclamation and Closure, some localized erosion and sedimentation may also occur from the decommissioning of mine site infrastructure and reclamation of remaining disturbed areas.

Post-Closure

During decommissioning of the Main Sediment Pond, coarse sediment and fine sediment input is likely to increase before eventually returning to pre-development conditions. During decommissioning of the Main Sediment Pond, the embankment will be lowered, which could potentially increase erosion due to increased flows and thereby increasing the sediment load carried downstream into Alexander Creek.

Calcite Precipitation and Concretion

Calcite is a carbonate mineral and the most stable polymorph of calcium carbonate. Creeks downstream of conventional coal mining waste rock dumps in the Elk Valley have been increasingly shown to have calcite ($CaCO_3$) concretions. These deposits are the result of contact waters emerging from the waste rock (MacGregor et al., 2012). This water chemistry results from the neutralization of acid produced by oxidation of iron sulphide reacting with dolomite ($CaMg(CO_3)_2$). Factors that influence the formation of calcite in water are temperature, changes in pressure, organic activity, and pH. Any activity that reduces the amount of carbon dioxide (CO_2) will increase the likelihood of calcite to precipitate (Natsi et al., 2019). Temperature plays an important role in calcite formation due to the fact that gases such as CO_2 are less soluble in warmer water, which promotes the precipitation of calcite. An increase in pressure increases the solubility of gases in liquid. This increased solubility of gases often increases carbonic acid, which decreases calcite precipitation. The reverse is also true: lower load pressure reduces the solubility of gases and therefore promotes the precipitation of calcite. Photosynthesis (organic activity) removes CO_2 from the water and promotes the precipitation of calcite. At the same time, decaying organic material increases CO_2 and therefore promotes the solubility of calcite. pH is linked to the amount of H^+ (hydrogen ions) that are freely available in a solution. As pH increases, the amount of hydrogen ion decreases, promoting the precipitation of calcite (Natsi et al., 2019). For these reasons, calcite formation is complex, and predictions surrounding the potential occurrence of calcite are still relatively poorly understood in the Elk Valley.

Calcite precipitation poses serious threats to fish and fish habitat by removing habitat for benthic invertebrates, suffocating aquatic plants, and reducing adequate spawning habitat (Hocking et al., 2019). Calcite precipitation does not necessarily affect fish and fish habitat immediately or detrimentally, since calcite is a naturally occurring substance in the Elk River watershed. However, when calcite volumes are increased substantially and under certain contributing conditions listed in paragraph above, it concretes the interstitial spaces and sediment. Concreted streambeds offer lower spawning potential and lower the ecological functioning of an ecosystem by the removal of benthic invertebrate, and other lower trophic levels, within a stream. Water quality as it relates to calcite precipitation and concretion therefore has the potential to adversely impact fish and fish habitat downstream of the Project.

Construction and Pre-Production

No effect from calcite precipitation and concretion is anticipated to occur during this Project phase.

Operations

During Operations, calcite is likely to leach from mine rock placed in West Alexander Creek that comes in contact with water.

Reclamation and Closure and Post-Closure

Calcite will continue to leach from contact water in the West Alexander Creek Mine Rock Storage Facility. With the decommissioning of the Main Sediment Pond, calcite could pose a potential long-term threat to streambed structure downstream of the Project footprint.

12.5.2.2.8 Functional Riparian Disturbance

Riparian habitats are often biologically diverse and may provide numerous ecosystem services, including removal of excess nutrients and suspended sediments, input of nutrients to waterbodies, temperature regulation of waterbodies, and providing habitat to terrestrial and aquatic wildlife. In general, the Project has the potential to affect riparian habitat through reduction of ecosystem abundance and alteration of ecosystem composition and structure.

Reduction of ecosystem abundance is predicted to occur during the Construction and Pre-Production phase of development through logging, clearing, and grubbing. Reduction of riparian habitat is specifically anticipated to occur along improvements to existing roads (e.g., Grave Creek Road), new access roads, the rail loadout, service corridors, Grave Creek Reservoir, explosive storage facility, mined areas, Mine Rock Storage Facility, as well as the Main Sediment Pond (including associated components). Changes in riparian abundance and composition have the potential to affect fish and fish habitat through removal of riparian vegetation and increased erosion and sediment deposition, which could lead to decreased leaf litter, instream cover, and less large woody debris, which play an important role in maintaining channel morphology and lead to increased water temperature due to the removal of cover.

There is also a cumulative perspective on landscape scale changes in a valley that feeds into the context of potential effects on fish habitat at the Fish and Fish Habitat LSA and Aquatic RSA scale. A cumulative effects assessment based on the EV-CEMF and the Aquatic Hazard indicator developed for the Elk Valley will be used to inform the potential impact on fish and fish habitat caused by riparian disturbance.

Construction and Pre-Production

Merchantable timber will be logged from the infrastructure and Pre-Production development footprint. This will be followed by clearing of the remaining vegetation from the infrastructure and pre-development footprint. Potential effects on the abundance of riparian habitats are anticipated in the Construction and Pre-Production phase of Project development.

Alteration of water quantity in downstream reaches of affected watersheds has the potential to reduce the area of riparian habitat, particularly where the magnitude of change in surface water quantity is high. This includes areas of riparian habitat within the lower reaches of the West Alexander Creek watershed.

Potential effects to the composition and structure of riparian habitats are anticipated during the Construction and Pre-Production Phase. There is potential for the operation of vehicles and equipment to result in the introduction of new occurrences, or the spread of existing occurrences, of non-native and invasive species. Collectively, these sources of non-native and invasive species, environmental impairment and altered water flows, together with an inherent susceptibility to incursion of non-native and invasive species, have potential to result in alteration of the composition and structure of riparian habitats downstream and/or downwind of the Project footprint.

Operations

Potential effects to the abundance of riparian habitats are anticipated during the Operations phase, attributed to the construction and expansion of pits, the Mine Rock Storage Facility, as well as construction of the Main Sediment Pond.

Potential effects to the composition and structure of riparian habitat are anticipated during the Operations phase. For the same reasons provided for the Construction and Pre-Production phase, the Operations phase has the potential to result in change to the composition and structure of riparian habitat.

Reclamation and Closure

Ecological restoration will be conducted during the Reclamation and Closure phase, during which abiotic conditions (e.g., surface contours, drainage pathways) and early successional trajectories of vegetation communities will be established in accordance with the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3). With successful implementation, the restoration of ecological conditions will partially reverse the loss of riparian habitats in the Project footprint.

If re-vegetation is not completely successful, then erosion and sedimentation of, or deposition of dust to, riparian habitats located downstream or downwind of the Project footprint may continue to occur. For the same reasons provided for the Construction and Pre-Production phase, the Reclamation and Closure phase has the potential to result in change to the composition and structure of riparian habitat caused by erosion and sedimentation or deposition of dust.

Post-Closure

Potential effects on riparian abundance and distribution are not anticipated during Post-Closure beyond those that occurred in the Construction and Pre-Production and Operations phases. For the same reasons provided for the Construction and Pre-Production phase, the Post-Closure phase has the potential to result in change to the composition and structure of riparian habitat caused by erosion and sedimentation or deposition of dust.

12.5.2.3 Transboundary Effects

The Project is located approximately 5 km west from the Alberta border and 85 km north from the Montana border in the U.S.A. As discussed in Chapter 1, Section 1.3.3, the nearest federal lands to the proposed Project are the ?aq'am First Nation Bummer's Flat 1 Reserve (approximately 69 km southwest), Stoney Nakoda Edan Valley 216 Reserve (approximately 70 km northeast), Tobacco Plains 2 (approximately 80 south), Piikani Nation Peigan Timber Limit 147B (approximately 52 km east in Alberta), and Parcels 73 and 82 of the Dominion Coal Blocks (approximately 20 and 40 km southwest, respectively). Federal land is not required to facilitate the Project and the Project does not overlap with any federal land. Of the federal lands listed above, only Parcel 73 and a small portion of Parcel 82 of the Dominion Coal Blocks are located with the Aquatic RSA; the other federal lands are located outside the Elk River watershed and therefore effects to fish and fish habitat will not occur within these lands. Although Parcel 73 and a small portion of Parcel 82 are located within the Aquatic RSA, changes to fish and fish habitat within these federal lands are not expected as the watercourses that have the potential to be affected by the Project (i.e., West Alexander Creek, Alexander Creek, the lower reaches of Michel Creek, and the Elk River) do not overlap with the Dominion Coal Blocks. Flow from the sediment ponds will move downstream from Alexander Creek to Michel Creek and subsequently the Elk River to its outlet with Lake Koocanusa, approximately 80 km downstream of the Project. Transboundary effects to fish and fish habitat, as a result of changes in surface water quantity, in Lake Koocanusa during the Operations, Reclamation and Closure, and Post-Closure phases are not anticipated, as the Project footprint accounts for a very small portion of the contributing watershed area of the Kootenay River at the Canada-U.S.A. border (i.e., less than 0.06%).

Potential impacts to fish and fish habitat caused by changes in water quality have the potential to impact waterbodies downstream of the Project in the Fish and Fish Habitat LSA and Aquatic RSA. However, minimal contribution lower down in the Aquatic RSA (Elk River and Lake Koocanusa) is anticipated to occur due to the sediment ponds and adequate management of releases downstream. Further details on potential transboundary water quality effects are discussed in Chapter 11.

Transboundary effects to fish and fish habitat in Alberta will not occur as a result of the Project, as all watersheds within and surrounding the Project footprint are located on the western side of the Continental Divide.

12.5.3 Mitigation Measures

The mitigation measures proposed for fish and fish habitat are based on available best management practices (BMPs), guidance documents, mitigation measures conducted for similar projects, and professional judgement. The identification and selection of technically and economically feasible mitigation measures followed the mitigation hierarchy approach outlined by the provincial Environmental Mitigation Policy and related Environmental Mitigation Procedures (Ministry of Environment, 2014a and 2014b). Technical and economic constraints dictated the highest level of the mitigation hierarchy that could be achieved for managing each potential effect.

Mitigation measures were identified for each potential effect on fish and fish habitat. For the purposes of this assessment, mitigation measures are defined to include Project design features, procedures, or practices that are intended to reduce or eliminate Project-related effects to fish and fish habitat. Potential Project-related changes to fish and fish habitat will be reduced through design mitigation, adherence to regulatory requirements, and BMPs, including management plans. Where mitigation measures are considered completely effective, potential Project effects to fish and fish habitat are not identified as residual effects.

The mitigation measures for potential effects on riparian habitat are based on available BMPs, provincial and federal guidance documents, and professional judgement.

Avoidance is the undertaking of measures to prevent adverse effects to fish and fish habitat. Avoidance measures may include the choice of appropriate location and design of a work, undertaking, or activity. In some cases, works, undertakings, or activities may need to be redesigned to avoid harmful impacts. Careful timing of certain activities may also avoid impacts to fish and fish habitat; for example, by timing activities to avoid overlap with key life stages such as spawning or migration for some works, undertakings, or activities, adverse effects may be avoided.

BMPs for measures to avoid adverse effects to fish and fish habitat are captured in the Fish and Fish Habitat Management Plan (Chapter 33, Section 33.4.1.5) and include, but are not limited to, some of the following measures:

- Designing Project works, undertakings, or activities so that no adverse effects to fish and fish habitat will occur;
- Completing Project works, undertakings, or activities in areas where adverse effects to fish and fish habitat will not occur; and

- Timing Project works, undertakings, or activities to prevent interactions with fish and fish habitat at key life stages such as spawning or migration.

Measures to minimize impacts reduce the spatial scale, duration, or intensity of adverse effects to fish and fish habitat when such impacts cannot be avoided. NWP will implement the best available mitigation measures or standards. Mitigation measures to minimize adverse effects to fish and fish habitat will include the implementation of BMPs during Project planning, construction, operation, maintenance, temporary or permanent closures, and decommissioning.

Measures to minimize adverse effects to fish and fish habitat may include, but are not limited to:

- Carrying out works, undertakings, and activities (e.g., physical infrastructure and other physical disturbances) where adverse effects are minimized;
- Employing best practices that minimize harm when carrying out works, undertakings, or activities;
- Undertaking measures to stabilize disturbed sites to minimize ongoing adverse effects; and
- Timing certain works, undertakings, or activities to minimize interactions with fish and fish habitat.

12.5.3.1 Mitigation Specific to Project Effects

The following subsections describe measures to avoid, minimize, and restore (mitigate) the following potential Project effects on fish and fish habitat:

- Fish Mortality;
- Change in Fishing Pressure;
- Instream Habitat Loss Due to Mine Design and Development;
- Habitat Loss Due to Changes in Water Quantity;
- Changes in Water Quality;
- Change in Fish and Fish Habitat Due to Blasting;
- Changes in Streambed Structure; and
- Functional Riparian Disturbance.

12.5.3.1.1 Fish Mortality

Measures to avoid fish mortality include:

1. Avoid:
   - Avoid killing fish during all phases of the Project and during any activity in and near a fish bearing aquatic habitat;
   - Avoid using explosives in or near water; and
   - Application for permitting when fish captures (or fish salvages) and relocations are required, such as will be the case for West Alexander Creek. Additional information regarding fish salvages are provided in Appendix 12-E: Crown Mountain Conceptual Fish Habitat Offsetting Plan (Dillon Consulting Limited, 2023).
2. Minimize:
   - Planning in water works, undertakings, or activities to respect timing windows to protect fish, including their eggs, juveniles, spawning adults, the organisms upon which they feed; and

- Managing and monitoring water quality parameters to minimize impacts and remain below the benchmarks and thresholds to protect aquatic life.

12.5.3.1.2 Change in Fishing Pressure

Measures to mitigate changes in fishing pressure include:

1. Avoid:
   - Develop NUE areas in collaboration with regulators and key stakeholders based on safety, logistical, and administrative considerations to prohibit public access to the Project footprint;
   - Secure access roads entering the Project site with gates attended by security personnel to restrict and enforce unauthorized access;
   - Implement the Access Management Plan (Chapter 33, Section 33.4.2.1); and
   - Educate Project workforce about Westslope Cutthroat Trout and Bull Trout and implement a no angling policy for NWP employees and contractors. In addition, NWP will coordinate with local conservation enforcement for Alexander and West Alexander Creeks should increases in recreational fishing be observed by NWP employees.

12.5.3.1.3 Instream Habitat Loss Due to Mine Design and Development

Measures to mitigate habitat loss as a result of mine design include:

1. Avoid:
   - Limit the mine disturbance footprint and avoid affecting additional drainages beyond West Alexander Creek;
   - Develop all surface water management infrastructure in accordance with standard industry practice;
   - Avoid conducting Project works, undertakings, or activities in water, where possible;
   - Avoid, when possible, placing fill or other temporary or permanent structures below the high-water mark;
   - Disturbing or removing materials from banks, shoreline, or streambeds, where possible, such as:
     - Sand;
     - Rocks;
     - Aquatic vegetation;
     - Natural wood debris; and
   - Avoid, where possible, building structures in areas that may result in erosion and/or scouring of the streambed or banks or that are inherently unstable, such as creek bends, meanders, floodplains, alluvial fans, and braided streams.
2. Minimize:
   - Obtain an authorization under Section 35(2) of the *Fisheries Act* for the HADD of fish habitat due to instream habitat loss, with appropriate offsetting to offset the residual effects of the HADD.
3. Restore On-site:
   - Progressive reclamation will occur such that habitat in the riparian and landscape is restored as quickly as possible to minimize the magnitude of Project impacts at the temporal scale.

12.5.3.1.4 Habitat Loss Due to Changes in Water Quantity

In general, the Site Water Management Plan (Chapter 33, Section 33.4.1.8) will include a range of drainage features and facilities for the conveyance, diversion, and storage of surface water runoff within the Project footprint. One of the principal goals of the Site Water Management Plan is to minimize disruptions to streamflow conditions in the receiving watercourses, which will be achieved through the following mitigation objectives:

1. Avoid:
   - Segregation and diversion of non-contact surface runoff around mine disturbed areas and water control facilities; and
   - Controlling outflows from water management facilities to maintain streamflow conditions in the receiving watercourses to the extent possible, particularly during low flow conditions.
2. Minimize:
   - Limiting surface water withdrawals to minimize impacts on streamflow.
3. Restore On-site:
   - Implementation of progressive contouring and reclamation of dump site areas to minimize changes in land use and hydrological characteristics; and
   - Decommissioning and reclaiming water management facilities to restore natural streamflow conditions in the receiving watercourses to the extent possible.

12.5.3.1.5 Changes in Water Quality

Ongoing monitoring of the discharge quality from the sediment ponds will be required as part of the mine's environmental program, as discussed in the Aquatic Effects Monitoring Program (AEMP; Chapter 33, Section 33.4.1.5.7). Primary mitigation measures are detailed in the Site Water Management Plan (Chapter 33, Section 33.4.1.8) and include, as organized by mitigation hierarchy level:

1. Avoid:
   - Limit the mine disturbance footprint through Project design and progressive reclamation; and
   - Clean, non-contact water will be diverted away from the sediment ponds and other Project infrastructure, where possible, to maintain water quality and natural drainage and reduce the burden on the sediment ponds.
2. Minimize:
   - Sediment ponds will be sized appropriately to minimize seepage losses and convey runoff during storm events;
   - Anti-scaling agents will be added as required to minimize the potential for calcite formation downstream of the discharge, should the layering approach not sufficiently reduce the potential for calcite precipitation;
   - Limit erosion and contain sediment through the application of standard industry practices;
   - Limit dust generation and emissions through the application of standard industry practices and emissions control measures; and
   - Conduct regular inspections to confirm control measures are effective and functioning properly.
3. Restore On-Site:
   - Progressive reclamation and re-vegetation will occur throughout the mine life to reduce the Project footprint, minimizing the potential for surface runoff from mine disturbed areas; and

- The Main Sediment Pond will be decommissioned Post-Closure once water quality objectives have been met.

The primary measure to mitigate changes in water quality as they relate to TSS from dust deposition is to reduce the potential for dust to settle in the West Alexander Creek, Alexander Creek, Grave Creek, and Elk River drainages through the implementation of the Air Quality and Greenhouse Gas Management Plan (Chapter 33, Section 33.4.1.1).

Specific mitigation measures, as organized by mitigation hierarchy level, include:

1. Avoid:
    - Earthmoving activities throughout the life of mine will be scheduled to limit the duration of exposed soils and to avoid dust-generating activities during windy periods, where possible;
    - Dust generation from mining activities and equipment will be contained through the application of standard emission control measures (e.g., fabric covers for the coal stockpiles and conveyors, a dust canopy for the ROM dump hopper) to intercept dust before it reaches the receiving environment; and
    - Regular inspections will be conducted to verify air quality and dust control measures are effective and functioning properly, which will allow for timely maintenance and adjustments as required.
2. Minimize:
    - The layout of the site has been designed to minimize travel distances between operations (e.g., between the pits and the Coal Handling Process Plant) in order to reduce vehicle travel distances and speeds that would result in additional generation of dust emissions;
    - Enforcement of low speed limits for vehicular traffic throughout the site;
    - Unpaved roads will be regularly maintained and kept in good repair, including regular compaction and use of coarse aggregate with low silt content, where possible;
    - Establish and follow site Soil Management Plan (Chapter 33, Section 33.4.1.9);
    - Soil stockpiles will be placed at appropriate locations, and soil stored and shaped in ways to maintain slope stability and reduce moisture content loss, including establishment of vegetation to reduce exposure to wind and water erosion; and
    - Water or dust suppression methods will be used from May to November to mitigate dust generation in areas including unpaved roads, work areas, and storage piles, if required. Water for dust suppression will be withdrawn from the Interim Sediment Pond and Grave Creek Reservoir for the first five years of Operations, and then supplemented from the North Pit sumps for the remainder of the mine life.
3. Restore On-Site:
    - Progressive reclamation and revegetation will occur throughout the mine life to minimize wind erosion potential and reduce the Project footprint, reducing the potential for dust deposition to nearby watercourses.

Continued monitoring will be used to validate the goals and water management strategies detailed in the Site Water Management Plan and AEMP. However, with these mitigation measures in place, there is still a potential for residual effects on surface water quality from sediment pond discharge.

12.5.3.1.6 Change in Fish and Fish Habitat Due to Blasting

Measures to avoid impacts of vibration on fish and fish habitat include:

1. Avoid:
    - Reduction of charge per delay by decking the blast holes;
    - Increasing the delay time between rows and holes to produce discrete explosions;
    - Use of bubble/air curtains to disrupt the shock waves; and
    - Design of blasts and delay configurations to minimize vibrations.

Appropriate mitigation measures are in place to ensure mine pit blasts do not cause serious harm or death to fish and fish habitat in line with the guidance outlined in Wright and Hopky (1998) and DFO (1995).

12.5.3.1.7 Changes in Streambed Structure

Implement proper sediment control by:

1. Avoid:
    - Introducing sediment in the water, such as:
        - Silts;
        - Clays; and
        - Sands.
2. Minimize:
    - Develop and implement the Erosion and Sediment Control Plan (Chapter 33, Section 33.4.1.4);
    - Install effective erosion and sediment control measures to stabilize all erodible and exposed areas;
    - Regularly inspect and maintain the erosion and sediment control measures during all phases of the Project;
    - Keep the erosion and sediment control measures in place until all disturbed ground has been permanently stabilized;
    - Install settling basin and/or filtration system for water flowing onto the site and water being pumped or diverted from the site, including:
        - Holding back runoff water until suspended sediment has resettled in the settling basin and runoff water is clear;
        - Dewatering gradually to prevent sediment resuspension and bank destabilization;
    - Disposing of and stabilizing all excavated material above the high-water mark or top of bank of nearby waterbodies and ensuring sediment re-entry to the watercourse is prevented;
    - Heeding weather advisories and scheduling work to avoid wet, windy, and rainy periods that may result in high flow volumes and/or increase erosion and sedimentation;
    - Regularly monitor the watercourse for signs of sedimentation during all phases of the work, undertaking, or activity and take corrective action, if required;
    - Use biodegradable erosion and sediment control materials whenever possible and remove all exposed non-biodegradable erosion and sediment control materials once site is stabilized;
    - Operate machinery on land in stable dry areas;
    - Stop work and containing sediment-laden water to prevent dispersal;

- Install temporary clear span bridges to accommodate expected high-water flows and to not damage erodible banks;
- Limit the impacts to stream or shoreline banks; and
- Develop a calcite management plan for receiving environments.

The primary measure to mitigate changes in streambed structure from dust deposition is to reduce the potential for dust to settle in the West Alexander Creek, Alexander Creek, Grave Creek, and Elk River drainages through the implementation of the Air Quality and Dust Control Management Plan (Chapter 33, Section 33.4.1.1).

Specific mitigation measures, as organized by mitigation hierarchy level, include:

1. Avoid:
    - Earthmoving activities throughout the life of mine will be scheduled to limit the duration of exposed soils and to avoid dust-generating activities during windy periods, where possible;
    - Dust generation from mining activities and equipment will be contained through the application of standard emission control measures (e.g., fabric covers for the coal stockpiles and conveyors, a dust canopy for the ROM dump hopper) to intercept dust before it reaches the receiving environment; and
    - Regular inspections will be conducted to verify air quality and dust control measures are effective and functioning properly, which will allow for timely maintenance and adjustments as required.
2. Minimize:
    - The layout of the site has been designed to minimize travel distances between operations (e.g., between the pits and the Coal Handling Process Plant) in order to reduce vehicle travel distances and speeds that would result in additional generation of dust emissions;
    - Enforcement of low speed limits for vehicular traffic throughout the site;
    - Unpaved roads will be regularly maintained and kept in good repair, including regular compaction and use of coarse aggregate with low silt content, where possible;
    - Establish and follow site Soil Management Plan (Chapter 33, Section 33.4.1.9);
    - Soil stockpiles will be placed at appropriate locations, and soil stored and shaped in ways to maintain slope stability and reduce moisture content loss, including establishment of vegetation to reduce exposure to wind and water erosion; and
    - Water or dust suppression methods will be used from May to November to mitigate dust generation in areas including unpaved roads, work areas, and storage piles, if required. Water for dust suppression will be withdrawn from the Interim Sediment Pond and Grave Creek Reservoir for the first five years of Operations, and then supplemented from the North Pit sumps for the remainder of the mine life.
3. Restore On-Site:
    - Progressive reclamation and revegetation will occur throughout the mine life to minimize wind erosion potential and reduce the Project footprint, reducing the potential for dust deposition to nearby watercourses.

12.5.3.1.8 Functional Riparian Disturbance

Measures to maintain riparian vegetation include:

1. Avoid:
   - Project design optimization;
   - Implementation of the Ecological Restoration Plan (Chapter 33, Section 33.4.1.3);
   - Minimize disturbance and cleared areas;
   - Monitor reclaimed wetlands and wetland function;
   - Minimum design standards for water management infrastructure; and
   - Energy dissipation devices.
2. Minimize:
   - Implement the Spill Prevention, Control, and Countermeasures Plan and Site Water Management Plan (Chapter 33, Sections 33.4.1.10 and 33.4.1.8);
   - Minimize the extent of disturbance within riparian habitats;
   - Limit exposed soils near riparian habitats;
   - Incorporate energy dissipation devices, structures, or other related armouring techniques;
   - Monitor water quality;
   - Inspect erosion and sediment control measures;
   - Education and training;
   - Low speed limits;
   - Regular road maintenance;
   - Minimize earthworks during windy periods;
   - Progressive reclamation and revegetation;
   - Dust suppression methods;
   - Proper covers/shielding where required;
   - Education and training; and
   - Monitor and inspect dust control measures.

For more details on how setback distances and more detailed mitigations will be applied to changes in riparian habitat, refer to the Vegetation and Ecosystems Management and Monitoring Plan (Chapter 33, Section 33.4.1.11).

12.5.3.1.9 Measures to Offset Direct and Indirect Habitat Loss

After efforts have been made to avoid and minimize risk of death of fish and HADD of fish habitat, residual habitat loss was identified in the Fish and Fish Habitat LSA. As per the *Fisheries Act,* any project resulting in a HADD can only proceed with authorization from the Minister of Fisheries and Oceans. In order to obtain the *Fisheries Act* authorization, any residual habitat loss must be addressed in an approved offsetting plan. An offsetting measure is one that counterbalances unavoidable death of fish and or HADD resulting from a work, undertaking, or activity with the goal of protecting and conserving fish and fish habitat. Offsetting measures should support available fisheries management objectives and local restoration priorities and be conducted in a manner consistent with DFO's offsetting policy (DFO, 2019b).

Offsetting measures may take a variety of forms, ranging from localized improvements to fish habitat to more complex measures that address limiting factors to fish production. The choice of appropriate offsetting measures will be guided by the restoration priority for degraded fish habitat (outlined in paragraph 34.1(1)(f) of the Policy and described below), fisheries management objectives, and the expected death of fish and harmful impacts to fish habitat. In some instances, the most desirable offsetting measures may be a replacement of the same type of habitat that is affected by the work, undertaking, or activity. In other situations, better outcomes for fish habitat may be achieved by undertaking offsetting in waterbodies or for fish species other than those affected by the work, undertaking, or activity being considered for authorization.

Measures to offset are actions taken to counterbalance the residual effects on fish and fish habitat at a given location, with measurable benefits for fish and fish habitat. These measures may take place where the residual effects will occur, or elsewhere. Measures to offset may include, but are not limited to:

- Restoring degraded fish habitat to improve conditions for the production of fish;
- Enhancing fish habitat to improve conditions for the production of fish; and
- Creating productive and sustainable fish habitat where none existed before.

In considering the application of measures to offset, the proponent should select measures that meet the following principles (DFO, 2019b):

- Principle 1: Measures to offset should support fisheries management objectives and give priority to the restoration of degraded fish habitat;
- Principle 2: Benefits from measures to offset should balance the adverse effects resulting from the works, undertakings or activities; and
- Principle 3: Measures to offset should provide additional benefits to the ecosystem.

The residual losses of the Project are anticipated to be 35,165 m^2 of instream fish habitat (i.e., 31,262 m^2 for instream habitat loss due to mine design and development, plus 3,237 m^2 for habitat loss due to changes in water quantity) and 36.13 ha of riparian habitat. Summarized below is the amount of fish bearing instream habitat resulted from habitat loss due to mine design and habitat loss due to changes in water quantity (Table 12.5-7), and the non-fish bearing habitat anticipated to be removed by the Project (Table 12.5-8). Fish habitat loss in the Fish and Fish Habitat LSA is shown in Figure 12.5-2.

Table 12.5-7: Summary of Fish Bearing Habitat Loss Due to the Project

Site ID	Fish Bearing	Type	Reach Length (m)	Average Bankfull Width (m)	Area (m^2)	Riparian Habitat (ha)
WAL1 u/s and WAL1 d/s up to downstream end of the Spillway	Yes	Due to Mine Design	5,001.94	6.25	31,262.13	27.53
WAL2	Yes	Due to Mine Design	174.23	3.82	665.56	0.9
WAL1 d/s of the Spillway up to confluence with Alexander Creek	Yes	Due to changes in Water Quantity	549.65	5.89	3,237.44	7.7
				TOTAL	35,165	36.13